Trauma to the Anterior Segment of the Eye

Mohammad Hafez Noroozizadeh MD
Freelancer
Basir Eye Center
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- The WHO Programme for the Prevention of Blindness, suggests that annually
  - 55 million eye injuries restricting activities more than one day
  - 750,000 cases will require hospitalization
  - 200,000 open-globe injuries
  - approximately 1.6 million blind from injuries
  - 2.3 million people with bilateral low vision
  - 19 million with unilateral blindness or low vision.

Terminologies & classification

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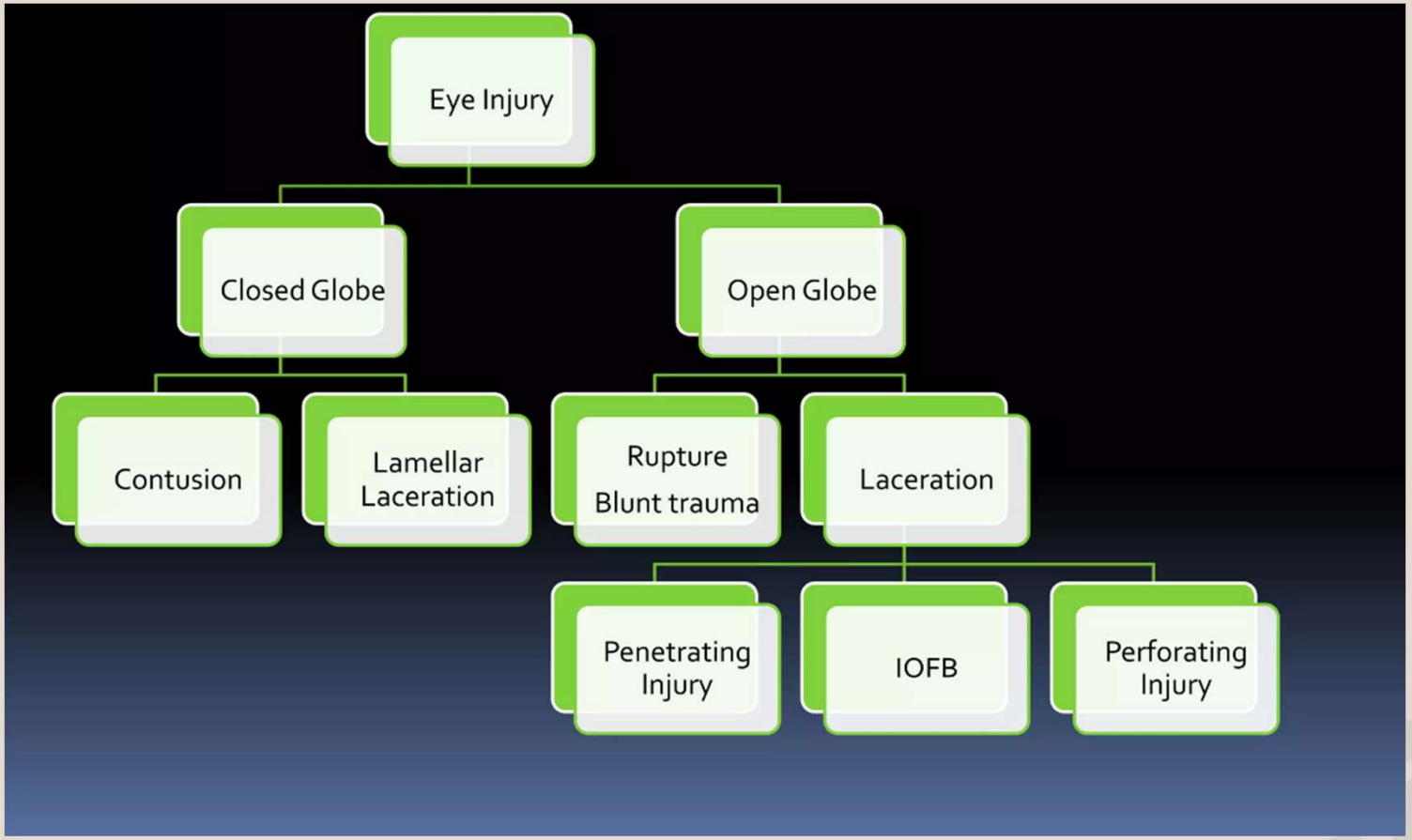
Birmingham Eye Trauma Terminology (BETT)

Term	*Definition and Explanation*
Eyewall	Sclera and cornea *Although technically the eyewall has three coats posterior to the limbus, for clinical and practical purposes, violation of only the most external structure is taken into consideration*
Closed globe injury	No full-thickness wound of eyewall
Open globe injury	Full-thickness wound of the eyewall
Contusion	There is no (full-thickness) wound *The injury is due to either direct energy delivery by the object (e.g., choroidal rupture) or the changes in the shape of the globe (e.g., angle recession)*
Lamellar laceration	Partial-thickness wound of the eyewall
Rupture	Full-thickness wound of the eyewall, caused by a blunt object *Because the eye is filled with incompressible liquid, the impact results in momentary increase in IOP. The eyewall yields at its weakest point (at the impact site or elsewhere; e.g., an old cataract wound dehisces even though the impact occurred elsewhere); the actual wound is produced by an inside-out mechanism*
Laceration	Full-thickness wound of the eyewall, caused by a sharp object *The wound occurs at the impact site by an outside-in mechanism*
Penetrating injury	Entrance wound *If more than one wound is present, each must have been caused by a different agent* Retained foreign object(s) *Technically a penetrating injury, but grouped separately because of different clinical implications*
Perforating injury	Entrance *and* exit wounds *Both wounds caused by the same agent*

Ferenc Kuhn, Dante J Pieramic eds. Ocular Trauma Principles and Practice. Thieme, 2002.

Open-globe Injury Classification	Closed-globe Injury Classification
Type A. Rupture B. Penetrating C. Intraocular foreign body D. Perforating E. Mixed	Type A. Contusion B. Lamellar laceration C. Superficial foreign body D. Mixed
Grade Visual acuity* 1. ≥20/40 2. 20/50 to 20/100 3. 19/100 to 5/200 4. 4/200 to light perception 5. No light perception†	Grade Visual acuity* 1. ≥20/40 2. 20/50 to 20/100 3. 19/100 to 5/200 4. 4/200 to light perception 5. No light perception†
Pupil Positive: relative afferent pupillary defect present in affected eye Negative: relative afferent pupillary defect absent in affected eye	Pupil Positive: relative afferent pupillary defect present in affected eye Negative: relative afferent pupillary defect absent in affected eye
Zone I: Isolated to cornea (including the corneoscleral limbus) II: Corneoscleral limbus to a point 5 mm posterior into the sclera III: Posterior to the anterior 5 mm of sclera	Zone‡ I: external (limited to bulbar conjunctiva, sclera, cornea) II: anterior segment (involving structures in anterior segment internal to the cornea and including the posterior lens capsule; also includes pars plicata but not pars plana) III: posterior segment (all internal structures posterior to the posterior lens capsule)

BETTS Classification



Open Globe Classification

- Type
  1. Rupture
  2. Penetrating
  3. Intraocular
  4. Perforating
  5. Mixed
- Grade- visual acuity
  1. ≥20/40
  2. 20/50 to 20/100
  3. 19/100 to 5/200
  4. 4/200 to light perception
  5. No light perception
- Pupil
  - Positive-RAPD+ in affected eye
  - Negative-No RAPD in affected eye
- Zone
  I. I- Isolated to cornea (Including the corneoscleral limbus
  II. II- Corneoscleral limbus to a point 5mm posterior into the sclera
  III. III- Posterior to anterior 5mm of sclera

Ocular Trauma Score (OTS)

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Calculating the OTS: variables and raw points

Variable	Raw points
Initial vision	
NLP	60
LP/HM	70
1/200 – 19/200	80
20/200 – 20/50	90
≥ 20/40	100
Rupture	−23
Endophthalmitis	−17
Perforating injury	−14
Retinal detachment	−11
Afferent pupillary defect	−10

Calculating OTS

Calculating the OTS: conversion of raw points into an OTS category, and calculating the likelihood of the final visual acuity in five categories

Sum of raw points	OTS	No light perception	Light perception / hand motion	1/200 – 19/200	20/200 – 20/50	≥ 20/40
0–44	1	74%	15%	7%	3%	1%
45–65	2	27%	26%	18%	15%	15%
66–80	3	2%	11%	15%	31%	41%
81–91	4	1%	2%	3%	22%	73%
92–100	5	0%	1%	1%	5%	94%

F. Kuhn et al: BETT-Terminology and classification of ocular injuries. Ophthalmol Clin N Am 15 (2002) 163-165

Mechanisms of ocular trauma

Blunt trauma:
- Closed globe injury
- Open globe injury

History:
- Blow to eye with fist, ball, stick or stone
- Roadside fall
- Automobile accidents, trauma by agricultural or industrial equipments

Penetrating trauma:
- Open globe injury

History:
- Sharp, pointed instruments like needles, knives, nails, glass piece
- FB travelling at high speed: Bullet, chopped wood,

Leading cause of BLINDNESS among children and young adults.

- *Mostly males affected.*

CAUSES:

- Occupational
- Sports
- Weapons
- Assault
- MVC
- War

OCULAR TRAUMA

- Initial intervention: non-ophthalmic practitioner (ED)
- **Chemical burn:** irrigate
- **Foreign body:** do not attempt removal
- **Patch/shield:** keep eye safe protect with patch, metal shield or stiff paper cup

Pre-Op Considerations in Trauma

- Triage
- Prioritizing the patient
- Preoperative assessment of injury
- Radiologic investigations
- Gentle, minimal globe distortion
- Protective shield
- Avoid inadvertent globe distortion
- Preparing for GA, Nil Per Oral (NPO)
- Counseling Prognosis Documenting Consent
- Medico-legal considerations

ASSESSMENT

- Eye trauma associated with head Injury.
- Remember ABC's.
- Evaluate general medical condition prior to conducting in depth ocular exam.

Eye Examination

Visual acuity, Projection, IOP?

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foreign body, Infiltrate/ subconjunctival hemorrhage/Chemosis (Jelly Role)

EOM Movement, Fundus Exam?

