

Intraoperative Zonular Dehiscence

Prof. Dr. Amit Raj

Introduction- Zonular dehiscence (ZD) represents a significant intraoperative challenge during cataract surgery and may compromise capsular bag stability. It can result in increased risk of posterior capsular rupture (PCR), vitreous prolapse, nucleus drop, and long-term intraocular lens (IOL) decentration. With the growing number of cataract surgeries performed in eyes, the incidence of zonular instability encountered intraoperatively is rising. It has been reported in approximately 0.5–2.0% of routine cataract surgeries, with higher prevalence (upto 8%) in pseudoexfoliation syndrome and post-vitrectomized eyes.

Risk Factors- Intraoperative ZD may occur due to pre-existing zonulopathy or may be iatrogenic following excessive hydrodissection, nucleus rotation, capsulorhexis extension, or aggressive cortical aspiration. Common predisposing factors include pseudoexfoliation syndrome, blunt ocular trauma, Marfan syndrome, prior pars plana vitrectomy, hypermature cataract, and high axial myopia. Both preoperative and intraoperative recognition is essential to prevent the progression of dialysis and maintain capsular integrity.

How to recognise a ZD- Early warning signs of zonular compromise include, localized capsular wrinkling, asymmetric deepening of the anterior chamber, difficulty in nucleus rotation and decentration, or anterior movement of the vitreous face. The extent of dialysis is often quantified in clock hours which determines subsequent surgical planning.

Management- It focuses on stabilizing the capsular bag, minimizing vitreous disturbance, and safely removing the nucleus. Immediate intraoperative measures include lowering bottle height, use of dispersive ophthalmic viscosurgical devices to tamponade, and avoidance of further hydrodissection or nucleus rotation. Further intraoperative support may be provided using capsular retractors or iris hooks placed to engage the capsulorhexis margin.

Definitive capsular support depends on the extent of dialysis. In cases involving less than 3 clock hours, insertion of a capsular tension ring (CTR) may provide adequate equatorial support and allow in-the-bag IOL implantation. Moderate dialysis (3–5 clock hours) may necessitate the combined use of capsular hooks with CTR implantation. More extensive zonular loss (>5 clock hours) often requires scleral fixation of a modified CTR such as a

Cionni ring or placement of a capsular tension segment (CTS) to provide focal support and prevent late in-the-bag IOL dislocation.

In situations with gross capsular instability or with PCR, alternative IOL fixation techniques, including sulcus placement, scleral-fixated IOL, or iris-claw IOL, may be required. Anterior vitrectomy with triamcinolone injection should be performed in the presence of vitreous prolapse.

Conclusion- A systematic intraoperative approach with early recognition, appropriate use of capsular support devices, and timely decision regarding IOL implantation can significantly improve surgical outcomes in eyes with zonular dialysis. This presentation aims to provide a practical algorithm for intraoperative management of ZD to ensure safe completion of cataract surgery and long-term visual rehabilitation for the patient.

References:

1. Zhang Y, Zhang H, Song X, Liu M, Wang N, Qiao C. Proportion and risk factors of zonulopathy in patients with age-related cataract. *Heliyon*. 2024 Mar 27;10(7):e28644. doi: 10.1016/j.heliyon.2024.e28644. PMID: 38586387; PMCID: PMC10998138.
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3. Zonular dialysis and cataract surgery: results from a UK tertiary eye care referral centre, Aiello, Francesco et al. *Canadian Journal of Ophthalmology*, Volume 59, Issue 2, 67 - 72
4. Khadia A, Upadhyaya S, Venkatesh R, Moutappa F, Gupta A, Thakur P, et al. Three-flanged capsular hook for zonular dialysis repair. *Indian J Ophthalmol* 0;0:0.
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6. Trikha, S., Agrawal, S., Saffari, SE. et al. Visual outcomes in patients with zonular dialysis following cataract surgery. *Eye* **30**, 1331–1335 (2016). <https://doi.org/10.1038/eye.2016.108>
7. Menapace R, Findl O, Georgopoulos M, Rainer G, Vass C, Schmetterer K. The capsular tension ring: designs, applications, and techniques. *J Cataract Refract Surg*. 2000 Jun;26(6):898-912. doi: 10.1016/s0886-3350(00)00446-6. PMID: 10889438.
8. Jacob S, Agarwal A, Agarwal A, Agarwal S, Patel N, Lal V. Efficacy of a capsular tension ring for phacoemulsification in eyes with zonular dialysis. *J Cataract Refract Surg*. 2003 Feb;29(2):315-21. doi: 10.1016/s0886-3350(02)01534-1. PMID: 12648643.

