MID-FACIAL AND OCULAR TRAUMA
Grant Gilliland MD
Texas Ophthalmic Plastic, Reconstructive & Orbital Surgery Associates

MID-FACIAL TRAUMA

- SPORTS RELATED EYE TRAUMA EPIDEMIOLOGY
- EYE TRAUMA PREVENTION
- EVALUATION OF INJURIES
- MID-FACIAL INJURIES
  - EYE TRAUMA
  - ORBITAL FRACTURES
    - Biophysics
    - Symptoms
    - Surgical Indications
  - FACIAL FRACTURES

EYE INJURY EPIDEMIOLOGY

- EYE TRAUMA
  - 83% Male
  - Median Age 27
  - White males 20-29 have highest incidence
  - 63% had best vision < hand motion
  - 1.5% injured wore safety glasses
  - 2.7% injured wore non-safety glasses
  - 1400/100,000 will have an eye injury in lifetime

- Types of Injury
  - Superficial (3.07/1000)
  - Foreign Body (1.95/1000)
  - Contusion (1.21/1000)
  - Open Wounds (.81/1000)
EYE INJURY EPIDEMIOLOGY

- Serious Eye Injuries
  - 40% in home
  - 13% Industrial
  - 13% Streets/Highways
  - 13% Sports/Recreation

- Causative Agents
  - 31% blunt objects
  - 18% sharp objects
  - 9% motor vehicle related
  - 5% gunshots
  - 5% nails
  - 6% BB or pellet guns
  - 5% fireworks
  - 3% explosions
  - 4% falls

Economic Impact of Vision Loss in the United States — Total $51 Billion

- 600,000 Sports related eye injuries/year
- 90% preventable
- “street wear glasses or sunglasses” put athlete at higher risk of injury
- 1/18 college athletes sustain an eye injury
- 1/10 college basketball players sustain eye injury

Sports Related Eye Injury Epidemiology

- Lawsuits
  - 1/8 victims of severe eye injury
  - 1/20 victims of minor eye injury
SPORTS EYE INJURIES

- A study of 746 sports eye injuries found
  - 43% hyphema
  - 12% traumatic cataract
  - 18% blind
- Sports involved
  - 33% baseball/softball
  - 10% basketball
  - 5% soccer

SPORTS SUCCESS STORY

- HOCKEY
  - Face shields have saved $10 million in eye injury related costs
  - Facial injuries 4.7x more likely without face shield
  - Face shields are mandatory for amateur hockey
  - No eye injuries documented with full face shield
  - Partial face shields reduced incidence of eye injuries 66%
  - 66% players in NHL wear face shields currently

HIGH RISK SPORTS

- Basketball
- Baseball
- Softball
- Lacrosse
- Hockey
- Tennis
- Soccer
- Volleyball
- Water Polo
- Football
- Air Rifle

SPORTS RELATED SAFETY EYE WEAR

- Standards depend on the sport being played
- Baseball = ASTM F910
- Racquet sports = ASTM F803
- Rec Specs and HILCO are ASTM certified
- Nike, Oakley, Bolle are NOT ASTM certified
SAFETY GLASSES
- Must have “ASTM F803 etc.” marked on frame/lens
- Tinted, wrap around, brow protection
- Face shield>Goggles>Safety Glasses
- Faceshields commonly worn over safety glasses
- Polycarbonate lenses – withstand a ¼” BB shot at 100 mph or One lb weight dropped from 4’
- Polycarbonate lenses- can withstand impact from ball traveling 90 mph (20x stronger than street wear)
- Polycarbonate>Glass>Plastic

EVALUATION
- Ophthalmic examination
  - Visual acuity in each eye
  - Pupillary function
  - Globe for penetration
  - Ocular motility
  - Eyelid position and movement
  - Facial sensation
  - Facial nerve function
  - Bony contours

MID-FACIAL TRAUMA EVALUATION
- Patient stabilization
  - ABC’s
  - C-spine
- General history and physical exam
- Assessment of visual system
- Assessment of soft-tissue injury
- Radiologic evaluation
- Photographic documentation

EYE EVALUATION
- Visual Acuity is a Vital Sign
- EOMI PERRLA is NOT an adequate eye exam!
- Test each eye separately
  - Snellen Chart
  - Near Card
  - Newspaper
  - Etc.
- JUST DO IT!
**EYE EVALUATION**

- **Pupillary Evaluation**
  - Afferent Pupillary Defect

<table>
<thead>
<tr>
<th>Ambient light</th>
<th>Penlight (right eye)</th>
<th>Penlight (left eye)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CORNEAL ABRASION MANAGEMENT**

- Antibiotic ointment (bacitracin or erythromycin)
- Cycloplegia (1% cyclopentolate)
- **NEVER dispense topical anesthetic!**
- Pressure patch
  - *never in a contact lens wearer!*
- Ensure close follow up

**CORNEAL FOREIGN BODY**

- Pain
- Antibiotic ointment
- Removal in ER or in OR semi-urgently

**HYPHEMA MANAGEMENT**

- Complete exam, rule out rupture
- CT if possible orbital fracture or rupture
- Sickle-prep in African-American patient
- Control IOP
- Pain control and anti-emetics
- SHIELD and minimize activity (hospitalization)!
- Consult
**EYELID AND CANALICULAR LACERATION**
- NPO and systemic antibiotics
- Antiemetics and Tetanus toxoid prn
- CT to rule out foreign body
- Immediate Surgical repair
- Protect Eye with shield until in OR

