



# Trauma



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# Standardized Classification: Terminology

Closed globe injury

Open globe injury



Rupture

Laceration



Standardized Classification of  
Ocular Trauma

Penetrating

IOFB

Perforating



# Standardized Classification: Prognosis

- Type: rupture vs. laceration
- Grade: presenting visual acuity
- Pupil: presence/absence of APD
- Zone: I, II, or III

## A System for Classifying Mechanical Injuries of the Eye (Globe)

DANTE J. PIERAMICI, MD, PAUL STERNBERG, JR, MD,  
THOMAS M. AABERG, Sr, MD, WILLIAM Z. BRIDGES, JR, MD,  
ANTONIO CAPONE, JR, MD, JOSE A. CARDILLO, MD,  
EUGENE DE JUAN, JR, MD, FERENC KUHN, MD,  
TRAVIS A. MEREDITH, MD, WILLIAM F. MIELER, MD,  
TIMOTHY W. OLSEN, MD, PATRICK RUBSAMEN, MD,  
AND TIMOTHY STOUT, MD, PhD  
(THE OCULAR TRAUMA CLASSIFICATION GROUP)

# Prognosis: TYPE

- Type: rupture vs. laceration

rupture



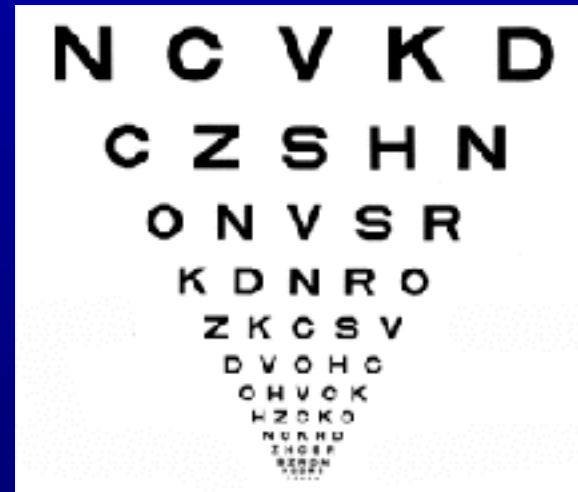
laceration



↑  
worse prognosis

# Prognosis: GRADE

- Grade: presenting visual acuity



**poor presenting visual acuity = poor prognosis**

# Prognosis: PUPIL

- Pupil: +/- afferent pupillary defect



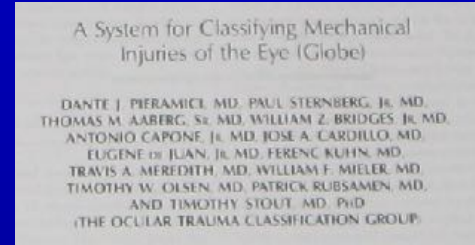
**presence of APD = poor prognosis**

# Prognosis: ZONE

- Zones

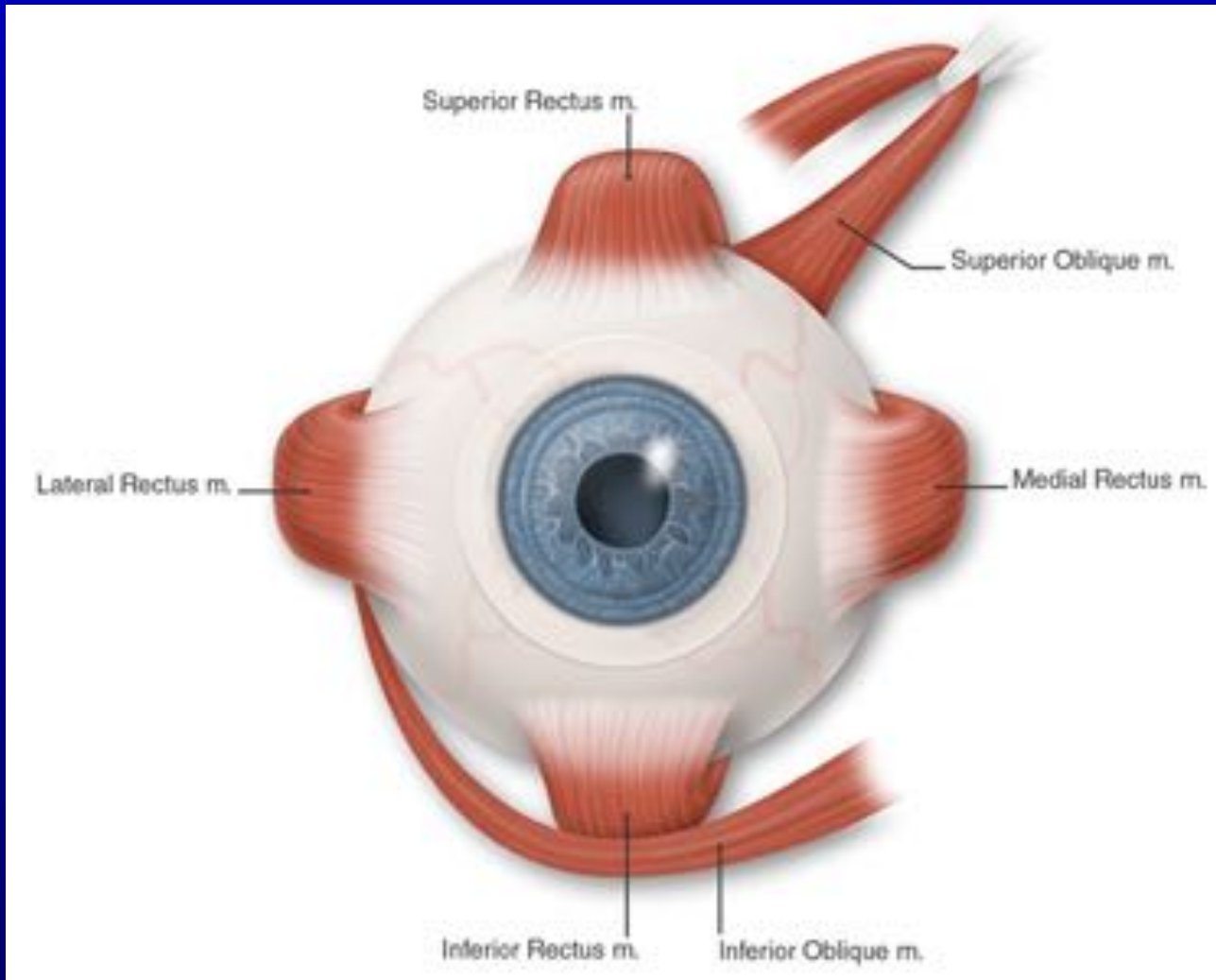
- I: cornea (including limbus)
- II: sclera between limbus and muscle insertions (5 mm posterior to limbus)
- III: sclera posterior to muscle insertions