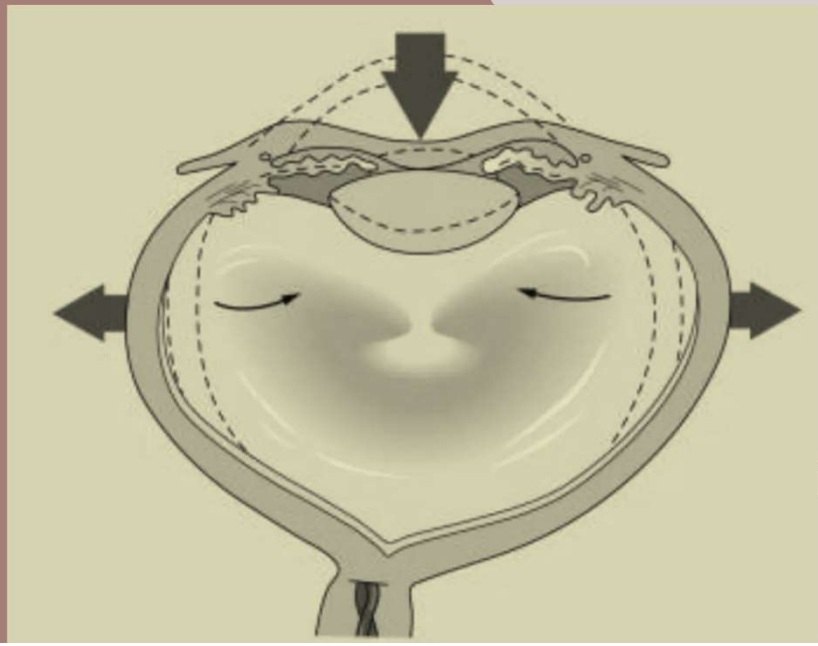
Extent of the laceration,

Pupillary/Consensual light reflex, iris status and lens status

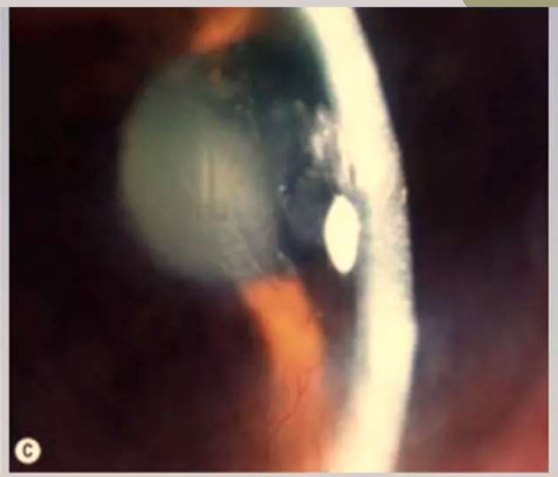
Blunt Trauma

Pathogenesis

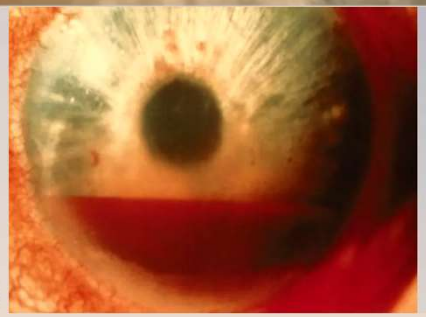
Anterior Segment Complication of Blunt Trauma



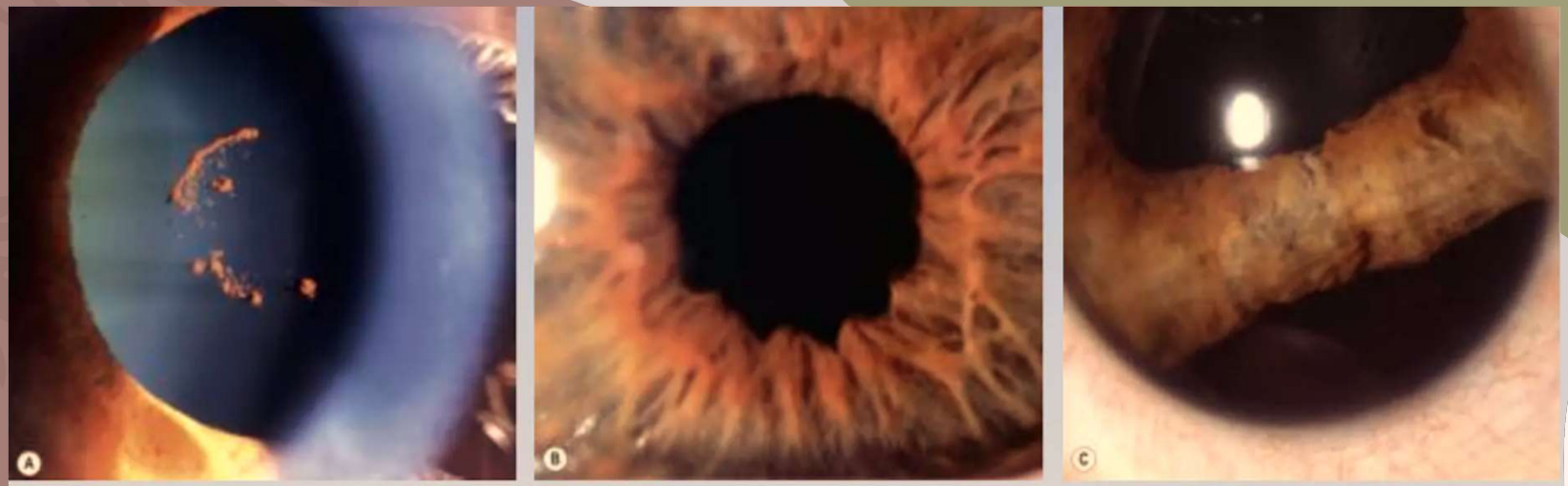
Corneal/AC Complications



- Hyphema
- Corneal abrasion
- Stromal oedema
- Tears in Descemet membrane



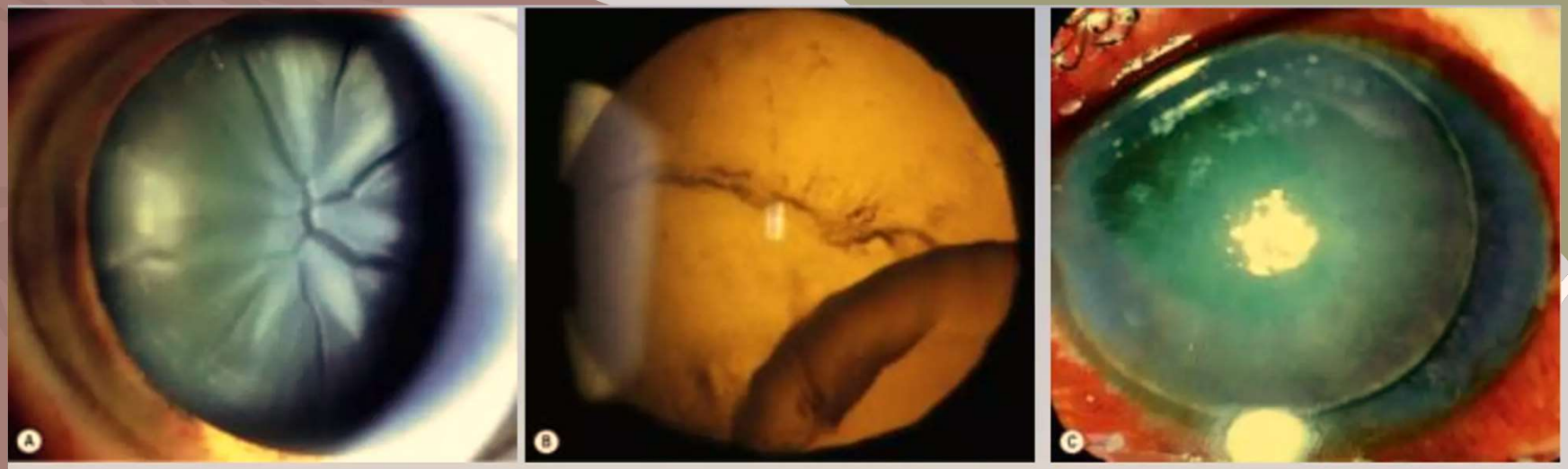
Pupillary Complications



- Vossius ring
- Radial sphincter tears
- Iridodialysis

Iridodialysis is a localized separation or tearing away of the iris from its attachment to the ciliary body

Crystalline Lens Complications



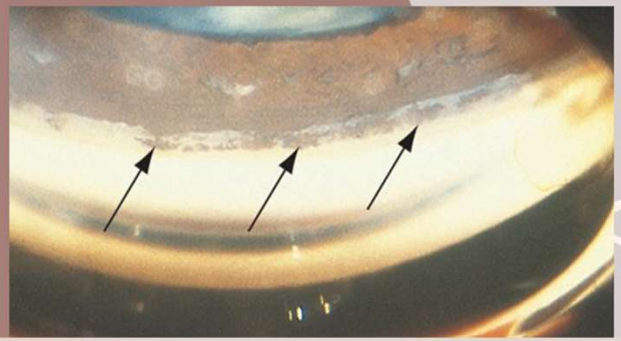
- Cataract
- Subluxation
- Dislocation

Two More Major Complications

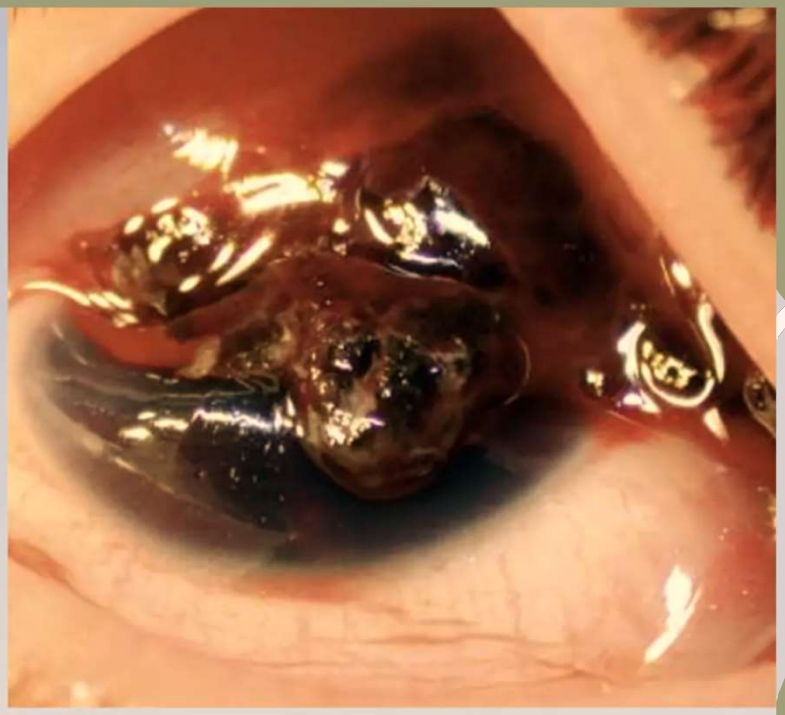
Angle Recession

Angle recession, with or without ***glaucoma***, is a common sequela of **blunt ocular trauma**.

It is characterized by a variable degree of **cleavage between the circular and the longitudinal fibers** of the **ciliary muscle**.



