Abstract Book
Table of Contents

• Lectures .................................................. page 4

• Papers ..................................................... page 8

• Posters
  Session 1 .................................................. page 47
  Session 2 .................................................. page 139
  Session 3 .................................................. page 229

• Symposia .................................................. page 322

• Workshops ................................................ page 327
Lectures
Costenbader Lecture

Strides & Challenges in the Diagnosis, Classification & Treatment of Childhood Retinal Dystrophies

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Introduction: The recognition of clinical manifestations of inherited infantile and childhood retinal dystrophies, combined with the appropriate diagnostic tests, remains the mainstay of their diagnosis. This presentation attempts to clarify the current approaches to diagnosing, classifying and managing children with inherited retinal disorders.

Methods: Review of the current literature and personal experience of the presenter.

Discussion: Advances in molecular diagnostic technology have allowed precise genetic diagnosis in a majority of cases and have paved the way to a broader classification scheme in which a blur has emerged between clinical diagnostic entities that at one time were better defined. Genetic heterogeneity has become the rule as more genes are recognized to cause the same phenotype and more mutations in the same gene to cause different clinical disorders. Finally, a better understanding of the underlying molecular mechanisms in childhood retinal disorders and advances in biotechnology have brought novel therapies very close and into the clinic.

Conclusion: The ophthalmic community is updating its approach to diagnosing and classifying childhood retinal dystrophies and is preparing for their treatment.
Purpose: To outline a systematic approach to strabismus reoperations.

Target Audience: Pediatric ophthalmologists and strabismologists

Current Practice: Many strabismologists have a formulaic approach to strabismus reoperations, e.g. treat it as a fresh case, advance previously recessed muscles to the original insertion, etc.

Best Practice: Effective strategies for strabismus reoperations are not formulaic and should be tailored to the specific history and findings of the patient. The first, and most important decision, is whether to operate on previously operated muscles or fresh muscles. This should be influenced, in part, by whether one is treating an overcorrection or undercorrection. Limitations of rotations and incomitance patterns should be addressed. Many important decisions should be made intraoperatively based on where muscles are found, their integrity (slipped in the capsule, stretched scar, etc.), repeated intraoperative forced ductions, and spring back balance testing.

Expected Outcomes: Orthophoria! (AKA improved results with reoperation strabismus cases.

Format: This presentation will be a narrative of pearls gained from the speaker’s 40+ years in practice.

Summary: A proper plan for a strabismus reoperation takes into account a number of preoperative factors, and the surgeon should be prepared to modify the plan based on intraoperative findings.

References
Bielschowsky Lecture

Accommodation and convergence – ratios, linkages, styles and mental somersaults

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Purpose/Relevance: Understanding the linkages between accommodation and convergence is fundamental to understanding concomitant strabismus, heterophoria and convergence and accommodation anomalies. The lecture will present an alternative conceptual framework around these two systems which fits clinical characteristics and responses to treatment as well, or better than, current models. The framework is based on the different weights the visual system places on the main cues to target position in depth across development and between patient groups.

Target Audience: Strabismologists, developmentalists and all healthcare professionals managing patients with concomitant strabismus

Current Practice: Accommodative convergence has traditionally been considered the major driver to the motor responses involved in near fixation; existing in a fixed, inflexible relationship expressed as the AC/A ratio. This viewpoint, however, only fits a small number of clinical diagnoses and fails to explain many others.

Best Practice: Our research suggests that the majority of non-strabismic people, and patients with intermittent strabismus, use binocular disparity as their primary visual cue, with blur and proximal/looming cues having less weight. The convergence to accommodation (CA/C) linkage is therefore more important than the AC/A relationship. Between-diagnosis differences in the relative balance between AC/A and CA/C relationships can explain many clinical findings.

Expected Outcomes: Increased awareness of accommodation / convergence linkages, their strengths, their development and variability, which can be used to explain clinical findings and predict responses to common treatments.

Format: Keynote lecture

Summary: Instead of thinking “accommodation drives convergence”, or even “convergence drives accommodation, we should instead think of the visual and non-visual cues which drive both.

References
Papers
New Pediatric Vision Questionnaires for Assessing Health-Related Quality of Life and Functional Vision in Childhood Eye Conditions

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Introduction: To report the development and content of new pediatric vision questionnaires designed to assess health-related quality of life (HRQOL) and functional vision.

Methods: Patient-derived instruments were created by interviewing 180 children (age 5-17y) and 328 parents across 10 diagnostic categories (esotropia, exotropia, hypertropia, amblyopia, refractive error, anterior segment, CNS, nystagmus, orbital, retina/optic nerve). Interview transcripts were coded using nVivo software, yielding 6824 concerns and 601 individual questions. After a standard process of binning and winnowing, a 97-item child questionnaire was created, with 4 response options, and administered to a new cohort of 278 children, across the 10 diagnostic categories. Factor analysis was performed (Eigenvalue >1.0) separately for 5-11y and 12-17y to identify unidimensional domains, followed by Rasch analysis, evaluating response ordering, local dependence, fit, differential item functioning, and targeting.

Results: The following unidimensional domains were identified; 1) functional vision, 2) bothered by eyes and vision, 3) social, 4) frustration/worry, 5) treatment (glasses, patching, contacts, drops). One response category (‘most of the time’) was underutilized, and will be removed in future versions. After evaluation of misfitting items and Rasch maps, the number of questions per domain was constrained to 10 items or less.

Discussion: Our new patient-derived questionnaires have design advantages over existing non-ophthalmic, non-patient-derived, and disease-specific instruments.

Conclusion: By following a rigorous process of questionnaire development we now have new patient-derived, pediatric vision questionnaires for assessing HRQOL, functional vision and treatment-related concerns across childhood eye conditions. These child questionnaires are now available, along with proxy and parent versions.
Red Reflex Examination in Reproductive and Child Health Clinics for Early Detection of Paediatric Cataract/Ocular Media Disorders: Evidence from Kilimanjaro Tanzania

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Introduction: Cataract is the leading cause of childhood blindness in sub Saharan Africa (1,2), due in large part to late presentation and absence of any screening programmes (3) or appropriate screening technology. We aim to determine the most suitable screening test for ocular media disorders in under-five reproductive and child health clinical setting.

Methods: Study 1. We compared reflex test with torchlight examination in 1152 children less than 5 years old attending Reproductive and Child Health clinics, using pen torch, direct and indirect ophthalmoscopy. Study 2. We evaluated the sensitivity and specificity of 4 screening tools (Arclight, I-Cam, Portable Eye Examination Kit (PEEK) and Torchlight) in detecting media opacities by ophthalmic nurses in an enriched sample of 41 cases and 60 controls in the hospital setting. Study 3. We then evaluated the feasibility of 2 new screening technologies (Arclight and I Cam) by trained non-ophthalmic nurses in Reproductive and Child Health clinical setting.

Results: Study1. Red reflex testing was more sensitive (p=0.0005) than torchlight detecting 18 out of 19 (94.7%) ocular media disorders (cataract, retinoblastoma and corneal scar) compared to 8 out of 19 (42%) by torchlight.

Study 2. The sensitivities of the 4 techniques were, I-Cam (97.56%), Arclight (92.68%), Portable Eye Examination Kit (90.2%) and torchlight (7.3%).

Study 3. Trained non-ophthalmic nurses screened a total of 2728 children. 24 children were referred and 7 were true positive (6 cataracts &1 retinoblastoma). Nurses reported I-cam initially easier to use but after learning curve, Arclight was easier.

Discussion: Our study shows that Red reflex testing was more sensitive than torchlight. The study also show that I-Cam had higher sensitivity than Arclight, Portable Eye Examination Kit, and torchlight. In addition, Nurses reported I-cam initially easier to use but after learning curve, Arclight was easier.

Conclusion: I-cam and Arclight offer exciting potential to reduce blindness from cataract in African children.

References:
Impaired Motion Perception in the Fellow Eye of Amblyopic Children is Related to Abnormal Binocular Function

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Introduction: While the clinical focus for amblyopia has been monocular patching to restore visual acuity of the amblyopic eye, recent evidence supports the primary role of binocular dysfunction in amblyopia. Binocular discordance due to strabismus, anisometropia, or both result not only in a monocular visual acuity deficit, but also fellow eye motion perception deficits. Here we examine these deficits and their relationship with clinical and sensory factors.

Methods: 73 amblyopic children (6-12y; 0.2-1.5 logMAR) with strabismus (n=18), anisometropia (n=32), or both (n=23) participated, along with 19 age-similar controls. Performance on a motion-defined form (MDF) task was evaluated in the context of a Star Wars game. The child viewed an array of moving white dots on a black background; dots within a stationary rectangle (‘the enemy spaceship’) moved coherently in one direction, and dots outside moved in the opposite direction. The child’s task was to indicate the orientation of the enemy spaceship. The proportion of coherently moving dots was progressively reduced to determine the minimum coherence needed to perform the task.

Results: MDF deficits were present in 82% of amblyopic eyes and 21% of fellow eyes. Amblyopic eye MDF deficits correlated with suppression severity (p=0.0001), amblyopic eye visual acuity (p<0.0001), stereoacuity (p<0.0001), and W4 fusion (p<0.0001). Fellow eye MDF deficits correlated with stereoacuity (p=0.0004) and W4 fusion (p=0.002). Children receiving binocular amblyopia treatment had milder fellow eye MDF deficits than children treated with patching (p=0.03).

Discussion: Fellow eye MDF deficits are common and likely reflect abnormalities in binocular cortical mechanisms that result from early discordant visual experience.

Conclusion: Binocular amblyopia treatment, which is effective in improving visual acuity, may also provide a benefit for binocular function.

Treatment Outcomes for Amblyopia Using PEDIG Amblyopia Protocols – A Prospective Study of 852 Cases

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Introduction: The landmark PEDIG ATS2a and ATS2b studies concluded that 6 hours of occlusion were as efficacious as full-time occlusion in a cohort of 175 children with severe amblyopia (logmar 0.7-1.3), and that 2 hours of occlusion were as effective as 6 hours, in a cohort of 189 children with moderate amblyopia (logmar 0.3-0.6). This is the first prospective analysis of 'real-world' outcomes of amblyopia treatment using PEDIG amblyopia protocols.

Methods: Using the Medisoft EMR audit tool we identified a cohort of 280 children who met the ATS2a inclusion criteria, and 572 children who met the ATS2b inclusion criteria. The mean pre-treatment visual acuity (VA) in the amblyopic eye, mean age at presentation and type of amblyopia were almost identical to the ATS2a and ATS2b cohorts. Severe amblyopes were prescribed 6 hrs occlusion per day, and moderate amblyopes 2 hours occlusion per day, after a period of at least 12 weeks refractive adaptation. The audit tool compared VA in the amblyopic eye at baseline, with best-corrected VA (BCVA) at 32, 48 and 64 weeks.

Results: In ATS2a and ATS2b, 67% of severely amblyopic eyes achieved BCVA ≥ 0.4 at 17 weeks, and 81% of moderately amblyopic eyes achieved BCVA ≥0.3. In our cohort, 44% of severely amblyopic eyes achieved BCVA ≥ 0.4 at 32 weeks, increasing to 59% at 48 weeks. 74% of moderately amblyopic eyes achieved BCVA ≥ 0.3 at 32 weeks. The mean number of lines of visual improvement was 4.3 for severe amblyopes versus 4.8 in ATS2a, and 2.2 for moderate amblyopes versus 2.4 in the ATS2b study.

Discussion: Although PEDIG reported outcomes at 17 weeks, this did not include the period of refractive adaptation and our 32 week data is therefore likely to be equivalent to PEDIG 17 week data. Our 'real-world' data shows that acuities continued to improve up to 32 weeks for moderate amblyopes, and up to 48 weeks in severe amblyopes, but not beyond these periods.

Conclusion: This is the largest reported series of children with amblyopia treated according to PEDIG protocols. The Medisoft EMR is a powerful tool for analysing amblyopia treatment outcomes.

References:
A randomized trial of prescribed patching regimens for treatment of severe amblyopia in children.
Sparing of Vernier acuity in Children with Recent Onset Strabismus and Amblyopia Before and After Treatment

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Introduction: Almost everything we know about visual functions in amblyopia other than visual acuity comes from adults, studied long after initial onset and often treatment of the disorder. Studies indicate that vernier and optotype measures are correlated in amblyopic adults. Here, we report fundamental differences between children and adults with strabismic amblyopia.

Methods: Prospective, longitudinal controlled study. Spectral analysis of swept Visual Evoked Potential (sVEP) responses were used to isolate vernier-offset related responses in children with recent onset strabismic amblyopia (strab-amb.) n=11, mean age 5.24 years, mean (SD) interocular acuity difference 0.27 (0.16) LogMAR. and typically developing children (control): n=16, mean age 5.14 years at presentation and following conventional treatment.

Results: Despite significant optotype acuity deficits and favorable treatment response (p<0.05); vernier response functions were not significantly different between a) the preferred and amblyopic eyes of strab-amb. children; b) either eye of strab-amb. group vs. control children; and c) stable vernier response after treatment in strab-amb. group.

Discussion: Vernier response in previously untreated strab-amb. children is unaffected, in contrast to the clear deficits reported in previously treated adults with the same amblyopia subtype and in children with anisometropic amblyopia of the same age. The difference between adult and child strabismic amblyopes may indicate differential amblyogenic processes at different stages of cortical involvement and in different etiologies.

Conclusion: Vernier sVEP function is spared in children with reductions in optotype acuity in untreated recent onset strabismus. These data underscore the need for caution when applying ‘one size fits all’ treatment regimes - at least in developing visual systems.

Novel Binocular iPad Cartoon Video Program Improves Stereoacuity and Central Fusion in Treated and Untreated Amblyopes

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Introduction: Several dichoptic strategies reveal promising therapeutic results but require expensive equipment[1-2]. Other low-cost dichoptic therapies do not improve stereoacuity[3]. This study demonstrates rapid recovery of stereoacuity and central fusion in amblyopic children who viewed modified 'Clifford the Big Red Dog' cartoons at home for 4 weeks.

Methods: Twenty-two amblyopes ages 4-15 years viewed videos 40 minutes daily on an iPad while wearing anaglyph glasses. Visual acuity at distance and near, stereoacuity, ocular alignment, suppression, compliance, and subjective experience were assessed at baseline, 2, 4, 8 and 16 weeks. Stereoacuity was tested using Linear (non-Randot), Randot Stereo, and Randot Preschool Stereoacuity tests with the highest arc seconds measured used for analysis.

Results: After 4 weeks, mean stereoacuity improved 0.362 logMAR (CI 0.167-0.557; p=0.0009). Mean distance VA improved 0.043 logMAR (CI 0.007-0.08; p=0.022). Stereoacuity improved in 63% of children (CI 41%-82%). Worth-4-dot testing showed recovery of central fusion in 56% of children. Compliance with 80% of prescribed viewing time was 77%. No adverse effects were reported.

Discussion: Clinically and statistically significant improvement in stereoacuity, defined as greater than 0.2 logMAR, was achieved in the majority of children. Stereoacuity and central fusion improved even in fully treated older amblyopes who initially presented with nil stereoacuity. Vision improvement was modest and variable.

Conclusion: This low-cost, home-based therapy improves stereoacuity and central fusion in amblyopic children as old as 15 years. Exploration of the pathways activated by this program may elucidate mechanisms to unlock stereoacuity development.

Effects of Immersive Virtual Reality Viewing on Young Children: Visuomotor Function, Postural Stability and Visually-Induced Motion Sickness

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Introduction: To assess the safety of VR Headset (virtual reality binocular near-eye display) use in young children. Product safety warnings that accompany VR Headsets generally ban their use in children under age 13 y. No studies to date have addressed VR Headset effects specifically in pediatric populations.

Methods: Recordings were obtained in 26 children (15 male) age 4-10 y (mean 7.95 ± 1.82 y). Minimum CDVA was 20/50 (logMAR 0.4) in each eye and stereoacuity 3000 arc sec or better (criteria did not exclude children with amblyopia or strabismus). A Sony PlayStation VR Headset was worn for 2 sequential play sessions (each 30 m) of a first-person 3D flying game (Eagle Flight) requiring head movement to control flight direction (pitch, yaw and roll axes). Baseline testing preceded VR exposure and each VR session was followed by post-VR testing of: CNVA and CDVA, stereoacuity; accommodation, vergence angle/phoria/tropia and refraction (digital PlusOptix Autorefractor). Postural stability was measured by a MEMS accelerometer (Sway Medical LLC). Visually-induced motion sickness (VIMS) was assessed by questionnaire (SSQ) modified for pediatric use.

Results: Twenty-four of 26 children (92%) completed both VR play sessions with no significant change from baseline in any visuomotor measure. Two girls (8% of participants) terminated VR play during session 1 due to VIMS. No other child in the study terminated a session (majority asked to continue beyond the session limit). Postural stability measures showed no significant change from baseline. No VR after-effects (“flashbacks”) were reported.

Discussion: VR play did not induce post VR postural instability. The prevalence of VIMS and post VR after effects may be less than that reported for adults.

Conclusion: Young children tolerate fully-immersive 3D virtual reality game play without noteworthy effects on monocular or binocular visual functions.
Introduction: Academic pediatric ophthalmologists face special challenges in clinical efficiency as they balance providing medical care with educating medical trainees. However, few studies have explored the relationship between medical education and clinical efficiency. To address this gap, this study examines the effect of presence of medical trainees on pediatric ophthalmology patient appointment times.

Methods: Data about 7,239 pediatric ophthalmology appointments with 4 pediatric ophthalmologists and 1 pediatric optometrist at Oregon Health and Science University (OHSU) Casey Eye Institute were analyzed. Presence of trainees as well as patient appointment time was determined by electronic health record visit data and audit logs. Differences in appointment length were tested by Welch’s t-test and linear mixed models.

Results: The average lengths of appointments with residents and fellows were significantly greater than appointments in clinic sessions without trainees (107.0±40.7 vs. 86.4±37.3 minutes, p<.001 for residents, and 104.7±38.5 vs. 86.4±37.3 minutes, p<.001 for fellows). Appointments with no trainee present in clinic sessions with trainees were also on average significantly longer than appointments in clinic sessions without trainees (91.9±36.1 vs. 86.4±37.3 minutes, p<.001).

Discussion: Key findings from this study are that (1) Trainees are associated with a significant lengthening of appointment time. (2) Trainees lengthen all appointments in a clinic session, even for appointments for which they were not present.

Conclusion: Presence of trainees was associated with longer appointment times, even for patients not seen by a trainee. This has important implications for efficiency of clinical care in academic centers and for pediatric ophthalmology education, and raises questions about provider reimbursement models.

Incidence and Profile of Strabismus in an Acute Stroke Population

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Introduction: Strabismus in stroke survivors is reported in about 30% [1]. There is limited information about its specific profile when due to stroke. This study reports the incidence of stroke-related strabismus, characteristics and recovery.

Methods: Prospective epidemiology study of all stroke survivors admitted to three UK acute stroke units over a 15-month period. Full documentation of stroke demographics and orthoptic assessments, including visual acuity, visual fields, visual perception, ocular alignment and motility.

Results: 1500 stroke survivors were recruited from 01/07/2014 to 30/06/2015 with follow-up through to 31/12/2016. Mean age was 73.2 years (SD 14). 189 had documented strabismus; 70 pre-existent and 119 new onset. Of new cases, 110 were recruited during the first year; annual incidence of stroke-related strabismus of 8.5%. 172 were ischaemic strokes; 17 haemorrhagic (88 right-sided, 80 left-sided and 21 bilateral). Exotropia occurred most commonly: 61.9% at near and 49.7% at distance fixation. Strabismus-related symptoms were reported by 54.5%. Ocular motility deficits were associated in 77.7% with associated visual field loss in 30.7%, visual perceptual deficit in 31.7% and impaired central vision in 75%. Management for 92.6% of patients included prisms, occlusion, compensatory advice. Recovery, where documented, ranged from within 1 week to 11 months.

Discussion: Acute onset strabismus is an important referral to ophthalmic services. This study reports an incidence of stroke-related strabismus of 8.5%. Over half were symptomatic and most required management.

Conclusion: Providing appropriate care to this at-risk population is important to their general rehabilitation to maximise functional ability.

Strabismus and Strabismus Surgery in The United States: Analysis from the IRIS Registry

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Introduction: To describe the rates of strabismus, strabismus surgery, and strabismus surgery reoperations among all ages in the United States.

Methods: Retrospective analysis of electronic health records from the IRIS® Registry (Intelligent Research in Sight) to identify unique patients with the diagnosis of strabismus and strabismus surgery from 2013 to 2016. The reoperation rate was calculated for first surgeries performed in 2013-2015.

Results: 29,445,231 unique patients were identified; 813,164 (2.76%) had a diagnosis of strabismus, 3.03% of males and 2.57% of females (difference=0.46 %, 95% CI:0.45 to 0.47, P < 0.0001). Strabismus surgery was performed in 39,262 (0.13%) patients. The rate of surgery ranged from 2.0% for children 0 to 5 years of age to <0.1% for adults older than 40 years of age. Horizontal surgery was most commonly performed in 35,093 patients, vertical surgery in 8,433, and superior oblique surgery in 619. Adjustable sutures were used in 2,873; 5,921(15.1%) were reoperations. Esotropia accounted for 30.7% and exotropia in 21.8% of cases. The rate of undergoing a second surgery within one year was 6.63%, lowest between 5-9 years of age (3.84%) increasing with age (p<0.001) to more than 10% for patients after 60 years of age.

Discussion: Strabismus is an uncommon diagnosis. About 1 in 750 had strabismus surgery during a 4-year period; about 85% of those were first surgeries. Reoperations were performed for 1 in 15 cases, with an increase rate among older patients.

Conclusion: 'Big' data from clinical data registries represent real world care that can be used to develop clinical benchmarks such as reoperation rate as well as identify areas suitable for practice improvement and for training program design.

Evaluation and Valuation of an Innovative Digital Ocular Motility Measuring System

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Introduction: Cover tests are the standard reference for measuring ocular deviation. Recently, a novel videoculographic system for strabismus measurement (Gazelab) was been introduced in the market. The aim of our work is to compare strabismus measurements done by Gazelab to that done by cover tests.

Methods: Fifty patients aged 7-40 years with congenital or acquired strabismus were included in the study. All patients were evaluated and re-evaluated with the new videoculographic system and with cover tests. |For both assessments, ocular deviations were measured at 9-point target grid located at 3 meters.

Results: Patients were classified into two groups.

The first group consisted of 30 patients with comitant deviation. 80.00% of patients were within 5 PD and 97.00 % were within 10 PD. Both methods reproduced the same characteristic strabismus patterns in the 9-point grid.

The second group consisted of 20 patients with incomitant deviation. 70 % of patients were within 10 PD for horizontal deviation and 60 % were within 8 PD for vertical deviation. Strabismus patterns were hard to be reproduced by cover tests but were feasibly reproduced by videoculographic system.

Discussion: While the agreement between the videoculographic system and cover tests was reasonable for the first group and partial for the second group, the new system was far superior to cover tests. |This because the measurements of the videoculographic system were more easily and accurately reproducible, which makes it more reliable for assessment of ocular deviation.

Conclusion: The novel videoculographic system provides a breakthrough in practice of strabismus and represents the future for strabismus research and management.

Eye-Tracking Based Device for Measurement of Both Manifest and Latent Eye Deviations in Adults and Children

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Introduction: The current gold standard test for eye deviation measurement is the manual prism cover test. This test is at times challenging and limited by the level of cooperation and the examiner's skill. Cover tests are time-consuming and cumbersome and studies have shown high inter-examiner variability 1. Moreover, the angle of strabismus itself may vary and the current tests do not allow quick multiple testing of the same patient.

Methods: We conducted a clinical trial to evaluate the accuracy and repeatability of the Eyeswift, a novel eye deviation angle measurement method using an automatic system based on eye tracking, and compared it to the prism cover tests. A group of 24 adult subjects with eye deviations, were tested by both the automatic and cover tests in a masked fashion.

Results: A correlation of 89% was found between the automatic test and the golden standard of prism cover tests. The repeatability of the automated test was twice as high as that of the manual test (mean STD 1.35 vs. 0.71 respectively (P<0.005 paired t-test)). The average deviation measured by the automatic test was 13.5±1.5 (SD) and comparable to the cover test results of 14.2±1.3 (SD).

Discussion: The automated measurement is an accurate reproducible system. The system also reduces chair time significantly and has the potential of becoming a standard of care.

Conclusion: The system performs accurate automated orthoptic measurements. This can increase the work efficiency of ophthalmologists, in addition it may aid in prescription of prisms, monitor orthoptic therapy and provide pre and post op measurements.

Introduction: The aim of this study was to compare the analgesic effect of the retrobulbar block with IV Fentanyl in children undergoing strabismus surgery.

Methods: This prospective, randomized, interventional comparative study included 50 children eligible for elective strabismus surgery. They were enrolled from April 2016 to March 2017 and were randomly divided into two groups, group R (Retrobulbar Block group) and group F (IV Fentanyl group). The primary outcome measure was the pain score using the FLACC score. Secondary outcome measures were the incidence of postoperative nausea and/or vomiting and the rate of complications.

Results: The study showed that the two groups were comparable concerning baseline characteristics: age, gender, ASA status and duration of anesthesia. The intraoperative monitoring was also comparable between both groups. The FLACC score in both groups was lower than 0.5 at 30, 60, 120, 180, 240 and 360 minutes postoperatively. However, the FLACC score was significantly higher in the Fentanyl group than in the Retrobulbar block group at 30 and 120 minutes postoperatively. Moreover, it was insignificantly higher in the Fentanyl group than in the Retrobulbar block group at 60, 180, 240 and 360 minutes postoperatively.

Discussion: During the postoperative period, no patient needed opioids in both groups. However, two patients from the Fentanyl group received Paracetamol.

Conclusion: The results of the current study prove that the retrobulbar block is beneficial in providing better analgesia and lowering the postoperative pain and the need for additional analgesics postoperatively with less sedation, less nausea & vomiting.

**Analgesic Eyedrops Reduce Opioid Demand after Strabismus Surgery**

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**Introduction:** Strabismus surgery may be associated with postoperative pain(1). We wanted to study if the need for intravenous (iv) sufentanil after strabismus surgery was influenced by addition of postoperative oxybuprocaine 0.4% eyedrops.

**Methods:** All patients operated for strabismus during 4 months were included. During the first two months (controls, group A), standard pain treatment was: Preoperative paracetamol and peroperative ketoralac iv. In the PostAnesthesiaCareUnit (PACU), iv sufentanil (0.05-0.1mcg/kg) was added if needed. During the following two months (group B), additional oxybuprocaine eyedrops was given after surgery in the operating theater, and if needed, supplemented with iv sufentanil in the PACU. We registered the number of patients treated with iv sufentanil in the two groups. Results were analyzed in two-by-two contingency tables and evaluated with chi-squared test. We chose a 0.001 threshold for significance.

**Results:** In group A(n=144), 53 were<18y, 91 were adults. In group B(n=109), 37 were<18y, 72 were adults. In the pediatric group, added oxybuprocaine eyedrops was associated with reduced need for postoperative sufentanil(24%, n=9), compared with controls(83%, n=44),p<0.001. In the adult group, added oxybuprocaine eyedrops was associated with reduced need for post-operative treatment with sufentanil(3%, n=2), compared with controls(82%, n=75),p<0.001.

**Discussion:** Yousafzai(2) showed topical oxybuprocaine eyedrops after strabismus surgery reduces pain, nausea and vomiting compared with iv opioid analgesics. We found local analgesic eyedrops after strabismus surgery may reduce postoperative need for rescue iv sufentanil in both children and adults.

**Conclusion:** Oxybuprocaine 0.4% eyedrops at surgery conclusion may reduce opioid demand after strabismus surgery.

**References:**

The data in this abstract was presented at The 10th Congress of the European Pain Federation, EFIC®, Copenhagen, Denmark, 6-9 September, 2017.
Risk of Developing Glaucoma/Glaucoma Suspect within 18 Months after Pediatric Cataract Surgery

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Introduction: Children undergoing lens removal from birth to <13 years of age were enrolled into a clinical research registry. We describe the incidence of glaucoma/glaucoma suspect within 18 months of cataract surgery.

Methods: Data were collected from medical records at enrollment (<=45 days post-cataract surgery) and annually. We analyzed follow-up data <=18 months after first eye surgery. The primary outcome was development of glaucoma/glaucoma suspect (similar to the Infant Aphakia Treatment Study and international definitions [1, 2], and hereafter termed 'glaucoma-related adverse events').

Results: The overall incidence of glaucoma-related adverse events was 6.0% (95% confidence interval = 4.6 to 7.7) in 1101 eyes. There was a strong association between age at surgery and glaucoma-related adverse events; and presence of anterior segment (AS) abnormalities (cornea, iris, or anterior chamber abnormalities noted at surgery) and glaucoma-related adverse events. The adjusted glaucoma-related adverse event risk was 15.6% for 259 eyes <3 months of age versus 4.3% for 841 eyes >=3 months, P<0.001; and 11.7% for 161 eyes with AS abnormalities versus 5.7% for 928 eyes without, P=0.01.|Sex, race/ethnicity, axial length, laterality, intraocular lens implantation, anterior vitrectomy, and baseline intraocular pressure were not related to glaucoma-related adverse event development.

Discussion: Glaucoma-related adverse events occurred in a minority of eyes within 18 months of cataract surgery. Although very young age at surgery and the presence of AS abnormalities were strong predictors of glaucoma-related adverse events, these complications occurred in all enrolled age cohorts.

Conclusion: These data from a large registry lend support to findings of prior studies [2, 3], underlining the risk of glaucoma-related adverse events following cataract removal in early infancy.

The Ahmed-Baerveldt Comparison (ABC) Study for Pediatric Refractory Glaucoma

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Introduction: Aqueous drainage devices have proven efficacious in adult glaucoma management, but their efficacy in pediatric glaucoma is unclear. In this study, post-operative outcomes from implantation of Ahmed FP7 valves (AGV) and Baerveldt 350 glaucoma implants (BGI) in a heterogeneous group of pediatric refractory glaucoma patients at a tertiary referral center were compared.

Methods: Patient charts detailing AGV or BGI implant surgeries between 2007-2013 were reviewed retrospectively. Valve failure rates over time were compared using Kaplan-Meier survival estimates. Cox proportional hazard modeling was used to examine effects of disease type, medications, patient age and sex on valve failure.

Results: Successful postoperative IOP control was observed in 22/41 AGV (54%), and 34/48 BGI (71%). After 12 months, 20% of AGV and 2% of BGI implants failed; after 5 years, over 80% of AGV failed, compared to 50% of BGI. Increased medication use preoperatively was associated with more frequent failure (HR = 1.54, 95% CI = 1.11-2.15). Failure was seen less frequently in secondary glaucoma cases (HR = 0.33, 95% CI = 0.13-0.83). Patient age and sex were not significantly related to failure.

Discussion: Both AGV and BGI devices achieved some surgical success in lowering intraocular pressure (IOP) postoperatively; however, BGI implants showed greater, more sustained IOP reduction over time, with lower rates of failure and postsurgical complications.

Conclusion: Aqueous drainage devices are efficacious surgical options for IOP control of pediatric refractory glaucomas. Patients' history, disease type and long-term needs should be carefully considered before selecting an appropriate drainage device.

Microcatheter-Assisted Trabeculotomy Versus Circumferential Trabeculotomy with the Rigid Probe Trabeculotome in Pediatric Glaucoma

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Introduction: The study compares outcomes of microcatheter-assisted trabeculotomy to circumferential trabeculotomy using the rigid probe trabeculotome in primary congenital glaucoma (PCG).

Methods: The medical records of PCG patients that underwent circumferential trabeculotomy (>/= 270° incised) using Glaucolight illuminated microcatheter or a rigid probe trabeculotome in the pediatric ophthalmology unit of Cairo University Hospital were reviewed. The primary outcomes were the percent reduction of intraocular pressure (IOP) and success rates. Complete success was defined as IOP<18mmHg without medications. Secondary outcomes were the postoperative IOP and glaucoma medications.

Results: The study included 92 eyes of 92 patients. Of these 33 eyes of 33 patients aged 6.4 ± 8.7 months underwent microcatheter-assisted trabeculotomy, with 19 eyes (58%) having a complete 360° cut. While 59 eyes of 59 patients aged 8.2 ± 13.1 months had 2-site trabeculotomy using a rigid probe trabeculotome through a combined superonasal and inferotemporal approach, with 33 eyes (56%) having a complete cut. After a follow-up period of 21.2 ± 8.9 months, there was a 42±25% IOP reduction and 73% rate of complete success in the microcatheter group, compared to 40 ± 22% IOP reduction and 80% success rate in the rigid probe group (P-value=0.7 and 0.3, respectively). There was no significant difference in survival time in both groups (P=0.6).

Discussion: Circumferential trabeculotomy using either the illuminated microcatheter or rigid probe trabeculotome yielded comparable results in terms of surgical success, IOP and medications.

Conclusion: Both techniques are recommended as an initial surgical procedure in primary congenital glaucoma yet the added cost of the microcatheter should be considered.


Visual Outcomes after Chemotherapy for Optic Pathway Glioma in Children with and without Neurofibromatosis Type 1: Results of the International Society of Paediatric Oncology (SIOP) Low-Grade Glioma 2004 Trial United Kingdom (UK) Cohort

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Introduction: To report visual acuity (VA) outcomes following chemotherapy for optic pathway glioma (OPG) in children with or without neurofibromatosis type-1 (NF1) and to analyse associated risk factors.

Methods: A prospective, multi-center, cohort study including 155 children treated between September 2004 and December 2012. Initial and final VA was used for per-eye and per-subject analysis. Correlation tests were performed to determine whether initial VA predicted final VA. Logistic regression was used to determine whether age and tumor location were associated risk factors.

Results: 90 children had complete ophthalmological data. At initiation of chemotherapy, 26% and 49% of eyes with NF1-OPG and sporadic-OPG respectively had VA of >/=0.7 LogMAR. At final visit, per-eye, 49% had </=0.2, 23% had 0.30-0.60 and 28% had VA >/=0.70 LogMAR in the NF1-OPG group. In the sporadic-OPG group, per-eye, 32% had </=0.2, 11% had VA 0.30-0.60 and 57% had >/=0.70 LogMAR. Children with sporadic-OPG, per-eye, were significantly less likely to have VA outcomes </=0.60 LogMAR compared with children with NF1-OPG (OR=0.30; 95% CI= 0.16-0.56; p<0.0001). Per-subject, VA improved in 24%, remained stable in 35% and worsened in 41% of children with NF1-OPG and improved in 18%, remained stable in 43%, and worsened in 39% of children with sporadic-OPG.

Discussion: Initial VA predicts final VA outcome. Younger age, post-chiasm tumor location and sporadic tumors were associated with unfavourable VA outcomes. MRI outcomes correlate poorly with VA outcomes.

Conclusion: Children with and without NF1 demonstrated the same rate of VA improvement, stabilization or worsening, however, children with sporadic-OPG had a poorer VA outcome.

Two-Point Fixation Levator Aponeurosis Tucking Versus Standard Levator Resection for Congenital Blepharoptosis

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Introduction: Isolated congenital ptosis is the most common type of ptosis in children mainly caused by maldevelopment of the levator muscle. Levator aponeurosis resection remains the most frequently used technique for correction. However this surgery requires careful dissection for identification, resection, and reattachment of the levator aponeurosis to the anterior tarsus. Two-point fixation levator tucking aims to minimize tissue dissection.

Methods: This is a prospective, randomized, comparative, interventional study that included 42 eyelids of 40 children with isolated congenital ptosis with fair to good levator function. Cases were randomized into either standard levator resection or levator tucking. Outcome was compared regarding margin reflex distance (MRD) and eyelid contour.

Results: At the end of the follow up period (3 months), successful outcomes of the two techniques regarding MRD within 3-5 mm were the same in both groups as met by 18 of 21 eyelids (85.7%). Good eyelid contour was met in the resection group by 17 eyelids (80.95%) and in the tucking group by 16 eyelids (76.2%). Complications were few and included undercorrection and overcorrection.

Discussion: Levator tucking showed similar success rate as standard resection technique. No significant complications related to the technique were noted. Using two-point fixation helped to reduce the operative time while maintaining good contour. Post-operative edema was less in the tucking group which was attributed to less dissection.

Conclusion: Levator tucking is a good alternative to resection. It respects the normal physiology of the levator aponeurosis complex, avoids lacrimal gland injury or conjunctival prolapse, and is a reversible procedure.

Parent Attitudes Toward Resident Involvement in Their Child's Strabismus Surgery

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Introduction: Ophthalmology residents are involved in all aspects of patient care including surgery on adults and children. This study aims to explore patterns in parents' understanding and preferences related to ophthalmology residents' participation in their child's strabismus surgery.

Methods: Over four weeks, a survey was distributed at an academic eye center to English-speaking parents of children with strabismus who have not previously undergone, or were not being scheduled for, strabismus surgery.

Results: Sixty-four parents were eligible for the survey and all participated in full. For a resident to assist or perform the surgery, 80% and 97% of parents, respectively, indicated it was important or extremely important to be asked permission beforehand. Sixty-nine percent of respondents indicated the attending surgeon should ask permission for the resident to perform the surgery, while only 11% believed a standard written consent was sufficient. Seventy-seven percent indicated they would agree to a resident assisting with their child's operation, while 36% would agree to a resident performing the surgery.

Discussion: Nearly all parents want to be informed of resident involvement by the attending surgeon. The vast majority of parents would consent to having an ophthalmology resident assist in their child's strabismus surgery and more than one-third would consent to having the resident perform their child's strabismus surgery.

Conclusion: The process of obtaining informed consent provides the opportunity to strengthen the doctor-patient relationship while increasing transparency and highlighting the importance of ophthalmology residency education. Disclosure of the involvement of an ophthalmology resident may alleviate the parents' concerns while promoting ophthalmology resident autonomy.

References:
Why Medial Rectus (MR) Recession is more Powerful Per Millimeter than Lateral Rectus (LR) Recession: The Globe’s Rotational Axis is Not Where You Thought It Was

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Introduction: Surgical dosing tables specify greater LR than MR doses for horizontal strabismus, a difference unexplained by models that assume globe rotation about its center. We tested this assumption by measuring angular displacements of lenses and globe-optic nerve (ON) junctions during horizontal ductions.

Methods: Eighteen orthophoric adults underwent high-resolution, axial orbital magnetic resonance imaging fixating targets in central gaze, abduction, and adduction. Lines connecting corneal apices through minor lens axes to retinas approximated clinical ductions. Globe centers were calculated from area centroids of the largest globe cross-sections omitting corneas. Lens and globe-ON junction rotations around globe centers were compared with clinical ductions.

Results: Globe-ON junctions rotated significantly less around globe centers than did lenses in abduction (20.6°±4.7° versus 27.4°±7.4°, p<10^{-15}) and adduction (25.3°±6.7° versus 31.9°±8.3°, p<10^{-14}). Both rotations differed significantly from clinical adduction (27.9°±8.3, p<0.007 for both), but only in abduction was globe-ON junction rotation significantly less than clinical abduction (28.6°±9.4°, p<10^{-6}). True globe rotational center was 2.2±0.5mm nasal and 0.8±1.0mm posterior to geometric globe center and shifted farther medially and posteriorly during adduction. This location gives each mm of MR recession approximately 30% more trigonometric rotational effect than equivalent LR recession.

Discussion: The large nasal and posterior decentration of the globe’s rotational axis is likely caused by the globe-ON attachment and profoundly influences horizontal rectus action, explaining why effects of smaller MR recessions are equivalent to larger LR recessions.

Conclusion: The globe’s rotational axis is decentered nasally and posteriorly from globe center, augmenting MR recession and diminishing LR recession.
Introduction: Bupivacaine (BPX) elicits a type of damage similar to weight-bearing exercise, thereby correcting strabismus by strengthening and shortening injected muscles. Botulinum type A toxin (BTXA) in the antagonist allows the BPX-injected muscle to rebuild at reduced length. Here, we evaluate clinical effectiveness and long-term stability of corrections achieved in a large series of comitant horizontal strabismus cases, and present preliminary data on non-comitant and vertical strabismus.

Methods: Seventy-four adult horizontal strabismus patients participated in a prospective observational clinical series. Five were non-comitant, and 28 had significant vertical components, including 4 with DVD. A second treatment was given to 30 of these patients who had residual strabismus after the first treatment. Eleven patients required additional injections. Doses per injection averaged 58mg for BPX and 2.3u for BTXA. Clinical alignment was measured at intervals, up to 10 yrs after treatment.

Results: On average, misalignment of 24.5∆ (13.8°) was reduced by 17.5∆ (9.9°). Sixty-five percent of the 74 patients had successful outcomes (residual deviation ≤10∆) at average followup of 31mo.

Discussion: Corrections were stable over followups as long as 10 yrs. Early in the series we favored low doses to avoid over-correction, which probably inflated the re-injection rate: on average, our earliest patients were 45% corrected with a single treatment (measured at 6mo), compared to recent patients who enjoyed 70% correction.

Conclusion: Injection treatment for comitant horizontal strabismus achieves stable corrections comparable to surgery, and may also be effective in some types of non-comitant and vertical strabismus.

Resection Versus Plication for the Management of Exotropia

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Introduction: Resection and plication can both be used to tighten extraocular muscles. The purpose of our study was to determine whether motor outcomes and stereopsis are equivalent for resection verses plication in management of exotropia.

Methods: We reviewed the medical records of 138 consecutive pediatric and adult patients who underwent lateral rectus recession paired with either medial rectus resection (N=62) or plication (N=76) for exotropia between May 2012 and May 2016. Patients with a history of prior strabismus surgery or a restrictive process were excluded. Motor success was defined as 10 PD or less of residual exotropia or 4 PD or less of consecutive esotropia. Outcomes were measured using a t-test for continuous variables and chi-square test for categorical variables. Statistical significance was defined as two-tailed p < 0.05.

Results: There was no difference in motor success at last follow up (52% plication; 48% of resection p=0.61; N= 138). The mean follow up time was 13.7 months with a standard deviation of 15.7 months. There was no difference in the percentage of patients not undergoing reoperation (92% plication; 95% of resection p=0.77; N= 138). There was no difference in final mean stereoacuity (plication 626.5 sec arc, resection 597.4 sec arc p=0.93).

Discussion: We found no difference in motor success or stereopsis for resection vs. plication at last clinic visit. Plication might offer the advantage of being a less traumatic procedure and might spare the anterior circulation.

Conclusions: Plication and resection appear to be equally effective for treatment of exotropia.

References:
Introduction: Plication of the recti is a well described tightening but sparingly used procedure. Resection on the other hand is the routinely performed strengthening surgery. The efficacy of plication to resection is limited by paucity of literature and has never been documented on imaging. This series attempts to compare the two techniques in exotropia along with quantitative assessment on Ultrasound Biomicroscope (UBM).

Methods: Patients with exotropia between 30-50 PD who had undergone first time horizontal strabismus surgery were recruited and underwent UBM evaluation 1 year after surgery. Plication was performed by folding the anterior part of medial rectus muscle posteriorly and then tying it at the insertion to the sclera. Resection was done in a routine manner. Only patients with basic comitant exotropia without any vertical pattern were included.

Results: 15 patients underwent a resection of the medial rectus and 13 patients underwent plication during the study period. The two groups were age and deviation matched preoperatively. The patients undergoing plication and resection fared equally in terms of postoperative deviation (p=0.81) and abduction limitation (p=0.169). UBM could identify and quantify plication in all cases with excellent agreement to the operative data (Intraclass correlation coefficient=0.886; p=0.000).

Discussion: Medial rectus plication or resection performed for similar angles of exotropia produced quantitatively similar effects. Plication offered an added advantage of being characteristically identifiable and measurable on UBM.

Conclusion: In those requiring additional surgery later one can measure the weakening and strengthening performed earlier to decide the next intervention with a fair amount of accuracy.

4. Alkharashi M, Hunter DG. Reduced surgical success rate of rectus muscle plication compared to resection J AAPOS 2017;21:201-204
Comparison Between Augmented Recession and Medial Rectus Recession with Posterior Scleral Fixation in Partially Accommodative Esotropia

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Introduction: Surgery for partially accommodative esotropia (PAET) has been to correct the residual angle that was not corrected with glasses. The most common approaches are the standard and augmented surgeries.

Methods: This was a prospective randomized interventional study comparing augmented medial rectus (MR) muscle recession to MR muscle recession with posterior scleral fixation (Faden) in children with PAET and normal accommodative convergence to accommodation ratio (AC/A). Surgery was performed on 53 patients: 25 in the Augmented group, and 28 in the Faden group. Patients were followed up at 1, 3 and 6 months postoperatively. Pre- and postoperative angles of deviation and the angle disparity, i.e. the difference between smallest and largest angles, were analysed.

Results: The surgical target angle and amount of MR recession were significantly less for the Faden versus the Augmented group (P < 0.01). The overall success in the Augmented and Faden groups were 48% and 64% respectively (P > 0.05). The success rate was higher in the Faden group for the near and distance uncorrected angles (P < 0.05), and for patients with preoperative angle disparity > 20 prism dioptres (P < 0.05).

Discussion: This was the largest prospective randomized study investigating the effect of Faden on PAET with normal AC/A ratio. [MR recession with Faden is superior to augmented MR recession in cases of large preoperative angle disparity. In addition it has a more pronounced effect on the angles of deviation without glasses.]

Conclusion: Faden targets the angles without correction which could be of cosmetic importance to the patients.


Comparison between Medial Rectus Pulley Fixation and Augmented Recession in Children with Convergence Excess and Variable-Angle Infantile Esotropia

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Introduction: Variability of the angle of strabismus in the absence of paralysis or restriction may be due to supranuclear abnormalities, for example, high AC/A ratio. Esotropia in infancy may also manifest as a variable-angle or intermittent deviation. Surgical alignment before 6 months of age on those patients has the potential benefit of improving long-term stereopsis.

Methods: This was a prospective randomized interventional study in which children with convergence excess esotropia or variable-angle infantile esotropia were randomly allocated to either augmented MR muscle recession (augmented group) or MR muscle pulley posterior fixation (pulley group). In convergence excess, the MR recession was based on the average of distance and near angles of deviation with distance correction in the augmented group, and on the distance angle of deviation in the pulley group. In variable-angle infantile esotropia, the MR recession was based on the average of the largest and smallest angles in the augmented group and on the smallest angle in the pulley group. Pre- and postoperative ductions, versions, pattern strabismus, smallest and largest angles of deviation, and angle disparity were analyzed.

Results: Surgery was performed on 60 patients: 30 underwent bilateral augmented MR recession, and 30 underwent bilateral MR recession with pulley fixation. The success rate was statistically significantly higher (P<0.037) in the pulley group (70%) than in the augmented group (40%). The postoperative smallest and largest angles and the angle disparity were statistically significantly lower in the pulley group than the augmented group (P<0.01)

Discussion: In the current study, patients with variable-angle infantile esotropia and convergence excess esotropia who had pulley fixation achieved a statistically significantly greater reduction in the largest angle of strabismus and in the angle disparity after surgery.

Conclusion: Medial rectus muscle pulley fixation is a useful surgical step for addressing marked variability of the angle in variable angle esotropia and convergence excess esotropia


Evaluation of the Strengthening Effect of the Superior Oblique Tuck Procedure

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Introduction: It is held in some quarters that tightening procedures (resection, plication, tuck) do not actually "strengthen" a muscle but only affect its passive properties. In this study we evaluate whether this is the case for superior oblique (SO) tuck procedures.

Methods: The surgical database at the Kellogg Eye Center was searched for cases of superior oblique palsy that underwent a SO tuck procedure from 1998-2014 and had pre- and post-operative measurements of the vertical deviation in primary gaze and in the field of action of the superior oblique muscle.

Results: Forty-two patients met study criteria. The mean change in vertical deviation was 7.1PD ± 4.6PD in primary gaze and 15.4PD ± 9.0PD in the field of action of the superior oblique muscle (P < 0.0001, paired t-test).

Discussion: If SO tuck acts only by affecting the elastic or restrictive properties of the muscle, it should produce less change of vertical deviation in the field of action of the SO muscle than in primary gaze. Instead we found that SO tuck produces, on average, roughly twice as much correction in the field of action of the SO muscle.

Conclusion: The SO tuck procedure improves vertical deviations, at least in part, by strengthening active contraction force of the superior oblique muscle.

Unwinding of Cyclodeviation After an Adjustable Harada-Ito Procedure

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Introduction: Harada-Ito disinsertion and advancement of the anterior fibers of the superior oblique tendon is commonly performed for torsional diplopia due to excyclotropia, but there are few data on regression of its effect.

Methods: We identified 45 patients who had undergone unilateral adjustable Harada-Ito surgery with adjustment the same day and assessed cyclodeviation (using the double Maddox rod test) at post-adjustment, one day, 6 weeks, 1 year, and 5 years postoperatively. We calculated change in cyclodeviation from postadjustment. Unwinding was defined as reduction of incyclodeviation or increase in excyclodeviation.

Results: Mean preoperative excyclodeviation was 8.9°±3.4°SD. Post Harada-Ito, the mean unwinding was 3.1°±2.3° between post-adjustment and day 1, and 3.3°±2.2° between day 1 and 6 weeks. Unwinding continued after 6 weeks, but at a slower rate with a mean change of 0.4°±2.9° between 6 weeks and 1 year (n=33) and of 1.9°±3.1° between 1 year and 5 years (n=7). Total unwinding was 6.4°±2.6° at 6 weeks, 6.5°±3.2° at 1 year and 7.4°±1.8° at 5 years. There was no relationship between preoperative excyclodeviation and amount of unwinding at 6 weeks (r=0.13231, P=0.4). There was a strong relationship (r=0.72521, P<0.0001) between postadjustment cyclodeviation and amount of unwinding at 6 weeks, but even those with no cyclodeviation at postadjustment unwound a mean of 4.3°±2.1°.

Discussion: The effect of Harada-Ito surgery regresses over time.

Conclusion: When performing same-day adjustable Harada-Ito surgery, an immediate postadjustment target angle of 7° to 10° incyclodeviation is reasonable.
Delayed Adjustment of Short Tag Noose Sutures in Strabismus Surgery Allows the Effect of Surgery to be Evaluated in Real Time Up to 7 days, Thus Reducing the Numbers Needed to Adjust

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**Introduction:** Adjustable sutures in strabismus surgery provides the surgeon an extra tool in order optimize the ocular alignment after the initial surgery depending on the effect on deviation in the individual patient. Short tag noose sutures hidden under conjunctiva may be adjusted up to 7 days after primary surgery. (Granet et al)

**Methods:** Retrospective evaluation of all patients treated by strabismus surgery during a 5-month period from January 1st 2017 to May 31st 2017 by 3 strabismus surgeons in one University Clinic by chart review. We evaluated all patients with adjustable sutures, time at adjustment from surgery, any spontaneous change in alignment during the first post-op week which could remove the indication for suture adjustment, and any complications.

**Results:** 72 of 251 (29%) had adjustable sutures applied. (Mean age 38.1y, range 2-80y). 23 patients did not reach target and 17(24%) patients underwent adjustment at mean 4.5 days after initial surgery. 6 patients avoided suture adjustment as the deviation improved spontaneously to within the target range.

**Discussion:** The postoperative deviation spontaneously improved in 6 or 23 patients during first week, and thus suture adjustment was not necessary. The suture knots left under conjunctiva did not need to be tied or removed if the deviation was within the target interval.

**Conclusion:** Postponed decision on the need for adjustment of short tag noose sutures allows the muscles and tendons to stretch and demask the long term effect and change in ocular deviation. This may thus decrease the need for suture adjustment.

Introduction: Anterior segment ischemia (ASI) is a serious but rare complication of strabismus surgery. Indocyanine green angiography (ICG-A) has been utilized to reveal iris-filling defects to assess a patient's risk of ASI. However, ICG-A is limited by its invasive, time-consuming nature and possibility to image unilaterally, as well as by potential side effects. Recently, optic coherence tomography angiography (OCT-A) has been introduced and used to image iris vasculature in normal subjects and for iris tumors.

Methods: Adults undergoing strabismus surgery on at least one vertical muscle were prospectively recruited to undergo iris ICG-A and OCT-A pre-operatively and post-operatively. A masked examiner evaluated all images and determined whether filling defects were present, qualitatively (ICG-A and OCT-A) and quantitatively (for OCT-A using software to calculate vessel density by quadrant).

Results: Seven patients were enrolled. Two patients with dark irides were excluded due to poor imaging quality. One patient was found to have a qualitative filling defect on ICG-A, and had a similar defect on OCT-A. There was a significant decrease in the mean vessel density of the iris quadrant adjacent to the operated muscle from 56.2% to 52.2% postoperatively (P<0.05). In non-operated quadrants, there was no difference between the mean preoperative (56%) and postoperative (55.9%) vessel density (p=0.93).

Discussion: OCT-A is comparable to ICG-A for determining iris vessel filling defects. In addition, OCT-A gives quantitative vessel density values that can be compared pre- and post-operatively.

Conclusion: OCT-A is a useful tool in the evaluation of ASI in patients undergoing strabismus surgery.

Evidence-Based Schedule for Retinopathy of Prematurity (ROP) Examinations

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Introduction: We sought to develop evidence-based recommendations for scheduling and termination of acute phase ROP examinations.

Methods: Secondary analysis of multicenter retrospective study of infants undergoing ROP examinations at 29 North-American hospitals, 2006-2012 (G-ROP Study). Analysis was by eye. Outcomes were timing for starting examinations, inter-examination intervals, and terminating examinations; based upon earliest, soonest, and latest occurrences of Type 1 ROP, respectively; and with respect to stage (S), zone (Z), and postmenstrual age (PMA) of current examination. Gestational age (GA) and birth weight (BW) strata were analyzed to further refine recommendations. Only Stage/zone strata with minimum 650 examinations (range 651-11,041) were considered.

Results: 39,943 individual eye diagnoses of 8,334 infants were studied. Type 1 ROP occurred in 838 eyes. Exams should begin by 31-weeks-PMA (PMA-31) for GA<27 weeks, or age 6 weeks for GA>=27 weeks. Inter-examination intervals could be S0Z1 1-2 weeks; S1Z1 1 week; S2Z1 <=1 week; S0Z2 2 weeks; S1Z2/3 2 weeks; S2Z2/3 1 week; S3Z2/3 <=1 week; S0Z3 2 weeks. Intervals could safely be lengthened for persistent S0, S1, S2, S3, after PMA-40, 41, 44, 44, respectively, or S0 after PMA-36 if BW>750g or GA>28 weeks. Acute phase examinations could be terminated for 'Mature'; 'Regressed'; or S0Z3 without prior disease in Z1 or 2 after PMA-37 or at any PMA if GA>28-weeks.

Discussion: Clinical judgment could be used to adjust these intervals, for pre-plus-changes, rapid progression, or clearly regressing disease.

Conclusion: Modification of current ROP schedules should be considered, based upon these data from a large cohort representative of infants receiving examinations.

Weight Gain Acceleration and Risk of Retinopathy of Prematurity

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Introduction: Slow postnatal weight gain (WG), a surrogate for low IGF-1, is predictive of retinopathy of prematurity (ROP). Early low IGF-1 inhibits retinal vessel growth, but a later rise activates VEGF, causing neovascularization. The rate of IGF-1 rising is represented by WG acceleration. We evaluated if faster WG acceleration later in life is associated with a higher, rather than lower, risk of severe ROP.

Methods: Retrospective cohort study at 29 North American hospitals, 2006-12 (G-ROP Study). WG rate during PMA 29-33 weeks (WGR-29-33) and WG acceleration during weeks 34-38 (WGA-34-38) were determined using linear regression of daily weights. The association between WGA-34-38 and type 1 or 2 ROP was assessed.

Results: 6835 infants with adequate data were studied. 868 (12.7%) severe ROP. Stratified by WGR-29-33 tertiles, the rate of ROP did not change with WGA for the lowest tertile; but for middle and high WGF-29-33 tertiles, rate of ROP increased with increasing WGA, except for the fastest (top 20%) growing infants.

Discussion: The relationship between weight gain and ROP is more complex than previously thought. Timing and rate of IGF-1 increases are important and would impact potential therapeutic measures.

Conclusion: The effect of WGA on ROP depends on WGR earlier in postnatal development. Low WGR-29-33 is associated with severe ROP regardless of subsequent WGA. But if WGR-29-33 is moderate or high, subsequent rapid rises in WGR are associated with increasing risk of severe ROP.

Automated Diagnosis of Plus Disease in Retinopathy of Prematurity using Deep Learning

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Introduction: The diagnosis of plus disease is highly variable and there is growing evidence this translates into real world treatment differences between clinicians. This paper presents and evaluates a fully automated algorithm based on deep learning (DL) for diagnosis of plus disease in ROP from retinal images and proposes a real world solution to this problem.

Methods: We developed a convolutional (deep) neural network (i-ROP DL) to diagnose three level plus disease using a multi-institutional database of nearly 6000 Retcam images with reference standard diagnosis (consensus of ophthalmoscopy and three or more telemedicine diagnoses). Performance was evaluated using area under receiver operating characteristic curves (AUC) and comparison with diagnoses from eight independent clinical experts using quadratic weighted kappa coefficients. We are developing a web-based centralized server with open source access to enable this technology to be utilized anywhere with an internet connection.

Results: Mean AUCs of 0.94±0.01 for diagnosis of pre-plus or worse disease and 0.98±0.01 for diagnosis of “plus” (versus not plus) were observed. The algorithm outperformed 6 out of 8 experts in the test set, demonstrating a quadratic weighted kappa score of 0.92 compared to the RSD, whereas the mean kappa among 8 experts compared to the RSD was 0.85 (range 0.80 – 0.95).

Discussion: The i-ROP DL algorithm can diagnose plus disease automatically with the same or higher proficiency than ROP experts. We will present a fully automated, open source screening platform for incorporation into telemedicine programs.

Conclusion: The i-ROP DL system has potential to improve the quality, accessibility, and cost of ROP screening worldwide.

**Introduction:** Infants with type 1 ROP were enrolled into a masked, multi-center, phase 1 dose de-escalation study and treated initially with doses of 0.25 mg, 0.125 mg, 0.063 mg, or 0.031 mg of bevacizumab. Additional treatment after 4-weeks was at investigator discretion. Ocular outcomes at 12-months corrected age are reported.

**Methods:** Infants were examined at 12-months corrected age.

**Results:** Forty-five of 58 infants (76%) completed the outcome exam.

Of 44 study eyes with a cycloplegic refraction, 6 (14%) had myopia > -5.00D spherical equivalent [SE]) and 2 (5%) had hyperopia >+4.00D SE. Mean SE refractive error was -0.88D. Abnormalities of the cornea, lens, or anterior segment were reported in 2 (4%), 1 (2%), and 1 (2%) eye(s), respectively. Optic nerve atrophy was identified in 6 (13%) eyes; 1 (2%) eye had a total retinal detachment.

Strabismus at near fixation was present in 13 infants (29%), 7 (16%) had nystagmus and 3 (7%) had amblyopia. Of 44 study eyes assessed for fixation behavior, 36 (82%) had central, steady, and maintained fixation behavior.

**Discussion:** In this study of low dose bevacizumab, the rates of high myopia, strabismus, nystagmus, and other ocular findings at one year were low and consistent with rates reported for higher doses.[1-3]

**Conclusion:** A larger comparative study with longer follow-up will be required to better assess the relative risks for developing ocular co-morbidities in infants receiving a lowest effective dose of bevacizumab for Type 1 ROP as determined by this phase 1 study.

Refractive Outcomes Comparing Primary Laser to Primary Bevacizumab with Delayed Laser for Type 1 ROP

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Introduction: The treatment of retinopathy of prematurity (ROP) with intravitreal bevacizumab (IVB) has been associated with less myopia than laser (1). Due to concerns about late reactivation after treatment with IVB beyond conventional screening guidelines, completion of treatment with laser ablation to persistent avascular retina has been recommended (2,3). This study evaluates refractive outcomes comparing eyes treated with IVB and delayed laser (IVB-PRP) to eyes treated with primary laser (PRP).

Methods: Retrospective chart review from 2006-2016 identified 89 treated patients. Patients with type 1 ROP were treated with PRP before the publication of BEAT-ROP. After BEAT-ROP, these patients were treated with IVB-PRP. Cycloplegic refractions at 2-4 years were available for 14 patients (25 eyes) after PRP and 16 patients (31 eyes) after IVB-PRP. An additional 3 patients (6 eyes) received IVB monotherapy.

Results: Mean spherical equivalent (SE) was -7.76 among patients who received PRP and -0.24 among patients who received IVB-PRP (p < 0.0001). Mean age at refraction was not significantly different between the two groups (3.12 and 2.87 years, p = 0.231). Compared to the small group who received IVB monotherapy (mean SE +0.71), refraction was similar among patients who received IVB-PRP (p = 0.535).

Discussion: Infants who received IVB-PRP were significantly less myopic than infants who received PRP. Despite a trend towards slightly older age at refraction in the PRP group, a few months would not explain this large refractive difference.

Conclusion: Delayed laser is recommended after IVB to prevent late retinal detachment. This does not increase undesirable refractive outcomes.

References:


Introduction: Voretigene neparvovec (VN) improves ambulatory navigation, light sensitivity, and visual field (VF) in subjects with RPE65 mutation–associated inherited retinal disease (IRD). We report original intervention (OI) Year (Y) 3, crossover-control (CC) Y2, and Y1 results for all subjects stratified by age < and >/=10y at injection.

Methods: Twenty-nine subjects with RPE65 mutations received bilateral, subretinal VN injections; the CC group received VN at Y1. Endpoints: change in multi-luminance mobility test (MLMT) performance, full-field light sensitivity threshold (FST), visual acuity (VA), and VF.

Results: Improvements from baseline MLMT and FST for the OI group versus the CC group at Y1 were significant (P=0.004, MLMT; P<0.001, FST). After treatment at Y2, the CC group achieved similar endpoints to Y1 OI. OI endpoints were maintained through Y3. MLMT Y3 OI change was 1.8(1.0) and for Y2 CC was 2.1(1.6). Bilateral FST Y3 OI change was -2.04(1.43) log10(cd.s/m2) and for Y2 CC -2.69(1.41). VA Y3 OI improvement was -0.16(0.35) logMAR (~8 letters) and for Y2 CC -0.06(0.23) (~3 letters). Goldmann VF III4e monocular sum total degree Y3 OI mean change was 282.2(256.5) and for Y2 CC 182.6(309.9). No significant difference between subjects < or >/=10y for MLMT, FST, GVF, or VA was found 1 year post-treatment (post-hoc; P=0.54, 0.98, 0.94, 0.084).

Discussion: Despite concerns about amblyopia limiting visual improvement in children treated after visual cortex maturity, no difference was found between subjects < or >/=10y.

Conclusion: VN OI improvements were maintained for 3Y and were not significantly different between subjects < or >/=10y 1 year post-treatment.

Mosaic Carriers of RB1 Develop Fewer Tumors Compared to Retinoblastoma Patients with Heterozygous Germline Mutations

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Introduction: The role of mosaicism in Retinoblastoma (Rb) is increasingly being recognised as molecular genetic tests become more sensitive (1). There is conflicting information regarding the phenotypic characteristics of mosaicism such as age of onset and laterality (2,3).

Methods: A retrospective analysis of mosaic and heterozygous RB1 mutation carriers (low penetrant (LP) and high penetrant (HP)) from 1992 to 2017 was conducted. Tumor number per eye was assessed in patients classified with A, B and C tumors using the International Intraocular Retinoblastoma Classification system. Patients with D or E group eyes were assessed based upon age at diagnosis.

Results: Data were analysed for 107 patients: 64 were full germline familial patients (53 HP and 11 LP) and 43 mosaic germline patients. 25% HP patients were unilateral and 9 of 13 developed tumors in their previously unaffected eye. 72% of mosaic patients were unilateral and only 1 of 31 developed tumours in their unaffected eye. Age at diagnosis was higher in mosaic patients (median 16 months range 2-117) than HP patients (median 7 range 2-33) (p<0.001). Tumor number per eye was lower in mosaic patients (median 1.5 tumors range 1-6) than HP patients (median 3 range 1-8) (p=0.009).

Discussion: Patients with mosaicism develop less tumors compared to patients with HP mutations in eyes with Rb at presentation. Advanced disease presents at an older age.

Conclusion: This is the first study to demonstrate that Rb mosaicism is associated with fewer tumors in eyes with Rb. This provides important prognostic information for clinicians and families.

Corneal Confocal Microscopy Shows Progressive Reduction in Corneal Nerve Fiber Length over a 2 Year Time Period in Children with Type 1 Diabetes

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Introduction: Corneal confocal microscopy (CCM) of the corneal sub-basal nerve fiber layer has been suggested as a surrogate marker for peripheral diabetic neuropathy. We report findings of corneal nerve fiber layer length (CNFL) at baseline and 2 years (yrs) later in children with type 1 diabetes mellitus (T1DM) of at least 5yrs duration.

Methods: 71 children with T1DM with mean (SD) age 14.7(2.3)yrs, T1DM duration 9.1(2.7)yrs; and 23 healthy controls aged 12.6(0.6)yrs underwent baseline and 2yr follow-up CCM examination. CNFL was quantified using automated image analysis and compared via independent t-tests and Repeated Measures ANOVA to explore change over 2yrs; and McNemar's Test to compare the proportion of individuals with abnormal CNFL over 2yrs.

Results: Mean CNFL was significantly lower in children with T1DM compared to controls at baseline (p=0.02) and at 2yrs (p=0.001). Point estimates of mean differences in CNFL indicated lower 2yr measures in T1DM and higher 2yr measures in controls, but this was not statistically significant (p=0.054). The proportion of participants with an abnormal CNFL (cut-off established from healthy controls) changed from 7 to 17 in T1DM (p=0.013) and from 0 to 2 in controls (p=0.500), over 2yrs.

Discussion: Children with T1DM of at least 5yrs duration have a lower CNFL compared to control subjects at baseline and 2yrs later; and after 2yrs, the proportion of children with an abnormal CNFL was significantly higher in T1DM, with no significant change in controls.

Conclusion: These findings suggest early and progressive corneal nerve loss over a relatively short period of time in children with T1DM.

Posters
Poster #1
Monday, 10:10 – 11:10 am

Linear and Periodic Trends in Ophthalmology-Related Internet Search Patterns of the US Population

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Introduction: Patients are increasingly reliant on web-based searches to self-assess eye-related symptoms, understand diagnoses, and decide on treatments. We hypothesize that search query analysis will provide insight into current presentation and treatment patterns of eye disease.

Methods: We performed a retrospective search query analysis using the Google Trends database for ophthalmology terms subdivided into symptoms, diagnoses and treatments. Queries were restricted to the USA within 5-year interval (01/2012 - 01/2017). Matlab Curve-Fitting Toolbox was used to perform linear and nonlinear regression analysis, and goodness-of-fit was assessed by adjusted coefficients of determination ($r^2$).

Results: Query frequencies for symptoms (N=20): linear increase observed for 'dry eye' ($r^2=0.67$), 'eye pain' ($r^2=0.62$) and periodic trends observed for 'pink eye' ($r^2=0.76$), 'itchy eye' ($r^2=0.67$), 'floaters' ($r^2=0.59$) and 'eye discharge' ($r^2=0.56$). For diagnoses (N=30): linear increase observed for 'diabetic eye' ($r^2=0.44$) and periodic trends observed for 'stye' ($r^2=0.81$), 'conjunctivitis' ($r^2=0.63$), 'chalazion' ($r^2=0.46$), 'corneal abrasion' ($r^2=0.30$). For treatments (N=10): linear increase observed for 'cataract surgery' ($r^2=0.74$) and periodic trends observed for 'eye drops' ($r^2=0.82$).

Discussion: We demonstrate both linear and periodic trends in ophthalmology related queries (N=60). We propose a tool to interpolate the period and amplitude of seasonal variations in query frequency of terms such as 'stye', 'conjunctivitis', 'chalazion' and 'corneal abrasions'.

Conclusion: Search query analysis can supplement understanding of epidemiologic factors of eye-related symptoms and diagnose and may potentially serve as a powerful tool for predictive modelling of future trends in ophthalmology.

Parental Stress in a Pediatric Ophthalmology Population

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Introduction: The purpose of our study was to characterize the impact of pediatric ophthalmic conditions on parental stress.

Methods: Parents who presented to pediatric ophthalmology were administered the Parental Stress Index Short Form. Demographic information and self-reported depression/anxiety were collected. Univariate analysis was performed.

Results: 116 parents were recruited. Mean percentiles for the total parental stress and subsections were: Total Stress 40.2 ± 25.6, Parental Distress (PD) 41.9 ± 25.5, Parent Child Dysfunctional Interaction (PCDI) 41.5 ± 25.1, and Difficult Child (DC) 42.5 ± 26.6. Total Stress and PD percentiles of nonmarried vs married parents was 46.8 ± 23.6 vs 36.5 ± 26.0; 52.6 ± 24.6 vs 36.1 ± 24.1; p<0.05. Total stress, PD, and DC percentiles of parents with depression/anxiety vs those without was 47.0 ± 24.4 vs 36.9 ± 25.6; 51.8 ± 23.3 vs 37.2 ± 25.2; 49.3 ± 27.8 vs 39.2 ± 25.5; p <0.05. PD percentiles of parents with a high school education vs those with higher education was 48.9 ± 25.6 vs 39.4 ± 25.0; p<0.05.