**ORBITAL FRACTURES**
- Orbital Roof Fracture
- Orbital Floor Fracture
- Medial Wall Fracture
- Lateral Wall Fracture

**RUPTURED GLOBE MANAGEMENT**
- Symptom – Pain
- Symptom – Double vision
- Symptom – Numbness (best predictor of fracture)
- Symptom – Nausea/vomiting

**ORBITAL FRACTURE**
- Signs
  - Restricted Eye Motility
  - Orbital emphysema
  - Numbess in V2
  - Enophthalmos
ORBITAL FRACTURE MANAGEMENT

- No Nose Blowing
- Nasal Decongestants
- Oral Antibiotics
- Ice Packs to the Orbit

BIOPHYSICS OF ORBITAL FRACTURES

- Injury Patterns
  - Hydraulic Theory
  - Buckling Theory

Measurements of impact force at fracture for each animal's eye. Force required to fracture eye socket typically less than 40 Newtons. Fracture force varies substantially.

(1) Denotes 21 animals with experiment performed on each eye of each animal
Twenty-four Days Appears Sufficient to Heal Fracture to Greater-than-Original Strength

![Graph showing impact force at first fracture vs. impact force at second fracture](image)

(1) Denotes 21 animals with experiment performed on each eye of each animal

**ORBITAL FRACTURE SURGICAL INDICATIONS**

- DIPLOPIA
- PAIN WITH EXTRAOCULAR MOTILITY
- ENOPHTHALMOS
- LARGE FRACTURE
- “WHITE-EYED” BLOW-OUT
- PULSATILE EXOPHTHALMOS (Roof fractures)
- BRADYCARDIA
  – Oculo-Cardiac Reflex

**DIPLOPIA**

![Diagrams illustrating diplopia](image)
Saggital CT Scan – Blow-Out Fracture

ORBITAL FLOOR FRACTURE

• Treatment
  – Transconjunctival
  – Subciliary
  – Subtarsal
  – Combined
  – Caldwell Luc
**Trapping Fracture**

- Nausea and Vomiting
- Pain with motility
- Restricted up and/or downgaze
- Bradycardia
- Syncope

**ORBITAL FRACTURE**

<table>
<thead>
<tr>
<th>Implant Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medpore Sheets</td>
</tr>
<tr>
<td>Silastic Sheets</td>
</tr>
<tr>
<td>Gelfilm</td>
</tr>
<tr>
<td>Homogenous Bone</td>
</tr>
<tr>
<td>Homogenous Cartilage</td>
</tr>
<tr>
<td>Autogenous Bone</td>
</tr>
<tr>
<td>Polylactin Polymer</td>
</tr>
<tr>
<td>Supramid Sheeting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Implant Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marlex Mesh</td>
</tr>
<tr>
<td>Methylmethacrylate</td>
</tr>
<tr>
<td>Teflon</td>
</tr>
<tr>
<td>Lyophilized Dura</td>
</tr>
<tr>
<td>Fascia Lata</td>
</tr>
<tr>
<td>Titanium Plate</td>
</tr>
<tr>
<td>Titanium Mesh</td>
</tr>
<tr>
<td>Hydroxyapatite Granules</td>
</tr>
</tbody>
</table>

**COMPLICATIONS**

- Loss of vision - incidence < 1 in 3,000
  - Retrobulbar Hematoma
  - Central Retinal Artery Spasm
- Diagnosis intraoperatively – (dilated pupil)
  - Ciliary Ganglion impingement (no blindness)
  - Optic neuropathy
  - Arterial Spasm

**ORBITAL FRACTURE REPAIR**

- Implant Material
  - Marlex Mesh
  - Methylmethacrylate
  - Teflon
  - Lyophilized Dura
  - Fascia Lata
  - Titanium Plate
  - Titanium Mesh
  - Hydroxyapatite Granules
**SURGICAL NAVIGATION IN ORBITAL FRACTURES**

- Green tinted Skull – Normal anatomy
- Red tinted Skull – Depressed ZMC Fracture
- Blue tinted Skull – Mirror image projection

**LEFORT FRACTURES**

- Rene LeFort described in 1901
- 6-25% of facial fractures
- Type 1 – Horizontal
- Type 2 – Pyramidal
- Type 3 – Transverse (craniofacial separation)
- Facial muscles play little role
- Type of fracture depends on direction and amount of force and facial buttresses

**NAVIGATION AND MIRROR IMAGE PROJECTION**

**CRANIOFACIAL SEPARATION (LEFORT 3)**
WILLIAM TELL

TAKE HOME MESSAGE

- SAFETY GLASSES PREVENT INJURIES
- PROPER EVALUATION INCLUDES MEASURING VISUAL ACUITY AND PUPILLARY REACTION
- YOUNG ATHLETES WITH SUSPECTED ORBITAL FRACTURES (NUMBNESS OF CHEEK) SHOULD HAVE EMERGENT SURGERY FOR BRADYCARDIA AND INCARCERATION OF MUSCLES (NAUSEA & VOMITING)