



Ophthalmology Update

Richmond Eye Associates, P.C.

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Ophthalmic Topics of Interest to the Medical Physician

Ocular Trauma

This issue discusses current information on ocular trauma, including causes of significant trauma and management of potentially vision threatening trauma.

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Ophthalmology Update:

Update from the Annual Meeting of the American Academy of Ophthalmology

- **AREDS report - oral antioxidants vs. macular degeneration and cataract**

Ocular Bungee Cord Injuries (Ophthalmology 2001;108:788-792)

Bungee cords are elastic cords with metallic S-shaped hooks at either end, used commonly to secure loads in cars, etc. Many occupational and recreational uses have been found for these cords. However, if one of the hooks is not adequately secured, or if the stress of the load causes the hook to straighten out, recoil forces can cause significant trauma. Both blunt and penetrating eye trauma are possible due to the design of the S-shaped hooks.

The study cited above was a retrospective chart review of subjects treated at Wills Eye Hospital in Philadelphia between 9/94 and 9/99 for bungee cord related ocular trauma. Additional follow-up information was obtained as possible. 67 bungee cord related injuries were identified during the 60 month study period. 90% of these were male, with an average age of 36 years. Overall, the incidence of injury increased during the study.

Details regarding the nature of these injuries are as follows:

- 91% of the injuries occurred when the hook released from the object that it was secured to.
- In 2 cases, injury resulted when a child

was playing with the cord.

- In 2 cases, the hook straightened out, causing release. In one case, the hook broke free from the cord.

Final visual acuity after injury was obtained in 62 of 67 subjects, ranging from 20/20 to no light perception (complete blindness). The **average final vision was 20/60, with 15% having vision worse than 20/400** (legally blind).

Eye injuries included hyphema (layered blood in the anterior chamber) at 63%, dam-



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Traumatic Causes of Retinal Hemorrhage in Infants

One fourth of all head injuries may be attributed to "non-accidental head injuries" in children, or "shaken baby syndrome," according to Monte D. Mills, MD, director of ophthalmology at Children's Hospital of Philadelphia¹. Retinal hemorrhages are commonly found in cases of non-accidental head injuries, and the threshold for retinal hemor-

rhage appears to be higher than that for intracranial hemorrhage in these children. Typically there are few signs of direct head or eye injury, although this could be possible in cases of trauma. Other conditions such as leukemia or a severe hematological abnormality could result in retinal hemorrhage

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Chemical Eye Injuries

Ocular exposures to chemicals are unfortunately very common, and inadequate treatment may lead to long-term consequences and visual loss. While some chemicals are substantially more toxic and potentially injurious than others, the primary treatment of ocular chemical exposure is constant - **immediate irrigation**. Ideally this would occur at the site of exposure, with tap water if necessary. Individual physician offices need to decide whether or not they will provide emergency ocular irrigation as a service, or if patients instead will be referred to an emergency room. The main points in managing chemical exposure include:

- Patients with chemical burns should be triaged immediately to treatment with irrigation. A detailed history should be deferred until after irrigation has begun, and even the measurement of vision can be deferred.
- The eye and conjunctival cul-de-sacs should be irrigated copiously with a continuous stream of eye irrigation solution or normal saline (with IV tubing) for 15 to 20 minutes. Topical anesthesia should be used prior to and during irrigation if necessary.
- After 15 to 20 minutes of irrigation, the corneal surface and superior and inferior cul-de-sacs should be inspected for particulate matter, which can be removed with forceps or a moistened cotton swab. If the history reveals exposure to acids or alkaline chemicals, the pH of the conjunctival surface within the inferior cul-de-sac should be tested. Anesthetic solutions will not generally interfere with the pH reading. Irrigation should resume until the pH is neutral (7.0), which may take many liters of fluid in the case of alkaline burns.