- defined by the most posterior extent of the wound



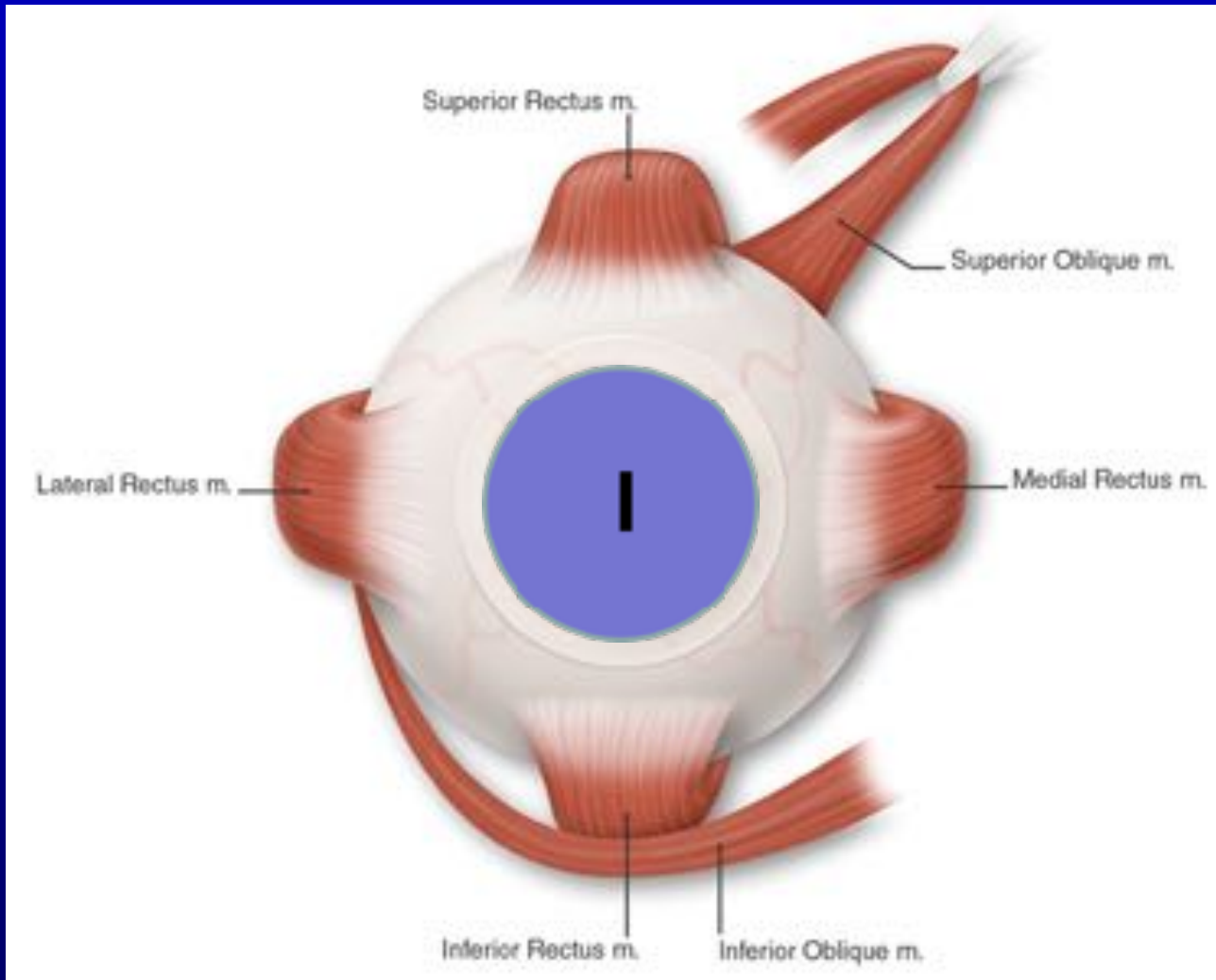
**higher zone = worse prognosis**

# Prognosis: ZONE



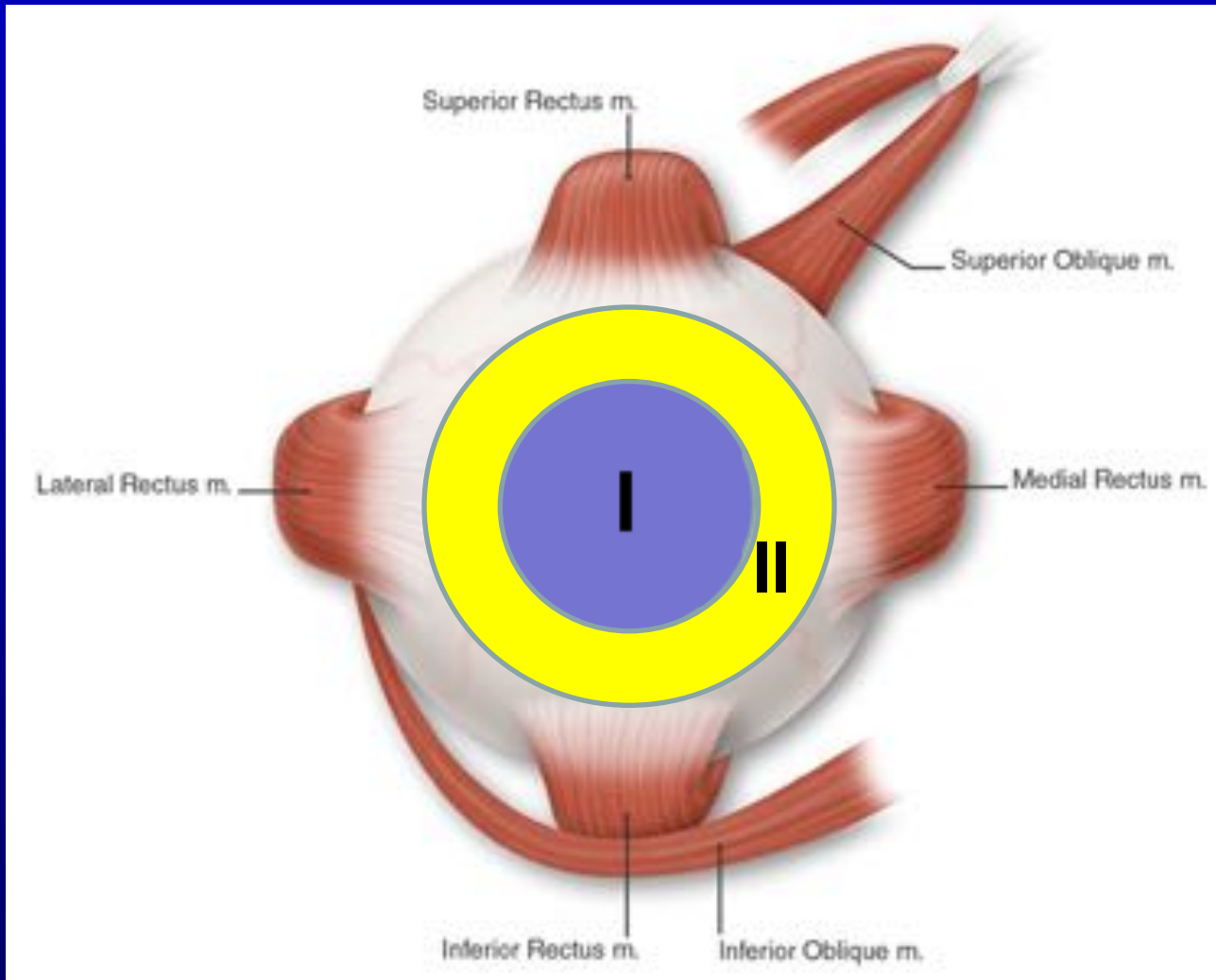
Courtesy of Yewlin Chee, MD

# Prognosis: ZONE



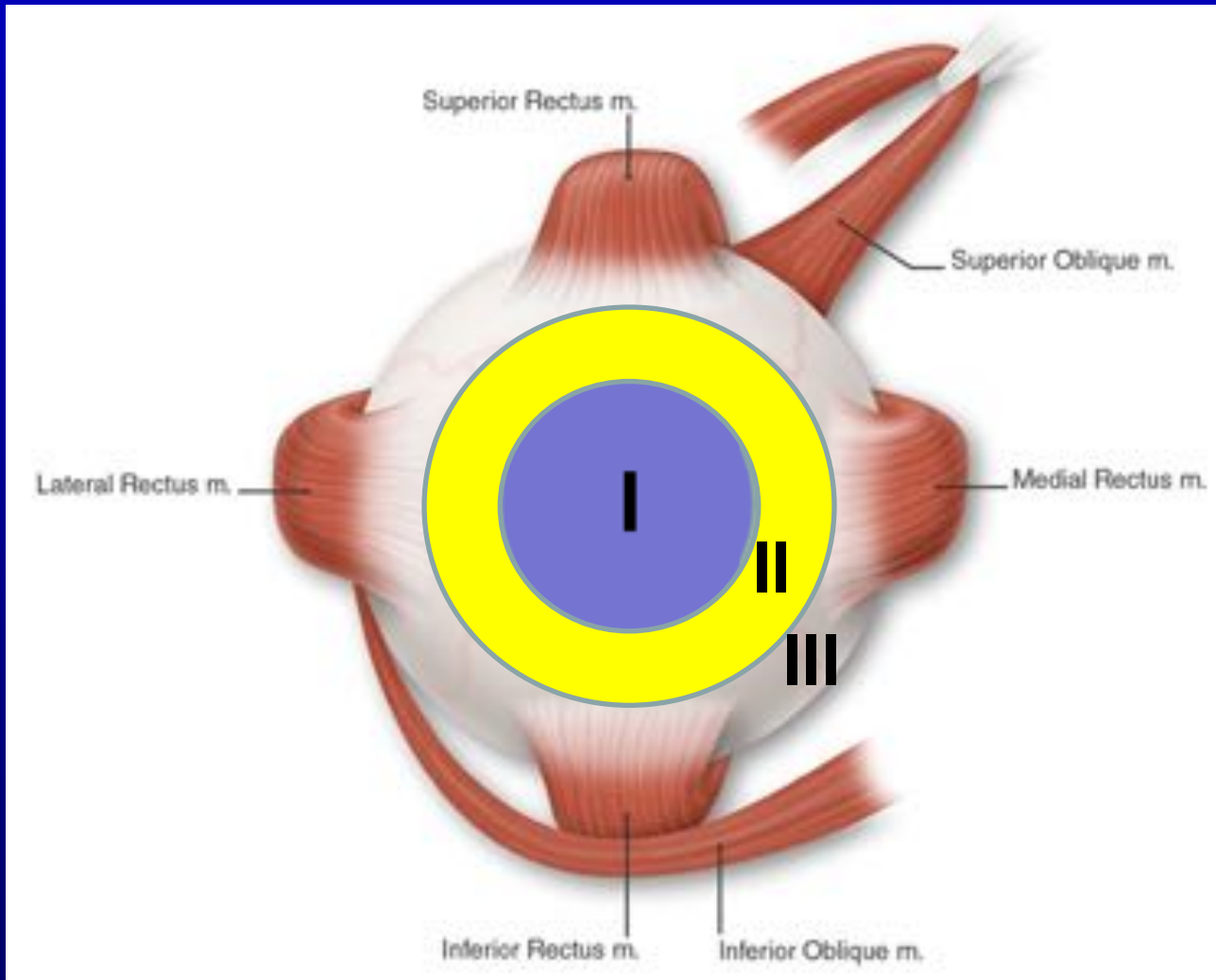
Courtesy of Yewlin Chee, MD

# Prognosis: ZONE



Courtesy of Yewlin Chee, MD

# Prognosis: ZONE



Courtesy of Yewlin Chee, MD

# Trauma Management

- **immediate (emergency)**

- endophthalmitis
- intraocular foreign body

- **urgent**

- open globe injury


- **prompt (secondary procedure)**

- media opacity
- progressive vitreoretinal traction
- retinal incarceration
- retinal detachment

# Indications for Vitrectomy after Open Globe Injury

1. endophthalmitis
2. intraocular foreign body
3. media opacity
4. progressive vitreoretinal traction (+/- RD)
5. retinal incarceration (+/- RD)
6. retinal detachment

# Indications for Vitrectomy after Open Globe Injury

1. endophthalmitis
  2. intraocular foreign body
  3. media opacity
  4. progressive vitreoretinal traction (+/- RD)
  5. retinal incarceration (+/- RD)
  6. retinal detachment
- 
- emergencies

# Indications for Vitrectomy after Open Globe Injury

1. endophthalmitis
  2. intraocular foreign body
  3. media opacity
  4. progressive vitreoretinal traction (+/- RD)
  5. retinal incarceration (+/- RD)
  6. retinal detachment
- 
- emergencies**
- secondary procedures**

# Trauma Management

- **immediate (emergency)**

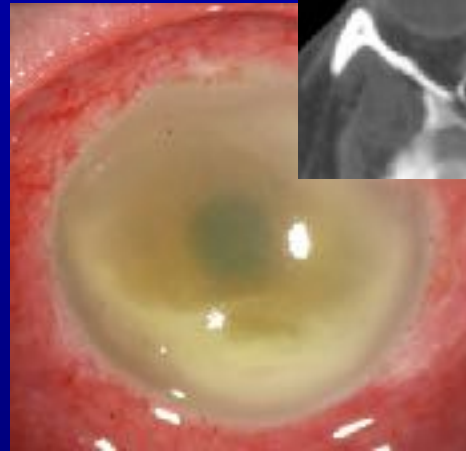
- endophthalmitis
- intraocular foreign body

- **urgent**

- open globe injury

- **prompt (secondary procedure)**

- media opacity
- progressive vitreoretinal traction
- retinal incarceration
- retinal detachment



# IOFB Diagnosis

- history
  - any possibility of high speed projectile?

hammering



chiseling



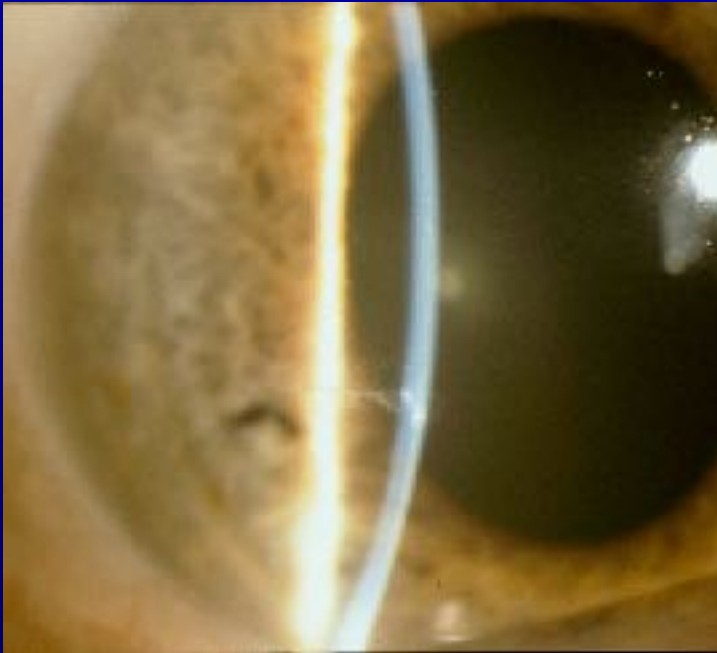
explosion



imaging study is essential to rule out IOFB

# IOFB Diagnosis

- careful slit lamp examination



# IOFB Diagnosis

- **CONTROVERSIES**

- Is it necessary to obtain an imaging study in all open globe injuries?

# IOFB Diagnosis

- **CONTROVERSIES**

- Is it necessary to obtain an imaging study in all open globe injuries?

- Yes\*

- \* depends on standard of care in your community

# IOFB Diagnosis

- **CONTROVERSIES**

- What is the best imaging study to obtain in cases of suspected IOFB?

# IOFB Diagnosis

- **CONTROVERSIES**

- What is the best imaging study to obtain in cases of suspected IOFB?

- CT scan

# IOFB Diagnosis

- ancillary studies
  - x-ray: plain films **not** sufficient to rule out IOFB
  - MRI: **not** performed
  - Ultrasound: **not** typically performed in setting of open globe

# IOFB Management

- to prevent endophthalmitis
  - incidence
    - 1 – 8 % of open globe injuries
    - 7 – 13 % of IOFB cases\*

Low Rate of Endophthalmitis in a Large Series of Open  
Globe Injuries

CHRISTOPHER M. ANDREOLI, MICHAEL T. ANDREOLI, CAROLYN E. KLECK, AUDREY B. AHUERO,  
DIMITRIOS YANNAS, AND MARLENE L. DURAND

- to prevent metallosis bulbi (iron, copper)

# IOFB Management

- **CONTROVERSY**

- How soon should an IOFB be removed?

# IOFB Management

- **CONTROVERSY**

- How soon should an IOFB be removed?

- Immediately\*

- \* depends on standard of care in your community

# IOFB Management

- 79 eyes IOFB - Iraq & Afghanistan
- 21 days median time to IOFB removal
- 0 endophthalmitis!!

## Delayed Intraocular Foreign Body Removal without Endophthalmitis during Operations Iraqi Freedom and Enduring Freedom

Marcus H. Colyer, MD,<sup>1</sup> Eric D. Weber, MD,<sup>1</sup> Eric D. Weichel, MD,<sup>1</sup> John S. B. Dick, MD,<sup>2</sup>  
Kraig S. Bower, MD,<sup>1</sup> Thomas P. Ward, MD,<sup>1</sup> Julia A. Haller, MD<sup>3</sup>

Colyer et al. Ophthalmology 2007; 114:1439-1447

# IOFB Management

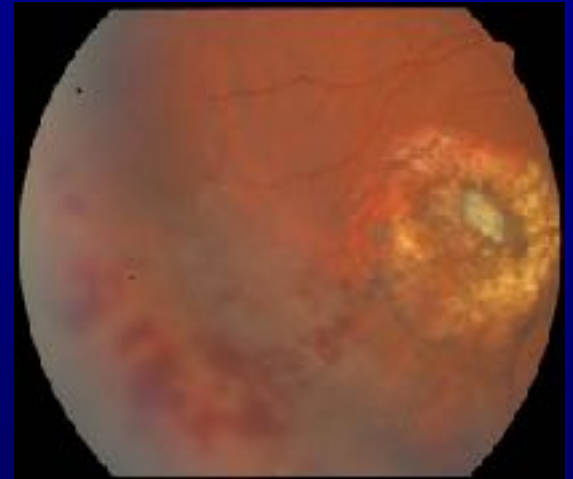
- Can these results (one study, unique combat setting) be extrapolated to the civilian setting?
  - numerous large series from many countries demonstrating clear association between delayed IOFB removal and endophthalmitis

# IOFB Management

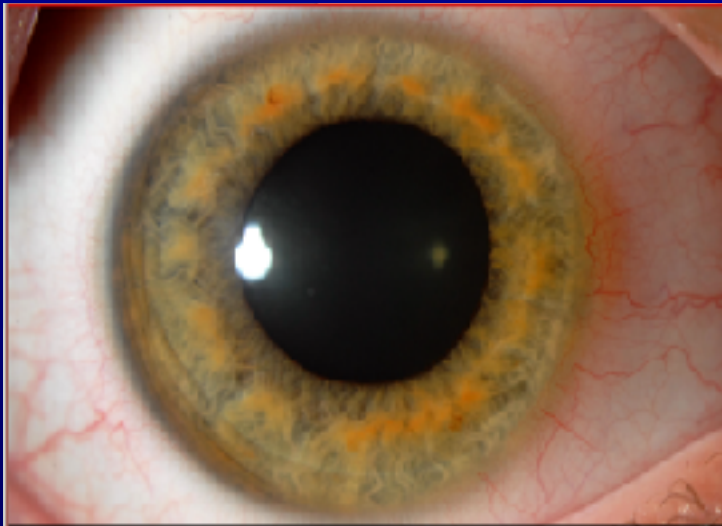
- All of these studies recommend immediate removal of IOFB
  - Williams, 1988
  - Mieler, 1990
  - Mieler, 1990
  - Thompson, 1993
  - Jonas, 2000
  - Knox, 2004
  - Chaudhry, 2008
  - Yang, 2009

# IOFB Management

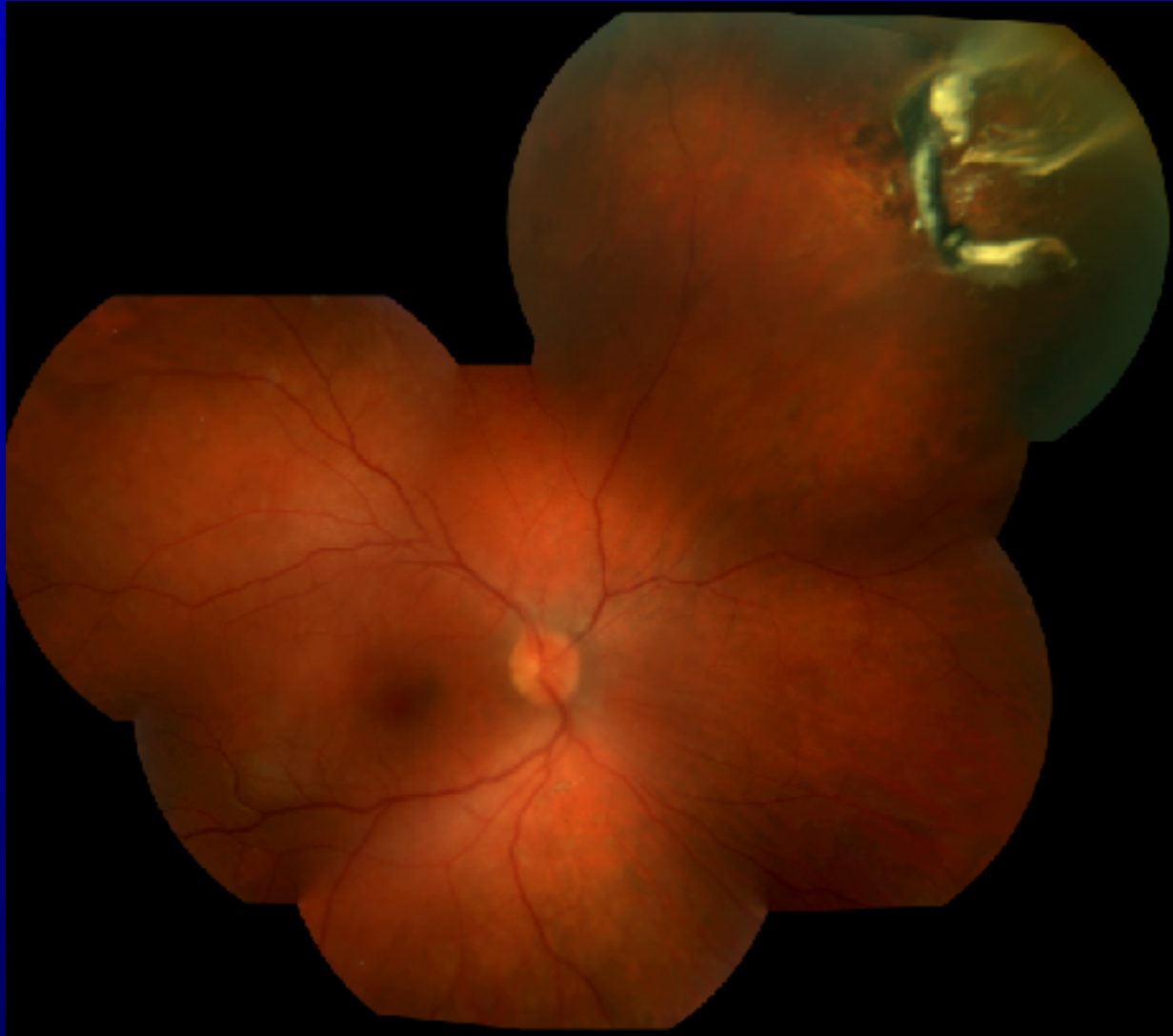
- closure of entrance wound
- vitrectomy / removal of IOFB
- assess the need for intravitreal antibiotics



