New Strabismus Surgical Techniques Workshop-Schedule

1. **Stretched Scar**   Irene H Ludwig, M.D.
2. **Bupivacaine Injection of Eye Muscles to Treat Strabismus**   Alan B Scott, M.D.
3. **Pulley Posterior Fixation**   Robert A Clark, M.D.
4. **Partial Avulsion of a Rectus Muscle (Flap Tear)**   Irene H Ludwig, M.D.
5. **Inferior Oblique Nasal Myectomy**   David R Stager, M.D.
6. **Full Tendon Advancement of the Superior Oblique**   Irene H Ludwig, M.D.
Stretched Scar

1. Diagnosis
   a. History-prior strabismus surgery, operative reports if possible.
   b. Time course of overcorrection or recurrence.
   c. Intraoperative findings.
      i. Stretchable, flimsy scar tissue.
      ii. Muscle often easily distracts away from globe with traction.
      iii. Recognizing demarcation line between healthy tendon and scar.

2. Repair
   d. Measure distance from original insertion to scleral attachment point, and distance from scleral attachment point to tendon.
   e. Place non-absorbable suture in tendon.
      i. 6-0 braided polyester for most muscles.
      ii. 6-0 clear polypropylene in tandem with 6-0 polyglactin for lateral rectus.
   f. Excise scar.
   g. Attach tendon directly to sclera, using standard surgical tables, and calculating total advancement as if a resection.

3. Postoperative
   h. No steroids
      i. Avoid gaze positions that will cause traction on suture.
      j. Vitamin C

References
Bupivacaine (BP) Injection of Eye Muscles to Treat Strabismus n=46

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Off-label use of BP
NIH Grant - R01 EY018633
Patent - US # 11/867,532 [Does not restrict medical use of BP]

BP changes EOM biomechanical properties, making the muscle bigger, stronger, stiffer, and shorter

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<th>Surgery</th>
<th>BT</th>
<th>BP</th>
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<td>Strength</td>
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BP injection of EOM, as in animal muscles, causes damage, regeneration, and hypertrophy over the course of about a month.

BP injection for Comitant Esotropia

n = 7 [2 re-injections]
276 - 725 days after the last injection
5 = improved average 12 pd, range 8 - 14 pd
(2 = minimal effect from small doses)

Current Rx for 12 pd or under is BP alone
Volume = 2.0 - 4.0 mL.
Concentration 1.5 - 2.0% [Leiter Pharmacy, San Jose, CA, makes 3%, easily diluted]
0.75% works, but use 4.0 mL.

BP effects are consistent, and are much longer lasting than the effects of Botox alone.

BP & Botox (BT)

The length of the rebuilt muscle appears to be determined by eye position during regeneration.

A small dose of BT in the antagonist reduces stretch on the BP-injected muscle, which then regenerates at reduced length.

Using BP & BT, seven comitant strabismus cases averaged 20 pd correction, about twice what we achieved with BP alone.
This sequence shows that wide swings of alignment do not occur with BP + BT.

Consistency and durability of effect with BP-BT

Deviation vs Days after Treatment with BP-BT

The next 6 slides show that 50% XT can be corrected with two injections of BP-BT.

Pre-injection ~50 pd XT
BP       BT

INJECTION #2  3.0% BP, 3.0 mL, LMR
4.0 U BT, .08 mL, LLR

224 days after second injections.
Coronal MRI at 224 days shows enlarged LMR and reduced LLR.

High myopia with slip of lateral rectus

113 days after Inj. #2. It appears that the stiffened LLR can hold the eye. Unlike the effect of LLR resection.

Palsy, Atrophy, CPEO

BP appears NOT to work in an atrophic muscle [Results of use in paralysis n= 4 ; CPEO n= 1 ]

This is likely due to the absence of satellite cells, which is known to occur with atrophy, or perhaps lack of muscle tissue damage to drive the regeneration as occurs normally.

BP DOES work in a partly paralyzed muscle, if there is not much atrophy.

It is possible that BP injection of a recently paralyzed EOM preserves volume, stiffness? To be tested.
Bupivacaine

### Technique

Alphagan, proparacaine x 5. Reclining or lying. Unlike Botox, EMG is nearly essential.

Warn of 1-2 hour blur, blindness from BP, ptosis.
Insert needle 5-6 mm behind insertion.
Once in EOM, follow EMG sound on back, 10-15 mm posterior to usual Botox site.
Inject 2/3 of dose slowly, moving forward 2-3 mm if resistance develops.
Inject remaining 1/3 in mid-muscle.
If BT then BP, switch syringes, same needle.
Mild orbit pressure for 5-10 min may reduce bleeds.