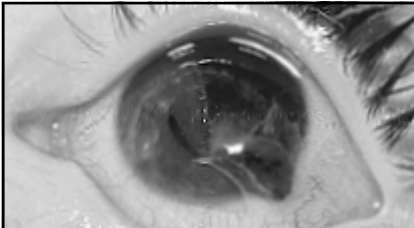
- **Please note that some pH strips do not include the full pH range, and instead only range from 2 to 7. Urine pH strips usually include both acid and alkaline readings.**
- After completing irrigation, the patient should be referred to an ophthalmologist to assess the severity of the injury and continue treatment.

Some common sources of chemical burns:

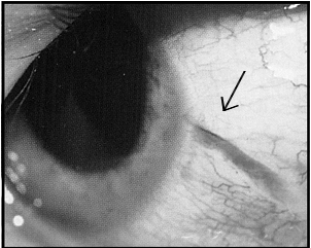
- **Alkaline** chemicals include lye, sodium hydroxide, contents of alkaline batteries, mortar, pesticides, household cleaners, and fertilizers. Alkaline chemicals penetrate into the eye to cause continuing damage, and may require many liters of irrigation to neutralize. Corneal opacification, scleral melting, and necrosis due to vascular obliteration are possible sequelae of alkali burns. Second and third degree skin burns are possible as well.
- **Acidic** chemicals include automobile battery fluid. Immediate coagulation of superficial cellular layers may prevent deeper absorption and injury, but irrigation to a neutral pH is still necessary.
- **Alcohol** based chemicals and solvents often cause significant and painful corneal and conjunctival abrasions.
- **“Pepper Spray”** used as a defense can cause vision threatening corneal scarring if not irrigated promptly after exposure.
- **Petroleum** based chemicals such as gasoline usually cause relatively mild injuries.
- **“Super glue”** primarily glues the lids and eyelashes together without damaging the eye itself.

Clinical Pearl: Indicators of Potentially Severe Ocular Trauma

This section discusses some clinical findings which may indicate severe, vision threatening ocular trauma worthy of **immediate** referral for evaluation.

- **Abnormal Pupil Shape** following direct ocular trauma - this may indicate a corneal or scleral rupture with iris plugging the wound. 
- **Severe Loss of Vision** - this could indicate significant internal ocular injury such as retinal detachment.
- **Afferent Pupillary Defect** (Marcus Gunn pupil) - this usually indicates severe retinal or optic nerve injury. Note that even a dense vitreous hemorrhage will not cause an APD. Cases of retrolbulbar orbital hemorrhage may cause a constrictive optic neuropathy due to progressively increasing orbital pressure.
- **“Tense Hemorrhagic Chemosis”** - this is a tense, 360 degree subconjunctival hemorrhage following trauma that could be

hiding a scleral rupture, and may require exploration.

- **A Conjunctival Laceration** - a scleral laceration can be present beneath a conjunctival laceration, and may require exploration.
- **A Prior History of Cataract Extraction, Glaucoma Filtering surgery, Corneal Transplant, or Refractive Surgery** - the integrity of the eye may be significantly weakened by prior surgeries.
- **Injury caused by a sharp object** (such as a knife, pencil, metal wire, screwdriver, etc.) or by an explosion - these can easily cut through the sclera while leaving very little external evidence of trauma, and an intra-ocular foreign body may be present. 
- **An inability to examine the eye** and severe ocular injury is suspected. This could include cases severely swollen lids that prevent examination, or uncooperative patients.
- **An unremovable corneal or conjunctival foreign body.**

Retinal Hemorrhages in Infants (from page 1)

also. The retinal hemorrhages found in non-accidental head trauma are somewhat unique in that they are characterized by hemorrhage throughout all layers of the retina, as well as vitreous and optic nerve hemorrhage.