# IOFB Management



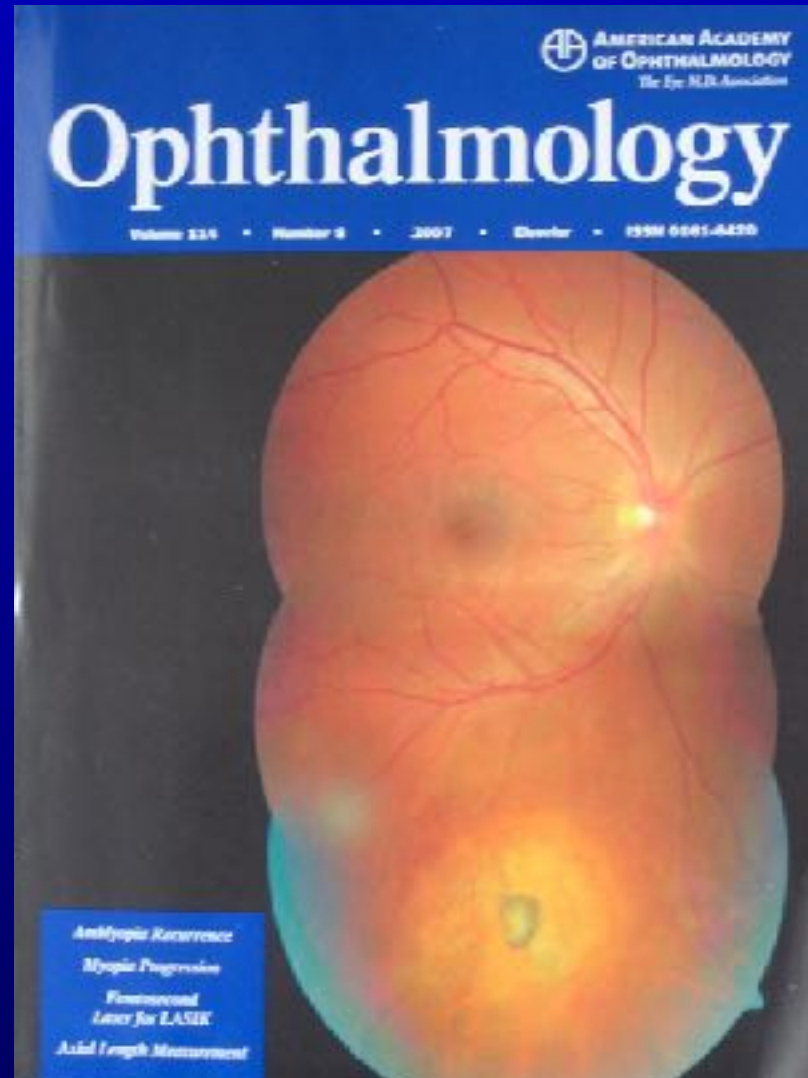
# IOFB Management





# IOFB Management

- injury 2 years ago
  - retained IOFB



# Traumatic Endophthalmitis

- incidence
  - 1 – 8 % of open globe injuries
  - 7 – 13 % of IOFB cases\*
- distinct features
  - Bacillus species in 25 %
  - poor prognosis



# Traumatic Endophthalmitis

- standard treatment
  - obtain specimens for culture
  - intravitreal antibiotics
    - vancomycin
    - ceftazidime



# Traumatic Endophthalmitis

- **CONTROVERSIES**

- Antifungals?
- Intravitreal steroids?
- Systemic antibiotics?
- Vitrectomy surgery?



# Traumatic Endophthalmitis

- **CONTROVERSIES**

- Antifungals?



- If possible contamination with organic matter
    - Amphotericin B, voriconazole

# Traumatic Endophthalmitis

- **CONTROVERSIES**

- Intravitreal steroids?

- In very severe cases

## **Post-traumatic Infectious Endophthalmitis**

Neelakshi Bhagat, MD, MPH, Saya Nagori, MD, and Marco Zarbin, MD, PhD

# Traumatic Endophthalmitis

- **CONTROVERSIES**

- Systemic antibiotics?

- Oral gatifloxacin or moxifloxacin

## **Post-traumatic Infectious Endophthalmitis**

Neelakshi Bhagat, MD, MPH, Saya Nagori, MD, and Marco Zarbin, MD, PhD

# Traumatic Endophthalmitis

- **CONTROVERSIES**

- Vitrectomy surgery?

- If view sufficient to safely perform surgery

## **Post-traumatic Infectious Endophthalmitis**

Neelakshi Bhagat, MD, MPH, Saya Nagori, MD, and Marco Zarbin, MD, PhD

# Trauma Management

- immediate (emergency)
  - endophthalmitis
  - intraocular foreign body
- **urgent**
  - open globe injury
- prompt (secondary procedure)
  - media opacity
  - progressive vitreoretinal traction
  - retinal incarceration
  - retinal detachment



# Trauma Management

- hemorrhagic chemosis
  - low IOP



# Trauma Management

- surgical exploration
  - hemorrhagic chemosis



**globe not ruptured!**

# Open Globe Management

- **CONTROVERSY**

- How soon should open globe injuries be repaired?

# Open Globe Management

- **CONTROVERSY**

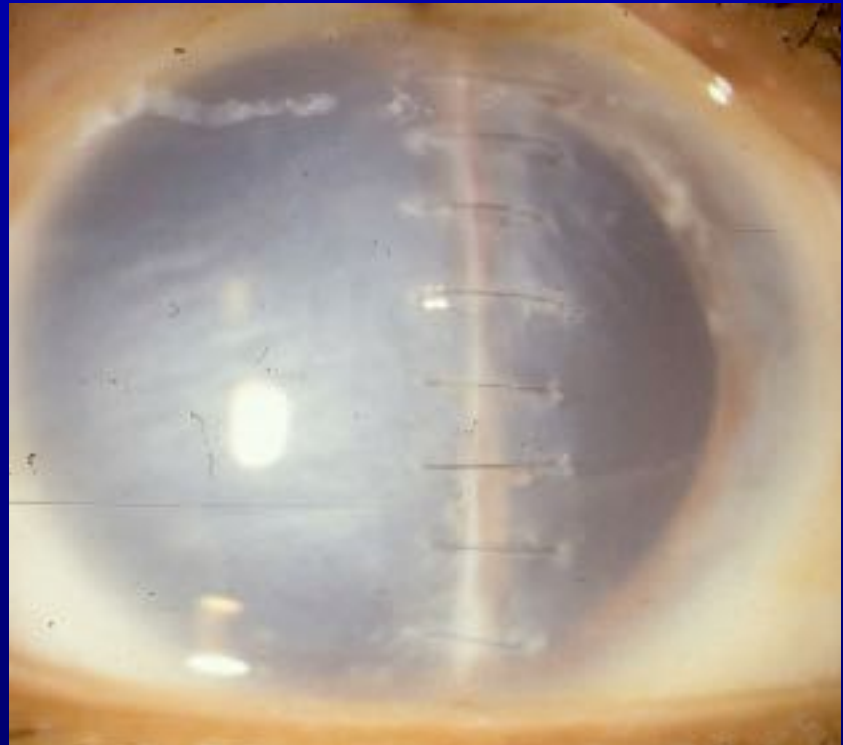
- How soon should open globe injuries be repaired?

- Urgently\*

- \* as soon as possible, within 24 hours from injury

# Open Globe Management

- wound repair
  - water-tight wound
  - formed anterior chamber



# Open Globe Management

- **CONTROVERSIES**

- How do you manage large wounds that extend into zone III?

- prophylactic scleral buckle?

# Open Globe Management

- **CONTROVERSIES**

- How do you manage large wounds that extend into zone III?

- scleral buckle not typically placed

# Open Globe Management

- **CONTROVERSIES**

- How do you manage large wounds that extend into

- posterior zone III (inaccessible zone III)?

- do you remove rectus muscles?

- do you suture the entire extent of the wound?

# Open Globe Management

- **CONTROVERSIES**

- How do you manage large wounds that extend into posterior zone III (inaccessible zone III)?

- rectus muscles not typically removed
- leave as is, do not repair posterior extent of wound

# Open Globe Management

- perforating injuries
  - entrance and exit wounds
  - long sharp object
    - fish pick



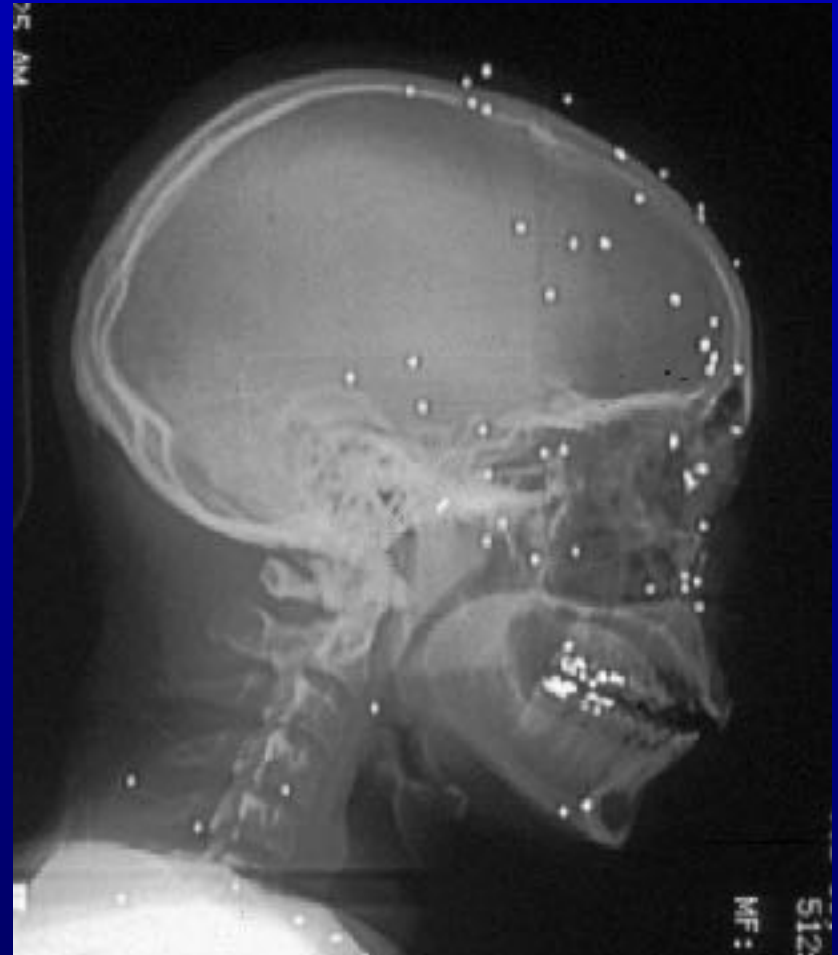
# Open Globe Management

- perforating injuries
  - entrance and exit wounds
- long sharp object
  - projectile foreign body
    - metal fragment



# Open Globe Management

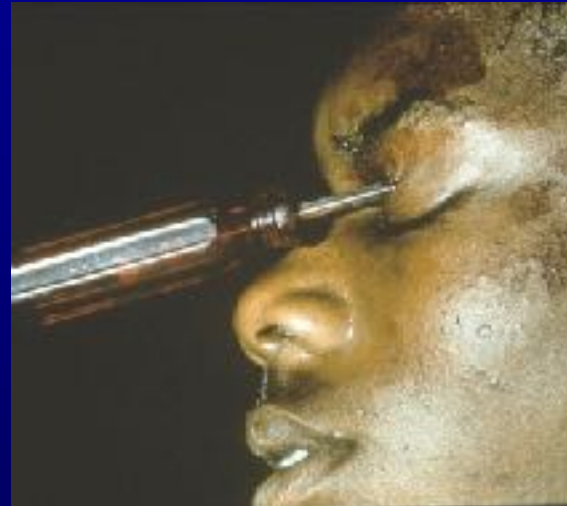
- perforating injuries
  - entrance and exit wounds
  - long sharp object
  - projectile foreign body
    - metal fragment
    - shotgun pellet



# Open Globe Management

- **CONTROVERSY**

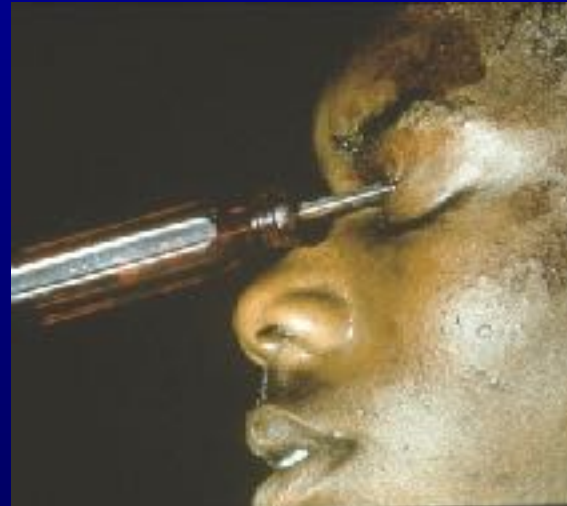
- How do you manage perforating injuries with posterior exit wound?



# Open Globe Management

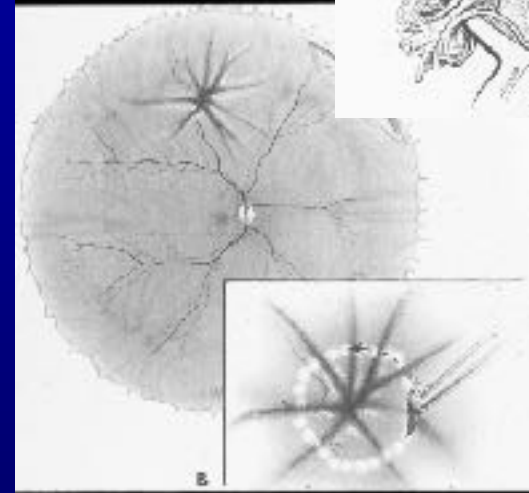
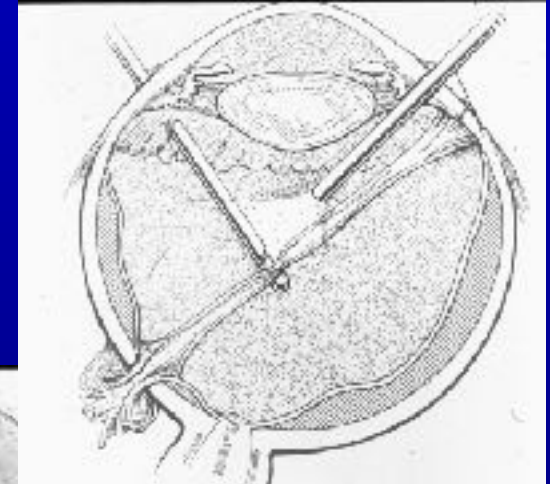
- **CONTROVERSY**

- How do you manage perforating injuries with posterior exit wound?
  - leave as is, do not repair posterior exit wound



# Trauma Management

- immediate (emergency)
  - endophthalmitis
  - intraocular foreign body
- urgent
  - open globe injury
- **prompt (secondary procedure)**
  - media opacity
  - progressive vitreoretinal traction
  - retinal incarceration
  - retinal detachment



# Vitreotomy for Trauma

- **CONTROVERSY**

- What is the proper timing of vitrectomy?

# Vitreotomy for Trauma

- **CONTROVERSY**

- What is the proper timing of vitrectomy?

