Pediatric Ocular Trauma Workshop - AAPOS 2014

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Introduction/Speaker introduction/Pre-Test

Pediatric ocular trauma is a major cause of ocular morbidity in children and is a leading cause of non congenital unilateral blindness in this age group.

Every year a quarter of a million children present with serious ocular trauma and the vast majority of these injuries are preventable.

Estimates of the incidence of serious ocular trauma varies from 8.85 to 15.2 per 100,000 per year. Extrapolation using global population data suggests that every year 160,000 to 180,000 children under 15 years sustain an ocular trauma serious enough to require hospitalization. 21% to 24% are penetrating globe injuries. Those that are less serious are more numerous: 95% of ocular injuries in this age group do not require hospitalization, suggesting that the number of eye injuries in children under 15 years of age might be as high as 3.3 to 5.7 million cases annually.


Eye Trauma in Children

- History often unreliable or cannot be obtained
- Children can be very difficult to examine after injury
- Medical/legal implications are severe if diagnosis is missed or delayed
- Worst possible injury must always be suspected
- *Remember Tetanus prophylaxis
- If office exam impossible: Exam under Anesthesia
Eyelid Trauma

Assess lid margin, repair promptly to avoid notch (7-0 Vicryl – does not require removal later)

Beware occult tarsal plate fracture: always evert lid. If present, convert to full thickness defect and repair accordingly

Don’t forget to check under lid for globe injury/hyphema

Lacrimal Duct Trauma

Suspect in any penetrating injury between inner canthus and nasal bridge

Ipsilateral bloody nasal discharge commonly seen

Common in dog bite: “canine-tooth injury”

Repair can be delayed for several days

Bicanalicular or monocanalicular stent placement

Overlying skin can be intact with posterior conjunctival/canalicular laceration: “mind the gap”


Penetrating Orbital Trauma

Retrobulbar hemorrhage represents an ophthalmic emergency

= extremity compartment syndrome

Delayed treatment can permanently affect ocular motility and vision

Proptosis/ophthalmoplegia/decreased vision/increased IOP

Blindness can result
Projectile Injury: Airsoft gun

- Round plastic 6mm sphere (BB=4.5mm; paintball=17mm)
- Muzzle velocity = 70-100 m/sec
- “Donut” shaped corneal erosion
- Energy on impact: Airsoft sphere < paintball (10x) < BB/pellet (100x)

*All air guns are capable of inflicting severe ocular injury, but this is more likely to occur with a higher velocity projectile (ie BB/pellet gun)*

Sharp/penetrating injuries often have a better visual prognosis than those injuries involving blunt projectiles that impact the globe at high velocity.

Hyphema in Children

***Highest risk of hyphema rebleeding = 2-5 days following injury***

Higher risk of rebleeding in SS/SC disease population

University of Colorado Study (J AAPOS)

138 unilateral cases between 2003 and 2011 reviewed retrospectively

88% in boys; average age 10.1 years (range 1-19 yrs)

Over 90% of injuries occur in the home setting

Etiology: general play/gun projectile/sports injuries

No patients experienced rebleeding

33/138 patients had elevated IOP; 4(12%) required surgery

Only 3 patients had <20/40 vision at one month follow-up

Outpatient care/activity restriction/topical meds usually led to resolution


Post-Test/Questions
Extraocular Muscle Injuries in Pediatric Ocular Trauma

Trauma can affect any structure in the eye, including the extraocular muscles which can lead to ocular motility disorders.

There are three basic mechanisms that can affect the extraocular muscles in the event of trauma and produce strabismus:

1) Muscle involvement in orbital wall fractures.
2) Muscle Contusion.
3) Traumatic disinsertion or laceration of the extraocular muscle.

Each of these possible mechanisms will have defined clinical characteristics with different management.

Orbital wall fractures caused by frontal impact of objects to the orbit will usually affect the inferior or the medial wall, which are the thinnest ones and more susceptible to fracture.