Angle Recession

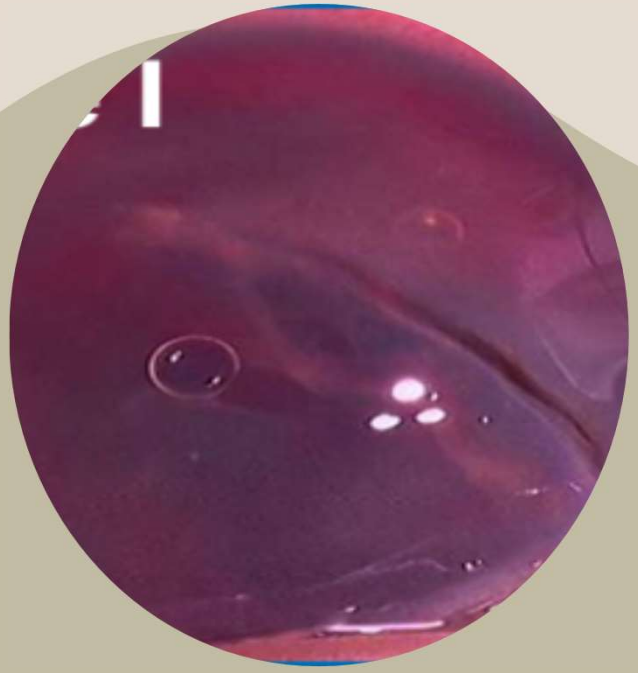


Rupture globe

Sharp Trauma

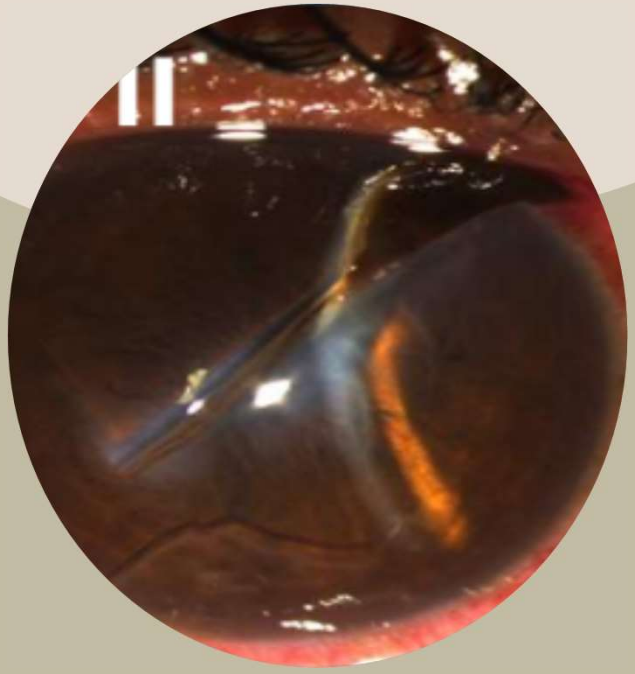
- Conjunctiva-
  - Chemosis, sub-conj. Haemorrhage
  - Examine fornices for any FB by double eversion
  - conj FB, abrasions (fluorescein staining), lacerations , emphysema
- Cornea-
  - abrasion- superficial/deep (Fluorescein staining)
  - Corneal FB- metallic burr/ vegetative matter
  - Chemical burns, ulceration
  - Corneal, Corneoscleral tear with/without iris prolapse
  - Seidel's test

Zones of Globe Injuries



Zone I

Only Cornea



Zone II

Cornea and Limbus

Zone III

Cornea, Limbus, and Sclera

Antibiotic of Choice

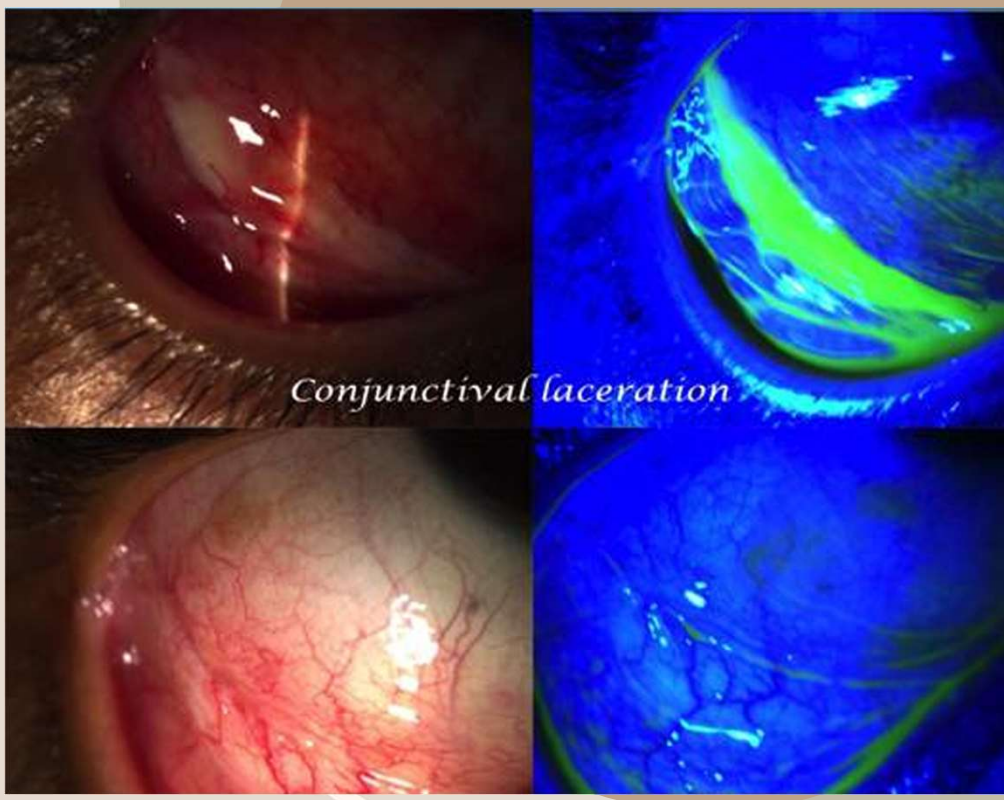
Broad spectrum IV antibiotics	Spectrum
Cefazolin 25-100mg/kg/day IV/IM divided	Gram Positive Bacteria
Vancomycin 40 mg/kg/day IV divided	Gram Positive Bacteria, Bacillus **Vancomycin**
Gentamycin 2-2.5mg/kg/dose IV/IM q8hr	Gram Negative Bacteria
Clindamycin 15-25mg/kg/day IV divided	IOFB, vegetative matter, Bacillus **Clindamycin is the drug of choice**

Conjunctival Lacerations

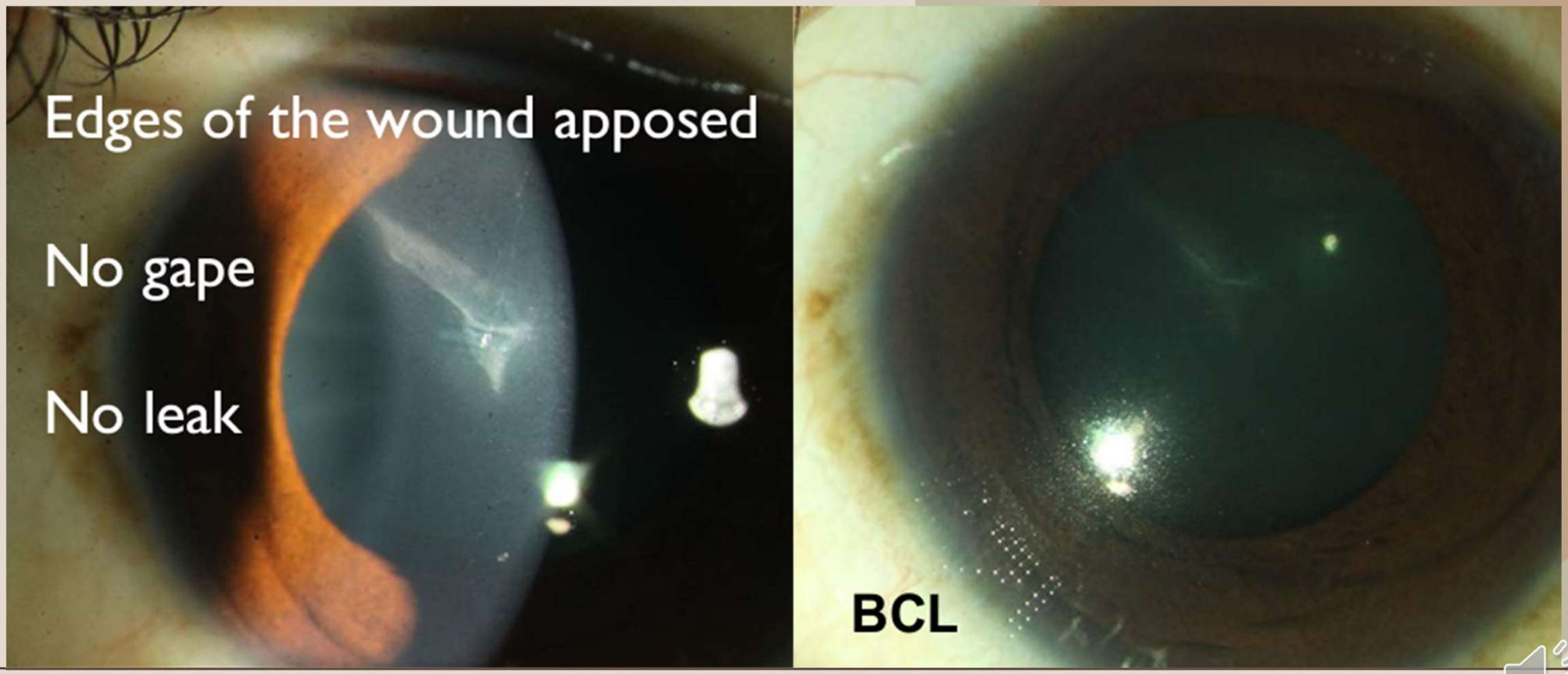
- Conjunctival lacerations generally do ***not*** require surgical repair.

- Large conjunctival lacerations–wound apposition with either absorbable or nylon sutures.

- Care is taken to ***avoid*** incarcerating Tenon's capsule.



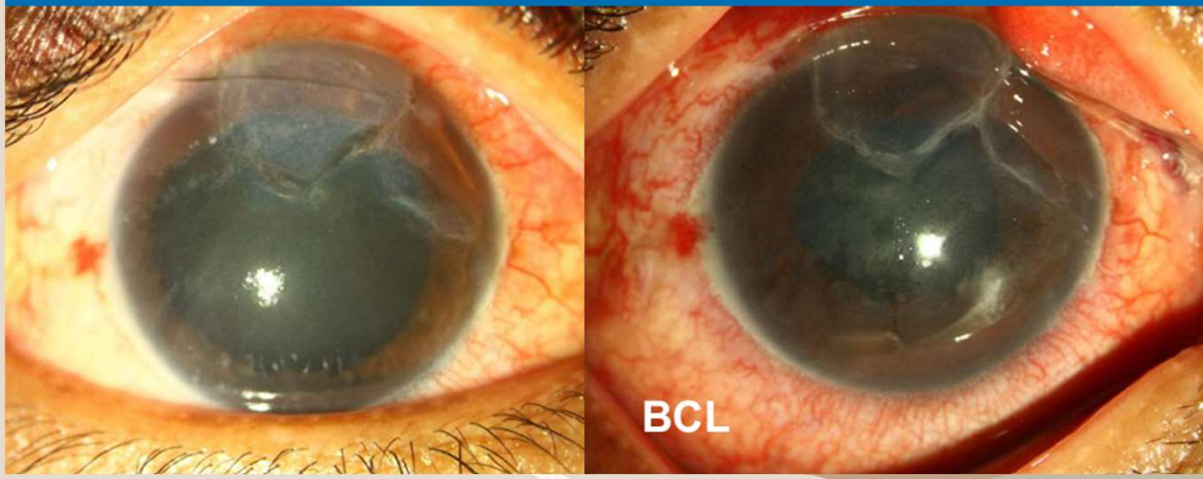
Partial Thickness Corneal Laceration



Lamellar Tear Needs Suturing when...