Some controversy exists as to whether other causes for the retinal hemorrhage may be present, such as a result of resuscitation or CPR, or from childbirth itself. A study recently published in *Ophthalmology*² indicates that intra-retinal hemorrhages are common in the immediate postnatal period, but that they usually resolve by one month of age. This study involved the examination of 149 healthy newborns within 30 hours of birth, and found that 34% of newborns had retinal hemorrhage ranging from a single dot hemorrhage to widespread bilateral hemorrhages. A higher rate of retinal hemorrhage was found in vacuum assisted deliveries (75% rate), and was lower for those delivered by cesarean section (7%). In 86% of eyes, retinal hemorrhage resolved by 2 weeks of age, and at 4 weeks no intra-retinal hemorrhage persisted.

Other types of trauma, such as falls or car accidents, rarely lead

to retinal hemorrhage. Another study³ looking at air bag associated ocular injuries in children reported no cases of retinal hemorrhage. Two other conditions are sometimes confused with retinal hemorrhage associated with non-accidental trauma, Terson's syndrome and Purtscher's retinopathy. Terson's syndrome is typically found in adults, and refers to optic disc and retinal hemorrhage following an intracranial hemorrhage from a ruptured intracranial aneurysm. Purtscher's retinopathy refers to retinal hemorrhages following chest compression.

Overall, the presence of retinal hemorrhages in cases of head injury appears to be fairly specific for non-accidental trauma, or shaken baby syndrome. Pediatric ophthalmologists typically perform the more specialized dilated eye examination for children under the age of 2.

¹Ocular Surgery News 2001.

²Ophthalmology 2001;108:36-39.

³Ophthalmology 2000;107:1472-1475.

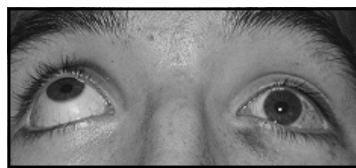
Orbital Blowout Fractures

Blunt trauma to the face and periorbital area can lead to orbital fractures, often involving the orbital floor and medial orbital wall. While medial wall fractures are usually not clinically significant, orbital floor fractures can lead to entrapment and restriction of the inferior rectus muscle, or can lead to the eye sinking back into the orbit and maxillary sinus (enophthalmous). In some cases more complicated facial fractures are also present (such as tripod fractures) which may need evaluation.

Findings suggesting a clinically significant orbital floor fracture (blowout fracture) include reduced sensation in the maxillary division of the trigeminal nerve and a reduced or limited elevation of the eye above the horizontal midline. A false appearance of enophthalmous may be present due to lid and periorbital edema, making this diagnosis difficult to make without specialized equipment. The reduction in sensation is caused by damage to the infraorbital nerve (which travels in the orbital floor.) Sensation to the face beneath the eye as well as to the gums and teeth are reduced.

Finding numbness of the upper gums ipsilateral to the suspected fracture is fairly specific. The photos below illustrate entrapment of the inferior rectus muscle in an orbital floor fracture, preventing upgaze of the left eye due to a tethering effect.

CT scanning is indicated in cases of suspected entrapment, as well as cases of facial deformity from other fractures. Coronal and axial 3mm cuts will identify the extent of most fractures. Entrapment cases are usually surgically repaired urgently, within 2-3 days. Other cases can be observed for development of enophthalmous. An ophthalmic exam is needed to rule out ocular pathology.



Today's Ocular Trauma

There are an increasing number of causes of ocular trauma from unusual sources not in existence a few years ago.

- **Airbag Related Ocular Injuries** - a study looking at airbag related ocular injuries from 1993 to 1996 found 170 ocular injuries in 113 drivers or passengers. 82% had eyelid injuries and 12% had corneal abrasions, and there were cases of retinal tears, vitreous hemorrhage and hyphema. An alkali ocular injury occurred when one airbag ruptured, releasing an alkaline powder into the driver's eyes. A separate study looked at airbag related ocular injuries in children aged 1 to 11. Corneal abrasions, eyelid lacerations, iritis, and hyphema occurred, in spite of most of the children involved being properly restrained.
- **Paintball sports** have resulted in ocular injury, primarily in

cases where the protective mask is removed by the victim. While the paint itself is non-toxic, the paintballs are fired at speeds of up to 300 feet per second. In a study looking at 35 cases of paintball related eye injuries from 1995 to 1998, many injuries were severe, with 40% requiring ocular surgery and 77% requiring hospitalization. Vision remained 20/200 or worse in 46% of cases long-term. While eye protection had been worn in 60% of cases, the protection had been removed at the actual time of injury. All victims were male, and 86% of cases occurred during commercial or informal war games.