Discussion: While our population did not reach the significant stress cutoff of 85%, we found that unmarried parents, those with depression/anxiety, or parents with lower education had significantly higher stress levels. These groups likely have underlying predisposition to increased stress.

Conclusion: This study suggests that there is no significant difference in parental stress between the parents of pediatric ophthalmology patients and the general population. Providers of children with pediatric ophthalmic conditions should be aware of groups with potentially higher stress identified in this study.

Introduction: Procedures such as eye drops, examinations, and surgeries can be very stressful for children. In addition, patient satisfaction scores are closely tied to patient and family anxiety. Child Life Specialists (CLS) are psycho-social professionals that use therapeutic play and education to help children cope with medical experiences. To address patient satisfaction issues and minimize patient and caregiver stress, a CLS was introduced into an academic pediatric ophthalmology clinic.

Methods: Press-Ganey (PG) satisfaction scores (percent top box) for one provider were compared before and after hiring the CLS. PG areas where the CLS may have impacted satisfaction scores were compared with those anticipated to not change.

Results: The CLS interacted with approximately 20 patients per day. PG percentile rank scores for overall assessment increased from 50th percentile to the 79th percentile. Moving through visit increased from the 40th percentile to the 94th percentile. The mean score of the other four sections (Access, Friendliness/Courtesy, Nurse/Assistant, and Personal issues) did not change (44th percentile to 44th percentile). Mean visit time did not change (73 ±31 minutes before compared with 72± 30 after).

Discussion: Top box scores showed significant improvement after hiring and implementing child life services.

Conclusion: Child life services in an academic pediatric ophthalmology clinic produced improved patient satisfaction without hindering patient flow, demonstrating that a CLS is a valuable addition to the ophthalmology clinic care team.

Introduction: Virtual visits (VV) connect the clinician to the patient through a live-interactive video system. This allows patients to access care from home or any convenient location. This study presents data on the feasibility of VVs in pediatric ophthalmology.

Methods: We developed a Health Insurance Portability and Accountability Act-compliant video platform and used it to implement VVs across 5 pediatric services including neurology, cardiovascular surgery, ophthalmology, oral surgery, and pain in December 2016. We retrospectively reviewed quality metrics for the program and for ophthalmology as a subset.

Results: After 9 months, we completed 513 virtual visits. The overall patient rating was 9.2/10 with 95% stating that they would conduct another VV and 94% citing convenience as the major benefit. The overall provider satisfaction was 9.5/10 with 94% commenting that the VV was equally effective as an in-person visit. Ophthalmology completed 35 (7%) VVs comprising of 15 post-operative strabismus evaluations, 12 ocular surface and periocular post-operative conditions, 8 return patients (1 on hospice), and 1 new patient. In comparison to in-person visits, ophthalmology VVs saved >$13,440 and >140 hours of travel and wait time for patients.

Discussion: VVs are feasible and appealing in pediatric medicine. In pediatric ophthalmology, we have used them predominantly for delivering post-operative care, and these qualitative data are reassuring. However, data comparing outcomes between VVs and in-person visits are lacking.

Conclusion: VVs are feasible, intuitive, and will revolutionize healthcare delivery as long as we are careful to ensure patient safety with more studies.

The Cycloplegic and Mydriatic Impact of Tropicamide Omission from a Routine Pediatric Eye Drop Combination

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Introduction: This study examined the cycloplegic and mydriatic impact of tropicamide omission from a common pediatric eye drop combination.

Methods: Seventy-five children between the ages of 4 and 11 received 1% tropicamide, 1% cyclopentolate, and 2.5% phenylephrine (TCP) in one eye and 1% cyclopentolate and 2.5% phenylephrine (CP) in the other. Spherical equivalent (SE), maximum pupil size (mm), and pupillary constriction in response to photostimulation (percent change) were measured prior to and 30 minutes after eye drop instillation using an autorefractor and pupillometer. Iris pigmentation was examined as a between-subjects variable.

Results: Mean differences in SE between TCP and CP were not statistically significant (p = 0.96). Significant interactions between eye drop regimen and iris pigmentation were observed for pupil size (p = 0.001) and constriction percentage (p = 0.04). Among only patients with dark irides, TCP, on average, yielded slightly larger pupils (7.72 vs. 7.34 mm, p = 0.003) that were less responsive to light (5.66% vs. 7.62%, p = 0.003). All pupils dilated to >/= 6.0 mm, with equivalent proportions achieving >/= 7.0 mm for TCP and CP (p = 0.17).

Discussion: TCP and CP elicited equivalent cycloplegic effects. Mydriatic differences between the regimens, although statistically significant in dark irides, were of negligible clinical magnitude, and all pupils achieved sufficient dilation for funduscopv.

Conclusion: Tropicamide may be omitted from the traditional TCP pediatric eye drop regimen. Fewer drops are typically better tolerated by children and may improve cooperation with the ophthalmic exam. Omission of tropicamide would also offer cost benefits for practitioners.

Prevalence of Visual Impairment and Ocular Pathology and Achievability of Examination in a University-Based Eye Clinic for Patients with Disabilities

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Introduction: Individuals with disabilities often have visual/ocular pathology. Examination can be challenging, yet services scarce. Our university-based eye center established a once/month clinic for patients with disabilities. We describe the demographics, types of visual/ocular pathology, and achievability of examination in this dedicated clinic, staffed by one pediatric ophthalmologist.

Methods: Medical records for patients examined January 2014 through December 2016 were reviewed. Descriptive statistics were calculated for demographics, visual acuity, ocular diagnoses (categorized as treatable, possibly treatable, or non-treatable), non-ocular diagnoses, refractive error, and achievable examination data.

Results: 178 patients with disabilities, 5 months to 95 years, were examined at 281 visits. 119 (66.9%) were non-verbal. 36/178 patients (20.2%) had a normal exam, 133 (74.7%) had treatable ocular diagnoses, 2 (1.1%) had possibly treatable diagnoses only, and 7 (3.9%) had non-treatable diagnoses only. 68/135 (50.4%) with treatable/possibly treatable diagnoses were newly diagnosed. 85/178 (47.8%) patients had a significant refractive error. 72.5% of patients with a treatable refractive error also had another treatable diagnosis. Cooperation precluded slit lamp examination in 1/178 individuals (0.6%), cycloplegic refraction in 3/178 (1.7%), dilated fundus exam in 4/178 (2.2%), and iCare/Goldmann IOP in 28/178 (15.7%).

Discussion: Patients with disabilities have a high prevalence of ocular pathology, often treatable and previously unrecognized. Refractive errors are common, frequently accompanied by other treatable conditions. Trained providers can achieve a complete ophthalmic examination in most patients.

Conclusion: A dedicated eye clinic is an advantageous setting for examination of patients with disabilities. Pediatric ophthalmologists are likely providers because of expertise in examining challenging, often non-verbal patients.

Microethics in Pediatric Ophthalmology

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Introduction: Microethics, also known as everyday ethics, recognizes that there are subtle ethical issues embedded in routine interactions with patients [1]. While formal ethics education focuses on principles of autonomy, justice, beneficence and non-maleficence, little guidance is provided to physicians or trainees about ethical dilemmas that arise during everyday clinical encounters [2]. No prior work has examined microethics in ophthalmology.

Methods: A retrospective chart review of 96 patients seen by one pediatric ophthalmology provider at an academic medical center was performed. Qualitative methodology techniques were used to identify ethics themes in clinical encounters by modifying constructs previously described by Truog and Moon [1,3].

Results: Encounters from 96 patients were analyzed (77 pediatric and 19 adult strabismus patients). The majority of patients (n=68) had strabismus and/or amblyopia; 12 were within the 6-month perioperative period. The most common microethics themes identified were:

- Shared decision-making with parents and other caregivers
- Managing patient expectations regarding goals of care
- Overcoming language and cultural barriers in communication
- Professionalism and disclosing medical errors
- Time management and competing patient demands
- Negotiating with non-compliant patients
- Clinical biases in decision-making
- Impact of electronic medical record on doctor-patient relationship

Discussion: Co-morbidities, language barriers and history of multiple providers were additional challenges in building trust and developing a therapeutic alliance with patients.

Conclusion: Microethics issues are commonplace in pediatric ophthalmology. Creating a framework to identify issues will help increase physician awareness and initiate conversations about ways to approach ethics in everyday practice. It can also be a useful strategy to incorporate ethics into the teaching of trainees.

Introduction: Pediatric ophthalmology practices vary widely in terms of the types of medical conditions and ages of patients cared for. This study was designed to study these practice patterns.

Methods: A survey was sent to AAPOS members through an E-blast. The responses to the survey were collated and analyzed.

Results: The survey was sent to 1408 international and US AAPOS members. Ninety members (6.4%) responded. 89% of respondents confine their practices to pediatric ophthalmology and adult strabismus. For conditions other than strabismus, 59% restrict their practice to patients less than 21 years of age. The percentages of respondents who provide primary surgical and medical treatment of the following conditions are: Ptosis and anterior orbital lesions - 68%; Cataract - 49%; Uveitis - 38%; Retinopathy of prematurity - 25%; Glaucoma - 19%; Retinoblastoma - 7%.

Discussion: Many AAPOS members provide primary medical and surgical care for patients with a wide variety of conditions. Awareness of this variety of practice might prove beneficial in enticing residents to consider careers in pediatric ophthalmology.

Conclusion: Pediatric ophthalmologists are an important part of the physician workforce, providing care for patients with many complex ocular disorders. In addition to treatment of the underlying diseases, pediatric ophthalmologists are uniquely qualified to also monitor amblyopia and refractive problems, which can have a beneficial impact on visual outcomes.

Introduction: Dyslexia is the most common learning disability. It is a language processing disorder that can result in problems with reading fluency, spelling, writing and comprehension. This study was undertaken to better assess our members understanding of dyslexia.

Methods: An IRB approved survey was sent to 1668 AAPOS members via the 2017 e-mail directory.

Results: A total of 157 (9.4%) surveys were returned to date. Members were cognizant that dyslexia is not rare. About half of the members reported feeling competent to identify patients at risk for dyslexia and who can aid in establishing the diagnosis. The majority (66%) indicated they were familiar with dyslexia referrals within their community. Forty seven percent reported receiving dyslexia education while in practice, 16% while in fellowship, and 5% during residency. Three quarters indicated they had reviewed the AAPOS learning modules and 55% reported sharing these handouts. The majority was well versed with signs of possible dyslexia but 15% or less recognized potential associated social and emotional issues.

Discussion: Diagnosis and management of dyslexia involves a multidisciplinary approach. Early identification and intervention is critical for the education and development of each child. Our survey demonstrates the majority recognize that dyslexia is neurological based and hereditary. It elucidated the opportunity for implementation of dyslexia specific education.

Conclusion: Our results demonstrate some areas of limited awareness amongst the AAPOS community regarding dyslexia. It highlights a need for increased educational experiences during training as well as ongoing updated information for practicing providers to be knowledgeable for those at risk children for dyslexia.

**Postural Considerations During Retina Examination at the Slit Lamp: Positional Adjustments to Patients and Equipment May Reduce the Risk of Musculoskeletal Symptoms in Ophthalmologists**

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**Introduction:** Ophthalmologists often maintain static, un-ergonomic postures during their routine clinical examinations, which may lead to musculoskeletal symptoms (MSS) and decreased capacity for healthcare delivery. Ophthalmologists' posture and ergonomics are currently evaluated using qualitative survey methods. Motion capture and electromyography may provide an objective, quantitative methodology to examine posture and suggest postural adjustments that will reduce the risk of developing MSS.

**Methods:** 10 pediatric ophthalmologists performed simulated retina exams on a child CPR manikin using a slit lamp and a 90D lens. Postural kinematics and muscle activity were measured using marker-based motion capture and electromyography, respectively. Examinations were performed under 3 conditions: No postural adjustments, postural adjustment by altering slit lamp platform height and patient position, and elbow rest placement under arm holding 90D lens, along with postural adjustment. Neck flexion angle and neck and shoulder muscle activity were compared among these 3 conditions for all ophthalmologists.

**Results:** Neck flexion angle range of motion decreased significantly after postural adjustment (41.8±10.9° vs. 36.8±9.2°, p = 0.041) and elbow rest placement (41.8±10.9° vs. 36.3±9.2°, p = 0.045). Trapezius muscle activity decreased after postural adjustment (0.02±0.02V vs. 0.01±0.005V, p =0.182) and elbow rest placement (0.02±0.02V vs. 0.01±0.007V, p =0.262). Paired t-tests were used to compare these variables.

**Discussion:** The observed reduction in neck flexion and shoulder muscle activity after postural adjustments may indicate lower exposure to sustained non-neutral neck postures that can cause MSS.

**Conclusion:** Quick postural adjustments may decrease the risk of MSS by reducing time spent by ophthalmologists in non-ergonomic postures.

Sensory Testing and Stereopsis with Nintendo 3DS Game

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Introduction: Most clinical tests of stereopsis are static images presented to either eye through Polarized or red-green goggles. The Frisby test is a static test viewed without goggles. All these could be memorized by a patient without stereopsis. Some children don’t understand the tests or are goggle-aversive. The Nintendo 3DS gaming system uses a unique bi-directional pixel screen so 3D dynamic images can be viewed without goggles.

Methods: We developed a 3DS game and compared it to conventional stereo goggle tests (Stereo Fly/Reindeer and preschool Randot) in a study of normal subjects and strabismic patients. Subjects, after consent, view the game module screen touching the corresponding screen when they first perceive the random one of four discs to dynamically "levitate."

Results: Twenty-seven subjects, aged 3-63 all completed the game endpoint from 3 to 30 seconds. The game score correlated well with Preschool Randot ($r(9) = 0.98, c=0.60 p<0.01$), Stereo Reindeer ($r(9) = 0.91, c=0.6 p<0.01$) and Stereo Fly ($r(24)=0.56, c=0.38 p<0.01$). The Nintendo 3DS game predicted good versus fair-poor stereo with sensitivity 86% and specificity 92%.

Discussion: The early version of the Nintendo dynamic stereo game reliably stratified normal and decreased levels of stereopsis. Further sensory tests including near acuity and color vision are being developed for this game platform.

Conclusion: A dynamic, interactive 3D video game may help clinical pediatric eye care and research.

References: n/a
Investigation of Maximum Disparity and Stereopsis

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Introduction: Previous research has been carried out into relating minimum disparity stereoacuity to the control of an intermittent deviation. This study measured maximum disparity and compared this to the fusion range which is also used to assess control.

Methods: Random-dot stereograms were viewed using crystal shutter goggles and the participants viewed a central circle stimulus. This circle either advanced or receded and either moved gradually or in static increments. When fusion was lost, the maximum stereoacuity was recorded in seconds of arc. The Prism Fusion Range was measured both base in and base out. A TNO stereotest was also performed to threshold.

Results: 21 participants were recruited all with good visual acuity and normal binocular single vision. The mean value for the advancing target was 206.7 seconds of arc for static disparity and 259.98 for gradually increasing disparity. For the receding target the mean was 128.52 for static and 157.38 for gradual. The ANOVA demonstrated a significant difference between advancing and receding stimuli p<0.05 as was the difference between static and gradual presentation p<0.05. There was no correlation between maximum disparity achieved and the TNO or Prism Fusion Range results.

Discussion: These results provide normative data for maximum disparity achieved. The reasons for the differences found will be discussed.

Conclusion: This method of assessment warrants further exploration in relation to heterophoria and intermittent deviations.

References: N/A
Fusional Vergence Amplitudes According to Ages

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Introduction: There are rare investigations on relationships between fusional amplitudes by age in healthy binocular people. The aim of this study was to find out the normative values fusional amplitudes according to the ages.

Methods: Ninety visually normal participants were recruited from ophthalmology practice at Kocaeli University Ophthalmology Department, Turkey. Inclusion criteria included subjects with best corrected visual acuity of 20/20 for distance, absence of any ocular pathology or abnormal ocular motility. None of the subjects had a vertical phoria at either a distance or near viewing distance. The amplitudes of horizontal and vertical are measured in prism diopters.

Results: A total of 30 children (group 1, range: 9-18 yrs) and 30 young adults (group 2, range:20 -31 yrs) and 30 older adults (group 3, range: 31-40 yrs) participated in the study. The mean fusional convergence was significantly different between groups 1 and 3(p<0.05), and group 2 and 3(p<0.05). Mean fusional divergence was significantly different between groups 1 and 3(p<0.05), and group 2 and 3(p<0.05). There was no significant main-effect of age on the vertical fusional ranges and titmus stereotest(p>0.05).

Discussion: The normal fusional horizontal amplitudes at 6 meters is lower than our study; but patients having esophoria tend to have larger amplitudes; also, in the exophoric patient the amplitudes may be smaller than normal. Also, this difference could be due to the fact that the great range of accommodation observed in children.

Conclusion: It is important to know that is possible to have normal fusional vergence amplitudes and still have dysfunction of vergence system.

New Developed 4 Dot Light Test Mobile Application

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Introduction: To present a newly developed mobile application to evaluate the 4 Dot Light test in children, that could be more versatile and also be able to evaluate the sustained fusion angle at different distances.

Methods: The new application has both pediatric and adult images with different sizes to evaluate the sustained angle, a version with 3 and 4 images, changes on the test to avoid memorization and sounds to implement the use in smaller children. We compared this new device with the projector 4WLT in 23 adults.

Results: We present the mathematical values of the sustained angle of the test when used from 5 meters to 20 centimeters, and the estimated value of peripheral, macular and foveal fusion. 82.61% and 86.96% of the patients had distance foveal fusion with the projector and the mobile app device respectively, and 17.39% and 13.04% had macular fusion. The concordance between the projector and the app was $k = 0.832$.

Discussion: The 4 Dot Light mobile application has a high correlation with the standard projector 4WLT.

Conclusion: The new Worth Test mobile application could be useful in the daily practice to measure foveal, macular and peripheral sustained fusion angles both in children and adults.

References:
Degeneration of Orbital Pulleys in Elderly Patients with Diplopia

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Introduction: In recent years, with the development of diagnostic imaging, diagnosis of diplopia induced by the degeneration of orbital pulleys has increased. We studied elderly patients with diplopia who could not be diagnosed by conventional testing and compared their MRI to those of controls.

Methods: The participants included 57 patients (73.2±6.9 years) who exhibited esotropia or vertical strabismus and did not present with cranial nerve palsy, systemic illness, or ocular injury. They were chosen from among 236 patients aged 60 years or older, who visited Kitasato University Hospital for bilateral diplopia between 2014 and 2017. Seventeen age-matched individuals were chosen as controls (69.8 ± 4.9 years). The participants were classified into three groups: esotropia (21 cases), vertical strabismus (22 cases), and combined esotropia and vertical strabismus (14 cases) The examined items included the lateral rectus tilting angle (LRT), lateral rectus sagging angle (LRS), lateral rectus–superior rectus open angle (LR–SR-OA), and LR–SR band condition (LR–SR-BC).

Results: The results for the esotropia, vertical strabismus, combined strabismus, and control groups were as follows: LRT: -21.6°, -21.8°, -18.8°, -13.3°, LRS: -12.5°, -11.6°, -5.6°, -7.0°, LR–SR-OA: 114.8°, 111.9°, 104.0°, 106.1°, and LR–SR-BC: 2.8, 2.9, 2.9, 1.9: 4-level, respectively.

Discussion: The LRT, LRS, and LR–SR-OA displayed significant differences between the two groups (the esotropia and vertical strabismus) and the control. The LR–SR-BC was significantly different between the three groups and the control.

Conclusion: We found that many of the diplopia patients who could not be diagnosed by conventional testing had orbital pulley disorders.

References:
Normal Range of Ocular Duction in Various Age Brackets by Prism Shifting Light-Reflex Test

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Introduction: To introduce a new direct measurement method for ocular duction by shifting light reflex with plastic prism. We named this method Prism Shifting Light-Reflex Test (PLR test). We used it to establish normative values of ocular duction in each age bracket defined by decade and investigate the change of ocular duction with aging.

Methods: Participants aged between 21 and 80 years old without history of significant ophthalmologic, neurologic, and thyroidal diseases were examined. All participants had best corrected visual acuity better than 20/70 in both eyes. The ocular adduction, abduction, supraduction and infraduction were measured separately by PLR test.

Results: Of 123 participants included in this study, majority are female (82%). There were 20 to 23 participants in each ten-year age bracket. From regression analysis, the 95% predictive intervals for ocular adduction, abduction, supraduction and infraduction in the youngest and the oldest groups were [78,109] and [64,95], [92,126] and [78,112], [50,88] and [31,70], and [115,146] and [100,131] prism diopters, respectively. With aging, the ocular adduction, abduction, supraduction and infraduction were significantly decreased (P<0.0001) by the rate of -0.33%, -0.27%, -0.66% and -0.25% per year, respectively.

Discussion: The normative values of ocular duction by age in each decade was established as reference range from 95% predictive interval. Aging has the largest and smallest decremental effect on supraduction and infraduction, respectively.

Conclusion: PLR test is a novel technique in ocular duction measurement. This test is applicable in clinical practice due to its practicality and ease of use.

Extraocular Movement Deficits Secondary to Granulomatosis with Polyangiitis Lesions in Children

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Introduction: To describe a small series of patients presenting with extraocular movement deficits secondary to rare orbital lesions that were biopsy proven positive for granulomatosis with polyangiitis (GPA).

Methods: The study is an observational case series of three children who presented with symptoms associated with GPA and were found to have variable degrees of binocular diplopia and extraocular motor deficits on initial examination.

Results: Specific characteristics of the patients included one child who had binocular diplopia and a very mild (-1) restriction in elevation and abduction with ptosis and erythema of the upper eyelid with a small, firm, non-mobile mass on palpation. The second patient also had binocular diplopia with a mild to moderate (-2) restriction and pain in upgaze with ptosis and swelling of the upper eyelid. The last patient had very mild restriction in upgaze (-0.5) with proptosis and enlargement of the lacrimal gland. All three children had full resolution of their extraocular motor deficits and diplopia following treatment for their GPA lesions.

Discussion: Orbital lesions that are less commonly encountered in children including granulomatosis with polyangiitis can cause differing degrees of impairment in extraocular movements with variable symptoms that often resolve with proper treatment of the underlying pathology.

Conclusion: Due to the transient nature of extraocular motor deficits in vasculitis-related orbital lesions in children, these patients should be treated by addressing the primary cause of their lesions based on histopathological diagnosis which often leads to rapid resolution of any impairments without the need for further unnecessary medical or invasive surgical management.

Correlation Between Age and Insertional Distance Between the Nasal Limbus and the Insertion of the Medial Rectus Muscle Measured in Surgery

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Introduction: The distance between the nasal limbus and the insertion of the medial rectus muscle (insertional distance) is sometimes observed shortly especially in early surgical treatment of congenital esotropia. We investigated basic characteristics of insertional distance in esotropia patients.

Methods: Retrospective research. All the patients underwent eye muscle surgery under 15-year-old and Asian population. Main outcome measures are correlations of the insertional distance, the onset of esotropia, angle of esotropia, refractive errors and age at the surgery. A single surgeon measured the distance using standard calipers at the surgery. All research was conducted under the tenets of the Declaration of Helsinki.

Results: 147 eyes of 80 patients (47 males) were investigated. Average age at the surgery was 3.9±2.9 (0.7~14.6). Average distance was 4.4mm±0.5mm (3.0mm~5mm). The correlation coefficient between insertional distance and the onset of esotropia(0.0027), age at the surgery(<.0001) was significantly high. Otherwise, correlations between insertional distance and refractive errors(0.06), angle of esotropia(0.053) was lower. (Spearman's rank correlation coefficient, JMP 8).

Discussion: Recently, a lot of group reported insertional distances using optical coherence tomography. However, non-invasive measurement is very difficult for infantile esotropia. Mild correlation between insertional distance and refractive errors might represent that axial length and insertional distance increase differently. Age at the surgery was strongly correlated with insertional distance, although we haven't experienced infants less than 6 months.

Conclusion: The insertional distance and the age at the surgery were strongly correlated. Average insertional distance was overall shorter than previously reported normal control.

References: 1. Mims JL. Confirmed: there is no correlation between the insertional distance between the nasal limbus and the insertion of the medial rectus muscle--and the size of the strabismus angle in infantile esotropia. Binocul Vis Strabismus Q. 2006;21(1):33-6.
AS-OCT to Assess Extraocular Muscle Insertion

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Introduction: Anterior Segment Optical Coherence Tomography (AS-OCT) is a fast, noninvasive technique for high-resolution imaging that can be performed in the outpatient setting without use of sedation or anesthesia on cooperative patients. Recent studies have found that AS-OCT can image horizontal extraocular muscle insertion distance with good level of agreement between AS-OCT imaging and intraoperative measurement with a caliper and excellent inter- and intraexaminer reproducibility. We aim to demonstrate the usefulness AS-OCT to assess the insertion of extraocular rectus muscles in a case of penetrating trauma to the eye.

Methods: Seventy-five year old female patient observed in the emergency after penetrating trauma to the right eye (OD). Upon observation, visual acuity was 0.8 on her right eye and 0.63 on the left; pupils were brisk with no afferent pupillary defect and color vision was maintained. Ocular movements were full with no apparent restriction or diplopia. A penetrating vertical wound on the nasal conjunctiva OD was observed on slit lamp and subsequently sutured. No significant findings were identified on fundoscopy. The following day the patient reported diplopia and a 45Diopters right exotropia was found with limited adduction OD.

Results: AS-OCT identified right medial rectus insertion and magnetic resonance imaging (MRI) revealed an increase in the size of the right medial rectus with hyperintensity on STIR probably related to muscle edema.

Discussion: Several techniques can be used to image the extraocular muscles, such as MRI, computed tomography and ultrasound biomicroscopy. However these methods are costly and not always available.

Conclusion: AS-OCT is a noninvasive, accessible technique for high-resolution imaging that can be used not only for the preoperative study of strabismus patients but also to identify extraocular rectus muscle insertion in cases of trauma and suspected muscle slippage.

References:
Characterization of the Neuromuscular Junction in Patients with Strabismus

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Introduction: Neuromuscular junction morphology in the extraocular muscles of strabismus patients was examined to identify abnormalities that might contribute to their ocular misalignment. We hypothesize that the neuromuscular junction morphology is abnormal in these patients.

Methods: Muscle samples were obtained from patients with strabismus undergoing extraocular muscle resection. The neuromuscular junction was identified by immunostaining with synaptic markers, and then analyzed with fluorescent microscopy.

Results: Five enrolled patients (ages 10-55 years) included decompensated intermittent exotropia, consecutive exotropia, esotropia associated with developmental delay and nystagmus, and esotropia associated with anisometropic high myopia. Four patients had an abnormally decreased number of "en plaque" synapses previously described in normal human extraocular muscle, which is responsible for fast twitch synaptic transmission[1]. One adult with acute acquired esotropia had no identifiable synapses.

Discussion: Preliminary data suggest the distribution of the neuromuscular junctions in extraocular muscles of patients with strabismus is abnormal compared to what is known about normal human extraocular muscle. In addition, one of our muscle samples had virtually no identifiable synapses, suggesting that variability in synapse distribution may correlate with different types of strabismus.

Conclusion: Patients with strabismus appear to have abnormal neuromuscular junction distribution, and the development of the neuromuscular junction is likely important for strabismus. Elucidating the role of the peripheral muscle in strabismus can significantly impact the treatment of strabismus and may contribute to prevention of ocular misalignment. To the author's knowledge, this is the first study to examine the neuromuscular junctions in extraocular muscles of strabismus patients.

Strabismus Evaluation with a New Videooculograph Device (GazeLab)

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**Introduction:** Controversy exists regarding the interobserver reliability of alternate prism cover test when measuring strabismus. We hypothesize by using a computerized video device with a strabismic deviation measuring software we could overcome the interobserver differences due to subjectivity. We here tested if the results of a new (ocular movement digitizer) named GazeLab displaying and measuring the horizontal and vertical ocular motility disorders compared to clinical measurements from one examiner.

**Methods:** As a retrospective study we compared the clinical evaluations of horizontal strabismus of 32 patients (15 men and 17 women) with mean age of 25 from one ophthalmologist to the recordings and interpretation of the videooculograph device. Because of lack of cooperation we were not able to include pediatric patients who usually have concomitant strabismus.

**Results:** Using Microsoft Excel Correlation data analysis the results of the clinical evaluations and videooculograph results were correlated. (0.85)

**Discussion:** Objective assessment of strabismus is utmost important since the only reliable way to assess it now is clinical evaluation which is subjective. Our results are consistent with our hypothesis results of the device with clinical evaluation shows strong correlation.

**Conclusion:** Objective measurement of strabismus is an ever evolving area of research with new machines and algorithms being developed. We believe devices like GazeLab will be an indispensable tool for strabismic evaluation in the future.

**References:** Shen E, Porco T, Rutar T. Errors in strabismus surgery. JAMA Ophthalmol. 2013 Jan;131(1):75-9
**Semi-Automatic Measurement of Horizontal Angle of Strabismus Using Digital Pictures**

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**Introduction:** To assess the validity of an objective and reproducible method for the measurement of the horizontal angle of deviation of strabismus with a new computer-assisted photographic method in adults and children.

**Methods:** The method proposed was first validated in patients without strabismus and then in patients with strabismus in a prospective study. It consisted of 3 steps: (1) acquisition of 3 pictures (binocular - monocular right eye and left eye), (2) tracking the nasal limbus, the corneal reflect and the temporal limbus with the mouse on each picture, (3) automatic measurement of the horizontal angle of deviation using innovative software. Each picture was taken twice in primary position at a "conversational distance (approximately 1 meter) with glasses but without any other equipment, and analyzed twice by two independent orthoptists.

**Results:** 2 populations were studied. 34 adults without strabismus were first included. Then 79 adults and children with strabismus were prospectively included. 4 were excluded because of non-analyzable pictures. The angle of deviation of 4 patients with deep amblyopia was analyzed separately with success using partial data of the non-amblyopic eye. The method provided quick semi-automatic data of the horizontal angle of deviation for both populations with no statistical difference between the two pictures and between the two computer-assisted measurements. The accuracy of the method was between 2 and 5 prism Diopters for both populations.

**Discussion:** This semi-automatic photographic method is simple, objective, reproducible and reliable for the measurement of the horizontal angle of deviation of strabismus. It is easily used for adults or very young children, for small and large angles, and for patients with deep amblyopia. It can also be used for measuring strabismus under general anesthesia. It provides new data of the angle of deviation of strabismus at a 'conversational distance' and has to be considered as a complementary method for measuring strabismus.

**Conclusion:** This semi-automatic photographic method of measurement of the horizontal angle of deviation of strabismus using digital pictures is an easy, quick and cheap way to measure strabismus in 'everyday life conditions' and should be used to standardize measurements for future studies.


Pediatric Strabismus Cases Possibly Related to Excessive Use of Information and Communication Technology Devices

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Introduction: The purpose of this study is to report development of strabismus related to excessive use of information and communication technology (ICT) devices.

Methods: From February to August 2017, we administered a questionnaire about use of ICT devices to 63 strabismus patients who were ICT users and identified seven patients (age range, 6-17 years) in whom strabismus developed or worsened after excessive use of ICT devices. No other factors were present that might have induced strabismus. We evaluated the ocular alignment, binocular function, ICT device use, and clinical courses.

Results: Two patients each developed acute esotropia, worsening of acquired esotropia, and had recurrent esotropia postoperatively; one patient with intermittent exotropia developed diplopia. All patients had concomitant strabismus with good visual acuities without restricted ocular movement. All patients used ICT devices, mostly Smartphones, more than 3 to 4 hours daily before strabismus began. We required patients to limit the use of ICT devices, but three patients required surgery, and two patients needed prismatic correction. Binocular function ultimately recovered in all cases, ocular alignment improved within 8 prism diopters in five cases, and the diplopia resolved.

Discussion: In the current study, five patients had a history of strabismus. Excessive use of ICT devices might disrupt ocular alignment and cause binocular function to fluctuate in young children and strabismus patients. Irreversible changes might develop if left untreated.

Conclusion: The amount of time that ICT devices are used should be limited especially in pediatric patients with strabismus.

**Introduction:** To report the natural history of high accommodative convergence/accommodation (AC/A) ratio among a population-based cohort of children with accommodative esotropia (AET).

**Methods:** The medical records of all patients < 19 years diagnosed with accommodative esotropia with a high AC/A ratio from January 1, 1975, through December 31, 2004, were retrospectively reviewed.

**Results:** A total of 517 patients were diagnosed with AET during the 30-year study period, of which 106 (20.5%) had a high AC/A ratio. Of the 93 (87.7%) high AC/A patients managed with bifocals, 50 (53.8%) were able to discontinue their use after a mean of 58.7 (range, 0 to 229) months. The Kaplan-Meier rate of discontinuing bifocals was 24.5% at 3 years, 36.4% at 5 years and 61.4% at 10 years. Patients who did discontinue bifocals were significantly more likely to have had surgery (44% vs. 18.6%, p=0.009) than those who did not discontinue bifocals. The high AC/A patients managed with bifocals were slightly less likely to undergo strabismus surgery compared to those managed without bifocals (p=0.13).

**Discussion:** The use of bifocals among esotropic children with high AC/A ratio is relatively temporary for most patients and not associated with an increased need for surgery.

**Conclusion:** In this cohort of children with high AC/A accommodative ET, bifocal use was discontinued in most children within 10 years, and more commonly among those who underwent strabismus surgery. The use of bifocals, however, did not increase the likelihood of undergoing surgery compared to those who did not use them.

**Distance Stereopsis in Patients with Accommodative Esotropia**

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**Introduction:** To investigate the factors associated with distance stereopsis (DS) in patients with accommodative esotropia.

**Methods:** Medical records of patients with accommodative esotropia from July 2013 to July 2016, with a follow up period >/>1 year were reviewed. Patients with a residual deviation of >/=4PD were excluded. Near and distance angle of deviation with and without correction, cycloplegic refractive error, presence of anisometropia and amblyopia, contoured and uncontoured near stereopsis were evaluated as prognostic factors.

**Results:** A total of 55 patients were included (mean age 9.55±4.15 years), 35 patients had distance stereopsis. Mean corrected distance deviation was 0.91±0.5 PD (0-3.9 PD). All DS(+) patients also attained uncontoured near stereopsis (UNS). UNS was present in 9 patients in the DS(-) group, and the difference was significant (p=0.001). Anisometropia (p=0.085), uncorrected near deviation (p=0.407), distance deviation (p=0.205), spherical equivalent in right (p=0.061) and left (p=0.306) eyes were not significantly different between the DS(+) and DS(-) groups. Spearman correlation analysis showed significant positive correlation between UNS and DS (r=0.588, p<0.001). When DS(+) patients were classified as 60-100 secs arc (n=21) and 200-400 secs arc (n=14) stereoacuity, contoured stereopsis outcome was significantly different between the DS(-) and the 60-100 secs arc groups (p=0.001).

**Discussion:** All patients displayed a range of contoured stereopsis and 80% had uncontoured near stereopsis. Distance stereoacuity was present in 63.6% of the study patients and showed strong correlation with near stereopsis.

**Conclusion:** Prognostic factors other than near stereopsis were not significant for distance stereopsis outcome in accommodative esotropia.

**References:**
New Method of Sensory Fusion Rehabilitation Using Intermittent Occlusion with LCD Glasses

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Introduction: Recovery of sensory fusion in children with congenital and early acquired strabismus is very important in the functional rehabilitation following strabismus surgery. This study aims to analyze sensory fusion recovery using method of intermittent occlusion with LCD glasses and compare its efficacy with orthoptic treatment using synoptophore.

Methods: Forty-six patients with prior esotropia and post-operative absence of sensory fusion were studied and divided into 2 groups. Main group (15 patients) underwent treatment with LCD glasses, while the control group (30 patients) underwent synoptophore treatment. Patients in the main group wore LCD glasses with optimal correction 4 hours/day. Patients in the control group received 3-4 courses of synoptophore treatment. The period of observation was 12 months.

Results: Mean age of patients was 7.1±1.1 years. Stable sensory fusion was achieved in 12 patients, unstable – in 3 patients in the main group. In control group stable sensory fusion was achieved in 3 patients, unstable – in 8 patients. Normal retinal correspondence was achieved in 11 patients in the main group, and in 3 patients in control group.

Discussion: Sensory fusion recovery in 80% of cases using LCD glasses compared with 10% of cases using synoptophore treatment can be explained by a more effective daily influence of LCD glasses on the patient's visual system.

Conclusion: Intermittent occlusion with LCD glasses is an effective mean of sensory fusion and normal retinal correspondence recovery in patients after successful strabismus surgery.

Axial Length as a Risk Factor for Development of Acquired Distance Esotropia

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Introduction: The aim of this study was to see if patients with acquired distance esotropia (ADE) differ in axial length measurements from other patients with esotropia and normal controls.

Methods: All adult patients operated for esotropia by the senior author during 1/2015-8/2017 were included. Patients with esotropia of at least 5 prism diopters greater for distance than near were included in the ADE group. Other patients with esotropia and patients without strabismus awaiting cataract surgery served as controls. Axial length was measured in all subjects.

Results: ADE, esotropia and cataract groups had 11, 15 and 15 patients respectively. Average age was 44±14 (range 23-69 years), 32±13 (range 16-58 years) and 61±19 (range 23-84 years) respectively. In ADE average esotropia for distance was 17.2±3.8 prism diopters (PD, range 10-25) and 8.18±7 PD for near (range 4-20), while in the esotropia group it was 27±14 PD for distance (range 20-50) and 31±12 PD (range 20-55) for near. ADE patients were significantly more myopic (average -2.11±2.89, range +0.75 to -7.5D) than the esotropia group (average +1.75±2.1, range -1.0 to +6.0) and the cataract group (average +0.75±1.5 range -2.5 to +3.0 p=0.003).
Average axial length in the ADE group was 25.05±1.7mm (range 23.4-29.54), significantly more than the esotropia group (average 22.4±0.8mm, range 21.0-23.3) and the cataract group (average 22.9±0.73mm, range 21.87-24.55, p=0.007).

Discussion: ADE may be caused by downshift of the lateral and nasal shift of the superior rectus muscles. Higher axial length may facilitate this phenomenon.

Conclusion: Patients with ADE have significantly bigger axial length than other patients with esotropia and normal controls. ADE may be a milder version of strabismus fixus seen in highly myopic patients with high axial length (heavy eye syndrome).

Decompensated Esophoria As A Benign Cause of Acute, Adult Onset Esotropia

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Introduction: Adult onset esotropia confronts the strabismologists with the potential for serious underlying neurological pathologies that have been described, yet the alternative benign possibility of decompensated esophoria has received scant attention. We conducted this study to determine the clinical and magnetic resonance imaging (MRI) characteristics of patients with symptomatic adult onset esotropia due to decompensated esophoria.

Methods: We reviewed cases of patients who presented with esotropia to the Stein Eye Institute between 2015 - 2017.

Results: Seven cases were identified of mean age 28.5 ± 10.2 (range: 20-48) years having gradually progressive intermittent horizontal, binocular diplopia for 10 months to 3 years. Mean pre-operative esotropia was 31.4±12.9Δ for distance and 30.7±12.3Δ for near, although this was intermittent in five patients who exhibited markedly enhanced fusional divergence. Neurological evaluation and MRI of brain, orbits, and extraocular muscles were uniformly unremarkable. Orthotropia was successfully restored in all by standard or enhanced doses of bimedial recession, improving mean stereoacuity from 200 to 73 arc sec, although five patients exhibited 2-14 Δ asymptomatic residual esophoria.

Discussion: Patients with decompensated esophoria slowly deteriorate and present with esotropia when their enhanced divergence fusional amplitudes no longer suffice. This contrasts with acute adult comitant esotropia (ACE) developing suddenly without history of phoria or intermittent diplopia. This makes decompensated esophoria progressing to esotropia a generally benign diagnosis distinct from ACE, yet occasionally difficult to distinguish clinically when decomposition is rapid. Mild surgical undercorrections are common yet usually asymptomatic due to enhanced divergence fusional amplitudes.

Conclusion: Decompensated esophoria is a benign clinical entity causing acquired adult esotropia treatable by enhanced medial rectus recession.


Cyclic Esotropia: White Matter Changes on MRI and Surgical Outcomes

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Introduction: Cyclic esotropia (CET) was first described in 1845. It occurs most frequently in children 2-6 years old. Patients present with alternating periods of orthophoria and esotropia, no amblyopia, insignificant refractive error, and a normal anatomical eye exam. We report five cases of CET who presented within ten months. Given the high incidence in a short period, we reviewed their charts to further characterize the disorder and review treatment outcomes.

Methods: Retrospective case series: History of onset, ocular exam, motility exam, MRI, labs, calendars documenting phases, surgical treatments, postoperative alignment, and fusion were reviewed.

Results: All patients had normal labs. MRI was abnormal in 2 of 5 cases. Both manifested abnormal white matter signal in the frontal lobes. 3 of 5 patients complained of diplopia, irritability, or distress when tropic. Typical periodicity followed a 48-hour cycle. Cyclic phase varied from 1 to 9 weeks. The average maximum deviation was 35^ ET. Bimedial rectus recessions for the maximum measured angle of esotropia was successful in all 5 patients. One patient required a re-operation. Fusion was present in 4 patients preoperatively and in all 5 patients postoperatively.

Discussion: All patients had normal labs. MRI was abnormal in 2 of 5 cases. Both manifested abnormal white matter signal in the frontal lobes. 3 of 5 patients complained of diplopia, irritability, or distress when tropic. Typical periodicity followed a 48-hour cycle. Cyclic phase varied from 1 to 9 weeks. The average maximum deviation was 35^ ET. Bimedial rectus recessions for the maximum measured angle of esotropia was successful in all 5 patients. One patient required a re-operation. Fusion was present in 4 patients preoperatively and in all 5 patients postoperatively.

Conclusion: We are unsure what caused this streak of CET in our practice. MRI with attention to frontal lobe white matter should be considered in the work-up of CET. Bimedial rectus recessions successfully restored fusion in our cases.

Health-Related Quality of Life in Japanese Children with Intermittent Exotropia and their Parents

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Introduction: The purpose of this study is to evaluate the health-related quality of life with intermittent exotropia (IXT) on Japanese patients and their parents using the Japanese version of Intermittent Exotropia Questionnaire (J-IXTQ).

Methods: J-IXTQ was administered to consecutive 5-17 year old patients with IXT and parents of 2-17 year old patients with IXT. The results were analyzed among sub-groups of 2-4, 5-7 and 8-17 year old using Mann-Whitney U test and Kruskal-Wallis test.

Results: A total of 138 patients were recruited for the study. The median child score was significantly higher than those of both the proxy score and the parental score (72.7 vs 63.6 vs 57.3; p < 0.05). The median score of older patients was lower than that of younger patients (63.6 vs 86.3; p < 0.05). There was no difference in the median score of parents among sub-groups of 2-4, 5-7 and 8-17 year old (56.7 vs 53.1 vs 54.1).

Discussion: The results showed similar tendency with those in USA.

Conclusion: J-IXTQ is useful in Japan. The score of parents was lower than that of patients.

Leske DA, Holmes JM, Melia BM; for the Pediatric Eye Disease 2015;122:874-81.
Abnormal Biorbital Angle in Children with Infantile Exotropia

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Introduction: Causative factors of the rare motility disorder, infantile exotropia, have yet to be determined. The purpose of this study was to investigate the relationship between abnormal findings of the orbit and causative factors of infantile exotropia.

Methods: Axial magnetic resonance imaging or computed tomography of the orbit in the transverse plane of the horizontal extraocular muscles was obtained in consecutive 26 infantile exotropic children without neurological disorder or developmental delay. The opening angle between both lateral walls of the orbit was defined as the biorbital angle.

Results: The 106.0°±6.1°(SD) mean biorbital angle was significantly larger than the 94.2°±5.1° angle found in 129 normal infants (p<0.001; t-test). There were 19 (73.1%) out of 26 cases that were outside of the 95% confidence interval calculated for the 129 normal infants. Cases were divided into the intermittent (14 cases) and constant (12 cases) groups. There was no significant difference between the two groups for the mean biorbital angles (105.3°±6.1° vs. 102.5°±5.7°).

Discussion: The relationship between the morphology of the orbit and the presence of strabismus has yet to be definitively established. Exotropia is the major type of complicated strabismus found in 39-90.9% of craniosynostosis patients. When craniofacial surgery is performed without any strabismic procedure, exotropia will change to orthophoria or esotropia. This suggests that the larger biorbital angle may be one of the causative factors of infantile exotropia.

Conclusion: Children with infantile exotropia have a larger biorbital angle, with this anatomical abnormality potentially one of the causative factors responsible for exodeviation.

Reversal of Central Fusional Disruption Associated with Severe Convergence Insufficiency

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Introduction: To demonstrate a treatment paradigm for loss of sensory and motor fusion associated with severe convergence insufficiency.

Methods: Retrospective case series of 2 patients with history of convergence insufficiency producing constant diplopia of at least 2 years duration. There was no history of intracranial pathology including traumatic head injury in either patient. Neither patient had visual acuity worse than 20/20 in either eye. On initial visit, the patients showed inability to obtain or maintain sensory fusion even after correction of their deviation with prisms.

Results: Both patients had severely reduced convergence and fusional reserves with inability to obtain binocular single vision. Treatment consisted of Fresnel prism glasses and convergence exercises. Both patients achieved binocular single vision within 6 weeks and were able to fuse without Fresnel glasses. Follow-up time was 5 and 10 months.

Discussion: We report, for the first time, central fusional disruption in association with severe convergence insufficiency and the successful reversal of fusional disruption with conservative management.

Conclusion: Fusional disruption is known to occur in association with midbrain damage(1), sensory deprivation to the visual cortex(2, 3), and in the setting of an acquired strabismus(1, 3), but has not been reported previously without these risk factors. Recognition of loss of fusion in association with severe convergence insufficiency is paramount to counsel these patients and initiate appropriate treatment to reverse disruption of binocularity.

Re-Reading the Same Line in Intermittent Exotropia is Related to the Saccadic Disconjugacy

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**Introduction:** Difficulty of reading is a typical symptom of intermittent exotropia (IXT) and is coupled with re-reading the same line. We investigated the relationship between the re-reading the same line and saccadic disconjugacy in patients with IXT.

**Methods:** Seven patients with IXT and ten healthy orthophoric individuals were studied. Video oculography was used to assess the eye movements during the reading of a Japanese novel displayed on a 23-inch liquid crystal monitor placed 60-cm from the eyes. The sentences were displayed horizontally and read from left-to-right. The rate of unintentional re-reading the same line was counted, and the disconjugacy at the median of the saccade between the end of a line to the next line was determined.

**Results:** The rate of the re-reading of the same line in the patients with IXT was 5.0±2.5 times which was significantly higher than that in the controls at 0.2±0.4 times (P<0.001). The rate of re-reading of the same line was significantly and positively correlated with the saccadic disconjugacy (P<0.01, R2=0.79) but was not correlated with the angle of strabismus at near (P=0.18, R2=0.28).

**Discussion:** Re-reading in IXT may be caused by the disturbance of binocular coordination during saccade from the end of a line to the next line.

**Conclusion:** The re-reading in IXT is related to the saccadic disconjugacy but not significantly related to the angle of strabismus at near.

**Introduction:** Few studies have compared saccade velocities before and after strabismus surgery. Furthermore, these limited number of studies tested with mixed subject populations of different types of strabismus, movement directions and operative methods. We compared the peak velocities (PVs) of horizontal saccades between normal subjects and patients with exotropia as well as between the pre- and post surgery in the patients.

**Methods:** Horizontal saccades (adduction and abduction) of monocular vision were recorded by an eye-tracking device in 21 patients with exotropia and 20 normal subjects. Twenty of these patients were examined using the same method after strabismus surgery.

**Results:** The PVs of adduction and abduction in the patients were higher than those in the normal subjects. Following to the surgery, the PVs of the abduction, but not those of the adduction, of the surgical eye (non-dominant eye) decreased to the level of the normal subjects. However, there was no correlation between changes in the PVs and the amount of surgery (resection and/or recession).

**Discussion:** The eye alignment correction by the surgery may exhibit this normalizing effect not only through the peripheral (extraocular muscle) mechanism but also through the central nervous mechanism for horizontal saccade accuracy.

**Conclusion:** The strabismus surgery normalized the patient's increased PV of surgical eye in the abduction of horizontal saccade.

Binocular Coordination during Smartphone Reading in Patients with Intermittent Exotropia

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Introduction: To evaluate binocular coordination during smartphone reading in patients with intermittent exotropia (X(T)) and normal subjects using video-oculography (VOG).

Methods: Ten patients with X(T) (21.8 ± 9.8 years) and fifteen control subjects (26.6 ± 4.3 years) were examined. Eye movements were recorded during smartphone reading at 50, 30, and 20 cm using VOG. The rate of monocular viewing, reading speed, and their correlation were analyzed.

Results: The rate of monocular viewing was significantly higher in the X(T) group than in the control group (50 cm, 13.1 ± 20.0 vs. 0%; 30 cm, 21.6 ± 24.2 vs. 0%; and 20 cm, 43.0 ± 30.1 vs. 0%; P < 0.001), and was significantly higher at 20 cm than at 50 cm in the X(T) group (P < 0.05). The reading speed was significantly slower in the X(T) group than in the control group at 20 and 30 cm [30 cm, 7.8 ± 1.4 characters per second (cps) vs. 9.3 ± 1.7 cps; 20 cm, 7.4 ± 1.1 cps vs. 9.4 ± 2.0 cps; P < 0.05] and was significantly and negatively correlated with the rate of monocular viewing at 20 and 30 cm in the X(T) group (P < 0.05).

Discussion: The decrease of reading performance is presumably due to the monocular viewing at close reading distance in patients with X(T).

Conclusion: It should be taken into account that patients with X(T) watch a smartphone monoculally with lower reading performance when they use a smartphone at close distances.

References: None
Quantitative Analysis of Inflammation in Orbital Fat of Thyroid-Associated Ophthalmopathy Using MRI Signal Intensity

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Introduction: We quantitatively analyze the inflammation in orbital fat seen in conjunction with thyroid-associated ophthalmopathy (TAO) using short-tau inversion recovery (STIR) sequences of magnetic resonance imaging (MRI).

Methods: The signal intensities of orbital fat and the superior rectus (SR), inferior rectus (IR), lateral rectus (LR), medial rectus (MR), and superior oblique (SO) muscles on STIR images were measured in 70 eyes of 70 treatment-naive TAO patients and 20 eyes of 20 controls. The signal intensity ratio (SIR) of each tissue and brain white matter was calculated.

Results: The mean SIRs of orbital fat were 1.77 ± 0.23 in TAO patients and 1.65 ± 0.16 in controls. The mean SIR in TAO patients was significantly higher than that in controls (P = 0.04). The mean SIRs in TAO patients were 1.99 ± 0.73, 2.23 ± 0.69, 1.86 ± 0.39, 2.10 ± 0.51, and 1.73 ± 0.43 in the SR, IR, LR, MR, and SO muscles, respectively. The SIR of orbital fat showed significant (P < 0.001) positive correlations with those of the extraocular muscles: SR (r = 0.64), IR (r = 0.55), LR (r = 0.58), MR (r = 0.71), SO (r = 0.65).

Discussion: The noninvasive use of STIR sequences of MRI to evaluate the signal intensity of inflammation in orbital fat quantitatively is useful in TAO patients.

Conclusion: The inflammation in orbital fat might develop in conjunction with inflammation in extraocular muscles.

Background and Characteristics of Elderly Patients with Binocular Diplopia

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Introduction: In recent years, with the development of orbital diagnostic imaging and pathology research, diseases caused by abnormalities in orbital pulleys (such as sagging eye syndrome and severe myopic strabismus) have been reported more often. In this study, we evaluated the background and characteristics of elderly patients with binocular diplopia as a main complaint.

Methods: The participants were 236 patients aged 60 years or older who visited the hospital for binocular diplopia as a main complaint between April 2014 and March 2017 (male:female = 137:99). The age of the patients was 71.6 ± 7.5 years. We classified strabismus by types and investigated the cause and treatment for each group. We diagnosed orbital pulley disorders using magnetic resonance imaging. Patients with orbital pulley disorders exhibited esotropia and/or vertical strabismus and did not present with cranial nerve palsy, systemic illness, or ocular injury.

Results: The cases of strabismus associated with vertical deviation were 50.9% of the total cases. The causes of disease in each group were as follows: convergence insufficiency exotropia (50.9%) and basic exotropia (21.1%) in the exotropia group; orbital pulley disorder (35.6%) and abducens nerve palsy (33.9%) in the esotropia group; IV paralysis (32.4%) and orbital pulley disorder (31.0%) in the vertical strabismus group; and orbital pulley disorder (28.6%) and IV paralysis (28.6%) in the combined strabismus group.

Discussion: About half of the elderly patients with binocular diplopia exhibited vertical deviation. In addition, binocular diplopia was mainly caused by orbital pulley disorders.

Conclusion: Orbital pulley disorders may be major causes for strabismus in elderly patients.

Influence of Diplopia on Health-Related Quality of Life in Medically- and Surgically-Treated Glaucoma Patients

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Introduction: To determine the factors associated with reduced health-related quality of life (HRQOL) in medically- and surgically-treated glaucoma patients.

Methods: 160 prospectively enrolled adult glaucoma patients treated medically (n=73) or surgically (51 had trabeculectomy, 36 had glaucoma drainage device (GDD) surgery) in a tertiary referral glaucoma practice completed 2 HRQOL questionnaires [VFQ-25 (2 subscales) and the Adult Strabismus-20 questionnaire (AS-20, 4 subscales)]. Multiple regression analysis was performed to assess association of factors with poor HRQOL (age, gender, worst-eye mean deviation (MD) on Humphrey visual field testing, best-eye mean deviation, treatment modality, best-eye visual acuity, worst-eye visual acuity, and diplopia score based on a Diplopia Questionnaire (DQ; scored 0 to 100)).

Results: Reduced HRQOL was associated with worse diplopia (DQ score) on all 6 subscales (VFQ-25 visual functioning and socioemotional, AS-20 self-perception, interactions, reading function, and general function). Reduced HRQOL was associated with lower best-eye MD on 5 of 6 subscales, lower worst-eye MD in 4 of 6 subscales, treatment group (GDD vs trabeculectomy vs medical) on 3 of 6 subscales, lower worst-eye visual acuity on 5 of 6 subscales, lower best-eye visual acuity on 2 of 6 subscales, and younger age on 2 of 6 subscales of the AS-20.

Discussion: The AS-20 Self-perception, Interactions, General Function and Reading Function subscales are sensitive in detecting reduced HRQOL in glaucoma patients.

Conclusion: Reduced HRQOL is common in glaucoma patients and is particularly associated with worse diplopia.
Correlation of Diplopia and Quality of Life in Patients with Graves Orbitopathy

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Introduction: At least 40% of patients with Graves Orbitopathy (GO) suffer from diplopia which affects severely to their the daily activities. The purpose of the study is to evaluate the single visual field SVF with an objective method and correlate it with the quality of life (QoL) in patients with GO.

Methods: 60 patients with GO were studied measuring clinical activity score, diplopia with a plane method, cover test, maddox rod, ductions and diplopia questionnaire. QoL was assessed with the GO-Qol questionnaire.

Results: Data analyze shows good correlation between QoL and area of BVF and perception of diplopia. We didn’t found statistical differences between active or inactive patients for visual functioning or the appearance in the QoL questionnaire.

Discussion: The difference in QoL between active and inactive patients didn’t achieved the statistical significance probably due to the small number of active patients in our study, compared to other studies published in the literature. Constant diplopia and BSVF are well correlated with QoL.

Conclusion: GO-QoL can be affected by several factors, for that reason it is interesting studying which of them are of more importance in order to plan treatment in these patients.

Enlargement of the Superior Rectus and Superior Oblique Muscles Causes Intorsion in Graves' Eye Disease

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Introduction: To review the prevalence of preoperative and postoperative intorsion in patients with strabismus and Graves' eye disease (GED), and to correlate the intorsion with coexisting superior rectus (SR) and superior oblique(SO) muscle enlargement as a possible mechanism causing intorsion in these patients.

Methods: Charts of consecutive patients with GED who underwent strabismus surgery between 1 January 2010 and 1 April 2013 were retrospectively reviewed. Of these, patients with orbital CT or MRI scan were identified for further analysis. Clinical characteristics documented included age, gender, horizontal and vertical deviation, subjective torsional deviation, specific extraocular muscles (EOMs) operated upon, EOM enlargement on CT/MRI scans and width and thickness of SO, SR group and inferior rectus (IR).

Results: Charts of 45 patients (14 males and 31 females) were reviewed. Mean age was 56.8 ±12.5 years. Of these, seven (15.6%) patients demonstrated intorsion, and 38 (84.4%) patients demonstrated extorsion preoperatively. But after strabismus surgery, 15 (39.5%) of the 38 patients with preoperative extorsion demonstrated postoperative intorsion and 23 (60.5%) patients continued to show postoperative extorsion. On analysis of CT/MRI scans in these patients, only an increase in the thickness of SR group and the thickness/width of SO muscle were significantly associated with preoperative and postoperative intorsion; while age, gender, preoperative horizontal or vertical deviation and IR recession were unrelated to preoperative or postoperative intorsion. Postoperative intorsion was also associated with smaller degrees of preoperative extorsion (<3.5°).

Discussion: Our study suggests that SR and SO enlargement may be a primary factor causing intorsion both preoperatively and postoperatively in patients with strabismus and GED. In patients with GED, IR is the most frequently enlarged EOM, whereas SR and SO muscles are much less often involved and when present, enlargement is usually masked by the coexisting ipsilateral IR involvement. Sometimes, it is difficult to observe SR and/or SO tightness by preoperative clinical examination. We suggest orbital imaging before surgery may be useful in earlier identification of enlargement of the SR group/SO muscles and global intorsion requiring alteration of surgical planning to prevent postoperative intorsion.

Conclusion: Preoperative SR and/or SO muscle enlargement appear to be a primary contributing factor relating to preoperative and postoperative intorsion in patients with GED-associated strabismus. Patients with only small amounts of preoperative extorsion (<3.5°) in the presence of tight IRs should be carefully evaluated for possible SR and/or SO involvement by CT or MRI scan to predict those at risk for and plan for prevention/treatment of postoperative intorsion.

Observer Variability in Assessing Passive Cyclorotation using Guyton’s Exaggerated Traction Test Before Strabismus Surgery

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Introduction: As an aid in planning strabismus surgery, we routinely perform Guyton’s exaggerated traction test (ETT) with retroplacement and passive excyclorotation and incyclorotation with forceps for evaluating tension of the superior and inferior oblique muscles, respectively. The purpose of this study was to investigate observer variability in this test.

Methods: Three experienced strabismus surgeons performed individual bilateral ETT on 30 eyes of 15 consecutive patients undergoing strabismus surgery in general anaesthesia. These measurements were compared with the same test using a protractor on the cornea (gold standard). We defined agreement as a deviation of at most 10 and 15 degrees from gold standard for excyclorotation and incyclorotation, respectively.

Results: We found no significant differences in measurements between observers. Observer measurement agreed with gold standard in 81% and 89% of cases for excyclorotation and incyclorotation, respectively. Mean deviation from gold standard for excyclorotation was an underestimation of 3° (95% confidence interval [CI] -17° to 24°). Mean deviation from incyclorotation was an overestimation of 6° (95% CI -19° to 30°).

Discussion: While Guyton’s exaggerated traction test is an excellent test for evaluating tension of the oblique muscles, we found that individual observers agreed less than expected with the gold standard performed with a protractor.

Conclusion: We believe that the present results illustrate the need for an objective measurement in the exaggerated traction test.

Objective Cyclodeviation Measurement in Normal Subjects by Means of Cyclocheck® Application

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Introduction: Recently proposed Cyclocheck® application for objective assessment of cyclodeviation occurred to be repeatable and reproducible method (1). Present study aims at evaluating the range of cyclodeviation in normal subjects by means of the above mentioned free web-based software.

Methods: 122 volunteers (75 females, aged 30.7±14.1) were enrolled in the study. The inclusion criteria were orthotropia in all gaze positions, full stereopsis and no past history of strabismus nor amblyopia. Digital fundus photographs of both eyes were obtained using DRS CenterVue nonmydriatic fundus camera. The disc-foveal angle was calculated using Cyclocheck®.

Results: The images were obtainable and of good quality in all subjects. The mean value of disc-foveal angle was 5.34±2.59 degrees(range: -0.40 to 12.55) in the right eye and 7.54±2.43 degrees(range: 1.25 to 12.76) in the left eye. We have found significantly (p= 0.0001) larger excyclodeviation in the left eye in 77% of the studied subjects with a mean difference of 3.4±1.63 degrees.

Discussion: The measurements obtained by Cyclocheck® concur with other studies on objective cyclodeviation (2,3). The disparity between the right and left eye evade simple explanation. It was not related to fixation preference, but on the other hand, natural asymmetry leading to higher prevalence of certain types of strabismus on the left side could be considered as a possible explanation.

Conclusion: Cyclocheck® allows easy assessment of cyclodeviation in normal subjects. Ortotropic subjects present with a positive value of disc-foveal angle with a certain spread of the results. There is a significant asymmetry between eyes with the left eye being more excyclodeviated.

**Strabismus Sursumadductorium or IVth Nerve Palsy: Similar Clinical Picture, Different MR Imaging Features**

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**Introduction:** To evaluate correlations between MRI findings and clinical data in clinically diagnosed IV nerve palsy.

**Methods:** Demographic and clinical data were collected. 1.5T orbital MRI was performed with head coil. SO Signal intensity and Cross-sectional area in primary and tertiary gaze were evaluated. Group 1 with SO hypotrophy. Group 2 no SO hypotrophy. Clinical features of the two groups were compared. Multivariate analysis between MRI features and clinical data was performed.

**Results:** 35 pts were evaluated. Group 1 (16 patients (49 years by mean, 10-71), 14 congenital, 2 acquired. Group 2 (19 patients (40 years by mean, 8-75), 10 congenital, 9 acquired. A statistically significant difference between the two groups was observed in primary position deviation but not for motility. In Group 2, rectus pulley displacements were found in 11/19 patients: medial rectus displaced superiorly, superior rectus temporally and inferior rectus pulley displaced nasally. 4 patients (mean age 38, range 11-56 years) exhibited contralateral lateral rectus muscle inferior displacement. 1 patient a supernumerary muscular band. The remaining 3 patients demonstrated normal MRI.

**Discussion:** Our data confirm that, despite similar clinical features, only 53% of patients diagnosed as IV nerve palsy exhibit mild to severe grade of SO hypotrophy (true IV° nerve palsy); in these patients a more consistent vertical deviation in primary position was found. In 37% of patients MRI demonstrated rectus pulley displacements alone. In 3 cases no significant alterations were found on MRI.

**Conclusion:** Strabismus in group 2 could be better defined as strabismus sursumadductorium. MRI allows to better identify the diagnosis.

**References:** Rectus pulley displacements with abnormal oblique contractility explains strabismus in superior oblique palsy

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Introduction: Video-oculography (VOG) is a useful tool for diagnosing and planning surgical treatment of DVD, being the only method that allows to measure horizontal and vertical deviations in the 11 gaze positions, both fixating with each eye and in binocularity. Thus, asymmetric DVD cases that appear to be monocular can be unmasked. Purpose: to measure DVD in the 11 gaze positions with VOG and decide whether unilateral or bilateral surgery should be performed.

Methods: Prospective study of 23 patients with DVD measured with VOG between June 2016 and June 2017.

Results: The vertical deviation in primary position in binocularity in the 23 cases studied was 5.34°in average. When fixing with OS while occluding OD the right hypertropia registered was 7° and when fixing with OD while occluding OS the left hypertropia was 9.34°. Nine cases had asymmetric DVD larger than 6°. In this group, when we occluded OD the DVD was 8° and when OS was occluded it was 10.5°. The amount of asymmetry for DVD was 14°.

Discussion: Very asymmetric DVD cases are usually found associated with unilateral deep amblyopia. Our results demonstrate that amblyopia is not a necessary condition for determining asymmetry in DVD. Just as oblique muscle dysfunction makes DVD incomitant in different gaze positions, the presence of a true vertical deviation makes it asymmetric.

Conclusion: VOG is a useful method for measuring vertical deviation in cases of DVD and it helps identifying asymmetric cases. Some cases that seem to be unilateral can be unmasked and therefore treated adequately.

Ocular Neuromyotonia: Hypovitaminosis as a Possible Underlying Cause

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Introduction: Ocular neuromyotonia (ONM) is a rare eye movement disorder, observable as a paroxysmal involuntary spasm of one or more extra-ocular muscles. The phenomenon is caused by a contraction of an extraocular muscle by a damaged nerve, which leads to delayed muscle relaxation.

Methods: Ten patients presented with ONM at the ophthalmology department of the University Hospital of Leuven, Belgium. The clinical picture and the underlying aetiology will be given as well as the response to treatment.

Results: The diagnosis of ONM was made after a thorough orthoptic examination. Four out of 10 patients had a history of cranial irradiation. In 2 patients thyroid dysfunction was found. Three patients had demonstrable hypovitaminosis (vitamin D and B12). In 1 patient no underlying cause could be demonstrated. All patients were symptom free after correction for the underlying pathology or with membrane stabilizing drugs.

Discussion: ONM is a rare eye movement disorder. Patients complain of intermittent diplopia and strabismus. ONM is a clinical diagnosis, therefore is important to recognize the symptoms and observe the eyes in primary position at rest and again after sustained eccentric gaze. In the absence of a history of cranial irradiation, an underlying disease must be ruled out. A hypovitaminosis can possibly provoke ONM by inducing nerve membrane instability.

Conclusion: We present 10 patients with ONM. The clinical picture and work up is presented. Two patients with ONM were presumably provoked by hypovitaminosis, an hypothesis for the underlying mechanism is given.

**Introduction:** The clinical manifestations of strabismus in children with optic disc lesions may be different from those without the lesions. We investigated the clinical feature of comitant strabismus combined with congenital optic disc anomaly.

**Methods:** We retrospectively reviewed the medical records of the patients who are diagnosed as congenital optic disc anomaly and strabismus concomitantly before 20 years old from 2011 to 2017. Patient with restrictive or paralytic strabismus was excluded. Demographics and clinical characteristics were analyzed.

**Results:** Total of 17 patients (10 male and 7 female) were included. Mean age was 25.94 (4 – 80) months. Six (35.3%) optic nerve hypoplasia, 9 (52.9%) excavated optic disc including 2 disc coloboma and 7 morning glory syndrome, 1 (5.9%) myelinated nerve fiber, 1 (5.9%) tilted optic disc and 1 (5.9%) optic disc atrophy. Three of 6 patients with optic nerve hypoplasia were bilateral. Nine patients had exotropia and 8 had esotropia and mean deviations were 29.29 (15 - 50, prism diopters). The mean follow-up period of 12 patients who are followed up longer than 1 year was 42.5 months. Among them, ocular deviation angle changed more than 10 prism diopters in 5 patients, and three of them showed changed type of strabismus.

**Discussion:** Excavated optic disc was the most common congenital deformity of optic nerve in the patient with strabismus. Exotropia and esotropia occurred in similar frequency. The clinical features of strabismus often change during the follow-up period in patients with disc anomaly.

**Conclusion:** Careful attention should be paid to follow-up and decision of surgery in patients with strabismus and congenital optic disc anomaly concomitantly.

**References:**
Introduction: Patients with INS often have a null-zone where the nystagmus intensity is at its minimum, resulting in an anomalous head posture to achieve better visual function (VF). Traditional measures of VF in primary gaze may not reflect the deficit imposed on the visual system, thus an improved method would be to measure vision as a function of gaze position. The purpose of this study was to assess the test/re-test of high-contrast (HCVA) and low-contrast (LCVA) visual acuity across horizontal gaze (HG) to determine if gaze dependent visual acuity (GDVA) measures are reliable.

Methods: Separate studies of subjects with HCVA (INS: n=20; 8-47 years; Control: n=14; 21-65 years) and LCVA (INS: n=18; 9-47 years, Controls: n=20; 19-53 years) were completed. Testing was performed binocularly in HG (30° left to 30° right in 10° steps) twice in each position. Test-retest reliability was analyzed using intraclass correlation coefficients (ICC). Differences between groups and gazes were determined by ANOVA.

Results: ICC was high for HCVA (INS: >/=0.97; Control: >/=0.88) and LCVA (INS: >/=0.77; Control: >/=0.83) for each gaze. A significant difference in letter score was not detected between group, gaze, or interaction of group and gaze for HCVA (p>0.05). For LCVA, a significant difference in test-retest was detected between groups (INS>Control; p<0.05) and interaction between group and gaze (p<0.05).

Discussion: Despite INS patients having significantly larger differences in test/retest than controls, using LCVA, on average, both HCVA and LCVA testing has excellent repeatability across 60° of HG.

Conclusion: GDVA is a reliable measure of VF in INS patients.

References:
Visual Outcomes in Children with Infantile Nystagmus (IN)

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Introduction: There is limited research on visual development in children with IN. Our study looked at the natural history of vision development, as well as the prevalence of refractive errors, strabismus, and current management.

Methods: We identified all children (<16 years old) with IN seen at Moorfields Eye Hospital (London) between 2001 and 2014 (excluding children with congenital cataracts). Retrospective notes review was performed on a random selection of 68 (to date).