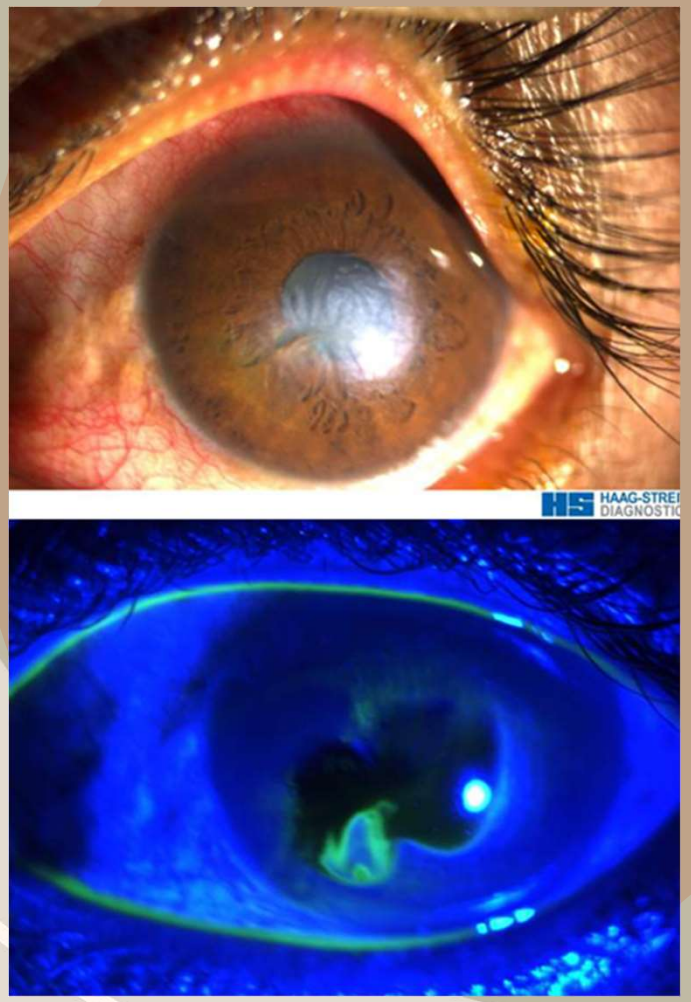
-Tear edges *not* apposed
-Gape
-Avulsed flap
-Flap with apex up-displacement with UL movement
-*Seidel Test*: Suspicious,
-Children.

When apex of the flap tear is pointed down
- Minimal / no displacement with lid movement



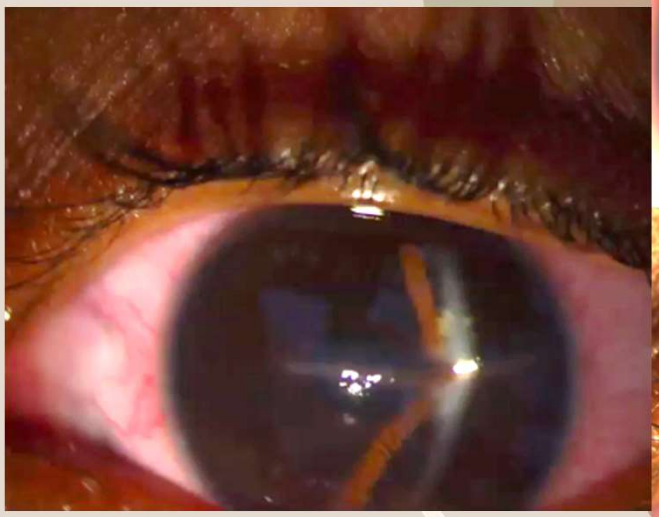
Check Seidel in Corneal Tear

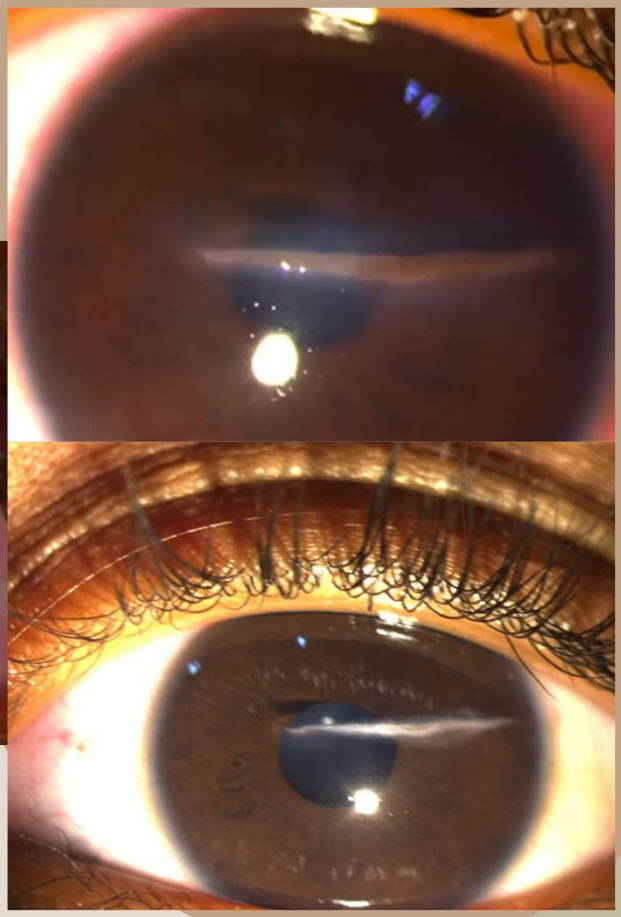
- Lamellar corneal tears may appear *self-sealing*,
- Seidel's test determines the need to repair,
- 2% fluorescein solution.



Full Thickness Lacerations

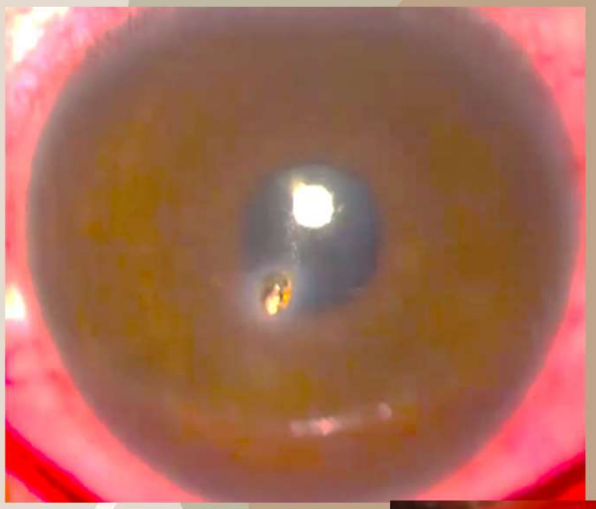
- Without Iris Prolapse
  - Positive Seidel Test
- With Iris Prolapse
  - Bird Beak Injury
- With Foreign Body (FB)
  - Infection Should Be Considered