CCC RUN OFF

Presenter - **Dr. Sonali Prasad**

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No Financial interest

Dr S Prasad

320

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CDE
11.70

IOP

50

Asp

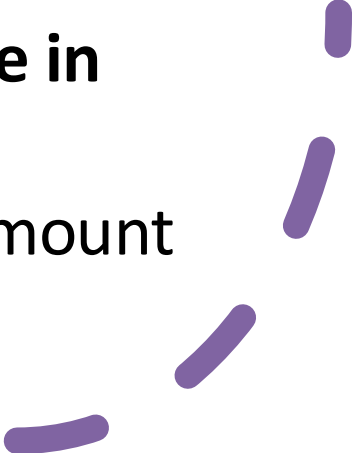
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Vac

600

CENTURION
VISION SYSTEM

Introduction

- A critical step in phacoemulsification is **making a window in anterior capsule wall** (i.e. anterior capsulotomy)
 - Continuous Curvilinear Capsulorhexis (CCC), **first popularized by Gimbel, Neuhann** and others has become recognized as the standard method of anterior capsulectomy
 - **Capsulorhexis- key stage in cataract surgery**
 - Precise rhexis is of paramount importance
- 

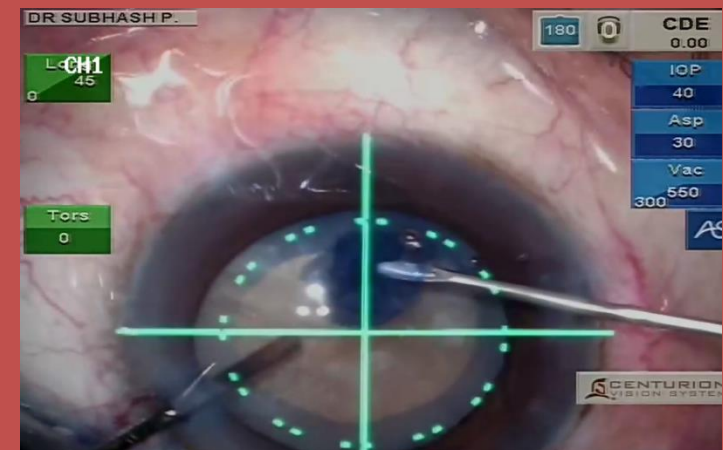
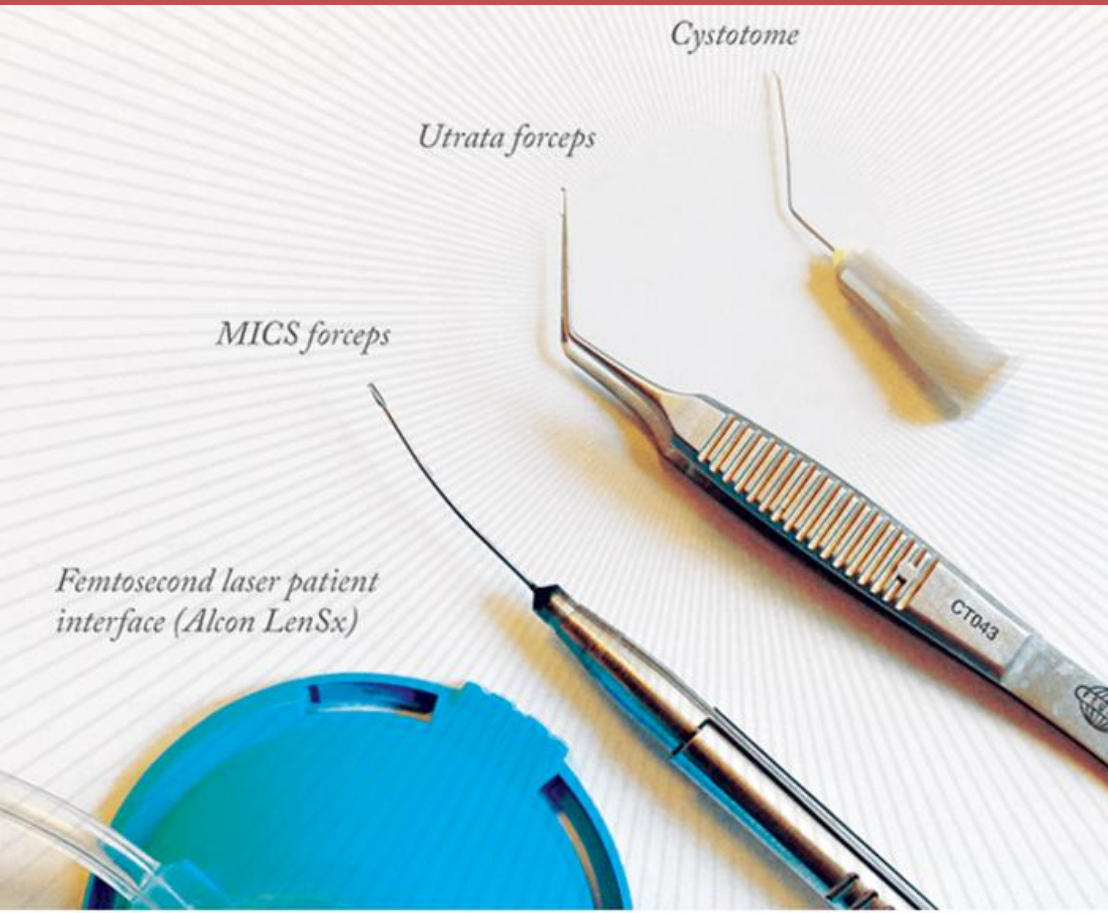
Key for good rhexis