Results: Mean age of presentation was 37 months. Mean duration of follow-up was 133 months (range 23-254). Diagnoses included: idiopathic (47), albinism (10), optic nerve dysfunction (5), and retinal dysfunction (6). Mean best-corrected binocular LogMAR Visual Acuity (VA) at presentation was 0.69 (range 0.02-2.0), and 0.39 (range 0.02-1.6) at the end of available follow-up. VA improved in 61/68 children over time with refractive correction +/- occlusion therapy. All patients had significant ametropia corrected with spectacles.

Discussion: Almost all patients demonstrated subnormal VA at presentation. In most, VA improved over time with correction of refractive error and treatment of strabismus/amblyopia. Contributing factors include: age of refractive correction, compliance, amblyogenic effect of constant oscillatory movements. 7/15 had worsening VA over time. These patients included those with co-existing pathology, for example optic nerve dysfunction.

Conclusion: Our results demonstrate the development of (delayed) visual maturation in children with IN over time, and will allow further evidence based information to be given to parents. This may change with emerging treatments. As expected, co-existing visual afferent abnormalities adversely affect visual outcome.

Introduction: Idiopathic Infantile Nystagmus syndrome is associated with visual impairment, strabismus and anomalous head postures. Recent publications demonstrate the negative impact of IINS on quality of life (QoL). Our study examines visual functioning of adults with IINS using the National Eye Institute Visual Function Questionnaire-25 (NEI-VFQ-25).

Methods: 38 patients were recruited into the study, which formed part of a randomised control trial examining the effects of contact lenses on IINS. Participants underwent detailed clinical examination and investigations including eye movement recordings. Patients were requested to complete the self-administered NEI-VFQ-25 at baseline.

Results: 35/38 (92%) participants completed the NEI-VFQ-25. Mean age was 35.1 years (range 16-64). Median overall NEI-VFQ score was 69, and interquartile range (IQR) was 56-76. IINS patients had specifically low scores in the categories of mental health (median 50, IQR 25-63), role limitations and dependency (median 50, IQR 25-75 and median 58, IQR 50-75 respectively). 26/35 (74%) participants did not drive, either due to sub-normal vision or lack of confidence.

Discussion: IINS can considerably impact QoL, without necessarily causing markedly reduced visual acuity. Our patients reported lowest VFQ-25 scores in the domains of mental health, wellbeing and visual functioning in driving. The VFQ-25 provides more insight into the effect of IINS on QoL than objective measures including high contrast Snellen or LogMAR visual acuity.

Conclusion: IINS can negatively impact QoL. Existing clinical methods may underestimate the true effect of IINS on everyday life and should be used in conjunction with quality of life surveys including the NEI-VFQ-25.

Long-Term Follow-Up of Spasmus Nutans

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Introduction: Spasmus nutans is an acquired form of fine and rapid nystagmus that is classically associated with torticollis and titubations of the head, often presenting in the first year of life and spontaneously resolving within the next two years. The purpose of our study was to record and characterize the long-term prognosis of spasmus nutans.

Methods: All patients under the age of 21 years with a diagnosis of spasmus nutans were included. Parameters of age, nystagmus symmetry and quality, presence of titubations, torticollis, and strabismus, and findings on CT or MRI were recorded.

Results: Our 22 patients had an average age of onset of 9.8 and a follow-up of 62.6 months. Nystagmus was unilateral in 5 children, asymmetric in 5, symmetric in 10, and inapparent in 2. Titubations were identified in 10 and torticollis in 7. Nystagmus persisted in 16 of 20 children, titubations in 3, and torticollis in 6. Neuroimaging, performed on 17 of the 22 children, was negative for any space-occupying lesions.

Discussion: Parents can be advised that many children do well, assuming normal imaging, but that nystagmus, torticollis, and even titubations may persist. Follow-up, especially for strabismus and amblyopia, should be continued throughout childhood.

Conclusion: We are reluctant to assure parents of children who have even the most typical spasmus nutans that their child will be normal after a predictable interval.

Nystagmus in Trisomy 21 (Downs Syndrome)

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Introduction: Nystagmus has been reported in about 30% of people with Down's syndrome (DS). Despite being a well-reported entity, it remains a poorly characterised condition. Our study describes the clinical features of patients with DS and nystagmus.

Methods: Retrospective medical-records review of all patients with a documented diagnosis of DS and nystagmus seen at Moorfields Eye Hospital (London) between January 2005 and June 2015.

Results: 51 subjects were identified over the 10-year study period with complete data in 48. The mean age of presentation was 5.1 years (range 0-26 years), with a mean reported age of nystagmus onset of 6.1 months (95% CI 2.2-10.0 months). A clinical diagnosis of Fusion Maldevelopment Nystagmus (FMN) was made in 3/48, Infantile Nystagmus (IN) 4/48, Internuclear Ophthalmoplegia in 1/48, and manifest horizontal nystagmus in 40/48. Electrodiagnostic tests were requested in 16/48 with diagnoses of Optic nerve dysfunction (2); achromatopsia (2); albinism (1) in 4/16.

Discussion: The findings of this small study suggest that children/adults with DS may be more heterogeneous than previously thought, i.e. not associated with DS (and associated cerebellar findings) alone. It is therefore prudent to consider the full context in which a child or adult with DS presents, as is the case with non-DS patients presenting to the ophthalmologist with nystagmus.

Conclusion: In accordance with previous work, the most frequent reported type of clinical nystagmus in our cohort was manifest horizontal nystagmus (presumed IN). However, this small study highlights the importance of differentiating the nystagmus subtypes (IN, FMN, neurological nystagmus), to guide further investigations and management.

Letting Nature Teach Us How to Cure Genetic Disease: The Identification of Modifier Genes

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Introduction: Disorders caused by mutations in a single gene can show a range of disease severity, the cause of which is often unknown (1). We used a mouse model of Marfan syndrome (MFS) to identify modifier genes that represent novel therapeutic targets.

Methods: There are many inbred mouse strains, with distinct genetic compositions. We backcrossed MFS mice onto pure C57BL/6J (BL6) and 129S6 (129) strains and assessed systemic disease severity. We measured globe axial length (AL) in vivo using interferometry. We bred intercrossed BL6/129-MFS mice to map modifier genes, and generated 129-MFS mice null for two candidate modifier genes.

Results: Compared to BL6-MFS mice, 129-MFS animals had greater aortic root aneurysm (p<0.0001), premature death from aortic dissection (p=0.007), lung disease (p<0.01) and spine kyphosis (p<0.05). 129-MFS animals selectively showed greater AL than WT littermates (p=0.002). We identified 2 QTLs on chromosomes 5 and 11 that linked with disease severity (p=0.008). We used the mouse genome project to identify Mmp17 (chromosome 5) and Map2k6 (chromosome 11) as likely modifier genes, knockout of which completely prevented severe disease in 129-MFS mice.

Discussion: This work identified two genes that strongly modulate disease severity in MFS mice. Parallel work in MFS patients identified MAP3K4 as a likely modifier gene; this is a direct activator of MAP2K6, establishing a common pathway of genetic modification in MFS that is shared between mice and humans.

Conclusion: We have identified two novel therapeutic targets to treat MFS, and are exploring small molecule inhibitors of these proteins to treat its ocular and non-ocular manifestations.

Recognizing Bradyopsia in Children

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**Introduction:** Bradyopsia is a rare but probably under-diagnosed stationary form of cone dysfunction due to biallelic mutations in the gene *RGS9* (regulator of G-protein signaling 9) or *R9AP* (regulator of G-protein signal 9-anchoring protein). Although the condition is congenital, most descriptions in the literature are of adult patients. The purpose of this report is to highlight clinical features of children referred to a pediatric ophthalmologist who were found to harbor a homozygous *RGS9* mutation.

**Methods:** Retrospective case series.

**Results:** 5 affected children ranging from 6-16 years old (3 families) harbored the same homozygous *RGS9* frameshift mutation (p.Pro108Hisfs*18; NM_207391.2). Findings included photophobia, variable decreased visual acuity, improved pinhole visual acuity despite no significant refractive error, and normal structural ophthalmic examination. Some had been previously diagnosed with functional visual loss. Extended electoretinography and/or suspicion for the condition led to appropriate genetic testing and confirmation of the diagnosis.

**Discussion:** Diagnosis can be challenging in young children because structural ophthalmic examination is typically normal and visual acuity can improve with pinhole despite no significant refractive error.

**Conclusion:** The diagnosis of bradyopsia should be considered in children with structurally-normal eye exams who have photophobia and improved pinhole acuity despite no significant refractive error.

**References:**
Fresh Frozen Plasma (Octaplas®) and Topical Heparin in the Management of Ligneous Conjunctivitis

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Introduction: Ligneous conjunctivitis is a rare membranous conjunctivitis, associated with reduced plasminogen activity. We present successful management of recurrent ligneous conjunctivitis in two children.

Methods: Patient 1: A six-year-old Arab girl presented with bilateral eyelid swelling and yellowish-white masses under both eyelids, noted since the age of two years. Prior surgical excision had resulted in a recurrence. She was known to have congenital plasminogen deficiency. Patient 2: An 18-month-old Caucasian boy was diagnosed with bilateral hemorrhagic conjunctivitis at the age of three months. Six weeks following resolution, he presented with two pedunculated, vascular masses on left upper tarsal conjunctiva. Excision was followed by a recurrence.

Results: Patient 1: Firm, sessile, woody lesions were observed in the tarsal conjunctiva OU. Plasminogen level was 0.24 IU/ml (normal range 0.730-1.270 IU/ml). Surgical excision and amniotic membrane grafting under cover of perioperative fresh frozen plasma (FFP) transfusion was performed. Topical heparin, steroids, and cyclosporine were administered in the postoperative period. Patient 2: Plasminogen level was found to be low at 0.25 IU/L (normal 2.5-4.2 IU/L). Repeat excision was undertaken under cover of perioperative FFP transfusion. Complete resolution of the condition was noticed in both patients. Follow up one year later has showed no recurrence.

Discussion: The management of ligneous conjunctivitis is challenging. Local excision is invariably associated with recurrences.

Conclusion: Currently, in the absence of a commercially available plasminogen preparation, the use of FFP together with topical heparin and local surgical excision of the membranes offers a curative treatment for ligneous conjunctivitis.

References:
COMMAD: A Novel Syndrome Caused by Biallelic Mutation of the MITF Gene

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Introduction: Waardenburg syndrome, type2a (WS2a), is caused by mutations in the basic helix-loop-helix zipper gene, MITF, and often includes prominent ophthalmic features. Biallelic mutations in MITF have recently been found to cause COMMAD (coloboma, osteopetrosis, macrocephaly, microphthalmia, albinism and deafness) syndrome (1).

Methods: Deep clinical phenotyping, DNA sequencing, in vitro molecular characterization

Results: Two unrelated probands exhibit the COMMAD phenotype, reminiscent of the mi/mi mouse model. DNA binding, nuclear localization, & transactivation were variably affected by different mutations. Examination of WS2a parents revealed variable decreased best-corrected visual acuity, anterior segment dysgenesis, and foveal hypoplasia.

Discussion: Visual impairment due to foveal hypoplasia in WS2a is not widely recognized. Neither set of WS2a parents was aware of their underlying diagnosis or their risk for having a profoundly-affected deaf-blind child.

Conclusion: COMMAD represents a novel constellation of signs and symptoms, leading to profound sensory system impairment. Recognition of WS2a and COMMAD syndrome by pediatric ophthalmologists is critical for genetic counseling and ophthalmic and medical care.

Electroretinographic and Optical Coherence Tomographic Characteristics of Mucopolysaccharidosis Type I Hurler and I Hurler-Scheie

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Introduction: To describe the clinical, electroretinography (ERG) and spectral-domain optical coherence tomography (SD-OCT) findings in mucopolysaccharidosis (MPS) type I.

Methods: Fourteen children (50% female) with MPS I Hurler (I-H, n=11) and Hurler-Scheie (I-H/S, n=3) who had ERG and SD-OCT were identified and retrospectively reviewed.

Results: Diagnosis was confirmed by IDUA mutational analysis (n=9) or alpha-L-iduronidase deficiency (n=5). Children with MPS I-H had hematopoietic stem cell transplant (mean 1.22 years) and I-H/S received enzyme replacement (mean age 4.69 years). All children had diffuse ground glass stromal opacities, 9 requiring deep anterior lamellar keratoplasty. At the initial ERG (mean 10.10 years, range: 1.58 - 17.92), mean visual acuity was 0.70 logMAR (range: 0.3 - 1.6) and mean cycloplegic spherical equivalent was +1.79 D (range: -25.00 to +8.75). Mean initial standard flash b/a ratio was 1.13 (range: 0.37-3.58). Eleven cases had at least one electronegative ERG. Four children had maculopathy, but none showed peripheral pigmentary retinopathy. SD-OCT demonstrated central macular external limiting membrane (ELM) thickening in all cases.

Discussion: Corneal opacities and macular ELM thickening were found in all children with MPS I-H and I-H/S. Reduced b/a ratio was common at initial ERG and 79% had at least one electronegative ERG. Macular ELM thickening was observed prior to any clinically apparent retinal changes.

Conclusion: Despite systemic therapy, micro-structural and functional retinal changes are uniformly seen in MPS I prior to clinically apparent retinal changes. The presence of an electronegative ERG represents a post-transductional abnormality, which could be explained by ELM thickening.

Attitudes Concerning Cortical Visual Impairment Among Pediatric Ophthalmologists and Teachers of the Visually Impaired

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Introduction: This study was performed to identify gaps that exist in the knowledge and attitudes of pediatric ophthalmologists and teachers of the visually impaired concerning the care of children with CVI.

Methods: A survey was distributed through email to the two groups via national organizations, AAPOS and AER.

Results: A significant gap was identified in opinion of the adequacy of communication from the pediatric ophthalmologist to the care team. Communication was deemed adequate by 61.9% of pediatric ophthalmologist respondents while it was considered inadequate by 68.4% of TVI respondents. The majority of respondents of both groups (pediatric ophthalmologists: 80.5% and TVI's: 85.8%) wished to learn more about CVI.

Discussion: This survey highlights gaps that exist in knowledge and attitudes concerning the care of patients with CVI which limit the effectiveness of the team in caring for patients. The strong desire to learn more about CVI expressed by both groups is a positive finding which bodes well for patients. It may indicate that there is a core section of individuals within both provider groups interested in CVI who could develop expertise in providing services for children with CVI.

Conclusion: Lack of a standardized method for evaluation, diagnosis and providing recommendations for children with CVI creates challenges for the care team. Improved clinical education of pediatric ophthalmologists as well as TVI's and development of standardized tools which can provide the necessary information needed by the patient's team are practical ways to approach this problem.

Visual Function after Cerebral Hemispherectomy

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Introduction: Cerebral hemispherectomy is an effective surgical treatment for children with intractable seizures. However surgery may result in coping strategies to improve vision including changes in head position and eye alignment [1]. Previous studies are limited by the number of patients and focus mainly on post-hemispherectomy homonymous hemianopia [1,2]. The purpose of this study was to determine and characterize visual function changes in a large population of patients following hemispherectomy.

Methods: Observational study was conducted on a cohort of children with seizure disorder treated with cerebral hemispherectomy. An online survey sent to the parents included demographic and clinical questions. Visual function was assessed by the presence of peripheral field defects, ocular misalignment and anomalous head posture.

Results: A total of 196 participants responded (12.5% of surveys emailed out). Postoperative follow up was 92 +/- 78 months (range 1-382). An acquired peripheral vision defect was reported in 181 patients (93%). Persistent torticollis was noted in 122 patients (62%). Strabismus was noted in 93 patients (49%). Both torticollis and strabismus were most frequently seen immediately after surgery. Sixty-six patients (34%) underwent strabismus treatment including monocular patching, extraocular muscle, chemodernevation, and surgery.

Discussion: Immediate torticollis and strabismus are common responses in patients following cerebral hemispherectomy. Persistent peripheral vision defect is the most common visual function abnormality observed in those patients.

Conclusion: Compensatory mechanisms to improve visual function are common in patients with seizure disorders undergoing cerebral hemispherectomy. Preoperative discussion with parents and patients regarding those compensatory mechanisms is recommended.

Comparison of Non-Sedated Cone Flicker ERG Screening Test and Conventional ERG under Anesthesia in Children

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Introduction: Electroretinography (ERG) is limited in children by cost, availability, and general anesthesia (GA) risks. We prospectively evaluated a handheld ERG device (RETeval) as a cone dysfunction screening tool and compared it to conventional ERG under GA.

Methods: Patients scheduled for conventional ERG under GA underwent 3 tests: 1) RETeval standard 30-Hz cone flicker ERG using skin electrodes prior to GA, 2) E3 Diagnosys conventional complete standard protocol full-field ERG using bipolar contact lens electrodes and handheld stimulus under GA, 3) repeat RETeval testing under GA. The 30-Hz cone flicker amplitudes and implicit times obtained with the 3 methods were compared. Negative (NPV) and positive (PPV) predictive values were calculated using a 5uV amplitude cut-off.

Results: Of 30 children included, 18 presented abnormal results on conventional ERG. RETeval amplitudes were smaller before GA (mean difference -42.24uV, SD 45.30) and under GA (-37.10uV, SD 44.45) than the Diagnosys. RETeval implicit times were shorter prior to GA (-1.06ms, SD 2.83) and longer under GA (1.28ms, SD 4.12) than the Diagnosys. RETeval amplitude values were lower (-3.05uV, SD 6.82) and implicit times were shorter (-2.25uV, SD 3.28) prior to GA than under GA. For the awake RETeval PPV=85% and NPV=90%.

Discussion: The 30-Hz cone flicker using the RETeval has smaller responses than the conventional ERG under GA, likely in part due to differences between electrodes. However, it is a feasible screening test for detecting cone dysfunction in children.

Conclusion: When responses of the RETeval test are impaired, a conventional ERG using full international protocol should be performed.

Introduction: Periventricular leukomalacia (PVL) of prematurity may affect peripheral vision. A prior study found inferior visual field function to be affected to a greater extent than superior, probably due to the specific damage of the optic radiation (Jacobson et al, 2006). Reliable visual field testing is not always possible in preterm children with other visual, motor and cognitive problems. The aim of this study was to evaluate visual evoked potential (VEP) responses of the superior and inferior visual fields in prematurely born school-children with documented PVL and to compare them to healthy age-matched controls.

Methods: 15 prematurely born school-children (age 6-17 years) of mean gestational age 27+1/7 weeks (range: 23-35w) and birth weight 1340g (range: 780-1700g) with documented white matter brain damage were included in this study. Pattern reversal VEPs to standard full-field stimulus were recorded monocularly. In addition superior (SUP) and inferior (INF) pattern reversal visual field stimuli were also applied, the other half of the stimulus being an isoluminant homogenous background. P100 wave amplitude and latency were recorded. The amplitude coefficient was calculated as INF P100 amplitude/SUP P100 amplitude. Results were compared to an age-matched control group of 30 healthy term children.

Results: Eyes of prematurely born children show very similar P100 wave amplitude of the INF and SUP field stimulation (11.7±3.5 vs 11.6±7.1; p=0.35) and also very similar P100 wave latency of the INF and SUP stimulation (101.5±2.7 vs 100.2±6.1; p=0.43). The average amplitude coefficient in the pre-term group was 1.00±0.22. All eyes of healthy term children showed significantly larger P100 amplitude to INF compared to SUP field stimulation (21.2±12.5 vs 15.3±7.5; p<0.0001) The P100 latency was similar to INF and SUP field stimulation (99.4±2.7 vs 102.7±3.4; p=0.22). The amplitude coefficient for the group of healthy children was larger than 1 (average 1.40±0.35) in all eyes. The average amplitude coefficient in the preterm group was lower than the amplitude coefficient in the control group (1.00 vs 1.40; p<0.001).

Discussion: In preterm children, the inferior visual field amplitude is similar to that of the superior visual field amplitude. Preterm children do not show the normal larger inferior visual field amplitude found in healthy age-matched controls.

Conclusion: The use of superior and inferior visual field VEP stimuli can detect abnormalities in inferior visual field function in prematurely born children with PVL.

Identification of Underlying Causes of Papilledema in Children

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Introduction: There are limited studies looking into the underlying disorders of intracranial disorders in pediatric patients who present with papilledema. The purpose of this retrospective study is to identify the types and relative frequencies of intracranial disorders in pediatric patients who present with papilledema.

Methods: This was a retrospective study conducted in two clinical settings. Pediatric patients aged between 0-16 years diagnosed with papilledema and who had imaging studies of the head performed at the time of the diagnosis were included in the study. Patient demographic data, ophthalmologic examination findings and underlying causes of papilledema were identified from clinical records.

Results: The mean age of 36 study patients (18F, 18M) was 8.8±4.8 years. Of the 36 patients, 16 (44.4%) had idiopathic intracranial hypertension (IIH), 6 (16.7%) had intracranial tumors, 6 (16.7%) had craniosynostosis, 2 (5.5%) had primary hydrocephalus, 1 (2.8%) had transverse sinus thrombosis related to mastoiditis, 1 (2.8%) had intracranial abscess, 1 (2.8%) had presumed neurosarcoidosis, 1 (2.8%) had Lyme’s disease, 1 (2.8%) had acute disseminated encephalomyelitis, and 1 (2.8%) had malignant hypertension. Of the six intracranial tumors, two (33.3%) presented in the sellar/parasellar region, two (33.3%) in the posterior fossa and two (33.3%) were located in cortical locations.

Discussion: IIH is the most frequent underlying disorder in pediatric patients presenting with papilledema in this cohort.

Conclusion: Clinicians should have a high index of suspicion for IIH in children presenting with papilledema, particularly if there is no history of coexisting medical problems.

Iatrogenic Papilledema in Pediatric Patients

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Introduction: To characterize the visual outcome in children with papilledema due to iatrogenic causes.

Methods: This ongoing retrospective study included children presenting to a pediatric neuro-ophthalmology clinic with papilledema caused by elevated intracranial pressure (ICP)>28 with normal neuroimaging. Those taking medications known to increase ICP were identified. Presenting and final visual function were evaluated.

Results: 11/53(21%) children with papilledema were attributed to an iatrogenic cause. Mean age was 16±1.6 years (range: 13-18). Potentially causative medications were: oral tetracyclines (4/11), subdermal hormonal birth control device (1/11), high dose oral emergency contraceptive (1/11), combination oral or subdermal contraceptive and tetracyclines (3/11), Accutane (1/11) and growth hormone (1/11). Of the 11 patients, 9 presented with new headaches, only 3 of whom had no subjective vision changes. One patient presented with light perception vision in one eye. Three presented with diplopia due to cranial nerve VI palsy. One patient was diagnosed on a routine eye exam, but had been having headaches. For final outcome, severe visual impairment (final vision 20/200 OD, 20/80 OS with severe visual field loss OU) was present in 1/11 children and moderate visual field loss in at least one eye was present in 4/11. Nine of 11 were weaned off acetazolamide by 1 year from diagnosis despite no weight change.

Discussion: Despite an FDA warning about papilledema on certain medications, it is an under-reported diagnosis.

Conclusion: Further prospective data is needed to describe the incidence of drug-related papilledema in order to implement appropriate screening strategies.

Incidence of Surgical Intervention in Pediatric Intracranial Hypertension

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Introduction: Optic nerve sheath fenestrations (ONSF), lumboperitoneal shunts (LPS) and ventriculoperitoneal shunts (VPS) are utilized in the management of intracranial hypertension (IH) when medical therapy is ineffective. The purpose of this study is to evaluate the incidence of surgical intervention amongst pediatric intracranial hypertension patients, and to determine if there are characteristics at presentation that predict the need for surgical intervention.

Methods: A retrospective chart review was performed on patients with primary and secondary IH from January 2010 through September 2015. Patients who underwent surgical intervention for IH (ONSF, LPS, or VPS) were identified and their presenting exam and testing data were compared to patients who were medically managed.

Results: 101 medically managed patients and 10 surgically managed patients were identified. The median ages at diagnosis were 12 and 16 years in the medically and surgically managed groups, respectively. 1.8% of patients required ONSF, 0.9% required ONSF and VPS, and 6.3% required LPS or VPS. Statistical analysis comparing body mass index (BMI, p=0.054), lumbar puncture opening pressure (LPOP, p= 0.20), gender (p= 0.29), grade of papilledema (p= 0.19), and the diagnosis of primary versus secondary IH (p= 0.17) between the two groups at presentation was not significant.

Discussion: BMI, LPOP, grade of papilledema, gender, and etiology were not predictive of the need for surgical intervention.

Conclusion: The incidence of surgical intervention for IH was 9.0%. The overall clinical course and response to treatment determined the need for surgery.

References: none
Visual Field Defects in Pediatric Intracranial Hypertension

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Introduction: Pediatric intracranial hypertension (IH) is of great interest to ophthalmologists due to its potential visual pathology. We sought to describe visual field defects (VFD) in a cohort with pediatric IH.

Methods: A retrospective review of IH patients seen between 1/2010-9/2015 was performed. All patients with an initial VFD were identified, and the defect was described. VFDs that persisted with treatment were identified, or alternatively, the time to resolution was noted.

Results: 111 IH patients were identified, 79 with primary and 32 with secondary etiologies. There were 39 males and 72 females, and age ranged from 7-18 years. 38 patients were identified with visual field deficits, 10 had monocular deficits, and 28 had deficits bilaterally. The most common defect was enlargement of the physiologic blind spot (EBS). EBS was identified in 57 (26%) eyes, either alone (45 eyes) or in combination with other VFDs (12 eyes). 18 (8%) eyes had peripheral VFDs. The most frequent location for any peripheral defect was superior (15 eyes). Three patients had a cecocentral VFD. The median time to resolution of VFDs was 144 days. 8 eyes of 8 patients had a persistent VFD.

Discussion: Resolution of VFDs occurred in a majority of the patients in our study, though a small percentage of VFDs were persistent, irrespective of underlying cause or treatment.

Conclusion: A large proportion of VFDs in pediatric IH patients resolve with appropriate treatment, although the duration of the VFD can be variable.

Clinical Features, Management and Visual Outcomes of Children with Cerebral Venous Sinus Thrombosis, Raised Intra-Cranial Pressure and Papilloedema

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Introduction: Intracranial hypertension (IIH) secondary to cerebral venous sinus thrombosis (CVST) in children is rare, with acute head and neck disorders being a leading cause. Resulting papilloedema can cause significant visual impairment if not treated adequately.

Methods: We performed a retrospective review of case notes for children under the age of 16 presenting to eye clinic in Cardiff with IIH and papilloedema secondary to CVST.

Results: Seven patients were identified. Four were male. Mean age was 6.4 years (4 to 10). All children had a preceding diagnosis of otitis media and mastoiditis with severe headaches. Diplopia was a presenting symptom in four children. Visual function was normal at presentation. The sigmoid sinus was involved in four cases, the transverse sinus in three and the sagittal sinus in one. Four patients were treated medically with acetazolamide and enoxaparin, three patients required surgery, including ventriculo-peritoneal shunts and optic nerve fenestration. Two children have been registered severely sight impaired with the remainder keeping good visual function. Esotropia and lateral rectus palsy resolved in all cases where present.

Discussion: CVST should be suspected in high risk children to avoid unnecessary delay in diagnosis. Optic nerve function needs to be monitored closely as blurred vision at presentation is rare.

Conclusion: Prompt management of IIH to preserve optic nerve function requires a close collaboration with neurology and neurosurgery. High risk children, such as those with mastoiditis and headaches should be screened regularly. Recovery of lateral rectus function can be a good indicator of disease resolution.

Introduction: Cerebral venous sinus thrombosis (CVST) can lead to papilledema secondary to increased intracranial pressure (ICP). Early detection and treatment of papilledema is important to prevent permanent vision loss. Medical management is often a first line therapy, however, surgical interventions, including optic nerve sheath fenestration (ONSF) may be a vision preserving. Herein, we report our experience with pediatric patients with papilledema secondary to CVST, and the safe and effective role ONSF can play in preserving vision.

Methods: This was a retrospective case series of three patients (ages 2-14) with CVST. There were inherited (n=2) and traumatic (n=1) etiologies for hypercoagulability. Dilated fundoscopic examination revealed at least bilateral grade III papilledema. Elevated ICP was confirmed by lumbar puncture. Patients underwent either unilateral or bilateral ONSF without complication.

Results: At six months post procedure, all patients had vision > 20/40 bilaterally. Visual fields and color vision testing, performed in the two oldest patients demonstrated mild to no areas of loss and was full, respectively. In the toddler, optic nerve edema had been present for several months prior to treatment. Despite bilateral ONSF, he needed stereotactic placement of right parietal to peritoneal shunt system, and developed optic atrophy.

Discussion: ONSF is an important adjunct surgical procedure to aid in vision preservation in patients with CVST.

Conclusion: We believe that ONSF for the treatment of papilledema secondary to CVST in the acute setting to preserve vision in pediatric patients is not only safe, but also effective. Younger patients may be more at risk for permanent vision loss. Collaborative, multidisciplinary medical and surgical management yields optimal patient outcomes.

References:
A Population-Based Study of Neurofibromatosis Type I

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Introduction: The purpose of this study was to describe the incidence, demographics, and clinical manifestations of neurofibromatosis (NF) type 1 among a population-based cohort of patients.

Methods: The medical records of all patients diagnosed with NF type 1 within a defined population, from January 1, 1980, through December 31, 2009, were retrospectively reviewed.

Results: Fifty patients were diagnosed with neurofibromatosis type 1 during the 30-year period, yielding an incidence of 1.2 per 100,000 individuals. Twenty-eight patients were new mutations, yielding a de novo mutation rate of 56%. The mean age at diagnosis was 11.7 years (95% CI, 0.2-47) and 26 (52%) were males. During a mean follow-up of 9.8 years (range 3 weeks to 32 years), café-au-lait macules were diagnosed in 49 individuals (98%), neurofibromas in 26 (52%), and skeletal anomalies in 14 (28%). Three (6.0%) individuals were diagnosed with glioma of the central nervous system (CI 1.2 to 9.7%) at a mean age of 13 years (range 5 to 26 years), including one patient with optic nerve glioma diagnosed at the age of 26 years. Only one patient (2%) was diagnosed with malignant nerve sheath tumor.

Discussion: The incidence of optic nerve gliomas in this cohort was much lower than prior reports.

Conclusion: Although the prevalence and de novo mutation rate of neurofibromatosis type 1 in this population-based study were similar to prior reports, the occurrence of optic nerve gliomas was much lower.

References: No references.
Tubulin Mutations and Ophthalmic Manifestations: A Paediatric Case Series

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Introduction: Tubulinopathies are a wide and overlapping range of brain malformations caused by six known gene mutations of different tubulin isotypes. Brain abnormalities include a range of lissencephalies and polymicrogyria-like cortical dysplasias with additional structural cerebral anomalies. Ocular findings involve associated cortical visual impairment, Congenital Fibrosis of Extraocular Muscles (CFEOM) and associated ptosis, strabismus, and less commonly optic nerve hypoplasia. We present an observational case series of children diagnosed with a tubulinopathy, with emphasis on ophthalmic manifestations.

Methods: Six children with genetically confirmed variants of TUBA1A, TUBB2B and TUBB3 gene, presenting at Great Ormond Street Hospital for Children, were included. All children underwent full ophthalmic examination including orthoptic assessment, anterior and posterior segment examination, cycloplegic refraction and electrophysiology.

Results: Ocular abnormalities involved CFEOM (3/6 patients), bilateral ptosis (3/6), strabismus (6/6), optic nerve hypoplasia (3/6), nystagmus (2/6), and visual impairment of varying degree (6/6). Electrophysiology showed normal electroretinogram in five cases and borderline cone dysfunction in one, abnormal pattern Visual Evoked Potential (VEP) in four and abnormal flash VEP in three.

Discussion: One case of TUBB3 mutation with cone dysfunction (association not previously reported) was identified. Strabismus, ocular motility defects and ptosis were common. Optic nerve hypoplasia previously described in one specific variant was more common in this study.

Conclusion: Ocular manifestations in tubulinopathies vary in severity. Management of the neuro-ophthalmological problems can be challenging. Early recognition by the ophthalmologist and association with non-ocular clinical and radiological findings may allow clinicians to identify individuals and guide genetic investigation to establish diagnosis.

Cerebroretinal Microangiopathy with Calcifications and Cysts (CRMCC) or "Coats Plus": When Peripheral Retinal Vasculature Signals Neurologic Disease

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Introduction: Cerebroretinal microangiopathy with calcifications and cysts (CRMCC) is a rare cerebroretinal disorder with neurologic and systemic manifestations.

Methods: Retrospective case report.

Results: An 8-month-old girl presented with exotropia, on a background of mildly delayed milestones and right thumb hypoplasia. On examination, vitreous hemorrhage with a ridge of peripheral neovascularization adjacent to an avascular zone was present in the right eye and telangiectasia was present in the left eye, and confirmed by fluorescein angiography. Magnetic resonance imaging of the brain showed multifocal T2 hyperintensities, with cystic changes and calcifications. A gene panel test was ordered to confirm the diagnosis of CRMCC or Coats plus disease. A heterozygous pathogenic mutation c.1994T>G p.Val665Gly in the conserved telomere maintenance component 1 (CTC1) gene was found.

Discussion: CRMCC is a rare autosomal recessive cause of pediatric retinal disease that occurs due to mutations in the CTC1 gene on chromosome 17p13.1. The disease manifestations are thought to result from a small vessel vasculopathy with retinal features similar to Coats disease in the form of telangiectasias, subretinal exudates, and vitreous hemorrhage. The eponym ‘Coats plus’ stems from additional small-vessel changes in the brain. Multisystem features are present, including pre and post natal growth restriction, sparse hypopigmented hair, gastrointestinal bleeding and various skeletal abnormalities. Early diagnosis of CRMCC is important for systemic management and genetic counseling.

Conclusion: Neuroimaging should be performed when peripheral retinal vasculature abnormalities are associated with neurological or syndromic features, however mild or seemingly unrelated.


Correlation of Disorders of the Spatial Vision System (Strabismus) and Amblyopia by Changes in Neural-Reflex Excitability and Metabolic Disorders at the Stages of Restoration of Pre-, Perinatal Encephalopathy

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Introduction: From 2000 to 2010 in more than 2000 children studied the development mechanism, the dynamics of transformation, variants of the restoration of two major ophthalmic syndromes: delayed visual maturation syndrome (DVM) and syndrome of optokinetic desadaptation (SOKD).

Methods: The clinical-physiological and clinical-biochemical spectrum of the executed studies, the correct organization of planned recovery courses of treatment of these children has significantly expanded. It was found that at the stages of development (from the neonatal to the pubertal) children suffering from pre-perinatal encephalopathy (PPE) encounter different variants of neurohumoral regulation, which to some extent contribute to determining the direction of neuroplasticity.

Results: Recently we have been able to demonstrate the essential role of certain features of metabolically deterministic mechanisms on the formation and dynamics of strabismus, amblyopia, and the consequences of PPE as a whole. Subjecting general material to the statistical variation processing by drawing up histograms we found that:

Discussion: 1. DVM is in a direct causal dependence on the clinical characteristics of catecholamine excite-dumping syndrome; with the long-term stabilization of DVM can serve as a basis for the appearance and progression of unilateral or bilateral esotropia. 2. There is a high degree of positive correlation between SOKD, esotropia and cholinergic irritation. 3. Prolonged sympathetic activation of blood promotes consistent inhibition of insulin sensitivity and, thereby, leads to the stabilization of the 'torpid' type of glycemic curve under sugar loading in children with PPE. 4. Prolonged intracranial distension and multistage interdependent metabolic dysfunctions lie in the basis of asthenopia, SOKD and cerebrostenotic manifestations.

Conclusion: Even simultaneous therapy, correction of each of the mutually correlating mechanisms, improves the quality of life of these children.

References: 1. Angcang Tang, MD, MS; Taolin Chen, PhD; Junran Zhang, PhD; Qiyong Gong, PhD; Longqian Liu, PhD. Abnormal Spontaneous Brain Activity in Patients With Anisometric Amblyopia Using Resting-State Functional Magnetic Resonance Imaging. J AAPOS September/October 2017 - Volume 54 · Issue 5: 303-310
2. Dima Andalib, MD; Alireza Javadzadeh, MD; Reza Nabai, MD; Yashar Amizadeh, MD Macular and Retinal Nerve Fiber Layer Thickness in Unilateral Anisometric or Strabismic Amblyopia. J AAPOS July/August 2013 - Volume 50 · Issue 4: 218-221
**Introduction:** Carbon monoxide is a colorless, odorless, tasteless and non-irritating gas which enters the bloodstream through the lungs causing hypoxia. CO exposure may result in a variety of neurologic sequelae. The eye movement system may be particularly vulnerable.

**Methods:** Three teachers were referred for neuro-ophthalmological and orthoptic evaluation for persistent ocular problems 2.5 years after CO exposure when a heater at school malfunctioned. Evaluation included HVF, OCT, color vision, dilated fundus exam, and full motility work up. Neurologic examinations, including MRI, were performed prior to referral.

**Results:** Visual acuity, fundus, visual fields, color vision, OCT (optic nerve/macular ganglion cell), ductions, versions, pursuit and saccades were normal. All three patients had asthenopia, intermittent diplopia, blurred vision, headache, convergence dysfunction and decreased accommodation. All had been prescribed base in prisms for reading elsewhere. Persistent neurologic findings included headache, dizziness, mild balance and memory problems, depression and anxiety in three patients, with photophobia, hyperacusis and motion-intolerance in two. All three patients had documented MRI abnormalities.

**Discussion:** CO poisoning causes acute damage to the brain and other tissues and may cause vergence, accommodation and vestibulo-ocular dysfunction. Vestibular therapy may be helpful. Convergence exercises are of limited value but may be supplemented with base in prisms and appropriate magnification.

**Conclusion:** The findings were remarkably similar to patients with post-concussion syndrome. Delayed neurologic sequelae (DNS) has been reported. Patients should be followed long-term for their ocular problems or as symptoms demand.

Oculomotor Ophthalmoplegic Migraine Associated with Schwannoma

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Introduction: To describe the clinical and MRI findings of two pediatric patients with oculomotor ophthalmoplegic migraines associated with schwannoma, review the literature, and consider the relationship of migraine to schwannoma.

Methods: Retrospective case series identifying two patients with migraine affecting the oculomotor nerve and MRI findings consistent with schwannoma of the oculomotor nerve.

Results: Two patients were identified with migraine-associated oculomotor nerve paresis. They began exhibiting transient episodes of unilateral cranial nerve III paresis at 1-2 years of age, with lid ptosis, exotropia, and limited extraocular motility. On presentation no anisocoria was noted for either patient. MRI and MRA demonstrated a mass of the oculomotor nerve with MRI signal consistent with schwannoma. Patients were treated with prednisone during the acute phase and propranolol for migraine prophylaxis.

Discussion: We report two cases of pediatric oculomotor ophthalmoplegic migraine associated with schwannoma. Ophthalmoplegic migraine is typically found without a structural lesion and only demonstrates oculomotor nerve enhancement on imaging. The symptoms are transient with pupillary mydriasis, though our cases were pupil-sparing. Treatment typically includes corticosteroid therapy. Oculomotor nerve schwannoma may be an etiology of ophthalmoplegic migraine. Controversy exists regarding whether the schwannoma precedes, or results from, transient migrainous ischemia. Surgery or radiation therapy have been considered for treatment, but risk complete oculomotor nerve palsy. Our patients improved with steroid therapy and migraine prophylaxis.

Conclusion: We recommend brain MRI for children with oculomotor ophthalmoplegic migraine in order to detect the presence of schwannoma.

Incidence and Clinical Features of Pediatric Myasthenia Gravis

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Introduction: The purpose of this study was to describe the incidence and clinical characteristics of pediatric myasthenia gravis.

Methods: The medical records of all children < 19 years in Olmsted County, Minnesota diagnosed with any form of myasthenia gravis from January 1, 1966, through December 31, 2015, were retrospectively reviewed.

Results: Six of the 364 children were residents of Olmsted County at the time of their diagnosis, yielding an annual age- and sex-adjusted incidence of 0.35 per 100,000 patients, or 1 in 285,714 patients younger than 19 years. The incidence of juvenile myasthenia gravis (JMG) and congenital myasthenia syndrome (CMS) was 0.12 & 0.23 per 100,000 respectively. Of the 364 study children, 217 (59.6%) had JMG, 141 (38.7%) had CMS, and 6 (1.7%) had Lambert-Eaton syndrome, diagnosed at a median age of 13 (N=210), 5 (N=137), and 12 respectively. A majority of the JMG and CMS patients had ocular involvement (90.3 and 85.1% respectively), including ptosis and ocular movement deficits. The median follow-up time was 3.5 years (range, 0 days to 50.5 years (N=351)); complete remission was reported in 42/133 (31.6%) of children with JMG and none of 89 children with CMS with follow up more than a year.

Discussion: There are no known prior studies on the incidence of CMS nor of JMG in the United States, and reports of childhood Lambert-Eaton syndrome are rare. (1-3)

Conclusion: Although relatively rare, myasthenia gravis in children has two predominant forms, CMS and JMG, both of which commonly have ocular involvement.

Corneal Injury and Impact of a Standard Eye Care Protocol in the Pediatric Intensive Care Unit

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Introduction: Patients in intensive care units (ICU) have impaired ocular protective mechanisms putting them at risk of ocular complications. The aim of this project was to delineate risk factors for corneal injury (CI) in critically ill children and to assess the impact of a standardized eye care protocol (ECP).

Methods: This prospective, observational project documented ophthalmologic findings and frequency of eye care in ventilated/sedated pediatric patients admitted to a tertiary care ICU between May 2015 and December 2016. Critical care staff were trained to implement the ECP which included routine ocular assessment with fluorescein staining and protocolized eye care.

Results: We evaluated 479 patient encounters and found that 15% had CI on admission (keratopathy 62, abrasion 16). Significant risk factors included age, primary diagnosis (trauma-39%, respiratory infection-17.8%, neurologic disorders-19.5%, shock-24.4%) and location of intubation (emergency department/field-22.2%). Of the 245 patients with multiple ocular assessments, 32.2% displayed CI at some point during their hospitalization (keratopathy 73, abrasion 24). Continued application of the ECP reduced this incidence to 8.5% (keratopathy 19, abrasion 2) by the last exam with no corneal infiltrates/ulcers or other complications. Clinical factors associated with increased risk of injury include lagophthalmos, chemosis, positive tracheal cultures, and sedation level.

Discussion: Corneal injury is a significant problem in the critically ill (up to 60%)1,2. Early diagnosis and treatment can prevent microbial keratitis and vision loss3. This standardized ECP reduced the incidence of CI, potentially preventing severe long-term ophthalmologic complications.

Conclusion: Implementation of an ECP should be initiated in all critically ill children with impaired ocular reflexes.

Introduction: Ocular trauma is a major cause of morbidity and blindness in the pediatric population. We sought to determine differences in epidemiologic patterns of intentional and unintentional pediatric ocular injury in the US.

Methods: A retrospective review of the National Trauma Data Bank (2008-2014) was performed and patients <21 years old, admitted with major trauma and ocular injuries, were identified using ICD-9 codes. The data was analyzed with students’ t and chi-squared tests and odds ratio calculations with SPSS software. Statistical significance was set at p<0.05.

Results: 58,765 pediatric patients were admitted with ocular injuries. The mean (SD; median) age was 11.9 (6.9; 14) years. Unintentional injuries (76.3%) were mostly associated with falls (OR=13.4; CI=11-16.3), and open wound of ocular adnexa in 0-3 year ages (OR=30.45; CI=23.66-39.19) and intentional or assault (16.3%), with firearms (OR=9.15; CI=8.32-10.06) and eye and adnexa contusions in the 0-3 year group (OR=5.8; CI=5.27-6.39); p<0.001. Self-inflicted trauma (0.7%), also was mostly associated with firearms (OR=44.66; CI=36.69-54.37). Open globe and visual pathway injuries were mostly the result of self-inflicted trauma in the 19-21 year group (OR=2.74; CI=1.86-4.05) and the 12-18 year group (OR=8.37; CI=5.61-12-39), respectively; p<0.001. Orbital fractures resulted mostly from unintentional trauma in the 0-3 year group (OR=11.6; CI=8.24-16.32); p<0.001. The majority of pediatric ocular trauma patients (68.7%) were male.

Discussion: Sight-threatening injuries were associated with both intentional and unintentional trauma in the youngest age group and mostly from assault and self-inflicted trauma in the older groups.

Conclusion: Patterns emerged of associations between age groups, different mechanisms and intention of trauma with types of ocular injuries.

References:
Barmparas G, Dhillon NK, Smith EJT, Tatum JM, Chung R, Melo N, Ley EJ, Marugulies DR. Assault in Children Admitted to Trauma Centers: Injury Patterns and Outcomes from a 5 Year Review of the National Trauma Data Bank. International Journal of Surgery 2017; 43:137-144


Firearm-Related Pediatric Ocular Trauma: Analysis of Patterns in the United States

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Introduction: Firearms rank second amongst causes of pediatric trauma-related injuries in the US, resulting in mortality and significant morbidity. We aimed to evaluate pediatric firearms-related ocular injuries (FOI).

Methods: We identified pediatric patients (<21 years), hospitalized with FOI, using ICD-9 codes from the National Trauma Data Bank (2008-2014). Tabulated data was analyzed using student’s t and chi-squared tests and regression analysis with SPSS software. Significance was set at p<0.05.

Results: 1,972 (22.6%) of 8,715 FOI occurred in pediatric patients. The majority (52.6%) were 12-18 years old. Mean (SD) age was 15.2 (5) years in males and 16.4 (4.1) years in females. Males represented 85.1%, Whites, 33%, Blacks, 43.2% and Hispanics, 18.9%. Common locations were home, 38.6% and street, 24.8%. Mean (SD) hospital stay was 7.6 (12) days, injury severity score was ‘severe,’ at 16 (13.1) and GCS was 11 (5.1). Common injuries were open wound of eyeball (41.6%) and ocular adnexa (25.5%) and orbital fractures (30%). The 0-3 years group had greater odds of unintentional injuries (OR=4.41; CI=2.51-7.75) and home location (OR=5.39; CI=2.81-10.38); p<0.001 while the 19-21 years group had greatest odds of assault (OR=2.17; CI=1.77-2.66) and street location (OR=1.61; CI=1.3-1.98); p<0.001. Blacks had greater odds of assault (OR=4.35; CI=3.68-5.59) and Whites, self-inflicted injury (OR=7.1; CI=5.92-9.51); p<0.001. Traumatic brain injury, TBI, (55.3%) resulted mostly from self-inflicted trauma (OR=5.99; CI=4.16-8.63) as did visual pathway injuries (OR=2.86; CI=1.95-4.2) p<0.001. Mortality rate was 12.2%.

Discussion: FOIs are predominantly sight-threatening and are associated with TBI. Identifiable risks include gender, age, race and intention.

Conclusion: Description of pediatric FOIs and risk factor identification can help us develop focused intervention strategies.

References: None
Pediatric ATV Facial and Ocular Injuries in the United States

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Introduction: It is estimated that over 40,000 all-terrain vehicle (ATV)-associated injuries occur every year in the United States involving children 2-18 years of age. Of these, there are close to 3,500 injuries annually to the face and ocular regions. The purpose of this project is to identify trends in emergency department visits for ATV-related facial and ocular injuries in the last 11 years.

Methods: Data on ATV injuries from the National Electronic Injury Surveillance System (NEISS) from 2006-2016 in the pediatric population (age 2-18) were utilized. Sample weights were applied to estimate yearly national injury trends. The data were assessed for overall injury numbers, male:female ratio, age of injured, setting, cases without helmet usage, location and type of facial/ocular injury, and mechanism of injury.

Results: Estimated US emergency department visits for ATV facial and ocular injuries declined over the last 11 years from 4,798 to 3,405. The mean age of injury was 10.1 years, with males injured more than females (67% males). In recent years, the rate of children riding without helmets has increased to 18% of all injury cases. Facial lacerations account for the majority of injuries, followed by fractures (orbital, mandibular and nasal). Falls from ATVs and ATV rollovers were the most prominent mechanisms of injury. Ocular injuries followed similar trends, with corneal abrasion and eyebrow laceration being the most common (26.3% and 27% respectively), followed by eyelid injury (15.6%) and orbital fracture (11.3%).

Discussion: While the number of pediatric facial and ocular injuries from ATV accidents has decreased over the past 11 years, the percentage of riders without helmets has increased. With over 3,400 facial and ocular injuries reported in 2016 alone, education in the importance of helmet usage with eye protection and enforcement of ATV safety regulations remain critical to further reduce facial and ocular injury rates in children.

Conclusion: Eyelid and eyebrow lacerations, orbital fractures, and corneal abrasions are common oculofacial injuries seen in ATV accidents involving children. It is important to encourage helmet use in addition to ATV safety in order to decrease injuries and fatalities.

References:


All-Terrain Vehicle–Related Nonfatal Injuries Among Young Riders in the United States, 2001–2010
Periocular Facial Scald Burns in Children: Is Ophthalmology Consultation Necessary?

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Introduction: Criteria that predict ocular injuries in children requiring treatment after periocular facial scald burns are not known. The purpose of this study was to evaluate the management of ocular injuries among children sustaining facial scald burns and to determine predictors of injuries requiring additional treatment.

Methods: Children treated at a burn center with periocular facial scald burns were identified. Patient and injury profiles were compared between those evaluated and not evaluated by ophthalmology. Univariate and multivariate analyses were used to determine factors associated with an ocular injury requiring treatment. Treatment differences before and after ophthalmology consultation were evaluated.

Results: Among 73 children with facial scald injuries, nine had ocular injury (corneal abrasion, conjunctivitis, scleral burn, or chemosis of the conjunctiva). Among 23 patients who received erythromycin ointment (the only prescribed treatment), only seven had a documented ocular injury. Children seen by an ophthalmologist (n=24) more often presented with (25.0% vs. 6.1%, p=0.05) and were treated for an ocular injury (58.3% vs. 14.3%, p<0.001). Only four patients had modification in their treatment plan after consultation, three of whom were started on treatment despite not having an ocular injury. Older age was the only predictor of an ocular injury requiring treatment (1.3 odds increase per year).

Discussion: Ocular injury after periocular facial scald burns is an infrequent finding. Ophthalmic antibiotic is an initial appropriate treatment in most symptomatic patients.

Conclusion: Among children with periocular facial scald burns, initial evaluation and treatment without ophthalmology consultation is appropriate. Ophthalmologic consultation may be limited to children with worsening symptoms or failure to improve.

References:
Hand-Held Spectral Domain Optical Coherence Tomography (HH-SDOCT) Findings in Children with Non-Accidental Injury (NAI)

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Introduction: The advent of HH-SDOCT has revolutionized pediatric retinal and optic nerve imaging. Previous studies in children with NAI have shown that HH-SDOCT helps in identifying characteristic and unique vitreoretinal abnormalities not detected on clinical examination, sometimes altering their future management. The aim of this study was to describe HH-SDOCT findings in children with NAI and evaluate their usefulness in differentiating NAI from non-NAI.

Methods: Retrospective case series of children with confirmed diagnosis of NAI and who underwent HH-SDOCT imaging. All the children underwent complete ophthalmic evaluation including RetCam fundus photography in addition to the HH-SDOCT imaging.

Results: A total of 8 children with NAI and retinal findings who underwent HH-SDOCT were included in the study. Multi-layered retinoschisis was the most common finding followed by multi-layered retinal haemorrhages and vitreous separation and traction. These findings seen on HH-SDOCT imaging were not evident on routine ophthalmological examination and RetCam imaging.

Discussion: Current study demonstrates that HH-SDOCT helps in identifying characteristic retinal findings associated with NAI which may not be evident on routine examination techniques and imaging. These findings could potentially guide the clinicians make distinction between lesions secondary to NAI from non-NAI. Current study benefits from being the largest series reported till date.

Conclusion: HH-SDOCT is a helpful tool in evaluating children with NAI. Future studies comparing HH-SDOCT findings in NAI and retinal hemorrhages due to non-NAI causes would be needed to identify the findings unique to NAI cases.

Pathology of Macular Retinoschisis Due to Vitreoretinal Traction in Abusive Head Trauma

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Introduction: Macular retinoschisis is seen in almost one-third of cases of abuse head trauma (AHT) during infancy or early childhood. The proposed mechanism is due to vitreoretinal traction. Evidence comes from studies using optical coherence tomography, but few studies present histopathologically confirmed vitreoretinal traction.

Methods: We performed gross and histopathologic examination of children with suspected AHT and identified those who demonstrated typical perimacular folds. Information was collected regarding the incident that led to the child's death and systemic manifestations noted at autopsy. Eyes were prepared in a fashion that allowed demonstration of the vitreoretinal interface.

Results: Ten eyes of 5 patients, aged 2 to 13 months, were examined. All patients had systemic manifestations of abusive trauma and intracranial injury. All cases provided evidence of the vitreoretinal traction producing perimacular folds. Condensed vitreous was seen attached to the apices of the retinal folds and the detached internal limiting membrane comprising the inner surfaces of the schisis cavity. Four cases showed severe bilateral multilayered symmetric retinal hemorrhages extending to ora serrata. All cases showed optic nerve sheath subdural hemorrhage and subarachnoid hemorrhage. Orbital hemorrhage was unilateral in 2 cases and bilateral in 3 cases. Four cases showed orbital fat hemorrhage. One case showed extraocular muscle sheath and cranial nerve sheath hemorrhage. Two cases showed juxtapapillary intrascleral hemorrhage.

Discussion: These findings have critical forensic implication on mechanism of injury when perimacular folds and retinoschisis are seen clinically.

Conclusion: Postmortem examination can assist in identifying the mechanism of ocular findings and injury in AHT.

References: Levin, AV. Retinal Hemorrhage in Abusive Head Trauma. Pediatrics 2010;126:961-70
A 6-Year Review on Preseptal and Orbital Cellulitis in Patients under 18 Years Old and the Use of Steroids in its Management within Our Tertiary Center in Abu Dhabi

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Introduction: The purpose of this study was to provide an analysis of paediatric patients with an orbital or preseptal infection, outcome of surgical intervention and the effect of steroid use on the duration of treatment. The causative organisms were analyzed.

Methods: The in-patient records were reviewed retrospectively from January 2011 to March 2017. The ocular findings, the duration of symptoms and hospital stay, microbiological culture reports, antibiotics, steroids used, surgical intervention, the response to therapy and complications were reviewed.

Results: A total of 37 patient records were reviewed. The inclusion criteria: <18 years old, diagnosis of preseptal or orbital cellulitis. The average age of patients at presentation was 5 years. 68% were preseptal and 32% were orbital cellulitis. Out of the orbital cellulitis cases, 50% underwent a surgical procedure with no complications. The range of inpatient stay was between 4-51 days (mean 6.86 days). 84% of the cultures came back negative but the causative organisms identified were streptococcus, micrococcus, haemophilus influenza, aspergillosis and actinetobacter baumanni.

Discussion: 30% of the patients received steroids and that did not influence the length of stay or prognosis compared to the 60% who did not receive steroids. It was noted that patients with orbital cellulitis (mean 13.1 days) had a longer inpatient duration compared to preseptal cellulitis (mean 3.88 days).

Conclusion: Based on the six-year review, it can be concluded that preseptal cellulitis remains the commonest among orbital infections and there was no benefit seen in the length of stay with steroid use.

TAYLOR AND HOYT'S PAEDIATRIC OPHTHALMOLOGY AND STRABISMUS, FIFTH EDITION, 2017, ELSEVIER. CHAPTER 14, PAGE 113-123, THE CHAPTER WAS COWRITTEN BY RICHARD SCAWN AND JIMMY M UDDIN, FROM. MOORFIELDS EYE HOSPITAL, LONDON
Paediatric Endophthalmitis: Incidence and Management

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Introduction: Paediatric endophthalmitis is a severe but rare complication of intraocular surgery, penetrating trauma, and far less commonly extra-ocular surgery and endogenous. We set out to establish the incidence and risk factors of endophthalmitis in children, and to develop a clear protocol that can be used for treatment of suspected endophthalmitis.

Methods: Microbiology reports and operation numbers were obtained from two large tertiary referral hospitals sharing 24-hour paediatric ophthalmology cover for the period January 2009 – December 2016. All cases of aqueous and/or vitreous tap performed on children aged $<=$16 years were identified and case notes reviewed for complete information on each case.

Results: 15 cases were eligible for inclusion as 'postoperative endophthalmitis': complete data was found on 12 cases. The incidence of postoperative endophthalmitis was 0.0025 over 7 years. The mean age of presentation was 4.5 years (range 7 months-11 yrs 9 months), from 3 days-21 months post op. 10/12 had at least 1 glaucoma procedure. Microbiology results showed growth in 8/12 with most being gram positive organisms, but also including fungus. The antibiotic regime varied depending on age, organism identified and sensitivities. 9/12 had hand movement or worse vision after treatment.

Discussion: Paediatric endophthalmitis is a rare but devastating condition with poor visual prognosis which may present to any paediatric/general ophthalmologist. It requires prompt treatment. Previous glaucoma surgery is a longterm risk factor in children.

Conclusion: Based on our audit and a literature review, a protocol and pathway for management is proposed in order to improve outcomes.

References: Al-Rashaed SA, El-Asrar AMA. Exogenous Endophthalmitis in Pediatric Age Group. Ocular Immunology and Inflammation (2006);14:5,285-292
AAPOS Member Understanding of Regional Vision Screening in the United States

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Introduction: Advances in photoscreening technologies have allowed community based screening programs to reach large geographic areas. Pediatric ophthalmologists have a vested interest in the quality, location and success of these programs.

Methods: An online survey sent to 1000 AAPOS members practicing within the United States asked about the presence of a screening program by geographic location, screening modalities used, personnel involved, referral rates and age range of children screened. Program characteristics as well as AAPOS member practice locations were displayed geographically using ArcGIS software (esri, Redlands, CA).

Results: 290 responses (representing nearly half of pediatric ophthalmology practices listed in the AAPOS directory) were obtained from pediatric ophthalmologists in 44 states. 210 (71.67%) reported that a vision screening program exists in their region. 148 (60.16%) indicated that pediatricians perform screenings, followed by preschool programs (140 or 57.38%) and Lions Club volunteers (96 or 39.34%). 29.44% of respondents indicated the age at initial screening to be 3-4 years while 23.33% of respondents indicated initial screening at age 0-1 years.

Discussion: The results suggest that much of the geographic United States has access to preschool vision screening. AAPOS members' responses regarding vision screening programs were largely confined to urban areas consistent with their practice location. Variability exists among vision screening programs within the same geographic area, often with multiple entities screening the same region.

Conclusion: Pediatric ophthalmologists' collective understanding of current vision screening programs is a valuable resource with potential application to the development of new vision screening programs or the enhancement of current programs.

Vision Screening Outcomes in Children Less Than 3 Years of Age Compared to Children Older than 3 Years of Age

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Introduction: The USPSTF states that vision screening is recommended for children ages 3-5, but that current evidence is insufficient to assess the benefits and harms in those younger than age 3. This study aims to compare vision screening outcomes between children in these age groups from a well-established photoscreening program.

Methods: This was a retrospective chart review of children over a 13-year period who failed vision photoscreening by Iowa KidSight and were subsequently seen at the University of Iowa.

Results: Of 304 subjects, 22% were 0-2 years and 78% were 3 years or older at the time of screening. Amblyopia rates were statistically similar in the two groups with 34% in the younger group and 45% in the older group (p=0.13). Normal vision was attained on average at 40.2 months of age in the younger group and 62.2 months in the older group (p <0.001). There were 4% of children in the younger group who did not attain normal vision and 25% in the older group (p=0.045).

Discussion: Vision screening in children younger than 3 years of age identifies similar numbers of children with amblyopia compared with ages 3 and older. The younger group attained normal vision at a significantly younger age and were more likely to attain normal vision in follow-up.

Conclusion: This study shows that earlier vision screening and referral leads to a better chance of attaining normal vision and at a younger age, thus providing evidence for vision screening in children under 3 years of age.

Results of Yearly Screening Using the SPOT Vision Screener in a Pediatric Cohort Between 2015-2017

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Introduction: Photoscreening allows community based vision screening programs to reach large numbers of children. Repeat photoscreening is recommended to maximize the chance of detecting amblyogenic risk factors. This study is the first to track a cohort of children who underwent yearly photoscreening over a 3-year time period.

Methods: Children ages 18 months-11 years were screened yearly at their school as part of a community vision screening program using the SPOT vision screener between 9/2015-9/2017. Data collected each year at the screening included age, gender, whether the child passed or was referred, and referral reason. Referral criteria adhered to published guidelines by the AAPOS Vision Screening Committee.

Results: Over 3 years, 799 screenings were performed. 285 children underwent repeat annual screening (671 screenings) of which 26 children were referred (9.1%). Of those referred, nearly half (42.3%) passed the first year but failed a subsequent screening. The average age of children who passed screening one year and were referred the next was 3 years.

Discussion: In this cohort, annual screening over a 3 year time period showed that almost half of all children referred would have passed an earlier screening but failed a subsequent screening. The average age of these children was 3 years, which is an age shown to be more responsive to amblyopia treatment.

Conclusion: These results support policy statements recommending yearly repeat vision screening of children in the amblyogenic age group. Further studies are needed to identify the positive predictive value of repeat screening.

Introduction: The Spot™ Vision Screener (SVS) has been demonstrated to provide good specificity and sensitivity in detecting amblyogenic risk factors in children. However, it has not been thoroughly evaluated in adults. This study aims to evaluate the accuracy of the SVS as a handheld and relatively inexpensive device to measure refractive errors in adult.

Methods: Prospective, cross-sectional study of adult patients at the Bascom Palmer Eye Institute from July to October 2017. The refractive error was measured using the SVS and the Retinomax K-plus3 autorefractor. The values of sphere, cylinder, and astigmatism axis were compared using interclass correlation coefficients (ICC). Excellent, good and poor agreements were defined as ICC levels of >0.75, 0.3-0.75 and <0.3, respectively.

Results: 46 participants (62% female, average age 52.15±18.76 years) were included. Overall, ICCs were found to be 0.88 for sphere and 0.89 for astigmatism axis, indicating excellent agreement. The ICC was 0.65 for cylinder power, indicating good agreement between the SVS and autorefractometer. In strabismic eyes (n=12), the sphere agreement was poor. The SVS was unable to capture measurements in 12 out of 19 pseudophakic patients.

Discussion: The overall favorable results show the SVS may be used as an autorefractor in adults, although inaccuracy of measurements should be considered in certain conditions, such as strabismus.

Conclusion: The preliminary outcome of this study shows overall strong agreement between the SVS and the Retinomax K-plus3 in adults. SVS might potentially be used to accurately detect refractive errors in adults especially in underserved areas.

Refractive and Biometric Outcomes Following Bevacizumab Versus Laser for Retinopathy of Prematurity

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Introduction: In 2010 and 2011, we conducted a prospective randomised study to compare the treatment of intravitreal Bevacizumab in one eye versus diode laser in the fellow eye of 15 premature infants with symmetrical zone 1 or posterior zone 2 ROP.

Methods: All 15 children were reviewed in 2017 with visual acuity, cycloplegic refraction and biometry recordings made of each eye that was treated.

Results: The laser treated eyes had a mean spherical equivalent of -3.06 Dioptres. The bevacizumab treated eyes had a mean spherical equivalent of -0.8 Dioptres. This was statistically significant. The laser-treated eyes had reduced mean anterior chamber depths (2.71mm) compared with the Bevacizumab treated fellow eyes (3.13mm) and this was statistically significant. The mean axial length of the lasered eyes was longer (21.21mm) compared to the mean axial length of the Bevacizumab treated eyes at 20.84mm.

Discussion: These results highlight the higher myopic results with narrow anterior chambers, steeper corneas and longer axial lengths in laser treated eyes compared to their fellow eyes which were treated with Bevacizumab.

Conclusion: These findings can be attributed to the adverse laser effects on anterior segment development in the premature infant eye. These findings will be of use to clinicians who use both treatments in premature infants and highlight benefits of Bevacizumab versus Laser.

Issac M, Mireskandari K, Tehrani N. Treatment of type 1 retinopathy of prematurity with bevacizumab versus laser. JAAPOS 2015;19:140-144
Neurodevelopmental Outcomes Comparing Bevacizumab to Laser for Type 1 ROP

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Introduction: Despite superior ocular outcomes for posterior type 1 ROP, use of intravitreal bevacizumab (IVB) remains controversial, largely due to potential adverse systemic effects. This study evaluates neurodevelopmental outcomes at our institution, where eyes with posterior type 1 ROP received laser before and IVB after the publication of BEAT-ROP.

Methods: Chart reviews identified 41 infants with laser and 48 with IVB from 2006-2016. Primary outcomes were Bayley-3 scores (BSID-III’s), collected for another NICU study. Secondary outcomes were developmental delay, cerebral palsy, hearing loss, and bilateral visual impairment.

Results: Baseline characteristics were similar by treatment group. Mean BSID-III’s were: cognitive 77.0 and 76.7, p = 0.97; language 83.8 and 84.5, p = 0.91; motor 81.2 and 77.3, p = 0.70; total 242 and 233, p = 0.68, in the IVB (n = 13) and laser (n = 9) groups, respectively. Severe delay (component score < 85) was common: 78% with laser and 69% with IVB (NS). Comparing all infants, secondary outcomes trended favorably for IVB, with a significant decrease in the rate of cerebral palsy.

Discussion: In contrast to the recent Canadian study, IVB was not associated with adverse developmental effects in this analysis. Baseline differences, propensity to treat sicker infants with IVB, and imbalance in exclusion criteria likely biased results of the previous study. In this study, the number and characteristics of patients excluded from BSID-III analysis are similar in each group.

Conclusion: Although developmental delay was common in both groups, there were no significant differences in primary outcomes by treatment group. The before/after study design minimizes selection bias.

References:
Retinopathy of Prematurity Growth Pattern after Anti-VEGF Treatment

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Introduction: The purpose of the study was to determine the typical growth patterns after intravitreal bevacizumab (IVB) injection for retinopathy of prematurity (ROP).

Methods: A retrospective chart review was performed on infants treated with IVB from 2010 to 2017. Demographic data, interventions, ophthalmologic exams, and outcomes were recorded.

Results: 39 patients (78 eyes) were identified. Improvement of plus disease was observed in 48/52 (92%) of eyes assessed at 1 day and 78/78 (100%) of eyes at 1-week post injection. Retinal vascular outgrowth into zone 2 was observed in 41%, 78%, 93%, and 100% of eyes at 2, 4, 6, and 9 weeks post injection, respectively. Vascular outgrowth into zone 3 was observed in 46%, 79%, 92%, and 100% of eyes at 10, 14, 18, and 23 weeks. A saw-toothed circumferential vessel at the leading margin of the vascular retina was noted in 53% of patients. Nineteen eyes had slow recurrence that was successfully treated with laser or additional IVB, average 9.6 weeks. Two eyes had rapid retinal detachment (10 and 30 weeks respectively) that occurred after reaching zone 3. Both had incomplete resolution of the ridge after IVB.

Discussion: Typical growth patterns after IVB are delayed and highly variable when compared to laser treatment. Saw-toothed circumferential vessels can be cautiously observed. Incomplete ridge resolution may be a predictor of rapid retinal detachment.

Conclusion: The use of IVB for type 1 ROP has become increasingly popular. Understanding typical growth patterns can help practitioners anticipate patterns of growth and guide follow up.

Re-Treatment of Retinopathy of Prematurity after Primary Intravitreal Bevacizumab Monotherapy

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Introduction: The efficacy of intravitreal Bevacizumab for the treatment of type 1 ROP, especially in zone 1 has been demonstrated by the BEAT-ROP study. Critics for using Anti-VEGF argue that the effects are transient and recurrences can occur. In this study we demonstrate the patterns of re-treatment after Primary Intravitreal Bevacizumab monotherapy for type 1 ROP in Cairo University hospitals.

Methods: A retrospective review of all infants who received intravitreal Bevacizumab as a primary treatment for Type 1 ROP and then required re-treatment from 2014 to 2017.

Results: Four out of 70 infants (5.7%) required re-treatment. Three of the four patients initially had aggressive posterior ROP, and the 4th patient had stage 3 zone 2 with plus disease. The time of re-treatment in our patients was before 45 weeks of adjusted age. Their birth weights ranged from 900 g to 1800 g and their gestational ages ranged from 29-32 weeks.

Discussion: Our results are similar to those published by Mintz-Hittner et al in that the majority of re-treatment initially had AP-ROP however they are different in demonstrating that re-treatment doesn't necessarily occur in very low birth weight infants and that it could occur earlier than then 45-55 weeks of adjusted age that had been described by Mintz-Hittner et al.

Conclusion: The use of Bevacizumab monotherapy should be undertaken with a strict follow up regimen. The risks for recurrences, reactivation or failure should be kept in mind, and the presence of skilled surgeons for rescue laser or vitrectomy is a must for any comprehensive ROP service.


Acknowledgements: Hala M. ElHilali, MD, Alia A. Ali, MD and Huda H. Al-Layouti, FRCS for their efforts in the screening of ROP in Cairo University, and Mariam El-Fiky, FRCS for her help in acquiring follow up images.
Fluorescein Angiography Findings in Infants Treated With Intravitreal Bevacizumab for Retinopathy of Prematurity

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Introduction: Medium and long term sequelae of intravitreal bevacizumab (IVB) for type 1 retinopathy of prematurity (ROP) are uncertain.