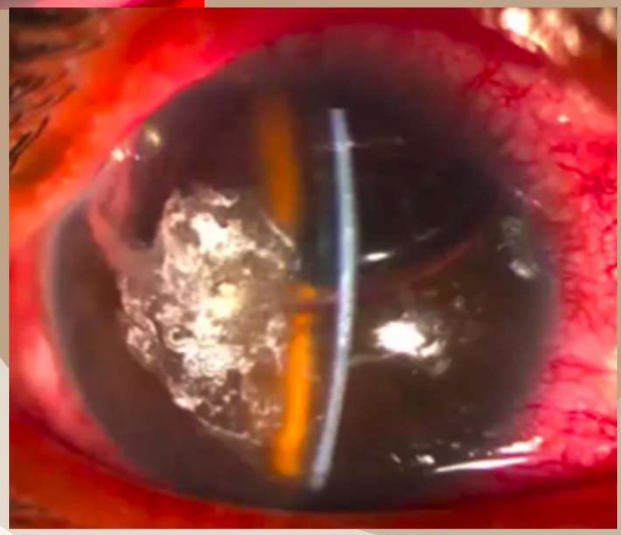




Impacted Foreign Body

- Metallic
- Others
  - Wood material

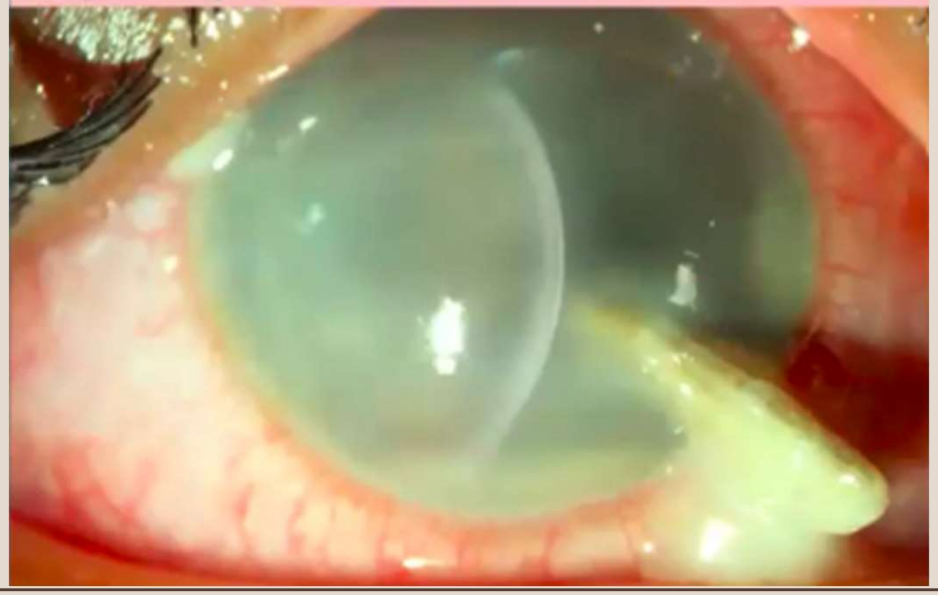


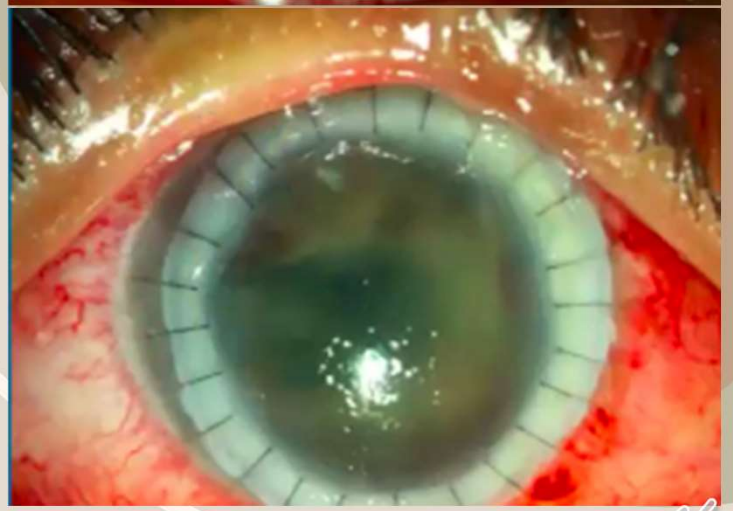


Full Thickness Laceration Should Be Ruled Out

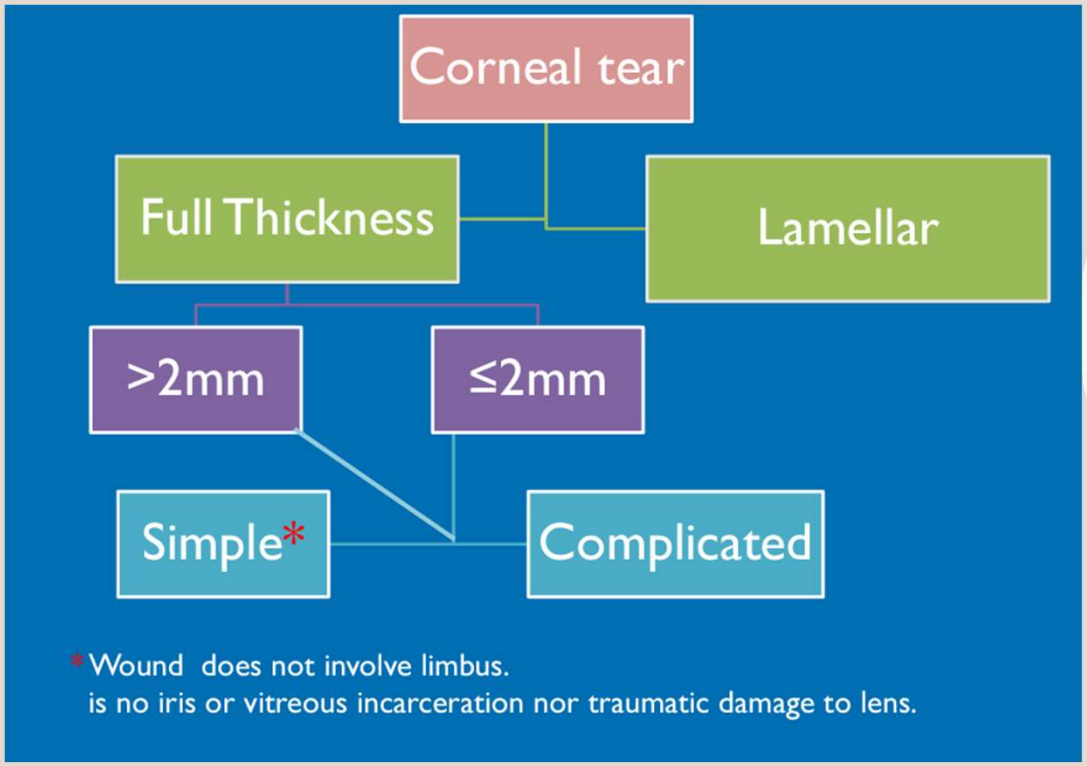
Vegetative Material / Wood

21 yrs old male
Injury 2 days back with wooden stick
Day 2 of presentation





Corneal Laceration Suturing



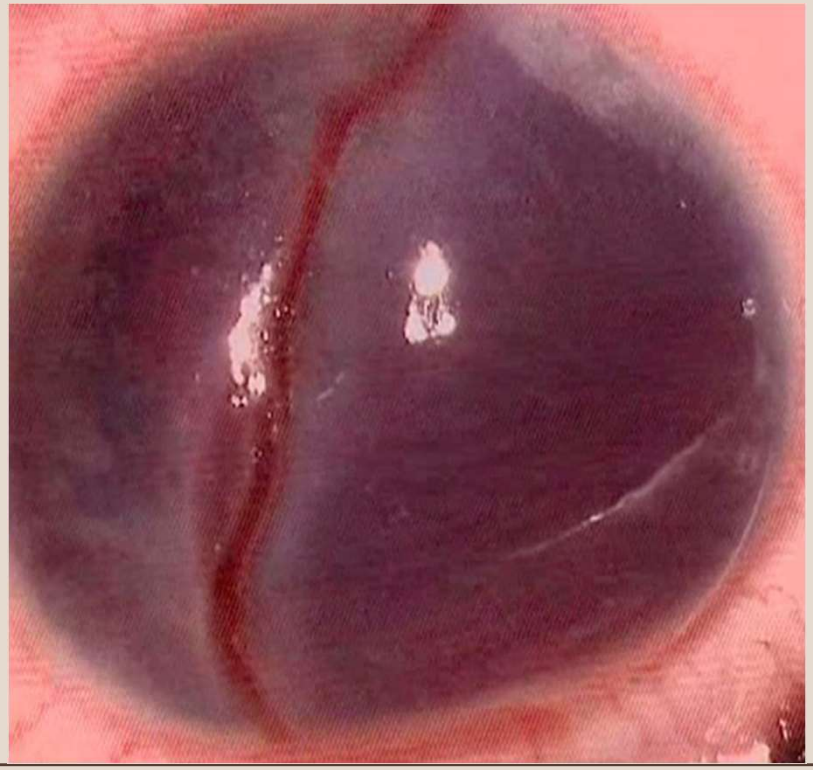
Complicated Laceration:

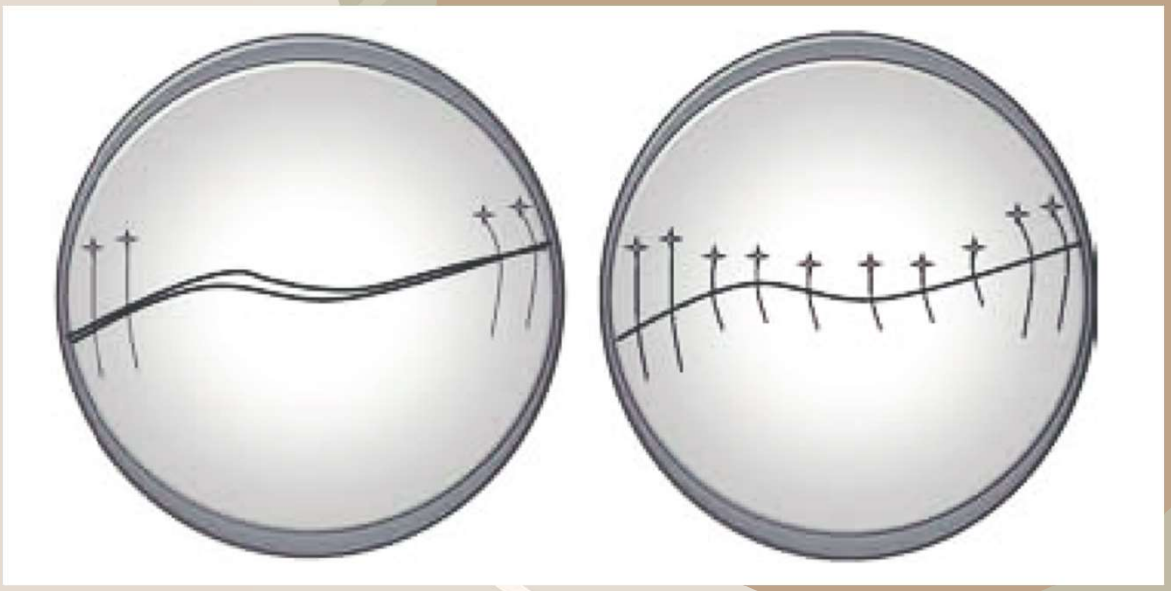
- Incarceration
  - Iris
  - Lens Material
  - Vitreous
- Triradiated

- Impacted FB

Principles of Corneal Tear Repair

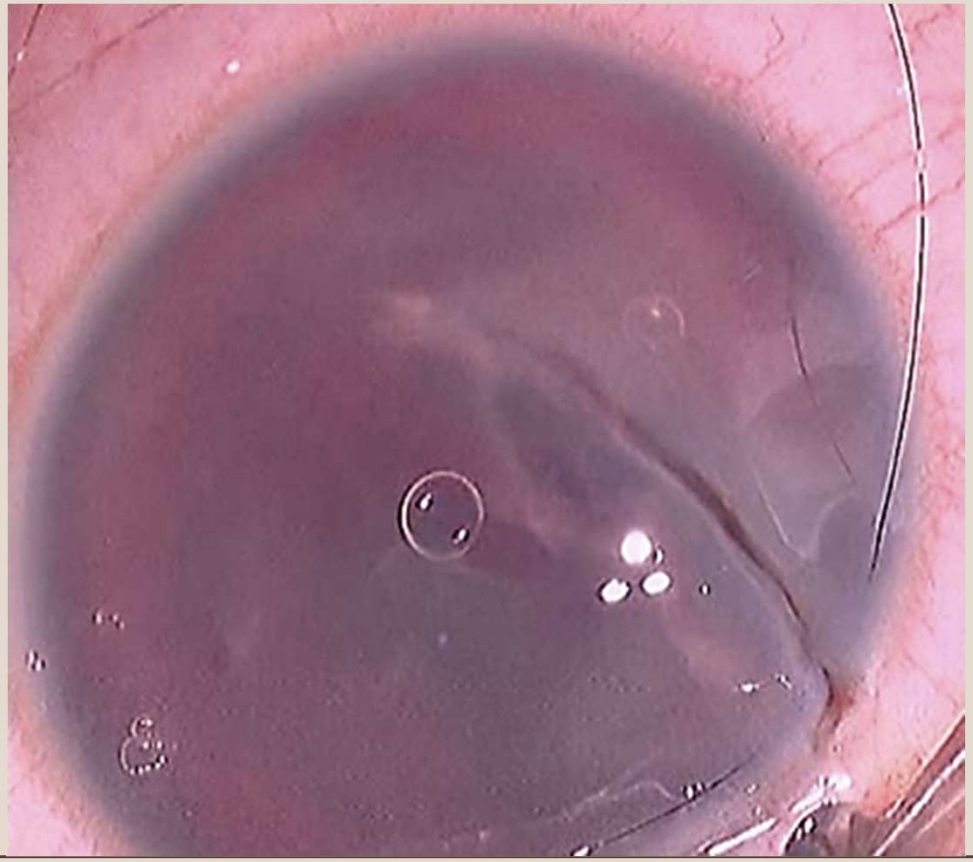
Because of Hidden Tear Extension in Limboscleral Lacerations Always *Do* Peritomy.