- usually 7 to 14 days after the injury

- less bleeding

- easier to create PVD

# Vitrectomy for Trauma

- goals of vitrectomy
  - create PVD
  - relieve vitreous traction
  - relieve retinal traction
  - reattach retina
- membrane peeling, scleral buckle, retinectomy, perfluorocarbon liquid, endolaser, extended tamponade



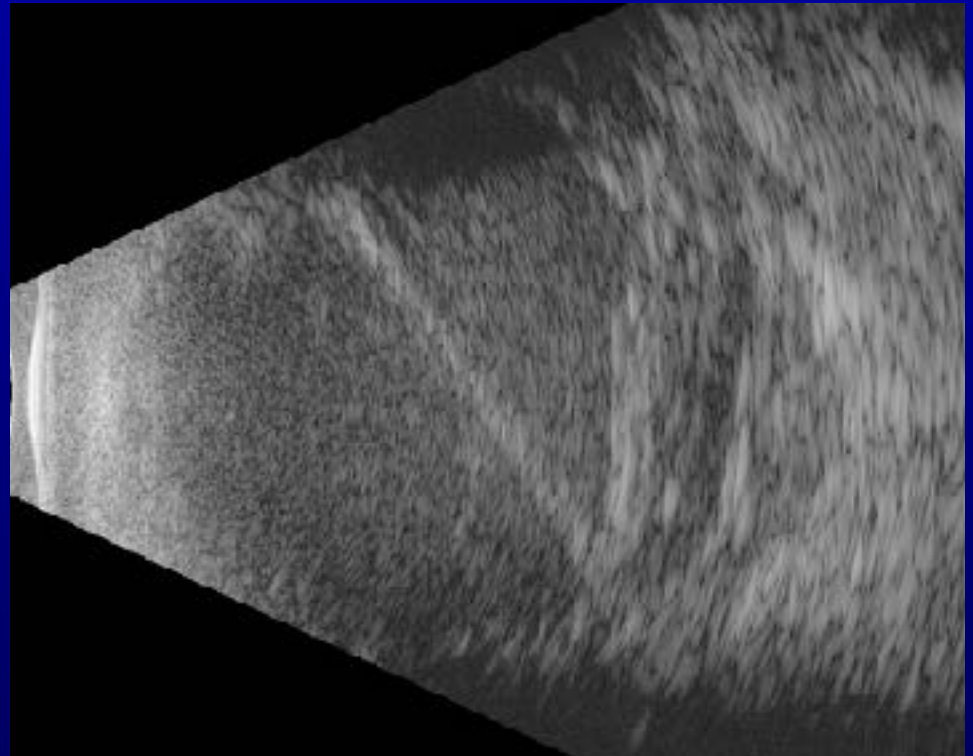
# Indications for Vitrectomy

1. media opacity
2. progressive vitreoretinal traction
  - +/- retinal detachment
3. retinal incarceration
  - +/- retinal detachment
4. retinal detachment

# Indications for Vitrectomy

## 1. media opacity

- rule out retinal traction and/or detachment
  - ultrasound



# Indications for Vitrectomy

## 1. media opacity

- in patients with dense vitreous hemorrhage after penetrating trauma, when do you consider vitrectomy?

# Indications for Vitrectomy

## 1. media opacity

- in patients with dense vitreous hemorrhage after penetrating trauma, when do you consider vitrectomy?
  - usually 7-14 days after the injury

# Indications for Vitrectomy

## 2. progressive vitreoretinal traction

– perforating injury – underwent primary repair

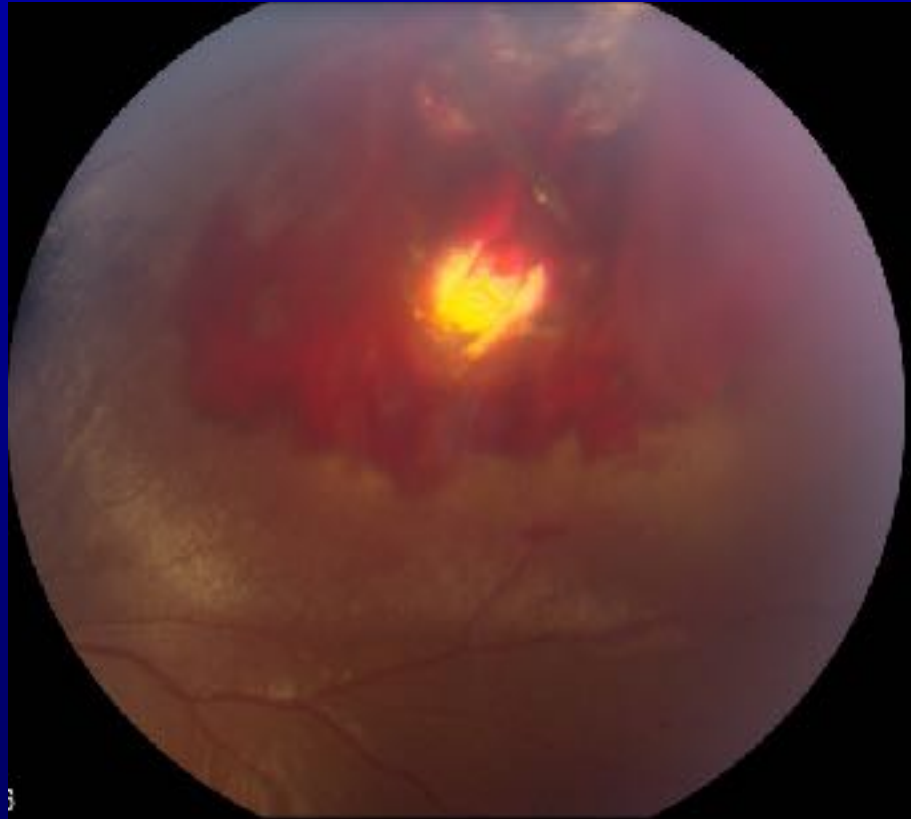
POD # 1



# Indications for Vitrectomy

2. progressive vitreoretinal traction

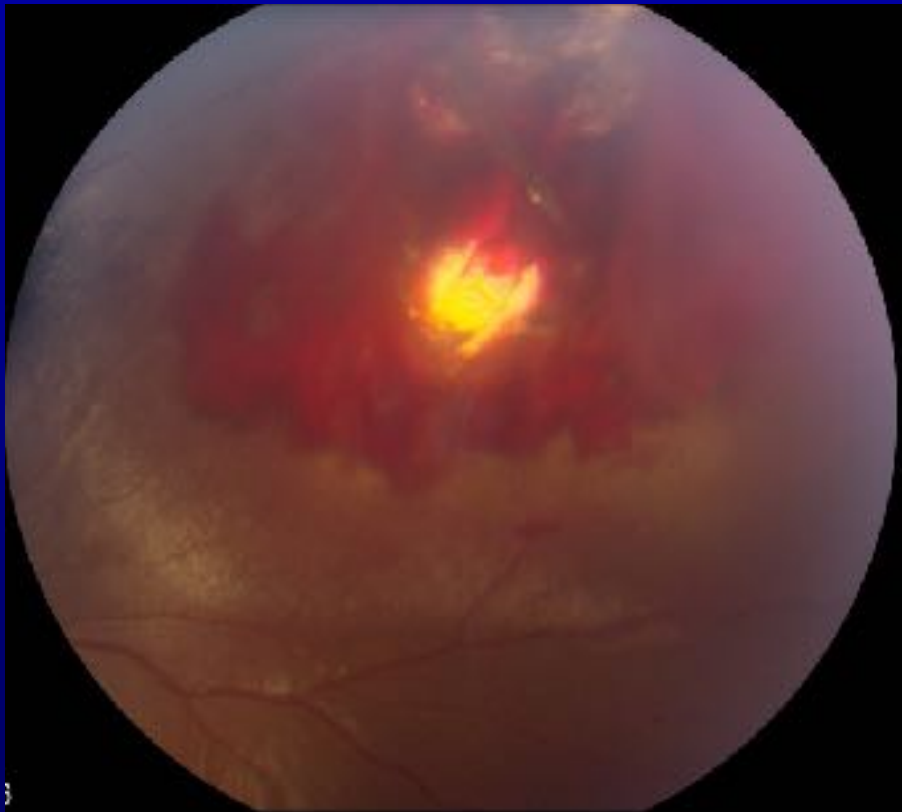
POD # 1



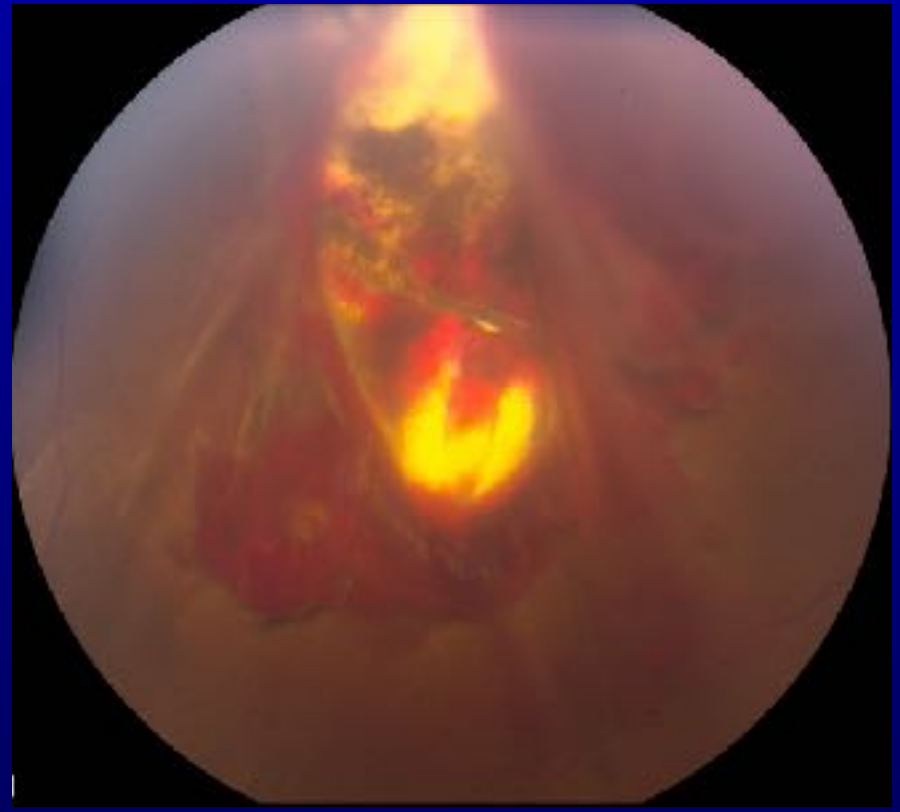
# Indications for Vitrectomy

## 2. progressive vitreoretinal traction

POD # 1



POD # 7



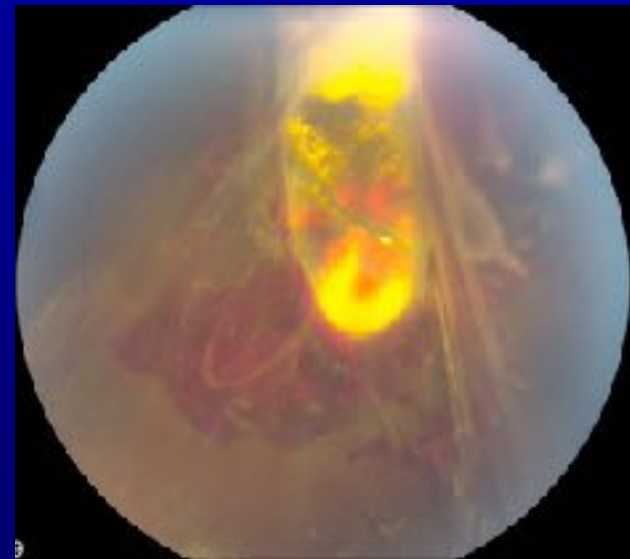
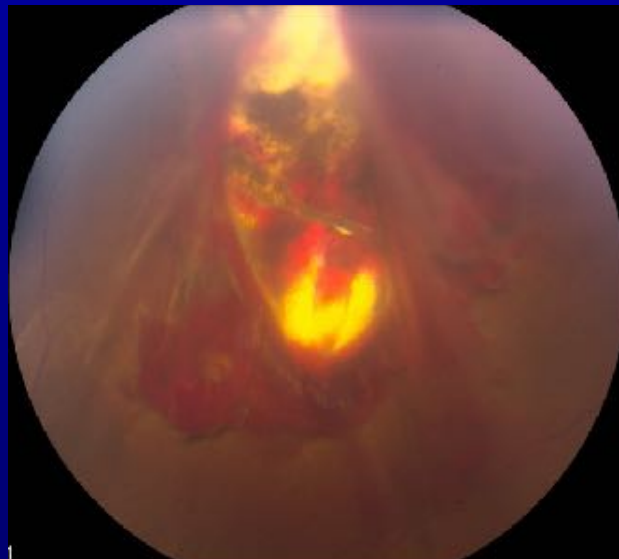
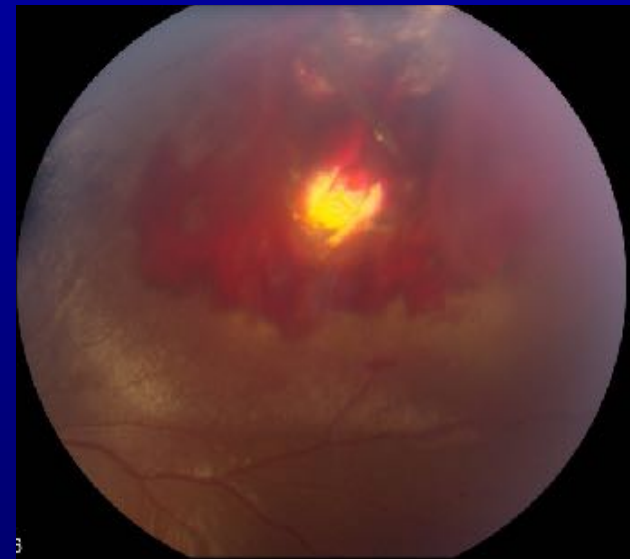
# Indications for Vitrectomy