- **Laser Pointer eye injuries** have been widely claimed, but there is little evidence of actual retinal damage occurring with laser pointer misuse. One case has been reported of retinal damage occurring in an 11 year old girl who subjected herself to close range light of laser pointer repeated on a school bus. Pigmentary retinal changes occurred with a final vision of 20/25. Incidental laser pointer light exposure is apparently not

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- Extensive patient information, including discussion of over 80 eye conditions and a section discussing risks and benefits of laser vision correction.
- Interactive Clinical Section concerning eye disease and physical findings
- Clinical Trials Database

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Ophthalmology Update

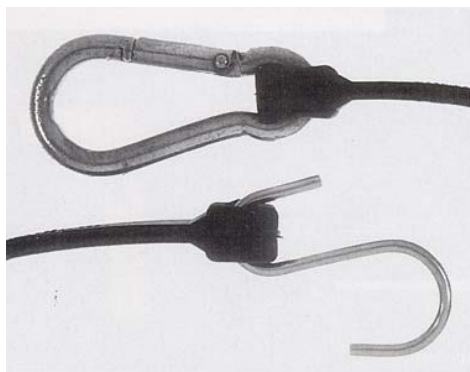
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Bungee Cord Injuries (page 1)

age to the anterior chamber drainage angle at 40%, retinal bruising (commotio retinae) at 55%, vitreous hemorrhage at 24%, eyelid lacerations at 24%, and 7 subjects with ocular lacerations, 7 with traumatic cataract, and 4 with a retinal tear or detachment.

31% needed some sort of surgical intervention after injury. Three eyes had to be removed due to irreparable injuries.

Because most of the injuries in this study occurred with the **proper** use of the bungee cords, it is likely that the rate of injuries will increase as the use of bungee cords increases. Previous authors have called for the J- or S-shaped hook to be replaced with a spring-loaded gate clip. This would have prevented most of the injuries in this study, which occurred after the hook spontaneously released, rather than after a separation of the hook from the cord.



**Spring-
loaded
Gate Clip**

**Traditional
Hook
Design**

Today's Ocular Trauma (page 3)

capable to causing injury, only voluntary exposure at close range for several seconds.

- **Slingshot launched water balloons** can cause vision and life threatening injuries. The energy of a launched water balloon has been estimated as similar to some rifle bullets. Speeds range from 20 to 92 MPH with a range of 30 to 200 yards. Ocular injuries have included orbital fractures, retinal and vitreous hemorrhage, traumatic optic atrophy, traumatic cataract, macular hole, hyphema, corneal abrasions, and eyelid lacerations. Loss of consciousness and cardiac arrest have also been reported.
- **Airsoft guns** are plastic pistols marketed primarily as toys with no age restrictions for purchase. They shoot hard plastic bullets up to 90 feet. Serious ocular injury has been reported with their use, including corneal abrasion, hyphema, vitreous hemorrhage, cataract, and retinal damage. Surgery was required in some cases to restore vision. The injuries occurred even in cases of the bullet ricocheting from a wall.
- **Fireworks** related ocular injuries are common, with bottle rockets accounting for most of the 2000 eye injuries per year associated with fireworks usage. About one-third of these injuries result in permanent ocular damage, and one-fourth in permanent loss of vision. 5% of eye injury victims lose all useful vision or require removal of the eye. 44% of the injured are children age 19 or below, 72% are male, and most are bystanders.