Methods: We reviewed records of consecutive patients undergoing fluorescein angiography (FA) after treatment with IVB for type 1 ROP between January 1st 2013 and June 31st 2017. FA was performed for incomplete vascularization or recurrent stage 3 ROP. Angiograms were reviewed for occult neovascularization (NV) and abnormal vascular patterns.

Results: Twenty-six eyes of 13 infants were included. Gestational age ranged from 22.7-26.4 weeks (24.4 ± 1.2; mean ± SD). Birth weight ranged from 510-1025g (686.2 ± 170.1; mean ± SD). Mean post-menstrual age at the time of IVB and FA was 35.5 ± 1.9 and 67.2 ± 13.7 weeks respectively. Review of angiograms revealed arrest of vascular development in zone 2 in 84.6% and occult NV in 29.2% of eyes. Abnormal vascular patterns seen at the vascular-avascular junction included blunted vessel terminals (84.6%) and circumferential shunts (7.7%). An unusual pattern of two circumferential rows of blunted vessel terminals ('double blunted vessel pattern') was also noted (11.5%). Posterior to the junction, shunts were seen in 73.1%. Macular abnormalities were seen in 46.2%. All but 2 eyes received laser treatment following FA.

Discussion: FA after bevacizumab injection for type 1 ROP may reveal subclinical NV and abnormal or incomplete vascularization. We recommend laser treatment for patients with NV or arrest of vascular development in zone 2. The significance of other abnormal vascular patterns is unknown.

Conclusion: Abnormal FA findings are common after IVB for ROP. Implications for long term vision are unclear.

Introduction: The purpose of this study was to examine the incidence and spectrum of corneal complications among premature infants in the NICU.

Methods: Corneal problems among preterm infants were noted in our institution. A questionnaire-based survey was conducted among AAPPOS members. Data on patient gestational age, number and type of corneal complications in preterm infants in the NICU was collected and analyzed.

Results: Thirty-two pediatric ophthalmologists reported corneal complications in preterm infants in the NICU. Eighty total cases of corneal complications were reported. Thirty cases occurred from exposure keratopathy. Thirteen cases of exposure keratopathy developed following laser for ROP. Thirty-one cases of ulcerative keratitis were observed: 17 cases were attributed to herpetic keratitis, 11 were bacterial ulcers and 3 were fungal ulcers. Eight corneal complications were due to trauma, six to anterior segment dysgenesis/Peters anomaly, four to glaucoma and one to rubella keratopathy. Analysis of gestational age revealed 26% of infants to be under 25 weeks, 55% at 26-29 weeks and 35% over 30 weeks. The majority (56%) of these cases were projected to sustain significant vision loss as a result of their corneal complication.

Discussion: Corneal disease and injury among preterm infants occurred from a wide variety of causes. Most infants were 29 weeks gestation or younger. Visual loss developed in a majority of cases.

Conclusion: Corneal complications affecting vision is not rare among very preterm infants. Vigilance by NICU nurses and neonatologists is critical. Protocols to protect corneas should be in place in each NICU.

Do Ophthalmology Residents Benefit from a Strabismus Surgery Course?

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Introduction: The purpose of this study is to determine if an eye muscle surgery course is beneficial to ophthalmology residents.

Methods: Prospective cohort study. First- and second-year ophthalmology residents were invited to participate in a 2-hour strabismus surgery course. A didactic session was followed by a wet laboratory session. The wet laboratory session used a model constructed of chicken breast followed by partial-thickness scleral suture passes in pig eyes. A structured self-assessment evaluation form and a questionnaire in the validated Ophthalmology Surgical Competency Assessment Rubric approved by the International Council of Ophthalmology (ICO-OSCAR: strabismus) were used to assess the effectiveness of the course.

Results: A total of 12 residents, 8 (67%) first-year and 4 (33%) second-year, were enrolled for this survey. Following the course, most residents felt less anxious (73%). The residents gave significantly higher ratings on questions of subjective experience, knowledge of steps, and understanding of potential complication after the course (P < .029). The change in the modified ICO-OSCAR: strabismus assessment's mean score was statistically significant (P = .038) before and after training (28.2 vs. 35.4, respectively). All residents responded that the course was helpful or somewhat helpful in preparation for strabismus surgery.

Discussion: Following a strabismus surgery course most residents felt less anxious, more knowledgeable of the steps and complications of strabismus, with an improvement in their strabismus surgical skills.

Conclusion: A strabismus course can play an important role in preparing residents for strabismus surgery.

Introduction: Men and women have been shown to receive significantly different care for an increasing number of medical conditions[1-2]. Incidence data suggest an equal sex distribution for most types of horizontal strabismus[3]. This study tested the hypothesis that female patients represent a statistically significant majority of strabismus surgeries.

Methods: Subjects were identified by searching the electronic health record of the Wills Eye Hospital Ambulatory Surgical Center from the time of its initiation. We included all patients who had procedures with the following CPT codes: 67311 (strabismus surgery, 1 horizontal muscle) and 67312 (strabismus surgery, 2 horizontal muscles). Patients with history of prior strabismus surgery, other significant ocular pathology, or neurologic disorders were excluded.

Results: Of the 1,262 patients included, 677 (53.6%) were female and 585 (46.4%) were male, a difference of 7.2% (p=0.01).

Conclusion: This study showed a statistically significant difference in the percentages of male and female strabismus surgery patients. Understanding the relationship between gender and the surgical management of strabismus may help to improve our awareness of hidden biases.

References:
What Makes a Good Operation Great?: The Role of HRQOL in Evaluating Success of Strabismus Surgery

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Introduction: Evaluation of strabismus surgery outcomes based on health-related quality of life (HRQOL) criteria is important from the patient's perspective. The main aim of this study was to explore pre- and postoperative factors that influence the success of adult strabismus surgery based on HRQOL criteria.

Methods: HRQOL criteria of strabismus surgery was assessed using the Adult Strabismus 20 (AS-20) questionnaire. Adult patients (≥16 y/o) undergoing strabismus surgery between 2014-2016 were identified using a treatment register. Pre- and postoperative AS-20 score were calculated. HRQOL surgical success was defined as a pre- to postoperative change in AS-20 score exceeding previously reported 95% limits of agreement.[1] Any relationship between: demographic factors (gender and age); presence or absence of diplopia; type and magnitude of deviation; change in total deviation; and preoperative AS20 score with HRQOL success was investigated.

Results: Eighty-seven patients (mean age 47 years; 53% female) were included in the study. The median preoperative AS-20 score was 58.8. Postoperatively, the median AS-20 score was significantly higher at 72.5 (Z=-6.536, p<0.0001). 54 of 87 (62%) of surgeries were classified as success. Lower preoperative AS-20 score was associated with a higher rate of HRQOL success (p=0.001). None of the other factors considered were significantly related to the rate of HRQOL success.

Discussion: Lower preoperative AS-20 score is strongly and independently related to HRQOL success in strabimus surgery.

Conclusion: This suggests that patients who are more concerned about the psychosocial or functional aspect of their strabismus seem to gain the most benefit from strabismus surgery.

Using an Electronic Medical Record (EMR) to Audit the Clinical Outcomes of Strabismus Surgery

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Cheltenham

Introduction: Most audits of strabismus surgery outcomes involve retrieving paper or electronic medical record (EMR) notes and inputting data into a spreadsheet for analysis. This is a slow and laborious process. This paper demonstrates how to analyse the results of strabismus surgery using the Medisoft EMR.

Methods: Medisoft is specialty specific EMR designed by ophthalmologists. It includes a strabismus audit suite capable of analysing multiple variables including, pre and post-operative prism cover test (PCT) deviations, mms of surgery performed and the planned post-operative deviation. We will use the audit suite to conduct a ‘live’ real-time audit of the results of surgery for infantile esotropia, intermittent exotropia and secondary exotropias.

Results: The change in strabismus angle vs mm's of surgery performed, the pre-operative vs post-operative angle and the deviation from the surgical aim will be analysed electronically for these three strabismus conditions. The interactive function of the audit suites box plot chart will be used to ‘drill through’ to review individual patients included within a box plot to provide detailed information on any outliers.

Discussion: The Medisoft EMR is the only EMR that allows meaningful analysis of the results of strabismus surgery. It enables surgeons to analyse their results and to modify their surgical numbers accordingly. Surgical outliers can be identified easily. It also provides patients with accurate information about the success rates of surgery.

Conclusion: Electronic audit using the Medisoft EMR enables instant and detailed analysis of the outcomes of strabismus surgery.
Towards Standardized Primary Strabismus Surgery: A Systematic Approach for a Surgical Plan

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HU-University of Applied Sciences
Utrecht

Introduction: Planning for strabismus surgery is a complex process and involves various variables. According to Dutch law, orthoptists in the Netherlands advise the surgeon about the plan for strabismus surgery. The purpose of this study was to investigate whether a newly developed mind map ‘Primary Strabismus Surgery’ (MM-PSS) could standardize the plan for surgery.

Methods: Four fictitious cases on paper of primary strabismus surgery were created consisting of a decompensated microtropia, intermittent exotropia, non-specific esotropia and a case with high risk of post-operative diplopia. Twenty-four final year orthoptists-in-training from HU-University of Applied Sciences were asked to formulate a surgical plan in these four cases. After receiving the MM-PSS these same students were assigned to create again a surgical plan in four comparable fictitious cases.

Results: In case microtropia, non-specific esotropia and adult with high risk of post-operative diplopia there was a significant increase in consistency in choice of the target angle (resp. p=0.022, p=0.039, p<.001) as well as performing additional diagnostics for surgery in case intermittent exotropia (p=0.012). No significant improvement was shown in the investigation for post-operative diplopia (p=0.459).

Discussion: Evidence based guidelines summarized in a new developed MM-PSS provided to orthoptists-in-training reduced the variety in plans for strabismus surgery. Higher level of evidence especially in setting terms for surgery is required to update the MM-PSS and improve the choice of surgery.

Conclusion: The MM-PSS is an effective tool for orthoptists-in-training and residents in approaching the plan for primary strabismus surgery.
Poster #98  
Tuesday, 9:45 – 10:45 am

Generating a Minimum Set of Outcome Measures for Auditing Strabismus Treatments – What to Collect and How To Do It – A Delphi Exercise

John E. Somner; Peter B. Thomas; Audrey Pang; Robert Froud; Narman Puvanachandra; Melanie Hingorani; Tony Vivian

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Introduction: Agreeing shared datasets can drive research and quality improvement1-3. This study develops a set of outcome measures considered important and practical to collect by strabismus specialists for auditing the effectiveness of strabismus treatments and identifies barriers to their collection.

Methods: An online Delphi exercise using the RAND/UCLA appropriateness method was conducted. 64 strabismus specialists took part. 831 cases from 3 centres were assessed for completeness of data capture. Adult Strabismus Quality of Life Questionnaire (AS-20) was prospectively collected on 100 patients and barriers to its routine use were identified using qualitative interviews and thematic analysis.

Results: Participants in the Delphi exercise agreed on 12 baseline data points, 8 indications for strabismus surgery, 4 per- and 11 post-operative complications and 10 clinical outcomes that were important and practical to collect. A reduction of, or alleviation of, patient-reported symptoms was considered the most important success measure but there was uncertainty about the practicality of measuring this in routine practice. The audit of 831 cases indicated that 79% were able to report on anatomical success while 68.5% had some comment on surgical outcome from the patient's perspective. AS20 data was successfully captured on 100 consecutive patients and barriers to collecting quality of life data from patients identified.

Discussion: There was broad consensus on a minimum dataset for reporting the outcomes of strabismus treatments. The importance of developing the infrastructure to routinely measure both clinical and patient reported outcomes is highlighted.

Conclusion: Adoption of the minimum dataset identified could drive quality improvement but new data collection tools are required.

Strabismus Success in Children of Lower Socioeconomic Backgrounds

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Baltimore, MD

Introduction: Lower socioeconomic status (SES) is linked to higher rates of isolated strabismus. Little is known about short-and long-term outcomes following strabismus surgery. This study reports the surgical outcomes following horizontal strabismus surgery in patients of lower SES and identifies factors that may be associated with surgical success.

Methods: A retrospective review of children with medical assistance (MA) undergoing horizontal strabismus surgery between 2014-2017 was performed. MA was used as a proxy for lower SES. Children were included in analysis if they had data from preoperative, POM1, and POM6 visits. Pre- and postoperative ocular alignment, fusion, amblyopia, visual acuity, and stereopsis were recorded. Demographic information and compliance with treatment recommendations were recorded.

Results: 69/105 patients met eligibility criteria. Racial distribution was 41% Caucasian, 33% African American, 17% Hispanic, 4.5% Asian, 4.5% other. 56.6% were male. Mean surgical age was 6.22 years (10ms - 17yrs). Preoperatively, 45% patients were amblyopic, 61% were esotropes, 39% were exotropes. Success rate was 75.36% at POM6. 70.58% of failures were male. Failures had 20% higher rate of noncompliance with treatment.

Discussion: The overall success rate in our study population is comparable to that of other published accounts. However, the study population excluded 35 patients in data analysis due to poor post-operative follow-up. Theorizing poor appointment attendance may coincide with worse outcomes, eliminating these patients could bias our data set.

Conclusion: We found that race, gender, and compliance with treatment influenced surgical success rates in our population of pediatric strabismus patients with MA. Awareness of these factors can help encourage further research to identify at-risk patients and improve surgical success.

Introduction: 'Heads up' surgery provides three-dimensional (3D) images of the surgical site in straight-ahead gaze. This has gained popularity in vitreoretinal surgery due to improved visualization and illumination, ergonomics, and surgical team involvement. We present early experiences with the system in strabismus surgery, outlining benefits and limitations.

Methods: We conducted a retrospective review of strabismus surgeries completed using the NGENUITY 3D Visualization System (Alcon and TrueVision® 3D Surgical). We surveyed involved surgeons and staff for their experiences with this technology.

Results: Three patients underwent uncomplicated strabismus surgery with excellent oculomotor outcomes using the 3D visualization system. Surgeries included inferior rectus recession, bilateral horizontal muscle recession-resection, and reoperation on a slipped lateral rectus muscle. Reported advantages of 'heads-up' surgery included improved illumination, posture, magnification, and better visualization for staff and trainees. Reported disadvantages included atypical positioning of the surgeon at the head of the bed for horizontal muscle surgery, atypical assistant views as the display is in the surgeon's perspective, increased operative time/cost, mild distortion of depth and color, and decreased space due to extra equipment.

Discussion: 'Heads up' surgery may improve strabismus surgery through better visualization leading to consistent scleral suture depth, easier vertical rectus muscle surgery, and easier deep orbit maneuvers such as posterior fixation or muscle splitting. It may also improve teamwork and education through engagement of staff and trainees. Lastly, posture benefits may decrease surgeon fatigue and extend careers.

Conclusion: While 'heads up' strabismus surgery offers advantages, outcomes data must be generated and disadvantages must be addressed prior to mainstream use.

Comparison of the Suture Material Vicryl 6-0 and 7-0 in Strabismus Surgery

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Russian Federation, Moscow

Introduction: Usually dissolving sutures 6-0 are used in the strabismus surgery. Few authors reported the use of 7-0 sutures. The use of thinner needles and sutures leads to a reduction in the injury level, weaker inflammatory reaction and minimal amount of fibrous tissue formed. However, concerns that thin sutures won’t stand strong contractions of oculomotor muscles exist. The goal of this research was to study the relative tensile strength of 6-0 and 7-0 vicryl sutures.

Methods: The research was performed on 20 enucleated pig eyes. The eyeballs were divided into two groups. Sutures 7-0 were used in the main group, 6-0 were used in the control group. Medial rectus muscle recession has been simulated. Samples were then tested for stretching using universal testing machine INSTRON 3382. The strain value was noted at the first suture breakage point.

Results: In the control group the average maximum strain before the breakage was 8.54±1.26 N. In the main group it was 4.38±1.05 N (P<0.05), while the maximum strain, which is endured by the muscles in the natural conditions is about 0.24-1.0 N.

Discussion: The sutures 7-0 are twice weaker than sutures 6-0, but this difference is not critical, as the force needed to tear off the muscle attached with the thinner sutures is at least 4 times bigger than the force extraocular muscles can exert in natural conditions.

Conclusion: Characteristics of thin vicryl sutures 7-0 meet the requirements for the surgery of extraocular muscles.

Use of Intra-Operative Optical Coherence Tomography in Assessing Depth of Scleral Passes During Strabismus Surgery

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Introduction: We report the first use of intraoperative OCT to assess and compare depth of scleral passes during strabismus surgery.

Methods: In this ongoing study, patients underwent strabismus surgery. During the scleral pass, the needle was left in the sclera. The intraoperative OCT (Zeiss Rescan 700, Oberkochen, Germany) was then used to image the needle in the sclera. After confirmation of appropriate depth, the needle was pulled through. The images were reviewed postoperatively.

Results: Most passes were between 20 and 50% of scleral thickness. There were no perforations.

Discussion: Two dreaded complications of strabismus surgery are slipped muscles and scleral penetration or perforation. Intraoperative OCT can be used as a tool to assess proper depth of passes, and confirm scleral penetration or perforation, if suspected.

Conclusion: Intraoperative OCT is a safe and easy way to assess depth of scleral passes during strabismus surgery.

Poster #103  
Tuesday, 9:45 – 10:45 am

Fornix Incision Versus Minimally Invasive Strabismus Surgery (MISS) Approaches to Strabismus Surgery, An Effectiveness Study

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Introduction: To compare the effectiveness and patient acceptance of Fornix incision versus Minimally Invasive Strabismus Surgery (MISS) approaches.

Methods: Over a 9 month period we looked at patients undergoing horizontal squint surgery to assess whether surgical outcome and patient satisfaction is dependent on surgical incision type. We assessed the effectiveness of surgery as well as the pre and post-operative quality of life using the AS20 score. We asked patients to rate their discomfort subjectively post-operatively and compared pre and post-surgical strabismus measurements and complications.

Results: In this period 14 patients met our inclusion criteria. The fornix patients (mean age 38, range 21-66) underwent a recess-resect procedure whereas the MISS patients (mean age 36, range 15-76) underwent a recess-plication. The effectiveness of the surgical procedure was 2.56D/mm for near and 2.89D/mm for distance in the fornix incision group and 1.76D/mm for near and 1.83D/mm for distance) in the MISS group. There was no clear effect of surgical incision type on patient satisfaction as assessed by subjectively reported post-operative comfort and AS20 scores.

Discussion: These results suggest that the distance muscles are moved may be overestimated through MISS incisions. There is no clear forerunner in terms of patient comfort.

Conclusion: Further research is needed to confirm the difference in effectiveness between the fornix incision technique and MISS and to investigate potential causes. A lack of significant difference in any of the patient comfort and perception markers suggests incision type may be best allocated based on patient and surgical factors on a case-by-case basis.

Risk Factors for the Surgical Failure in Different Types of Strabismus

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Introduction: To analyze the effects of various independent factors on midterm surgical outcomes in different types of strabismus.

Methods: Strabismus cases, who underwent surgery from January 2015 to June 2016 were reviewed. Minimum follow-up was 12 months. Success was defined as alignment with 10∆ of orthophoria. Binary logistic regression with backward stepwise method was used to determine the significant factors associated with failure. Various independent factors (age at surgery, sex, best-corrected visual acuity, refraction, types of strabismus, surgical choice [unilateral vs bilateral], presence of oblique muscle dysfunction (OMD), restriction, nystagmus, neurologic disease, alphabet patterns, secondary surgery, amount of deviation) were included.

Results: 159 cases with a mean follow-up of 15.2 (12-24) months and a mean age of 18.4 (1-67) years at surgery were included. 66 esotropia (45 infantile, 18 sensory, 3 residual), 40 exotropia, 11 consecutive exotropia (CXT), 17 sensory exotropia, 18 vertical strabismus, 10 Duane retraction syndrome were analysed. OMD was present in 24 cases. Unilateral surgery was preferred in 67 patients. There were 24 failures (15%). The diagnoses of exotropia (Odds ratio [OR] = 6.3, P = 0.001), and CXT (OR = 10.1, P = 0.008), performance of symmetrical surgery (OR = 3.7, P =0.039) and preoperative angle of deviation (OR = 1.043, P = 0.015) were associated with surgical failure.

Discussion: Multicenter studies with longer follow-up are needed to support our findings.

Conclusion: Exotropia, CXT, deviation amount, and symmetrical surgery was associated with poor surgical outcomes.

A Survey on Conjunctival Closure in Strabismus Surgery

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Introduction: Our previous survey on perioperative management of strabismus showed unexpected variability in technique for conjunctival closure in surgery. A follow-up survey will be repeated to illuminate on specific aspects surrounding conjunctival closure.

Purpose: The purpose of this study is to identify surgical management protocols for conjunctival closure amongst strabismus surgeons around the world.

Methods: A survey about conjunctival closure in strabismus surgery was sent to all pediatric ophthalmologists around the world.

Results: Over 6% of the respondents do not close conjunctival incisions after strabismus surgery. A majority (53%) close conjunctival incisions with 8-0 vicryl. This was followed by 6-0 vicryl (19%), 6-0 plain gut (9%), 7-0 vicryl (5%), and 10-0 nylon (0.8%). One surgeon reports using tissue glue to close conjunctiva after strabismus surgery.

Discussion: The follow-up survey is still on going, and the data will be updated once more responses are collected.

Conclusion: There are a wide range of approaches in the management of conjunctival incisions in strabismus surgery. The lack of concrete rationale favoring one technique over the other encourages more scientific investigation to be pursued.
Chronic Inflammatory Granulomata after Intraoperative Use of GenTeal Gel during Strabismus Surgery

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Introduction: Goals of strabismus surgery include acceptable binocular alignment, postoperative comfort, and limited complications. Corneal hydration reduces epitheliopathy and improves comfort. GenTeal gel (hydroxypropyl methylcellulose 0.3%, carbopol 980, phosphonic acid, sorbitol, sodium perborate 0.028%; Ciba Vision, Duluth, GA) is an ocular surface lubricant and has been advocated to maintain intraoperative corneal clarity in vitreo-retinal surgery [1]. We report 2 cases of chronic inflammatory granulomata after intraoperative use of GenTeal gel during strabismus surgery.

Methods: Retrospective case series: A 5-year-old African-American boy and a 19-year-old Caucasian female underwent uncomplicated, virgin strabismus surgery via inferior fornix incisions. Corneal hydration was maintained with GenTeal gel in both cases.

Results: Alignment and healing were good at postoperative week 2. At postoperative month 3, each patient noted elevated yellow subconjunctival lesions with surrounding injection in the inferior fornix. The younger patient was asymptomatic and elected observation; the older patient chose excision. Histopathology showed amorphous collagen surrounded by inflammatory cells.

Discussion: A recent report documented chronic inflammatory subconjunctival granulomata after intraoperative use of GenTeal gel in vitreo-retinal surgery with large conjunctival incisions [2]. Similar lesions have been reported after use of similar compounds during lipoplasty [3]. Clinical presentation and histopathology were similar in our two cases. No such complications have occurred since intraoperative GenTeal was discontinued.

Conclusion: When GenTeal is used during strabismus surgery, copious irrigation is recommended to reduce the risk of developing postoperative granulomata. Alternative lubricants such as balanced salt solution or Goniosol should be considered for corneal hydration during eye surgery with open conjunctiva.

Orbital Cysts after Strabismus Surgery: A Worldwide Survey

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Introduction: Orbital cysts following strabismus surgery represent a rare post-operative complication. The characteristics of patients, risk factors, and the recommended management will be analyzed by an international survey.

Methods: Strabismologists from around the world contributed cases of orbital cysts through an online survey. Incidence, risk factors, management, and outcomes were identified.

Results: Ninety-three cases of orbital cysts from 50 surgeons in 10 countries were collected to date. Average years of practice of participating surgeons is 21.1 years. Average case number per participant is 2.4 cases. The most common age of patients at time of presentation is 31-40 years (4/121 [3%]). The most common time of cyst presentation was within the first 10 years after surgery (15/121 [12%]). Most common presentation of cyst was a visible mass (18/121 [15%]).

Discussion: Orbital cysts most often present as a visible mass, diplopia, or can be asymptomatic and detected as an incidental finding. Only 21 cases of orbital inclusion cysts after strabismus surgery have been previously published and little is known about this surgical complication. We aim to detect specific risk factors for developing orbital cysts after strabismus surgery and report the different strategies for managing this complication.

Conclusion: Our data which encompasses greater than 4x the total previous cases reported in the literature suggests that strabismus surgeons might encounter one case of orbital cyst approximately every 10 years. There are multitude of surgical approaches with excision being the most common.

Post-Operative Infection Following Strabismus Surgery: Case Series and Increased Incidence in a Single Large Referral Center

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Introduction: Infection following strabismus surgery is uncommon, with orbital infection reported in approximately 1/1100[1] and 1/1900 cases[2] and possible infection occurring in 2.9% (46/1603).[3] Our purpose was to identify patients with probable post-operative infection following strabismus surgery, and to report incidence, risk factors and outcomes.

Methods: We searched our database to identify strabismus procedures from 7/1996-10/2017 at one large referral center, defining clinical infection based on change in clinical management including systemic antibiotic use, hospitalization, and/or surgical intervention.

Results: Thirteen of ~9200 strabismus surgeries(0.0014%), met criteria for probable infection, all occurring since 10/2012 [0/6674 vs. 13/2558 before/after 10/2012, p<0.0001]. Mean age was 11.4 years, with 11/13(85%) under 18. One case had bilateral infection, and 6/7(86%) having bilateral surgery developed the infection in their second operated eye. Clinical infection developed at mean 8.3 days (range 1-20) post-strabismus surgery, with 5/13(38%) demonstrating systemic signs e.g., fatigue, anorexia, fever, irritability. Associated previous diagnoses included: developmental delay (5/13,38%) and skin or ear infections (4/13,31%). Treatment included hospitalization (7/13,54%), with surgical incision/drainage in 4/13(31%). Surgical site cultures revealed MRSA (4/13,31%), MSSA (3/13,23%), and Group A Streptococcus (2/13,15%). Infection remained extraocular in all cases, but one eye lost vision (NLP) from optic atrophy. No common OR/surgeon/procedure/preparation-related risks were identified.

Discussion: Post-strabismus-surgery infections have recently become more common at Duke Eye Center, without obvious unifying cause, mostly in children, and were often associated with developmental delay, preceding non-ocular infection, and MRSA/MSSA.

Conclusion: Post-strabismus-surgery infection is vision-threatening, and our recent increased incidence despite meticulous pre-/intra-operative technique requires further investigation.

Introduction: Studying the early effect of strabismus muscle surgeries on corneal biomechanics

Methods: This is a comparative study, that 42 candidates for elective strabismus surgeries at Cairo university hospitals, aged 14 - 37 years, were recruited. All participants had measuring of the visual acuity, refraction(spherical equivalent(SE),assessment of the EOM motility and muscle balance , sensory evaluation, fundus examination, and assessing the ocular biomechanics using the Ocular response analyzer (ORA, Reichert, INC., Depew, NY) noting the Corneal hysteresis(CH)&Corneal resistance factor (CRF) pre-operatively. Same patients were reassessed using ORA 4 weeks postoperatively following different standard EOM surgery (Recti weakening/strengthening & Inferior oblique weakening either (graded recession ) according to the surgical indication, and ^CH & ^CRF were calculated, each is the preoperative - the postoperative value.

Results: ^CH & ^CRF =-0.78±1.56 & -0.72±2.15 respectively, and a highly significant difference was found between each of the pre and postoperative CH & CRF ( p< 0.001). 18 eyes had single EOM surgery, while 24 had multiple (2 or 3) EOM surgery, ^CH in single group = -1.28±1.5, ^CH in multiple group = 0.4±1.49 (p=0.07). 23 eyes had EOM weakening surgery, while 18 had combined weakening & strengthening EOM surgery, ^CH in weakening group = -1.24±1.77, ^CH in combined group = -0.26±1.07 (p=0.04). A non significant difference was found for ^CRF (p=0.53).

Discussion: The release of anterior traction forces on the sclera is the suggested explanation of postoperative increase of CH

Conclusion: Strabismus surgery has an early tendency for increase of the postoperative CH specially for muscle weakening procedures

Effects of Strabismus Surgery on Fixational Eye Movements

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Introduction: Microsaccades are miniature eye movements that constantly change the gaze during attempted visual fixation. Saccades and microsaccades represent an oculomotor continuum and are produced by common neural sensory and motor machinery. Strabismic patients have impaired binocular horizontal saccades and fixational eye movements. We examined the fixational eye movements in strabismic patients with and without latent nystagmus (LN) before and after surgery.

Methods: Eye movements were recorded with infrared video-oculography in 13 strabismic patients (stereopsis present=3; stereopsis absent=10) with LN (n=8) and without LN (n=5) and 13 controls while they performed a visual fixation task before and after strabismus surgery.

Results: Strabismic patients with and without LN had greater fixation scatter in both the viewing and non-viewing eyes. (Bivariate contour ellipse area (BCEA) viewing eye: controls=-0.49, without LN = -0.28, with LN=0.06, p<0.05 one way ANOVA; non-viewing eye: controls = -0.48, without LN = -0.04, with LN = 0.55, p<0.05 one way ANOVA). The fixational saccades in strabismic patients without LN were disconjugate. The disconjugacy of fixational saccade decreased after strabismus repair (preop =0.19 ± 0.33; postop =0.14 ± 0.23, p=0.01 unpaired t-test). A similar decrease in the disconjugacy of amplitude of quick phases of LN was noted after surgery (preop =0.43 ± 0.70; postop =0.26 ± 0.58; p<0.001 unpaired t-test).

Discussion: Fixational saccades and quick phases of LN are disconjugate in strabismic patients.

Conclusion: This exceed the capabilities of the sensory system to achieve fusion. Strabismus repair reduces the disconjugacy thereby facilitating fusion in strabismus patients.

2) Ghasia FF, Otero-Millan Jorge, Shaikh AG. Abnormal fixational eye movements in strabismus. BJO 2017
A Quantitative Inferior Oblique Traction Test: Clinical Applications

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Introduction: We describe an inferior oblique (IO) traction test (IOTT) to gauge IO stiffness before and after IO myectomy (IOMy). We determined if IOTT correlated with pre-operative IO overaction (IOOA), and whether eyes with IOOA have stiffer muscles than control eyes.

Methods: We performed a 10-year retrospective chart review for IOMy and intra-operative IOTT by a single surgeon. Under anaesthetic, we determined the number of ‘clock hours’ of ‘intorsion freedom’ (nearest 0.5 hr.) We compared the clock hr. of freedom before and after 10 mm. IOMy. We correlated IOTT at start of surgery with pre-operative IOOA (scale 0 to +4) in 56 myectomies (43 patients) and compared it to control group of 23 eyes (15 patients) with minimal/no IOOA.

Results: Mean intorsion freedom in the operated eyes was less than in control eyes (1.63 vs 1.89 clock hr.; p<0.005). There was an inverse relationship between IOOA and IOTT (Pearson rank coefficient, r = -0.45; p<0.001). IOMy produced mean 1.32 clock hr. increase in freedom (range 1.0-2.5 hr.). All 5 double-bellied IO muscles also showed minimum 1 clock hr. change (range 1.0 to 1.5 hr.) after myectomy of the anterior belly.

Discussion: IOTT confirmed that overacting IO muscles have significantly greater stiffness than control eyes. IOOA grade predicted the degree of IO stiffness at surgery. Finally, although IOMy creates at least 1 hr. of increased intorsion freedom, IOTT cannot rule out presence of second belly.

Conclusion: IOTT after IOMy does not substitute for careful inspection to ensure no IO fibers remain.

The Effect of Horizontal Rectus Muscle Surgery on Distance-Near Incomitance

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Introduction: To determine the effect of horizontal rectus muscle surgery on distance-near incomitance.

Methods: Prospective evaluation of patients > 7 years old who had medial rectus or lateral rectus muscle surgery between 12/09 and 7/12. PACT testing was performed at distance (6 meters) and near (0.3 meters) after > 1 hour of monocular occlusion at the pre-operative and post-operative examinations. The change in distance-near incomitance was calculated. Post-operative examinations within 1 week and closest to 1 year after surgery were analyzed. Patients with muscle fibrosis or paralysis were excluded.

Results: Forty-five patients met inclusion criteria. Twenty-three patients had esotropia treated with medial rectus muscle resections (21 patients) or lateral rectus muscle resections (2 patients). Twenty-two patients had exotropia treated with lateral rectus muscle resections (18 patients) or medial rectus muscle resections (4 patients). Post-operative examinations within one week after surgery were obtained in 44 patients. The change in distance-near incomitance was ≤ 5 prism diopters (pd) in 37 patients; ≤ 10 prism diopters in 42 patients. Follow-up examinations 6 - 24 months after surgery were obtained in 28 patients. The change in distance-near incomitance was ≤ 5 pd in 20 patients; ≤ 10 pd in all 28 patients. Change in distance-near incomitance did not correlate with the specific surgical procedure (TOST p-value < 0.05 for 90% CI +/- 2 pd).

Discussion: Horizontal rectus muscle surgery does not have a clinically significant effect on distance-near incomitance.

Conclusion: It is not necessary to consider distance-near incomitance when choosing between medial rectus and lateral rectus muscle surgery.

Botulinum Toxin-Augmentation of Strabismus Surgery in Large-Angle, Infantile Esotropia

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Introduction: The purpose of this study was to determine whether botulinum toxin augments the effect of strabismus surgery in pediatric patients with large-angle, infantile esotropia.

Methods: This was a retrospective, non-randomized, comparative cohort study at a tertiary-care pediatric hospital. Patients who underwent treatment with botulinum toxin-augmented bilateral medial rectus recessions (‘augmented-surgery group’) were compared to patients who underwent traditional bilateral medial rectus recessions (‘surgery-only group’). The main outcome measure was the effect of surgery on ocular alignment, measured in prism diopters of change per mm of surgery (PD/mm).

Results: There were 14 patients in the augmented-surgery group and 16 patients in the surgery-only group. The mean effect on alignment was significantly greater in the augmented-surgery group compared to the surgery-only group at 4 months (5.7 vs 4.0 PD/mm, p = 0.002) and at 1 year (5.4 vs 3.7 PD/mm, p = 0.002). There was a partial loss of treatment effect between 4 months and 1 year in both groups, which was similar in magnitude (p = 0.57). On linear regression, there was a trend toward a positive correlation between botulinum toxin dose and treatment effect, but this was not statistically significant (p = 0.09).

Discussion: Botulinum toxin augments the effect of bilateral medial rectus recessions by approximately 40% in large-angle, infantile esotropia. The augmentation effect is maintained for at least a year after surgery. A surgical dosing table is proposed for this technique.

Conclusion: Botulinum toxin-augmented surgery may be an alternative to traditional options for large-angle, infantile esotropia.

Botulinum Toxin in High AC/A Ratio Accommodative Esotropia

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Introduction: Children with high AC/A ratio accommodative esotropia may have deviation at distance and near. We study the results of botulinum toxin (BTX) (group 1) compared to bimedial recession and posterior fixation (group 2) in treating this condition.

Methods: We retrospectively reviewed the charts of children treated for high AC/A ratio accommodative esotropia and deviation of at least 10 PD at distance (2010-2016). Visual acuity, APCT, stereoacuity, biomicroscopy, and cycloplegic retinoscopy were carried out at initial visit, 6 months and 1 year after BTX injection or surgery. We used multiple regression analysis to control for potential confounding variables.

Results: We identified 48 eligible children in group 1 and 36 in group 2 (after 11 and 7 patients were excluded, respectively). Motor and sensory outcomes were similar in the two groups at 6 months, but significantly better in the BTX group at 1 year (4 PD, 95% CI 0 to 8 PD vs 10 PD, 6 to 16 PD p 0.03; 60 arc sec, 40 to 200 arc sec vs 200 arc sec, 100 to 400 arc sec, p 0.02).

Discussion: Motor and sensory results of BTX injection were better than those of bimedial recession and posterior fixation. Due to retrospective design (risk of bias), results should be interpreted with caution.

Conclusion: BTX is better at middle term than bimedial recession and posterior fixation in high AC/A ratio accommodative esotropia with deviation at distance and near, from a motor and sensory point of view.

Long-Term Effect of Botulinum Toxin A in Early and Late Onset Esotropia

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Introduction: The purposes are: To compare the motor and sensorial results of botulinum toxin A (BTA) treatment in children with infantile esotropia (IET) and acquired nonaccommodative esotropia (ANAET) during the first two years. To evaluate the rate of amblyopia treatment through this period.

Methods: Retrospective study that included 23 children with IET and 25 with ANAET. At 6 months, 1 and 2 years after treatment, the deviation and stereopsis were evaluated. At 2 years, the rate of occlusion or penalization therapy with atropine was determined.

Results: At six months and 1 year after treatment, there were no differences on the rate of orthotropia and stereopsis between the 2 groups. Two years after treatment, orthotropia was achieved by 4 children (21.1%) on IET group and by 15 children (60.0%) on ANAET group, with statistical significance (p=0.007). Four children (21.1%) with IET developed stereopsis and 18 (72.0%) on ANAET group (p=0.004). After two years, amblyopia treatment was used in 7 patients (36.8%) on IET and in 12 patients (48.0 %) with ANAET.

Discussion: We have demonstrated that the results of BTA treatment are different in different types of esotropia and can change over time. It is a safe procedure and most children don't need amblyopia treatment after BTA injection.

Conclusion: We recommend BTA as a definite treatment for ANAET but not for IET. The motor and sensorial effects of BTA wear-off after 1 year of treatment for IET. However, most of the patients (IET or ANAET) don't require amblyopia treatment after BTA.

References:
• Rowe FJ, Noonan CP. Botulinum toxin for the treatment of strabismus Cochrane Database syst rev Published Online: 2 MAR 2017
The Use of Botulinum Toxin to Treat Infantile Esotropia: A Systematic Review with Meta-Analysis

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Introduction: The purpose of this review was to examine the efficacy of botulinum toxin in the treatment of infantile esotropia and to evaluate the average response of BT and its complication rates.

Methods: A research was performed in the Latin American and Caribbean Literature on Health Sciences (LILACS), MEDLINE and Cochrane Central Register of Controlled Trial (CENTRAL). The database was searched between 28 December 2016 and 30 January 2017. The selection was restricted to articles published in English, Spanish or Portuguese. There were no date restrictions in the search.

Results: Nine studies were eligible for inclusion. The grouped success rate of BT treatment in infantile esotropia was 76% (95% CI = [61% - 89%]). For the success rate, I2 of 94.25% was observed, indicating a high heterogeneity (p <0.001). The complication rates were also analyzed. The grouped consecutive exotropia (XT) rate was 1% (95% CI = [0% - 2%]). The grouped ptosis rate was 27% (95% CI = [21% - 33%]). The grouped vertical deviation rate was 12% (95% CI = [4% - 22%]). The mean change of the deviation after BT injection was -30.7 (95% CI = -37.7, -23.8), demonstrating a significant improvement in alignment.

Discussion: The average change of the deviation after BT injection was -30.7, revealing a significant improvement in alignment after the intervention, although the mean deviation change in the studies was heterogeneous. This supports the indication of BT injection as a good alternative to treat moderate esotropia (until 30-35PD of deviation).

Conclusion: Botulinum toxin injection into medial recti muscles reveals to be a safe procedure and a valuable alternative to strabismus surgery in congenital esotropia, especially in moderate deviations.

Role of Botulinum Toxin A in Cyclic Esotropia – A Long Term Follow up

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Introduction: Cyclic strabismus is a rare entity with unknown etiology. The few case reports with the use of Botulinum toxin A (BTXA) did not include the long term outcome. We herein report two cases of childhood cyclic esotropia who underwent BTXA treatment with a follow up at least 8 years in an attempt to demonstrate the long term outcome of BTXA treatment.

Methods: Two cases who presented with sudden onset cyclic esotropia at 2 and 4 years of age were included. BTXA injection was performed into appropriate muscles. Follow up was 8 and 9 years.

Results: Case 1 was a 2 year old boy with left dominant alternating esotropia on a cyclic basis. The squint ranged between 25-45 prism diopters (PD) at near and distance. He underwent BTXA injection into the left medial rectus muscle. He became orthotropic at near and distance with 60 sec arc stereopsis. During the 9 years follow up, he remained stable. Case 2 was a 4 year old girl with the complaint of double vision and squint. Her deviation was 40 PD at near and 35 PD at distance on a cyclic pattern. She underwent bimedial BTXA injection and became orthotropic with glasses. During the 8 years follow up she remained stable with 120 sec arc stereoaucuity.

Discussion: Considering the consecutive and recurrent deviations with surgical treatment in previous reports, BTXA seems to be a more appropriate first line option for treatment of cyclic deviations despite the limitations of a non-comparative assumption.

Conclusion: Our results suggest that BTXA is effective to break the cycle permanently in cyclic esotropia.

References:
Characteristics and Surgical Outcomes of Acquired Nonaccommodative Comitant Esotropia with Diplopia in Children and Young Adults with Different Functional Prognoses

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Introduction: Acquired nonaccommodative comitant esotropia (ANAET) with diplopia can be a diagnostic challenge because of its association with neurological abnormalities and difficulty in estimating the accurate time of onset and functional prognosis. We aimed to describe the clinical characteristics and surgical outcomes of ANAET with diplopia in children and young adults and to classify them into esotropia types based on postoperative binocularity.

Methods: Twenty patients with ANAET with diplopia who had undergone strabismus surgery were retrospectively investigated.

Results: The mean (SD) age at awareness of diplopia was 14.0 (6.7) years, and the duration from onset to presentation ranged from 1 day to 12 years. Neurological evaluations were normal in all patients except 2, who refused the examination. Of the 20 patients, 18 were aligned within 8 prism diopters (PD) esotropia or 20 PD esophoria postoperatively. Six (30%) were diagnosed as type 3 (Bielshowsky) acute acquired concomitant esotropia (AACE) with good postoperative stereopsis (Titmus test ≥50 arcsec), and 6 (30%) were type 2 (Franceschetti) AACE with good-to-moderate stereopsis (40–400 arcsec). The remaining 8 (40%) patients were diagnosed with decompensated esodeviation or monofixation syndrome with some level of stereopsis (40–3000 arcsec); 6 of them exhibited unstable normal or abnormal retinal correspondence on the Bagolini striated glass test at the prism-adapted angle and underwent additional sensory testing (Worth 4-dot and/or synoptophore) preoperatively.

Discussion: Of the patients with ANAET with diplopia, only about half could obtain good central foveal stereopsis postoperatively.

Conclusion: Careful preoperative assessment of the sensory status might allow for predicting postoperative binocularity.

The Value of Fusional Convergence Amplitudes in Esodeviation Surgery without Adjustable Sutures

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Introduction: Ongoing debate exists in the literature over whether adjustable suture utilization achieves binocular single vision (BSV) more consistently than non-adjustable surgery. We explored whether for certain esodeviation sub-groups, using the magnitude of individual fusional amplitudes when choosing a surgical target angle (TA) would prove efficacious without utilizing adjustable sutures.

Methods: Thirty-one consecutive cases of presumed acquired non-accommodative, deteriorated intermittent esotropia managed surgically between 2005-2016 were reviewed retrospectively. For each individual, TA was selected pre-operatively after analysis of fusional convergence amplitudes. Outcomes in patients selected for overcorrection at 6 meters, (TA > angle in primary position at 6 meters (PPA)), were compared to those who had planned surgery based on a TA that did not exceed their measured angle (TA<= PPA) at 6 meters.

Results: All 31 patients achieved BSV in primary position both at near and at 6 meters without prisms, orthoptic therapy or additional surgery at 4-6 months post-operatively. There was a trend towards a greater correction in the TA>PPA group compared to TA<=PPA group, but this difference was not statistically significant (p=0.57).

Discussion: Amongst this diagnostically specific cohort of intermittent esotropes with symptomatic diplopia and measurable BSV preoperatively, targeted surgery based on analysis of pre-existing fusional convergence amplitudes had an outcome that compared favorably to that of documented adjustable suture strabismus surgery.

Conclusion: While we recognize the benefits of adjustable sutures in complex cases with less robust BSV potential, categorizing esodeviations by their aetiology and BSV potential allows suitable cases to be planned for non-adjustable suture surgery, achieving successful outcomes by economical and subjectively less stressful means.

References: NA
Introduction: To compare the effectiveness of bimedial rectus recession surgery on the patients with Down Syndrome and normal neurological developmental patients.

Methods: We evaluate retrospectively our patients with Down Syndrome (age range 2-17 years), who underwent bimedial rectus recession surgery for esotropia. Control group was selected from the age-matched patients with normal neurological development. We compared case and control groups in terms of preoperative and postoperative esodeviation angle at 1 year follow-up, the amount of recession and surgical success.

Results: A total of 21 patients with Down syndrome and 42 control subjects were included. The groups did not differ in either preoperative (Down syndrome 39.73±8.47 PD, control 37.91±7.65 PD) and postoperative near deviation angle (Down Syndrome group 5.45±11.45 PD, control group 2.36±7.13 PD) or amount of surgery (Down syndrome group 4.68±0.40 mm, control group 4.78±0.38 mm). Surgical success was achieved in 15 patients with Down syndrome (80.90%), and in 35 of control patients (83.33%) at 1 year follow-up.

Discussion: The presence of ET in Down's syndrome cases with strabismus is between 18%-70%. Only studies in patients with Down syndrome demonstrated a high success rate with standard bimedial rectus surgery. In our study, it was determined that in Down syndrome cases with ET, bimedial rectus recession surgery in accordance with the standard table was successful.

Conclusion: Surgical success between esotropia patients who underwent bimedial rectus recession surgery with or without Down syndrome was similar.

Bilateral Medial Rectus Recession for Möbius Sequence Esotropia

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Introduction: Möbius Sequence (MS) is a rare congenital anomaly of the brainstem. The minimum clinical diagnostic criteria is congenital, uni or bilateral, non-progressive facial paralysis and horizontal gaze palsy. Approximately 50% of the affected patients presents esotropia and strabismus correction is indicated in most of these cases.

Methods: Seventeen patients with MS who underwent strabismus surgery for esotropia were retrospectively reviewed. Patients presenting other strabismus patterns and with previous surgeries were excluded. Patients ages ranged from 1 to 18 yo (3.5 years average).

Results: The mean preoperative esotropia was 65 PD (range 35 to 100PD), medial rectus recess ranged from 5,5 to 11mm (8,5 mm average). The final horizontal alignment was orthotropia in 12 patients, 4 patients had residual esotropia of 10PD, 15PD, 20PD and 35PD; 1 had XT 8PD. Three patients required a second surgery to treat residual strabismus. The mean follow-up time was 50 months.

Discussion: Few studies discuss the surgical results of strabismus in MS. Previous authors have suggested lateral rectus resection and transposition of the superior rectus to treat large-angle esotropia in MS. In our study, patients were submitted to greater recessions than those previously described with good postoperative alignment of the eyes.

Conclusion: Large medial rectus recession alone is effective in treating MS esotropia.

References: 1. de Souza-Dias CR, Goldchmit M. Further considerations about the ophthalmic features of the Möbius sequence, with data of 28 cases. Arq Bras Oftalmol 2007;70:451–7
A New Approach to Treat Esotropia in Patients with Large V-Pattern

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Introduction: To find alternative surgical approach for correction of esotropia in primary position.

Methods: Six patients aged from eight months to five years. Their orthoptic evaluation revealed esotropia in primary position varied from 12 to 25 prism diopter (PD), large V-pattern with bilateral hypertropia for both eyes. All of them had not less than esotropia 30 PD on down gaze. The V-pattern was as large as 25 PD or more. There were bilateral inferior oblique overaction from +3 to +4. We did, for all patients, asymmetric bilateral inferior oblique recession in addition to equal bilateral inferior rectus recession.

Results: Reduction of amount of esotropia in primary position by mean of 13.6 PD (±5.55), and in down gaze by mean of 28.8 PD (±7.66). V-pattern collapsed by mean of 28.8 PD (±8.4). Bilateral large inferior oblique overaction disappeared completely.

Discussion: By using the new approach, significant reduction of esotropia in primary position (P<0.05). Bilateral inferior rectus recession decreases esotropia in down gaze.

Conclusion: Not only recession of medial rectus will treat esotropia in primary position. But, correction of esotropia can be achieved also by bilateral recession of inferior rectus and inferior oblique.

Audit of Inferior Oblique Weakening Surgery to Determine Impact on Horizontal Alignment

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Introduction: It has been reported that surgery for inferior oblique weakening surgery (IOOA-) can cause a modest eso-shift but does not significantly impact horizontal alignment in primary position1,2. An audit was undertaken to determine our clinical data on the impact of IOOA- on horizontal alignment.

Methods: A retrospective casenotes review of patients who underwent IOOA- between March 2014 and March 2016 in our department was conducted. There were 106 patients (57 male, 49 female), of which 43 were under 16 years. Collected data included patient characteristics, surgery technique, pre and post-surgery vertical and horizontal deviations as well as extent of inferior oblique overaction(IOOA).

Results: Average patient age was 28 years (range 2 to 75 years); 76 procedures were unilateral, 30 were bilateral. There were 43 disinsertions; 24 myectomies; 28 recessions; 11 anterior transpositions. Mean change in horizontal alignment (both near and distance) for each subcategory was within 8 prism diopters (PD), although this masked a wide range (up to 55PD eso-shift and up to 20PD exo-shift). Overall 16% of patients had a change of 10PD or more in horizontal alignment following IOOA-.

Discussion: Our audit demonstrated a wide range of changes to the horizontal alignment affecting a small proportion of patients, particularly those with moderate pre-existing horizontal deviations.

Conclusion: Given the potential unpredictability, this would support the clinical practice for considering two stage surgeries (IOOA-, followed by horizontal surgery) for patients with IOOA in the presence of moderate horizontal deviations.

Introduction: Inferior oblique overaction (IOOA) is a common condition seen by pediatric ophthalmologists, either primary or with other forms of strabismus. Surgery is the primary intervention. The purpose of this study is to compare surgical outcomes of myotomy, anteriorization, myectomy and recession.

Methods: A retrospective chart review of all patients undergoing IOOA correction from July 2010 to March 2017 at the Children's Hospital of Colorado was performed. Preoperative grading of IOOA (+0.5 to +4.0) was compared to postoperative IOOA (0 to +4.0). Decrease in IOOA was considered a success with resolution (grade 0) of IOOA. Average follow-up was over 9 months for all surgical groups.

Results: There were a total of 296 patients with 408 eyes. Gender and age were similar across surgery types. 95.1% of patients had a decrease in IOOA with recession of the inferior oblique (n=183), while 86.3% decreased to no IOOA. Anteriorization of the inferior oblique (n=127) decreased overactivity in 97.6% of patients with 83.5% improving to zero degree of IOOA. Myotomy of the inferior rectus (n=91) was found to decrease overaction in 98.9% of patients and reduce IOOA to zero in 89.0%. Myectomy (n=7) patients had zero post-operative IOOA in all seven eyes. There was no significant difference between type of surgery and outcome.

Discussion: All four surgical interventions were found to be equally successful in reducing the amount of IOOA.

Conclusion: There is no superior surgical intervention when choosing an approach to IOOA. Myotomy is technically faster and safer as it does not require suturing to the globe.

Evaluation of Augmented Temporal Superior Rectus Transposition Combined with Adjustable Medial Rectus Recession in Sixth Nerve Palsy and Esotropic Duane Syndrome Type 1

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Introduction: Treatment of 6th nerve palsy (CN6p) and Duane syndrome (DUANE) by a combined augmented Superior Rectus transposition (aSRt) and Medial Rectus recession (MRc) was introduced by Mehendale et al. in 2012 (1). We wanted to evaluate the efficacy of this procedure in our patients.

Methods: In a retrospective case-review of 27 patients (30 eyes) who underwent combined aSRt and MRc for CN6p or DUANE, we studied the change in abnormal head posture (AHP), Abduction-Restriction (AR) graded from -5 to 0, the angle of esotropia in Primary Position (PP), and the change in stereopsis. We used short-tag-noose adjustable suture on the medial rectus in 19 patients; six required reoperations, four underwent adjustments; follow-up mean was 5.8 months.

Results: Preoperative AHP was found in 24/27 patients. AHP was corrected in 10, reduced in 11, and not quantified in five patients. Preoperative AR was reduced from a mean of -4.3 to -2.7 at follow-up with a mean change of -1.57 (CI95%: [-1.98; -1.15], P<0.0001). Ocular deviation in PP at near was reduced from a mean of 33.3PD to 3.9PD at follow-up with a mean change of 29.4PD (CI95%: [22.4PD; 36.5PD], P<0.0001). Ocular deviation in PP at distance was reduced from a mean of 38.7PD to 5.0PD at follow-up with a mean change of 33.7PD (CI95%: [26.9PD; 40.4PD], P<0.0001). Eight patients had gained stereopsis, four remained non-stereoptic, and 13 were not quantified. The induced vertical deviation in PP was observed in 10 patients.

Discussion: Mehendale et al. (1) found improved AHP from 28 degrees to 4 degrees, mean AR from -4.3 to -2.7 and deviation in PP from 44PD to 10.1PD. Furthermore, stereopsis was recovered in 8/17 patients, and the induced vertical deviation was observed in 2/17 patients. In our study, we found similar effects on these outcomes.

Conclusion: aSRt combined with MRc is effective in reducing AHP, AR, and ocular misalignment in CN6p and DUANE. The effects of this procedure are persistent and may reduce these patients’ needs for further surgery in the future.

Lateral Rectus Resection in Type 1 Duane Retraction Syndrome (DRS)

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Introduction: Normally lateral rectus muscle resection is not recommended in Duane Retraction Syndrome (DRS). We aimed to assess the effect of lateral rectus muscle resection on abduction in DRS.

Methods: Nine patients whom lateral rectus resection for DRS performed were included. Ocular ductions, abnormal head position (AHP) and globe retraction existence were recorded. Globe retraction more than grade 1 was an exclusion criteria.

Results: Five patients were female and 4 patients were male. Mean age was 12.67±14.67 (2-50) years. Mean follow up time was 22.88±10.61 (9-46) months. While preoperative deviation was mean 19.66±19.64(0-45) prism diopters (pd) at near, it was mean 20.11±19.97(0-45) pd at distance. Limitation of abduction was noted as -4 in 3 patients, -3 in 3 patients, -2 in 2 patients and -1 in 1 patient. Five patients had AHP, one patient had mild globe retraction. Mean lateral rectus resection was 4.05±1.42 (2.5-6.0) mm, 6 mm was performed in only 2 patients. Postoperatively at six month, when mean near deviation was 2.66±4.12 (0-10) pd, mean distance deviation was 2.00±4.00 (0-10) pd. While limitation in abduction was improved in five patients, it remained unchanged in 4 patients. Abnormal head position resolved in all patients.

Discussion: Limiting resection of lateral rectus muscle to no more than 3.5 mm in selected patients with medial rectus muscle recession performed less than 4.0 mm is recommended.

Conclusion: Lateral rectus resection improves abduction in patients with Duane syndrome showing mild globe retraction.

Withdrawn
Comparison of Supramaximal Recession and Disinsertion/Extirpation of the Lateral Rectus Muscle for Treatment of Large Angle or Recurrent Exotropia

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Introduction: To compare surgical results of supramaximal lateral rectus recessions (SMRc) and LR disinsertion and extirpation (D&E) for the treatment of large-angle or recurrent exotropia.

Methods: Retrospective review of 12 patients treated with either lateral rectus SMRc (6 patients) or D&E (6 patients). One patient underwent bilateral SMRc and 3 patients underwent bilateral D&E.

Results: The average SMRc was 12 mm from the original insertion. Mean preoperative exotropia was 36 PD (range 18-50 PD) in the SMRc patients and 48 PD (range 10-80 PD) in the D&E patients. Mean postoperative deviation was 22 PD (range 0-50 PD) in the SMRc patients and 28 PD (range 14-60 PD) in the D&E patients. One patient in each group developed consecutive esotropia. The average change in abduction was -0.57 after SMRc and -0.75 after D&E. Postoperative follow-up averaged 2.6 years (range 2 mos-13 years).

Discussion: Supramaximal LR recessions and complete disinsertion and extirpation of the muscle had surprisingly modest effects on postoperative abduction and the risk of consecutive esotropia was small.

Conclusion: The study provides support for the use of SMRc and D&E of the lateral rectus muscle for treatment of large angle and recurrent exotropia. We found similar outcomes for these procedures.

Binocularity After Strabismus Surgery in Adult Patients

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Introduction: In this study, we present the demographic features and results of strabismus surgery in adult patients with various etiologies.

Methods: The records of patients that are older than 18 years and underwent strabismus surgery from January 2012 to June 2017 were evaluated. Demographic features of the patients, main complaints, diagnosis and surgical procedures as well as preoperative and postoperative ophthalmological findings including; visual acuity, distance and near deviation, sensory and motor fusion were recorded.

Results: There were 119 patients with a median follow up of 50 (3-144) months. Mean age at the time of admission was 32 (18-71) years. Ninety-five (79, 8%) patients had strabismus diagnosis from childhood. Seventy (58.8%) patients had diagnosis of exotropia, 26 (21.8%) esotropia, 20 (16.9%) cranial nerve palsies. When stereopsis was evaluated, 33 patients (27.8%) had improved stereopsis after surgery and 26 patients (21.8%) had no change. Stereopsis couldn't be measured in 60 patients (50.4%) because of low vision and lack of cooperation. Preoperatively diplopia was the main complaint in 9 patients and this was corrected in 88.9% of them (8 patients) however diplopia developed postoperatively in 1 patient.

Discussion: Strabismus surgery can be performed for providing binocularity and improving cosmesis in childhood and adulthood. Strabismus surgery in adults can increase the quality of life by correcting diplopia and regaining stereopsis. Our study showed that stereopsis can be achieved in adulthood.

Conclusion: Binocularity can be improved by strabismus surgery in adult patients.

**The Importance of the Orthoptist in the Treatment of Neurological Acquired Binocular Diplopia**

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**Introduction:** This paper stresses the importance that Orthoptists should carry out Orthoptic treatment in the presence of acquired neurological diplopia. It is based on over 40 years of practical clinical experience, both in National Health and Private practice.

**Methods:** Referrals from Ophthalmologists, Neurologists and Neurosurgeons, Endocrinologists etc. of cases with acquired neurological binocular diplopia, were examined and treated by the Author. Orthoptic treatment was the principle method of therapy.

**Results:** Examples will be documented, showing good responses to Orthoptic Treatment. Primarily all cases were given Orthoptic treatment in the clinic, combined with Orthoptic homework treatment. Complementary treatment may be given such as prisms, botox, surgery.

**Discussion:** The philosophy is based on restoring preexisting binocular single vision, having Orthoptic treatment playing a major part, so the patient can either fully recover or partially recover.

**Conclusion:** Further research, in parallel to the Orthoptic treatment, would be to record any changes which occur within the brain using functional MRI. On the internet non Orthoptists offer a variety of treatments for diplopia, they do not have the professional training of Orthoptists, therefore the professional body should promote our expertise in cases of diplopia.

**References:** S. Polychroniadis-Scouros Orthoptic Treatment as Part of the Management of Ocular Motility Impairment on Acquired Neuro-Ophthalmological Cases with Diplopia. XIIIth International Orthoptic Congress IOA 2016 June 27-30 Amsterdam poster 31
Longitudinal Study of the Ocular Phenotype in Mucopolysaccharidosis

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Introduction: The mucopolysaccharidoses (MPSs) are a heterogeneous group of lysosomal storage disorders. Ocular features include corneal clouding, retinopathy, glaucoma and optic atrophy. Treatments have greatly improved systemic outcomes, yet there is limited understanding of their effect on the eye. We aim to longitudinally study the ocular phenotype in MPS, using objective and clinical measures of eye disease.

Methods: Prospective observational cohort study, recruiting from Paediatric Ophthalmology clinics at a single tertiary referral centre. Participants underwent ocular examination including visual acuity, assessment of corneal clouding (Iris Camera Corneal Opacification Measure (COM) score, Pentacam densitometry), and retinal and optic nerve imaging (optical coherence tomography and wide-field fundus imaging). Data on delivered therapies was also collected. Patients were followed up at 4-12 month intervals.

Results: Follow up data within 13 months of the initial review was collected for 20 patients (12 MPSI, 4 MPSIV and 4 MPSVI). 12 patients were on Enzyme Replacement Therapy, 7 were post Haematopoietic Stem Cell Transplantation and 1 had no treatment. During this period, median visual acuity was found to decrease for MPSI and MPSVI groups, but improved in MPSIV. No significant change in IOP was seen. Median COM scores were found increase in all groups. Optos (n=2) and OCT (n=2) findings were stable over the follow-up period.

Discussion: The severity of corneal clouding increased over time in all subtypes of MPS and this was not influenced by systemic treatment.

Conclusion: Objective measurements of ocular phenotype in MPS over time will increase our understanding of the effect of systemic treatments on the eye.
Prevalence of Cerebrotendinous Xanthomatosis Among Patients Diagnosed With Acquired Juvenile-Onset Idiopathic Bilateral Cataracts

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Introduction: Cerebrotendinous xanthomatosis (CTX) is a rare autosomal recessive bile acid synthesis disorder caused by mutations in CYP27A1, the gene encoding sterol 27-hydroxylase, which leads to elevated plasma cholestanol and urinary bile alcohols. Symptoms may include early-onset chronic diarrhea, juvenile-onset cataracts, cholestatic jaundice, tendon xanthomas, and progressive neurological deterioration. Diagnosis often occurs after onset of permanent damage. Strategies for early diagnosis are needed.

Methods: Observational, multicenter study to evaluate the prevalence of CTX among patients with idiopathic bilateral cataracts diagnosed between ages 2-21 years. Plasma cholestanol levels >/=0.4 mg/dL or positive urine bile alcohols measured by GC/MS prompted CYP27A1 genetic testing.

Results: Of 170 tested patients, 3 (1.8%) had biochemical (elevated plasma cholestanol: (>1.6mg/dL, 3.17mg/dL, >3.2mg/dL), and positive urine bile alcohols) and as well as genetic confirmation of newly-diagnosed CTX. Mean age at cataract surgery was 12.7 years (range 8-18). Reported symptoms included abnormal gait/balance (n=3), learning disability/developmental delay (n=2), seizures (n=2), frequent fractures (n=2), and chronic diarrhea (n=1).

Discussion: To date, 1.8% of patients in this study had CTX, which is 500-1000 times the currently estimated prevalence. A fourth patient was screened and tested positive prior to the initiation of the site. These data suggest that juvenile-onset idiopathic bilateral cataracts may be a marker for CTX that can facilitate early identification of CTX, possibly allowing prevention of permanent neurological damage.

Conclusion: Ophthalmologists can play an important role in helping to diagnose CTX earlier, possibly preventing irreversible neurological decline and other serious complications.

Factors Associated with Improved BCVA in OCA1A

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Introduction: OCA1A, with lifelong absent melanin in skin, hair, and eyes, is the most severe type of albinism with greatest ametropic refraction and poorest visual outcomes.1,2 Our study evaluates the relationship between refraction and age when spectacles were begun on BCVA in OCA1A.

Methods: After IRB approval, retrospective chart review of 70 consecutive patients with OCA1A identified 21 fitting inclusion criteria of BCVA recorded at age 12. Excluded were those with other vision-threatening diagnoses. We also recorded age at beginning glasses, refraction, most recent BCVA, and gender.

Results: Regression analysis showed monocular astigmatism was significantly associated with logMAR BCVA at age 12 (p=0.029); gender, spherical equivalent, and age when glasses were started were not. There was a positive relationship between most recent logMAR BCVA and age at glasses initiation (p=0.061). Best BCVA (20/50) occurred in a patient beginning glasses at age 3 months. Poorest BCVA (20/250) was in a patient beginning glasses at age 4 years. When glasses were begun by age 12 months (n=9), mean BCVA was 20/85; when begun later (n=12), mean BCVA was 20/106 (p=0.287). All in the first group and only half in the second group had improved visual acuity from age 12 to last follow up.

Discussion: BCVA in OCA1A is occasionally reported to be about 20/50-60.1,3 Earlier glasses wear may be related to the severity of refractive error, yielding better BCVA. Overall, BCVA was better when glasses were initiated by age 1 in this small cohort.

Conclusion: Several factors influence visual outcome in albinism. BCVA may be better than expected in OCA1A when refractive error is great and glasses wear begins by age 1.

Multimodal Imaging Including Optical Coherence Tomography in Pediatric RP2 Patients

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Introduction: The RP2 gene is thought to be the underlying cause of disease in 10-20% of patients with X-linked retinitis pigmentosa. Jayasundera et al. (1) reported the most recent cohort study with clinical phenotype description in 2010. To date, an RP2 cohort study employing Optical Coherence Tomography (OCT) and multimodal imaging has not been performed.

Methods: Five pediatric patients with childhood retinal degeneration enrolled in a National Eye Institute (NEI) protocol to characterize and understand genes involved in eye disease (06-EI-0236). They were confirmed to have mutations of the RP2 gene as the underlying disease cause. Demographic information, visual function (including acuity, fields, and color vision), and multimodal imaging including OCT are summarized here.

Results: The five RP2 patients (age range 5-15, mean 11.0, SD 3.8 yrs) had a mean visual acuity was 0.18 OD and 0.25 OS (SD 0.09 OD and 0.11 OS). Mean central macular thickness on spectral-domain OCT was 156.5um OD and 148.3um OS (SD 28.1um OD and 18.5um OS). Fundus autofluorescence images are presented.

Discussion: Early macular involvement and high myopia, as noted in the literature, are confirmed in our cohort. Significant macular thinning noted by OCT might present a challenge for therapies necessitating subretinal injection.

Conclusion: Studies characterizing the natural history of RP2 disease in pediatric patients are required for potential therapeutic clinical trials involving gene replacement therapy.

OCT and ERG Initial Findings in Leber Congenital Amaurosis and Genetic Analysis

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**Introduction:** This study aims to investigate the initial status of retinal features in Leber congenital amaurosis (LCA) and perform genetic analysis.

**Methods:** Twenty-nine patients with LCA (ages 4-83 months; mean, 39 months) were examined under general anesthesia. The fundus photography including fluorescein angiography (FA), optical coherence tomography (OCT), full-field and focal macular electroretinography (ERG), and visual acuity (VA) were evaluated. To identify causative mutations, 74 genes that cause LCA or retinitis pigmentosa were examined by targeted-next generation sequencing.

**Results:** Ophthalmoscopy and FA showed minimal to significant retinal degeneration. Macular degeneration was found in 18 patients (62%). Scotopic and photopic ERG responses were extinguished in 16 patients (55%), in which the entire retina was attenuated and coarsely laminated in 10 patients; only the ellipsoid zone (EZ) was absent in 6 patients. However, reduced ERG responses were recorded in 13 patients (45%) including minimal focal macular response (n=4), in which the entire retina was attenuated (n=1), and the EZ was absent (n=6), but the foveal EZ was maintained in some (n=6). The VA, available for 21 patients, was light perception (n=8), 0.01~0.1 (n=6), 0.1~0.3 (n=4), and =0.4 (n=3), which agreed with the initial ERG and OCT findings. To now, genetic examinations have confirmed causative mutations in 8 patients.

**Discussion:** ERG and OCT identified various retinal features in the initial LCA stage, which may be consistent with the VAs.

**Conclusion:** These findings might facilitate evaluation of genotype-phenotype associations and estimation of progression of retinal degeneration.

Leber Congenital Amaurosis in Chuuk, Federated States of Micronesia

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Introduction: Leber Congenital Amaurosis (LCA) is an early severe form of retinal dystrophy. Mutations in at least 18 genes cause LCA, including crumbs homolog 1 (CRB1), which may account for 10% of LCA [1].

Methods: Our team visited Chuuk, Micronesia to investigate ocular genetic disease in this geographically confined population. We tested genes associated with LCA for causative mutations by PCR target enrichment and Next Generation Sequencing. Novel pathogenic variants were confirmed by Sanger sequencing and restriction analysis.

Results: Five children from three consanguineous kindreds on Tonoas Island were diagnosed as having LCA based on clinical history and ophthalmological exams. All were born with poor vision. They had hand-motion or light perception vision, nystagmus and a fundus appearance of diffuse gray gliosis, marked midperipheral pigment clumping for 360° and retinal vascular attenuation. All affected children were homozygous for a novel c.3134delT frameshift mutation in CRB1 exon 10, and their parents were heterozygous. CRB1 genotypes of 47 other DNA samples, representing 7 islands in Chuuk state, were wild-type.

Discussion: Pathogenic loss-of-function mutations in CRB1 (LCA8, OMIM #613835) are known to cause severe retinal dystrophy, with autosomal recessive inheritance. Previously reported mutations include a downstream frameshift allele, c.3345delT in exon 12, and support the pathogenicity of the novel change in our patients [2].

Conclusion: Homozygosity in this small island community reflects a history of population bottlenecks, with identity by descent, and suggest a new founder mutation for LCA disease in Chuuk, Micronesia.

Impact of Age on the Ocular Surface Microbiome

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Introduction: 16S sequencing is a technique that uses ribosomal DNA with primers and amplification to identify bacteria. This technology enables analysis of bacterial numbers and proportions, even in paucibacterial environments such as the ocular surface. We sought to characterize the ocular surface microbiome (OSM) via 16S sequencing in children and compare with an adult population.