## 2. progressive vitreoretinal traction

POD # 1

POD # 7

POD # 14



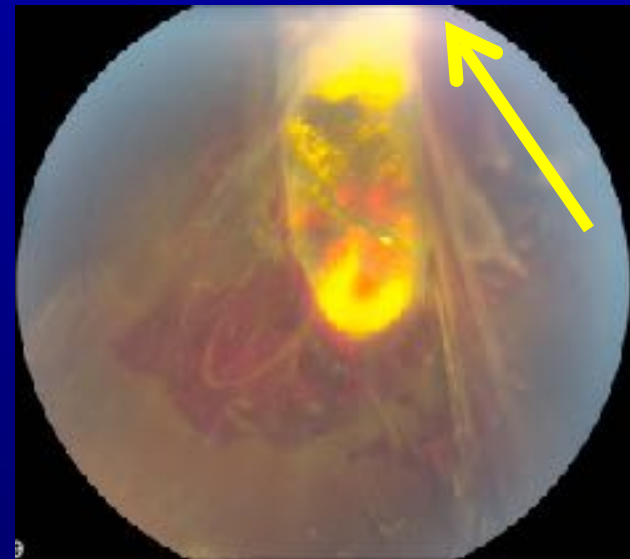
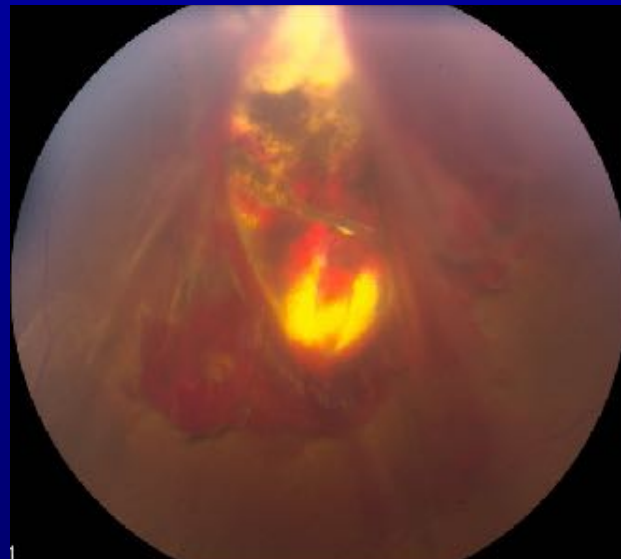
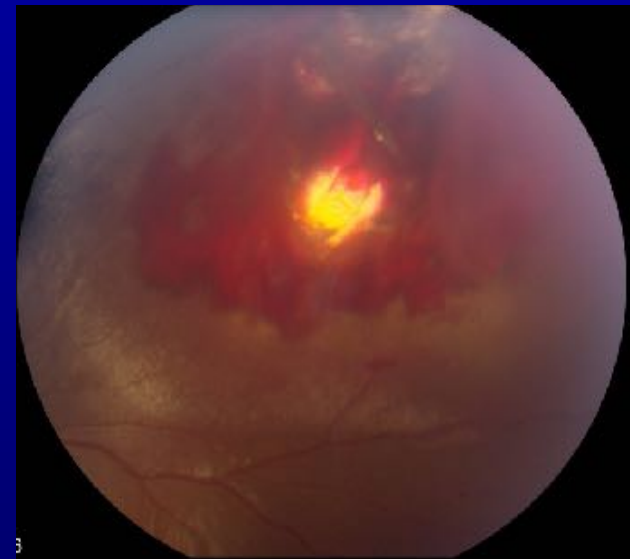
# Indications for Vitrectomy

## 2. progressive vitreoretinal traction

POD # 1

POD # 7

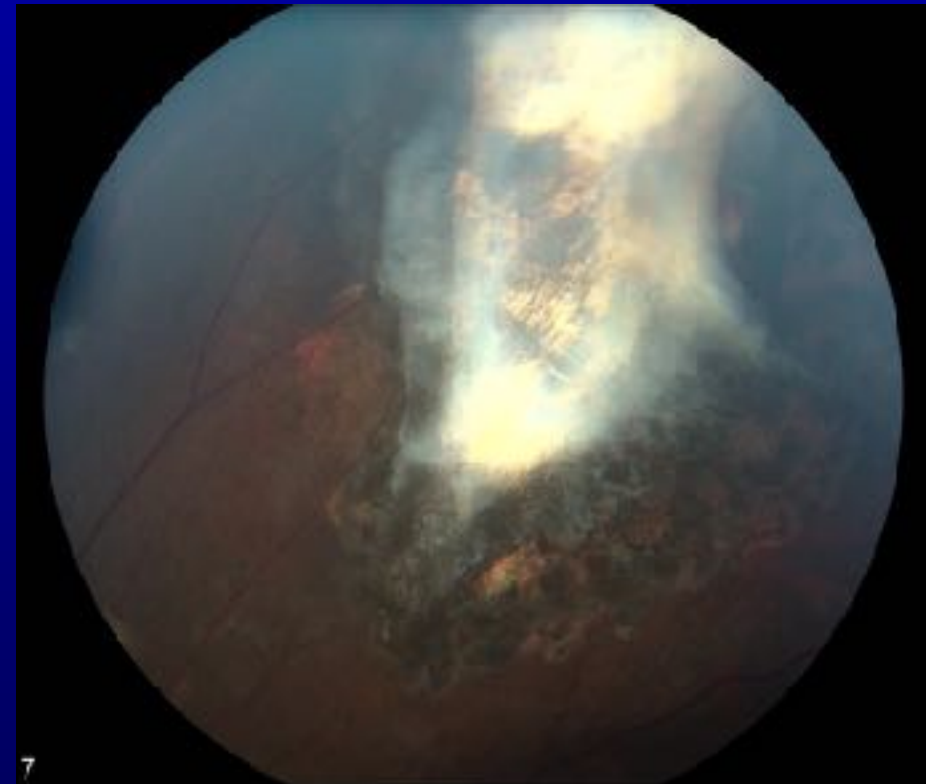
POD # 14



# Indications for Vitrectomy

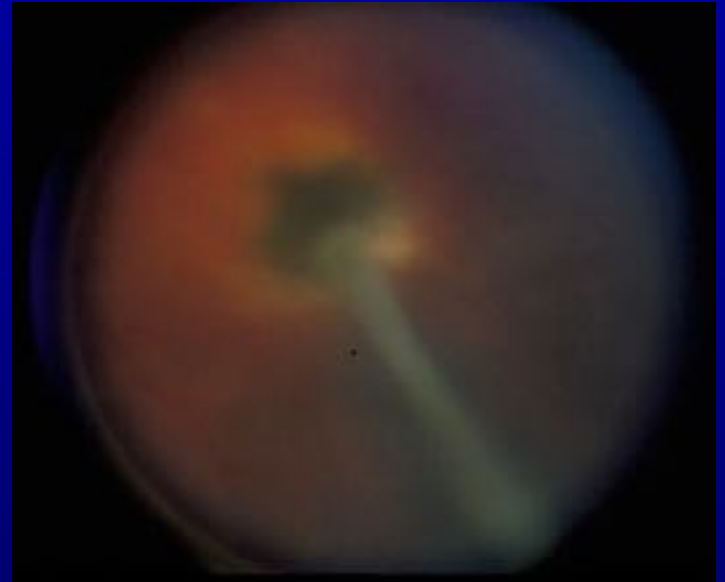
## 2. progressive vitreoretinal traction

postop 20/30



# Indications for Vitrectomy

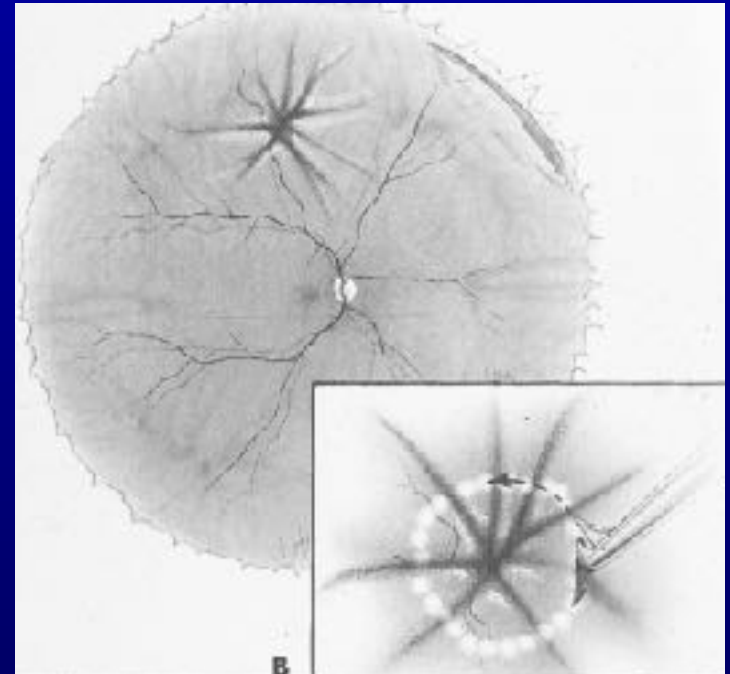
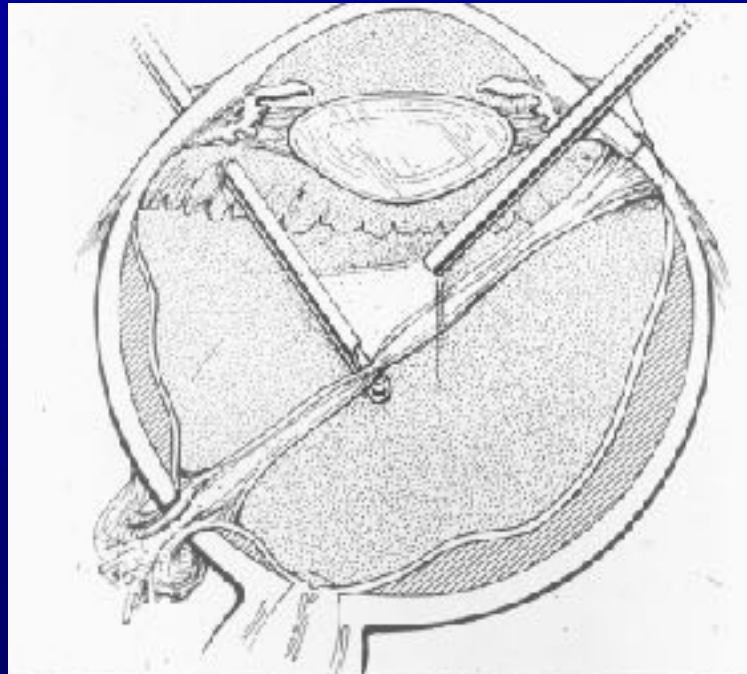
- vitreous traction at exit site



# Indications for Vitrectomy

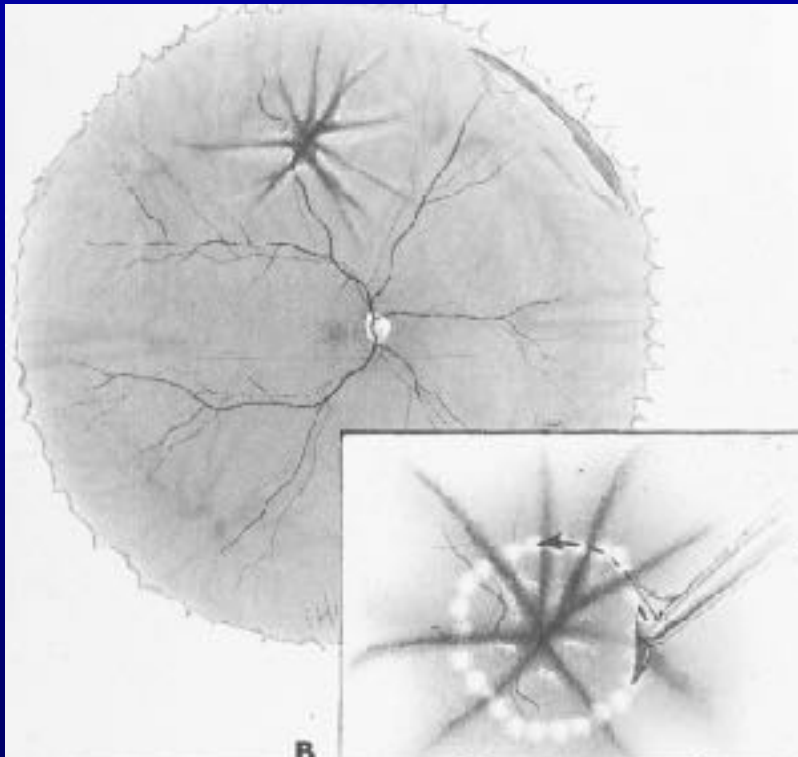
## 3. retinal incarceration

– perforating injury – underwent primary repair



# Indications for Vitrectomy

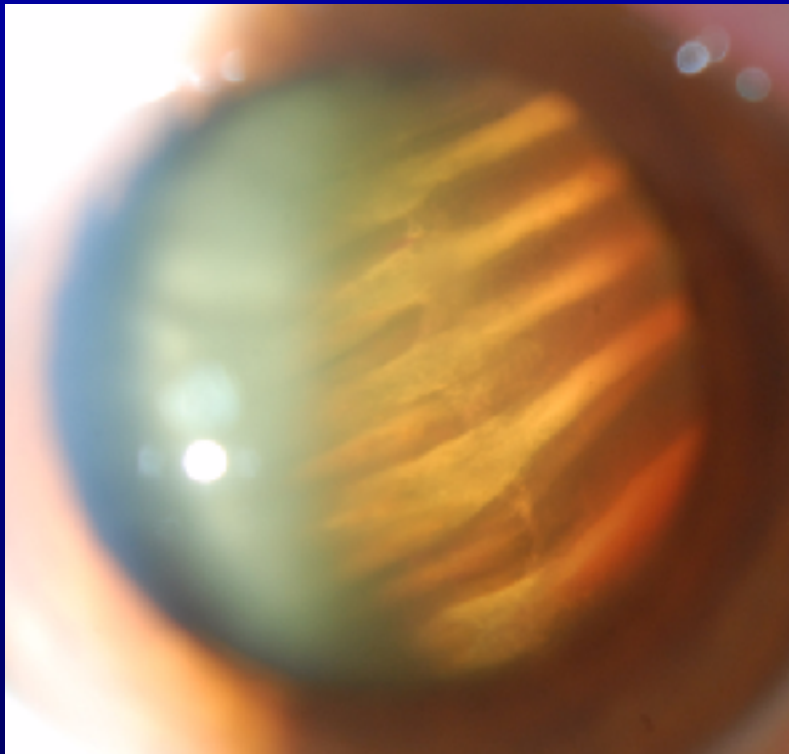
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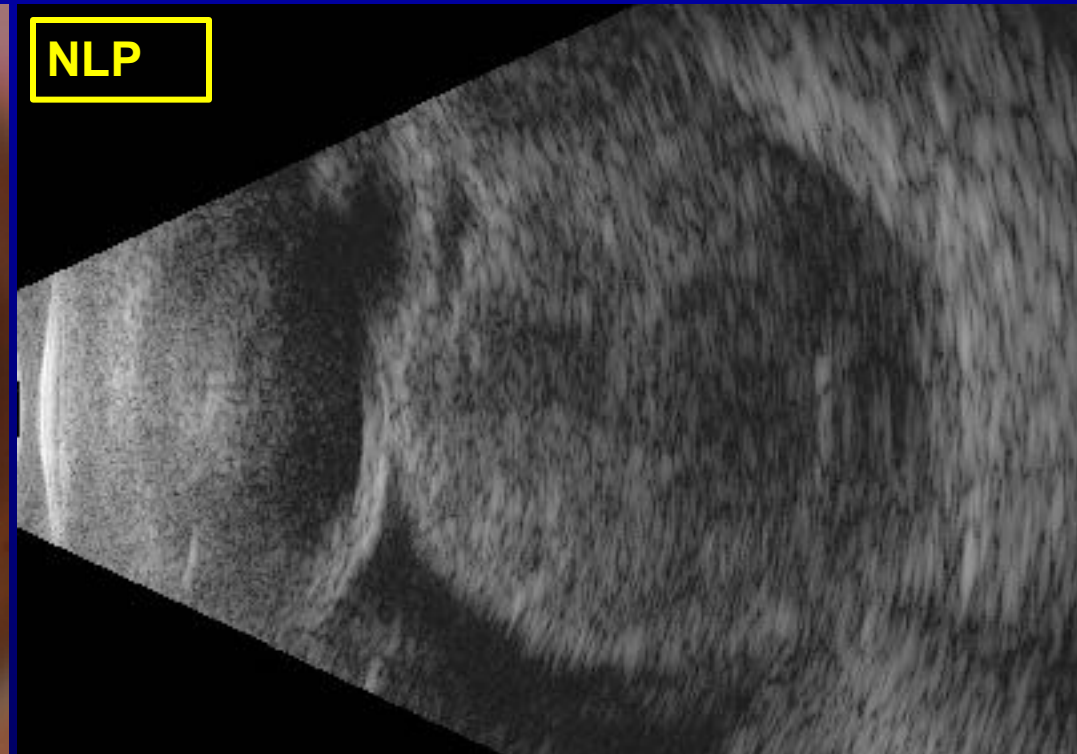
# Indications for Vitrectomy