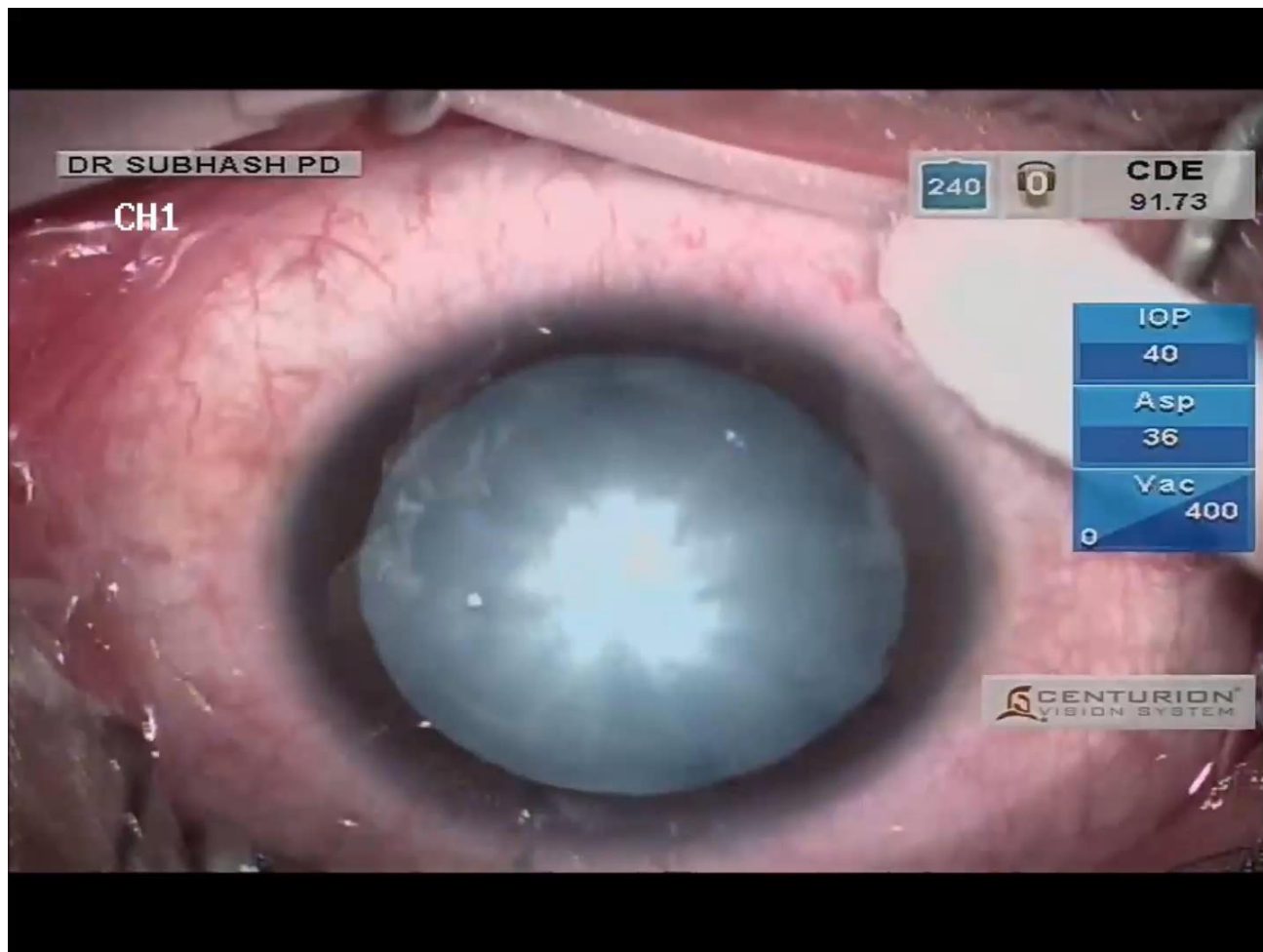
- Adequate visualisation
- Adequate dilatation
- Adequate OVD
- Balance the pressure
- **Don't try in shallow ac with convex lens iris diaphragm**