Methods: Prospective, cross-sectional study using 16S sequencing to evaluate the OSM. Comparisons were made in bacterial yield and composition by (1) age and (2) sampling location (periocular skin, eyelid margin, or conjunctiva). 16S sequencing was performed using Illumina MiSeq 250 and analyzed using Qiime. Statistical analysis was performed using a two-sided student's t-test and Monte Carlo permutations.

Results: 30 patients (15 children [mean 3.7 years], 15 adults [mean 60.4 years]) were sampled. Bacteria were 1.87-fold more abundant in children. Both principal coordinate analysis and unifrac distance analysis showed significant differences in the OSM composition between children and adults (both p=0.001). The periocular skin and eyelid margin OSM were similar to the conjunctiva in children, but all were distinct in adults (p=0.028).

Discussion: The adult OSM is paucibacterial compared to children, and showed distinct compositional differences between the periocular skin, eyelid margin and conjunctiva. This implies that there is mutual tutoring of the host immune system and the microbial ecosystem with aging.

Conclusion: Age and anatomic location are important distinguishing factors in the composition of the OSM. Future studies can examine the underlying mechanisms for these differences and their impact on ocular surface immunity and metabolism.

References: Not applicable
A Phase 2, Randomized, Controlled Trial of Povidone-Iodine/Dexamethasone Ophthalmic Suspension for the Treatment of Adenoviral Conjunctivitis

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Introduction: Conjunctivitis due to adenovirus or bacterial infection affects both adults and children. Studies demonstrate the potential of an ophthalmic combination of povidone-iodine (PVP-I) and dexamethasone to treat either condition [1,2,3], and provide preclinical evidence of rapid antibacterial efficacy against various gram-positive and gram-negative bacterial isolates. We evaluated efficacy/safety of PVP-I/dexamethasone ophthalmic suspension for acute adenoviral conjunctivitis in adults.

Methods: A multicenter, randomized, double-masked phase 2 study was conducted in adults with a positive Rapid Pathogen Screening Adeno Detector Plus(TM) test. Patients were randomized 1:1:1 to one drop of 0.6% PVP-I/0.1% dexamethasone suspension, 0.6% PVP-I or vehicle bilaterally 4x daily on days 1-5 and evaluated on days 3, 6, and 12 (+1-day window allowed). Main efficacy measures included adenoviral eradication and clinical resolution.

Results: Overall, 144 were included in the primary analysis (n=48 PVP-I/dexamethasone, 50 PVP-I, 46 vehicle). The proportion of patients with adenoviral eradication (primary study eye with last observation carried forward [LOCF]), PVP-I/dexamethasone versus vehicle: day-3 visit, 35.4% versus 8.7% (p<0.01); day-6 visit, 79.2% versus 56.5% (p<0.05); and versus PVP-I: day-3 visit, 32.0% (p=nonsignificant [NS]); day-6 visit, 62.0% (p=NS). Clinical resolution (primary study eye with LOCF): day-6 visit, PVP-I/dexamethasone versus vehicle: 31.3% versus 10.9% (p<0.05). Treatment emergent adverse events (AEs) occurred in 69.0% (vehicle), 62.7% (PVP-I), and 53.4% (PVP-I/dexamethasone) of patients. Discontinuation due to AEs occurred in 37 patients (n=16 vehicle, 12 PVP-I, 9 PVP-I/dexamethasone).

Discussion: PVP-I/dexamethasone ophthalmic suspension was efficacious and safe for adenoviral conjunctivitis in adults.

Conclusion: Ongoing phase 3 studies will evaluate efficacy/safety in children.

Pediatric Corneal Structural Development Characterized by Ultrasound Biomicroscopy

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Introduction: Cornea pathology in the early years of life can have a profound impact on visual development. Our understanding of normal cornea development is relatively limited. Ultrasound biomicroscopy (UBM) has a key advantage in studying the anterior structures of the eye in its unique ability to image eyes with corneal opacity. This study aims to evaluate healthy corneas as they mature from infancy to adulthood using UBM.

Methods: UBM images obtained from 21 healthy eyes of 21 patients, age 30 weeks gestational age to 26 years. ImageJ software was used to measure 21 corneal parameters from 7 images for each eye. Parameters were fit with logistic growth curves and evaluated for significant differences.

Results: Selected average values as follows: Corneal thickness: 556um centrally, 590um paracentral, 810um peripherally, anterior curvature: 43 diopters, posterior curvature: 50.5 diopters, cross-sectional width: 11.0mm, endothelium cross-section 12.6mm. The youngest patient group (age under 6 months) had markedly lower angle-to-angle length, lower endothelial cross-sectional length, and lower corneal radii of curvatures.

Discussion: Based on our findings, most of the structural changes and growth in the cornea occurs in the first months of life.

Conclusion: UBM is an effective and accurate method for describing corneal growth and structural characteristics in the pediatric population. Further study will focus on comparing this control data to data from eyes with corneal pathology. Greater understanding of pediatric corneal development may facilitate improvement in managing pediatric ocular disease involving the cornea.

Ronneburger A, Basarab J, Howland H. Growth of the cornea from infancy to adolescence. Ophthalmic and Physiological Optics. 2006; 26: 80-87
**Use of Integrated Intraoperative Optical Coherence Tomography in Pediatric Cornea Surgery**

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**Introduction:** We describe our experience with the use of a microscope integrated intraoperative optical coherence tomography (i2OCT) for pediatric cornea surgery, and its effect on achieving intended surgical procedures.

**Methods:** Retrospective case note and video review of all children undergoing corneal transplant surgery in whom i2OCT was used at CHP.

**Results:** Penetrating Keratoplasty (PK, n = 3), Descemet's Stripping Automated Endothelial Keratoplasty (DSAEK, n = 6), and Deep Anterior Lamellar Keratoplasty (DALK, n = 3) surgeries were performed with the use of i2OCT. Indications were mucopolysaccharidoses (DALK), peter's anomaly (PK), haab's striae, endothelial dystrophy or corneal decompensation following pediatric cataract or glaucoma surgeries (DSAEK). All cases of DSAEK and DALK were successfully completed as intended. i2OCT allowed a better evaluation of graft-host junction for proper apposition in cases of PKP, improved visualization of the endothelial graft in opaque corneas for DSAEK and allowed delineation of the posterior stroma Descemet membrane separation for cases of DALK.

**Discussion:** i2OCT offers a reliable method of real time imaging during pediatric cornea surgeries, and enables view of structures that could not be seen with a surgical microscope.

**Conclusion:** i2OCT is a useful tool in pediatric cornea surgeries, especially as these are often more difficult surgeries due to unpredictable and distorted anatomy. It increases the likelihood of completing the intended procedure as planned, as well as flattens the learning curve for surgeons dealing with children's corneal diseases.
Outcomes Following Crosslinking for Keratoconus in Pediatric Population

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Introduction: The aim of this study was to assess corneal changes in keratometry (K) and best corrected visual acuity (BCVA) following crosslinking in pediatric patients with keratoconus.

Methods: A retrospective chart review was performed on patients ≤20 years of age who underwent corneal crosslinking in the last 5 years. Delta BCVA (logmar) was defined as the difference between postoperative and preoperative BCVA. Delta Kmax was defined as the difference between postoperative and preoperative steepest K (diopters). If delta BCVA divided by time since surgery (years) was +/-0.1 logmar/year, the vision was defined as stable.

Results: Sixteen patients met inclusion criteria for the chart review. Fifteen patients (18 eyes) had complete preoperative and postoperative data that could be analyzed for at least one eye. Range of follow up after surgery was 1 month to 3 years (median of 1 year). Of the 15 patients, 12 were males and 3 females. Age at first intervention ranged from 9 to 20 years (median of 17 years). Preoperative BCVA ranged from 20/20-1 to CF at 4 feet (median of 20/50-3). Postoperative BCVA ranged from 20/20+2 to 20/200 (median of 20/32-3). The difference between the post- and preoperative K's (post-op K-preop K= ΔK) ranged from -2.5 to 0.9 diopters (median -0.45). Six patients had stabilized vision, 10 improved vision, and 2 had worsened vision.

Discussion: The results of this study indicate that crosslinking in the pediatric population stabilizes and in some cases even improves corneal keratometry and vision.

Conclusion: Crosslinking should be strongly considered in managing pediatric patients with keratoconus.

Visualization of Schlemm’s Canal from 3D Reconstruction of UMB Images

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Introduction: Ultrasound biomicroscopy (UBM) is widely used by ophthalmologists for visualizing anterior segment structures. Compared with other ophthalmic imaging modalities, UBM excels in its ability to penetrate opaque tissue and visualize structures such as Schlemm’s canal which cannot be seen through the lens.

Methods: We use a Quantel 50 MHz UBM probe attached to the surgical microscope with a precision translation stage. Approximately 1000 slices are captured and reconstructed to create a 3D volume of the anterior chamber extending peripherally beyond Schlemm’s canal. Those images are registered and filtered to highlight the canal and create a fully manipulable model.

Results: We have used this system to visualize anterior chamber structures, including Schlemm’s canal, in cadaver eyes, animals, and anesthetized patients. Image acquisition is completed in a few minutes and, depending on the level of image processing required, results are available to the surgeon in real time.

Discussion: Visualization of Schlemm’s canal is difficult because of its small size compared with the resolution of the UBM. However, under certain circumstances, our large datasets and extensive image processing are able to reveal the canal along with other, less elusive, anterior segment structures.

Conclusion: We have used ultrasound biomicroscopy to visualize Schlemm’s canal and other anterior segment structures in the laboratory and clinical settings. The ability to characterize these important structures promises to contribute significantly to research, diagnosis, and treatment planning.

Evaluation of the Digital Slit Lamp for Pediatric Anterior Segment Telemedicine Consultations

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Introduction: To evaluate the validity of using videos obtained with the digital slit lamp for assessing anterior segment findings during live-streamed telemedicine consultations.

Methods: Thirty-two children (5-17 years old) with known anterior segment pathology were recruited for this prospective study. A pediatric cornea specialist simultaneously performed and recorded anterior segment examinations using the Topcon Digital-Ready Slit Lamp. Components of the examination included eyelids, eyelashes, conjunctiva, sclera, cornea, iris and lens. Masked to clinical findings, a pediatric ophthalmologist reviewed and graded live video feed transmitted at 4096 kbps. Reliability between remote and gold standard in-person findings was determined by sensitivity, specificity, and kappa statistics.

Results: During examination of 63 eyes (one excluded due to exam intolerance), agreement for conjunctiva/sclera, iris, anterior chamber, and lens findings was almost perfect (sensitivity 89-95%, specificity 95-97%, kappa 0.89-0.95). Substantial agreement was found for cornea pathology (sensitivity 84%, specificity 78%, kappa 0.62). Subtle findings such as mild scars, corneal neovascularization and posterior subcapsular cataracts had higher rates of disagreement.

Discussion: Videos obtained from the Topcon slit lamp have similar sensitivities and specificities as slit lamp photographs obtained with other digital slit lamp devices. Future analyses include re-evaluation of stored video clips by both graders 3 months after conclusion of enrollment to assess intra- and inter-physician reliability.

Conclusion: The digital slit lamp can capture videos of anterior segment examinations with a good level of reliability for use during real-time telemedicine consultations.

Efficacy of Infliximab Treatment and Effect of Treatment Adherence on Disease Control in Children with Severe, Refractory Uveitis

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Introduction: To report the effect of infliximab (IFX) on uveitis disease control and the effect of adherence on treatment efficacy

Methods: Retrospective study of 27 children treated for uveitis between 12/30/2002 and 4/30/2016. Disease activity (active visits/year) 2 years prior to or from the onset of uveitis to IFX initiation until most recent visit on IFX was analyzed by a repeated measures logistic regression analysis. Control of ocular and/or joint disease and pre-/post-treatment topical corticosteroid and glaucoma medications were analyzed. Non-adherence was defined as deviance in corticosteroid use and prescribed infusion and follow-up frequency.

Results: Patients were treated with IFX for an average of 41.6 +/-31.2 months. 63% had JIA, (77% anterior, 18.5% intermediate, 4% pan-uveitis). Prior to IFX, 14 patients failed adalimumab+/-MTX and 9 failed MTX monotherapy. IFX led to uveitis control in 88.9% and arthritis control in 75% (13/17). The odds ratio of having inactive disease after IFX was 4.1 (2.6, 6.4) compared to pre-treatment visits. Topical corticosteroids and glaucoma medications were statistically decreased (p=0.007 OD, p=0.003 OS and p=0.001 OD, p=0.028 OS respectively). Non-adherent patients had a 10.3 times greater odds of having disease activity than adherent patients (7.1, 15.0).

Discussion: IFX treatment led to improved uveitis and JIA control and reduced topical corticosteroid and glaucoma medication use. Non-adherence remains highly associated with the likelihood of persistent disease activity.

Conclusion: This study supports the use of IFX as primary and/or secondary TNF-alpha treatment. Interventions to improve patient adherence represent an integral step to achieving uveitis control and require further study.

**Precision Pulse Capsulotomy (PPC) in Pediatric Cataract Surgery - Initial Results**

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**Introduction:** To evaluate the safety and efficacy of new precision pulse capsulotomy (PPC) in pediatric cataract surgery

**Methods:** It is a retrospective study of all children (age<12years) undergoing cataract surgery using the PPC technique for anterior capsulotomy. Best corrected visual acuity (BCVA) and intra ocular pressure (IOP) were measured pre-operatively; centration and size of the capsulotomy, pupillary dilatation, surgical time and time required for PPC were measured intra-operatively; post operatively BCVA, IOP, centration and size of capsulotomy were noted. Any complications intra or post operatively were noted

**Results:** 11 eyes of 7 patients (mean age= 6years, range 11months to 9years, 5 boys and 2 girls) were included. Mean PPC time was 91 (±28)seconds (n=8) and mean surgical time was 31.2 (±5.6)minutes. Intra-operatively, all patients had good pupillary dilatation, well-centered, circular and complete capsulotomy of appropriate size, successful intra-ocular lens (IOL) implantation with capsular edge covering the IOL. 2 eyes had inferiorly de-centered capsulotomy which was clinically insignificant. 2 eyes had increased post-operative IOP, which was controlled with anti-glaucoma medications. At an average 1month follow-up, no other intraoperative or postoperative complications were noted.

**Discussion:** Precision pulse capsulototmy has shown circular, centered, strong and consistent outcomes in cadaver, animal and adult human studies (1-3). We found PPC to be effective in pediatric eyes.

**Conclusion:** PPC is safe, precise and effective in pediatric cataract surgery with a short learning curve. No major complications or change in surgical time was noted.

**References:**
Clinical Outcomes of Pars Plana Posterior Capsulectomy and Anterior Vitrectomy in Pediatric Cataract Surgery

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Introduction: When performing a primary posterior capsulotomy at the time of pediatric cataract and IOL surgery, an anterior or posterior approach can be utilized, with or without a planned anterior vitrectomy. To date, there have been reports of outcomes of the pars plana approach, but additional data is necessary to further elucidate clinical outcomes seen in patients undergoing this surgery. 1

Methods: After IRB exemption, a retrospective analysis was conducted for patients, under 21 years of age, undergoing planned pars plana capsulectomy and anterior vitrectomy at the time of cataract removal with IOL implantation by a pediatric anterior segment surgeon. No cataract etiologies were excluded. The results of clinical characteristics, complications, and outcomes were compiled and statistical parameters calculated.

Results: A total of five hundred-fifty one (551) eyes were included, with a median age at surgery of 3.25 years (range: 11 days-19 years). Fifty-seven were of traumatic etiology (10.3%). Three eyes (0.54%) were diagnosed with retinal detachments during follow-up, none in the perioperative period or the first 18 months after surgery. Visual axis opacification requiring subsequent operative intervention occurred in approximately 10 percent of eyes (58/551). There were no cases of intraoperative hemorrhage or IOL displacement during the procedure and no postoperative endophthalmitis.

Discussion: These data demonstrate the effectiveness and low expected rate of complication using the pars plana approach.

Conclusion: The pars plana approach to posterior capsulectomy and anterior vitrectomy is a clinically safe and effective procedure.

Comparison of Transscleral Sutureless Intraocular Lens and Retropupillary Iris-Claw Lens Fixation for Aphakia without Capsular Support in Children

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Introduction: Intraocular lens (IOL) implantation in aphakic eyes without capsular support poses a challenge in children.

Methods: Fifteen eyes underwent sutureless transscleral IOL fixation (Group 1) and 15 eyes iris-claw lens fixation (Group 2) with 6 months follow-up. The primary outcome measured was best-corrected visual acuity (BCVA). Secondary outcomes included operative time, postoperative astigmatism, central corneal thickness (CCT), endothelial cell count, IOL decentration and tilt, central foveal thickness (CFT) and intraoperative and postoperative complications.

Results: The mean postoperative BCVA in Group 1 was 0.41±0.28 and in Group 2 was 0.42±0.21 (p=0.21). The iris-claw lens group had significantly shorter operative time (47.86± 4.2 min) than scleral fixation group (61.74±9.13 min) (p=0.0014). The mean decrease in endothelial cell count in Group 1 was 370.14 ± 472.08 cell/mm2 and in Group 2 was 468.43 ± 491.09 cell/mm2 (p=0.48). There was no statistical difference in astigmatism, CCT, IOL tilt and decentration or CFT (p=0.62, p=0.054, p=0.1, p=0.078 and p=0.32, respectively). Postoperative complications in the Group 1 included IOL haptic slippage and IOL capture whereas ovalization of the pupil, IOL disenclavation and retinal detachment occurred in Group 2. Glaucoma and hypotony occurred in both groups.

Discussion: Primary and secondary outcomes show no statistically significant difference in the 2 groups, except for significantly longer operative time in the transscleral sutureless IOL fixation, which is more technically demanding than iris-claw lens implantation.

Conclusion: Retropupillary iris-claw lens fixation procedure is shorter and technically easier. It is the only option in severe iris damage. Modifications in IOL design could facilitate transscleral IOL fixation.

Introduction: Persistent fetal vasculature (PFV) can be anterior, posterior or combined. We report the visual and anatomic outcomes in patients who underwent surgery for PFV.

Methods: We retrospectively reviewed medical records of patients over a 20-year period who had undergone surgery for PFV without IOL implantation, prior to 7 months of age. Patients without other ocular comorbidities and whom had follow-up of more than 12 months were included.

Results: Seventy eyes of 67 patients were included. Sixty-one eyes (87.1%) had anterior PFV, 1 (1.4%) had posterior PFV and 8 (11.4%) had combined PFV. Twenty-seven eyes were microphthalmic, 4 (5.7%) had a retinal fold and 6 (8.6%) had retinal detachment at the time of surgery. The mean age at surgery was 2.0 months (range 0.2-6.3 months) and the mean follow-up was 88.9 months. At final follow-up, 24 eyes (34.3%) had visual acuity better than 1.0 LogMAR, 22 of which had anterior PFV (P=0.15), and 12 eyes (17.1%) had acuity better than 0.7 LogMAR, all of which had anterior PFV (P=0.34). Thirty-nine eyes (55.7%) had an adverse event; glaucoma in 22 (31.4%), retinal detachment in 10 (14.2%) and phthisis in 9 (12.9%). Of these 39 eyes, 35 had anterior PFV (P=0.5) and 14 had pars plicata incisions (P=0.97).

Discussion: Despite broader inclusion criteria, the rate of adverse events in our study matches that of PFV eyes in the contact lens group of the Infant Aphakia Treatment Study.¹

Conclusion: Despite the high rate of adverse events, many eyes with PFV achieve functional vision.

Rate and Success of Secondary Procedures in Children after Primary Intraocular Lens Implantation

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Introduction: Young children have a high rate of visual axis opacification (VAO) after IOL implantation. Primary posterior capsulorhexis (PCCC) and anterior vitrectomy (AV) is recommended in children <= 6 years. Our objective was to determine the rate and success of secondary procedures in children with primary IOL implantation.

Methods: Database review of patients <18 years of age operated for cataract between 1998-2015 to evaluate timing and success rates of secondary procedures. Included patients with single piece Acrysof in the bag and minimum 1 year follow-up.

Results: 192 eyes of 130 patients were included. The mean age at primary surgery was 6.3 years (Range: 8 months-18 years). 122 eyes (63.5%) had primary PCCC+AV and 70 eyes (36.5%) had intact posterior capsule (PC). At the last visit, with mean follow-up of 2.2 years, 50 eyes (26%) had required a secondary procedure: 10/122 eyes with primary PCCC+AV and 40/70 eyes with intact PC. 34 eyes had YAG capsulotomy, which was successful in 76%. Surgical AV +/- capsulectomy was performed in 16 eyes with 94% success rate. Failure of YAG was noted in younger children who had dense fibrous proliferation. No significant complications were noted from either procedure type.

Discussion: VAO occurs in 57% eyes with intact PC by 2 years; YAG capsulotomy can be a successful procedure for older children. Surgical AV has a higher success rate and is often needed in younger children.

Conclusion: Patient age and type of VAO should be considered when planning for secondary procedures.

Cataract Surgery in the Second Decade of Life: Outcomes and Cataract Characteristics

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Introduction: Few studies have investigated the characteristics and management of cataracts of older children. This study explores the features of cataract and outcomes of surgery in patients from the ages of 10-20.

Methods: Retrospective study investigating the characteristics of cataract and surgical outcomes of consecutive patients from age 10-20 operated on by a single surgeon.

Results: A total of 148 eyes of 101 patients were included. Median age at time of surgery was 13.7 years, and at time of last follow-up, 17.3 years. Fifty-three percent were female, and 61% of the study cohort was of Caucasian descent. Sixty-four percent of eyes were left with an intact posterior capsule, 6% PCCC without vitrectomy and 30% with posterior capsulectomy and vitrectomy. Ninety-eight percent of eyes had a primary intraocular lens placed, and 97% were placed within the capsular bag. A fourth of eyes left with an intact posterior capsule developed posterior capsular opacification (PCO), which was, on average, removed 3 years after surgery. Median visual acuity of unilateral cataract was 20/60 and bilateral was 20/25. Postoperatively, one eye had retinal detachment, and three eyes developed ocular hypertension. No patient developed glaucoma.

Discussion: Better visual acuity outcomes occur with bilateral cataract. There is a low complication rate in cataracts operated on from the ages of 10-20.

Conclusion: Visual acuity outcomes were excellent in bilateral cataracts operated in the second decade. Visually significant PCO occurred in a fourth of the eyes with an intact posterior capsule. These data have important implications for cataract surgery in this pediatric population.

References:
Introduction: The management of ectopia lentis is complex. We report herein the outcomes of a consecutive case series of children after lensectomy for ectopia lentis.

Methods: Retrospective study of patients who underwent lensectomy for ectopia lentis between January 1, 1996 to July 31, 2017 at one institution. Patient characteristics, refractive outcomes, and surgical details were collected. Endpoints included postoperative complications and associated eye conditions that developed during the follow up period.

Results: 124 eyes of 64 patients (21 female, 43 male) were included. 60 patients were operated bilaterally and 4 had unilateral surgery. 69 eyes belonged to patients with a diagnosis of Marfan syndrome, 6 eyes from children with other systemic diagnoses, and 49 eyes from children with an unknown diagnosis. The mean age at surgery was 6.88 years. After lensectomy, 69.4% were aphakic (27.4% received secondary IOL) while 30.6% underwent primary IOL implantation. The mean follow up was 5.16 years. The median visual acuity was 20/30. Complications included visual axis opacification requiring surgery in 6 eyes, glaucoma in 15 eyes, and retinal detachment in 4 eyes. In 6 eyes, an angle-supported ACIOL rotated after years of stability and was exchanged for an iris-claw IOL. Two of these eyes, from 1 patient, developed cystoid macular edema that resolved after IOL exchange.

Discussion: Visual axis opacification, glaucoma, retinal detachment, and IOL rotation were the most common postoperative complications.

Conclusion: This study adds to the current understanding of long-term visual outcomes and complications of children with lensectomy for ectopia lentis.

A Comparison of Lens Fixation Techniques Versus Aphakia in the Treatment of Pediatric Ectopia Lentis

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Introduction: No standard approach exists for treatment of pediatric ectopia lentis. Individual studies evaluating iris-sutured intraocular lenses (IOL), scleral fixated IOLs, scleral fixated capsular tension segments (CTS)/capsular tension rings (CTR) with IOL, and aphakia exist, but none directly compare these approaches.

Methods: Retrospective study of pediatric ectopia lentis comparing lensectomy and aphakia, iris-sutured IOL, trans-scleral fixation of CTR/CTS with placement of IOL in-the-bag, and scleral-sutured IOL.

Results: 71 eyes were included (43 CTR/CTS, 12 iris-sutured, 11 aphakic, and 5 scleral-sutured). Average follow was 2.0 years for CTR/CTS, 4.4 years for aphakic, 5.4 years for scleral-sutured, and 7.0 years for iris-sutured. Vision improved significantly in all but the iris-sutured group. IOL repositioning was required due to IOL dislocation in 6/12 (50%) iris-sutured, 1/5 (20%) scleral-sutured, and 2/43 (9.3%) CTR/CTS eyes. 24/43 (55.8%) CTR/CTS and 1/5 (20%) scleral-sutured eyes developed visual axis opacification (VAO). Other complications included wound leak in 3/43 (7%) CTR/CTS and 1/5 (20%) scleral-sutured eyes, retinal detachment (RD) in 2/12 (16.7%) iris-sutured eyes, iris capture in 2/5 (40%) scleral-sutured and 1/43 (2.3%) CTR/CTS eyes, corectopia in 3/5 (60%) scleral-sutured and 2/43 (4.6%) CTR/CTS eyes, and vitreous wick in 1/43 (2.3%) CTR/CTS eyes.

Discussion: Clinically, visual outcome was poorest for the iris-sutured eyes since 2 eyes developed RD after IOL dislocation. The CTR/CTS group had the highest rate of VAO.

Conclusion: VAO is the most common complication after CTR/CTS in pediatric ectopia lentis; iris-sutured IOLs are associated with a higher rate of dislocation and RD. Longer follow up is required to assess long-term outcomes of all techniques.

Strabismus in Infants following Congenital Cataract Surgery

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Introduction: This study aimed to determine the incidence and characteristics of strabismus following congenital cataract surgery in infants.

Methods: Patients aged<12 months who underwent surgery for congenital cataract and were followed-up for >/=1 years were included. Patients that had strabismus prior to surgery were excluded. Data regarding gender, cataract laterality, age at the time of surgery, ocular motility postsurgery, and the presence of nystagmus, best corrected visual acuity (BCVA), development amblyopia and aphakic glaucoma, posterior capsular opacification formation were retrospectively received from the patients’ records.

Results: 78 patients who had congenital cataract surgery were identified (47 male, 31 female). Unilateral surgery was performed in 25 patients, versus bilateral surgery in 53 of the patients. Strabismus did not occur post-operatively in 38 (48.5%) of the patients (group 2), whereas 40 (51.5%) (group 1) developed strabismus following surgery. The patients in group 1 were followed-up for a mean 76.58±26.72 months, versus 77.39±33 months in group 2. Mean age at the time of surgery and best corrected visual acuity were similar. Unilateral cases were more prone to develop strabismus (p<0.05). Additional ocular surgery in group 1 which was statistically significant (p<0.05). Age at the time of cataract surgery, gender, the occurrence of aphakic glaucoma, the presence of nystagmus, were not significantly associated with the development of strabismus.

Discussion: Based on the results of this study, we would recommend long-term follow-up to monitor the development of strabismus is required in all infants undergoing cataract surgery, especially unilateral cases.

Conclusion: In the present study strabismus occurred in more of the patients that underwent unilateral surgery.

Optos Ultra-Wide Field Imaging in Intubated Pediatric Patients

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Introduction: We aim to report the feasibility of Optos ultra-widefield retinal imaging in intubated patients. The technique has previously been successfully used in non-intubated infants and young children [1].

Methods: The Optos ultra-widefield scanning laser ophthalmoscope was used to obtain imaging in 5 intubated pediatric patients. Rate of successful imaging and associated adverse outcomes were reviewed.

Results: Premature intubated babies with retinopathy of prematurity (ROP) were examined on the neonatal intensive care unit. Imaging was performed in the operating room in older children in different clinical settings requiring examination under general anesthesia. Successful images were obtained in all 5 cases using a modified 'flying baby position'. We have not encountered any serious adverse outcomes such as oxygen desaturation or need for re-intubation.

Discussion: ROP and other retinal diseases in infants or children requiring examination under general anesthesia often show significant peripheral retinal pathology. Ultra-wide field imaging using Optos therefore offers an advantage over other fundus cameras by being capable of capturing images of the posterior pole and retinal periphery simultaneously.

Conclusion: Optos imaging using a modified ‘flying baby position’ can be safely used in intubated infants and young children in different clinical settings to obtain high quality fundus images.

Electroretinography Using the RetEval™ ERG System in Healthy Children

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Introduction: Recent innovation has led to the development of the hand-held RetEval™ ERG system (LKC Technologies, Gaithersburg, MD USA) which utilizes skin electrodes and can be performed without anesthesia. The purpose of this study is to determine reference range values for electroretinography (ERG) in healthy children using the RetEval™ ERG system.

Methods: The RetEval ERG system was used to record full ERGs in 20 healthy, awake subjects (age 4-17) using skin electrodes. A modified ISCEV 5 step protocol was utilized.

Results: Data was obtained from 38 eyes of 20 healthy subjects. The results of the ERG recordings, expressed as median values (range), are as follows:
- Isolated rod amplitude: 50.2μV (15.3 - 102.0)
- Mixed rod/cone b-wave amplitude: 67.1μV (43.8 - 125.0)
- Mixed rod/cone b-wave implicit time: 45.7ms (32.5 - 69.1)
- Oscillatory potential: 53.5μV (22.0 - 114.0)
- Isolated cone amplitude: 35.8μV (18.2 - 192)
- Flicker amplitude: 27.9.2μV (13.6 - 105)
- Flicker implicit time: 24.4ms (23.3 - 28.3)

Discussion: This study provides data that allows calculation of reference values for full ERG using the RetEval™ system in healthy children. The RetEval™ ERG system was well tolerated by all ages and could eliminate the need for ERG under anesthesia in children.

Conclusion: RetEval is useful for ERG in children.

Case Series of Children Presenting with Unilateral Retinitis Pigmentosa

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Introduction: Retinitis pigmentosa (RP) has only rarely been reported to be unilateral given its genetic etiology (1-2). Two potential mechanisms have been proposed: mosaicism or the presence of a somatic rather than a germline mutation (3). We present 4 cases with electroretinography (ERG) and imaging documentation.

Methods: We examined 4 children (1 male, 3 female, ages 9-15) referred for possible unilateral RP based on unilateral symptoms and fundus appearance. They underwent full-field ERG, optical coherence tomography, red-free imaging, and fundus photography and autofluorescence.

Results: Unilateral degeneration was found in 2 patients and 2 patients were diagnosed with highly asymmetric disease based on full-field ERG and longitudinal fundus exams (range 0.3-9.8 years). Full-field ERG showed severe unilateral decrease in amplitude and increased implicit time in the affected eye of all patients with unilateral disease. Autofluorescence in these eyes showed widespread lost fluorescence in the periphery and a hyperfluorescent macular ring demarcating the zone of partial foveal preservation. In the patients with asymmetric disease, the ERG revealed subtle abnormalities suggesting retinal degeneration in the fellow eye. Long term follow-up in one asymmetric patient showed patchy peripheral involvement although progression was difficult to assess; long term follow-up in one of the unilateral cases still showed no evidence of disease in the good eye.

Discussion: Functional testing and serial exams revealed subtle changes in the fellow eye of 2 of these 4 patients who all initially presented with unilateral signs and symptoms.

Conclusion: Childhood onset RP may occasionally be very asymmetric. True unilateral RP during childhood is rare.

Optical Coherence Tomography Angiography after External Beam Irradiation

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**Introduction:** It is estimated that 0.1% of individuals 20 years of age are survivors of childhood cancer and many of them have been treated with cranial or whole body radiation. Detection of subtle radiation retinopathy (RR) in the pediatric population is challenging but can have significant long term visual consequences. Optical coherence tomography angiography (OCT-A) effectively detects subtle vascular changes in the retina.

**Methods:** OCT-A images (3x3 mm foveal scans, Cirrus Angioplex) were obtained for healthy patients 18 years and under and those pediatric patients with prior cranial irradiation (CI) or total body irradiation (TBI). Foveal avascular zone (FAZ) area and circularity were obtained using Image J and parafoveal capillary density using Photoshop. High-definition OCT through the fovea was used to measure choroidal thickness.

**Results:** Nine patients, CI (n=5) and TBI (n=4), were included. Three patients had RR on clinical exam and OCT-A. Four patients had vascular abnormalities detected on OCT-A that were not present on clinical exam or other imaging. The mean FAZ area in superficial (radiation: 0.31 ± 0.13 vs normal: 0.18 ± 0.10) and deep (radiation: 0.85 ± 0.46 versus normal: 0.53 ± 0.15) capillary plexi were significantly different (p<0.05). The parafoveal capillary density was significantly less in the superficial (radiation: 40.66 ± 6.08 vs normal: 45.41 ± 5.23; p<0.05) but not the deep (radiation: 20.84 ± 5.54 vs normal: 22.67 ± 5.30; p>0.05) capillary plexi. Circularity of the foveal avascular zone was not different between conditions but choroidal thickness was significantly less in the radiation group (224.15 ± 54.36 vs 276.91 ± 38.18; p<0.05).

**Discussion:** OCT-A can detect early radiation retinopathy before clinical features appear and it would aid in close monitoring and early treatment of macular edema and preserve long term vision.

**Conclusion:** Non-invasive OCT-A may aid in the early detection of RR.

**References:** Cindy L. Schwartz. Long-Term Survivors of Childhood Cancer: The Late Effects of Therapy. The Oncologist (1999); 45-54.
Retinal Findings in Children with Increased Intracranial Pressure

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Introduction: Increased intracranial pressure (ICP) has been suggested in courtrooms as an alternative cause of retinal hemorrhages (RH) in suspected victims of abusive head trauma (AHT). We assessed the role of increased ICP in the formation of RH in children.

Methods: We conducted a prospective, multicenter study of children < 4 years old with increased ICP, as determined by direct measurement or clinical criteria. Premature infants, neonates, and AHT victims were excluded. Fundus examinations were performed; extent, number, and type of RH in each of four distinct retinal zones were recorded.

Results: 56 patients (27 males) were enrolled (mean age 14.8 months, range 1-43 months). All patients had elevated ICP which required intervention. One child had papilledema. No child (0%, 95% CI: 0-6.3%) or eye (0%, 95% CI: 0-3.32%) was found to have RH. Imaging findings revealed hydrocephalus, intraventricular hemorrhage, congenital malformations, malfunctioning shunts, and presence of a mass, lesion, or cyst.

Discussion: Many studies have sought to elucidate the role of ICP in the formation of RH in children. In our cohort, we found no cases of ICP causing RH and only one child with papilledema.

Conclusion: Our study supports the published evidence that increased ICP uncommonly results in the formation of RH in the absence of papilledema and is therefore not a satisfactory explanation of RH seen in cases of AHT.

Diabetic Retinopathy in Children: Results from a National Screening Programme

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Introduction: Children with confirmed type 1 diabetes mellitus (DM) undergo a national annual digital screening from the age of 12 years. We report the results of 10 years of this screening programme.

Methods: All children <\=18 years at the time of diagnosis of type 1 DM was identified from the Wales Diabetic Eye Screening Wales (DESW) database between 2003 and 2013. Data collected included the age, gender, duration of DM and the presence or absence of any diabetic retinopathy.

Results: There were 1770 subjects <\=18 years were identified on the database during this period. The mean age at the time of first screening was 14.1± 21.1 years. There were 827 males (46.7%) and the mean duration of DM was 5.8± 4.0 years. During this period 82.6% (1462) had no DR, 13.4% mild background DR, 3.7% (66) moderate background DR, 0.1% (1) had proliferative DR and 0.4% with maculopathy. The mean age for the presence of any DR was 14.7 ± 2.1 years compared to those with no DR was 13.9 ± 2.1 years (P= 0.001) and the mean duration of DM for any DR was 8.6 ± 4.2 years compared to 5.0 ± 3.5 years for those without DR (P=0.001). The incidence of referral was 7.4% during this study period.

Discussion: The DESW is a national programme providing screening for all children with DM over 12 years of age. DR in children increases with age and duration of diabetes.

Conclusion: Our screening programme promptly identifies and refers all children with sight threatening DR for management.


Wang SY, Andrews CA, Herman WH, Gardner TW, Stein JD. Incidence and Risk Factors for Developing Diabetic Retinopathy among Youths with Type 1 or Type 2 Diabetes throughout the United States. Ophthalmology 2017;124:424-430
Introduction: Spectral domain optical coherence tomography (SD-OCT) is useful in identifying/managing macular and optic nerve pathology; however, normative reference ranges are lacking for very young children. Purpose: to develop norms for macular layers and peri-papillary retinal nerve fiber layer (pRNFL) thicknesses in young children's healthy eyes using Spectralis (Heidelberg, Germany) SD-OCT.

Methods: Ongoing, prospective, IRB-approved study of healthy, full-term (≥37 weeks) children ages 0-5 years undergoing general anesthesia for eye examination/procedure with at least one normal eye (excluded any ocular or neurologic disease and refractive error outside -3Diopters to +8Diopters). Ocular data collected included: intraocular pressure, axial length and refraction. The optic nerve and macula in one eye/child were imaged with a portable Heidelberg Spectralis unit mounted on a Flex arm. Analyses were performed with Heidelberg SD-OCT segmentation software.

Results: Thirty-four eyes (34 children) are included to date; 19 females; mean age 2.4±1.5 years. Mean spherical equivalent was +1.5±1.3D, with mean axial length 21.05±1.12mm. Mean macular central subfield thickness was 239.3±29.5µm and mean total average macular volume was 8.52±0.40mm³. Mean pRNFL thickness was 108.6±11.2µm. Macular central subfield thickness and outer nuclear layer volume increase with greater age and axial length. No significant relationships were found between pRNFL and age or axial length.

Discussion: Normative Spectralis pRNFL measurements in children aged 0-5 are not different from those of older children (1).

Conclusion: There are physiologic variations in the macular structural anatomy in early age. Understanding these variations is important to diagnose and follow pathologic retinal and optic nerve conditions in this age group.

Optic Nerve Morphology in Normal Children: A Validation Study

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Introduction: In 2015, we used the Optovue Optical Coherence Tomograph (OCT) to demonstrate decreased cup-to-disc ratios (CDR) and increased retinal nerve fiber (RNFL) thickness in normal preschool children when compared to normal adults [1]. We undertook this validation using a similar instrument, the Heidelberg Retina Tomograph (HRT).

Methods: In a community-based, cross-sectional analysis, 77 four- to five-year-old healthy children were recruited from pediatric practices. No subject had any known ocular disorder. Their optic nerves were assessed concurrently using OCT and HRT. In addition to RNFL thickness and CDR, disc area (DA) and cup area (CA) measurements were compared.

Results: Measurements made on HRT showed an average DA of 1.96 mm², CA of 0.37 mm², CDR of 0.39, and RNFL of 184 um. On OCT, average DA was found to be 2.01 mm², CA 0.36 mm², CDR 0.38, and RNFL 104 um. A student t-test demonstrated a significant difference between the two imaging modalities only in RNFL measurements (p<0.00001).

Discussion: OCT and HRT agreed except for average RNFL thickness, previously demonstrated to be greater using HRT in adults [2].

Conclusion: Our results validate our previous conclusion that optic nerves of normal children are less cupped and their RNFL thicker than normal adults.

Optical Coherence Tomography of Retinoblastoma Shows Origin in Inner Nuclear Layer. Goldfish Tail, Shark Fin, Porpoise Nose Signs.

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Introduction: To investigate hand-held optical coherence tomography (HH-OCT) of flat (<1 mm thickness) retinoblastoma.

Methods: Retrospective case series of 20 tumors evaluated with HH-OCT using Optovue iVue.

Results: The mean patient age at examination was 4.1 months (median 4.4, range 0.5-11 months). All tumors were <1 mm thickness. The mean largest tumor basal diameter by HH-OCT was 2.2 mm (median 1.9, range 0.7-4.1 mm) and mean tumor thickness was 468 µm (median 441, range 151-998 µm). By HH-OCT, each retinoblastoma demonstrated epicenter in the inner nuclear layer (INL) in 20/20 (100%) with minute calcification noted in 14 (70%) cases. There were 3 discrete OCT findings included the 'goldfish tail sign' where the INL was slightly expanded at the tumor margins (19/20, 95%), the 'shark fin sign' where the external limiting membrane (ELM) was pushed into sharp configuration from the mass (15/20, 75%), and 'porpoise nose sign' where the tumor herniated and pushed into the outer nuclear layer (ONL) with rounded lateral margins (17/20, 85%). Tumor thickness was correlated with tumor basal dimension yielding a significant linear relationship (height = 0.21 x width, Pearson r=0.89, p<0.001). There was no correlation between tumor size, location, and patient age (all p>0.05). There was no case of subretinal or vitreous seeding.

Discussion: HH-OCT has provided information that suggests retinoblastoma might originate in the inner nuclear layer of the retina.

Conclusion: HH-OCT demonstrated that sub-millimeter retinoblastoma appears to originate from the inner nuclear layer, with typical features of 'goldfish tail', 'shark fin', and 'porpoise nose' signs.

Invisible Intraocular Tumors in Children: Detection with Multimodal Imaging

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Introduction: To review our experience with detection of childhood intraocular tumors which were not clinically visible with indirect ophthalmoscopy, but were later apparent on multimodal imaging. We called them ‘ghost tumors’.

Methods: Review of clinical and imaging features of affected patients.

Results: Approximately 1-2% of eyes with retinoblastoma, retinal hemangioblastoma, and retinal astrocytic hamartoma demonstrate subclinical tumors. In all cases, the fundus appeared normal by ophthalmoscopy and the tumor(s) were discovered on multimodal imaging. In some cases, the tumors were found in asymptomatic children. The diagnoses included invisible retinal hemangioblastoma in patients with von Hippel Lindau syndrome, only seen on fluorescein angiography (FA) or optical coherence tomography (OCT); invisible retinal astrocytic hamartoma(s) in patients with tuberous sclerosis complex found on OCT; and invisible retinoblastoma(s) in children with germline-mutation retinoblastoma found on FA and OCT.

Discussion: The imaging methods most likely to detect invisible tumor included OCT, FA, and autofluorescence.

Conclusion: Using modern multimodal imaging, earlier recognition of subclinical intraocular tumors is possible. This may allow for earlier diagnosis, prompt treatment, and ultimately improved visual outcome in children with intraocular invisible ‘ghost’ tumors.

**Preferred Retinal Locus in a Child with a Macular Retinoblastoma in the Only Eye**

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**Introduction:** Assessment of visual function of children with macular retinoblastoma has previously relied upon visual acuity. Preferred retinal loci of fixation have been identified in several retinal paediatric conditions, but not in retinoblastoma. We aim to study fixation in children with a macular tumour in their remaining eye.

**Methods:** Children with bilateral retinoblastoma -in whom one eye had been enucleated or had very poor vision- and a macular tumor in the other eye were enrolled. Patients underwent ophthalmic clinical examination and tested with MP-1 Microperimeter (NIDEK Technologies, Padova, Italy). Structural changes in neurosensory retina and choroid were assessed by swept source OCT.

**Results:** Five patients were enrolled. Only one patient successfully completed microperimetry assessment. Her vision was LogMAR 1.3 (Snellen 20/400) and was found to have a preferred retinal locus for fixation on the superior border of her macular tumour. Two patients failed to complete the examination due to high-amplitude nystagmus and other two patients did not produce reliable results.

**Discussion:** Though a macula-involving tumour is one of the most important factors in eyes with poor visual outcome in retinoblastoma, it is not always possible to predict visual behaviour. Microperimeters can be considered as an additional investigation for the functional assessment of the macula in cooperative children with low vision. This area presents with defined neurosensory retinal anatomy.

**Conclusion:** To our knowledge, this is the first time microperimetry has been used in a child with macular retinoblastoma and a preferred retinal locus identified for fixation. Applied to children with only one remaining eye, microperimetry offers clinicians a new approach in understanding the adaptive mechanisms after macular damage and may have a role in future visual rehabilitative treatments.

**References:**
Associated Features of Strabismus in the Presentation of Retinoblastoma

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Introduction: The common presenting features of intraocular retinoblastoma (RB) include Leukocoria (L), Strabismus (S) and inflammation (I). Leukocoria has been associated with poorer ocular survival (1). Exotropia has been shown to be more common than expected in infantile strabismus (2). The impact of the combination of L and S presenting together has not been assessed. The need for enucleation at presentation and the use of adjuvant chemotherapy post-enucleation are recognised indicators of advanced disease (3).

Methods: The medical notes of sporadically presenting patients referred to our unit between 2009 and 2015 were reviewed. Patients were assessed by an orthoptist on admission.

Results: 125 patients' records were reviewed. 91% of patients were assessed by an orthoptist at presentation. 60% of patients presented with leukocoria only, whilst 13% had strabismus only, and 12% presented with LS together. 10% presented with inflammatory signs. 78% of patients with strabismus as a feature of their presentation (LS or S) were enucleated, compared to 50% who presented with L only (P = 0.005). 10 out of 11 children who presented with inflammation required enucleation, and 50% underwent adjuvant chemotherapy, significantly more than if inflammation was not present (p = 0.005). 63% of the strabismic patients had exotropia, 20% had esotropia, and 17% had variable exotropia/esotropia.

Discussion: Strabismus and inflammation are prognosticators of advanced disease. Exotropia is more common than esotropia, at a much higher ratio than previously demonstrated. In patients with LS, the parents may be unaware of the strabismic component.

Conclusion: An accurate assessment of strabismus at presentation may be a prognostic indicator in patients with RB.

Training of Residents and Fellows in Retinopathy of Prematurity (ROP) Around the World: an International Web-based Survey

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Introduction: As the rate of neonatal survival continues to rise in lower and middle-income countries, the number of newborns who are susceptible to developing retinopathy of prematurity (ROP) will increase. Therefore, there will be a greater need for ophthalmologists skilled in ROP diagnosis and management. The purpose of this study is to characterize ROP training practices in international residency and fellowship programs.

Methods: The study was granted an exemption by the Institutional Review Board. A publicly available online-based platform (http://www.SurveyMonkey.com) was used to develop a 28 question, multiple-choice survey that targeted ROP screening and treatment methods. We solicited training programs in the Philippines, Thailand, Mongolia, Costa Rica, and Taiwan.

Results: A total of 101 responses collected from residents, fellows, and attending ophthalmologists from three countries were analyzed. Responses from three countries had adequate participation to be included in the analysis, and results from two countries were excluded due to either no response or incomplete responses. Descriptive analysis demonstrated that 46 of 96 participants (48%) reported 1-33% of screenings were performed under direct attending supervision, and 35 of 95 participants (37%) reported the use of formal assessments. The majority of respondents (Country A, 88%; Country B, 72%; Country C, 75%) estimated 1-33% of their practice was spent screening for ROP. Notably, 44 of 96 participants (46%) reported performing zero laser photocoagulation treatments during training (Country A, 63%; Country B, 38%, Country C, 32%).

Discussion: International ophthalmology trainees perform a limited number of ROP examinations and laser interventions. ROP examinations by trainees are often unsupervised and lead to no formal evaluation by an attending ophthalmologist. Limited ROP training among ophthalmologists may lead to misdiagnosis and ultimately mismanagement of a patient. Loss of vision and exposure to unwarranted treatments are among the implications of such errors.

Conclusion: Our findings may serve as a foundation to improve ROP curriculum and highlight the need to improve ROP training in international ophthalmology residency and fellowship programs.

References:


Survey of Current Retinopathy of Prematurity Practices in China

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Introduction: Despite being a large public health concern in China, retinopathy of prematurity (ROP) screening practices remain poorly understood. The most commonly utilized anti-vascular endothelial growth factor (VEGF) for ROP in China, Ranibizumab, has been implicated with high rates of ROP recurrence. This study aims to understand screening and treatment preferences, particularly with the use of anti-VEGF vs. laser, throughout China.

Methods: A Chinese language survey was administered anonymously using WebQ (Catalyst, Seattle, WA, USA) among Chinese ROP screeners from December 2016 to January 2017.

Results: Among 70 ophthalmologists contacted, 65 responded (78% female, mean age 40 years, 57% pediatric ophthalmologists and 25% retina specialists). Thirty percent received <3 months supervised ROP training. Most screened infants weighed 2 kg (62%) at birth and were 37 weeks (34%) gestational age. Screening was mostly performed with assistance of RetCam (Clarity, Pleasanton, CA, USA; 72%). Anti-VEGF was preferred over laser for both zone I (65% vs. 20%) and zone II ROP (49% vs. 35%). Retina specialists (p=0.004) and ophthalmologists with >3 months of training (p=0.03) were more likely to use Anti-VEGF over laser for zone I ROP.

Discussion: Chinese ROP screeners favored anti-VEGF injection and RetCam imaging for ROP management. Lack of training with laser or access to anesthesia are potential barriers to laser treatment.

Conclusion: A better understanding of ROP screening and treatment informs future research and education efforts in China.

Introduction: Published guidelines provide recommendations for retinopathy of prematurity (ROP) examination timing and completion. However, patient-level data describing ophthalmologist practice patterns for such decisions have not been reported. We sought to describe current practices of intervals between ROP examinations and timing for terminating acute phase examinations.

Methods: Secondary analysis of all ROP examination data from a multicenter retrospective cohort study of infants undergoing ROP examinations at 29 North-American hospitals during 2006-2012 (G-ROP Study). Analysis was completed by infant-examination. Distribution of inter-examination intervals, stratified by ROP diagnosis in the worse eye, was assessed. Comparison was made to American Academy of Pediatrics guidelines, as proportions completed during the recommended time interval ('agree'), 'earlier', or 'later.'

Results: 8,334 infants underwent 32,409 examinations. Overall, 23,604 (72.8%) inter-exam intervals 'agreed' with published guidelines, 4,996 (15.4%) were 'earlier', and 2,125 (6.5%) were 'later.' 'Later' follow-up was particularly high for 'immature-zone-1' (46%, with 5% >3 weeks; ); regressing-zone-2 (24%), 'stage-1-zone-3' (23%), and 'regressing-zone-3' (21%). Acute-phase ROP screening was terminated for 98.8% of 3259 ‘mature retina’ and 88.4% of 637 ‘regressed ROP’, but only 53.7% of 4066 ‘immature-zone-3 without prior ROP’. 94.4% of 763 ‘Type 1 ROP’ cases received treatment within the recommended 72 hours; 39 (5.1%) had treatment beyond 3 days.

Discussion: Practice patterns for ROP examination timing were described in a large cohort representative of infants undergoing screening in North America. Additional investigation is needed to determine why intervals are often longer than recommended for immature-zone-1; one reason might be postponement by the neonatal team.

Conclusion: Ophthalmologists performing ROP examinations choose inter-exam intervals similar to or earlier than recommended guidelines for 88% of examinations.

Identifying Premature Infants at Lowest Risk of Developing any ROP

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Introduction: According to current AAP guidelines, a subset of very premature infants unlikely to require treatment for severe ROP must undergo fundus examinations after hospital discharge/transfer. We identify characteristics that predict at-risk infants who will not develop ROP by hospital discharge/transfer.

Methods: Secondary analysis of ROP examination data from infants enrolled in the e-ROP study.(1) We characterized infants without ROP during eye examinations at a given postmenstrual age (PMA) (noROPvisit) and those without any ROP at all examinations prior to study endpoint or hospital discharge/transfer (noROPhistory).

Results: 1257 infants with BW <1251 grams underwent 4113 ROP study examinations between 31-47 weeks PMA including 1553 (38%) examinations that showed no ROPpresent. 456 (36%) of all infants demonstrated noROPhistory on examinations prior to study endpoint/discharge/transfer. Among 247 infants born at 27-33 week GA, 237 (96%) did not receive treatment for ROP and 122 (49%) had noROPhistory. No infant with noROPhistory by >37 weeks PMA underwent treatment for ROP. In multivariable analysis, larger BW (>750g) and older GA (>28 weeks) both demonstrated more than 4-fold increased odds of noROPhistory (p<0.01).

Discussion: Absence of ROP on hospital examination in older PMA infants can further identify infants at lowest risk of developing severe ROP and potentially risk adjust the need for ongoing examinations.

Conclusion: Efforts to determine which infants will not develop ROP in a larger sample could provide insight into ways to minimize low-yield eye examinations, thereby reducing the burden for infants and families after the infant is discharged, and allowing focus of scarce resources on high risk infants.

Winter Season of Conception Associated with an Increased Risk for Retinopathy of Prematurity (ROP)

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Introduction: Previous mouse studies found a melanopsin-dependent light-response pathway for retinal vascular development during early gestation (embryonic days E16-17). A single-center human study then found that lower average day-length during the first 90 days after conception was associated with increased risk of severe ROP. We sought to compare ROP risk when post-conceptual day 58 (correlates with mouse E16-17) falls near December 21 versus June 21, dates with minimum and maximum day lengths, respectively.

Methods: Secondary analysis was performed using retrospective data from the G-ROP Study, which included infants undergoing ROP screening at 29 North American hospitals in 2006-2012. Date of conception (DOC) was calculated as [(date of birth) - (estimated gestational age) + (14 days)], and 58 days were added (DOC+58). Prevalence of ROP for infants with DOC+58 within 90-day time windows centered on December 21 and June 21 were compared with multivariable logistic regression.

Results: 3740 infants had DOC+58 within the time windows studied. 885/1949 (45.4%) and 762/1791 (42.6%) of winter and summer conception infants, respectively, developed ROP (p=0.08). After adjustment for birth weight and gestational age, the odds of ROP for winter conception was 20% higher compared to summer conception (OR: 1.20; 95% CI: 1.01-1.42; p=0.03). The same association existed for 120-day time windows (OR:1.21, p=0.009).

Discussion: The increased ROP risk associated with winter conception may support a melanopsin-dependent light response for retinal vascular development.

Conclusion: If confirmed by additional studies, an interventional study of light therapy during early gestation may be considered to reduce ROP risk.

Introduction: Demand for telemedicine to detect retinopathy of prematurity (ROP) is growing due to increasing survival of preterm infants and shortage of ROP specialists. Estimates are 20,000-30,000 infants are blind/severely handicapped from ROP annually worldwide.

Methods: Cross-sectional exploratory study in the US consisted of open-ended semi-structured interviews and focus groups with key stakeholders. Purposeful sampling ensured representation of varied, salient perspectives on the integrated ROP experience among users and non-users of ROP imaging. A grounded theory approach was used to derive themes from the narrative data. Open coding was applied to transcripts to identify ROP telemedicine use-relevant concepts. Results were analyzed in NVivo11.

Results: Participants included 4 parents, 5 neonatologists, 12 nurses, 10 ophthalmologists, and 1 administrator; 59% had imaging experience. Perceived retinal imaging advantages included improved communication/integrated care team with clinicians citing consistent care across specialties/institutions, improved decision-making, communication enabling prevention of unnecessary transfers/hospitalizations. Image usefulness emerged across neonatologists, nurses and parents. Disadvantages included increased time, baby's stress and high imager/image quality dependency.

Discussion: These findings highlight both agreement and differences among clinicians, nurses, parents and hospital administrators in their perceptions of teleretinal imaging for ROP. Understanding these differences is critical to developing implementation strategies for an effective and efficient ROP telemedicine system in the US.

Conclusion: As cost of imaging declines, quality improves and standard grading protocols become available, this research may also be useful in other regions of the world where implementation of ROP programs is being established and access to care by ophthalmologists is limited.

**ROP Telemedicine M-Health Network with Smartphone Holder Helmet Device. Hands-Free Digital Indirect Ophthalmoscopy Technique**

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**NEW ROP ZONA SUR PROVINCIA DE BUENOS AIRES LA PLATA- BERAZATEGUI. PROVINCIA DE BUENOS AIRES**

**Introduction:** Interest in Smartphone funduscopy is growing unceasingly, and several strategies and accessory devices developed. However both hands are busy, limiting the possibility of simultaneously performing globe rotation or scleral depression in premature babies. Our purpose is to report the development of a helmet device, that holds smartphone, permitting performing hands free indirect funduscopy with smartphone, with advantages.

**Methods:** The prototype is constructed with adjustable headband, similar to those used in indirect binocular ophthalmoscopy, a flexible tube with a smartphone holder with magnets. This allows to hold any smartphone with head control, using 8 MP or more resolution smartphone cameras, with continuous flash lighting. As in indirect technique, a condensing 20, 28, 30, 40 diopters lens to perform funduscopy, in the same manner than in indirect ophthalmoscopy. In video recording mode.

**Results:** This prototype gives the observer the opportunity to perform retinal images in ROP, video recording quadrants and reconstructing retinal images with a greater angle of retinal images results. The same observer performs the sequence. With both hands free, it is easy to reach periphery of the globe. Having the smartphone attached to the device, the examination is more secure (no smartphone and hands contact) during the procedure. We are working in a telemedicine team, sharing ROP images.

**Discussion:** Although smartphone funduscopy can be achieved with multiple techniques, this helmet prototype proved to be very simple to use, for hands-free indirect funduscopy, with smartphone. Especially in settings without the availability of sophisticated fundus imaging technology for telemedicine and teaching. Our team is working now on validation to build an m-health ROP and pediatric ophthalmology network in Argentina.

**Conclusion:** This prototype may be very useful in m-health ROP and pediatric ophthalmology networks. Still needs the validation work. The advantage of hands free technique, and quadrants recording can make a difference. With the addition of smartphone artificial intelligence recognition, it may be in the future very useful in constructing big data algorithms of data images.

**References:**
1. Smartphone Photography Safety David Y. Kim, MD, François Delori, PhD, Shizuo Mukai, MD PlumX Metrics DOI: http://dx.doi.org/10.1016/j.ophtha.2012.05.005
Influence of Serial Retinal Images on the Diagnosis and Management of Retinopathy of Prematurity (ROP)

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Introduction: Wide-angle digital retinal imaging is currently being utilized for retinopathy of prematurity (ROP) telemedicine programs. Digital imaging has allowed serial comparison of vascular change over time, which anecdotally many clinicians describe as being informative. This study examines the influence of serial retinal images on ROP diagnosis and management.

Methods: Seven ROP examiners interpreted 15 sets of wide-angle retinal images from infants with ROP. Images were independently reviewed on a secure website and a three-level plus disease diagnosis and management plan (follow-up interval or treatment) for each index case were recorded, first based on a single retinal photograph, and then based on a series of three images over time with the index image as the third image.

Results: When viewing the serial retinal images, examiners changed plus disease diagnosis in 24 of 105 (22.9%) responses. Changes in management occurred in 32 of 105 (30.5%) responses.

Discussion: Analyzing a progression of serial retinal images enables direct comparison of vascular changes over time in ROP. The findings in this study suggest a potential effect of using serial images to diagnose plus disease, as opposed to using a single image at a single point in time. The implication of this change requires further study. More objective and quantitative techniques may assist in providing a more consistent and precise identification of retinal vascular progression.

Conclusion: There is variability in diagnosis and management of ROP if presented with serial retinal images. This may have implications for how image based diagnosis is utilized in clinical practice.

Symmetry of Disease in Retinopathy of Prematurity

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Introduction: Correlation of retinopathy of prematurity (ROP) between eyes has been reported in high-risk populations. We sought to evaluate inter-eye symmetry for ROP in a broad-risk cohort representative of infants undergoing ROP screening.

Methods: Retrospective cohort study of infants undergoing ROP examinations from 29 hospitals between 2006-2012 (The G-ROP Study). Primary outcomes were symmetry for type (type 1, 2, not 1 or 2, no ROP), highest stage of ROP, and disease course of asymmetric fellow eyes when one eye developed type 1.

Results: 7483 infants were studied. 94% of right and left eyes were symmetric for type. 93% of eyes were symmetric for highest stage. 378/459 (82%) infants developed type 1 in both eyes together. In 44 infants, one eye had type 1 and the fellow eye was treated simultaneously for type 2. All 37 remaining fellow eyes had ROP: 8 developed type 1 and were treated (6 within 2 weeks, all within 4 weeks); 4 developed type 2 and regressed; and 25 developed ROP less than type 1 or 2 and regressed.

Discussion: This large, broad-risk cohort is representative of infants receiving ROP screening. When asymmetric for type 1, nearly all type 2 eyes were treated along with the more severe eye, so it is not possible to know what proportion would have progressed to type 1.

Conclusion: ROP is a highly symmetric disease between eyes with respect to the presence and severity of disease. When type 1 ROP develops in only one eye, the risk of progression to type 1 in the fellow eye is very low if it has not occurred within 4 weeks.

The Fix and Follow Grade: A New Method of Grading the Visual Performance in Infant

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Introduction: Optokinetic nystagmus, visual evoked cortical potential, forced choice preferential looking have been used to evaluate the visual acuity in infants, but there are limitations to the methods that are objective and easy to apply to clinical practice. We performed this study to describe the development and application of a novel scoring system for grading the ability for fixation and following in infant who are not able to cooperate in testing visual acuity.

Methods: We made the grading system of fixation and follow (FFG) as followed; Fixation: Grade1; no response to target, grade2; response to target but not last > 3 seconds, grade3; satisfy the one criteria, grade4; satisfy the two criteria; (1) fix the target lasting > 3 seconds (2) move gaze from target to another. Follow: Grade1; poor, grade2; partial, grade3; complete movement. Two ophthalmologist evaluate the FFG of 21 infants. One ophthalmologist (A) repeated the exam within 4 weeks.

Results: In fixation grading, intra-observer (test-test) reliability was very good (r= 0.95, 95% CI 0.95 - 1.0) while inter-observer reliability was moderate (r= 0.51, 95% CI 0.21 - 0.81). Similar result was observed in follow grading. Intra-observer (test-test) reliability was very good (r= 0.85, 95% CI 0.65 - 1.0) while inter-observer reliability was moderate (r= 0.45, 95% CI 0.12 - 0.76).

Discussion: Limitation in ocular movement was significantly more frequent in the patients with grade disparity. (p=0.021)

Conclusion: It is more appropriate for longitudinal follow-up by the same examiner, and grading and interpretation should be careful in patients with ocular motility disorder.

2001 Poor correlation between 'fix-follow-maintain' monocular/binocular fixation pattern evaluation and presence of functional amblyopia. Binocul Vis Strabismus Q 16(2):85-90
Introduction: Tests of contrast sensitivity are not performed routinely in the clinic, although contrast is reduced in many conditions such as amblyopia or glaucoma. This may be due to perceived time constraints or unaffordability of equipment.

Methods: In 18 healthy subjects, aged 24-78 years, we compared contrast sensitivity functions with the FACT, the CSV 1000E and the Lea Symbols.

Results: All tests were equally comfortable for patients and took less than 5 minutes to perform (one eye). While all measure contrast sensitivity at 3, 6, 12 and 18 cpd, the FACT included 1.5 cpd. Linear mixed-effect models were performed. While there was no significant difference at low spatial frequencies, the Lea contrast sensitivity test showed a ceiling effect in that range, while the FACT showed a floor effect at high spatial frequencies.

Discussion: In contrast to Koefoed et al (2015) we did not find the CSV and FACT to be interchangeable and we did not find a ceiling effect in FACT or CSV at 18 cpd. This may be secondary to the wider age range in our study, as contrast sensitivity at intermediate and high spatial frequencies decreases with age. In agreement with Leat and Wegman (2004) the Lea gives no detailed determination of contrast sensitivity threshold in healthy children. We did not test children or adults with low vision or multiple disabilities where Leat and Wegman reported that Leat may give useful Information.

Conclusion: All three CS-Tests can be meaningfully applied in the clinic. Results are not interchangeable.

Vision and Ametropia in School Students with Albinism

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Introduction: Ocular or oculocutaneous albinism may result in significant vision impairment from birth. Identification and treatment of ametropia during childhood is pivotal in allowing full visual potential to be reached. We aim to quantify refractive error in school students with ocular and oculocutaneous albinism in Victoria, Australia.

Methods: A retrospective audit of students with a clinical diagnosis of ocular or oculocutaneous albinism from the Education Vision Assessment Clinic at the Royal Victorian Eye and Ear Hospital between 2002 and 2015 was conducted. Significant ametropia was defined as spherical equivalent >/=4 diopters in magnitude or astigmatism >/=1.5 diopters in magnitude. Significant anisometropia was defined as >/=1.0 diopter in magnitude.

Results: Fifty-one students with a mean age of 5.6 years (range 4.1-14.3 years) were included in the study. The mean best-corrected visual acuity with both eyes open was 0.81 logMAR (SD ±0.18). Forty-three students had oculocutaneous albinism and eight had ocular albinism. Significant hyperopia was present in at least one eye of 37.2% of students, significant myopia was found in 3.9% and significant astigmatism in 78.4% of students. Eight students (15.7%) had significant anisometropia.

Discussion: Students with albinism have significant vision impairment. Amblyogenic hyperopia and/or astigmatism were present in most cases. This is similar to the refractive error findings of a Jerusalem-based cohort (1). Interestingly the findings of myopia and astigmatism were more common in a Nigerian cohort (2).

Conclusion: Amblyogenic refractive error is a common finding in students with ocular and oculocutaneous albinism. Correcting refractive error is an important intervention.

Visual Function Assessment in Children with Congenital Zika Virus Infection

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Introduction: To evaluate visual function of infants with presumed or confirmed in utero Zika virus infection at 3-6 months of age.

Methods: Prospective cohort of infants with presumed or confirmed congenital Zika virus infection (by reverse-transcriptase polymerase chain reaction - RT-PCR) at a referral center for high-risk pregnancies and infectious diseases in infants and children. ‘Fix and follow’ was used to evaluate visual function at 3 months and quarterly thereafter.

Results: 273 infants were evaluated, 169 (62%) had serological confirmation for Zika virus by RT-PCR; 92 (34%) had microcephaly and 72 (26%) had eye abnormalities. 229 infants (82%) were assessed at 3-6 months of age, and 69% (158/229) were able to fix and follow. Not being able to fix and follow was highly correlated (p<0.0001) to both eye abnormalities (OR 48, CI 21-114) and microcephaly associated with central nervous system abnormalities (OR 55, CI 16-183). No correlation was seen between visual function and symptoms of Zika infection during pregnancy (p=0.9) or a positive RT-PCR result (p= 0.2).

Discussion: Children with congenital Zika virus infection are at increased risk of developing visual impairment due to eye and central nervous system abnormalities. Accessing visual function is challenging in children with CZS due to cerebral and cognitive impairment. Early identification and management of visual impairment are crucial for adequate and comprehensive care of this children.

Conclusion: Children with visual impairment associated to congenital Zika virus infection should be provided integrated, long term eye care follow-up.

Prevalence of Uncorrected Refractive Errors among School-Aged Children in the School District of Philadelphia

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Introduction: Uncorrected refractive error increases a child's risk for visual, academic, and cognitive challenges. Conducting vision screening directly in schools has the potential to effectively reach underserved children. We developed an on-site pediatric vision screening program to detect and correct refractive errors and refer those with non-refractive eye disease to a pediatric ophthalmologist.

Methods: We screened 18,974 children in grades K-5 in Philadelphia public schools between January 2014 and June 2016. Children who failed the vision screening were examined by an on-site ophthalmologist or optometrist who determined whether the child's decreased visual acuity could be corrected with eyeglasses.

Results: Of the 18,974 children screened, 2492 (13.1%) exhibited uncorrected refractive errors: 1776 (9.4%) children had myopia, 459 (2.4%) had hyperopia, and 1484 (7.8%) had astigmatism. Of the children screened, 846 (4.5%) exhibited uncorrected anisometropia. Of the 2492 children with uncorrected refractive error, 368 (14.8%) children had more than one refractive error diagnosis. Mild myopia (spherical equivalent of -0.50 D to <-3.00 D) was the most common diagnosis, present in 1573 (8.3%) children.

Discussion: We found mild myopia to be the most common uncorrected refractive error in our study population. Rates of uncorrected low astigmatism, anisometropia, mild hyperopia, emmetropia, high astigmatism, moderate myopia, and moderate hyperopia were also substantial, while rates of uncorrected high myopia and high hyperopia were very low.

Conclusion: Our data show that 13.1% of school-aged children in this population exhibited uncorrected refractive errors that caused suboptimal visual acuity. On-site vision screening programs may provide an avenue to identify and address uncorrected refractive errors.

References:
Discriminative Validity of Color Vision Tests in Young Children: Comparison of Normal and Impaired Vision Subjects

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Introduction: To investigate the diagnostic ability of pseudoisochromatic plate-based color vision tests (Ishihara and Matsubara), the Mollon-Reffin-Minimalist (MRM) color vision test and the Cambridge Color Test (CCT) to compare the performance of young children with reduced visual acuity to children without visual impairment.

Methods: Data of 23 children with reduced visual acuity (mean logMAR 0.19) and 37 children with age-related normal visual acuity (mean logMAR -0.01), both groups aged 3-10 years were included in a prospective study. The Cambridge Color Test is a computer assisted test on static screens resembling pseudoisochromatic plates. The discriminative chromaticity threshold is adjusted according to the subject's performance.

Results: All children successfully completed the Pseudoisochromatic and MRM test, CI[87%,100%] for patients and CI[91% ,100%] for probands. The success rate for the CCT was 89%, CI[71%,98%] for patients and 89%, CI[75%,97%] for the control group. No significant difference in the rate of correct answers could be found between groups for the Matsubara/Ishihara test and the MRM. Mean discrimination levels for the protan/deutan/tritan confusion axes in the CCT trivector test were 168/169/231, CI[125,211]/[118,221]/[136,326] for patients and 117/116/137, CI[99,134]/[95,137]/[121,153] for probands, with a tendency towards higher discriminative levels in children with reduced visual acuity. A portion of 50% of all amblyopic patients had a tritan discrimination level beyond the 95% confidence interval for the mean of controls.