## 3. retinal incarceration

- globe rupture, zone III – underwent primary repair (17mm)



NLP

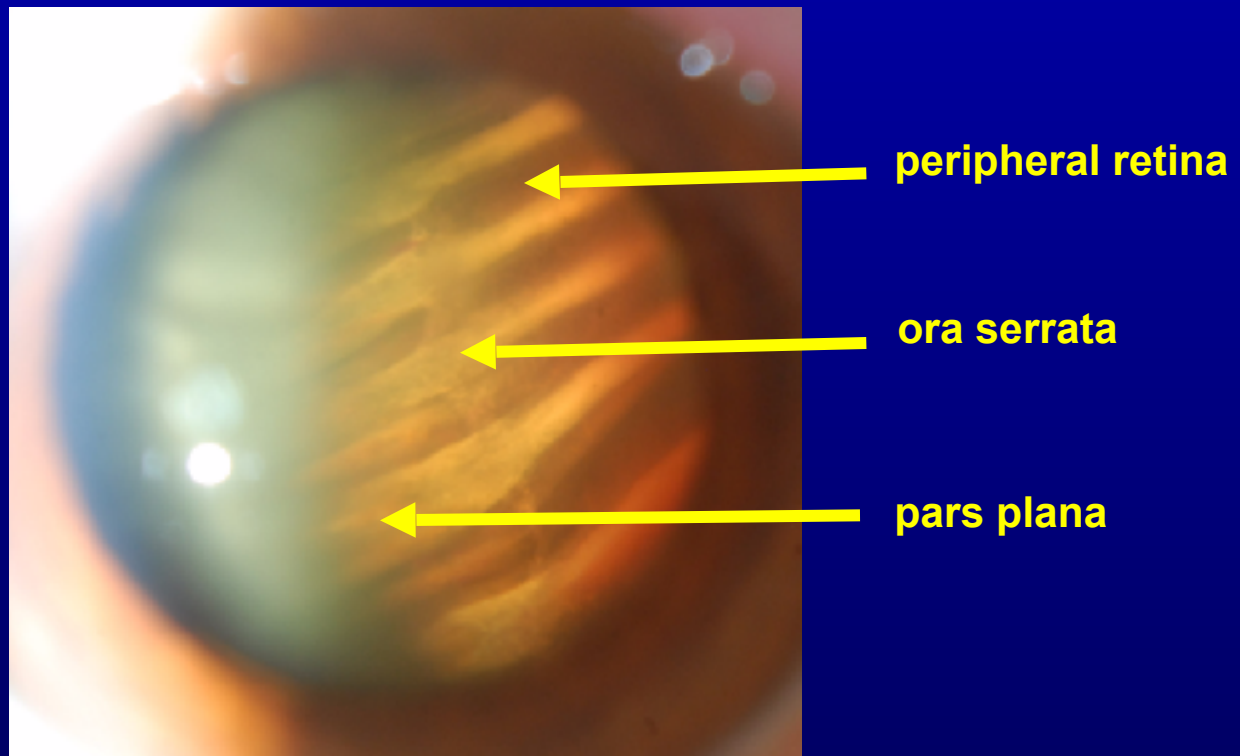


massive choroidal nasally

# Indications for Vitrectomy

## 3. retinal incarceration

- globe rupture, zone III – underwent primary repair (17mm)

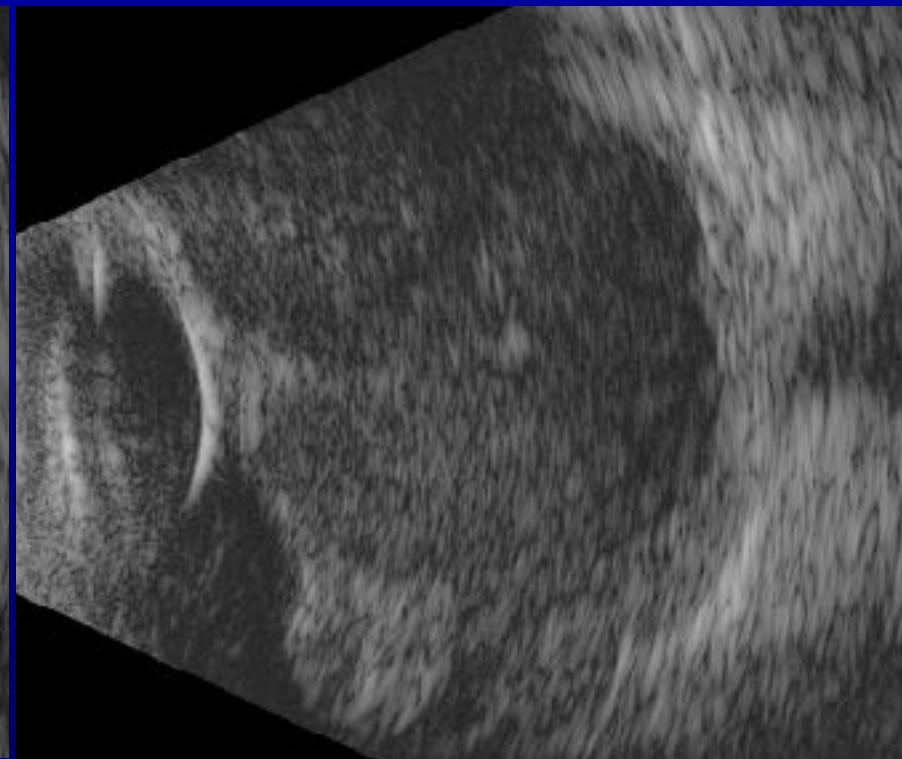
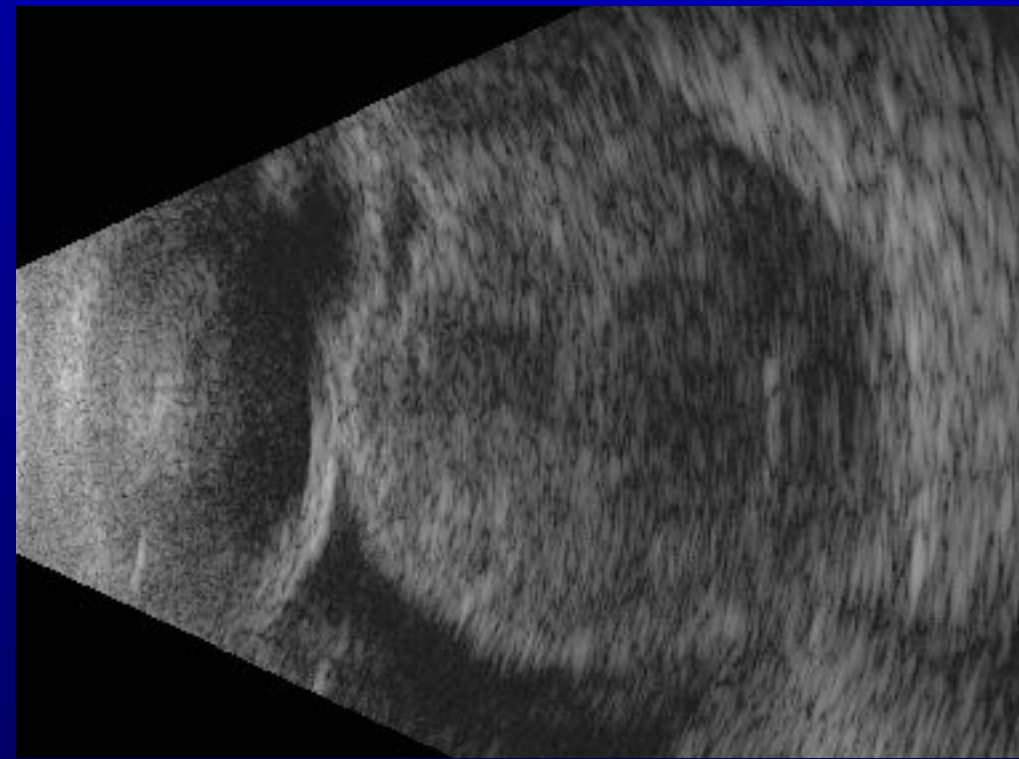


massive choroidal nasally

# Indications for Vitrectomy

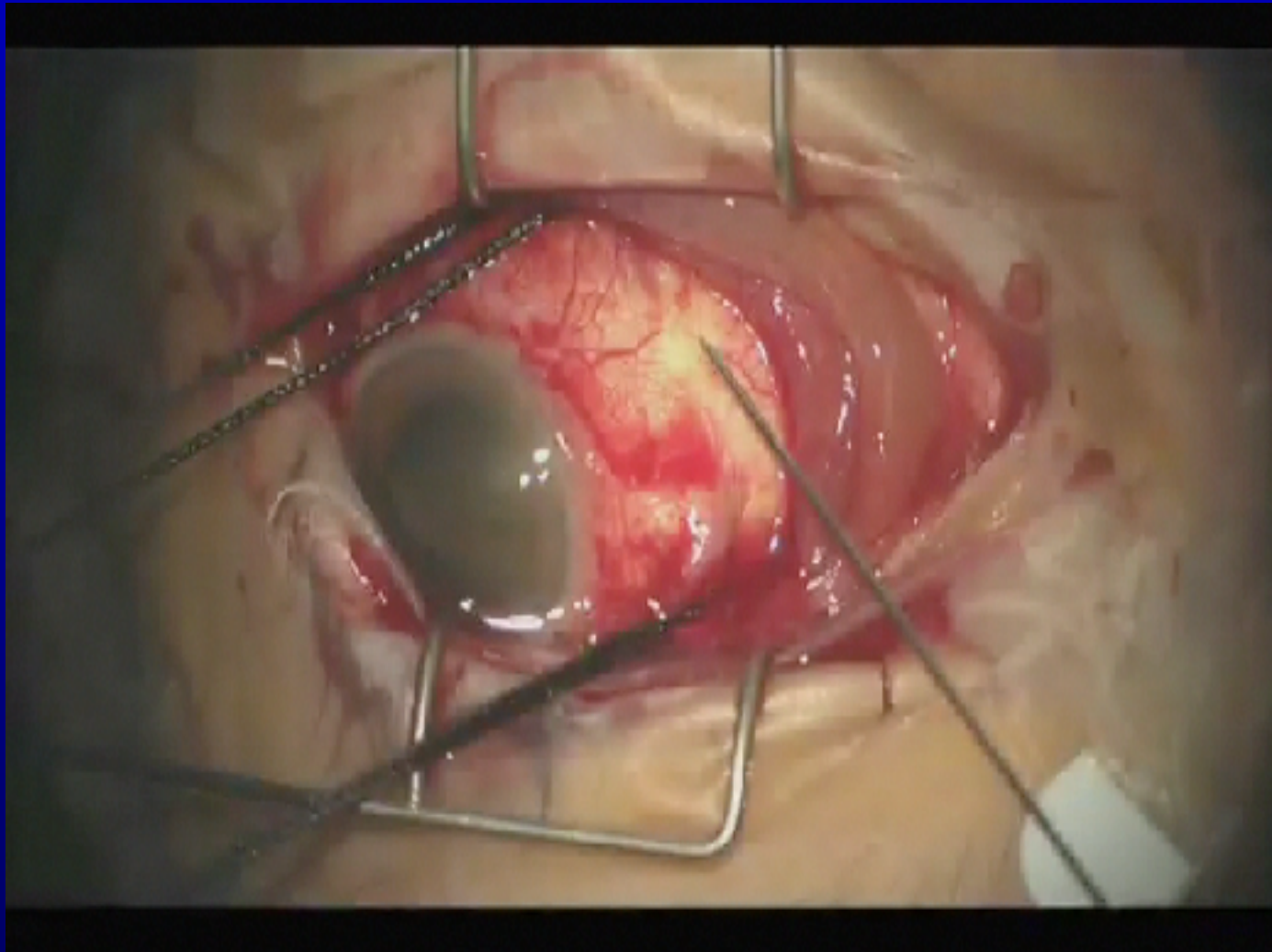
## 3. retinal incarceration

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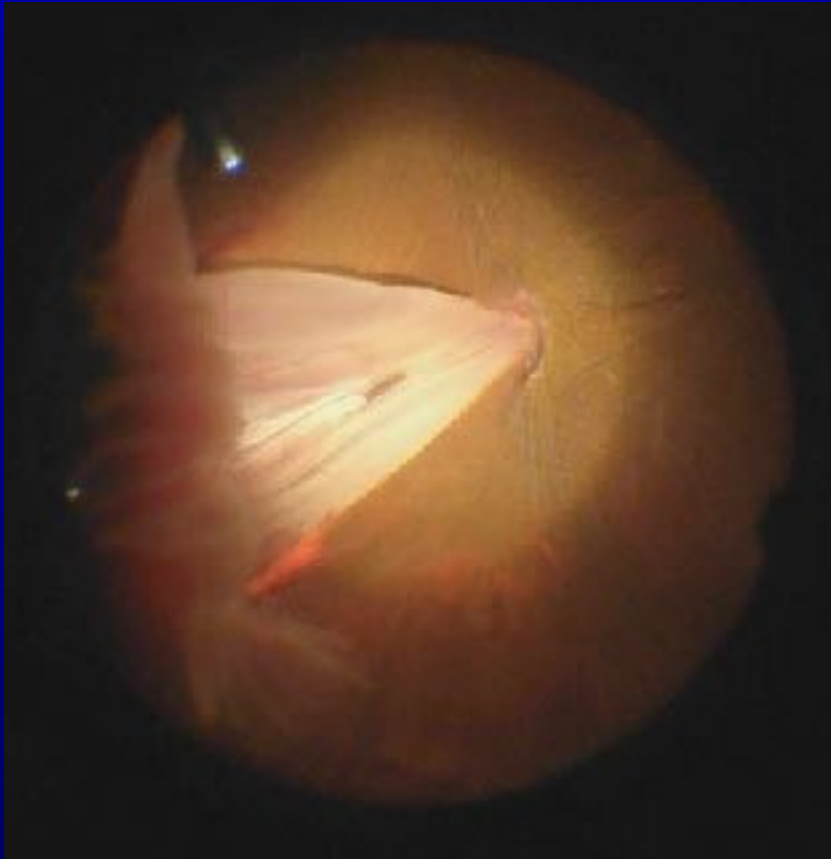
1 week later: choroidal hemorrhage liquefied