The muscles more commonly affected are the inferior rectus, inferior oblique, medial rectus and the superior oblique. Superior rectus and lateral rectus are very infrequently affected.

Entrapment of more than one muscle is also possible in the setting of multiple fractures; this most commonly involves the inferior and medial rectus muscles.

Strabismus due to muscle involvement in orbital wall fractures can be produced by two different mechanisms: 1) muscle incarceration in an orbital wall fracture or 2) a flap tear of a rectus muscle as described by Ludwig in 2001.

Flap tear of a rectus muscle can be produced by the sudden downward force exerted by the orbital tissue displaced to the fracture site. This traction of the connective tissue produces the tearing of the outer orbital layer away from the inner global layer of the muscle.

Both types of injuries, the muscle entrapment and the flap tear, produce a similar clinical scenario. A restrictive strabismus is present with a positive forced duction test and usually a positive forced generation test since the entrapped muscle usually does not lose its contractility. If there is substantial prolapse of orbital contents through the orbital fracture enophthalmos may be present. The patient will suffer diplopia that is usually avoided by the adoption of an anomalous head posture.
The motility restriction is usually opposite to the affected muscle. However in cases where the entrapment is in the posterior portion of the muscle, restriction of the eye movement can also be seen towards the affected muscle.

Trapdoor fractures are more commonly seen in children than in adults. These type of fractures usually affect the extraocular muscles producing entrapment of the muscle with diplopia and in some cases autonomic symptoms of increased vagotonia (nausea, bradycardia, hypotension) that require immediate medical attention. (2)

**Contusion** of an extraocular muscle can be seen as with any other muscle in the body and is produced by the impact of an object on the surface of the muscle without perforating any structure in the eye or ocular adnexae. After impact, edema and/or hematoma can form in the muscle belly thereby limiting muscle function.

This type of trauma can produce an incomitant strabismus with positive forced duction testing due to the hematoma. The muscle often does not contract well explaining why the force generation test might also be diminished. There is no visible external wound, although ecchymosis of the inferior lid might be seen. The most important feature of this type of injury, is that the strabismus improves spontaneously. The most susceptible muscle to suffer a contusion is the inferior rectus due to its exposure during Bell’s phenomenon.

Traumatic **disinsertion** is caused by the impact of a blunt object that perforates the conjunctiva and disinserts the muscle. The disinserted muscle usually reattaches posteriorly explaining why the muscle function might remain intact but slightly decreased from normal.

**Laceration** of the muscle is usually caused by the impact of a sharp object that perforates conjunctiva and ruptures the muscle. These cases often demonstrate a more significant limitation of muscle function muscle than in disinserted muscles. The angle of strabismus might be larger and fibrosis reaction around the affected tissue can be significant making surgical repair more difficult.

Clinical features of these type of cases include large angle incomitant strabismus. Forced duction test is usually negative but might become positive with time due to contracture of the antagonist muscle or if important fibrotic reaction is present. Forced generation test isn egative or diminished. Patient presents with widening of the palpebral fissure when looking towards the affected muscle. Diplopia and anomalous head posture are also commonly seen.

All rectus muscles can be affected but the most frequently involved are the inferior and medial rectus. This has been attributed to the fact that these two muscle are closest to the limbus and to the exposure which occurs during Bell’s phenomenon.

When faced with a case where an extraocular muscle might be affected due to trauma, it is very important to determine the condition of the affected muscle.

Useful diagnostic testing includes forced generation and forced duction. These tests will provide very useful information about the contractility potential of the muscle and the presence of restriction.
Evaluation of saccadic velocities will also help evaluate the potential function of the muscle.

Imaging a patient with traumatic strabismus is very important. Crucial information for the management of the patient can be obtained through a CT SCAN or MRI. CT scans are more useful in defining orbital wall fractures, as this technique provides the best image of the relation between the muscle and the bony fracture site. The MRI provides better imaging of orbital soft tissue and can determine muscle structure. Multipositional MRI is even better and can often provide information about the strength of muscle contractility.