### Summary of current usage [2/11]

[1] Comitant Horiz and Vert of 6-12 ∆: BP 0.75%, 3.0-4.0 mL.
[2] Comitant 12-50 ∆: BP 1.5 -2.5%, 3.0 - 4.0 mL.
[3] Paretic VI with LR atrophy = small effects.
[5] CN III with anomalous regeneration- EOM are not atrophic = good effects.
[6] CN IV, not tried; but many non-atrophic SO cases.
Pulley Posterior Fixation

I. Indications – Anywhere you would use scleral posterior fixation
   A. Esotropia with high AC/A
   B. Reduce ductions into the field of action of the operated muscle
   C. Augment maximal recessions

II. Mechanism of Action
   A. No significant “loss of arc of contact” occurs with posterior fixation
   B. Mechanical impingement of posterior fixation suture on the pulley sleeve – prevents the muscle belly from sliding posteriorly
   C. Creates restriction (positive forced duction) into the muscle’s field of action

III. Description of Procedure
   A. Use your typical conjunctival incision
   B. Use your typical method of isolating the muscle insertion
   C. Use primarily blunt dissection to clean the muscle
   D. Perform your technique of recession or resection
   E. Load a permanent suture backhand (I use USS 6’0 Novafil on an SS-24 spatula needle)
   F. Slide a small muscle hook flat along the surface of the muscle belly beneath the muscle sleeve posteriorly about 10 mm
   G. Rotate the tip of the small muscle to point anteriorly
   H. Grasp the conjunctiva at the incision with a locking, toothed forceps
   I. Pull the small muscle hook towards the conjunctival incision while pushing the conjunctival tissue posteriorly with the forceps to create a “band” of pulley tissue on the hook
   J. Pass the permanent suture backhand through the pulley tissue, following the arc of the small muscle hook, leaving the needle on the needle driver
   K. Remove the small muscle hook and grasp the exposed needle tip
   L. Unlock the needle driver and advance the suture through the pulley sleeve
   M. Reload the permanent suture forehand
N. Grasp the insertion and rotate the eye opposite to the muscle
O. Slide two Jameson muscle hooks or a small Desmarre retractor beneath the conjunctiva and elevate to expose the posterior muscle belly
P. Take a 2mm bite of the posterior muscle where it enters the pulley sleeve
Q. Tie the suture permanently.
R. Repeat for the other pole of the muscle to create a firmer restriction
Partial Avulsion of a Rectus Muscle (Flap Tear)

1. Diagnosis
   a. History
      i. Direct facial trauma, ecchymosis, loss of consciousness.
      ii. Was diplopia instantaneous or delayed by days or weeks?
   b. Office examination
      i. Motility usually restricted toward the injury site due to tether effect (such as downgaze restriction after orbital floor fracture due to inferior rectus flap tear), but other motility patterns may occur.
      ii. Forced duction usually restricted.
      iii. Force generation test usually shows good muscle strength.

2. Intraoperative Assessment and Repair
   a. Forced duction test.
      i. Torsional forced duction restricted due to abnormal connections between intra and extraconal space.
   b. Use small fornix incision, and dissect minimally so as not to disturb the intermuscular septum and muscle capsule.
   c. Place muscle on hook and retrace posteriorly with Desmarres retractor.
   d. May need to compare with opposite eye to recognize the defect.
   e. Free up flap, gently dissecting torn end from surrounding tissues.
   f. Reattach to sclera with non-absorbable suture (6-0 braided polyester).
   g. Repair capsule with vicryl.
   h. Repair posterior rent in Tenon’s capsule, if present.
   i. Consider steroid injection perimuscularly.

3. Postoperative Management
   a. Begin moving eye immediately.
   b. In-office forced duction manipulation two to three times weekly for several months, akin to physical therapy.

References:

NASAL MYECTOMY INFERIOR OBLIQUE

Anatomy
Origin, insertion, innervation
Nerve structure
Surrounding tissue - Nasal vs Temporal
Weakening options
At insertion
At nerve
At origin
Reversing action
AT
ANT
Nasal myectomy
Approach - avoid fat pad
Skin approach - fat
Cul De Sac approach - fat
Temporal approach - intracapsular - no fat
Indications
Recurrent OA, Extortion
Missing S.O. - Crouson, Apert
Possibly as a primary procedure - preserve AT option with ancillary IO nerve origin
Concern
Fat pad penetration
New origin - Scar tissue
Further studies needed
Full Tendon Advancement of the Superior Oblique

1. Clinical indications
   a. Unilateral congenital SO palsy.
   b. Bilateral congenital SO palsy with downgaze V (arrow) pattern and extorsion.
   c. Acquired SO palsy-unilateral or bilateral.

2. Advantages
   a. No Brown’s syndrome.
   b. Complete flexibility about where to place insertion-especially useful for congenital malinsertions, which are common, and not addressed by the tuck.
   c. Less scarring than Harada-Ito, making it easier to reoperate.
   d. Stable long term results.

3. Technique
   a. Torsion test. (normal 60-70 degrees)
   b. Superotemporal fornix incision.
   c. Hook superior rectus.
   d. Expose SO insertion with Desmarres retractor.
   e. Hook SO with Steven’s hook.
   f. Place suture through insertion in standard fashion.
   g. Disinsert tendon, and advance circumferentially 3-6 mm.
   h. Anterior half of tendon reattached in an antero-posterior direction, and posterior half reattached nasally to temporally. This plus a central locking bite reconstructs the normal 90 degree curvature of the superior oblique insertion.
   i. Need to feel resistance to extorsion on torsion forced duction test at about 60 degrees. Resect the tendon or advance further, if inadequate resistance. Recess slightly if tendon is too tight. May use a slip knot to tie temporarily until satisfied about the position.