# Indications for Vitrectomy

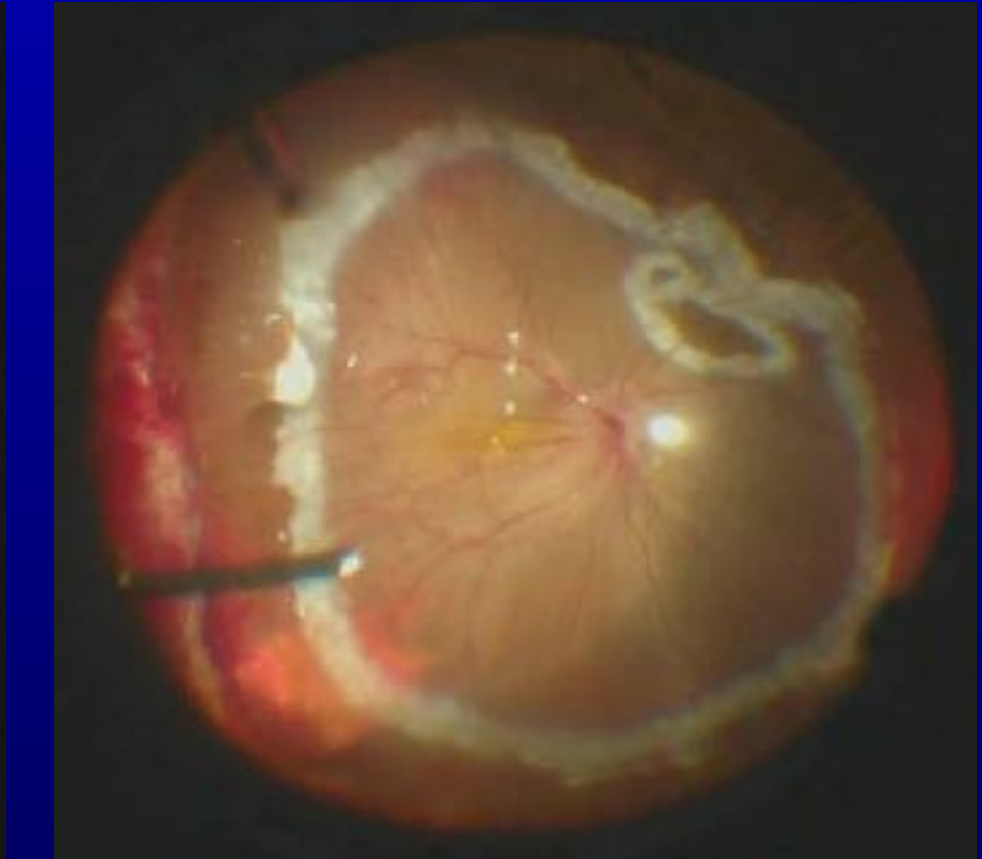


# Indications for Vitrectomy

## 3. retinal incarceration



intraoperative view



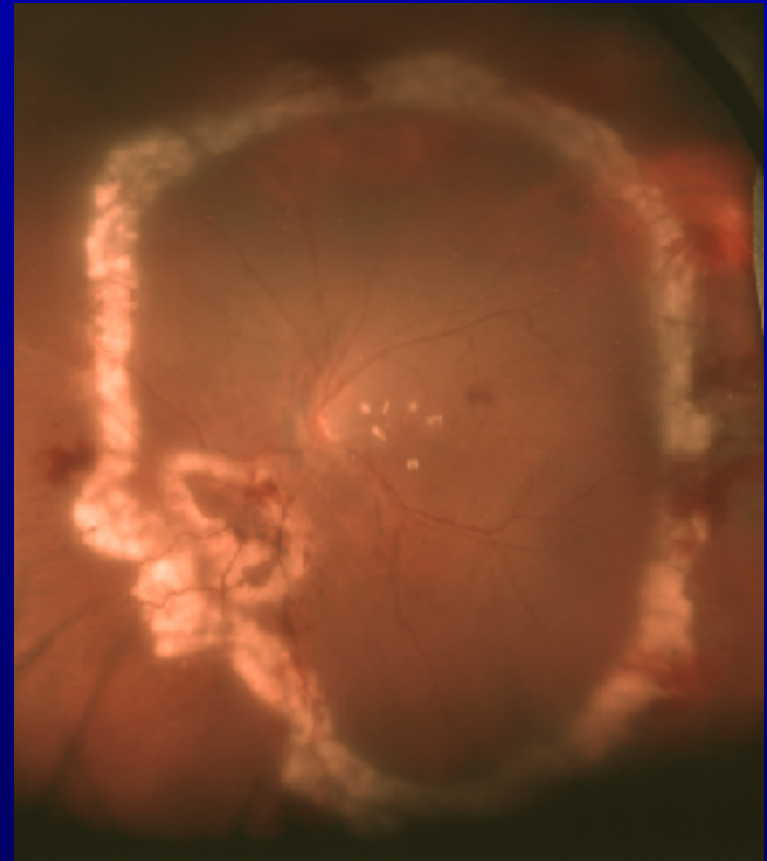
intraoperative view

# Indications for Vitrectomy

## 3. retinal incarceration



intraoperative view



postop week 1

# Indications for Vitrectomy

## 3. retinal incarceration



20/60 PH 20/50

postop month 4

Remarkable visual recovery after severe open globe injury

Yewlin E. Chee <sup>a</sup>, Justin M. Kanoff <sup>b</sup>, Dean Elliott <sup>a, \*</sup>

# Indications for Vitrectomy

## 4. retinal detachment

- in patients with RD after penetrating trauma, when do you consider vitrectomy?

# Indications for Vitrectomy

## 4. retinal detachment

- in patients with RD after penetrating trauma, when do you consider vitrectomy?
  - usually 7-14 days after the injury, sometimes sooner

# Indications for Vitrectomy

## 4. retinal detachment

- incidence?

# Retinal Detachment after Open Globe Injury

– 10 year review (893 open globes)

- 255 cases of RD **(29%)**

- 28% within 1 day **(8% of total)**

- 47% within 1 week **(13% of total)**

- 72% within 1 month **(21% of total)**

- Remainder 1 month to several years **(29% of total)**



## Retinal Detachment after Open Globe Injury

Tomasz P. Stryjewski, MD, MPP,<sup>1,2</sup> Christopher M. Andreoli, MD,<sup>1,2,3</sup> Dean Elliott, MD<sup>1,2</sup>

# Retinal Detachment after Open Globe Injury

– probability of developing RD

- visual acuity
- zone of injury
- vitreous hemorrhage

Table 5. The ED-OGI Score: Probability of Developing Retinal Detachment Based on Initial Clinical Findings

Clinical Variable at Presentation after Open Globe Injury*	Retinal Detachment after Open Globe Injury Points†	$\beta$ Coefficient	P Value
Visual acuity better than count fingers	0	—	—
Count fingers at 1 ft	1	1.02	0.03
Hand motion at 1 ft	2	2.04	<0.001
Light perception	2.5	2.44	<0.001
No light perception	3.5	3.58	<0.001
Zone I injury*	0	—	—
Zone II injury*	0.5	0.62	0.023
Zone III injury*	2	1.83	<0.001
Vitreous hemorrhage	2	2.04	<0.001
Sum of RD-OGI points		Probability of developing retinal detachment	
0.0		1%	
0.5		2%	
1.0		3%	
1.5		4%	
2.0		7%	
2.5		10%	
3.0		16%	
3.5		24%	
4.0		34%	
4.5		46%	
5.0		58%	
5.5		69%	
6.0		79%	
6.5		86%	
7.5		95%	

## Retinal Detachment after Open Globe Injury

Tomasz P. Stryjewski, MD, MPP,<sup>1,2</sup> Christopher M. Andreoli, MD,<sup>1,2,3</sup> Dean Elliott, MD<sup>1,2</sup>

# Retinal Detachment after Open Globe Injury

– probability of developing RD

**Low Risk  
Category**

**<2 %**

**Moderate Risk  
Category**

**33 %**

**High Risk  
Category**

**80 %**

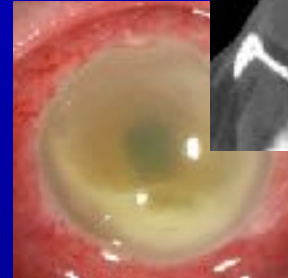
**Validation of the Retinal Detachment after Open Globe Injury (RD-OGI) Score as an Effective Tool for Predicting Retinal Detachment**

*Katarzyna Brodowska, MD, Tomasz P. Stryjewski, MD, MPP, Evangelia Papavasiliou, MD, PhD,  
Yusuf K. Chea, MD, Devin Filoni, MD*

# Trauma Management

## – immediate (emergency)

- endophthalmitis
- intraocular foreign body



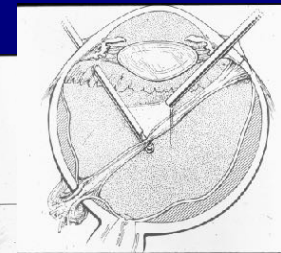
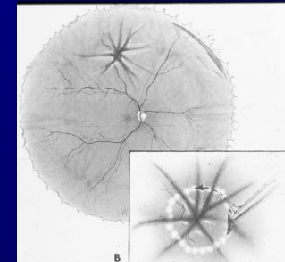
## – urgent

- open globe injury



## – prompt (secondary procedure)

- media opacity
- progressive vitreoretinal traction
- retinal incarceration
- retinal detachment



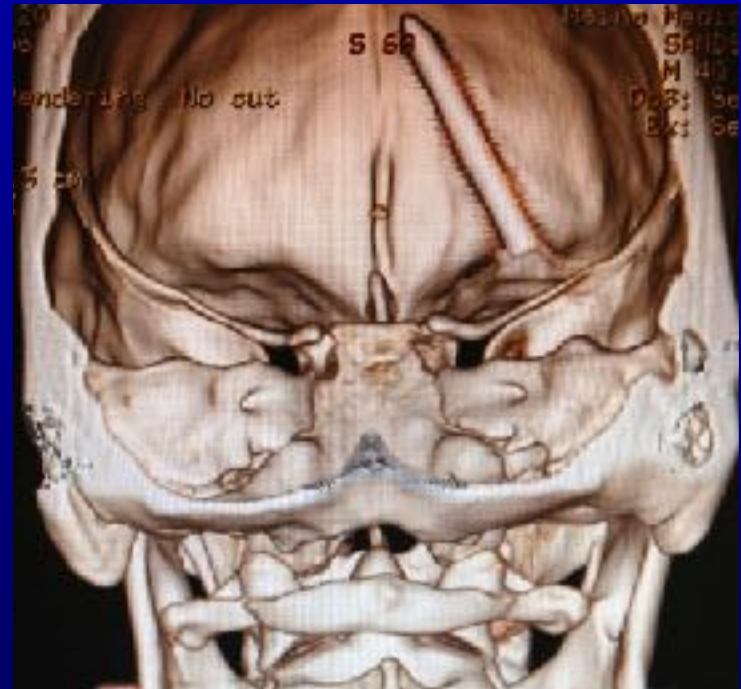
# Closed Globe Injury

- delayed presentation
  - **1 week at home!**
  - sclopetaria



# Closed Globe Injury

- 1 week at home!



# Closed Globe Injury

- 1 week at home!



# Closed Globe Injury

- Sclopetaria
  - at risk for retinal detachment



## Retinal Detachment Associated With Traumatic Chorioretinal Rupture

Thanos D. Papakostas, MD;  
Yoshihiro Yonekawa, MD; David Wu, MD, PhD;  
John B. Miller, MD; Peter E. Veldman, MD;  
Yewlin E. Chee, MD; Deeba Husain, MD;  
Dean Elliott, MD

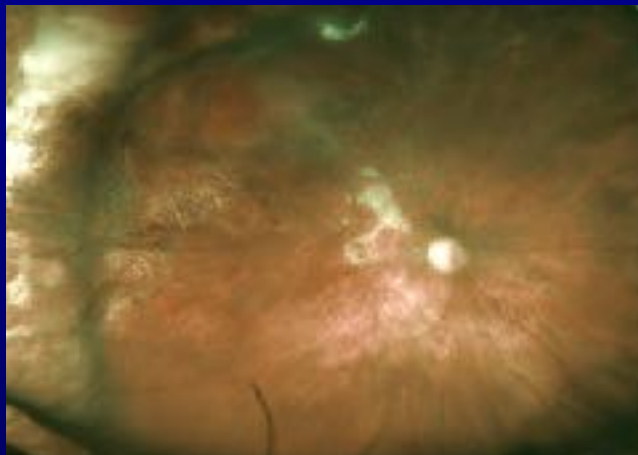
# Closed Globe Injury

- Sclopetaria
  - at risk for retinal detachment



## Retinal Detachment Associated With Traumatic Chorioretinal Rupture

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Yewlin E. Chee, MD; Deeba Husain, MD;  
Dean Elliott, MD



## Ocular Blast Injuries in Mass-Casualty Incidents

*The Marathon Bombing in Boston, Massachusetts, and the Fertilizer Plant Explosion in West, Texas*

Yoshihiro Yonekawa, MD,<sup>1,2,3,4,5</sup> Henry D. Hacker, MD,<sup>6</sup> Roy E. Lehman, MD,<sup>6</sup> Casey J. Essi, MD,<sup>7</sup>  
Peter E. Veldman, MD,<sup>1,4,5</sup> Neil M. Vyas, MD,<sup>8</sup> Ashoor S. Shah, MD, PhD,<sup>1,3,4,5</sup> David Wu, MD, PhD,<sup>1,4,5</sup>  
Dean Elliott, MD,<sup>1,4,5</sup> Matthew F. Gardner, MD,<sup>1,5</sup> Mark C. Rubenstein, MD,<sup>9</sup> Robert H. Kozak Jr., MD,<sup>6</sup>  
Jean E. Ramsey, MD, MPH,<sup>3</sup> Jean W. Miller, MD,<sup>1,4,5</sup> Robert A. Marshall, MD,<sup>6,10</sup> Mary G. Louvenne, MD,<sup>11</sup>  
Jorge G. Aronow, MD, MPH<sup>12</sup>