Discussion: Color vision is one of the earliest developed visual function in children. Pseudoisochromatic plate-based color vision tests and MRM are of widespread use in clinical routine. However, preliminary data suggest that the discriminative validity of the CCT is higher compared to former tests. Reduced success rate occurred in the subgroup of 3-5y old children most probably due to difficulties in the handling of the adult adapted CCT equipment and limited attentiveness.

Conclusion: The CCT test can be performed by children with reduced visual acuity and could be useful for detecting, grading and monitoring those patients.


Baltimore Reading and Eye Disease Study (BREDS): Two-Year Results on Compliance with Eyeglass Usage

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Introduction: Little is known about long-term use of glasses provided through school-based programs, although poor adherence has been reported [1, 2]. We report 2-year data on compliance with eyeglasses usage, factors predictive of wear and frequency of replacement.

Methods: Second and third graders attending twelve elementary schools received school vision examinations as part of a school-based study. 198 children had follow-up vision exams 3 months after glasses were prescribed and 67 were seen again the subsequent school-year. Eyeglass wear was assessed by observation and students were interviewed about eyeglass usage.

Results: The median time between baseline and first follow-up exam was 90 days (range: 29, 203); the median time between baseline and second follow-up exam was 434 days (range: 308, 537). At the first follow-up, 87.4% were wearing glasses, decreasing to 65.7% at the second visit. At least one pair of replacement glasses was required by 62.4%. Students were more likely to be wearing glasses if reminded by their teachers, (adjusted OR 5.5 (p=0.01)) or parents (adjusted OR 8.8 (p=0.01)). Neither happiness with glasses nor degree of refractive error were associated with increased likelihood to wear glasses, with adjusted OR 3.4, p=0.7 and OR 1.2, p=0.08 respectively.

Discussion: In our school-based program, the majority of children prescribed glasses were still wearing them at follow-up in the same academic year, but this decreased in the subsequent academic year.

Conclusion: Along with the capacity to provide replacement glasses, parental and teacher engagement to promote eyeglass wear are important elements for a successful intervention program.

School-Based Delivery of Eye Care: The Baltimore Experience

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Introduction: Many children who fail vision screenings never receive recommended follow-up (1,2,3). School-based delivery of eye exams could increase access to care. This report summarizes the initial year experience of Vision for Baltimore, a city-wide initiative providing screenings, exams and glasses in inner-city schools.

Methods: 17,614 students in grades PK-8 were screened at 46 schools. Parental consent forms were sent home upon failed screening to allow an eye exam in a mobile clinic. To encourage consent collection, teachers were offered incentives (school supplies) beginning January 2017.

Results: 5,596 students failed vision screening, 3,029 (54.1%) provided consent and 2,920 (52.2%) received exams. 2,349 were prescribed glasses, and 146 students were referred for further care. Average consent return increased from 38% to 54% after incentives were offered.

Discussion: Most screening failures had refractive error necessitating glasses. Strengthening engagement with schools and providing incentives improved participation.

Conclusion: Vision for Baltimore is an effective school-based eye care model and can help inform implementation of similar programs. Opt-out consent mechanisms and barriers to participation should be explored further.

Introduction: The purpose of this study was to report the worldwide experience of strabismus surgeons treating complete third nerve palsy with nasal transposition of the split lateral rectus muscle.[1]

Methods: Pediatric ophthalmologists and strabismologists that have performed at least one nasal transposition of the lateral rectus muscle were invited to participate in a cloud-based survey designed to capture outcomes and complications using this procedure.

Results: Thirty-three patients and 38 eyes with complete third nerve palsy treated with a nasal transposition of the lateral rectus muscle were included in this study. Fifty-one percent of patients were female. Median age was 36.5 (IQR: 19.8, 49.8). Congenital, ischemic and traumatic third nerve palsies were the most common. The median pre-operative deviation was an exotropia measuring 65 prism diopters (IQR: 55, 90). At 6 months the majority of patients were orthotropic at near, by Krimsky. Patients were followed for 26 months (IQR: 10, 32). Final post-op alignment was excellent, measuring within 7 (0, 12.5) prism diopters of orthotropia. There were two reported complications, choroidal effusion (5%) and scleritis (3%).

Discussion: Our cloud-based survey facilitates reporting the international experience with a novel surgical technique for treatment of a rare strabismus problem.

Conclusion: Adjustable nasal transposition of the split lateral rectus provides excellent post-operative Krimsky alignment, long-term stability, and a low risk profile.

Fascia Lata Augmented Nasal Transposition of Split Lateral Rectus for Reoperation of Complete Third Nerve Palsy

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Introduction: Complete third nerve palsy causes incomitant strabismus. Traditional recession and resection procedures often yield limited outcome. Nasal transposition of split lateral rectus were reported to correct the deviation successfully.[1] However, this procedure was mainly recommended in primary cases, with concerns of lateral rectus contracture and extensive scarring in re-operative cases.[2] Therefore, we developed a technique of fascia lata augmentation for split lateral rectus for nasal transposition in re-operative cases.

Methods: The posterior edge of adhesion of previously operated lateral rectus was evaluated with magnetic resonance imaging. The lateral rectus was carefully identified and isolated. Fascia lata autografts were used to augment split lateral rectus for nasal transposition. The augmented split halves were then transposed and reattached at the borders of medial rectus.

Results: Two cases successfully underwent the procedure. One case had prior surgery of recession and resection. The other case had several prior surgeries, including recession and resection, posterior lateral tendon fixation, and globe fixation with medial periosteal flap. The procedure resulted satisfactory results in both cases.

Discussion: Extensive fibrosis and adhesion were the major challenge of this technique in re-operative cases. Preoperative image study could help to locate the displaced lateral rectus. The muscles were often fragile and should be manipulated cautiously.

Conclusion: With careful preoperative evaluation and meticulous surgical manipulation, fascia lata augmented nasal transposition of split lateral rectus might be an option of rescue for re-operative cases of complete third nerve palsy.

Surgical Overcorrection in Two-Muscle Surgery for Unilateral Superior Oblique Palsy Associated with Ipsilateral Gaze Deviation

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Introduction: Surgical overcorrections in unilateral fourth nerve palsies are generally less well tolerated than undercorrections. We investigated the angle of deviation in various gaze positions as a risk factor for overcorrection of moderate angle unilateral fourth nerve palsies undergoing two-muscle surgery.

Methods: The medical records of 45 patients, age 12 to 77 years, who underwent two-muscle surgery for unilateral fourth nerve palsy with 14-25 prism diopters (pd) of hypertropia in primary position were retrospectively reviewed. Patients with overcorrection, defined as any reversal of hypertropia at both distance and near, were compared to non-overcorrected patients for preoperative deviations in primary, side and near gaze as well as torsion.

Results: Of the 45 patients, 8(17.8%) experienced surgical overcorrection by 6 weeks. For overcorrected and non-overcorrected patients, the median deviation in primary position was 20.0pd and 18.0pd (p=0.39), 25.0pd and 25.0pd in contralateral gaze (p=0.53), 8.5pd and 16.0pd in ipsilateral gaze (p=0.029), and 17.0pd and 18.0pd at near (p=0.49), respectively. There was no difference in preoperative torsion between overcorrected and non-overcorrected patients (p=0.7666). Ipsilateral gaze of <10pd was associated with overcorrection with two-muscle surgery (p=0.008).

Discussion: Vertical deviation in ipsilateral side gaze may assist in surgical planning for moderate angle unilateral fourth nerve palsies when considering two-muscle surgery.

Conclusion: For hypertropias of 14-25pd in primary position due to unilateral fourth nerve palsies, two-muscle surgery should be approached with caution if the hyperdeviation to the palsied side is nine or less prism diopters.

References: none
Long Term Outcome of Surgery for Vertical Strabismus Secondary to 4th Nerve Palsy

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Introduction: Patients with vertical strabismus due to 4th nerve palsy require surgical correction for diplopia and abnormal head postures. This study evaluates our long term outcome in surgical treatment of this condition.

Methods: Retrospective chart review 1995 - 2015. Patients with surgically treated 4th nerve palsy and at least 5 years of follow up were included. Criteria for surgical success: elimination of abnormal head position if present preoperatively, elimination of diplopia and fusion of the Worth 4-dot +/- using a small amount of prism (< 5 PD).

Results: 68 charts meet the inclusion criteria.
Outcome:
• 32/68 (62%) meet the success criteria
• 26/68 (38%) unsatisfactory results and require a reoperation during the follow up period
• 15/26 (58%) undercorrections (residual vertical deviation, late recurrent vertical deviation and/or residual torsion)
• 8/26 (31%) masked bilateral SOP
• 3/26 (12%) overcorrections

Reoperations:
• 8/26 (31%) were performed within 12 months after the surgery due to immediate unsatisfactory result – 6/8 of masked bilateral cases and 2/15 undercorrections
• 18/26 (69%) experienced late overcorrections (3/18) or recurrence (13/18) and underwent additional surgery 2 to 10 years later. 2/8 cases of masked bilateral had small deviation immediate postop that worsen over time
• 3rd surgery - 4 patients, for residual vertical strabismus and torsion (all bilateral cases)
• 4th surgery - 2 patients, same reasons

Discussion: Long term follow up reveals the late overcorrections and recurrent cases

Conclusion: • Good results immediate postoperative did not correlate with long term result in 17/64 (26.5%) of the patients
• 62% of the patients had a long term satisfactory outcome after one surgery.

Novel Surgical Approach to Superior Oblique Myokymia

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Introduction: Superior oblique myokymia (SOM) is a rare eye movement disorder that produces debilitating oscillopsia and diplopia. Various medical and surgical techniques have been reported to attempt to alleviate oscillopsia including superior oblique (SO) tenectomy with inferior oblique (IO) myectomy, SO nasal tendon displacement, and intracranial neurovascular decompression.[1-3] These techniques have inherent risks of iatrogenic vertical strabismus or carry high risk for morbidity. We report a novel surgical approach that alleviates oscillopsia and avoids creating vertical strabismus.

Methods: A 40 year-old female presented with a 2-year history of diplopia and oscillopsia refractory to medications. Examination revealed 2 X(T) and 4-6 LH(T). Slit lamp examination revealed torsional microtremor of the left eye. Patient underwent left superior oblique tenectomy with insertion of 10mm silicone retinal band.

Results: Patient had resolution of oscillopsia at first postoperative visit. Exam revealed stable comitant 2 XT and 6 LHT which were managed with prisms. At 8 years post-op, patient remained free of oscillopsia with 4 LHT and free of diplopia with prisms.

Discussion: Trochlear nucleus dysfunction, localized irritation, aberrant peripheral and microvascular compression of trochlear nerve are proposed etiologies of SOM. The common pathway involves myotonic excitation of the muscle. Our technique introduces a silicone segment that may buffer excitatory impulses and dampen myokymia while retaining primary function of the muscle.

Conclusion: Superior oblique myectomy with spacer may be an effective technique for alleviating SOM without inducing vertical strabismus.

Challenges of Managing Monocular Elevation Deficiency – A Series of 14 Patients

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Introduction: Monocular Elevation Deficiency itself presents a surgical challenge to the strabismologist. It is further complicated by the presence of associated horizontal strabismus and complex ptosis. Here a series of 14 patients with MED managed in our hospital are presented.

Methods: A series of 14 MED patients were followed prospectively. Thorough pre-operative evaluation was done for every patient. The surgical procedure, post-operative course, complications, final outcome and follow up pattern were noted.

Results: Age ranged from 6 years to 18 years. 8 were female and 6 male. Right eye was involved in 8 (57%) of them, 12 (85.71%) had amblyopia in deviated eye, 10 (71.43%) had associated horizontal strabismus, 2 patients underwent previous strabismus surgery. Surgical planning included correction of strabismus in first stage and ptosis correction with or without surgery for residual strabismus in second stage. 6 (42%) patients underwent bilateral surgery in first stage. Second surgery was done in 6 (42%) patients where only 3 needed additional strabismus correction. 7 (50%) patients were lost for follow up. Out of the rest 7 patients 6 (85.7%) achieved orthophoria.

Discussion: Delayed presentation and loss of follow up were two major challenges affecting outcome in management of MED. Proper counselling about the need for two/more stages of surgical treatment may improve patient compliance and follow up rate.

Conclusion: A precise pre-operative work up and meticulous decision making can improve surgical outcome in Monocular Elevation Deficiency immensely.

3. Sean M Blaydon, MD, FACS; Chief Editor: Hampton Roy Sr, MD : Marcus Gunn Jaw-winking Syndrome Treatment & Management: Medscape references
Single Muscle Transposition in Monocular Elevation Deficit (MED) – A Novel Surgical Technique

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Introduction: The purpose of this study is to put forth a novel surgical technique for the treatment of MED and report its short-term outcomes.

Methods: This is a prospective interventional case series consisting patients with MED. Single horizontal rectus muscle is transposed to 2 mm from the insertion of the superior rectus (SR) along the spiral of tillaux, augmenting it with the Fosters suture taken 8 mm behind its insertion.

Results: Five patients with MED were included. Mean age was 12.4 years. 4 patients underwent lateral rectus (LR) and one underwent medial rectus (MR) transposition respectively. Intraoperatively IR was tight in all subjects. Mean follow up period was 2 months. Mean hypotropia reduced from 34.6 prism diopters (PD range:20-48) preoperatively to 2PD (range:0-8) postoperatively at 2 months. Additionally horizontal deviation was seen in all patients, 3 of which had exotropia with mean of 12PD (2-20) and 2 had esotropia with mean of 28.5PD (12-40); one underwent LR recession and one MR recession. All underwent inferior rectus(IR) recession. Mean elevation deficit in abduction, straight upgaze, adduction improved from 4.6, 3.2, 2.4 to 1.8, 2, 2 respectively. Mean depression deficit was 0.5, no limitation of adduction and abduction were noted. No adverse effects were noted.

Discussion: This modification allows sparing of at least one horizontal muscle to tackle accompanying horizontal deviation. It achieves adequate elevation effect with no torsional changes and overcorrections at least in the short term follow up.

Conclusion: Single muscle transposition with IR recession is a promising primary surgical option in MED with good surgical outcome.

An Easy and Safe Operation Technique for Monocular Elevation Deficiency

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Introduction: Monocular elevation deficiency (MED) occurs either congenitally or acquired following some devastating situation. If the inferior rectus function is normal, horizontal recti superior transpositions were performed with or without augmentation suture. We aimed to introduce new alternative operation for these patients.

Methods: There were 4 patients who were operated and followed at least 3 months in this study. Only one patient had congenital MED. Patients' records are evaluated retrospectively.

Surgical technique: Conjunctiva was opened with limbal incision between 4 and 8 o'clock; medial, lateral and superior rectus muscles were exposed. 6/0 non-absorbable suture was used for grasping 1/6 width of muscle portion, 10 mm posterior to the insertions of medial and lateral rectus muscles. Then, sutures were tied and locked three times, approximately 8-10 mm behind the insertion of superior rectus. Scleral suture was not used. Superior rectus plication performed either during or after the surgery according to remaining deviation.

Results: Two of the patients had brain surgery, one had stroke in their history. When patients' preoperative vertical deviations in primary position were between 20-35 prism diopter (pd), they were found between 0-4 pd. without any inferior gaze restriction.

Discussion: In these cases, we preferred to perform muscle union surgery prior to superior rectus placation or inferior rectus recession or both. In this procedure, while performing transposition and union of medial and lateral rectus muscles, we did not use any scleral suture.

Conclusion: We noticed that this technique is easier, safer than and as effective as other transposition procedures.

Lateral Rectus Equatorial Myopexy (LREM) for Sagging Eye Syndrome (SES)

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Introduction: To report results of LREM for SES.

Methods: We reviewed records of three patients with age-related distance esotropia who underwent unilateral LREM by suturing the superior LR border to the equatorial sclera as a primary procedure (2 cases) or an adjunct. 1-month postoperative results were evaluated.

Results: All patients with SES exhibited at surgery the predicted significant inferior displacement of the LR pulley. Two cases also simultaneously underwent additional strabismus procedures. Mean age was 71 years (range 62-82). Median preoperative distance esotropia was 17PD (range 0-45) while the median ipsilateral hypodeviation was 5 PD (0-14). Surgery corrected to 2 PD median esotropia (0-6) and 1.6 PD (0-5) hyperdeviation at 1 month postoperatively. One patient has consecutive hypertropia who also had inferior rectus weakening.

Discussion: While standard surgeries such as medial rectus recessions can correct esotropia, these procedures are employed without correcting the underlying problem of the inferiorly displaced LR pulley and weakened LR-SR band. LREM for sagging eye syndrome is a viable surgical option for sagging eye syndrome presenting with hypotropia and/or esotropia. However, additional procedures should be incorporated cautiously as there is limited data regarding the results of equatorial myopexy for SES.

Conclusion: Given the mechanical nature of the sagging eye syndrome, LREM is a logical surgical approach that addresses the underlying pathophysiology.

The Management of Vertical Deviations in Sagging Eye Syndrome

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Introduction: Sagging eye syndrome (SES) may cause acquired distance esotropia secondary to degenerative changes of the lateral rectus-superior rectus band and subsequent inferior displacement of the lateral rectus muscle. Asymmetric displacement of the lateral rectus muscles may result in vertical deviations. Recent reports indicate changes in vertical rectus muscles in patients with SES. This study was conducted to report findings and management of SES patients with vertical deviations.

Methods: Charts were reviewed of patients with acquired vertical deviations associated with SES. Only those with a minimal follow-up of 1 year were included. Preoperative and postoperative alignment, ocular rotations, and torsion were evaluated.

Results: A total of 21 patients were included. Mean preoperative vertical deviation measured 2±1° (standard deviation). Mean preoperative torsion measured 5.1±2.2° with a mean postoperative torsion of 0.7±1.7°. All patients underwent horizontal muscle surgery. In ten patients who underwent simultaneous inferior rectus recession, the preoperative vertical deviation improved from 2.8±1.3 to 0.2±0.6°. In 3 patients who underwent simultaneous superior rectus tightening procedures, the preoperative vertical deviation improved from 2.6±1.1 to 0±0° postoperatively. In 8 patients who underwent horizontal surgery alone, the preoperative vertical deviation improved from 1.3±1.7 to 0.1° 0.3°.

Discussion: SES may be associated with small non-restrictive vertical deviation and excylotorsion. Small vertical deviations can be corrected with horizontal surgery alone. Larger deviations may require simultaneous selective vertical muscle procedures.

Conclusion: Acquired vertical deviations may result from connective tissue disorders as seen in patients with SES. Surgical planning may require operation on the vertical rectus muscles.

References:
Techniques and Outcomes of Strabismus Surgery in the Setting of Glaucoma Drainage Devices in the Pediatric Population

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Introduction: Glaucoma drainage devices can worsen strabismus in adults[1,2] and children[3], presenting surgical challenges. Purpose: to evaluate techniques and outcomes of strabismus surgery concomitant with, or following glaucoma drainage device(GDD) implantation for refractory childhood glaucoma.

Methods: Review of strabismus surgery performed concomitant with, or following GDD implantation for childhood glaucoma (ages 0-21yrs), with a single attending, 12/2005-6/2016. Included were surgeries with motility/alignment data pre-operatively and ≥3mos post-operatively. Data collected included: demographics, vision, glaucoma diagnosis, GDD type/location, pre-/post-operative sensorimotor/alignment measurements, and strabismus surgery details.

Results: Twenty-five patients met criteria. Mean age at strabismus surgery was 9.1±4.6yrs. GDDs included: Ahmed FP7/S2(n=13,52%), Baerveldt 250mm²(8,32%), Baerveldt 350mm²(4,16%). Glaucoma diagnoses included: following cataract surgery(GFCS,10/25,40%), primary congenital(PCG,6/25,24%), other(9/25,36%). Only 1/25(4%) had pre-operative diplopia. Of 15 strabismus surgeries concomitant with GDD, 13(86.7%) were lateral rectus recession for exotropia. Pre-operative motility restriction and/or intraoperative scarring occurred in 4/15(26.7%). Mean pre-operative deviation (27±9.7 prism diopters(PD)) decreased by mean 40.4% post-operatively, with improved alignment in 11/15(73.3%). Techniques included hangback(12,80%) and GDD plate trimming(4,26.7%). Of 10 strabismus surgeries following GDD, deviations included exotropia(4,40%), esotropia(3,30%), and multiple/other(3,30%). The most common procedure was two-muscle recession/resection(6,60%), with peri-GDD capsule dissection in 8/10(80%). All cases had pre-operative motility restriction and/or intraoperative scarring. Mean pre-operative deviation (27+/−14.6PD) decreased by 43.0% post-operatively, with improved alignment in 7/10(70%). There were no surgical complications(0/25).

Discussion: Strabismus surgery for children with existing/planned GDDs requires techniques tailored to their poor binocularity, motility restriction, scarring, and muscle-GDD plate/capsule proximity.

Conclusion: Strabismus surgery involving GDDs, while challenging, can safely and substantially improve alignment in refractory childhood glaucoma, whether performed concomitant with, or subsequent to, GDD placement.

Botulinum Toxin for Strabismus following Retinal Surgery

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Introduction: Botulinum toxin treatment is acknowledged as an acceptable alternative in the management of complicated strabismus. We provide an updated review of our experience with botulinum toxin for strabismus following retinal surgery.

Methods: A retrospective case file review of all patients who received botulinum toxin treatment for strabismus following retinal detachment surgery at Moorfields Eye Hospital, London between January 2006 till August 2017.

Results: 20 patients fulfilled our criteria. Mean length of follow-up was 20 months.

Main presenting symptoms were diplopia (65%) and poor cosmesis (35%). 12/20(60%) had detached macula pre-operatively. Cryobuckle (20%) and vitrectomy (80%) accounted for the retinal surgeries performed.

9/20(45%) had vision of 6/60 or worse in the affected eye. Exotropia (75%), esotropia (15%) and hypertropia (10%) accounted for the manifest deviations. Mean angle (near and distance) was 40PD. Patients received a mean of 2.5 toxin injections, with a reduction in the angle of deviation by half or more in 9/20(45%). Of the decompensated phorias (5/20), 80% regained single vision. 10/20(50%) demonstrated poor response to toxin. 1/20(5%) subsequently underwent strabismus surgery.

3/20(15%) developed a transient consecutive esotropia and 1/20(5%) developed a persistent secondary vertical deviation. Intractable diplopia was noted in 1/20(5%).

Discussion: Botulinum toxin often restores binocularity in patients with pre-existing fusion potential. Ocular cosmesis can be achieved but requires ongoing injections. Factors related to poor response to toxin treatment include: multiple retinal surgeries, concurrent macular pathology and pre-existing sensory strabismus.

Conclusion: Botulinum toxin represents a safe alternative to strabismus surgery in a selected group of patients.

Induced Hypertrophy of Extraocular Muscles after the Administration of Synthetic Peptides Into Them

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Introduction: The purpose of the research was to conduct morphometric study of extraocular eye structures in rabbits after the introduction of synthetic peptides (SP) into them.

Methods: Morphometric research of m. rectus lateralis (MRL), m. levator palpebrae (MLP) and m. orbicularis oculi (MOO) was done in 10 experimental rabbits after the administration of SP into the periorbital area.

Results: During microscopy in the study group, the thickness of MRL and MOO muscular fibers was 30% bigger, of MLP - 56% bigger as compared with the values of this parameter in the control group.

Discussion: The hypertrophy had a non-uniform character in respect of the fiber length and was more expressed in the middle sections. It may be assumed that muscle fiber hypertrophy happens to a greater degree due to sarcoplasmic hypertrophy. Myofibrillar hypertrophy was registered only in certain MLP fibers. The most expressed differences in the compared groups were observed when assessing angiogenesis processes. The number of vessels in intramuscular space of muscle increased mainly due to hyperplastic processes with the formation of newly formed vessels of the microvasculature, exceeding the values of the similar parameter in the control group by 52.4%, which testifies to expressed stimulation of early angiogenesis with the application of peptides with an increase in capillarization and improvement of trophic processes.

Conclusion: Administration of SP into muscle activates reparative processes expressed in heterogeneous hypertrophy of muscular fibers; activation of fibrogenesis with increased number density of fibroblasts; increased reactivity of the vessel component with neoangiogenesis activation.

Comparison of Immediate and Long-Term Outcomes in Basic Exotropia Treated with and without Adjustable Suture Strabismus Surgery

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Introduction: The purpose of this clinical study was to evaluate the immediate and long-term postoperative anatomic and functional outcomes of non-adjustable versus adjustable suture strabismus surgery in basic exotropia.

Methods: Patients with the diagnosis of basic exotropia whose near-distance disparities were within 10 prism diopters (PD) and who underwent surgical correction were included in the study. Clinical data including pre- and post-operative alignments at near and distance fixation were included in analysis. All patients who underwent adjustable suture surgery were left with a small angle (4-6PD) esodeviation at distance immediately following adjustment. The target alignments for non-adjustable group were based on standard surgical tables. Post-operative success was defined as alignment within 8 PD at the end of 6 months of follow-up.

Results: The overall success rate at the end of 6 months follow-up was 62.8% for adjustable suture group (n=34) and 66.6% for non-adjustable group (n=35) (p=0.749). The mean pre-operative distance deviation for the adjustable and the non-adjustable group was 40.5±19.9 PD and 34.0±12.5, respectively (p=0.116). The mean postoperative deviations at distance for patients who underwent adjustable versus non-adjustable suture were 6.9±9.2 PD and 6.6±10.1 PD, respectively (p=0.884).

Discussion: Our results reveal that, in patients with basic type of exotropia, adjustable and non-adjustable suture surgeries have similar success rates at the end of the initial 6 month follow-up period following successful surgical alignment.

Conclusion: Successful alignment is achieved in two thirds of patients with basic exotropia at the end of 6 months postoperative follow-up.

Evaluation of Surgical Efficacy of Plication Versus Resection of Medial Rectus in Intermittent Exotropia

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Introduction: To evaluate the surgical efficacy of plication of medial rectus muscle in comparison to resection as an effective muscle strengthening procedure.

Methods: A prospective interventional study in 20 patients of intermittent exotropia, 10 patients underwent MR plication (group 1) and other 10 underwent MR resection (group 2) along with LR recession in both the groups. A reinforcement suture used to prevent late under-correction. A minimal follow-up of 3 months kept.

Results: Mean preoperative deviation in group 1 was 44.1±10.17 and 47.5±10.7 in group 2 with a p-value of 0.488. The amount of surgical correction done was 4.8mm ±0.82 of MR plication, 7.75±0.97 of LR recession for group 1 and 5.15mm ±0.57 of MR resection, 8.05mm±0.64 of LR recession in group 2. The mean postoperative deviation at the end of 3 months was 7.7pd ±6.6 in group 1 and 7.6pd ±2.79 in group 2. Both plication and resection group produced similar results (pvalue 0.42).

Discussion: Per mm effectivity of Plication(4.58mm) vs resection(4.6)was seen. One patient had a consecutive esotropia of 25pd on the first postop day which was corrected simply by release of plication, thereby making this procedure effectively reversible. This is a major advantage.

Conclusion: Plication can be effectively used as an alternative to resection in routine horizontal rectus muscle surgery with the added advantage of being partly reversible in early postoperative phase.

Primary Bilateral Medial Rectus Resections in Large Angle Childhood Exotropia

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Introduction: Traditional surgical approaches for large-angle exotropia often result in undercorrection, abduction deficits and/or incommittance. We report results with primary bi-medial rectus resections previously reported only in adults.

Methods: Retrospective review of children undergoing primary medial rectus resections for childhood exotropia from 2012 to 2016 with minimum 3 months follow-up.

Results: Thirty-two patients underwent primary bi-medial rectus resections (median age 58 mos (range 6 mos-15 yrs) for a mean exotropia of 52PD (range 40 -70PD) distance and 51.4 PD (range 40-65PD) near. Mean resection was 6.3 mm per muscle (range 5.75-8mm) The mean correction was 39.8 PD distance and 37.4 PD near at last follow-up (mean 18 mos., range 3-51 mos). Mean dose response was 3.14PD/mm resection distance and 2.97 PD/mm at near. Success (< 10PD residual deviation), was achieved in 59% of patients at last follow-up, none were esotropic. No significant incommittance or abduction defects were noted at last follow-up.

Discussion: Success with primary bi-medial rectus resections compare favorably to large bilateral lateral rectus recessions and monocular recession-resection procedures for large angle exotropia in childhood avoiding potential abduction deficits or incommittance seen with other procedures. Increasing resection amounts based on observed dose-response in this study will likely improve outcomes further.

Conclusion: Primary bi-medial rectus resection should be considered in children with large angle exotropia.

References:
ElKamshoushy AA. Bilateral medial rectus resection for primary large angle exotropia. J AAPOS. 2017 Apr;21(2):112-116

Comparison of Bilateral Lateral Rectus Muscle Insertion in Patients Who Have Intermittent Exotropia with Non-Dominant Eye

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Introduction: Two third of patients with concomitant intermittent exotropia (IXT) have a non-dominant eye. We aimed to investigate whether the lateral rectus muscle insertion would make any difference between two eyes in patients who have IXT with a non-dominant eye.

Methods: One hundred nine patients who underwent bilateral lateral rectus recession for the basic type of IXT were included: 81 with a non-dominant eye and 28 with equal dominance. The distance between the corneal limbus and the midpoint of lateral rectus muscle insertion was measured intraoperatively using calipers. The arc of contact was calculated as the difference in distances between the measured insertion and the estimated equator based on axial length and cornea diameter. The distances in each eye were compared according to the dominancy.

Results: Mean limbus-insertion distance of lateral rectus muscle was 6.12 ± 0.74 mm, and estimated arc of contact was 5.71 ± 1.04 mm. There was no difference in the limbus-insertion distance according to the dominancy. Forty six of 81 patients with a non-dominant eye (56.8%) had the longer estimated arc of contact by 0.5 mm or more in the non-dominant eye (28.6% in patient with equal dominance, P=0.046).

Discussion: The arc of contact of lateral rectus muscle in the non-dominant eye was more frequently longer than that in the fixating eye. This suggests that the dominancy may be determined by structural difference in both eyes as well as sensory function.

Conclusion: We should be aware of this difference when planning surgery for IXT in patients with a non-dominant eye.

Clinical Outcomes of Adjustable Strabismus Surgery for Sensory Exotropia

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Introduction: The purpose of this retrospective study is to look into the immediate and long-term postoperative anatomic and functional outcomes following adjustable suture strabismus surgery in sensory exotropia.

Methods: Patients with the diagnosis of sensory exotropia who underwent surgical correction between January 2007 and January 2015 by a single surgeon were included in the study. Clinical data including pre- and post-operative alignments at near and distance fixations were included in analysis. Post-operative success was defined as 8 PD of misalignment at the end of 6 months follow up.

Results: The mean age of study patients (10M:10F) was 28.7± 15.5 SD years (range=9-67 years). All patients were left with a small angle (<8PD) esodeviation immediately following adjustment. The overall success rate at the end a 6m follow-up was 68.4% with 13 out of 19 patients being orthotropic or having a misalignment less than 8PD. The mean pre-operative and post-operative deviations were 35.3 (± 17.3) PD and 6.7 (±9.6SD) PD, respectively.

Discussion: The majority of patients with sensory exotropia retain their postoperative alignment, even in the setting of poor visual acuity in the operated eye. Our results suggest that adjustable suture surgery may be advantageous in sustaining good long-term alignment through reliably positioning the deviated in the eso-position to decrease the likelihood of recurrence.

Conclusion: Adjustable strabismus surgery can be offered to patients with sensory exotropia with approximately 68% success rate within 1 years following surgical correction.

Evaluating the Clinical Effectiveness of Medial Rectus Local Anaesthetic Injections for the Treatment of Near Exotropia

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Introduction: Earlier studies demonstrate injecting local anaesthetic (LA) into extraocular muscles disrupts their structure, encourages remodelling whilst increasing their strength and stiffness. This study evaluates the clinical effectiveness of LA injections to the medial rectus (MR) muscle of patients with near exotropia.

Methods: Retrospective case-note study of patients with symptomatic near exotropia who underwent LA injections to their MR muscles between October 2014–May 2017. Data analysed via Microsoft Excel; T-Test statistical analysis performed (P<0.01 significant). Patient age, pre-operative angle of deviation in prism dioptres (PD), post-operative angle (PD), mean reduction of angle (PD), improvement of diplopia, post-operative follow-up period, further management and complications evaluated.

Results: 10 eyes of 8 patients. Mean age=34.9 years. All patients underwent injection of their MR with 5ml Marcain 0.5%. Mean pre-operative angle of deviation=11.2PD. Mean post-operative angle=7.70PD (P=0.009). Mean reduction in angle=3.50PD (P=0.0004). 62.5% (5 patients)=improvement of diplopia. 50% (4 patients)=further procedures. 2 patients=LA to contralateral MR. 1 patient=ipsilateral MR resection/LR recession (adjustable suture). 1 patient=ipsilateral LR botox+repeat MR LA. Mean post-operative follow-up=3.7 months. No complications.

Discussion: Injecting LA into the MR of patients with near exotropia achieves a reasonable reduction in the angle of deviation that is statistically significant. Nearly two-thirds of the patient sample experienced improvement of diplopia and half required further management. There were no complications.

Conclusion: Although achieving statistically significant results with regards to reducing angles of deviation, injecting LA into MR of near exotropia patients produces a modest clinical response for reducing diplopia. It is a safe procedure that may be a useful initial and/or adjunctive treatment option for these patients.

Periosteal Muscle Anchoring for Large Angle Incomitant Squint

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Introduction: To describe the evolution of a modified surgical technique for correcting large angle incomitant exodeviations. This study expands on a previous report of 7 patients.1

Methods: A consecutive series of 27 patients with predominantly third nerve palsy (n=21, medial rectus palsy=2, exotropia=2, Moebius=1, CPEO=1) were operated on between 2005-2017 by a joint Strabismus/Adnexal team. All patients had minimal medial rectus function and 15 patients had undergone prior surgery. Retrospective analysis included prism dioptre (PD) deviations and complications.

Results: Four patients were excluded for lack of follow up. Pre operative exotropia ranged from 45 to >115 PD base in. There were 30 operations (19 patients one operation, 4 patients >1) with the medial rectus insertion anchored to periosteum via a retrocaruncular approach.2 The lateral rectus was disinserted then fixated to the lateral orbital rim except for 2 recessions and 5 botulinum toxin injections (4 performed 2005-6). Medial traction sutures were inserted in 23 of 30 surgeries (the 7 without performed 2005-6) for a mean of 5 weeks (range 2-8). Final review was at an average 26 months (range 2 to 130) with deviations ranging from 80 PD base in to 14 PD base out and a mean reduction of 42 PD (range 10 to 79). There were no complications.

Discussion: Large angle incomitant exodeviations present a difficult surgical challenge. The surgical approach has evolved with lateral rectus disinsertion now preferred and traction sutures routinely inserted.

Conclusion: We advocate a combined bi-rectus fixation approach with traction sutures to hold the globe in the primary position.

Genetic Analysis of Children with Hereditary Retinal Dystrophy within the National Health Care System of Costa Rica

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Introduction: Hereditary retinal dystrophy has been reported a significant cause of poor childhood vision in Latin America (1,2). Given centralized Costa Rica healthcare, children are followed at the pediatric retina clinic of the National Children's Hospital, allowing detailed and longitudinal phenotypic data to be obtained. Our study identifies genetic variants in this unique population.

Methods: DNA was analyzed from 32 individuals from 18 different families with Leber's congenital amaurosis (LCA) or retinitis pigmentosa. Single nucleotide genotyping arrays were performed on probands to detect copy number variants/regions of homozygosity that demonstrated identity by descent. Whole exome sequencing identified single basepair mutations and small insertions/deletions. All patients received complete ophthalmologic examination, fundus photography, and ERG.

Results: Probands, mean age 8.7 years (range 4-16), demonstrated poor vision in infancy and flat or diminished ERG, with minimal variability. Given clinical findings, twelve of the children were diagnosed with LCA. Microarray detected a median 5% homozygosity with many known recessive retinal dystrophy genes mapping within homozygous regions. Of the 26 affected individuals analyzed, 22 (85%) demonstrated biallelic mutations in RPE65 predicted to be disease-causing. Three other affected probands demonstrated assumed biallelic loss in ADMATS18, NYX-1 and RDH12, and the fourth individual had an X chromosome deletion involving OPN1LW and Æ OPN1MW and a mutation in NYX1.

Discussion: We find a very high prevalence of biallelic RPE65 mutations in LCA Costa Rican children, likely arising from founder effects.

Conclusion: We report the first genetic analysis of children with hereditary retinal disease in Costa Rica, perhaps allowing hope for future therapy (3).

Introduction: Neuronal ceroid-lipofuscinoses (NCL) are a group of inherited, neurodegenerative disorders characterized by progressive motor and cognitive decline and early death. Vision loss due to retinal degeneration is a common feature and in some cases, the first presenting symptom.

Methods: Patients underwent evaluation at the National Eye Institute’s Ophthalmic Genetics clinic, including medical and ocular history, visual acuity measurements, dilated fundoscopic examination and when possible, electroretinography, optical coherence tomography and fundus imaging. Patients with clinical diagnosis of retinal degeneration were offered genetic testing with a multi-gene retinal dystrophy panel.

Results: Four patients were found to have genetic testing results associated with NCL (three with mutations in CLN3 and one in CLN1). At the time of their initial evaluation, none of the patients had a diagnosis of seizure disorder or any reported neuro-cognitive deficits. With time, all four have demonstrated personality and behavioral changes, some level of cognitive decline, with one patient developing seizures and cortical atrophy on MRI.

Discussion: Neurodegenerative disease should be considered in all pediatric patients who present for evaluation of retinal degeneration since visual complaints may be the first manifestation of the condition. Additionally, common diagnoses such as Attention Deficit Hyperactivity Disorder may represent an initial presenting sign of neurologic decline. As genetic testing becomes more routine in ophthalmic practice, we will continue to expand the spectrum of phenotype of inherited retinal conditions.

Conclusion: Families of children with retinal degeneration who are undergoing genetic testing should be counseled on the possibility of identifying neurodegenerative disease.

Optical Coherence Tomography in Knobloch Syndrome

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Introduction: Knobloch syndrome is a rare genetic disorder classically defined by a triad of occipital defect, high myopia, and vitreoretinal degeneration with high risk for retinal detachment. Our study aims to characterize the morphological changes of the retina in patients with Knobloch syndrome using optical coherence tomography (OCT).

Methods: This retrospective case series reports findings on patients with a clinical and/or DNA diagnosis of Knobloch syndrome who received OCT testing during their clinical care. Diagnosis was made on the basis of high myopia, characteristic fundus appearance, and presence of occipital scalp or skull abnormalities with or without featureless iris and/or ectopia lentis.

Results: Over a five-year period, we studied 8 eyes from 5 patients (mean age 8.7 years, range 3 months to 39 years). Two eyes were excluded due to chronic retinal detachment. OCT findings included epiretinal membrane and peripapillary vitreoretinal traction with retinoschisis, an absent or rudimentary foveal pit in all but 2 eyes of 1 patient, poor retinal lamination, RPE atrophy, and photoreceptor depletion. Four eyes demonstrated myopic choroidal thinning, while 3 eyes disclosed enlarged choroidal vessels similar to pachychoroid.

Discussion: Our findings of epiretinal membrane, vitreoretinal traction, retinoschisis and pachychoroid have not been previously reported. The epiretinal membrane and vitreoretinal traction may explain the high incidence of retinal detachment in this syndrome.

Conclusion: We present novel OCT findings in Knobloch syndrome which may have diagnostic and treatment implications.

Prevalence of Ophthalmic Pathology in Children with Trisomy 21; A 5-Year Retrospective Review

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Introduction: The American Academy of Pediatrics (AAP) recommends an ophthalmologic exam within the first 6 months of life, then yearly until age 5, in Down Syndrome. Data to support this recommendation are scarce and automated vision screening has forced its re-evaluation.

Methods: A retrospective chart review of over 700 children with Trisomy 21 seen by the pediatric ophthalmology service at Vanderbilt University from August 2012 to 2017. Charts were reviewed for visual acuity, sensorimotor examination, cycloplegic refraction, prescription of glasses, and ophthalmic, medical, and surgical history. AAPOS guidelines were used to define amblyogenic risk factors (manifest strabismus, cataract, refractive error).

Results: The charts of 705 children were reviewed. Average age of encounter reviewed was 7.0 +/- 4.8 years, 56% male. 377 (53.5%) children had a meaningful finding noted by the provider. Based on AAPOS guidelines, 460 (65.3%) had at least one amblyopia risk factor. Significant refractive errors were found in 23% (age 0-3, N=192) and 60% (age > 3, N=513). 253 (36%) had strabismus (15.9% required surgery). Esotropia accounted for 84.6%, exotropia 12% and superior oblique palsy 7%. Accommodative esotropia was most common (30.4% of all strabismus). Cataract prevalence was 5.7% (N=40, 74% bilateral) but only 41% required surgery. Nystagmus prevalence was 13.3% (N=94).

Discussion: The prevalence of amblyogenic risk factors in Down Syndrome was similar to those quoted by 2011 AAP guidelines (vision problems 60%, cataracts 15% and refractive error 50%).

Conclusion: Screening exams in Down Syndrome are warranted as automated screening devices would need to refer >65% of patients based on our data.


Whole Exome Sequencing in Familial Primary Comitant Exotropia

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Introduction: Familial forms of primary concomitant strabismus (PCS) support a genetic basis for the condition, which remains an enigma. A few loci have been linked to PCS so far. We performed whole exome sequencing (WES) in an informative family of self-reported north Indian ancestry with exotropia (XT) in an attempt to identify genetic determinants of PCS.

Methods: A three-generation family manifesting presumptive autosomal dominant (AD) XT was recruited. Complete ophthalmic evaluation was done on five affected and three unaffected family members along with pedigree documentation. WES of all the samples was performed and analyzed on a standard bioinformatic pipeline.

Results: WES analysis identified three rare heterozygous missense variants in 3 genes, one on chromosome 1 and two on the long and short arms of chromosome 11, segregating with the phenotype and confirmed by Sanger sequencing. Subsequent Sanger sequencing-based mutation screening performed in an independent PCS cohort comprising both familial and sporadic cases identified two additional rare variants in one sporadic and one familial case with XT. In silico analysis showed both these variants to be damaging. Computational gene-gene interaction networks were made to study possible role of these variants in ocular motility disorders.

Discussion: WES revealed three rare damaging variants in one gene in two familial and one sporadic case of XT. While the interpretations have to be cautious, these results encourage replication efforts in other ethnic populations and functional validation of the findings.

Conclusion: WES in informative families with PCS may reveal likely causal or contributory genetic determinants of the same.

2. Chaudhuri Z, John A, Aneja S, Thelma BK. Identification of a novel putative variant in the EPHA2 gene on chromosome 1p in a family with exotropia by whole exome sequencing. Oral presentation at the ARVO 2017; Program No 3439; Strabismus: Basic and Clinical Session on May 9, 2017 (ARVO 2017 Annual Program Abstracts)
**Amblyopia screening in Finland**

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**Introduction:** Amblyopia screening is well organized in Finland since there are annual vision screenings in all children aged 3 to 7 years. Referral criteria for asymptomatic children are: (1) the suspicion of amblyogenic factors in children aged under 3 years, (2) bilaterally reduced visual acuity (VA) (<0.5 in 3–4-year olds, <0.63 in 5–6-year olds or <0.8 in 7-year olds), (3) suspected unilateral amblyopia (≥2 lines) or (4) manifest squint. This study explores the need for follow-up and treatment among referred children.

**Methods:** Retrospective data was collected on 110 consecutive children aged under 10 years at the initial visit to Oulu University Hospital in 2012.

**Results:** Intermittent tropia (43%), bilaterally reduced VA (33%) and suspected unilateral amblyopia (15%) were the main reasons for referral. The mean age was 4.0 years (SD 1.9). Up to 75% of the referral letters fulfilled the defined criteria with odds ratio of 5.1 (95% CI 2.0-12.9) for the need of follow-up.

Emmetropia was found in 64%, hyperopia in 16%, myopia in 6% pure astigmatism in 14% and anisometropia in 36% of the children. Esodeviation was present in 25% and exodeviation in 28%. Prevalence of amblyopia was 16% (anisometropic 53%, strabismic 12% and combined 35%).

Of the 110 subjects, control visit was scheduled for 67 (61%) and treatment was started for 54 (49%). Spectacles were prescribed for 47 (43%) and patching was started for 19 (17%). No control visit or treatment was needed for 36 (33%) of the subjects.

**Discussion:** Two-thirds of the referred children need follow-up and every second child needs treatment. The nationally defined referral criteria for each age category are relevant and they should be adhered to.

**Conclusion:** The present referral criteria for asymptomatic children predict the need for follow-up well.

**References:**


Access to Pediatric Eye Care Following Vision Screening

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Introduction: Vision screening identifies children who require a comprehensive eye exam. Distance to an eye care provider is a potential barrier to follow up for referred children. This study quantifies geographic distances and driving times between screening centers and follow-up locations and correlates these with median household income.

Methods: Driving times between vision screening centers and local eye care providers (pediatric ophthalmologists and optometrists agreeing to participate) were mapped and analyzed using OpenStreetMap software (Esri, Redlands, CA). Population density and median household income was linked with screening centers using ArcGIS online (Esri, Redlands, CA).

Results: 290 driving times for routes between 145 screening centers, 7 pediatric ophthalmologists, and 147 optometrists comprising a community vision screening program were calculated and mapped. Median driving times from a screening center to the nearest eye care provider were 25.10 minutes (ophthalmologist) and 4.74 minutes (optometrist). 90% of screening centers were located within one hour of an eye care provider. Decreased driving times correlated with increased population and median household income.

Discussion: Comprehensive exam following vision screening is important to the success of a community vision screening program. Although median driving times remained relatively low in this study, children in outlying communities still faced geographic barriers to follow up care with a pediatric ophthalmologist. These areas correlated with lower median family income.

Conclusion: Geolocation allows a screening program to recruit appropriate providers for comprehensive care in close proximity to the locations they screen and to plan screenings so as to reduce geographic and economic barriers to care.

2. Williams, Summer et al. The challenges to ophthalmologic follow-up care in at-risk pediatric populations. J AAPOS 2013; 17:140-143
Clinical Outcomes of State Mandated Kindergarten Eye Examinations in a Suburban Ophthalmology Clinic

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Wheaton, IL

Introduction: The state of Illinois has required a screening by an optometrist or ophthalmologist prior to kindergarten since 2007. This requirement has allowed us to gather information regarding disease prevalence in a local population.

Methods: IRB approval was through Northwestern Medicine. A retrospective chart review was undertaken of kindergarten eye examinations performed at the Wheaton Eye Clinic between September 2008 and February 2017. Inclusion criteria included school eye examination as reason for visit and a cycloplegic refraction was completed. Data was collected regarding patient demographics, family history, past medical/birth history, all exam findings, and final diagnoses.

Results: Of 1131 patient charts identified, 676 satisfied the inclusion criteria, of which 49% were female. Historical characteristics showed 84 were premature, 20 patients were autistic and 52 were developmentally delayed. On examination, 147 had <20/30 vision in either eye, 17 had refractive errors >+3.50 diopters and one <-3.00 diopters. Abnormal external exam finding was found in 135 while 14 had an abnormal fundus finding. Diagnoses included 9 as glaucoma suspects, 36 with amblyopia, 28 with anisometropia, 1 with esotropia, 4 with exotropia, 95 with phorias, and 13 with convergence insufficiency. 50% of the autistic children were diagnosed with ocular pathology. At the end of the examination, 49 patients were given glasses.

Discussion: Using the published criteria by Donahue, we found 8% had amblyopia risk factors compared to the 10% referral rate for photoscreening. Glasses were given to 7.2% of the cohort, similar to Traboulsi et al. Autistic children maybe more likely to have eye disorders.

Conclusion: Our rate of treatable ocular conditions discovered via state-mandated kindergarten eye examinations compares favorably to photoscreening and large scale screening programs.

Traditional and Instrument-Based Vision Screening in Third-Grade Students

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Introduction: AAPOS recommends optotype-based vision screening for children > 5 years old.[1] Instrument-based screening for 3-4 year olds are more time-efficient and have higher positive predictive value (PPV) than traditional optotype screening.[2] This study evaluates instrument-based vision screening and traditional screening for third-grade students.

Methods: Third-graders from 16 schools in a single county in Virginia were screened by traditional methods (optotypes and stereoacuity) and Plusoptix S12. Children referred from either method received a comprehensive eye examination with cycloplegic refraction in the schools. Time to screen was recorded.

Results: 1593 children were screened by both methods. 516 (32.4%) children were referred—287 (18.0%) by traditional and 398 (25.0%) by Plusoptix. 247 (47.9%) children received cycloplegic examinations. There was no statistical difference (p > 0.05) of PPV between the methods for identifying children with acuity < 20/30 (75.2% and 70.1%) or who were prescribed glasses (73.8% and 82.2%). Time to screen was significantly less (p < 0.01) for the Plusoptix (2.0 vs 0.5 minutes). Eight children referred only by the traditional screen (passing the Plusoptix screen) had visual acuity < 20/40 without any explainable refractive error or amblyopia risk factors.

Discussion: The Plusoptix has similar PPV to traditional vision screening and detects children with acceptable visual acuity but may have a need for glasses. Children with non-refractive decreased visual acuity may be missed by instrument-based screens.

Conclusion: Instrument-based vision screening is more time efficient than traditional screening and has a similar PPV in third-grade students. Input from teachers to identify struggling students may be helpful if students are screened solely with autorefractors or photoscreeners.

References:
2 April A. Salcido, Joel Bradley, Sean P. Donahue. Predictive Value of Photoscreening and Traditional Screening of Preschool Children. JAAPOS;9:114-120.
Setting High Referral Thresholds in Non-Cycloplegic Refraction Screening: Most Missed Children Have Borderline Refractive Risk Factors

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Introduction: Amblyopia should be detected as early as possible. However, in early life without reliable visual acuity we can only detect amblyogenic risk factors. Over referrals and over prescription of glasses must be avoided by setting high referral thresholds in non-cycloplegic refraction screening. The aim of the study was to evaluate which children will be missed by videorefractometry.

Methods: Five studies with PlusoptiX (A04-A12) from 2005 - 2015 (n=883 children aged 0.5 to 7y) were analyzed. Amblyogenic refractive error was defined by German guideline (hyperopia >3dpt, astigmatism >1dpt, anisometropia >1dpt in cycloplegic retinoscopy). Thresholds for referral were set at >2dpt, >0.75dpt and >1dpt respectively for high specificity (94%).

Results: Prevalence of risk factors were: hyperopia 11%, astigmatism 20%, anisometropia 6%. Overall sensitivity was 80%.
26% of hyperopes were missed on screening. Of those 39% had severe hyperopia > +4dpt.
24% of children with astigmatism were missed. Of those only 5% had severe astigmatism > 2dpt.
5 of 43 children with anisometropia were missed. Of those only two had anisometropia > 2dpt.

Discussion: Although astigmatism was the most frequent amblyopia risk factor in this amblyopia enriched population, only 2 children with severe astigmatism went undetected. As expected in non-cycloplegic screening, severe hyperopia was the most frequent overlooked risk factor (9 children).

Conclusion: Overall, a sensitivity of 80% is acceptable because most missed children will have mild, if any amblyopia and can be treated later when it is picked up with visual acuity testing at a later age.
Referral Outcomes from a Vision Screening Program for School-Aged Children

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Introduction: Community vision screening programs rely on appropriate care of identified ocular disease through pediatric ophthalmology referral and consultation to ensure successful correction of each student's vision challenges.

Methods: We reviewed the referrals generated by our in-school vision screening program for children in grades K-5 in School District of Philadelphia public schools between January 2014 and June 2015. Children with subnormal best corrected visual acuity or other ocular conditions were referred to a pediatric ophthalmology service. A social worker assisted parents/guardians of referred children in scheduling an appointment and navigating insurance/payment issues.

Results: Of 10,726 children screened, 509 (4.7%) were referred for a follow-up eye examination. Of these 509 children, only 127 (25.0%) completed their referral eye examination. Most children (57.5%) were diagnosed with more than one eye condition. The most common ocular conditions were refractive error (75.6%), amblyopia (42.5%), strabismus (15.7%), and anisometropia (12.6%). Other conditions included macular hypoplasia, ptosis and other congenital anomalies.

Discussion: Our study illustrates the potential efficacy of a community based vision screening program to identify significant ocular pathology and connect affected students with pediatric ophthalmology consultation thereafter.

Conclusion: This program addressed potentially vision-threatening conditions in underserved children by offering social work services and financial support to enable children to complete a referral eye examination following a failed in school vision screening.

References:
What is Amblyopia? A Primary Care Physician's Perspective

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Introduction: Amblyopic vision loss can be both reversible and/or preventable if identified in a timely matter. With the proper knowledge, primary care physicians are able to identify these patients earlier and refer them to a specialist for prompt management. The purpose of this study is to investigate the knowledge of pediatric primary care physicians regarding amblyopia and their practice patterns for vision screenings and referrals.

Methods: An online physician survey was sent to pediatric primary care physicians in the Texas Children's Hospital to evaluate their knowledge regarding amblyopia, as well as vision screening and referral practice patterns.

Results: 250 emails have been sent and 87 physicians have responded. 100% of physicians answered they understood what amblyopia was, but only 16.7% could correctly define amblyopia. 81.2% perform vision screenings, most of them starting around ages 3-5. 64.4% refer patients once they identified vision was decreased in at least one eye; 75% of them directly referred to a pediatric ophthalmologist.

Discussion: Based on the results thus far, the surveyed physicians do not have a complete understanding of this disease and how it should be managed. Early detection is one of the most important aspects of successful amblyopia management. Our results validate the need for better physician education in this matter to help improve patient quality of care.

Conclusion: This information can help us improve physician education in this topic in order to identify the patients at risk of amblyopia earlier and treat this time sensitive disease more efficiently.

Intact Reading But Impaired Motor Skills During Binocular Viewing in Deprivation Amblyopia

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Introduction: Motor deficits and slow reading are present in children with strabismic and/or anisometropic amblyopia during binocular viewing conditions. Two studies have found similar deficits in children with deprivation amblyopia from a dense, visually significant unilateral cataract. However, motor skills were assessed in 4 year olds only, and oral reading was assessed monocularly. Thus, it is unknown how deprivation amblyopia affects these developing abilities under habitual, binocular viewing conditions.

Methods: Reading and motor skills of children treated for unilateral congenital or developmental cataract were compared to age-similar controls under binocular viewing conditions. Children 3-14 years old completed manual dexterity (unimanual, bimanual, drawing trail), and aiming and catching tasks from the Movement Assessment Battery for Children. Children 8-13 years old silently read a grade-appropriate paragraph. Reading rate (words/min) was recorded using the ReadAlyzer®. Amblyopic eye best-corrected visual acuity (BCVA) was obtained.

Results: Motor. Amblyopic children (0.3–1.9 logMAR BCVA) had lower scores compared with controls for drawing trail (amblyopia: n=17, mean±SD=7.5±3.5 vs control: n=41, 9.5±3.3; p=0.045), catching (6.2±2.1 vs 9.6±2.8; p=0.00005), and aiming (7.7±2.1 vs 9.6±2.9; p=0.015). Lower bimanual dexterity (r=-0.52, p=0.032) and catching (r=-0.57, p=0.017) scores were associated with worse BCVA. Reading. Amblyopic children (0.5–1.9 logMAR BCVA) did not differ from controls in reading rate (amblyopia: n=10,189±64 words/min vs controls: n=18, 214±62 words/min; p=0.33).

Discussion: Among children with moderate to severe unilateral deprivation amblyopia, motor skills, but not reading, were affected during binocular viewing. Poorer bimanual dexterity and catching were related to poorer amblyopic eye BCVA.

Conclusion: Motor deficits may hinder academic, athletic, and social success in children with deprivation amblyopia.

Vernier-Derived Position and Motion Deficits in Previously Untreated Anisometropic Amblyopia

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Introduction: Despite a constellation of visual deficits in amblyopia, treatment endpoints typically focus around threshold measurements (eg. visual acuity). We examined neural responses to a stimulus containing both relative position and relative motion cues in children with amblyopia and age-matched controls. The visual responses were recorded across a wide range above and around threshold performance before and after clinical treatment.

Methods: Spectral analysis of swept-parameter Visual Evoked Potential (sVEP) responses were used to isolate relative position (1st harmonic) and motion (2nd harmonic) related responses in children with previously untreated anisometropic amblyopia: n=10, mean age 6.3 years, mean(SD) interocular acuity difference 0.40 (0.20) logMAR. Comparison was made with typically developing children: n=16, mean age 5.14 years. Measurements were repeated after conventional treatment.

Results: Across a range of supra-threshold vernier offsets, children with anisometropic amblyopia displayed super-normal position responses in the fellow eye and markedly subnormal ones in the amblyopic eye (p=0.005). Motion responses on the other hand, showed no difference from normal in the fellow eye and milder losses in the amblyopic eye. After treatment, the position response decreased in the fellow eye and increased in amblyopic eye (p=0.007). After treatment, the motion responses reduced in the fellow eye (p=0.01), but no significant change occurred in the amblyopic eye.

Discussion: The differential effect of early deprivation (amblyopia) on position vs motion evoked potentials and their responses to treatment suggests an unequal level of plasticity in differing neural substrates.

Conclusion: Form versus motion processing mechanisms in developing human visual cortex may have different neural origins and/or plasticity.

Boston Amblyopia Study 1: Complete Resolution of Subthreshold Amblyopia with Standard Clinical Treatment

Suzanne M. Michalak, MD; Kaila M. Bishop, BA; Talia N. Shoshany, BA; David G. Hunter, MD, PhD

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Introduction: Published studies of amblyopia include only patients with visual acuity (VA) worse than 0.30 logMAR bilaterally or an interocular VA difference (IOD) of \( \geq 2 \) lines. This study examines the outcomes of patients who were coded as and treated for amblyopia despite not meeting official criteria for amblyopia.

Methods: Retrospective review of 4096 patients seen at a teaching hospital from 2010-2015 and coded as amblyopic. Unilateral amblyopia was defined as IOD \( \geq 0.14 \) with VA <0.30 in one eye; bilateral was defined as VA \( \geq 0.30 \) bilaterally. Statistical analysis was performed using Wilcoxon signed-ranked test within groups.

Results: Of 642 patients reviewed to date, 48 did not meet traditional criteria for either bilateral or unilateral amblyopia but had an IOD >0. Half (24 patients, 67% male) returned for follow-up. No follow-up visit was requested for 13 patients; another 11 were lost to follow-up. The average age at treatment initiation was 7.1±4.0 years and average length of follow-up was 2.8±1.8 years. Patients improved significantly with traditional amblyopia therapy (median IOD_initial =0.08, IOD_final =0.00, \( p =.007 \)), with over half achieving a VA of 0.0 bilaterally. For patients who were treatment naive, 88% achieved a final visual acuity of 0.0.

Discussion: Patients with IOD <0.14 do not meet published diagnostic criteria for amblyopia and thus do not always receive treatment. When offered treatment, visual acuity improves significantly and usually reaches 0.0 (20/20) or better.

Conclusion: Patients with any IOD should be offered treatment for amblyopia.


Boston Amblyopia Study 2: Treatment Outcomes in Patients with Asymmetric, Bilateral Amblyopia

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Introduction: Many bilateral amblyopia patients have asymmetric visual acuity (VA). There is no standard treatment protocol for these patients, and outcomes have not been well described.

Methods: Retrospective chart review of 4096 patients evaluated for amblyopia at a teaching hospital between 2010-2015. Inclusion criteria for asymmetric bilateral amblyopia: interocular difference (IOD) ≥0.14 logMAR; VA ≥0.30 bilaterally; minimum 2 visits. Statistical analysis was performed using Wilcoxon signed-ranked test within groups and t-test and chi-squared test between groups.

Results: Of 642 patients reviewed to date, 82 (12.8%) met bilateral amblyopia inclusion criteria; 34 had asymmetric amblyopia. Most received glasses (82%) and nearly half of asymmetric patients (44%) were prescribed occlusion averaging 2 hours/day. Initial VA did not differ significantly between groups (0.40-0.45 in stronger eye; 0.79-0.82 in weaker eye), nor did mean initial IOD (occlusion: 0.40; no-occlusion: 0.37, p=0.7) or mean follow-up (occlusion: 2.7y; no-occlusion: 3.1y, p=0.5).

Occlusion did not result in significant additional improvement in IOD (0.22 improvement with occlusion vs. 0.19 without, p=0.7). Likewise, VA improved similarly in both groups (0.24 VA in stronger eye with occlusion vs. 0.30 without; 0.45 VA in weaker eye with occlusion vs. 0.53 without, p=0.3). Asymmetry resolved to <0.14 in both groups (occlusion: 53.3%; non-occlusion: 52.6%, p=0.9).

Discussion: For bilateral, asymmetric amblyopia, VA improved two lines in both eyes while VA asymmetry resolved in half of patients, regardless of whether occlusion was prescribed.

Conclusion: In patients with asymmetric bilateral amblyopia, occlusion provides no further benefit to spectacle correction alone, nor does it hinder VA improvement in the stronger eye.


Use of Electronic Reminders in the Treatment of Amblyopia

Kammi B. Gunton; Aldo Vagge; Bruce Schnall

Wills Eye Hospital
Philadelphia

Introduction: To determine whether a smartphone medical adherence application (app) (RxmindMe® Prescription/Medicine Reminder and Pill Tracker) can be used to improve compliance to treatment of amblyopia in patients 3-7 years of age.

Methods: Prospective, case-control study. Patients 3-7 years of age were randomized to receive electronic reminders (reminders group) or standard instructions (control group). Visual acuity and compliance with treatment was assessed at the follow up visit. The patient's adherence with the prescribed treatment was calculated as the reported number of hours of patching performed divided by the number of hours prescribed or compliance percentage. The validated 'Amblyopia treatment Index Parental Questionnaire' was administered to the parent/guardian to assess the impact of patching treatment during the follow up appointment.

Results: 23 patients were enrolled. Twelve children in the reminder group were compared with 11 in the control group. No significant differences were found between the two groups in terms of age (p=0.168), gender (p=0.684), visual acuity improvement (p=0.36), or percentage compliance (95% vs. 90%, p=0.40).

Discussion: While some families felt they benefited from the reminder app, visual improvement and compliance was similar to standard treatment.

Conclusion: Our findings indicate that a smartphone reminder app can be used in this patient population in the treatment of amblyopia. Targeting the app to specific patient demographics or when difficulty with compliance is encountered needs to be further investigated.

References:
**Introduction:** Intermittent occlusion therapy (IO-therapy) glasses (at 30-second opaque/transparent intervals) avoid the need for an adhesive patch, potentially improving compliance. Our previous clinical trial supports the effectiveness of this new device for amblyopia treatment. However, there was no objective compliance measured for these glasses, which limits understanding of the dose-response for this treatment. This study reports pilot data of a microsensor to monitor objective compliance with IO-therapy glasses.

**Methods:** Fifteen children (3-8 yr) with unilateral amblyopia associated with strabismus and anisometropia were enrolled. At enrollment, they were prescribed 4 to 12 hours of intermittent occlusion therapy glasses. An microsensor was attached to the temple arm to monitor compliance with IO-therapy glasses wear for 4 to 12 weeks. Compliance was defined as the percentage of hours of actual glasses wearing compared to the hours of prescribed. Daily compliance and general compliance were analyzed. Mean daily compliance with IO-therapy was compared with mean daily objective compliance with patching.

**Results:** General compliance over treatment period varied among individuals (ranged from 16% to 90%) and was averaged at 56%. Daily compliance declined with treatment time course for most patients; mean daily compliance decreased by 0.8% everyday. On average, the mean daily compliance is similar to the mean daily compliance with patching.

**Discussion:** Although these preliminary results are limited by the small sample size, improving compliance in children with amblyopia is still challenging.

**Conclusion:** Objective compliance with IO-therapy therapy glasses varies among individuals, but on average declines over time.

Amblyopia with Eccentric Fixation: Is Inverse Occlusion Still an Option?

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Introduction: To present our treatment protocol for patients with amblyopia and eccentric fixation who do not respond to conventional occlusion therapy.

Methods: In this consecutive case series, 11 patients were included, age 3.5 to 5, with mixed amblyopia and eccentric fixation, who had minor improvement of visual acuity (VA) despite good compliance after 6 hours to full-time occlusion of the dominant eye (VA ranged from 20/800 to 20/63). Total inverse occlusion of the amblyopic eye was done for 4 to 8 weeks to convert steady eccentric fixation into wandering fixation. No binocular viewing was allowed. Once the fixation became wandering, the dominant eye was occluded day and night and in most patients a red filter was placed before the amblyopic eye to stimulate foveal fixation.

Results: In nine children the fixation became central and VA improved to at least 20/32 in the amblyopic eye, the VA of the dominant eye did not change.

Discussion: In our case series inverse occlusion was used to eliminate the eccentric fixation point in amblyopic children where conventional occlusion failed to restore central fixation. Our goal of inverse occlusion was not to improve vision but only to eliminate the eccentric fixation point.

Conclusion: Inverse occlusion followed by conventional occlusion is still a valuable option to improve vision in amblyopic eyes with eccentric fixation. Placing a red filter before the amblyopic eye may be helpful to stimulate foveal fixation.

References:
Using an Electronic Medical Record to Perform a 'Live' Audit of the Results of Amblyopia Treatment

Rebecca Hunn; Jane Hadlington, BSc; Miranda Buckle, FRCOphth; Parth Shah, FRANZCO; John D. Ferris, FRCOphth

Gloucestershire Eye Unit
Cheltenham

Introduction: Auditing the results of amblyopia treatments using paper based notes or electronic medical records (EMR), is always a time consuming and laborious process, that is frequently plagued by incomplete data. This presentation will demonstrate how the results of amblyopia treatment can be analysed using the Medisoft EMR.

Methods: We will conduct a 'live' audit of our Medisoft amblyopia database to analyse the results of occlusion therapy for children presenting at different ages, with different visual acuities and with different types of amblyopia.

Results: The visual acuities at 16, 32, 48 and 64 week intervals for these different audit parameters will be presented in graphical form.

Discussion: The potential benefits of this type of audit include:
1) It enables departments to measure the quality of the amblyopia treatment they provide and to benchmark themselves against the results of the PEDIG studies.
2) Children / Parents can be given accurate predictions of their likely visual outcome based on the child’s age at presentation, presenting visual acuity and type of amblyopia.
3) Groups of children with poor outcomes can be identified easily and resources directed towards them.
4) The effect of a new amblyopia treatment, can easily be compared with established treatment protocols. This “real world” data is likely to be a more accurate reflection of the efficacy of a treatment than trial data.

Conclusion: The Medisoft EMR is the only EMR that enables clinicians to accurately analyse the results of treatment for amblyopia, with no additional data entry being required.

References: No relevant references
Introduction: To introduce a novel concept of myopia growth chart based on population-based survey for the prediction of myopic progression.

Methods: This study included 7,695 subjects from 5 to 20 years of age from a population-based health survey. We collected spherical equivalent (SE) data converted from noncycloplegic refraction data. For drawing up a myopia growth chart, we sorted the SE data from hyperopia to myopia to acquire specific percentiles (the 5th, 10th, 30th, 50th, 70th, 90th, and 95th percentile) of the SE by age. We calculated myopia progression rates between specific ages in each percentile group.

Results: Mean age of the subjects was 11.8 years, mean SE was -1.82 diopters (D). The SE of the 10th percentile group was +0.72 D in 5 years of age, and -0.25 D in 20 years of age, resulting in total refraction change as -0.97 D. On the contrary, the SE of the 90th percentile group was -0.75 D in 5 years of age, and -6.73 D, showing -5.98 D of myopia progression. The myopia progression rate was estimated as -0.06 D per year, -0.15 D per year and -0.40 D per year each in the 10th, 50th and 90th percentile group from 5 to 20 years of age.

Discussion: Those who have higher percentiles of refractive error may show more rapid myopic progression.

Conclusion: Myopia growth chart may be used to predict the severity or the progression estimates in myopia. A patient having a higher percentile of myopia for his or her age may have more myopia progression rates and is needed for close observation for myopia suppression treatment.

Introduction: Myopia is the most common ocular disorder and its prevalence has risen significantly during the last two decades reaching epidemic proportions. Several studies were conducted with variable results on progression rate. One of the limitations in all studies is insufficient follow-up time, with only few studies who observed subject for more than two years, and a relatively small sample size. We aimed to evaluate the natural myopia progression rate observed among subjects treated at a pediatric ophthalmologist clinic in Israel.

Methods: Retrospective collection of refractive measurements taken at a single clinic. Subjects aged 5-15 who had at least 3 consecutive annual measurements were included. Myopia yearly progression rate was determined using Generalized Estimating Equations (GEE) model.

Results: Out of 56,869 subjects treated at the clinic 2,235 met the inclusion criteria with a mean of 5.7±2.9 visits over a period of 6.0±3.6 years (22,856 visits total). In the general population the yearly rate of progression was -0.12±0.11 diopter. The progression rate was higher among children who developed mild-moderate myopia (-0.19±0.03) and over thrice among children who reached high myopia (-0.39±0.04).