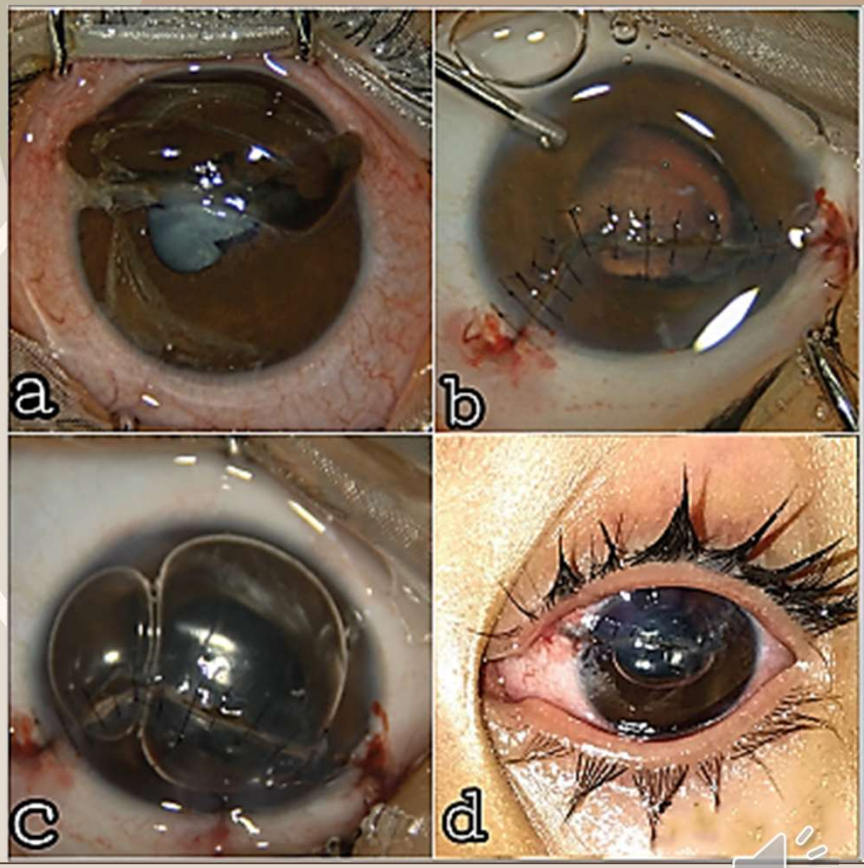




Principal Anatomic Element Is *Limbus*

Principles of Corneal Tear Repair

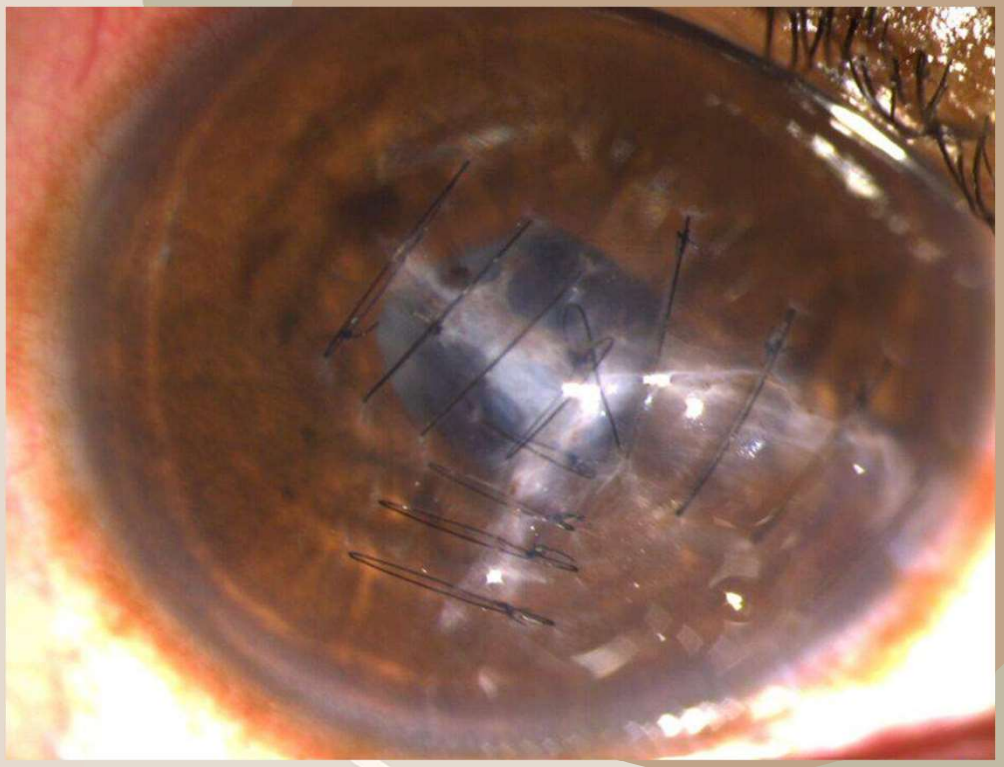




Principal Anatomic Element Is *Limbus and then Angulations*

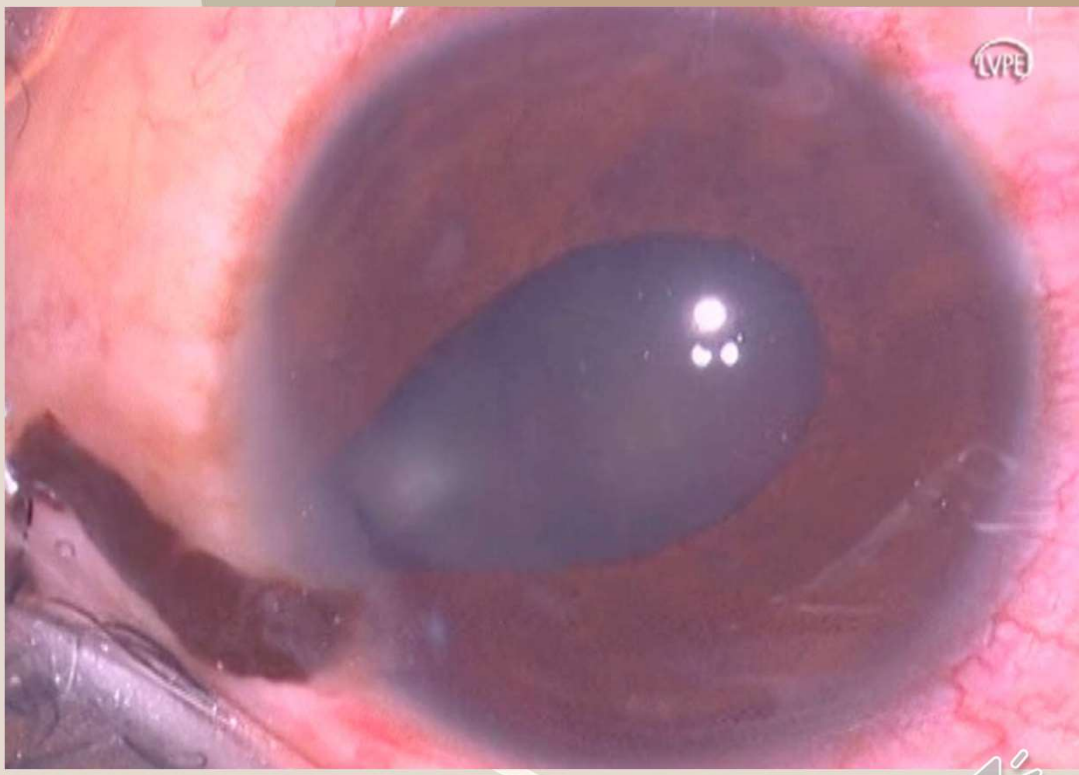
Stellate Lacerations Are Sutured with:

a. Bridging sutures
b. Purse string sutures
c. Multiple sutures and tissue adhesive



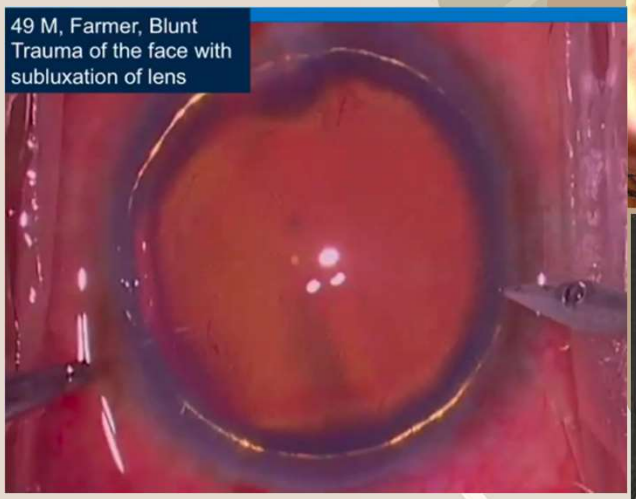
Management of Uveal Incarceration

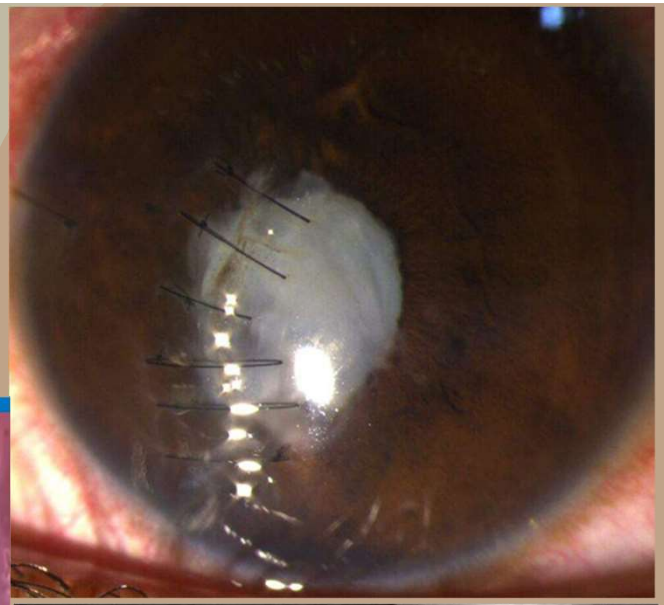
- Repositioning
  - Golden Time
  - Infection
  - Incarceration/PAS/PS/Glaucoma
  - OVD/Stab Incisions
- Resection
  - Incarceration
  - PI
  - PAS/PS/Glaucoma
  - OVD/Stab Incisions