# Closed Globe Injury

- Patient presents after a night out at a strip club

exotropia



# Closed Globe Injury

- Patient presents after a night out at a strip club

exotropia

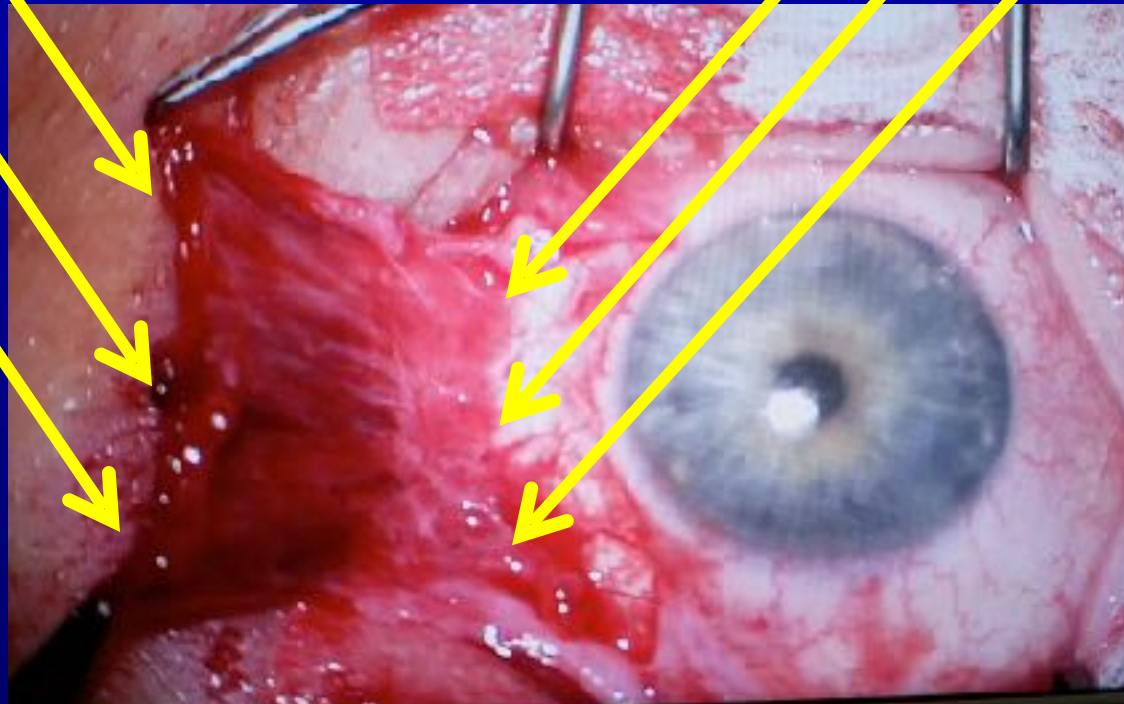


# Closed Globe Injury

- Patient presents after a night out at a strip club

lacerated medial rectus

medial rectus insertion

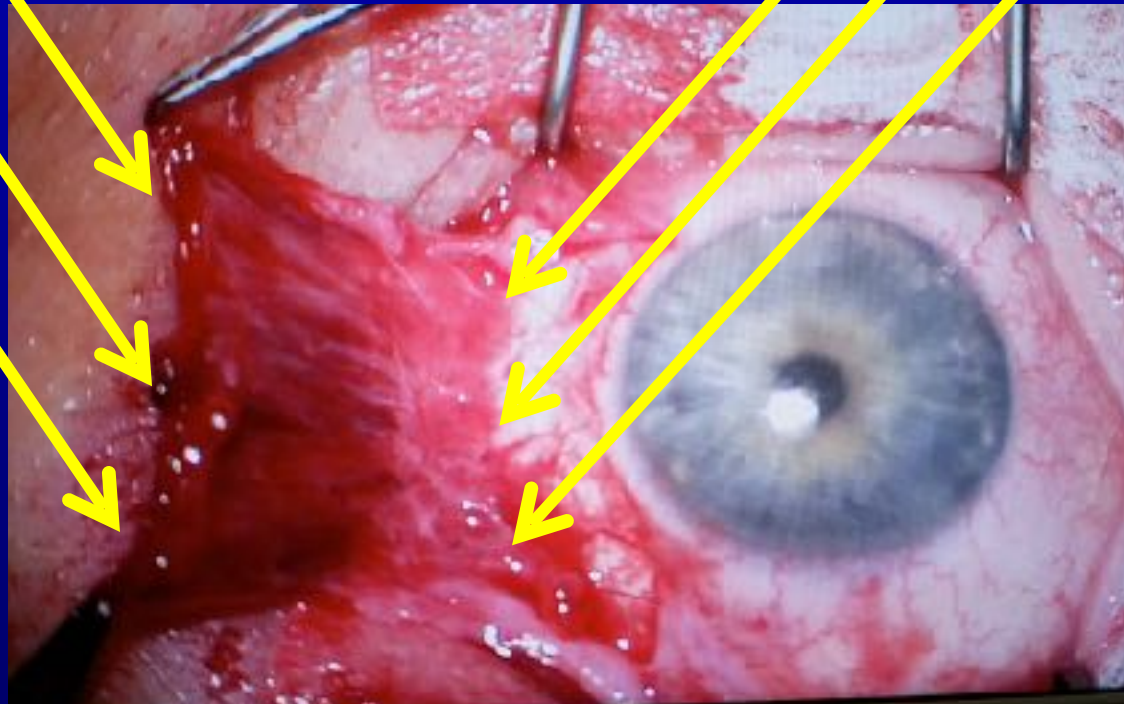


# Closed Globe Injury

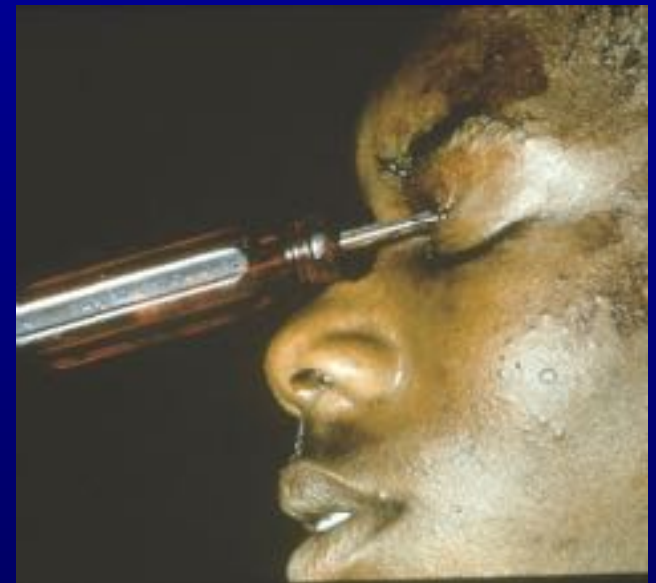
- Patient presents after a night out at a strip club

lacerated medial rectus

medial rectus insertion

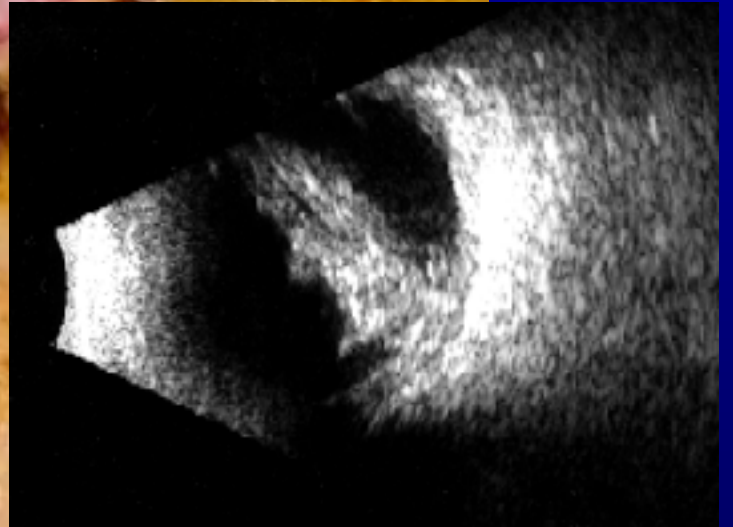


medial rectus lacerated by stripper heel











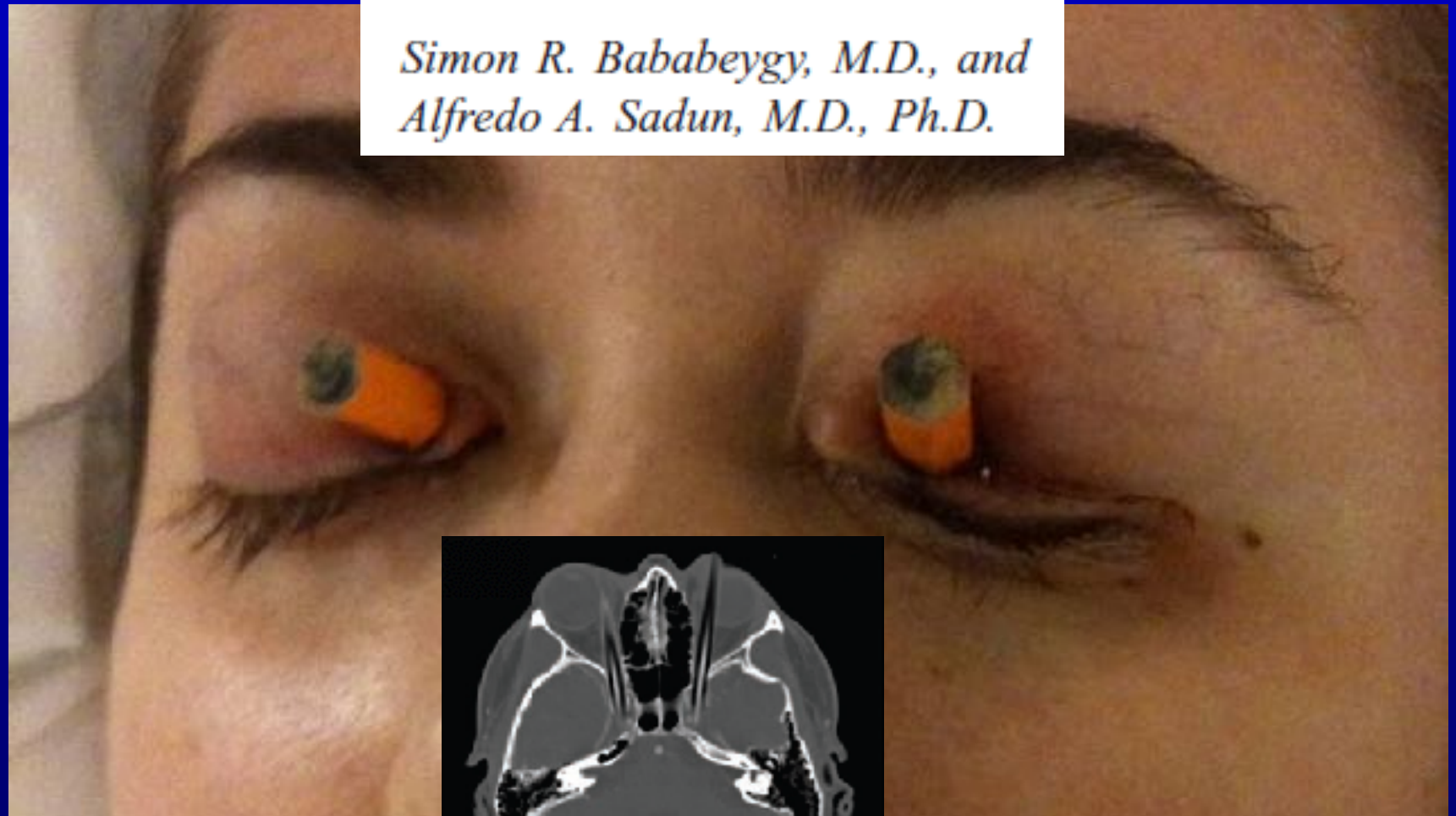
AP PHOTO





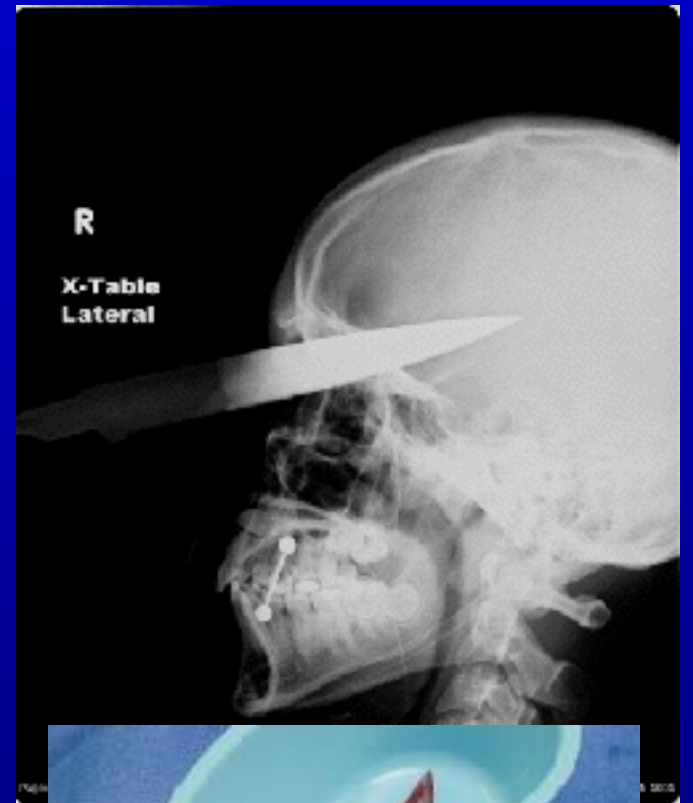
# Bilateral Oedipism

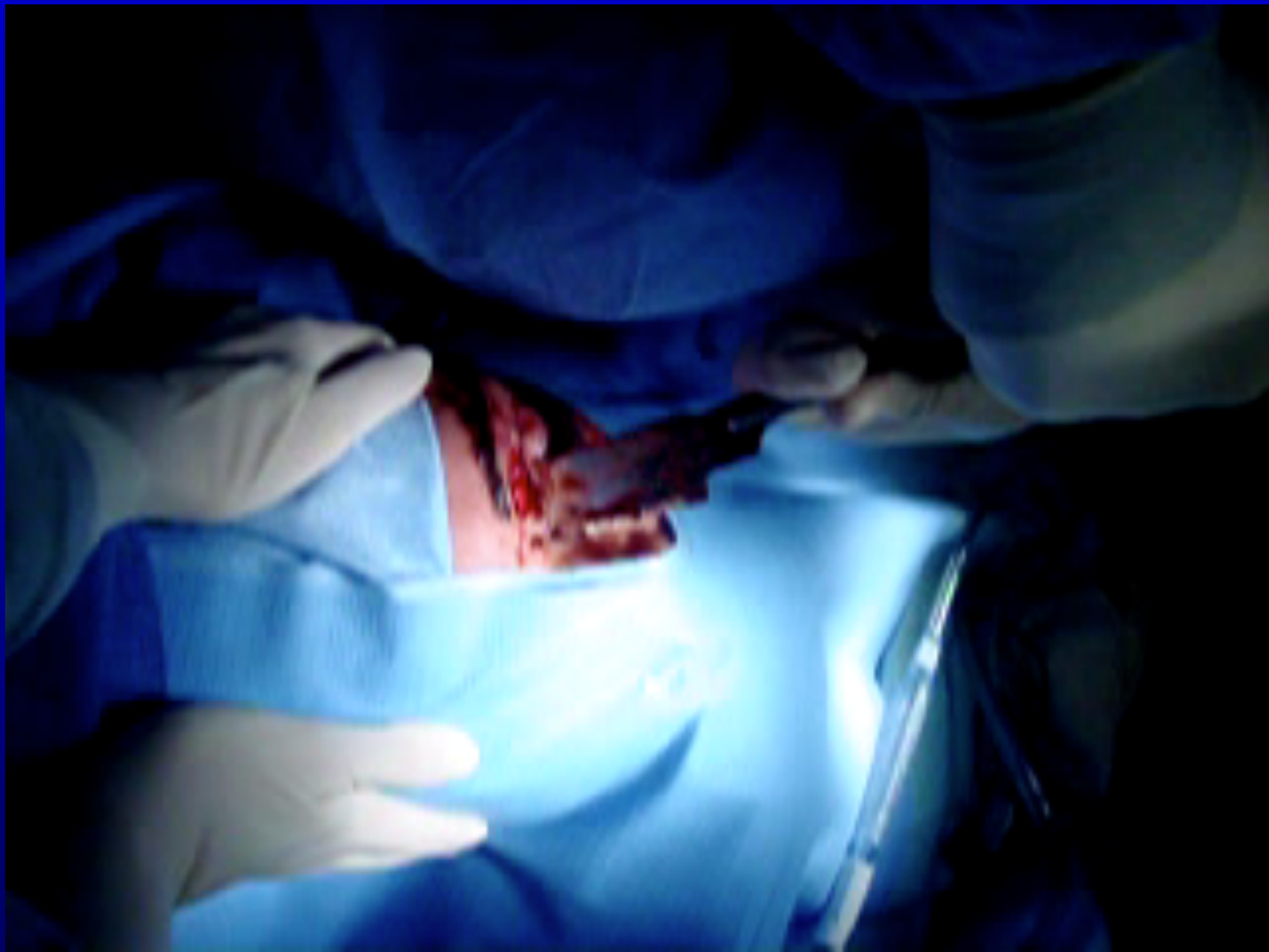
*Simon R. Bababeygy, M.D., and  
Alfredo A. Sadun, M.D., Ph.D.*













**OD**



**OS**



# Intraoperative Photos

OD



OS



# Thank You



IOFB s/p removal