Discussion: We present clinical practice data regarding refractive changes among children and adolescence collected for a period of over 15 years. The observed myopia progression rate was substantially lower than previously reported. However they are unique in both sample size and duration of follow-up.

Conclusion: 1) Myopic progression in Israeli population is much lower than in the East. 2) Consequently procedures taken to retard myopic progression might be unnecessary.

Introduction: To determine the prevalence and its risk stratification of myopia in Chinese children according to their parental myopia in a population-based study.

Methods: A total of 3199 children (response rate 91.4%) from Grade One to Grade Three (aged 6 to 9 years) and 4496 parents were recruited from Hong Kong Children Eye Study. Axial length (AL), anterior chamber depth (ACD), and corneal curvature were obtained. Cycloplegic auto-refraction was measured for children and non-cycloplegic refraction for parents. Multiple regression analysis was performed to explore the associations between refraction and ocular biometry.

Results: The prevalence of myopia in children (aged 6 to 9 years) was 26.21%, which was higher in boys and in the older age group. In parents, the myopia prevalence was 78.53%. The prevalence of myopia in parents increased with their educational level. The prevalence of myopia in children was 10.53%, 12.31%, 17.76%, 24.77%, 25.25%, 36.13%, 26.58%, 34.47%, 41.62%, and 54.10% when the severity of myopia in both parents was nonmyopic/nonmyopic, nonmyopic/mild, mild/mild, nonmyopic/moderate, mild/moderate, moderate/moderate, nonmyopic/high, mild/high myopia, moderate/high, and high/high. There was 11.9-fold increase in risk of myopia when both parents were highly myopic.

Discussion: The prevalence of myopia in children and their parents are high in Hong Kong. Risk of myopia in children is highly dependent on parental myopia.

Conclusion: We have stratified the risk of myopia of children according to the severity of myopia of both parents. This serves as an important guide for our predication.

Current Trends to Decrease Myopia Progression Survey: An IPOSC Global Study

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Haifa, Israel

Introduction: Myopia has become an epidemic. We compiled data worldwide to reach a consensus for preferred clinical practice to decrease myopia progression.

Methods: A questionnaire was sent to all members of supra-national and some national pediatric ophthalmology and strabismus societies.

Results: The questionnaire was fully completed in 847 of 940 responses. The majority routinely treat to decrease myopia progression (524, 59.1%). The most common parameter to initiate treatment was a myopic increase of 1 diopter/year or more (246, 74.8%). Most respondents (242, 51.1%) did not know at what age response to treatment was most effective. Most (345, 70%) prescribed eye drops and the average age they were initiated was 5.2 (0.5 to 16 years old). Atropine 0.01% was the most popular (277, 63.4%) with the highest number of respondents that have not discontinued treatment in any of their patients (178, 79.5%) and showed the least number of respondents, who had reported a rebound effect (53, 45.7%). Most respondents opted for more time outdoors (394, 85.7%), to spend less time looking at screens (277, 60.2%), and decrease the use of smart phones (294, 63.9%).

Discussion: Most pediatric ophthalmologists use a variety of means to decrease myopia progression. Atropine 0.01% is the most popular and safe modality similarly to recent reports [1]. However, there is no consensus when treatment should be initiated.

Conclusion: Further prospective studies are needed to elucidate the best timing to start treatment and the applicability of recent studies in the Asian population [2] to other ethnic groups.


Poster #227
Wednesday, 10:05 – 11:05 am

Influence of Orthokeratology Lens on Axial length Elongation and Myopic Progression in Childhood Myopia

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Introduction: To investigate the clinical effects of orthokeratology lens wear on inhibition of the myopic progression and axial length elongation in Korean children with myopia.

Methods: The authors reviewed out-patient records of 37 eyes of 19 patients wearing orthokeratology lenses. The 46 eyes of 23 patients wearing spectacles were included into the control group. We evaluated the relationship between orthokeratology lens wear and control group according to age, initial myopia, initial astigmatism, axial length elongation.

Results: There were no significant differences between two groups as for age, initial myopia, astigmatism, spherical equivalent, and axial length at baseline (t-test, p > 0.05). Significant reduction of refraction was shown in patients with wearing lenses after 1 year (t-test, p < 0.001). The mean axial length before and after 1 year was 24.62 ± 1.39 mm and 24.73 ± 1.28 mm respectively after lens wearing, and 24.59 ± 0.74 mm and 24.80 ± 0.71 mm respectively after wearing glasses. The axial length elongation was 0.11 ± 0.12 mm, and 0.21 ± 0.07 mm in patients with wearing lenses and glasses, respectively, which showed statistically significant difference (t-test, p < 0.0001).

Discussion: The axial length elongation in the overnight orthokeratology group was significantly smaller than that in the glasses group. Although orthokeratology lens cannot completely arrest axial elongation in myopic children, it can retard it, suggesting the potential effect of this treatment for controlling the progression of myopia.

Conclusion: The orthokeratology lens was found to be effective in suppression of myopic progression through less axial length elongation, compared with the glasses.

A Three Year Follow-Up Study of Atropine Treatment for Progressive Myopia in Europeans

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Introduction: Atropine is the most effective treatment for myopia. This study explores the 3-year efficacy of atropine 0.5% for progressive high myopia in a clinical setting, and the risk factors for poor response.

Methods: We performed an effectiveness study of atropine eye drops for progressive myopia in a university clinic. We included children who had 3 year consecutive data using atropine eye drops 0.5% daily (N=109). A standardized eye examination, including cycloplegic refraction and axial length at baseline was performed with follow up every 6 months. Chi-square analysis was used to evaluate risk factors associated with progression of myopia during atropine treatment.

Results: At baseline, median age was 9(IQR 5) years, the median spherical equivalent (SphE) -5.56D(IQR 3.75) and median axial length (AL) 25.03mm(IQR 1.28). Adherence to therapy was 73%. The median annual progression before treatment was -1.1D(IQR 0.97) and the median annual progression over a three year period for SphE was -0.31D(IQR 0.77) and for AL 0.12mm(IQR 0.27). Age at start of therapy was a risk factor, children <10-years had median annual progression of -0.38D/year and >/=10-years -0.25D.(P=0.01)

Discussion: Atropine for progressive myopia has an inhibiting effect on SE and AL over a 3-year period. On average, 15% of children did not meet treatment target and progressed 1D or more per year.

Conclusion: Atropine 0.5% is effective for the majority of European children with progressive myopia over a period of 3 years. Atropine treatment was less effective in children under 10-years and may need to be combined with additional interventions to arrest progression.
Computed Tomography (CT) Based 3D Modeling to Provide Custom 3D Printed Glasses for Children with Craniofacial Abnormalities

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**Introduction:** Children with craniofacial abnormalities frequently have a variety of ophthalmic problems including high rates of refractive error with oblique astigmatism and anisometropia. In order to prevent amblyopia spectacle use is critical but very challenging given the mechanical difficulty of wearing glasses beyond the normal problems of spectacle adherence in the pediatric population.

**Methods:** Existing head CT scans are transformed into 3D models upon which custom computer aided design (CAD) models of glasses frames are developed. These unique glasses frames are then printed using a 3D printer.

**Results:** We have developed well-fitting custom 3D printed glasses for a 5-year-old patient with craniosynostosis and other craniofacial abnormalities that prevented the use of conventional glasses.

**Discussion:** We take advantage of the extensive imaging patients with craniofacial abnormalities routinely undergo to generate high-quality 3D model upon which custom glasses frames can be designed. 3D printing allows for rapid, cost-effective production of entirely customized glasses frames for each patient.

**Conclusion:** The use of new digital modeling and 3D printing technology allows us to bring new custom solutions to our patients that are not well served by 'off the rack' products. Additionally, as the design process is entirely digital and based on existing radiologic data, these custom glasses could be developed remotely for patients throughout the world.

Rubella Virus a Cause of Congenital Cataract – Not To Be Forgotten

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Introduction: Despite a reduction in disease burden of quite a few vaccine-preventable diseases through childhood immunization, congenital rubella syndrome continues to be an important cause of avoidable morbidity in developing countries. This study is conducted to determine the contribution of Rubella infection towards the development of congenital cataract.

Methods: The data of the patients less than one year of age (n=384) admitted for the management of congenital cataract from January 2012 - December 2016 was reviewed. Blood samples of all the infants were tested for the presence of specific immunoglobulin M (IgM) and immunoglobulin G (IgG) antibodies by the enzyme-linked immunosorbent assay (ELIZA) method. The data were statistically analyzed using Microsoft excel software.

Results: A total of 384 patient's data was included in the study. Rubella-specific IgM and IgG were found in 69 (17.9%) infants of whom 93% were less than six months of age, mean age being 2.9mths +/- 2.1(SD). Associated ocular problems such as microphthalmos were seen in 16 infants (23.1%). Glaucoma was however not so common present only in 6 infants (8.6%). Cardiac involvement was seen in 19 patients (27.5%).

Discussion: The results of the study are indicative of high prevalence rate for Rubella infection in our part of the world.

Conclusion: Proper surveillance and immunization against rubella is highly imperative in reducing the long-term morbidity such as childhood blindness, deafness, cardiac malformations and mental retardation.

Infectious Risk Factors for Congenital Cataract in Tanzania

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Introduction: Cataract is the leading cause of blindness in children in sub Saharan Africa - the importance of congenital rubella and CMV infection in the aetiology is unknown (1-3).

Aim: To investigate the prevalence of congenital rubella and cytomegalovirus (CMV) infection in congenital cataract cases and controls

Methods: We collected lens tissue, oral fluid and dried blood spots (DBS) from 74 children (<12 months) with bilateral congenital cataract attending tertiary facilities in Tanzania. We also collected saliva and DBS from 74 age-matched controls attending Reproductive and Child Health (RCH) clinics. DBS samples from cases and controls were tested for IgM antibodies to Rubella Virus and CMV by ELISA. Molecular detection of Rubella and CMV was performed using qPCR on saliva specimens from cataract cases and matched controls and on lens tissue specimens taken from cataract cases during surgery.

Results: CMV specific IgM was detected in 9/74 (12.16%) cases. There was no case of raised CMV or Rubella IgM titres in controls. CMV was detected in 56 of 74 (75%) saliva specimens of cases compared to 25/74 (33.8%) of controls (p<0.0001). In cases, 9/74 (12.2%) lens aspirates were CMV positive; 8 of these cases were also saliva positive whereas only one was positive for saliva, lens, and DBS. Rubella specific IgM was detected in 9/74 (12.16%) cases. Only one sample was positive for both CMV and Rubella IgM. Rubella virus was detected in only 1 of 74 (1.4%) saliva samples but 9/74 (12.16%) lens aspirates from cases; 4 were also serology positive.

Discussion: Our study show that, there was no case of raised CMV or Rubella IgM titres in controls. CMV was detected in saliva specimens of cases at a higher prevalence compared to of controls. In cases, CMV was also detected in lens aspirates. Rubella specific IgM was detected in cases at a lower prevalence.

Conclusion: Both congenital CMV and rubella infections appear to be implicated in the aetiology of congenital cataract in Tanzanian children.

References:
**Molecular Characteristics of Primary Pediatric Lens Epithelium Cells**

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**Introduction:** After-cataract is a common complication of cataract surgery in children. Epithelial-to-mesenchymal transformation (EMT) of lens epithelium cells is thought to be involved in after-cataract formation. To better understand the molecular basis of these processes, we studied the molecular characteristics of PLEC and of a lens cell line (HLE-B3) before and after stimulation with transforming growth factor beta2 (TGFbeta2), which has been implicated in EMT and after-cataract formation.

**Methods:** PLEC were obtained during pediatric cataract surgery by harvesting anterior capsules, and were cultivated in DMEM/F-12. HLE-B3 cells were cultivated in EMEM medium supplemented with 20% fetal calf serum and 1% penicillin-streptomycin. We studied the expression of the genes for crystalline alpha (CRYAB) and connexin 43 (Cx43) as epithelial markers, and for fibronectin (FN1), integrin alpha V (ITGAV), alpha smooth-muscle actin (aSMA) and collagen 1 alpha 2 (COL1A2) as mesenchymal markers. Expression profiles before and after stimulation with TGFbeta2 were examined using reverse transcription (RT), quantitative real-time (qRT) PCR and gel electrophoresis.

**Results:** The protocol for cultivating PLEC was established. Expression of CRYAB (in HLE-B3, p= 0.0003), ITGAV (in HLE-B3, p= 0.01), COL1A2 and FN1 (in pLEC, p= 0.003 and HLE-B3, p= 0.0002) were significantly upregulated after stimulation with TGFβ-2. Total gene expression levels were significantly higher in PLEC compared to HLE-B3. Patient age at surgery and cataract morphology affected growth of PLEC in culture.

**Discussion:** Compared with HLE-B3, PLEC showed higher overall gene expression levels. Stimulation of PLEC and HLE-B3 cells with TGFbeta2 led to a shift in the expression profile, compatible with EMT. EMT is involved in the development of after-cataracts.

**Conclusion:** Using cell culture, gene expression profiles of PLEC can be studied. This model may be useful to study mechanisms of after-cataract development, its prophylaxis and treatment.

**References:**  
Assessment of the Necessity for Surgical Intervention in Unilateral Pediatric Cataract

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Introduction: We describe the use of Sweep Visual Evoked Potential (SVEP) as a surrogate for accurate, objective measure of visual acuity and therefore need for surgical intervention, in our preverbal pediatric patients with unilateral cataract.

Methods: 30 pediatric preverbal children in the amblyopic age with unilateral cataract were included. Analysis of final corrected visual acuity with blocked HOTV or linear Snellen. Ad-hoc analysis of pre-operative features relating to need for surgical intervention were analyzed.

Results: Normal visual maturation by SVEP is found to follow a logarithmic growth curve. A graph provides logarithmic analysis for normal visual development by SVEP vision recordings over the first three years of life. Children who did not maintain logarithmic vision development underwent surgical intervention. Ad-hoc analysis showed that successful non-surgical treatment of unilateral cataract was highly correlated to ability to achieve endpoint in retinoscopy, compliance with 4 hours/day occlusion therapy and absence of strabismus.

Discussion: Determination of the need for intervention traditionally has been based on morphologic features of the cataract alone. We have found the use of SVEP along with retinoscopic reflex and compliance to occlusion therapy a useful guide to successful visual outcome in pediatric cataract.

Conclusion: The SVEP recording provides logarithmic data of acuity development in preliterate children, which we found critical in assessing the need for intervention.


Influences of Unilateral Posterior Lens Opacity on Visual Function and Ocular Structure

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Introduction: To investigate the impairment of visual function and ocular structure in patients with unilateral posterior lens opacity, one type of congenital cataract (CC) in our novel CC category system, and to provide clinical treatment guidance for the current controversial options.

Methods: This study included 25 patients (aged 3-15 years) who were diagnosed with unilateral posterior CC at the Zhongshan Ophthalmic Center from 2015 to 2016. Ocular structures and visual evoked potential (VEP) were compared between two eyes by paired t-test.

Results: Compared with contralateral healthy eyes, larger corneal astigmatism and deeper anterior chamber depth were found in cataractous eyes. The P100 peak time of pattern VEP-60'in cataractous eyes were longer than those in contralateral healthy eyes. The amplitudes of both pattern VEP-60' and -15'in cataractous eyes were smaller than those in the contralateral healthy eyes. No obvious positive or negative linear relationship was found between best corrected visual acuity and parameters of VEP.

Discussion: Posterior CC has the most controversial treatment option among all our novel categories due to the seemingly mild lens opacity and small affected area. Results of this study showed that the ocular structures, subjective and objective visual function of patients with posterior cataracts were significantly impacted by lens opacity. Furthermore, visual electrophysiology examinations are necessary independent of the visual acuity.

Conclusion: For patients diagnosed with posterior cataracts based on our novel CC system, timely surgical intervention is considerable.

Factors Affecting Visual Acuity after Unilateral Cataract Extraction in Pediatric Age Group

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Introduction: To evaluate the preoperative risk factors for poor visual outcomes in unilateral pediatric cataract, mainly the interocular axial length difference (IALD).

Methods: Retrospective chart review of pediatric patients with unilateral congenital cataracts was done in a tertiary referral hospitals in Egypt ‘ABO El Reesh Children Hospital, Cairo University’ and Fayoum university hospital. Subjects that had cataract extraction with primary IOL implantation were included and if the surgery was performed at the age from 10 months to 11 years. Statistical analysis was done.

Results: Thirty subjects were used in our study that had all inclusion criteria, with complete response. Mean IALD was 1.37 mm. The mean IALD was 0.26 mm only in patients with good visual outcome while those who had fair and poor outcome, it was 1.87 mm and 2.24 mm respectively. All the patients who had good visual outcome were compliant to amblyopia therapy while 60% of patients with fair visual outcome and 28.50% of those with poor visual outcome only showed compliance. Mean age at the time of surgery was 39.40 months. Eleven patients had good vision. 91.9% of them were younger than 2 years old at the time of surgery.

Discussion: It goes with the opinion of Fangqin Ma et al., Gochnauer et al., Chak et al., Lundvall & Kugelberg and Ondraaek & Lokaj but not with Ledoux et al.

Conclusion: The smaller preoperative IALD, the younger the surgical age, the better the compliance to amblyopia therapy, the better will be the visual outcome in child with unilateral cataract.

Automated Volumetric Measurement of Anterior Chamber and Other Structures and Iridocorneal Angle Based on 3D Reconstruction of UBM Images

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Introduction: Ultrasound biomicroscopy is widely used by ophthalmologists to acquire 2D images of the anterior segment and to measure parameters such as the anterior chamber depth and iridocorneal angle. We present a system for automatic measurement of the angle and the anterior chamber volume based on 3D reconstruction of UBM images.

Methods: We use a Quantel 50 MHz UBM probe attached to the surgical microscope with a precision translation stage. Approximately 1000 slices are captured and reconstructed to create a 3D model of the anterior chamber. The 3D model is analyzed to quantify the anterior chamber volume and the IC angle.

Results: We have used our device to create 3D models of the eye in animals, cadaver eyes, and patients. Our software is able to perform automatic measurement of the AC volume and IC angle in these eyes and to provide those results in near real time.

Discussion: Our results are in quantitative agreement with other techniques including manual segmentation and angle measurements. Furthermore, because we capture the entire eye at fairly high resolution, our measurements do not rely on geometric simplifications or other approximations which could compromise the results.

Conclusion: We have demonstrated the use of 3D models from UBM images to measure anterior chamber parameters as the AC volume, segmentation of structures, accurate volumetric measurement of structures and the IC angle around the entire circumference of the eye. Other methods exist for making these measurements, however, the combination of the UBM resolution and its ability to penetrate opaque lenses makes it a unique tool for clinicians. This promises to be a valuable tool for diagnosis and treatment planning.

Long-Term Experience Utilizing Optic Capture Through a Capsular Buttonhole for Pediatric Cataracts

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Introduction: Capsular management is a significant concern with intraocular lens (IOL) use in pediatric patients. This study presents long-term experience and technical details for a procedure that yields a stable clear visual axis in pediatric IOL surgery.

Methods: This is a retrospective review of 58 eyes in 42 patients that underwent IOL implantation between 2005 and 2017. The prolene haptics are fixated in the ciliary sulcus and the 6.0mm acrylic optic is captured in a buttonhole of both the anterior and posterior capsules created with a vitrector.

Results: Mean age at surgery was 6.0 years (0.5-13) with mean follow of 43.2 months (3-139.2) and 38% bilateral. Cataracts treated included 83% congenital, 10% traumatic and 7% metabolic. There were no cases of opacification of the visual axis, contracture of the anterior or posterior capsule, iris chaffing, iritis or late IOL dislocation. One case required early IOL repositioning and IOL implantation was aborted in one case due to radial capsular tear.

Discussion: Buttonholing of the acrylic optic through the anterior and posterior capsule resulted in a stable and clear visual axis in all study patients. This single entry technique obviates the need for incisions through the pars plana and YAG capsulotomy. The technique is effective for secondary IOL implantation and in cases following trauma.

Conclusion: Capturing the IOL optic in a buttonhole consisting of anterior and posterior capsule is a technique that has a short learning curve, provides stable IOL fixation and a consistently clear visual axis in pediatric patients. The technical details will be described.

Clinical Course and Treatment Rates of Retinopathy of Prematurity in Extremely Premature Infants

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Introduction: Advances in neonatal care have increased survival of the youngest premature infants. This study aims to better characterize the incidence and natural history of Retinopathy of Prematurity (ROP) in this population.

Methods: A retrospective and prospective chart review of infants born less than 26 weeks gestational age (GA) at birth was performed. 253 infants were identified with the rates of incidence and course of ROP evaluated.

Results: The weight at birth was 563.33±25 grams at 22 to 22 6/7 weeks, 573.29±13.83 grams at 23 to 23 6/7 weeks, 658.71±10.99 grams at 24 to 24 6/7 weeks, and 701.32±15.03 grams at 25 to 25 6/7 weeks. The incidence and age of treatment requiring (Type I) ROP was 50% at 34.2 weeks for 22 week infants, 66.66% at 35.02±0.35 weeks for 23 week infants, 37.61% at 35.57±0.35 weeks for 24 week infants, and 30.93% at 36.33±0.39 weeks for 25 week infants. The GA at initial treatment for each group was: 22 at 34.29 weeks, 23 at 34.31±0.69 weeks, 24 at 35.31±0.51 weeks, 25 at 36 ± 0.41 weeks. There was no difference in the weights of infants with Type I ROP at 22-23 GA, but older infants did have lower weight (p<0.01).

Discussion: Younger premature infants had earlier and higher rates of Type I ROP. Gestational weight was only significantly lower for infants with Type I ROP 24 weeks and older.

Conclusion: Infants born at less than 25 weeks GA may require closer follow-up since they develop Type I ROP more frequently and earlier than older infants.

Delayed Resolution of Retinopathy of Prematurity

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Introduction: We investigated the clinical course of infants with unresolved retinopathy of prematurity (ROP) at 50 weeks corrected gestational age (CGA). We compared clinical characteristics between infants whose ROP resolved before 50 weeks CGA and those with a delayed resolution of ROP.

Methods: A retrospective chart review was performed on the medical records of infants screened for ROP at our institutions between January 2008 and December 2016. Delayed resolution was defined as the presence of persistent ROP or immature retinal vasculature at ≥50 weeks CGA. Chi-square was used to compare infants with delayed resolution to infants without delayed resolution. Variables with a p-value ≤0.05 were considered statistically significant.

Results: 990 infants were included in the analysis. 131 (13.2%) showed delayed resolution. Infants with more severe ROP (higher stage, lower zone, plus/pre-plus disease) and type II ROP were significantly more likely to have delayed resolution. Variables associated with delayed resolution (p≤0.05) included <28 weeks CGA at birth, =3rd percentile birth-weight, positive blood culture sepsis, necrotizing enterocolitis, and intraventricular hemorrhage. No infants required treatment for ROP after 50 weeks CGA.

Discussion: In our cohort, infants with more severe ROP, <28 weeks CGA at birth, low birth-weight, and neonatal complications were more likely to have delayed resolution of ROP. Infants with delayed resolution did not require treatment for ROP after 50 weeks CGA.

Conclusion: Clinicians may expect infants with more severe ROP or a more complex clinical course to have delayed resolution. Further studies are needed to determine if ROP exams after 50 weeks CGA are necessary.

Level, Timing, and Duration of Thrombocytopenia as a Risk Factor for the Development of Severe ROP in the Postnatal Growth and ROP (G-ROP) Study

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Introduction: Identification of modifiable risk factors for retinopathy of prematurity (ROP) may lead to preventive or therapeutic targets. Beyond hemostasis, platelets store, transport, and deliver VEGF and IGF-1, which are both involved in ROP pathogenesis.

Purpose: To evaluate the association between degree, timing, and duration of thrombocytopenia and severe ROP.

Methods: Retrospective study at 29 North-American hospitals, 2006-2012 (The G-ROP Study). Multivariable regression evaluated associations between thrombocytopenia and type 1/2 ROP, controlling for birth-weight, gestational age, necrotizing enterocolitis, sepsis. Mean platelet levels and proportions of infants with thrombocytopenia (defined three ways: \(\leq 150,000\), \(\leq 100,000\), \(\leq 50,000/mcl\)) were compared. Onset and thrombocytopenia duration were evaluated.

Results: 7,238 infants studied, 917(12.7%) developed severe ROP. Mean platelets were significantly lower and proportions with thrombocytopenia at each level (\(\leq 150k\), \(\leq 100k\), \(\leq 50k\)) were significantly higher in infants with severe ROP during each PMA-week 25-40. Proportions of infants with/without severe ROP with thrombocytopenia by 34 weeks PMA were 72%/34% (\(\leq 150k\)), 46%/15% (\(\leq 100k\)), 14%/3% (\(\leq 50k\))(all p<0.0001). Corresponding aORs(95% CI), were 1.63(1.36-1.96), 1.62(1.33-1.96), 1.68(1.14-2.48). 86% infants who had platelets \(\leq 50K\) by PMA-week 27 developed severe ROP (aOR 4.97). Increasing thrombocytopenia duration during PMA-weeks 29-34 was associated with increased risk, especially for \(\leq 50k\) level.

Discussion: Thrombocytopenia with onset prior to 34-weeks PMA is independently associated with severe ROP, even for levels above those considered as bleeding risk, and short time periods. Low serum platelet levels increase risk of severe ROP.

Conclusion: Low serum platelet levels increase risk of severe ROP. Further study of these associations and the potential of platelet transfusions as a preventive intervention to reduce ROP risk are warranted.

The Relationship between Severe Bronchopulmonary Dysplasia and Severe Retinopathy of Prematurity in a Colorado Cohort

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Introduction: Bronchopulmonary dysplasia (BPD) and Retinopathy of Prematurity (ROP) are two adverse sequelae of preterm birth associated with abnormal vascular development. Our purpose was to characterize the interrelationship between these two outcomes in a Colorado cohort.

Methods: We performed a retrospective review of infants screened for ROP at the University of Colorado Hospital and Children’s Hospital Colorado between January 2012 and July 2015. We classified ROP using the ET-ROP criteria and BPD by the 2010 Criteria from the National Institute for Child Health and Development. We examined the relationship between moderate-severe BPD and the development of severe ROP (Type 1 or 2) using univariate analysis and multivariable logistic regression with the odds ratio (OR) as a measure of association. Co-variates included gestational age (GA) and birth weight at delivery (BW).

Results: In the cohort (n = 660), 77 (12%) infants developed severe ROP and 220 (33%) infants developed moderate-severe BPD. We found a significant relationship between these two outcomes following adjustments for GA and BW (OR = 3.8, 95% CI = 2.0-7.1, P < 0.01).

Discussion: We found a significant relationship between moderate-severe BPD with severe ROP.

Conclusion: We suggest that these two neonatal outcomes have links with a common pathogenesis.


Prevalence and Risk Factors of Retinal Detachment from Retinopathy of Prematurity

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**Introduction:** Retinal detachment (RD) can develop from retinopathy of prematurity (ROP) despite treatment for Type 1 ROP. We sought to determine the prevalence, timing, and risk factors for RD from ROP.

**Methods:** Retrospective 'G-ROP Study' at 29 North-American hospitals between 2006-2012. Primary outcomes were prevalence of eyes developing RD (stage 4 or 5) and onset post-treatment. Birth weight (BW), gestational-age, postnatal-weight gain, surgical necrotizing enterocolitis (NEC), sepsis, and days of oxygen supplementation were evaluated as risk factors among treated eyes using multivariable regression.

**Results:** RD developed in 70/14,996 eyes (0.47%, 95% CI 0.37-0.59%) and 46/7,483 infants (0.61%); 37 stage 4, 33 stage 5; 52% had bilateral RD. 6 eyes/3 infants developed RD without Type 1 ROP diagnosis or treatment. 64/867 eyes developed RD following laser (7.4%, 5.8-9.3%): 56/742 Type 1, 8/128 Type 2. RD occurred at median 5.6 weeks (range 0.7-19 weeks) following treatment. 10 (15.6%) RD's were within 2 weeks of treatment. #Treated within 72 hours of Type 1 diagnoses was similar between RD and non-RD eyes. In multivariable analysis, lower BW (OR 1.03 per 10 gram decrease (1.01-1.05)) and NEC (OR 3.0, 1.5-5.9) were significant risk factors for RD following treatment. RD rates were, for example, 11.9% for BW<500g without NEC; 16.9% for BW<700g with NEC.

**Discussion:** Further investigation of infants at increased risk for RD could lead to modifications of treatment criteria or timing for such infants.

**Conclusion:** 7.4% of eyes progress to RD despite treatment for ROP. Infants with low BW and/or NEC are at increased risk for RD.

**References:** None
Treatment of Pre-Type 1 Disease in the Postnatal Growth and Retinopathy of Prematurity (G-ROP) Study

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Introduction: Current ROP guidelines recommend treatment for ETROP Type 1 pre-threshold disease. We sought to determine the prevalence and characteristics of eyes treated for ROP not meeting Type 1 criteria.

Methods: Retrospective study of infants from 29 North American hospitals between 2006-2012 (G-ROP Study). Primary outcomes were prevalence and characteristics of eyes treated for ROP milder than Type 1 ROP.

Results: 1,004 eyes of 7,483 infants in the G-ROP study received ROP treatment. 151 eyes (1% of all eyes, 15% of treated eyes) of 102 infants without Type 1 ROP underwent treatment at a mean post-menstrual age (PMA) 38 weeks (range 32-49). 126 (83.4%) eyes were treated for Type 2 ROP and 25 (16.6%) eyes were treated for milder ROP. Among the 102 infants, 50 (49%) had Type 1 ROP in the worse eye; 38 (37%) had Stage 3 Zone 2 pre-plus in the worst eye; and 12 (12%) had stage 3 without plus (10 were treated for stage 3 before 40 weeks PMA; 2 were treated for persistent stage 3 at 47 and 49 weeks PMA).

Discussion: Ophthalmologists commonly treat both eyes even if only one eye has Type 1 ROP. Some clinicians consider pre-plus disease in treatment decisions. Treatment for persistent stage 3 is less common.

Conclusion: One-sixth of eyes treated for ROP have disease milder than currently recommended Type 1 criteria. Clinician judgment of risk for progression supersedes recommended treatment criteria in such cases and is usually related to contralateral Type 1 disease or pre-plus vascular changes in one or both eyes.

References: N/A
Introduction: Retinopathy of prematurity (ROP) in zone 1 is a risk factor for unfavorable visual and structural outcomes. Outcomes are typically only reported for those requiring treatment. We report outcomes for all zone 1 eyes with ROP.

Methods: Since 1996, all infants screened for ROP have been tracked in a STOP-ROP database. Structural outcomes and procedures were collected for infants who developed stage 1 ROP in zone 1. Those with follow up to age 2 years were assessed for vision and refractive error.

Results: 196 eyes (110 infants) were in zone 1, 121 eyes (69 infants) had stage 1 ROP. Final retinal status was available for 53 infants (11 followed elsewhere, 5 deceased), who are the subject of this report. Mean gestational age was 24.5±1.3 weeks, birth weight was 682±195 grams. 76 eyes (72%) were type 1 or worse, receiving primary treatment with retinal ablation (79%) or bevacizumab (21%). Unfavorable structural outcomes were noted in 6/16 (62%) eyes treated prior to 2003, compared to 5/60 (8%) treated according to current guidelines. Visual acuity correlated with structural status: mean 0.38 (20/47) in eyes not requiring treatment, 0.40 (20/50) in treated eyes with favorable structural outcomes (p = 0.86), and no light perception in all eyes with unfavorable structural outcomes except one with light perception.

Discussion: Presence of zone 1 ROP is a predictor of need for treatment; earlier treatment and favorable structural outcome correlate with better visual outcomes.

Conclusion: Current treatment strategies for zone 1 ROP allow improved structural and visual outcomes.

Plus Disease in Retinopathy of Prematurity: Should Diagnosis Be Eye-Based or Quadrant-Based?

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Introduction: Plus disease in retinopathy of prematurity (ROP) is defined as at least 2 quadrants of retinal vascular abnormality. However, recent evidence suggests that experts often deviate from the published definition of plus disease, and it is uncertain whether experts truly perform 'quadrant-based' diagnosis or rather obtain a gestalt 'eye-based' diagnosis by assessing the overall retinal appearance, and which of these approaches is more accurate. We aimed to determine agreement between eye- vs. quadrant-based diagnosis for plus disease and accuracy and inter-grader agreement of each diagnostic approach.

Methods: As part of a prospective multicenter cohort study, 6 graders graded 197 wide-angle retinal images and their respective 4 cropped quadrant images, which were provided one at a time in random order. 'Quadrant-based' plus diagnosis was made when 2 or more quadrants were diagnosed as plus by combining grades of individual quadrants. 'Eye-based' plus diagnosis was defined as plus diagnosis based on the entire retinal images.

Results: There was variable agreement between eye- and quadrant-based plus diagnosis among the 6 graders (kappa=0.32-0.75). Quadrant-based diagnosis showed a tendency for lower agreement with reference standard diagnosis than eye-based diagnosis. Inter-grader agreement of quadrant-based diagnosis was significantly lower than that of eye-based diagnosis (kappa[95% CI] = 0.75[0.71-0.78] vs 0.55[0.51-0.59]).

Discussion: There was a discrepancy between quadrant- and eye-based analyses for plus disease diagnosis.

Conclusion: Eye-based diagnosis may be more reliable and accurate than combining individual quadrant grades for plus diagnosis in ROP. These study findings have important implications for clinical ROP management, and for education in ROP diagnosis.

How is Plus Disease Diagnosed in ROP? Insights from a Deep Learning Computer-Based Image Analysis System with Occlusion Analysis

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Introduction: Diagnosis of plus disease in retinopathy of prematurity (ROP) is subjective and variable. We have shown that computer-based image analysis can diagnose plus disease with comparable or better accuracy than experts. This study uses outputs from a deep learning algorithm to identify vascular features considered most significant by experts for plus disease diagnosis.

Methods: 31 wide-angle retinal images with plus disease, based on a consensus reference standard, were selected for this study. Occlusion analysis was performed using a convolutional neural network (CNN) to compute the significance of each 12x12 pixel image region to the network's ability to make a diagnosis, visualized as a 'heat map'. Vascular features were extracted from the areas that most relatively increased or decreased the probability of diagnosis.

Results: Retinal features identified as being important for plus disease based on occlusion analysis were: (1) central retinal location of vessels (31/31 images), (2) mid-peripheral location of vessels (25/31 images), (3) arterial tortuosity (31/31 images), (4) venous dilation (31/31 images), (5) arterial dilation (31/31), (6) venous tortuosity (31/31).

Discussion: Experts are often unable to explain their diagnostic process, and occlusion analysis methods can provide important insight about this process. Study findings show that many features considered important for diagnosis are not included in the definition of plus disease.

Conclusion: Vascular abnormalities including dilation and tortuosity of both arteries and veins in all fields of view are important for the diagnosis of retinopathy of prematurity. This has important implications for clinical care and education in ROP diagnosis.

New and Unique Features of Aggressive Posterior Retinopathy of Prematurity

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Introduction: In 2005, IC-ROP introduced AP-ROP characterized based on the prominence of plus disease, faint neovascularization and posterior location. Today, AP-ROP remains difficult to diagnose early in its course. An epidemic of AP-ROP remains prevalent in premature infants in middle-income countries around the world, representing up to 30% of all Type 1 ROP cases. We report new photographic findings of AP-ROP to improve recognition of this disease.

Methods: Premature infants 1-6 months old (PCA 31-55 weeks) were examined in three large NICUs in Moscow between 2007 and 2016. Diagnosis of AP-ROP was made using indirect ophthalmoscopy and retinal pathology was documented using RetCam and B-scan ultrasonography.

Results: New and unique features of AP-ROP include: (1) retinal vessels appearing discontinuous or 'broken' due to retinal 'edema', making dilation and tortuosity less apparent; (2) dome-shaped elevation of the retina around the optic disc that spreads to involve the entire retina; (3) posterior shunt vessels; (4) large hemorrhages, even hemoglobus; (5) earlier onset; and (6) dilation of Cloquet's canal.

Discussion: Features of AP-ROP may be different in middle-income countries due to neonatal care, where unrestricted oxygen may be given for weeks and delay in transport to level 3 NICUs is common. The picture of retinal 'edema' resembles findings in published the 1984 IC-ROP article. The cause of the retinal 'edema' is unclear; further investigation is needed.

Conclusion: Recognizing these new features allows for earlier diagnosis and treatment of AP-ROP. Early diagnosis is imperative to prevent infant blindness from this difficult-to-treat disorder.

Outcomes of Laser Photocoagulation for ROP in the Decade after Early Treatment for Retinopathy of Prematurity Trial (ETROP)

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Introduction: We report the structural, visual, and refractive outcomes following laser treatment for type 1 ROP at a Canadian centre in the decade after the publication of results of ETROP randomized trial.1

Methods: We reviewed charts for infants treated between 2004-2014. Patients with type 1 ROP and follow-up examination at 8-15 months corrected age (CA) and/or 3 years ±6 months were included. We report structural outcome as per ETROP criteria. Secondary outcomes were refractive error and visual acuity (VA), reported in spherical equivalent (SE) and logMAR, respectively.

Results: One hundred and seventeen infants (n=213 eyes) received laser in zone I (n=43), and zone II (n=170). Mean gestational age was 25.4±1.6 weeks. Mean birth weight was 758.5±272.1 grams. Four eyes (1.9%) demonstrated unfavorable structural outcome; three were in zone I. At 8-15 months CA, mean VA was 0.9±0.34 logMAR (range 0.00 to 2.12), and mean refractive error was -3.23±4.63 SE diopters (range -18.50 to +12.50). At 3 years, mean VA was 0.4±0.38 logMAR (range 0.00 to 1.90), with mean refractive error of -5.41±5.99 SE diopters (range -21.00 to +2.25).

Discussion: We observed lower rates of unfavorable structural outcomes compared to ETROP.1 Refractive error and VA findings are consistent with previous studies.2,3

Conclusion: Structural outcomes following laser may have improved since ETROP. Our results highlight the value of incorporating institutional data as well as published comparisons when obtaining consent for ROP treatment. This is particularly relevant when parents are offered a choice between laser and anti-VEGF treatment modalities.

Retinopathy of Prematurity after Intravitreal Ranibizumab Monotherapy

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Introduction: Anti-VEGF agents are a treatment alternative for Type 1-ROP. Intravitreal ranibizumab (IVR), considered by some a safer alternative to bevacizumab, can result in ROP regression, with variable rates of disease recurrence. We describe a series of 9 consecutive Type 1-ROP eyes injected with IVR.

Methods: Retrospective chart review on consecutive infants treated with IVR for Type 1-ROP. Infants were followed for ROP until total resolution and/or complete vascularization. Follow-up was 75 to 116 weeks PMA. All patients had fundus photo-documentation (Retcam; Clarity Medical Systems, Inc.).

Results: 5 infants (9 eyes) underwent intravitreal injection of 0.25mg/0.025mL ranibizumab. 8 eyes had initial regression and 1 required an additional injection. Despite initial response, 5/9 eyes demonstrated reactivation or recurrence. Total regression was assured with additional laser treatment for 5 eyes that met Type 1 criteria again and 2 eyes for incomplete vascularization at 70 weeks PMA. Mean time between injection and additional treatment was 9 weeks (range 6-12). One patient was followed for Type 2-ROP until regression; at 107 weeks PMA both eyes had incomplete vascularization.

Discussion: It appears that treatment failure with ranibizumab monotherapy occurs at higher rates (0-83%) than with bevacizumab. There is a lack of consensus on what constitutes treatment failure, reactivation and recurrence as well as clear indications for when additional treatment is necessary.

Conclusion: In this series, all the eyes responded favorably to intravitreal ranibizumab followed by laser treatment. All patients required intensified and prolonged follow-up. Here we propose a classification system of ROP after IVR in an effort to create consensus on disease nomenclature and indications for adjuvant treatment.

Does Esotropia (ET) Cause Globe Retraction In Adduction Similar to Primary Open Angle Glaucoma (POAG) with Normal Intraocular Pressure (IOP)?


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Introduction: It has been proposed that optic nerve (ON) tethering in adduction causes repetitive strain to the ON, creating an IOP-independent mechanism for optic neuropathy in POAG without elevated IOP. We investigated whether ET is associated with similar globe retraction in adduction.

Methods: We acquired quasi-coronal orbital magnetic resonance imaging using central, ~20° abduction, and ~30° adduction fixation targets in 41 healthy controls (77 orbits), 20 patients with POAG but IOP<21mmHg (40 orbits), and 25 esotropic (19±4Δ SEM) adults without POAG (49 orbits). ON path straightness and globe position were computed from area centroids.

Results: The ON was significantly (P<0.025) more sinuous than normal in central gaze and abduction for POAG but not ET, and straightened completely in all groups in adduction, indicating tethering. POAG uniquely, not ET or controls, demonstrated globe retraction due to adduction tethering of 0.75±0.10mm (P<10^{-7}). In abduction, the globe translated temporally 0.43±0.04mm in ET, significantly less than normal (0.77±0.05mm, P<10^{-4}), but not different from POAG (0.36±0.07mm, P=0.3).

Discussion: Similar to POAG without elevated IOP, ON tethering in adduction occurs in ET, but similar to controls, no globe retraction occurs during adduction in ET. ET patients may avoid the pathological ON and sheath stiffening proposed in POAG to inhibit ON elongation in adduction and transfer muscle reaction force to the peripapillary sclera to retract the globe.

Conclusion: While adduction tethering significantly retracts the globe in POAG with normal IOP, this potential cause of optic neuropathy is absent in ET without glaucoma.

Primary Angle Closure Glaucoma in Children: Four Cases and a Review of Pediatric Plateau Iris Configuration

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Introduction: Glaucoma, and subsequently angle closure, is rare in children. We describe two pairs of siblings with angle closure glaucoma from a primary anatomical predisposition and review the differences between pediatric and adult management.

Methods: The first sibling pair presented with plateau iris configuration and anterior positioning of the lenticular zonules resulting in pupillary block. The second sibling pair was initially diagnosed with juvenile open angle glaucoma, but was found to have shallow anterior chambers, more consistent with chronic angle closure glaucoma.

Results: Cases 1 and 2 developed acute angle closure glaucoma requiring peripheral iridectomies. Postoperatively, they had patent iridectomies, but continued to have intermittent elevated intraocular pressures. Cases 3 and 4 were medically managed for chronic angle closure glaucoma and continued to have normal intraocular pressures.

Discussion: Children with acute angle closure are usually unable to tolerate a YAG laser peripheral iridotomy, thus requiring surgical iridectomies. Unlike adults, children are left phakic since they tend to have functionally accommodating lenses. To preserve the lens, a shunt is placed to control intraocular pressures rather than undergoing a lensectomy.

Conclusion: Cases 1 and 2 highlight the differences in surgical management of pediatric and adult acute angle closure. Cases 3 and 4 remain well managed medically, which may be due to earlier presentation and aggressive initiation of therapy, and demonstrate the differences between acute and chronic angle closure. All four cases underscore the importance of re-evaluation of diagnoses and tonometry as a routine part of pediatric screening.

Introduction: The aim of this study was to determine the risk factors predisposing for failure of goniotomy and trabeculotomy surgeries performed in the Pediatric Ophthalmology department of Cairo University Hospitals as well as calculate the time to failure.

Methods: This was a retrospective review of records of children aged ≤12 years who underwent goniotomy and/or trabeculotomy from the 1st of January 2013 to 31st of December 2015. With a minimum of 6 months follow up, 452 eyes met the inclusion criteria (120 and 332 had goniotomy and trabeculotomy, respectively). Failure was defined as a final IOP > 18 mmHg on medications or the need for a subsequent glaucoma procedure.

Results: Failure occurred in 55.8% of eyes that underwent goniotomy and 30.4% of eyes that underwent trabeculotomy, with a mean time to failure of 4.25±3.97 and 6.37±8.25 months, respectively. Aniridic and aphakic glaucoma eyes had the worst outcome. Positive consanguinity and higher preoperative IOP were significant risk factors for failure in both groups. Larger cup-to-disc ratio was a specific risk factor for goniotomy (p=0.022) while female gender, opaque corneas and early age at surgery were specific risk factors for trabeculotomy (p=0.002, 0.02 and 0.021 respectively). A complete circumferential trabeculotomy showed superior results (p=0.001).

Discussion: Identification of risk factors associated with poorer outcome in pediatric angle surgery can help in guiding the choice of surgery. Failure tends to occur early and is more likely and relatively earlier with goniotomy than with trabeculotomy.

Conclusion: Positive consanguinity and higher preoperative IOP as well as secondary glaucomas like aniridic and aphakic are poor prognostic factors for angle surgery. Success in trabeculotomy is higher when the extent of the cut is bigger. The early time to failure demands meticulous follow-ups.

Poster #253
Wednesday, 10:05 – 11:05 am

Withdrawn
Nanophthalmos in Children – Morphometric and Clinical Characterization

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Introduction: Nanophthalmos is a rare disorder characterised by short axial length and hyperopia. Lens is normal sized but large relative to a small globe leading to angle closure and glaucoma. Several posterior segment anomalies have also been reported. This study aims to describe morphometric and clinical characteristics of children with nanophthalmos.

Methods: Electronic medical records of children under age of 18 years diagnosed as nanophthalmos, were retrospectively reviewed. Data which was collected included demographic details, family history, history of consanguinity, visual acuity (VA), spherical equivalent (SPEQ), presence of any strabismus and amblyopia, axial length (AXL), anterior chamber depth (ACD), lens thickness (LT), intra-ocular pressure, gonioscopy and posterior segment findings. Data from right eye was used for analysis.

Results: A total of 88 children were identified. Mean age at presentation was 9.9 years. Mean SPEQ was +13.17 D. VA was between 6/6 - 6/18 in 55 children, between 6/18-6/60 in 28 children and <3/60 in 1 child. Four preverbal children's VA was central, steady and maintained. Eighteen children had esotropia and 3 had exotropia. Mean AXL was 16.9 mm. Mean ACD was 2.95 mm. Mean LT was 3.84 mm. Fifteen children had occludable angles. Fourteen children underwent prophylactic peripheral iridotomy and 3 children required anti-glaucoma medication.

Discussion: There is limited literature available on clinical characteristics of children with nanophthalmos. The leading cause of visual impairment in our series was uncorrected refractive errors and amblyopia. This was compounded by the fact that mean age of presentation was at a relatively older age of 9 years. Nearly one in six children had a occludable angles on gonioscopy requiring intervention. This underlines the importance of gonioscopy and close follow up in these children. To the best of our knowledge this is the largest study examining children with nanophthalmos.

Conclusion: Pediatric patients with nanophthalmos require comprehensive eye evaluation including gonioscopy. Most common presenting complaint is visual impairment. Nearly 20% of the patients may require intervention for occludable angles.

References:
Cyclodiode Photocoagulation in the Management of Paediatric Glaucomas over a 15-Year Period

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Introduction: Cyclodiode laser has a lower success rate in paediatric versus adult glaucoma. It may be used as a temporary measure or as an adjunct to surgery. We aim to report our experience with cyclodiode laser for children with secondary and congenital glaucoma.

Methods: Retrospective series in a tertiary centre. 25 eyes of 20 patients were included. Mean age 5.6 years (SD 5.5) with a median follow-up of 103 months (range 16-295 months)

Results: 7 eyes (28%) had aphakic glaucoma. 76% had undergone at least one previous procedure.|Patients underwent a mean of 1.92 (SD 1.4) treatments per eye. Following a single treatment, 40% had a clinically useful reduction in IOP (<22 mmHg or by 30%), which increased to 68% with second cyclodiode. Of treatment failures, 20% had no useful IOP response. A single treatment of cyclodiode was curative (without medication or surgery) in 2 eyes. 11 (44%) patients went on to need drainage surgery. |Cyclodiode treatment reduced the mean number of eye drops from 2.3 to 1.9. There were no complications from cyclodiode treatment.

Discussion: Aphakic and pseudophakic glaucoma were our most common diagnoses. Cyclodiode procedures may be used to reduce the intraocular pressures before surgery or after surgery has failed to control IOP. In a small number of children cyclodiode laser with medical treatment may help avoid invasive surgery.

Conclusion: Cyclodiode laser is a safe procedure and can be used as a temporising measure as well as in conjunction with medical or surgical therapy to control intraocular pressure in children.


Endoscopic Diode Cyclophotocoagulation (ECP) for Refractory Childhood Glaucoma

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Introduction: Usually reserved for refractory childhood glaucoma, endoscopic cyclophotocoagulation (ECP) has been used as both primary and adjunctive surgery.[1-3] The purpose was to evaluate ECP as a primary or adjunctive procedure in refractory childhood glaucoma.

Methods: This retrospective study included consecutive ECP for refractory childhood glaucoma from a single surgeon/single site from 12/22/1999-12/22/2016. Successful ECP included postoperative IOP ≤21 mmHg, with or without medications and without severe procedure-related complications or further glaucoma surgery. Cox-proportional hazard modeling and survival analyses were performed.

Results: Included were 113 ECP procedures on 83 eyes/71 children. Glaucoma diagnoses included: following-cataract-surgery (51/61%), anterior segment dysgenesis (10/12%), primary congenital (7/8%), other (15/18%). Mean age at first ECP was 9.2±5.8 years and pre-operative IOP was 27.7±7.8 mmHg. Most eyes (69/83%) had prior glaucoma surgery, 74(84%) eyes were aphakic or pseudophakic at first ECP, 6(7%) phakic, and 3(4%) congenitally aphakic. Mean follow-up was 4.5±3.2 years after initial ECP; mean number of ECP sessions/eye was 1.4 (range 1-3). Kaplan-Meyer success for a single ECP at 1-, 3-, and 5-years was 66%(95% CI 57,78), 37%(27,51) and 20%(10,38), respectively. Cumulative success (≥1 ECP) at 5-years was 40%(29,55). Long-term complications were rare and included retinal detachment(1) and chronic inflammation(1). Success was not significantly associated with prior GDD, glaucoma type, or initial IOP.

Discussion: When applied to cases of refractory childhood glaucoma, ECP showed modest success, which declined over time. This large clinical series including diverse refractory childhood glaucoma with long follow up, complements published smaller studies.

Conclusion: ECP represents a relatively safe and modestly effective long-term therapy for refractory childhood glaucoma.

References:
Management of Glaucoma Associated with Peters Anomaly

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Introduction: Peters Anomaly, which is characterized by a central corneal opacity, is often associated with glaucoma.

Methods: We retrospectively reviewed cases of Peters Anomaly who have been followed at our institution since childhood and included 52 eyes of 34 patients.

Results: Mean follow-up was 10.95 ± 11.05 years (0.14-31.1 years). Thirty one eyes of 19 patients were diagnosed with glaucoma at a mean age of 2.91 ± 6.5 years. Twenty eyes of 15 patients required at least 1 glaucoma surgery (mean 2.9 ± 2.0). Six eyes underwent angle surgery, all of which required additional glaucoma surgery after 0.3 ± 0.3 years. Twelve eyes underwent trabeculectomy, of which 10 needed additional glaucoma surgery. Fourteen eyes had glaucoma drainage device (GDD) placement of which 9 had combined vitrectomy, lensectomy, and posterior tube placement. Eight eyes with GDDs at last follow-up had continued IOP control.

Discussion: At last follow-up, 39 eyes of 27 patients had stable or improved vision compared to initial presentation. Of these 39 eyes, 21 had glaucoma with 16 requiring surgery to obtain IOP control. Thirteen eyes of 10 patients had worse vision. Of these 13 eyes, 10 had glaucoma with 6 requiring surgery to lower IOP. Not surprisingly, angle surgery is typically unsuccessful and trabeculectomies often fail in obtaining IOP control. Glaucoma drainage device placement can be effective, but may require combined vitrectomy and lensectomy for posterior placement due to anterior segment anomalies.

Conclusion: Glaucoma associated with Peters Anomaly is frequently diagnosed during early childhood and often requires multiple surgeries to obtain IOP control.

Surgical Outcomes of Glaucoma Drainage Device (GDD) Implantation for Refractory Sturge Weber-Associated Childhood Glaucoma

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Introduction: Refractory Sturge Weber-associated glaucoma (SWG) in children presents management challenges; glaucoma drainage device (GDD) implantation has met with variable success [1-3]. Purpose: To evaluate GDD implantation for refractory pediatric SWG.

Methods: This retrospective, single-center study included consecutive GDD implantation for refractory SWG from 1994 to 2017 with >/=6mos follow-up. Failure occurred when IOP was clinically insufficient for glaucoma status, or additional intraocular pressure (IOP)-lowering surgery or devastating complication occurred. Primary outcome was surgical success (Kaplan-Meier survival) at 1-, 3-, and 5-years post-GDD.

Results: Thirty-two eyes met inclusion criteria, and had either Ahmed or Baerveldt GDDs. Mean preoperative IOP was 32.2±7.9 mmHg on 3.6±0.8 glaucoma medications. Mean postoperative IOP was significantly lower on significantly fewer glaucoma medications at one, three and five years postoperatively (POY1: 18.0±5.6 mmHg, 1.9±1.1 medications, p<0.00001; POY3: 19.8±8.4 mm Hg, 1.8±1.1 medications, p<0.001; POY5: 17.6±2.2 mm Hg, 2.5±1.2 medications, p<0.01). Mean IOP reduction was 39.9%, 34.7% and 48.7% at postoperative years one, three and five, respectively. Surgical success [95% confidence interval] at 1-, 3-, and 5-years post-GDD was: 89.1% [96,70], 71.3% [85, 49], and 54.9% [73, 32], respectively. Failure occurred in 11 eyes (34%) by 5-years post-GDD: 6 eyes required additional IOP-reducing surgery, 1 had chronic hypotony, 3 required GDD tube explantation (1 with blebitis), 1 had cilioretinal artery occlusion immediately post-GDD (final vision 20/80).

Discussion: See Conclusion.

Conclusion: GDD implantation offers a reasonable approach to management of refractory childhood SWG, despite modest success at 5 years and some complications.

Failure of Goniosurgery for Glaucoma Associated with Sturge-Weber Syndrome

Helen H. Yeung, MD; David S. Walton, MD

Introduction: To report the surgical results of goniosurgery (goniotomy or trabeculotomy) for patients with Sturge-Weber Syndrome (SWS) associated glaucoma.

Methods: Retrospective review of patients who had initial goniosurgery for SWS glaucoma (SWSG). The main outcome measure was the postoperative intraocular pressure (IOP) and need for other types of glaucoma surgery.

Results: 42 patients with 46 eyes with SWSG that underwent initial goniosurgery were identified to determine its therapeutic efficacy. The average age at time of goniosurgery was 1.5 years (range: 0.2-23 years). The average preoperative IOP was 35 mm Hg (range: 25-50 mm Hg). 46 eyes underwent goniosurgery with failure rate of 98% (45 of 46 eyes) and qualified success of 2% (1 of 46 eyes). The average interval to failure was 4.0 months (range: 1-48 months). On gonioscopy, the filtration angles of all operated eyes were all abnormal with variable width and visibility of the ciliary body and less visible scleral spur. The trabecular meshwork was present in 100% of 41 eyes examined, all of which underwent goniosurgery; five eyes underwent goniosurgery without documented gonioscopy. The ciliary body was present in 39% (16) and the scleral spur was visible in 10% (4) of the 41 eyes.

Discussion: Goniosurgery is not an effective initial glaucoma surgery for SWSG. It can temporize the IOP, but ultimately other forms of glaucoma surgery must be considered when surgery is indicated to control the IOP in SWSG patients.

Conclusion: It is clinically imperative to understand the potential failure of initial goniosurgery for SWSG.

**Introduction:** Congenital nasolacrimal duct obstruction (CNLDO) is the most common cause of epiphora in the pediatric population and hence is one of the most common causes of surgical intervention usually requiring general anesthesia at an early age. There is significant rise in the rate of medically indicated and personal preference primary cesarean section (CS) in many countries. Our purpose is to study any possible association between congenital nasolacrimal duct obstruction with mode of delivery, birth weight and gestational age.

**Methods:** Charts of all patients under the age of 3 who were born between April 2015 and May 2017 and were examined by the ophthalmology clinic at the same inner city hospital were retrospectively reviewed (n= 2591). Patients who were diagnosed as CNLDO were identified (n=105). The mode of delivery (CS versus normal spontaneous vaginal delivery (NSVD)), birth weight (BW) and gestational age (GA) along with any adverse event during or after delivery or any other ocular and health history were determined. Birth statistical data corresponding to the period were obtained from the hospital's medical records database.

**Results:** Incidence of CNLDO in CS group (65/861) was significantly higher than in NSVD group (40/1775) (p=0.001). CS group was found to have 3.75 times higher risk of developing NLDO in comparison to NSVD group (OR=3.754). GA of babies in CS group was lower in comparison to NSVD group (p=0.002). BW of babies in CS group was higher which was statistically significant.

**Conclusion:** Our results suggest a possible association between CS and CNLDO.

**References:**
Association Between Congenital Nasolacrimal Duct Obstruction and Mode of Delivery

Daniela P. Reyes-Capo, BA; Mehdi Tavakoli, MD; Carla J. Osigian, MD; Catherine J. Choi, MD; Piangporn Saksiriwutto, MD; Elizabeth A. Vanner, PhD; Kara M. Cavuoto, MD; Sara D. Wester, MD

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Introduction: Congenital nasolacrimal duct obstruction (CNLDO) is one of the most common ocular disorders in infants and is typically caused by a persistent membrane covering the valve of Hasner (1). During a vaginal delivery (VD) the mechanical forces of the uterus may have a massage effect on the nasolacrimal system, resulting in the opening of Hasner’s valve (2). This study investigates the association between mode of delivery [VD versus cesarean section (CS)] and CNLDO.

Methods: A retrospective chart review of patients with CNLDO evaluated at a tertiary referral center between 2012-2017 was performed. Patient demographics, birth history, clinical characteristics, and treatment outcomes were compared in patients delivered via CS versus VD. Annual rates of CS and prematurity were obtained from the CDC National Center for Health Statistics.

Results: A total of 104 children were included. Mean age at presentation was 9.4 ± 9.2 months for the CS group and 15.7 ± 20.2 for the VD group (p=0.03). A statistically significant higher percentage of patients with CNLDO (61%) were delivered via CS (p<0.0001). The prevalence of prematurity was 26%, significantly higher than the general population (p<0.0001). CNLDO did not resolve spontaneously and surgical intervention was required in 37 CS versus 13 VD patients (P=0.007). Among patients who failed first line probing and required additional interventions, 86.2% were born via CS and 13.8% were born via VD (P=0.0009).

Discussion: CS and prematurity are associated with a higher prevalence of CNLDO.

Conclusion: Children born premature or via CS are at risk for developing a complicated course of CNLDO.

Resolution Rates in Congenital Nasolacrimal Duct Obstruction Managed with Massage and Antibiotics Compared to Observation Alone

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Introduction: Although digital nasolacrimal massage and topical antibiotics are commonly recommended for management of congenital nasolacrimal duct obstruction (CNLDO), their influence on resolution is unknown. The purpose of this study was to determine if the use of nasolacrimal massage or topical antibiotics is associated with higher rates of spontaneous resolution compared to observation alone.

Methods: The medical records of all children < 5 years diagnosed with CNLDO over a 10-year period were retrospectively reviewed. Patients were, at the discretion of their care provider, prescribed the administration of digital massage, topical antibiotics, both, or neither (observation).

Results: Of 1998 infants diagnosed with CNLDO at a mean age of 5 weeks, 527 (26.4 %) were merely observed, 516 (25.8 %) were prescribed massage, 495 (24.8 %) were prescribed at least one course of topical antibiotics, 405 (20.2 %) were prescribed both topical antibiotics and massage, and 55 (2.8 %) did not have documented therapy. The resolution rate, during a median follow-up of 3.1 months, was 73.1% for the merely observed, 88.0% for those with digital massage, 85.3 % for those prescribed antibiotics, and 88.9% for those treated with both (p<0.01).

Discussion: Although there are rare reports of small series suggesting the efficacy of digital massage in resolving CNLDO compared to observation alone, reports on the effectiveness of topical antibiotics are nonexistent.

Conclusion: Prescribing topical antibiotics and digital massage for infants with CNLDO, individually or in combination, is associated with a higher rate of resolution than observation alone.

References: NA
The Treatment of Neonatal and Infantile Dacryocystoceles and Dacryocystitis with the Microdebrider

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Introduction: The use of the nasal microdebrider in treating nasal cysts associated with neonatal and infantile dacryocystoceles and dacryocystitis in a small series is described.

Methods: This is a retrospective chart review of patients treated with a microdebrider over a 3-year period at a single institution. Subjects with a diagnosis of dacryocystocele or dacryocystitis with associated intranasal cysts within the first 5 months of life were included. Patient age, date of post-operative care, orbital imaging (when obtained), intra-operative findings and wound culture were recorded. The resolution of symptoms with a clear dye disappearance test was used to denote surgical success.

Results: 24 charts were identified. 7 subjects had dacryocystoceles (4 bilateral, 3 unilateral). All cases of dacryocystoceles had associated intranasal cysts. 17 subjects had dacryocystitis (2 bilateral, 15 unilateral). A total of 5 subjects were excluded (2 subjects lost to follow-up and 3 with dacryocystitis without intranasal cysts). A total of 29 intranasal cysts (in 19 subjects) were included in this study. The average age at the time of surgery was 1.64 months (range 1 day to 5 months) with an average follow-up of 7.94 months (range 1.1 to 33.8 months). All cysts were fully removed with a nasal microdebrider (2.9 tri-cut blade). The overall success rate was 96.5% (28/29 cysts treated). The one failure required a dacryocystorhinostomy.

Discussion: Neonatal and infantile dacryocystoceles and dacryocystitis are often associated with intranasal cysts found under the inferior turbinate. This can cause respiratory distress and require urgent surgical care. The nasal Microdebrider represents a surgical alternative to intranasal cyst marsupialization in the treatment of nasal cysts associated with neonatal and infantile dacryocystoceles and dacryocystitis. It offers the advantage of speed, accuracy and the capacity for complete cyst wall removal with encouraging results in this small series.

Conclusion: The microdebrider is a safe and effective surgical device in the treatment of nasal cysts associated with neonatal and infantile dacryocystoceles and dacryocystitis.

Introduction: To report the incidence of endoscopic abnormalities in children with nasolacrimal duct (NLD) obstruction and analyze the surgical outcomes of NLD probing and endoscopy in young children.

Methods: Nasal endoscopy was performed in conjunction with NLD probing in 152 eyes of 100 consecutive patients between 6 and 18 months of age. Retrospective review of the medical records was performed to identify the number of patients with endoscopic abnormalities. The types of endoscopic abnormalities and results of endoscopically-guided removal of cysts in conjunction with NLD probing were analyzed.

Results: NLD cysts were identified in 15 (15%) patients. 1 patient had an inferior turbinate apposed to the lateral nasal wall, and 84 patients had no endoscopic abnormalities. The success rate of NLD probing was 95% in patients without abnormalities and 87% in patients with NLD cysts treated with cyst removal and NLD probing.

Discussion: NLD cysts were found in 15% of patients who presented with typical symptoms of NLDO. The success rate of surgery for patients without cysts (95%) was higher than in most published reports, suggesting that unrecognized cysts may contribute to failure in some patients treated with NLD probing alone. NLD probing in conjunction with cyst removal had a high rate of success (87%) in patients with these endoscopic abnormalities.

Conclusion: The findings of this study call for more research into comparing endoscopic-guided probing to standard probing and provide support for the procedure’s use in clinical practice. NLD cysts are fairly common in children with NLDO. Endoscopy may identify these abnormalities and facilitate their removal, which may improve surgical outcomes.

Visual and Refractive Outcomes in Early Versus Late Congenital Nasolacrimal Duct Obstruction Spontaneous Resolution or Intervention

Thomas B. Gillette, MD; Kristina Tarczy-Hornoch, MD, DPhil; Leona Ding, MS; Calvin Lee; Darren Liu; Michelle T. Cabrera, MD
University of Washington
Seattle, WA

Introduction: Among patients presenting with congenital nasolacrimal duct obstruction over 9 months old, this study investigates whether late (> 1 year) spontaneous resolution or late (> 15 months) surgical intervention results in poorer visual outcomes compared to early resolution or intervention.

Methods: The medical records of patients at a single tertiary pediatric ophthalmology clinic from 2007 to 2017 were retrospectively reviewed. Rates of clinically significant anisometropia (>/= 1 D of sphere or cylinder) and amblyopia (>/= 2 lines difference in Teller acuity or optotype testing) between eyes over 15 months of age were compared between groups.

Results: Of 319 patients included, 167/319 (52.3%) were unilateral and 152/319 (47.6%) were bilateral. Fifty-five of 319 (17.2%) had early intervention/resolution, 214/319 (67.1%) had late intervention/resolution, and 50/319 (15.7%) were unknown. Of those with known intervention/resolution, 239/267 (89.5%) received surgery and 28/267 (10.5%) resolved spontaneously. The median age at surgical intervention in the early group was 13 (range: 2-15) months compared to 27 (range: 16-142) months in the late group (P < 0.01). Anisometropia was found in 9/34 (26.5%) early and 17/166 (10.2%) late group patients (P = 0.021). Amblyopia was found in 4/55 (7.3%) early and 13/206 (6.3%) late group patients (P = 0.762).

Discussion: This study is limited by small sample size in the early intervention/resolution group.

Conclusion: Anisometropia was significantly higher in the early group while amblyopia showed no significant difference between groups. This suggests that delaying intervention in congenital nasolacrimal duct obstruction may not result in worse visual outcomes. Larger studies are needed to confirm these findings.


Refractive Status of Children with Unilateral Congenital Nasolacrimal Duct Obstruction

Aysel Pelit, MD; Nedime Sahinoğlu-Keskek, MD; Handan Canan, MD

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Adana, Turkey

Introduction: Aside from refractive errors, many risk factors may be ambliogenic. Studies indicated that children with congenital nasolacrimal duct obstruction (NLDO) have a higher prevalence of amblyopia. The objective of this study was to investigate refractive status of children who underwent probing for unilateral NLDO.

Methods: This descriptive cross-sectional study included consecutive children with unilateral congenital NLDO. All of the patients underwent a complete ophthalmic evaluation including cycloplegic refraction before probing. Refractive errors of the involved and sound fellow eyes were compared.

Results: Fifty-one children were included in this study. The mean age at presentation was 21.5±1.3 months (range, 12 to 46 months). Based on spherical equivalent refractive error, hyperopia was common in the affected eyes, however there was no statistical significantly difference between two eyes (p=1.00). Anisometropia more than 0.5 diopters (D) was present in 11.7 % of patients. Interocular difference was statistically significant in terms of cylindrical refractive error (p=0.01) but not spherical refractive error and spherical equivalent (p=0.17, p=1 respectively).

Discussion: Congenital NLDO is a common childhood disorder which usually improves spontaneously during the first year of life; however its effect on refractive status and any correlation with amblyopia have been controversial. In the recent years, CNLDO has been speculated to have an increased risk of amblyopia. In our study, anisometropia is found higher in patients with unilateral congenital NLDO.

Conclusion: It is advisable to perform detailed ophthalmological examination including refraction and initiate proper follow up program at a younger age in cases of NLDO.

Developmental Change of the Biorbital Angle in Normal Japanese Children

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Introduction: To investigate changes in the biorbital angle with increasing age in normal Japanese children.

Methods: Axial magnetic resonance imaging or computed tomography of the orbit in the transverse plane of the horizontal extraocular muscles was obtained in 129 ophthalmologically healthy children (aged a few months to 11 years: mean age ± SD = 5.14 ± 2.65 years). The opening angle between both lateral walls of the orbit was defined as the biorbital angle.

Results: The mean biorbital angle in 11 infants less than a year of age was 105.0° ± 6.0°. The mean biorbital angles for each of the subsequent age groups were 97.7° ± 3.1°, 96.2° ± 4.0°, 96.3° ± 4.1°, 92.8° ± 3.8°, 92.3° ± 2.3°, 93.1° ± 2.8°, 91.5° ± 3.9°, 91.9° ± 2.3°, 91.4° ± 2.3° and 90.9° ± 3.1°. The mean biorbital angle in infants less than a year old was significantly larger than those found in the groups of children older than one year (p<0.01, Newman-Keuls test).

Discussion: The morphology of the orbit is known to gradually change from wider to narrower as gestation progresses. Current results suggest that the orbital change continues to be normal within a year after birth, with exotropia in 70-80% of newborns gradually disappearing in most cases by 2-4 months of age.

Conclusion: The biorbital angle in infants less than a year old was larger than that found in children older than one year, with this larger biorbital angle potentially the causative factor of exodeviation in newborns.

An Alternative Surgical Approach for Marcus Gunn Jaw Wink Ptosis

Karen Revere, MD; Akusoa Nti, MD; William R. Katowitz, MD; James A. Katowitz, MD; Gil Binenbaum, MD, MSCE

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Philadelphia PA

Introduction: Traditional management for unilateral Marcus Gunn jaw wink ptosis (MGJWP) is levator extirpation and bilateral frontalis suspension. We sought to determine whether unilateral ptosis surgery without extirpation results in good outcomes in children with MGJWP.