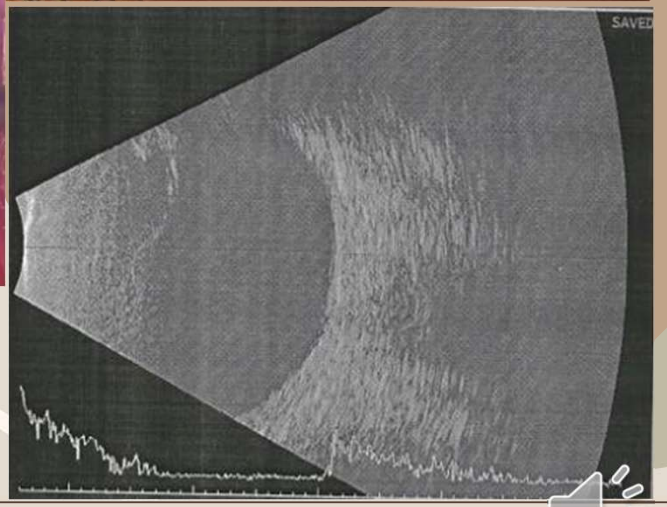


Management of Traumatic Cataract

- Simultaneously with corneal trauma
  - More inflammation
  - Ant. Lens Dislocation
- Later (within 2 weeks)
  - B-scan
  - IOL Power Calculation







R/O Intraocular foreign body and Traumatic Endophthalmitis/Lens Abscess

Traumatic Lens Luxation

- Zonular Dehiscence
  - Closed vs. Open Injury
  - Subluxation vs. Dislocation
  - Anterior vs. Posterior
  - Clear vs. Cataractous

Traumatic Vitreous Loss

1. Do ***Not*** Put Traction to Vitreous Strands within the Wound,
   - *Giant Retinal Tear / CME*
2. Manual Cut: Vannas Scissors / Spatula / Weck-Cell Sponge,
   - *Not* Preferred
3. 3- Automated PPVit.X / Behind the Wound.
   - *Preferred* Method
4. AC Should be Well Formed
   - *OVD*
   - *Air Bubble*
5. Avoid any PAS / PS Formation / Glaucoma

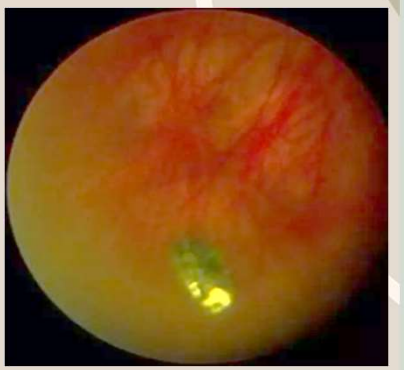
Ocular Foreign body

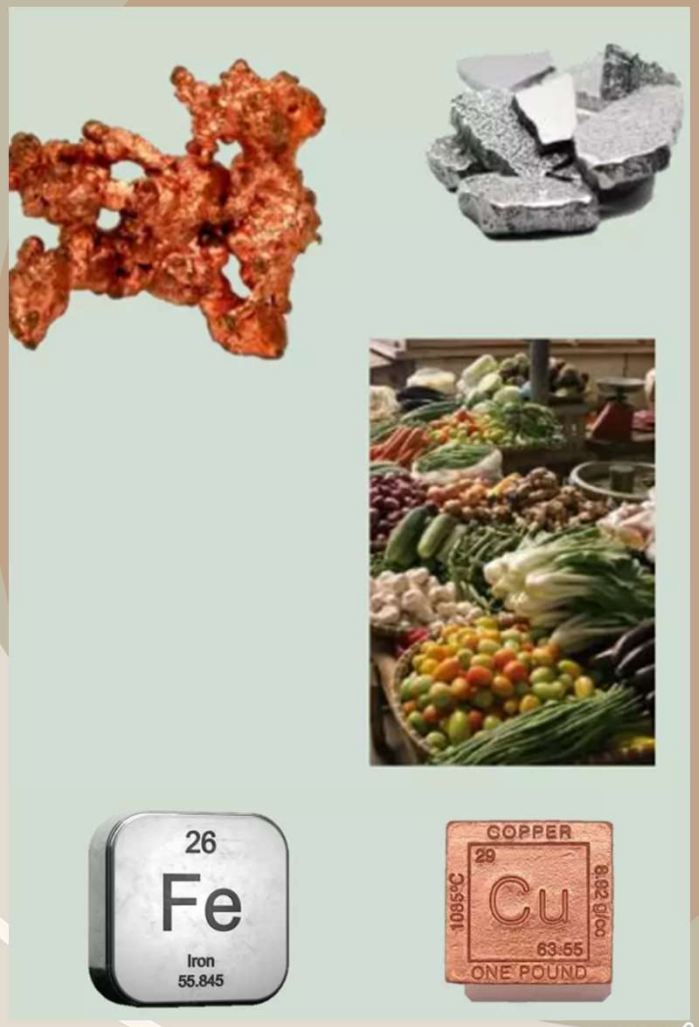
- Chief Complaint
  - Blurred Vision
  - Ocular Discomfort
- Hx of Recent Injury/Exposure
- Diagnostics
  - Slit Lamp
  - Indirect Ophthalmoscope
  - B-scan
  - X-Ray (Water's View)
  - CT Scan
    - MRI Contraindicated in Metallic FB

- Surface FB
  - Conjunctival FB
    - Behind Upper Eyelid
  - Corneal FB
- Intraocular FB
  - Endophthalmitis
  - Penetration (IOFB)
  - Perforation (FB out of the globe e.g. orbit)
  - Medical Treatment
    - Antibiotics/Anti-Tetanus
  - Surgical Treatment
    - Removal ?!
    - Lensectomy/Vitrectomy
    - Barrier Laser

Ocular Foreign body

- Most Can Be Well Tolerated Except:
  - Copper
  - Iron
  - Vegetable/Wood Materials
- Contamination and pH should be considered.



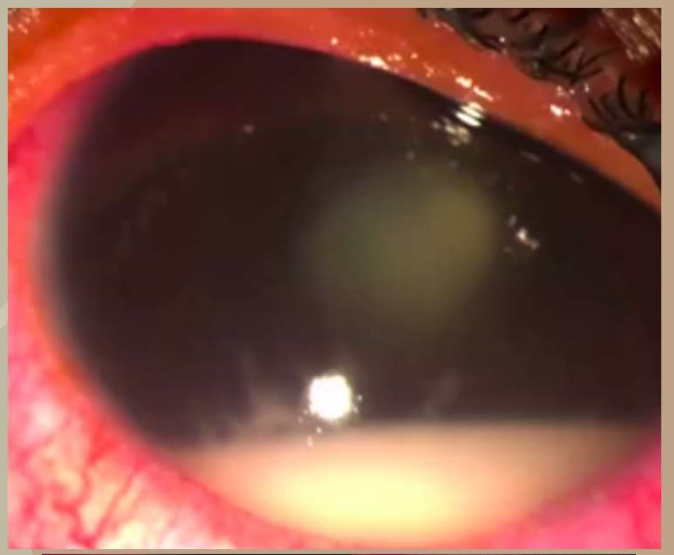


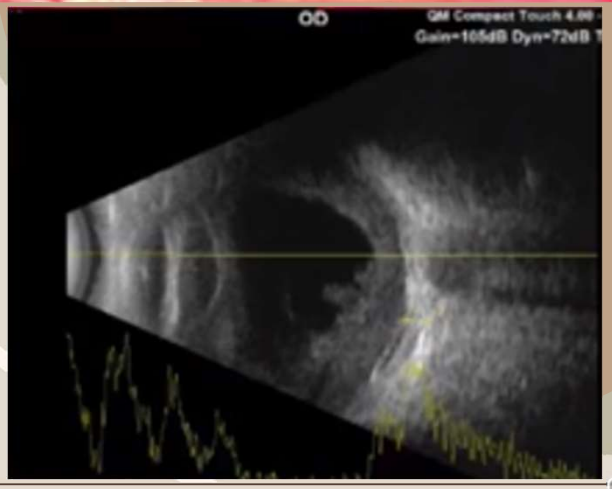
IOFB Symptoms and Signs

Typical scenarios

Needle Stick Injuries

1. R/O Needle Stick Endophthalmitis
2. Cataract / Lens Abscess
3. Vitreous Wick Syndrome





Typical scenarios

Bird Beak Injuries

1. Injuries While Playing with Pets/Birds
2. Expulsion of Intraocular Contents
3. Grossly Contaminated Wound

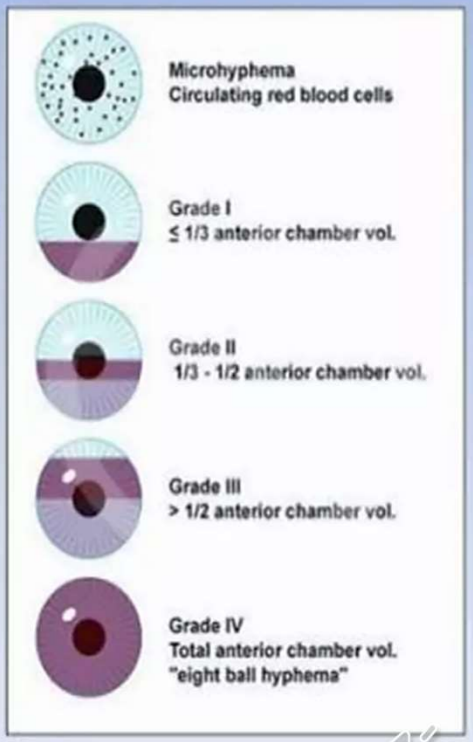
Typical scenarios

- **Hyphema**
  - 2/3 Globe Injuries
  - 1/3 Open Globe Injuries
  - ↑ Rebleeding (3-5 days)
  - Prognostic Factors (Rule of 10)
    - Corneal Blood Staining
    - High IOP
  - Management
    - Medical
      - Semi-sitting Position / Shield
      - Cycloplegics?!
      - Topical Steroids
      - Anti-Glaucoma Agents (No Prostaglandin Analogues)
      - Anti-Fibrinolytic Agents
        - Tranexamic Acid
        - Epsilon Aminocaproic Acid
    - Surgical
      - Clot Removal

Grading

Hyphaemas can be graded from I-IV in the following manner:

- **Grade 0:** No visible layering, but red blood cells within the anterior chamber (microhyphaema)
- **Grade I:** Layered blood occupying less than 1/3 of the anterior chamber
- **Grade II:** Blood filling 1/3 to 1/2 of the anterior chamber
- **Grade III:** Layered blood filling ½ to less than total of the anterior chamber
- **Grade IV:** Total clotted blood, often referred to as blackball or 8-ball hyphaema

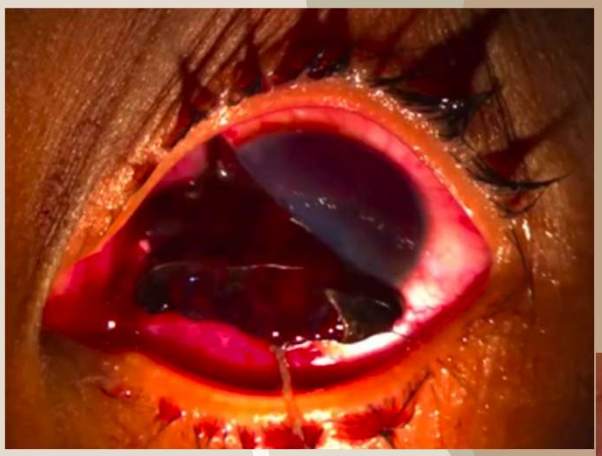


Complications of Total Hyphema

- Corneal blood staining
- Peripheral anterior synechiae
- Ischemic optic neuropathy
- Optic atrophy, Decreased vision and visual field defects
- Amblyopia in children d/t corneal blood staining