With the exception of muscle contusion, all types of extraocular muscle injury require prompt treatment.

References


The Seven Firework-Related Eye Injuries

Jan Tjeerd de Faber MD
Rotterdam Eye Hospital
The Netherlands

The 7 trauma types

1. Pneumatic Trauma: The Blast injury to an eye can damage an eye without direct contact of a projectile to the globe. The mere shockwave of the explosion close to the eye can destroy microvasculature delicate structures like zonulae, iris base, retina and choroid. It can be compared with rupture of alveolar capillaries which have caused death in several patients after explosions. These patients will drown in their own blood due to bleeding into the lungs.

2. Thermal Trauma: Firework explosions produce a lot of heat due to the exothermal reaction of the chemical compounds of gunpowder and additives. When the explosion occurs close to the face this thermal energy will cause burns to the eyelid skin and cornea. Often the eyelashes and eyebrows will appear burned. Third degree burns in the area of the eyes will result in secondary scarring. The corneal epithelium usually heals quite well when the limbus is intact.

3. Chemical Trauma: Explosion of firework is an exothermal chemical reaction in which acid turn into alkaline. Both acids and alkaline are very toxic to the eye tissues. Due to the caustic property of firework components denaturation of the proteins of eye tissue will occur and result in a detrimental irreversible effect to the eye. This is the main reason to irrigate the eyes as soon as possible in an emergency situation. The eye is chemically cooked by exploded gunpowder and many eyes are lost due to delayed or insufficient removal of gunpowder remnants. When in doubt always examine a patient under full anesthesia and remove all visible gunpowder under the microscope and perform a double eversion of the upper eyelid to get full exposure of the upper fornix. All gunpowder has to come out!!!

4. Blunt Trauma: When a rocket or a banger hits the eye with kinetic energy the globe will be compressed. The cornea will indent, the lens and iris will be pushed posteriorly possibly resulting in traumatic cataract, zonulolysis, rupture of the iris sphincter, and iris-dialysis at the iris root often causing a hyphema. Trauma to the angle may cause glaucoma. The kinetic energy can cause a macular hole, retina and choroidal defect often ending in a sclopetaria scar of the posterior pole.

5. Sharp Trauma: Particles of the firework or even the shattered glasses of a patient can cause a penetrating eye injury. Depending on the type of projectile and the location of the wound severe damage to the eye can occur. Chemical particles and contaminated intraocular foreign bodies can lead to the loss of an eye due to endophthalmitis. The eye needs to be operated and closed as soon as possible to remove foreign bodies and inject antibiotics.

6. Skin Tattoo: Due to the blasting energy of firework particles they will perforate the skin and coloured chemical compounds are blasted in the skin. This can leave irreversible skin tattoo like scars.

7. Psycho Trauma: The psychological aftershock in firework victims is a common problem. At least 50% of these victims in The Netherlands are bystanders and often young children. We see and treat them as war victims because they often show post traumatic stress disorder (PTSD). In very young children this can have detrimental influence on their personality development. For example, the 3 year old boy who needed 3 surgeries and amblyopia treatment for several years starting school with less than 0.1 Snellen acuity in his damaged eye.
Dutch Ophthalmologist are requesting a ban on consumer fireworks in The Netherlands (Pop. 16.5 mil.) because every hour of legal consumer firework during New Years Eve will cost 1.4 blind eyes.
### Table 1:

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<th>Year</th>
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<th>2012/13</th>
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<td>86 (30%)</td>
<td>78 (26%)</td>
<td>104 (34%)</td>
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<tr>
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<td>85 (19%)</td>
<td>69 (28%)</td>
<td>84 (34%)</td>
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### Table 3:

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<td>23</td>
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