Methods: A retrospective cohort study of children undergoing ptosis surgery for MGJWP without levator extirpation was done over 6 years at Children’s Hospital of Philadelphia. The primary outcome was a successful post-operative result, satisfying all of the following criteria: (1) parent and surgeon satisfaction in appearance of lid height and jaw wink, (2) functional ptosis success (MRD1>=2mm), (3) no subsequent extirpation necessary. Additional outcomes were further surgery and complications.

Results: 32 children were studied, mean age at first surgery 2.6 years (0.1-16.8), mean follow-up 30.7 months (1.2-182). All children had unilateral surgery. Initial procedures were frontalis suspension (n=12), levator advancement/resection (n=12), and modified Fasanella-Servat (n=8). 88% had a successful post-operative result, meeting all 3 primary outcome criteria. 63% achieved a successful outcome after one procedure, 24% after two procedures. 4 children had persistent jaw wink, and two underwent secondary levator extirpation. One child developed a hypertrophic scar, and 3 mild post-operative exposure keratopathy treated with lubrication.

Discussion: Unilateral ptosis surgery without levator extirpation for MGJWP is an effective and less aggressive surgical approach that can be used as an initial surgical option with appropriate counseling that a minority of children may require secondary extirpation.

Conclusion: Unilateral ptosis surgery without extirpation can treat Marcus Gunn jaw wink ptosis with a very high success rate.

Using a Low Cost 3D Printer for Pre-Contouring Orbital Implants in Children with Floor and Rim Fractures

Mitchell Strominger; Kayva Crawford; Mark Vecchiotti; Andrew Scott

Tufts Medical Center
Boston, MA

Introduction: Orbital reconstruction following injury can be challenging. Recently the use of 3D printing to model the orbit has aided in understand the extent of the damage and planning repair. However these models can be costly. Low cost printers are now becoming available and their efficacy is being demonstrated in the adult population. We report our experience using this technology in pediatric orbital rim and floor fractures.

Methods: 5 pediatric patients with orbital floor and rim fractures underwent transconjunctival repair with implantation of titanium or resorbable prostheses. These materials were pre-contoured using a low cost 3D printed model of the bony orbits.

Results: The creation of a high fidelity model at a cost of only $7 plus materials allowed precise preoperative fitting of the orbital prosthesis that saved intraoperative time and was more precise than traditional methods. Postoperative outcomes demonstrated rapid healing and excellent structural results.

Discussion: The combination of pre-planning in the repair of orbital fractures by using a low cost 3-D model of the orbit along with pre-contouring both titanium and restorable material is feasible. This saves intraoperative time and allows for a more anatomically accurate fit of the implant.

Conclusion: Using a 3D printed model of the orbits to per-contour implants prior to surgery facilitates insertion and assures a precise fit at a low cost.

Topical Cyclosporine-A in Pediatric Ocular Graft Versus Host Disease

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Introduction: Ocular involvement has been reported with a range between 3-90% in graft versus host disease (GVHD) and dry eye syndrome is most frequent finding of ocular involvement. Topical cyclosporine-A might be an effective and safe treatment option in dry eye related to chronic GVHD in combination with topical steroids, autologous serum, lubricant eye drops and ointments. In this study we evaluated the efficacy of topical cyclosporine-A in pediatric ocular GVHD patients.

Methods: Pediatric patients with ocular GVHD were enrolled into this study. Ophthalmic examination findings, Schirmer test results, tear break up time and corneal staining grades were recorded. Topical cyclosporine-A treatment was given to the patients with severe dry eye and results were evaluated.

Results: Between 1996-2015, 218 pediatric patients (mean age: 11.8 ± 2.9 years) underwent bone marrow transplantation. GVHD was detected in 51 patients (23.4%) and 30 of them (58.8%) had ocular GVHD. Four patients of ocular GVHD had severe dry eye and were treated with topical cyclosporine-A in addition to topical lubricants with a median follow-up of 12.1 months. Severe dry eye symptoms and findings significantly improved in 2 patients.

Discussion: Tissue damage in GVHD is mediated by activated donor T cells and pharmacological agents such as cyclosporine-A prevents the activation and proliferation of T-cells. Topical cyclosporine-A treatment can be useful in pediatric GVHD patients with ocular involvement.

Conclusion: Ocular involvement is less frequent in pediatric patients and topical cyclosporine-A can improve dry eye symptoms in pediatric ocular GVHD patients.

Meibum Structure in Pediatric Graft Versus Host Disease

Aparna Ramasubramanian; Ryan Blackburn; Samiyyah Sledge; Douglas Borchman

University of Louisville
Louisville, KY

Introduction: Annually 4500 allogenic hematopoietic stem cell transplantation are done in US in children less than 20 years of age.(1) Graft versus host disease is the most significant cause of long term morbidity and mortality and ocular manifestations occur in 40-60% of these patients. Meibomian gland disease is common in GVHD and it may be that damage to the gland results in a modification of the composition of meibum from donors with graft verse host disease (GHm) which then contributes to dry eye.

Methods: The structure of meibum from five GVHD patients (GHm) were compared to meibum from 28 donors without signs and symptoms of dry eye (Cm). Infrared spectroscopy was used to measure seven meibum lipid phase transition parameters.

Results: The age range of the donors of GHm and Cm was 13 to 18 and 1 to 20 years, respectively. Age differences in the phase transition parameters for Cm were not significant. The lipid phase transition temperature (Tp) is the temperature at which half the lipids undergo a phase transition. The Tp for GHm was 37.7° C significantly higher (P < 0.001) than that for Cm, 30.6° C. This small change in Tp resulted in a large significant difference (P < 0.001) in the lipid order (fluidity) at 33.4°C, 60% trans and 40% trans for GHm and Cm, respectively. The cooperativity of the phase transition is the measure of how the melting of a lipid affects adjacent lipids. The cooperativity for GHm was 6, significantly lower (P = 0.02) than that for Cm, 9, which indicates that GHm contains a greater variety of lipids, perhaps degradation products. The minimum and maximum frequency, rentropy and renthalpy of the phase transitions were not significantly different (P > 0.05) between GHm and Cm.

Discussion: GHm structure and thus composition was significantly different compared with Cm. These changes could block the meibomian gland orifice and perhaps lead to tear film instability when on the surface of tears. Dry eye is a chronic problem in kids with graft versus host disease and it can cause significant scarring of the ocular surface in addition to causing eye discomfort.

Conclusion: Infrared spectroscopy may be useful to diagnose and to determine the efficacy of dry eye treatment in patients with GH. Future studies designed to measure meibum compositional, structural and functional relationships could aid in developing therapies to ameliorate dry eye symptoms.

Periocular Asymmetry in Patients with Deformational Plagiocephaly

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Minneapolis, Minnesota

Introduction: Deformational Plagiocephaly (DP) refers to a misshapen skull in infants caused by repeated pressure to the same area of the back of the head, commonly produced by sleep position, birth trauma, torticollis, or in-utero constraint. Its main features are occipital flatness and facial asymmetry. The prevalence of amblyopia in patients with DP is similar to the general population. The purpose of this study was to identify whether there are clinically significant periocular features associated with DP.

Methods: We identified patients with DP in our ophthalmology clinic that met the criteria of occipital flatness, ipsilateral frontal bossing, and contralateral frontal flatness. The patients had their face and top of the head photographed. Four examiners analyzed the photographs and assessed the patients’ periocular features.

Results: Twenty-five patients were included (age range 3 to 12 months). Pseudo-enophthalmos and pseudoptosis were detected in all patients. Nineteen patients presented pseudo-brow ptosis. All affected eyes were contralateral to the DP. None of the patients presented amblyopia. Five children came to our clinic specifically for blepharoptosis evaluation. All of them were diagnosed with pseudoptosis associated to DP. Only two of the five children returned for a follow-up, and showed improvement of the eyelid asymmetry post-helmet treatment.

Discussion: Children with DP may present non-amblyogenic periocular asymmetry consisting of pseudo-enophthalmos, pseudoptosis, and pseudo-brow ptosis as a result of the changes in the facial bones that are common in DP. Helmet therapy may improve periocular asymmetry without any ophthalmology intervention.

Conclusion: Recognizing the association between DP and periocular asymmetry may help examiners eliminate concerning conditions involving blepharoptosis in infants.

References:
Poster #273
Wednesday, 10:05 – 11:05 am

Withdrawn
Strabismus Associated with Congenital Ptosis

Lauren Fletcher, DO; Leemor Rotberg, MD
Children’s Hospital of Michigan
Detroit, MI

Introduction: Congenital upper eyelid ptosis has previously been recognized to be associated with strabismus and amblyopia; however, the frequency of strabismus among patients with ptosis has varied widely. Griepentrog and Mohney identified strabismus in only 18% of children with ptosis while Anderson and Baumgartner, found strabismus in 36% of patients and Thapa reported strabismus in 27% of patients with congenital ptosis. Our purpose was to determine the frequency and type of strabismus in patients with congenital ptosis. We were also interested in the association, if any, of amblyopia or anisometropia to strabismus in patients with congenital ptosis.

Methods: In this retrospective, cohort study, we reviewed the charts of over 430 patients for the prevalence of strabismus, amblyopia and anisometropia in children who were diagnosed with congenital eyelid ptosis from 1997 through 2017.

Results: Strabismus was diagnosed in 103 (23.6%) of the 437 patients with congenital ptosis. Anisometropia occurred in 17.4% of patients with ptosis and strabismus, while amblyopia occurred in 45.6%. Children with bilateral ptosis developed strabismus on average 2 years later than patients with unilateral ptosis (5.4 yrs and 3.4 years, respectively). Of note, 12.6% of the patients with ptosis and strabismus were also developmentally delayed.

Discussion: Strabismus occurred in almost 24% of the children in this study. This is significantly higher than the general population where strabismus occurs in just 2-3% of children. Similarly, while amblyopia is present in 2-3% of the general population, nearly half of children with congenital ptosis in our study experienced amblyopia.

Conclusion: Based on our findings, an ocular motility evaluation and continued follow up of children with congenital ptosis remains an important practice pattern for the ophthalmologist.

Symposia
Symposium #1  
Monday, 8:35 – 9:35 am

ISA Symposium  
Concepts for Management of Paralytic Strabismus

International Strabismological Association  
Indianapolis, Indiana, USA

Moderators – Michael X. Repka, MD & Andrea Molinari

Pearls for Management of Abducens Nerve Palsy – Jan-Tjeerd deFaber  
New Approaches to Third Nerve Palsy – Mauro Goldchmit  
Adjustable Bilateral Superior Oblique Tendon Advancement – Jonathan Holmes  
Can We Correct Torsion with Inferior Rectus Surgery – Miho Sato  
Significance of Compartamentalization in Ocular Motor Nerve Palsies – Joseph Demer

Purpose/Relevance: Paralytic Strabismus is a common problem in specialized strabismus practice resulting from tumor, trauma or inflammatory disease of the brain. The management decisions are complex. This program will highlight some approaches being utilized by surgeons from around the world.

Target Audience: Strabismus specialists including pediatric ophthalmologists.

Current Practice: Paralytic strabismus is difficult to manage often with frequent undercorrections.

Best Practice: To understand the best surgical approaches to these difficult conditions as well as the limitations of these surgical approaches. In some cases surgery may not be the best option.

Expected Outcomes: To learn approaches currently be employed for surgical management of complicated paralytic strabismus. These could improve the outcomes for our patients.

Format: A series of focused talks on each subject with 3 minutes of panel discussion for each talk.

Summary: Paralytic strabismus is a difficult clinical problem often managed with surgery. For each of the cranial neuropathies there are best practices which will be discussed. In addition new imaging information suggests specific portions of the extraocular muscle are damaged in paralytic strabismus which may influence treatment decisions.

Symposium #2  
Monday, 2:30 – 4:00 pm

ISA Symposium  
Developmental Disorders of Ocular Motility  
International Strabismological Association  
Indianapolis, Indiana, USA

Moderators: Frank Martin & Tsuranu Yokoyama

Current Perspectives of CCDD – Elias Traboulsi  
CFEOM - Pearls for Management – Arif Khan  
Treatment Guidelines in Typical Forms of Duane Syndrome – Gill Adams  
What to Do in Atypical Duane Syndrome – Seyhan Ozkan  
Brown Syndrome - When to do Surgery and What to Do – David A Plager  
Monocular Elevation Deficiency – Subhash Dadeya

Purpose/Relevance: These unusual disorders of ocular motility are difficult to manage and the purpose is to update knowledge of the participants. The spectrum eye movement pathology of CCDD is evolving as is the management. Other known ocular motility patterns including Duane Syndrome, Brown Syndrome, and monocular elevation deficiency will be discussed in terms of management

Target Audience: Pediatric ophthalmologists, comprehensive ophthalmologists and strabismus specialists.

Current Practice: These are relatively uncommon disorders so discussing patterns of disease can make their recognition easier. Discussion of the management problems can improve the outcome for these children and adults affected with these conditions.

Best Practice: Performing correct diagnosis of the CCDDs. Performing the right surgery for each of the discussed disorders

Expected Outcomes: Improved understanding of the genetic basis of these conditions, the need for testing, as well as the best available surgical approaches.

Format: Panel of speakers with panel discussion after each talk.

Summary: The current types of disorders classified as CCDD. Surgical approaches to CFEOM, Duane Syndrome, Brown Syndrome, and Monocular elevation deficiency will be described and discussed.

Symposium #3  
Wednesday, 2:00 – 3:00 pm  

ESA Symposium  
Challenges in Adult Strabismus  

European Strabismological Association  

Organizer & Moderator:  John Sloper  

Dosage of Recessions and Muscle Elongation in Surgery for Grave’s Orbitopathy – Oliver Ehrt  
Management of Consecutive Exotropia. – Laura Lindberg  
The Tight Inferior Oblique Muscle – Rosario Gomez de Liano  
The Role of Orbital MRI in Patients with Strange Strabismus Patterns. – Giovanni Marcon  
The Contribution of Examination under Anesthesia to Decision Making in Strabismus Surgery. – Dominique Thouvenin  
The Effect of Suture Adjustment on Surgical Outcomes in Adults with Symptomatic Intermittent Exotropia. – John Sloper  

Purpose/Relevance:  This symposium will discuss difficult or controversial topics in adult strabismus surgery  

Target Audience:  Strabismologists and orthoptists at all levels  

Current Practice:  Strabismus surgeons undertake surgery for patient with these conditions  

Best Practice:  The presenters are experienced strabismus surgeons and will present their experience of undertaking surgery for these conditions  

Expected Outcomes:  Improved understanding of the best surgical approaches for patients with these conditions.  

Format:  Didactic lectures with questions and discussion  

Summary:  This symposium will discuss difficult or controversial topics in adult strabismus surgery including surgery for patients with difficult thyroid eye disease and consecutive exotropia, recognizing the tight inferior oblique muscle, the role of MRI scanning and examination under anesthesia in planning strabismus surgery and the effect of suture adjustment on surgical outcomes in adults with intermittent exotropia.
Symposium #4
Wednesday, 3:10 – 4:10 pm

IOA Symposium
The World of Amblyopia Treatment
International Orthoptic Association

Organizers & Moderators: Karen McMain, Med, OC(C); Shelly Klein, CO

Dichoptic Training and Video Games in the Treatment of Amblyopia: Fantasy or [Virtual] Reality? – Linda Colpa OC(C)
Inverse Occlusion – Birgit Wahl MSc
Benefits, Barriers and Understanding: The Importance of Spectacle Wear in Young Children – Alison Bruce PhD
Complications of Amblyopia Treatment – David Newsham PhD
Adherence to Therapy in Occlusion – Jan Roelof Polling PhD candidate

Purpose/Relevance: Amblyopia causes more unilateral cases of reduced vision in childhood than all other causes combined, and it affects as many as four out of every one hundred children. An important public health problem because of its prevalence, visual impairment from amblyopia is lifelong and can be profound.

Target Audience: Pediatric Ophthalmologists, General Ophthalmologists, Orthoptists, Researchers

Current Practice: Occlusion therapy

Best Practice: There is a need for evidenced-based medical approaches in amblyopia treatment.

Expected Outcomes: Our symposium speakers will take a trip around the world of amblyopia examining different aspects of treatment and the effect of untreated amblyopia on children's learning. They will examine the evidence for a range new treatments from dichoptic training, perceptual learning and video gaming to a new look at older methods such as inverse occlusion. The adherence to treatment its complications and need for spectacle wear in the young will be addressed. There will be an opportunity to look at the results from these treatment modalities and discuss “take home” recommendations for care.

Format: Panel discussion

Summary: 1. Linda Colpa (Canada): Dichoptic training and video games in the treatment of amblyopia: Fantasy or [virtual] reality?
2. Birgit Wahl (Germany): Inverse Occlusion
3. Alison Bruce (UK): Benefits, barriers and understanding: The importance of spectacle wear in young children
4. David Newsham (UK): Complications of amblyopia treatment
5. JR Polling (The Netherlands): Adherence to therapy in occlusion

Workshops
Workable Solutions for High-Stake Risks

Robert S. Gold, MD; Anne M. Menke, RN, PhD
OMIC (Ophthalmic Mutual Insurance Company)
San Francisco CA

Purpose/Relevance: Tracking and following up on patient appointments and tests, and coordinating care with other physicians are challenging tasks. The stakes for the patient, the ophthalmologist, and the practice are high, especially if the patient is a premature infant. Through the lens of lawsuits against pediatric ophthalmologists, we will analyze these vulnerable points in the care process.

Target Audience: Pediatric ophthalmologists

Current Practice: Infants being screened for ROP miss key examinations because of inadequate tracking systems. The decision to treat ROP has been delayed when ophthalmologists in an ROP screening team do not conduct a hand-off discussion. Pediatric patients with possible neurological conditions do not get needed diagnostic tests when parents do not make or keep the appointments.

Data source ROP: Risk Analysis (at www.omic.com) and OMIC claims data base

Best Practice: Infants being screened for ROP are tracked by the ophthalmologist, an ROP coordinator in the hospital, and an ROP coordinator in the office. Diagnostic tests are tracked until the results are received, the patient is informed, and follow up care is arranged. Data sources at www.omic.com: ROP Safety Net: Hospital and Office Toolkits, Noncompliance Toolkit

Expected Outcomes: Participants will collaborate with the speakers to explore solutions that ophthalmologists and practices can readily implement for their patients.

Format: Malpractice claim presentations|Group discussion of specific scenarios|Risk management recommendations and resources

Summary: We will analyze malpractice claims and discuss scenarios. We will identify vulnerabilities in systems designed to track ROP infants during the screening process, clarify follow-up obligations of ophthalmologists and other members of the team treating the patient, and determine a safe, efficient way to coordinate care when multiple physicians are treating a patient.

References: These articles may be accessed at www.omic.com | Menke AM et al. ROP: Create a Safety Net (available at www.omic.com)| Menke AM. Noncompliance: A Frequent Prelude to Malpractice Lawsuits
2017 AAPOS Financial Benchmarking Survey

Robert E. Wiggins, Jr

**Purpose/Relevance:** Pediatric ophthalmologists are finding it increasingly challenging to maintain profitability in their practices.

**Target Audience:** Pediatric Ophthalmologists; Practice Administrators

**Current Practice:** Static or declining reimbursement combined with rising practice expenses are creating financial challenges for pediatric ophthalmologists. There are limited data sets available that provide financial benchmarks for pediatric ophthalmologists.

**Best Practice:** Ideally, pediatric ophthalmologists and their administrators should be performing financial benchmarking and using that information to improve the financial health of their practices.

**Expected Outcomes:** The benefits of providing this information to pediatric ophthalmologists and their administrators include: 1) providing a context to pediatric ophthalmologists and their administrators by giving them a baseline assessment of the financial health of their practices, 2) allowing identification of potential areas of opportunity for performance improvement, 3) providing comparison with 'like kind' practices, and 4) creating an 'early warning system' before financial disasters occur.

**Format:** Didactic Lecture (15 minutes) as part of the SEC workshop

**Summary:** The results for 141 pediatric ophthalmologists will be presented. Productivity and expense data will be reported. Examples of statistics reported will include the median and percentiles for productivity statistics such as revenues, clinic encounters, and volume of common surgical procedures. Examples of expense statistics will include staffing costs and facility utilization as well as overhead ratios.

Cybersecurity and Cyberliability

Michael J. Bartiss, OD, MD; Anne Menke; Dominic A. Paluzzi, Esq

AAPOS-Socioeconomic Committee

Purpose/Relevance: The purpose of this workshop is to present and discuss cybersecurity risks facing pediatric ophthalmologists and their practices. Steps to mitigate these risks as well as recommendations for levels of cyberliability insurance will be discussed.

Target Audience: The target audience for the session is pediatric ophthalmology practice administrators, practice owners and individual pediatric ophthalmologists.

Current Practice: This topic has become of increasing importance to pediatric ophthalmologists and their practices as news of data breaches continues to increase in frequency and magnitude.

Best Practice: Physicians and their office managers will learn recommended steps to take in their office management to decrease the risk of successful cyber attacks leading potential compromise of PHI contained within their EMR systems, as well as to their personal and practice finances should the financial institutions with which they do business be compromised.

Expected Outcomes: As a result of attending this workshop, physicians and administrators should have a better understanding of the scope and breadth of risks to themselves and their practices from cyber attack. They will learn steps to take to help mitigate these risks. Recommended levels of cyberliability insurance will also be discussed.

Format: This will be a didactic lecture presentation.

Summary: Subjects covered will include discussion of personal and practice cybersecurity risks and how to mitigate these risks. Cyberliability insurance coverage will also be discussed.

References: United States Department of Homeland Security
Workshop #4  
Monday, 2:05 – 3:15 pm  

Advocacy Preparation Workshop

Kenneth P. Cheng, MD; Michael X. Repka, MD; Jordana M. Smith, MD; Kyle E. Miller, MD; Steven C. Thornquist, MD; Todd J. Murdock, MD; John W. Simon, MD; John D. Roarty, MD; Stacey J. Kruger, MD; Constance E. West, MD; Iris S. Kassem, MD, PhD; Pamela E. Williams, MD; Rebecca Hyder

Purpose/Relevance: There should be no doubt in any physician's mind that governmental regulation, on the state and federal level, has a tremendous impact on how physicians practice and on the care that patients receive.

Target Audience: Everyone, including physicians, needs to realize the growing importance of advocacy and of becoming a part of the political decision making process to ensure delivery of the best possible healthcare. Participants in the AAPOS Advocacy Day and all meeting attendees are encouraged to attend.

Current Practice: Unfortunately, too few physicians have embraced advocacy as a part of their professional responsibility and their skills with advocacy need to be improved.

Best Practice: Physicians need to be more active in developing relationships with their legislators on the state and federal level. A phone call or a visit once a year to introduce or reacquaint yourself would have a tremendous impact on making sure that the interests of our profession and patients are not overlooked.

Expected Outcomes: This workshop will prepare attendees to visit their legislators. Current legislation of interest will be reviewed and talking points will be distributed. Effective communications methods will be demonstrated so participants will be comfortable in these meetings and to help them build the legislative relationships that are so important to our profession and patients.

Format: Several current bills will be reviewed, with time for discussion, and mock legislative visits will be staged so that participants will be ready for legislative visits now and in the future.

Summary: 1. The importance of Advocacy on both the state and federal level will be reviewed.
2. Current legislative issues will be discussed.
3. Participants will be introduced to the process of legislative visits and effective communication techniques will be demonstrated so they will be ready to be more involved and effective in advocating for our profession and patients.

References: none
Another Day in the Life of the Pediatric Ophthalmologist

Sue Vicchrilli, COT, OCS; Michael J. Bartiss, OD, MD; Robert S. Gold, MD; Heather H. Dunn, COA, OCS

AAPOS SEC

Purpose/Relevance: Audit recoupments are not based upon unique cases. They are based on what pediatric ophthalmologists do every day. Section 1 of this intensive course will begin with testing your coding competency with a rapid fire question and answer session. Section 2 will follow with real life case presentations and coding (CPT and ICD-10) options depending upon the payer. Section 3 will address the most common payer denials and how to rectify them. All sections designed to help pediatric ophthalmologists appropriately maximize reimbursement and bullet proof their documentation in any audit situation. Participants are encouraged to email coding questions to coding@aaao.org. Please list AAPOS in the subject line.

Target Audience: Pediatric ophthalmologists, practice managers and billing personnel

Current Practice: Many pediatric ophthalmology encounters and interventions can become difficult to code correctly. Failure to do so results in delayed or denied payments for services provided.

Best Practice: Better understanding correct coding in pediatric ophthalmology will not only result in more timely reimbursement for services thus increasing cash flow, but better practice efficiency by spending less time processing (and re-processing) claims.

Expected Outcomes: Upon completion of this course the participant should be able to:
- Accurately answer questions on the fundamentals of pediatric coding
- Apply principles of chart documentation, testing services requirements, and surgical coding for all payers
- Identify and correct claim submission errors which are costly to the practice

Format: Interactive format with case presentations, questions and answers

Summary: This presentation will review basic pediatric ophthalmology coding, review principles of proper documentation and surgical coding and identify common claim submission errors that result in delayed or denied payments from insurance carriers.

References: 2018 Ophthalmic Coding: Learn to Code Pediatrics and Strabismus; AAO

CD-10-CM for Ophthalmology: The Complete Reference; AAO

Ophthalmic Coding Coach; AAO
Child Abuse: When Do We Get It Wrong?

Gil Binenbaum; Alex V. Levin; Steve E. Rubin; Cindy W. Christian

Children's Hospital of Philadelphia
Philadelphia, PA

Purpose/Relevance: Abusive injuries must be considered as the potential cause of an anterior segment injury or posterior segment finding such as retinal detachment or retinal hemorrhage (RH) in childhood. This workshop aims to raise awareness of situations that may result in under or over diagnosis of abuse, either of which can result in adverse effects for children and families.

Target Audience: Ophthalmologists who regularly examine children of any age, but particularly children presenting with signs of ocular or adnexal trauma, young children being evaluated for potential abusive head trauma, or children less than two years of age regardless of the indication.

Current Practice: In the United States and Canada, all physicians are mandated reporters of suspected child abuse. As many as 10% of child abuse cases present with eye trauma, such as hyphema, open globe injury, or eyelid laceration. In addition, pediatric ophthalmologists frequently are called upon to interpret the pattern of RH observed in children with suspected abusive head trauma. Numerous alternative potential causes of such anterior and posterior segment findings may cause ophthalmologists to under or over diagnosis abuse.

Best Practice: Ophthalmologists play an important role in protecting both victimized children and innocent caregivers by accurately assessing the risk of an abusive injury, considering the consistency of the provided medical history with the observed ocular and adnexal findings. To meet this role, the pediatric ophthalmologist should remain vigilant for external signs of abuse, well versed in the diagnostic interpretation of specific RH patterns, and cognizant of systemic conditions that might mimic abuse.

Expected Outcomes: Participants will improve their ability to identify and distinguish among signs of abuse and mimickers of abuse and accurately communicate the level of suspicion to pediatricians and if necessary to legal officials in court.

Format: Case presentations with audience discussion led by child abuse pediatricians and ophthalmologists with expertise in the subject matter. The cases will highlight potential mistakes in the diagnosis of traumatic and non-traumatic conditions as well pitfalls in the clear communication of the likelihood of abuse to non-ophthalmologists.

Summary: Pediatric ophthalmologists may fail to identify subtle signs of child abuse, misdiagnose mimickers of abuse or not recognize the significance of particular patterns of ocular or retinal findings. This workshop will better equip audience members to make the correct diagnosis, whether it is trauma or not.

References:
Strabismus Surgery in Complex Neurologic Disease: Surgical Strategy and Outcomes

Gena Heidary, MD, PhD; Stacy Pineles, MD; Jason Peragallo, MD; Jane Edmond, MD; Mitch Strominger, MD; Linda Dagi, MD

Boston Children's Hospital
Boston, MA

Purpose/Relevance: Strabismus occurs frequently in children and adults in the setting of neurologic disease such as brain tumor or cortical visual impairment.1-3 The purpose of this workshop is to discuss and evaluate the approach to strabismus surgery in patients who harbor complex neurologic disease. We seek to highlight important considerations with respect to surgical strategy and discuss surgical outcomes in the context of these neurologic conditions.

Target Audience: Pediatric ophthalmologists and neuro-ophthalmologists

Current Practice: Ophthalmologists may not be familiar with the ophthalmic symptoms/signs suggestive of CNS disease, the significant morbidity of oculomotor dysfunction secondary to CNS disease, and the current literature regarding oculomotor outcomes in this context.

Best Practice: Ophthalmologists should recognize the clinical signs and the types of strabismus that are associated with these CNS conditions and be familiar with the pearls and pitfalls of strabismus management in the context of complex neurologic disease.

Expected Outcomes: The attendee will be empowered to recognize clinical signs suggestive of specific CNS diseases that affect ocular motor function and the pattern(s) of strabismus associated with these disease processes. The clinician will become aware of evidence based ocular motility outcomes for these patients thereby enhancing clinical management.

Format: Panel with case presentations, didactic lectures and question/answer period

Summary: The workshop will focus on topics such as surgical management of cranial neuropathies, hemifield slide-associated strabismus, acute comitant esotropia, and iatrogenic strabismus after treatment of brainstem and posterior fossa tumors. Each topic will be led by one of the authors with a case presentation followed by a didactic talk. The talk will include a brief review of pertinent clinical findings associated with the condition, a discussion of surgical strategy/decision making, and any relevant literature regarding ocular motor outcomes in the context of each topic.

Workshop #8
Tuesday, 7:00 – 8:15 am

Audience Directed Workshop: Modern Evaluation and Treatment of Nystagmus

Richard W. Hertle, MD; Veeral Shah, MD.PhD; Lionel Kowal, MD

 Akron Children's Hospital
 Akron, Ohio

**Purpose/Relevance:** This course will include experts who will respond directly to previously gathered queries by those AAPOS members interested in the current evaluation and treatment recommendations for nystagmus.

**Target Audience:** The target audience includes clinicians, researchers and ancillary professionals who care for patients with nystagmus and related disorders of motility.

**Current Practice:** Current road blocks to caring for patients includes discrepancies in terminology, variable evaluation protocols, inadequate distribution of current knowledge, and, treatment paradigms that are outdated or poorly shared by multiple disciplines.

**Best Practice:** As a result of this unique interactive workshop common questions by the audience regarding efficient evaluative protocols and medical, optical and surgical treatment paradigms will be addressed.

**Expected Outcomes:** We hope that this workshop will stimulate the participants to further increase their knowledge and broaden their skills when evaluating and treating patients with nystagmus.

**Format:** The format will include a unique, pre-meeting preparatory phase and formal panel presentations. In the months leading up to the 2018 meeting the membership will be contacted electronically through the AAPOS email server and pediatric ophthalmology list serve. The content of this contact will include a brief introduction to the audience directed workshop and ask for those interested in attending to return an email with their 10 top questions they would like answered by the experts. These will be collated and consolidated prior to the AAPOS meeting by the panel and answered as part of 4 formal presentations.

**Summary:** A panel of experts will discover the most common questions regarding the evaluation and treatment of patients with nystagmus. These questions will be obtained electronically during a pre-meeting electronic contact phase. The questions will then be formally discussed by the panel.

Musculoskeletal Symptoms Among Ophthalmologists and How to Prevent Them

Scott E. Olitsky, MD; Safeer F. Siddicky, MS; Donny Suh, MD; Derek Sprunger, MD

Children's Mercy Hospital
2401 Gillham Rd, Kansas City, MO 64108

Purpose/Relevance: Musculoskeletal symptoms (MSSs) affect a large number of ophthalmologists. Unfortunately, our awareness of this increasingly frequent problem is far behind some of our colleagues in the healthcare industry. This leads to unnecessary injury, shortened careers and decreased capacity for healthcare delivery. Awareness and preventative measures are important not only to protect ourselves but also our patients who depend on us for their healthcare. This workshop will discuss the nature of the ergonomic issues important in the field of ophthalmology in general as well as some that may be specific to pediatric ophthalmology. Discussion will focus on the need for increased awareness, better clinic and equipment design and techniques that can be used in the operating room to lower the risk of injury. Preliminary evidence from recently designed motion analysis studies will be presented.

Target Audience: Pediatric ophthalmologists

Current Practice: Many pediatric ophthalmologists are unaware of the risks they face with regard to their own health while seeing patients or performing surgery. Improved knowledge of this issue and the ergonomic changes that can be made in both the clinic and the operating room can decrease these risks.

Best Practice: Utilization of data-driven qualifying criteria for equipment design (including surgical loupe selection and adjustment) and understanding of basic clinical ergonomics principles are crucial to maintaining balanced postures while seeing patients and while operating.

Expected Outcomes: Decreasing the risk of MSSs among pediatric ophthalmologists.

Format: This workshop will consist of a panel discussion, latest research information, selected case presentations and audience participation. Specific recommendations regarding surgical loupe selection will be given.

Summary: This workshop will consist of an overview of MSSs that occur among ophthalmologists who treat children and adults with strabismus, with recommendations targeted at decreasing attendant musculoskeletal risks. It will also present preliminary findings from a recently designed motion analysis study that targets postures that may contribute to MSSs.

What’s New and Important in Pediatric Ophthalmology and Strabismus in 2018

Darron A. Bacal, MD; Tina Rutar, MD; Sudha Nallasamy, MD; Marina Eisenberg, MD; Kara Cavuoto, MD; Hee-Jung Park, MD, MPH; Leah Reznick, MD; Melanie Schmitt, MD; Elena Gianfermi, MD; Michael Gray, MD; Ilana Friedman, MD

AAPOS Professional Education Committee

Purpose/Relevance: The authors will investigate the literature for articles of interest to the sub-specialty of Pediatric Ophthalmology and Strabismus for the time period March 2017-February 2018. Ophthalmic journals are stressed but journals from other specialties such as pediatrics, neurology and comprehensive medicine will be included. The authors will summarize the key findings in the major topics including, but not limited to, vision screening, amblyopia, neuro-ophthalmology, retinopathy of prematurity, strabismus, cataract, glaucoma, genetics, retina, orbit, uveitis and practice management. The presentations in these topic areas will summarize and emphasize second-order analyses of the material.

Target Audience: Pediatric and Comprehensive Ophthalmologists who examine, diagnose and treat children and adults with strabismus, Orthoptists

Current Practice: Pediatric Ophthalmology is a rapidly evolving sub-specialty. It is difficult to remain current with all of the literature in this field.

Best Practice: The authors will summarize, analyze and present the most current and important information from more than 20 medical journals. This will allow the audience to have an overview of the most current and important literature.

Expected Outcomes: The audience will understand the most current published information in this sub-specialty.

Format: Didactic lecture|

Summary: More than 20 medical journals will be reviewed for relevant new findings in the sub-specialty of Pediatric Ophthalmology and Strabismus from March 2017-February 2018. The material presented will educate the Ophthalmologists and Orthoptists in new research.

References: References: Journal of AAPOS, Ophthalmology, Pediatrics
Newer Signatures for Evidence Based Evaluation in Strabismus: Imaging and Genetics

Zia Chaudhuri, FRCS (Glasg), FICO; Joseph L. Demer, MD, PhD

Lady Hardinge Medical College, University of Delhi, New Delhi, India and Stein Eye Institute and Department of Neurology, University of California, Los Angeles, United States of America
New Delhi, India and Los Angeles, United States of America

Purpose/Relevance: With newer modalities of investigations available in the form of high-resolution surface-coil orbital imaging for extraocular muscle (EOM) evaluation, and genetics in the form of next generation sequencing (NGS) tools to assess the etiology of both common and special forms of strabismus, it becomes important for the strabismologist to have an overview.

Target Audience: Strabismologists

Current Practice: Clinical strabismus practices globally do not incorporate these modalities for routine application. While imaging for strabismus is now an established modality for assessing EOM position as well as function, cost is a major impeding factor. Application of NGS in the evaluation of strabismus is relatively new and still in the research domain.

Best Practice: Both imaging and genetics provide customized signatures for the evidence-based diagnosis of conditions including strabismus. Imaging can clarify internal phenotypes not evident on clinical examination. With the emergent recognition of newer likely genetic determinants of strabismus, basic research supportive of strabismus has become very exciting.

Expected Outcomes: The practicing strabismologist will be informed about the latest available tools in the strabismus diagnosis armamentarium.

Format:
1. Two lectures on:
   a. Imaging as a phenotypic marker in congenital cranial dysinnervation disorders and rectus pulley heterotopy: Professor Joseph L Demer
   b. Whole exome sequencing in common forms of strabismus: Professor Zia Chaudhuri
2. Case presentations
3. Question – answer forum

Summary: Evidence based, highly specific diagnostic signatures for strabismus that have long languished in the research domain are now increasingly relevant to the everyday practice of strabismology. EOM imaging is already used for diagnosing difficult cases of strabismus. With advances in genetic tools and relentlessly decreasing cost of many investigations, a plethora of clinical information should soon be available. The practicing strabismologist should be aware of these modalities.

Difficult Discussions: Can We Improve the Way We Communicate with Patients and Families?

Gregg T. Lueder; Brian Campolattaro; Robert Enzenauer; Gena Heidary; Alex Levin; Alan Richards

Washington University School of Medicine
Saint Louis

Purpose/Relevance: Effective communication is an important aspect of providing optimal care and easing the burden of serious medical conditions on patients and families. Some situations are particularly challenging, either because of the serious nature of the medical disorder or because the family presents particular communication problems. The purpose of this workshop is to discuss communication strategies and techniques that can help both medical practitioners and their patients.

Target Audience: Pediatric ophthalmologists and orthoptists

Current Practice: There is little formal training during medical education regarding communication techniques. Much of this is learned haphazardly through observation of mentors and staff. Following medical training, most physicians do not have the opportunity to observe their peers in these situations.

Best Practice: Ideally, teaching of effective communication techniques would be a part of continuing medical education.

Expected Outcomes: The goal of this workshop is to provide tips and techniques that medical providers may use in their own practices when dealing with difficult communication problems.

Format: The panel will present and discuss various challenging clinical scenarios and methods for optimizing communication with patients and families. Topics include vision or life-threatening disorders, functional vision loss, parental guilt, and potentially serious non-ocular disorders that may be suspected based on the ophthalmic examination. Approaches to challenging families will also be discussed, including non-compliance, unrealistic demands on physician time, alternative medical treatments that interfere with appropriate medical care, and dysfunctional family relationships.

Summary: The workshop will provide examples and discussion of communication techniques that can help pediatric ophthalmologists and orthoptists improve the care of their patients and families.

References: Krahn GL, Hallum A, Kime C. Are there good ways to give 'bad news'? Pediatrics 1993;91:578-82.
Innovative Techniques for the Treatment of Adult Strabismus

Stacy L. Pineles, MD; Federico Velez; Melinda Chang; Jonathan Holmes; Ramesh Kekunnaya; Seyhan Ozkan

University of California, Los Angeles
Los Angeles, CA

Purpose/Relevance: To introduce newer innovative techniques for the treatment of adult strabismus by a diverse panel in a case-based format.

Target Audience: Pediatric Ophthalmologists and Strabismus Specialists

Current Practice: Adult strabismus is often characterized by surgical complexity. Often strabismus surgeons rely on a limited armamentarium of classic surgical techniques learned in their fellowships, but a number of innovative techniques have been recently developed. Innovative techniques for the management of complex strabismus have been developed. Strabismus surgeons should understand the indications for various strabismus surgical techniques in the management of these difficult cases.

Best Practice: Newer techniques will be discussed and videos will be utilized wherever possible. Strabismus surgeons should understand the indications for various strabismus surgical techniques in the management of these difficult cases.

Expected Outcomes: Participants will be able perform techniques described for the management of complex adult strabismus.

Format: Case-based panel format with videos and descriptions of surgical techniques described by the innovator on the panel.

Summary: Six cases will be presented over the course of the workshop, which will frame our discussion regarding the surgical procedures that can be considered for this select group of patients. Techniques discussed may include the use of adjustable sutures in patients with scleral buckles, inferior rectus transposition, botulinum toxin as a replacement for traction sutures, anterior superior oblique plication, and extraocular muscle transplantation. Audience participation will be encouraged.

Evaluating the Evidence: AAPOS Research Committee Analyses of What's Hot in Pediatric Ophthalmology

Gil Binenbaum; Brian P. Brooks; Steven E. Brooks; Alejandra de Alba Campomanes; Fatema Ghasia; Judith Gurland; Gena Heidary; Iris Kassem; Stacy Pineles; Bahram B. Rahmani; Michael Yang

Children's Hospital of Philadelphia
Philadelphia, PA

Purpose/Relevance: To help clinicians evaluate the quality and clinical generalizability of recent high-profile research studies presented by the AAPOS Professional Education Committee at the 2018 Meeting, and in the process, build the critical appraisal skills of the audience.

Target Audience: Pediatric ophthalmologists and strabismologists who wish to evaluate noteworthy new research publications in pediatric ophthalmology and strabismus and acquire new skills in critical analysis of the literature.

Current Practice: Clinicians often are aware of new key articles in their field but feel unsure of how to evaluate the quality and validity of the studies, as they decide whether to incorporate new findings into their own practice. While research workshops have been conducted at past AAPOS meetings, these workshops have been mostly conceptual.

Best Practice: Practicing ophthalmologists should have the skills to critically evaluate the methodology and findings of new research findings, particularly recent studies that have a potential to change clinical practice. They need to appreciate limitations posed by bias and generalizability and assess the impact of such limitations before making changes in practice. Such skills are best taught by practical application, using studies of particularly high interest to the field.

Expected Outcomes: The audience will gain high-yield analysis of the most recent 'hot' studies in pediatric ophthalmology and strabismus and develop critical appraisal skills in the process.

Format: This workshop is a 'sister-workshop' to 'What's New in Pediatric Ophthalmology and Strabismus' and will occur in the same room and immediately follow the 'What's New' workshop. A panel of AAPOS Research Committee members will critically analyze for the audience 4-5 studies selected in collaboration with the Professional Education committee as being among the most important from those presented in the 2018 'What's New' workshop.

Summary: In an innovative collaboration between AAPOS committees, attendees will receive a helpful, in-depth analysis of new research studies, which may impact their clinical practice. In the process, they will increase their understanding of study design and critical appraisal, so that they can make to their own, well-informed judgments about research publications in the future.

The IOL Didn't Last: Indications and Tips for IOL Removal, Repositioning, and Exchange

Erick D. Bothun, MD; David Morrison, MD; Faruk Orge, MD; David A. Plager, MD; M. Edward Wilson

Mayo Clinic
Rochester, Minnesota

Purpose/Relevance: Pediatric cataract surgeons hope that intraocular lenses (IOLs), once implanted, will meet the refractive needs of the patient and stay well centered and optically clear for many years. However, the IOLs we've counted on lasting a lifetime may opacify, decenter, or become an optical hindrance. Additionally, as the age of primary implantation shrunk, the number of severe myopes from overpowered IOLs in our practices has dramatically expanded. Lastly, piggyback IOL implantation strategies include a planned removal of one of the IOLs after the eye has grown. For all these reasons, the frequency of IOL removal, repositioning, and exchange has meaningfully increased in our practices. A discussion of the indications, challenges, options and tips for such IOL re-operations is warranted.

Target Audience: Pediatric Ophthalmologists

Current Practice: Pediatric cataract surgeons are re-operating on IOLs that decenter, lose optical clarity or contribute to high myopia. The use of piggyback IOLs with planned later removal of one IOL is being performed more commonly. Most of the reports on the frequency of such challenges is found in the adult refractive and cataract literature and under-reported for children. This panel includes pediatric cataract surgeons with experience and expertise in managing such IOL challenges

Best Practice: Clinical and surgical management with high level evidence.

Expected Outcomes: Attendees will understand the limits of existing knowledge in long term IOL stability and will be prepared to surgically manage piggyback, subluxated, and opacified IOLs.

Format: Panel presentations and discussion of IOL removal and exchange including literature review, perspectives on patient care and surgical videos.

Summary: 1. We will discuss the indications for IOL removal, exchange, or repositioning including literature review. 2. Surgical management of IOL related high myopia and piggyback lenses will be explained. 3. Videos will be displayed with surgical advice and tips including techniques and instrumentation.

Best Practice Patterns: How to Effectively Use OCT in Pediatric Ophthalmology

Allison R. Loh; Leah G. Reznick; J. Peter Campbell; William L. Hills; Beth Edmunds

Oregon Health and Science University
Portland, OR

Purpose/Relevance: As Optical Coherence Tomography (OCT) technology has advanced, it has become more widely utilized in pediatric ophthalmology. It is critical for pediatric ophthalmologists to understand how to incorporate OCT into their clinical flow, interpret results, and make clinical decisions based on OCT findings. The purpose of this workshop is to review basic OCT interpretation and discuss recent advances in OCT technology, including OCT angiography. We will discuss the pearls and pitfalls in utilizing OCT in the evaluation and management of pediatric glaucoma, optic neuropathies, and pediatric retinal pathology.

Target Audience: Pediatric ophthalmologists, researchers

Current Practice: There are unique challenges to the application of OCT technology in the pediatric practice and few resources to help pediatric ophthalmologists apply novel technology to the clinical care of children. By educating pediatric ophthalmologists about OCT, children will benefit from the diagnostic and management information provided by this valuable resource.

Best Practice: With pediatric ophthalmologists being educated by experts in OCT, a standard of practice will be developed for integration of OCT into the clinical care of pediatric ophthalmic conditions.

Expected Outcomes: Participants will gain skills in interpreting OCT scans of the optic nerve head, retinal nerve fiber layer and macula. With these interpretative skills, ophthalmologists can responsibly and effectively incorporate OCT into patient management.

Format: 1) Panel presentations (60 minutes) Each presenter on the panel will provide didactic training as well as an interactive case discussion for the audience to evaluate their understanding and ability to interpret OCT's. 2) Open question and answer forum (15 minutes)

Summary: This workshop will discuss: 1) Fundamentals of OCT interpretation 2) OCT pediatric normative data 3) Role of OCT in pediatric neuroophthalmology 4) Role of OCT in managing pediatric glaucoma and 5) Role of OCT in understanding the retinal pathology.

Reading Difficulties and the Pediatric Ophthalmologist

Melinda Rainey, MD; Deborah M. Alcorn, MD; Linn M. Mangano, MD; Laura J. Heinmiller, MD; Sheryl M. Handler, MD

AAPOS Learning Disability Committee, A. Melinda Rainey, MD Chair

Purpose/Relevance: Difficulties in learning to read occur in up to 40% of children. Many of these children will have dyslexia which represents 80% of all learning disabilities. Many people wrongly believe that reading difficulties are due to ‘visual problems.’ It is important for Pediatric Ophthalmologists to be conversant in the signs and symptoms of dyslexia, its underlying etiology, evidence based treatments as well as controversial treatments and to provide parents clarity and guidance to appropriate resources.

Target Audience: Pediatric Ophthalmologists and Orthoptists

Current Practice: Pediatric Ophthalmologists have very little training about dyslexia in residency or even fellowship. However, we are often ask to examine children with reading problems but may lack the knowledge to be able to properly counsel families.

Best Practice: Pediatric Ophthalmologists will be able to evaluate children with reading difficulties, ensure a normal eye exam, recognize the salient features of suspected dyslexia and provide information on local resources.

Expected Outcomes: The participant will gain understanding of the etiology of dyslexia, controversial and unproven therapies, evidence-based proven therapies and be able to provide families with factual information and how to find appropriate therapeutic resources.

Format: Workshop as a didactic lecture with question and answer forum

Summary: This course will provide a summary of the latest information on how we read, eye functions necessary to read, etiology of dyslexia and evidence-based remedial treatments. It will further examine controversial therapies such as Vision Therapy, Behavioral Optometry practices and Colored lenses/filters. We will further provide information on what to tell parents to assist our patients in finding the correct diagnosis, treatment and educational modifications.

Handler SM, Flierson WM. Reading Difficulties and the Pediatric Ophthalmologist. JAAPOS. 2017, in press.
AOC-AAPOS Combined Workshop: Re-examining the Data: PEDIG Conundrums

Stephen P. Christiansen, MD; Ronald J. Biernacki, CO; Alex Christoff, CO, COT; Sean Donahue, MD, PhD; Burton J. Kushner, MD; Nina M. Palomba, CO; Michael Repka, MD; Sarah Whitecross, OC(C)

Boston University School of Medicine
Boston, MA

Purpose/Relevance: The best clinical care is care informed by high-quality data. The Pediatric Eye Disease Investigator Group (PEDIG), formed in 1997, is a collaborative network dedicated to facilitating multicenter clinical research in strabismus, amblyopia and other eye disorders that affect children. The results of many PEDIG studies have changed and enlightened practice patterns. At the same time, PEDIG studies have raised important questions that warrant further analysis and, perhaps, further study. In this workshop, designed to enhance our understanding and interpretation of the data, questions arising out of four PEDIG studies will be addressed in a point-counterpoint discussion format.

Target Audience: Orthoptists, Pediatric Ophthalmologists

Current Practice: ATS 2A was a randomized controlled trial that compared 6 hours versus full-time daily patching as treatments for severe amblyopia in children less than 7 years of age. The study showed equivalent improvements in visual acuity in the two treatment arms. Much to the delight of children and parents alike, some providers began to recommend part-time patching for initial therapy of amblyopia. Other providers still consider full-time patching the gold standard. How does the data address either approach? This and other conundrums still exist despite well-designed and well-executed PEDIG studies. In this workshop, the data and the interpretation of the data will be re-examined to shed light on our current treatment paradigms and areas where further study may be helpful.

Best Practice: Clinical and surgical management supported by high-level evidence

Expected Outcomes: Attendees, by understanding limitations of current studies, will be prepared to more knowledgeably treat patients with conditions in which management remains in flux.

Format: Point-counterpoint discussion with audience participation.

Summary: Topics which will be addressed in this workshop include: Patching vs atropine penalization for moderate amblyopia; part-time vs full-time patching for severe amblyopia; home-based near target push-ups vs computerized vergence therapy for convergence insufficiency; and observation vs occlusion therapy for intermittent exotropia.

References:
Cortical/Cerebral Visual Impairment 2018: What You Need to Know to Diagnose and Treat including Perspective from a Parent of a Child with CVI

Sharon S. Lehman, MD; Rebecca Davis, Linda Lawrence, MD; Kanwal Nischal, MD, FRCOphth

American Academy of Pediatrics Section on Ophthalmology

Purpose/Relevance: Cortical/Cerebral Visual Impairment (CVI) is the most common cause of visual loss in children in developed countries. Lack of a standardized method for evaluation, diagnosis and providing recommendations for children with CVI creates challenges for the pediatric ophthalmologist. This workshop will provide practical information to close those existing gaps.

Target Audience: pediatric ophthalmologists, orthoptists

Current Practice: Lack of knowledge and attitudes of pediatric ophthalmologists concerning the care of patients with CVI limits the effectiveness of the team in caring for patients. A recent survey of teachers of the visually impaired showed that 68.4% of the TVI's determined communication by the pediatric ophthalmologist about children with CVI to be inadequate.

Best Practice: A pediatric ophthalmologist familiar with the latest information about CVI using standardized tools will improve the effectiveness of the pediatric ophthalmologist as a part of the team caring for a child with CVI and ultimately provide the best care for the patient.

Expected Outcomes: Participation in this workshop will allow the pediatric ophthalmologist to have practical tools (questionnaires and templates) that will allow for easier diagnosis, evaluation and communication of recommendations to the child's team.

Format: Case presentation, didactic lecture, question and answer

Summary: Lack of a standardized method for evaluation, diagnosis and providing recommendations for children with CVI creates challenges for the care team. Education of pediatric ophthalmologists and development of standardized tools which can provide the necessary information are practical ways to approach this problem.

References: Lehman SS. Attitudes Concerning Cortical Visual Impairment Among Pediatric Ophthalmologists and Teachers of the Visually Impaired. Poster presented at: 2016 American Conference on Pediatric Cortical Visual Impairment; 2016 July 8-10; Omaha, Nebraska
Loosening the Tension – Evaluation, Differential Diagnosis and Treatment of Restrictive Strabismus

Daniel J. Salchow, MD; Oliver Ehrt, MD; Michael Schittkowski, MD
Charite - University Medicine Berlin
Berlin

**Purpose/Relevance:** Evaluation and treatment of restrictive strabismus is challenging. Many causes for restrictive strabismus exist. Treatment for underlying causes includes conservative measures (e.g. medical treatment for orbital inflammation) and surgery (e.g. repair of an orbital fracture or excision of an orbital mass). Diplopia secondary to strabismus may be treated optically (prisms, occlusion) or surgically. This workshop aims at improving the ability to differentiate causes for restrictive strabismus, expanding the knowledge about their respective treatments, and to optimize strabismus treatment to improve the patient's health and quality of life.

**Target Audience:** Physicians, particularly strabismologists and orbital surgeons; orthoptists; physician assistants; ophthalmic technicians.

**Current Practice:** While some causes for restrictive strabismus are well known (e.g. thyroid related orbitopathy or orbital fracture), others may be overlooked or underdiagnosed. Standard strabismus surgery techniques and dosage tables may not be appropriate to treat patients with restrictive strabismus.

**Best Practice:** Knowledge about new entities causing restrictive strabismus has emerged (e.g. IgE4-associated orbital inflammation). Treatment of these causes should employ the least invasive option. Examination modalities such as the Harms tangent screen help to characterize the ocular deviation more comprehensively, enabling the physician to design effective surgical plans. Techniques beyond standard strabismus surgery include the use of tissue surrogates (irradiated bovine pericardium for eye muscle lengthening or amniotic membrane as a substitute for conjunctiva) and may be helpful in complicated cases. Surgery is not always aimed at correcting the deviation but sometimes at improving ocular motility by relieving restrictions. Recent advances in the conservative treatment of orbital vascular malformations including lymphangioma and capillary hemangioma may improve ocular motility and obviate the need for surgical intervention.

**Expected Outcomes:** Using the knowledge transferred in this workshop, clinicians will be better equipped to diagnose and treat restrictive strabismus and to recognize its underlying causes.

**Format:** Lectures, interactive case discussion, audience quiz and polling

**Summary:** Restrictive strabismus has many facets, and its treatment may be challenging. In this workshop we interactively discuss the causes of restrictive strabismus, its treatment options as well different approaches to treating the strabismus itself. Diagnostic and therapeutic advances including the use of tissue grafts in the surgical treatment of restrictive strabismus is the focus of this workshop

**References:** Esser J, Schittkowski M, Eckstein A. Graves' orbitopathy: inferior rectus tendon elongation for large vertical squint angles that cannot be corrected by simple muscle recession. Klin Monbl Augenheilkd 2011;228:880-6
Flanders M. Restrictive strabismus: diagnosis and management. Am Orthopt J 2014;64:54-63
Workshop #21
Tuesday, 1:15 – 2:30 pm


Federico G. Velez, MD; Sharon F. Freedman, MD; Deborah K. VanderVeen, MD; Kamiar Miresandari, MBChB, FRCSEd, FRCOphth, PhD

Stein Eye Institute, Doheny Eye Institute, Duke University Eye Center, Boston Childrens Hospital, The Hospital for SickKids
Los Angeles CA, Durham NC, Boston MA, Toronto ON

Purpose/Relevance: To familiarize pediatric ophthalmologists with common and advanced surgical techniques for the treatment of pediatric lens disorders, glaucoma and corneal abnormalities.

Target Audience: Pediatric Ophthalmologists, Fellows and Specialists

Current Practice: Surgical treatment of anterior segment disorders in children is challenging. Conditions are rare and usually managed at referring centers. Extra training and a long-steep learning curve are common in achieving the level of expertise and comfort required to surgical manage these conditions.

Best Practice: Basic and advanced step-by-step techniques will be discussed.

Expected Outcomes: Participants will familiarize with common and advanced anterior segment surgical procedures including techniques, challenges, and management of potential complications.


Summary: Panelist will present and discuss step-by-step surgical procedures including angle surgery, glaucoma drainage devices, and minimally invasive glaucoma techniques, lensectomy and complex intraocular lens implantation, collagen crosslinking and penetrating and lamellar corneal transplant. Audience participation will be expected and encouraged.

References:
AAPOS Genetic Task Force Workshop: Does This Patient Have a Genetic Eye Disease? Should I Refer?

Arlene V. Drack; Brian P. Brooks; Deborah M. Costakos; Natario L. Couser; Elias I. Traboulsi; Alex V. Levin; I. Christopher Lloyd; Virginia Miraldi Utz; Melanie A. Schmitt; Deborah Alcorn; Elise Heon; Mary C. Whitman

AAPOS Genetic Eye Disorder Task Force

Purpose/Relevance: Recent molecular genetic advances, including FDA approval of the first gene therapy for an inherited retinal disorder, RPE65 LCA, compel pediatric ophthalmologists to take increasing responsibility for accurately identifying, counseling or referring patients with genetic eye diseases. Understanding the role of genetic testing and interpretation of results is complex and updated guidelines are needed.

Target Audience: Pediatric ophthalmologists, residents and fellows

Current Practice: Pediatric ophthalmologists have varying levels of experience with evaluating genetic eye diseases. Many are concerned that during a busy clinic, a patient with underlying genetic disease identifiable by testing and amenable to treatment could be missed. For others, their confidence in management may not reflect the current standard of care.

Best Practice: Establishing pathways for coordination of care with a genetic eye disease specialist, genetic counselor or medical geneticist is vital. Understanding benefits and limitations of genetic diagnostic testing in relation to clinical phenotype helps to ensure correct diagnosis, counseling, and prompt referral for clinical trial enrollment or treatment interventions.

Expected Outcomes: (1) Clinicians will develop a systematic approach to identify patients with genetic eye disorders. (2) Clinicians will be able to devise pathways for comprehensive care, including differentiating between disorders appropriate for work-up by pediatric ophthalmologists versus those which require referral.

Format: Case-based presentations that focus on algorithms for specific categories of genetic eye disorders, for example, work-up or refer patients who have: Coloboma? Congenital nystagmus? Early-onset cataract? Poor vision in infancy? Multi-systemic disorders? Early-onset high myopia? Atypical strabismus? Optic nerve anomalies? Congenital glaucoma? Photophobia?

Summary: In a rapidly changing field, it is essential that clinicians utilize algorithms to confidently provide the best care for patients with genetic eye disorders.

Amblyopia: Update on Basic and Translational Science, 2018

David G. Hunter; Takao K. Hensch; Elizabeth M. Quinlan; Jonathan M. Holmes

Lasker Foundation / International Retinal Research Foundation
New York, NY

Purpose/Relevance: The Lasker/IRRF Initiative on Amblyopia convened an international group of basic scientists and clinicians to evaluate the scientific challenges and opportunities in the study and treatment of amblyopia. The group developed recommendations for multidisciplinary approaches to accelerate innovations to better prevent, diagnose, and treat amblyopia. In this workshop, we will share the key findings of this report on amblyopia and invite discussion about future directions and priorities.

Target Audience: Clinicians and researchers interested in the diagnosis, treatment, and prevention of amblyopia.

Current Practice: Despite more than a century of research, amblyopia remains difficult to detect and a challenge to treat effectively; it is more difficult to treat if not discovered early in life.

Best Practice: We envision a future where amblyopia is detected as soon as it develops and is fully treated using well-tolerated and easy-to-implement therapy, and where patients treated later in life will recover normal monocular and binocular vision via reopened critical periods of brain plasticity.

Expected Outcomes: Attendees will have an understanding of the current state of amblyopia research at a basic, translational, and clinical level. The participant will develop a framework for anticipating and interpreting the results of new studies as they emerge.

Format: Introduction, with four presentations by leaders of the Lasker/IRRF Amblyopia Initiative, followed by audience interaction with the panel of experts.

Summary: The content will focus on key aspects of amblyopia diagnosis and treatment, following the format outlined by the major topic areas of the Initiative, and will be led by four authors of the recently published report. Topics include: Refining the definition of amblyopia; Early diagnosis and current treatment; Critical periods and extending the treatment window; Amblyopia as a template for brain science; Animal models for amblyopia; and New pharmacologic and environmental approaches to treatment.

The Academic Peer Review Process: How to Succeed as an Author and Reviewer

James D. Reynolds, MD; William Good, MD; Rudy Wagner, MD; R.V. Paul Chan, MD; Michael Chiang, MD; Kyle Arnoldi, CO, COMT

University at Buffalo/Ross Eye Institute
Buffalo, NY

Purpose/Relevance: Many pediatric ophthalmologists and orthoptists aspire to publish significant work. Once one establishes a body of work, we are often asked to critically review journal submissions as ad hoc reviewers or editorial board members. Despite this large contingent of publishing professionals, there is little guidance on becoming a good writer or reviewer. This workshop will provide strategies and tactics to improve your publication acceptance rate as well as methods to be of more value as a reviewer.

Target Audience: Ophthalmologists and orthoptists who are interested in becoming a better author or reviewer.

Current Practice: Scientific publications are the foundation of clinical medicine. Many of us wish to contribute. Yet few of us receive instruction or guidance. Rejection rates are high, manuscript quality is highly variable, and reviewers can fail in their duty to improve manuscripts.

Best Practice: Authors and reviewers should be clear, concise, pointed, guided by the data and not over reaching in their discussion or conclusions. Reviewers must be honest, logical, insightful, knowledgeable, forthright, equi poised, and importantly, take the time and effort to make the manuscript better.

Expected Outcomes: Aspiring authors and reviewers will have a good understanding of the peer review process; formulating a hypothesis, applying appropriate methods, presenting data, and most importantly, analyzing the data and discussing it in a way that supports appropriate conclusions. Participants will learn the value of brevity, clarity, good sentence construction, good grammar, reference utilization, limited, data driven discussions and conclusions.

Format: Panel discussion and audience participation.

Summary: A respected panel of current editors (including JAAPOS; JPOS; AOJ; and Retina) and researchers will provide concrete pearls and recommendations on how to organize research material, present it clearly and appropriately, analyze it, draw appropriate conclusions, and provide insightful criticism.

Workshop #25
Tuesday, 2:45 – 4:00 pm

Adult Strabismus Workshop

David Stager, Jr., MD; Edward G. Buckley, MD; Forrest J. Ellis, MD; Joanne Hancox, FRCOphth;
Gena Heidary, MD, PhD; David L. Guyton, MD; Steven M. Archer, MD

Purpose/Relevance: The management of adults with strabismus is a growing portion of the clinical and surgical volume for many pediatric ophthalmologists. This workshop is designed to educate attendees about surgical treatment of adults with strabismus and offer practical ways to better prepare one's practice to manage this often neglected group.

Target Audience: Pediatric ophthalmologists, strabismologists, and orthoptists interested in evaluating and treating adults with strabismus.

Current Practice: Pediatric ophthalmologists may be intimidated by preparing one’s practice for the unique challenges that arise in treating adult strabismus. Complicated forms of strabismus, post-operative diplopia, management of torsion, re-operations, and adjustable sutures are among the adult-specific challenges that can deter surgical intervention.

Best Practice: Clinicians will gain a more thorough understanding of surgical approaches and techniques which yield better outcomes in adults with strabismus.

Expected Outcomes: At the conclusion of this workshop, attendees will have a better understanding of how to prepare their practice for adults with strabismus through specialized diagnostic tools, surgical techniques, and advice on how to increase referrals of affected adults.

Format: The workshop will include case presentations, useful advice unique to the adult population, and discussion by a panel of experts. In addition, time for audience participation with questions of the panelists is planned. Use of video for teaching will be included. Throughout the discussions, pertinent scientific literature will be presented and reviewed.

Summary: Topics will include challenging cases of adults with complicated forms a strabismus and special surgical considerations for the adult population, as well as tips, pearls, and advice on how to prepare one's practice for adult strabismus from surgeons with years of experience.


Pineles S; Capo H; de Alba Campomanes A; Holmes JM; Kushner B; Velez F. Case-based overview of the management of adult strabismus secondary to ocular surgery. JAAPOS 2017 Aug;21(4):e54.

Workshop #26  
Thursday, 7:00 – 8:00 am

**Video Demonstrations of Signs, Diagnostics of Diseases, and Complex Surgical Procedures in Pediatric Ophthalmology and Strabismus**

Sharon F. Freedman, MD; Jan-Tjeerd de Faber, MD; Laura B. Enyedi, MD; Sandra Guimaraes, MD; Tamara Wygnanski-Jaffe, MD; Federico Velez, MD  
Duke University Eye Center  
Durham, NC, USA

**Purpose/Relevance:** Video demonstration of unusual signs, diagnostics of diseases, and surgical procedures in pediatric ophthalmology and strabismus, with an emphasis on strabismus since we are joint with ISA this AAPOS meeting.

**Target Audience:** Pediatric Ophthalmologists and Strabismologists, Orthoptists, and Ophthalmologists in training.

**Current Practice:** Video offers the opportunity to demonstrate clinical signs, as well as complex (and even difficulties encountered in 'common') surgical procedures that are difficult to describe fully in text or with still photographs or diagrams. Some 'common' but difficult surgical scenarios can be greatly eased by simple 'pearls' while other, more rare conditions and certain surgical approaches are seldom seen outside tertiary referral centers, but are of great interest to all who care for children and patients young and old with strabismus.

**Best Practice:** This workshop allows the attendees to view videos of rare signs and both common and complex surgical procedures, presented and explained by the ophthalmologist who recorded them first-hand, with discussion by an expert panel and the audience.

**Expected Outcomes:** This workshop is intended to increase the attendee's level of familiarity with, and confidence in examining, diagnosing, and planning treatment for these unusual clinical scenarios.

**Format:** Six experienced pediatric ophthalmologists and strabismologists will present and discuss videos of signs, diseases, and surgical procedures. Panelists will discuss the differential diagnosis and potential treatment options. Audience participation is encouraged.

**Summary:** Demonstration of classical or rare signs, diseases, surgical procedures using high quality video presentations.

**References:** N/A
Difficult Non-Strabismus Problems in Pediatric Ophthalmology

Laura B. Enyedi, MD; Sharon F. Freedman, MD; Phoebe Lenhart, MD; Steve Rosenberg, MD; Saurabh Jain, MD

Duke University
Durham, NC

Purpose/Relevance: This workshop will discuss pediatric ophthalmology cases with a diagnosis other than strabismus in which the diagnosis, findings, and/or treatment pose a clinical dilemma to even an experienced pediatric ophthalmologist. These cases may include rare diagnoses or more common diagnoses with unusual presentations and/or atypical courses. Discussion will include the experiences with similar cases of a panel of seasoned pediatric ophthalmologists, as well as audience participants, and consideration of alternative evaluation and treatment plans.

Target Audience: Pediatric ophthalmologists, orthoptists, vision scientists and trainees

Current Practice: Pediatric ophthalmologists are presented with a challenging variety of cases which they may manage themselves or elect to refer other pediatric ophthalmologists or subspecialists with more extensive experience. Consultation with colleagues and review of the literature can provide insights into best practices.

Best Practice: If the diagnosis and/or treatment plan for a particular patient is in doubt, consultation with colleagues can be very helpful to provide patients with the best potential for good outcomes. Group presentation of cases in some instances is helpful, particularly with very rare pediatric ophthalmology problems. Advanced practitioners and audience members may have valuable insights that can assist in patient care.

Expected Outcomes: At the conclusion of the workshop the audience and the panel will have shared their experiences and strategies for the diagnosis and management of a few challenging non-strabismus pediatric ophthalmology cases. The practitioner in the audience is expected to gain new insights into the clinical reasoning behind each diagnosis and the purpose of any intervention.

Format: Each panelist will present one case and invite the other panelists to discuss their approaches to diagnosis and treatment. The audience will participate by asking questions or providing personal insights.

Summary: Case-based learning experience involving several challenging pediatric ophthalmology non-strabismus cases

References: None
Difficult Problems in Strabismus

Linda R. Dagi, MD; Seyhan B. Ozkan, MD; Ramesh Kekunnaya, MD, FRCS; Lionel Kowal, MD; Andrea D. Molinari, MD; Federico G. Velez, MD

Boston Children's Hospital
Boston, Massachusetts, USA

Purpose/Relevance: Evaluation and surgical repair of complex strabismus poses diagnostic and therapeutic challenges, even for the experienced surgeon. Addressing strabismus secondary to cranial nerve palsy, orbital trauma and deformity, or after multiple prior strabismus or other ophthalmic procedures is particularly problematic. This workshop will address difficult cases like these to fill a potential knowledge gap for the practicing ophthalmologist.

Target Audience: Pediatric ophthalmologists, adult strabismus specialists, ophthalmic residents, fellows, and orthoptists.

Current Practice: Practitioners utilize strategies and surgical techniques taught in fellowship or addressed at professional meetings, on the listserv, in journals, and as a result of peer-to-peer discussion.

Best Practice: Enhancing all of the above with the opportunity to discuss treatment options for particularly challenging cases presented and discussed by experienced strabismologists.

Expected Outcomes: As a result of extensive discussion and debate referable to management of six challenging cases, attendees will be introduced to novel strategies and techniques. Exposure is designed to enhance future practice by enabling participants to apply new concepts presented.

Format: The workshop will consist of expert panel discussion following presentation of a series of individual cases. Audience questions and participation will be encouraged, time permitting. The result of one expert's surgical intervention will be presented along with a discussion of the pearls and pitfalls of the intervention chosen.

Summary: All panel participants are internationally recognized experts in the field of strabismus. Each expert will present a difficult case for discussion by the others in an open forum format. The results of surgery performed to address the strabismus will be shared, and advantages and drawbacks to this choice will be addressed.

References: Strabismus Surgery
Basic and Advanced Strategies
Ophthalmology Monographs 17
The American Academy of Ophthalmology
Oxford University Press
2004