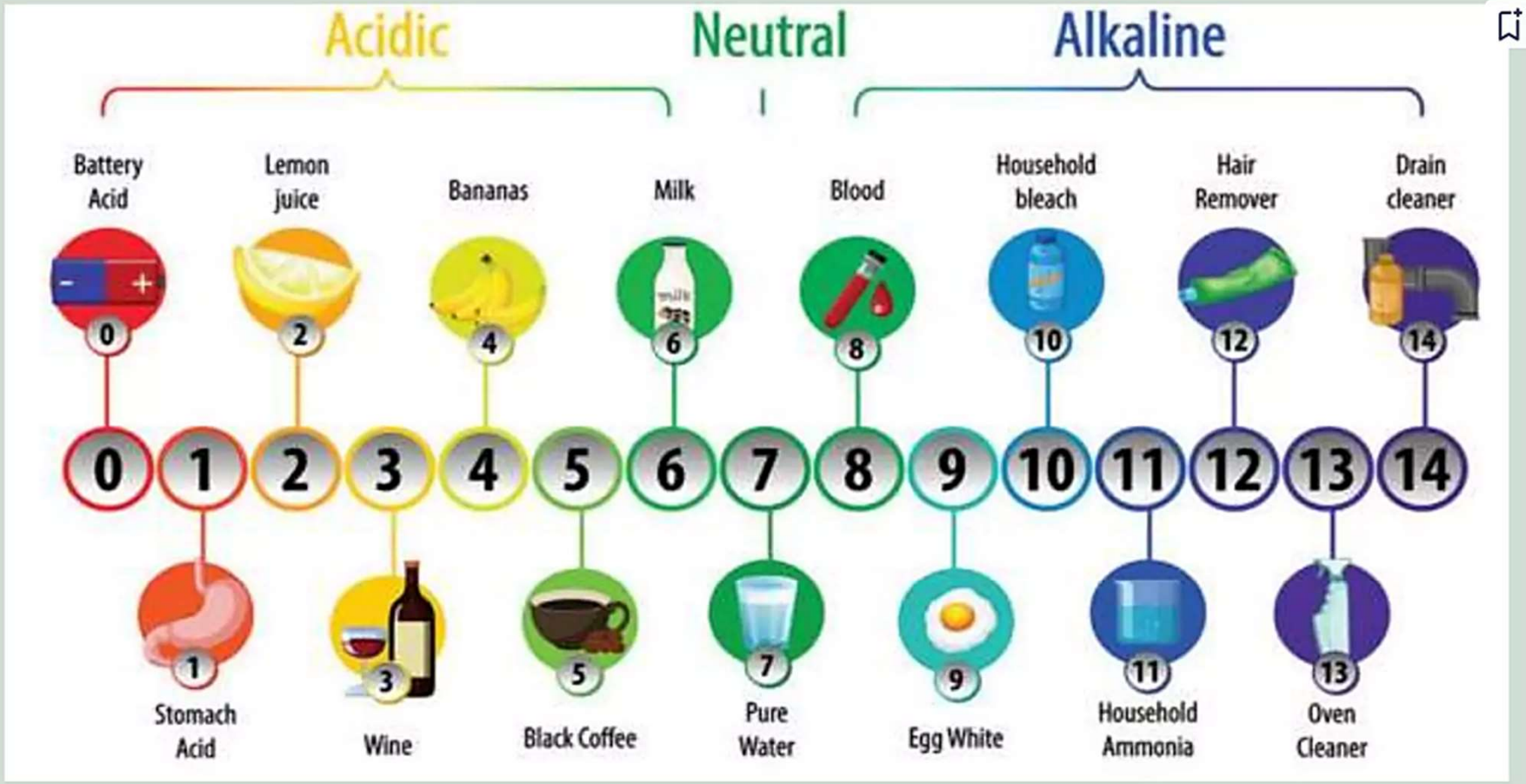
If the corneal wound is grossly irreparable?!

1. Try to Do Primary Repair
2. Check Vision (NLP/Poor LP/LPP/HM)
3. Get Second Opinion
4. Discuss the Patient and Family
5. Consider Enucleation (Within 2 Wks)
6. Aware Patient About ***Sympathetic Ophthalmia***



Ocular Burn

- Heat Burn
  - Fire or Steam
- Chemical Burn
  - Neutral Chemical
  - Acidic
  - Alkaline


Acidic
Neutral
Alkaline
Battery Acid
Lemon juice
Bananas
Milk
Blood
Household bleach
Hair Remover
Drain cleaner
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Stomach Acid
Wine
Black Coffee
Pure Water
Egg White
Household Ammonia
Oven Cleaner

Alkali Burn

- **Alkali: most damaging**
- penetrate ocular tissue rapidly & continues to damage eye.
- Ammonia and lye solutions.
- Causes an immediate rise in Intra-ocular pressure

Alkali		
Substance	**Chemical Composition**	**Found in**
Ammonia	NH_3	Cleaning agents, fertilizers, refrigerants
Potassium Hydroxide	KOH	Caustic potash
Lye	NaOH	Drain cleaners, airbags
Magnesium Hydroxide	$Mg(OH)_2$	Firework sparklers, flares
Lime	$Ca(OH)_2$	Plaster, mortar, cement, white wash

- Massive Hemorrhage
- Tissue Destruction
- Opaque Cornea

Acid Burn

- **Acids: less damaging**
  - Bleach, car batteries and refrigerant.
  - **Necrotic tissue forms a PROTEIN BARRIER that prevents further penetration → less damage occurs**

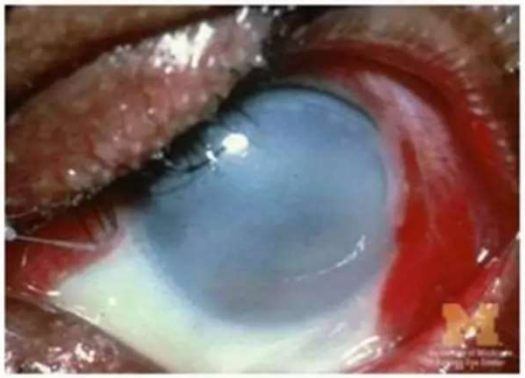
Acid		
Substance	**Chemical Composition**	**Found in**
Sulfuric acid	H_2SO_4	Car batteries
Sulfurous acid	H_2SO_3	Bleach and refrigerant
Hydrofluoric acid	HF	Glass polishing and mineral refining
Acetic Acid	CH_3COOH	Vinegar, glacial acetic acid
Hydrochloric acid	HCl	Swimming pools

- Protein Coagulation
- Less Penetrating
- More Superficial Damage
- e.g. Car Batteries

Comparison…

Alkali Burns

- Liquefactive necrosis
- Continue to penetrate cornea long after exposure
- Eg. Ammonia, lye, lime



Acid Burns

- Coagulative necrosis
- Typically confined to superficial tissue
- Eg. Exploding car batteries (sulfuric acid), lab chemicals

Prognostic Factors:

1. Limbal Necrosis
   - Most Important
   - High IOP
2. Corneal Opacity
   - Marbelization
3. Timing

Roper-Hall Prognostic Classification Hughes Modification

Grading of severity of chemical injuries

Grade I (excellent prognosis)
- Clear cornea
- Limbal ischaemia - nil

Grade II (good prognosis)
- Cornea hazy but visible iris details
- Limbal ischaemia <1/3

Grade III (guarded prognosis)
- Hazy cornea with no iris details
- Limbal ischaemia 1/3 to 1/2

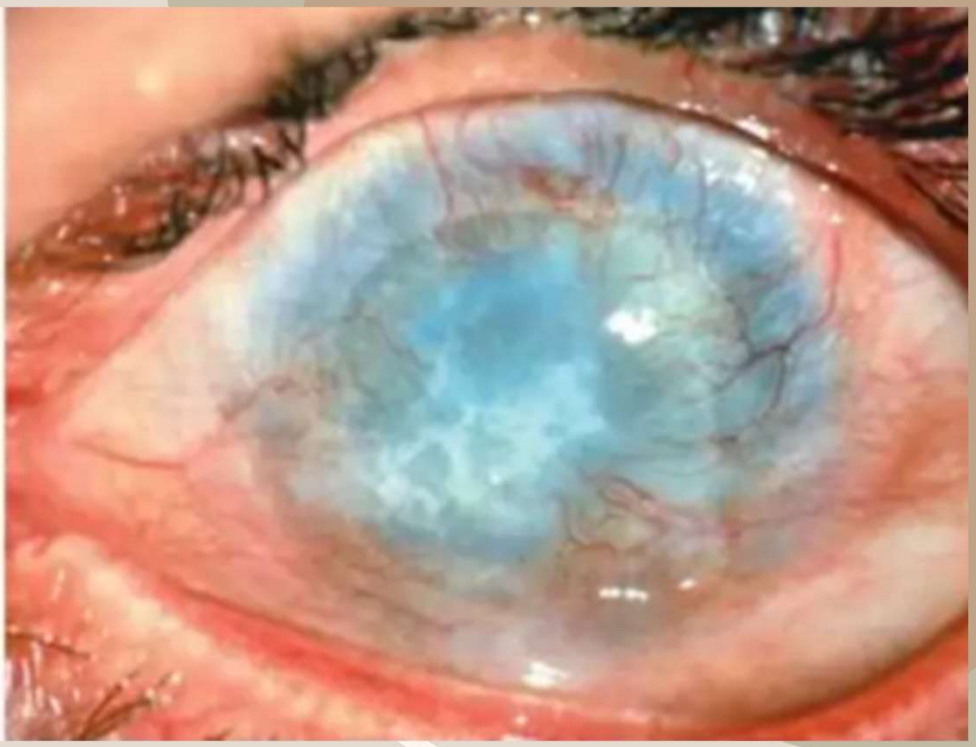
Grade IV (very poor prognosis)
- Opaque cornea
- Limbal ischaemia >1/2

- G - II

- G - III

- G - IV

Comparison...



Chemical Burn Intervention

- Early Intervention
  - Copious Irrigation
    - Tap Water/BSS/Saline
    - No Neutralizing Agents
  - Removal of Solid Material
    - Lid Speculum
  - Topical Agents
    - Antibiotics
    - Steroids (Low Dose)
    - Cycloplegics
    - IOP
    - Vitamin C
    - Lubricants
  - Eye Patching

- Late Intervention
  - Releasing All Impending Symblepharon
  - *No* Topical Steroid (Days 5-21)
    - Corneal Melting
  - Control IOP
  - Management of Dry Eye
  - Surgical Intervention
    - Trichiasis/Entropion/Ectropion
    - Oculoplastic/Cornea Surgery

Corneal Abrasion

- Treatment
  - Impending Keratitis R/O
  - Topical Antibiotics
  - Pressure Patching?
  - Bandage CL?
  - Short-Acting Cycloplegics
  - Closed F/U
  - Avoid Topical Anesthetics
    - Tetracaine


Thank you