Good CCC

- Complete circle without tear
- Centration
- Size 5-5.5 mm

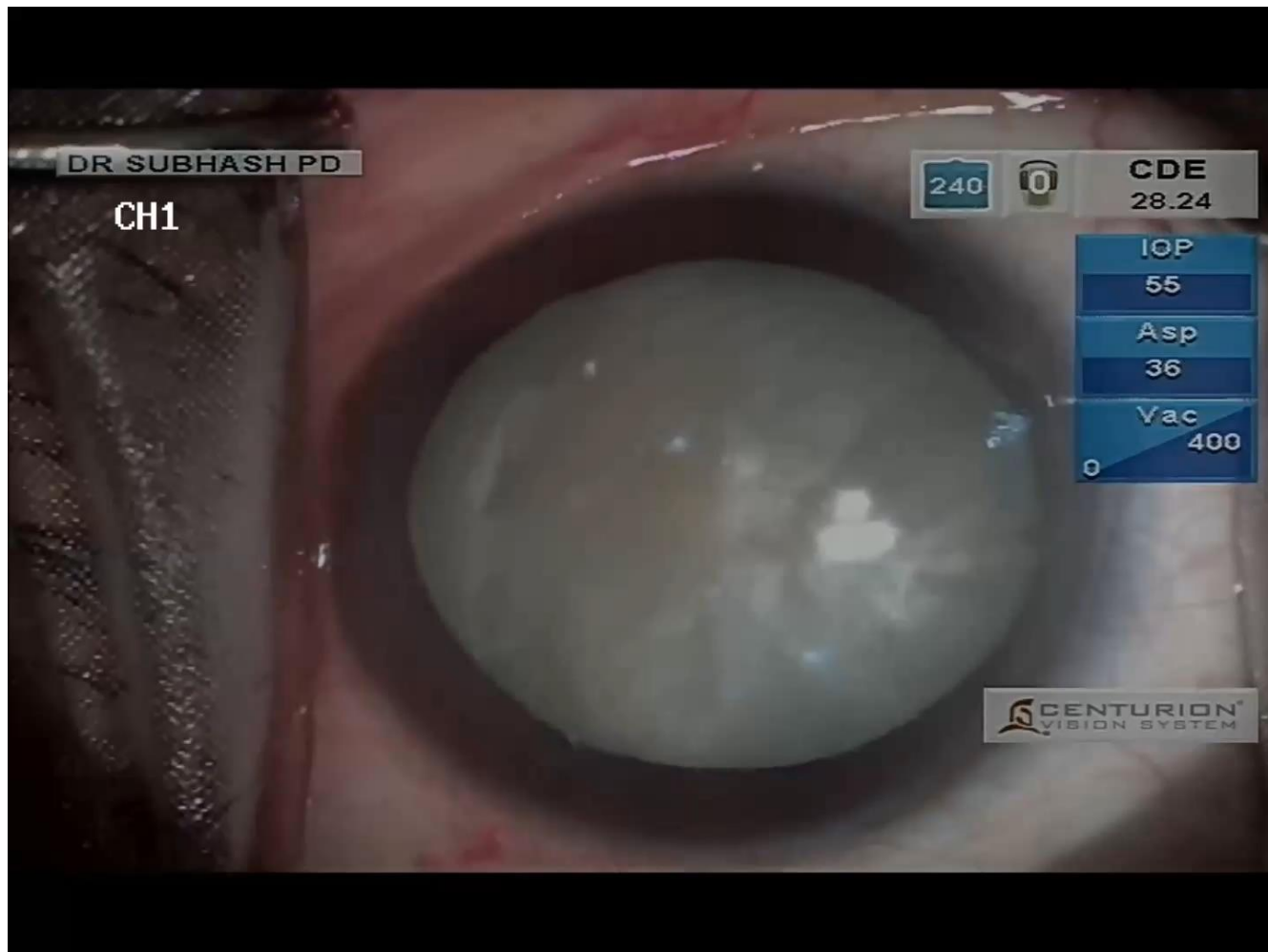
Ways to do CCC

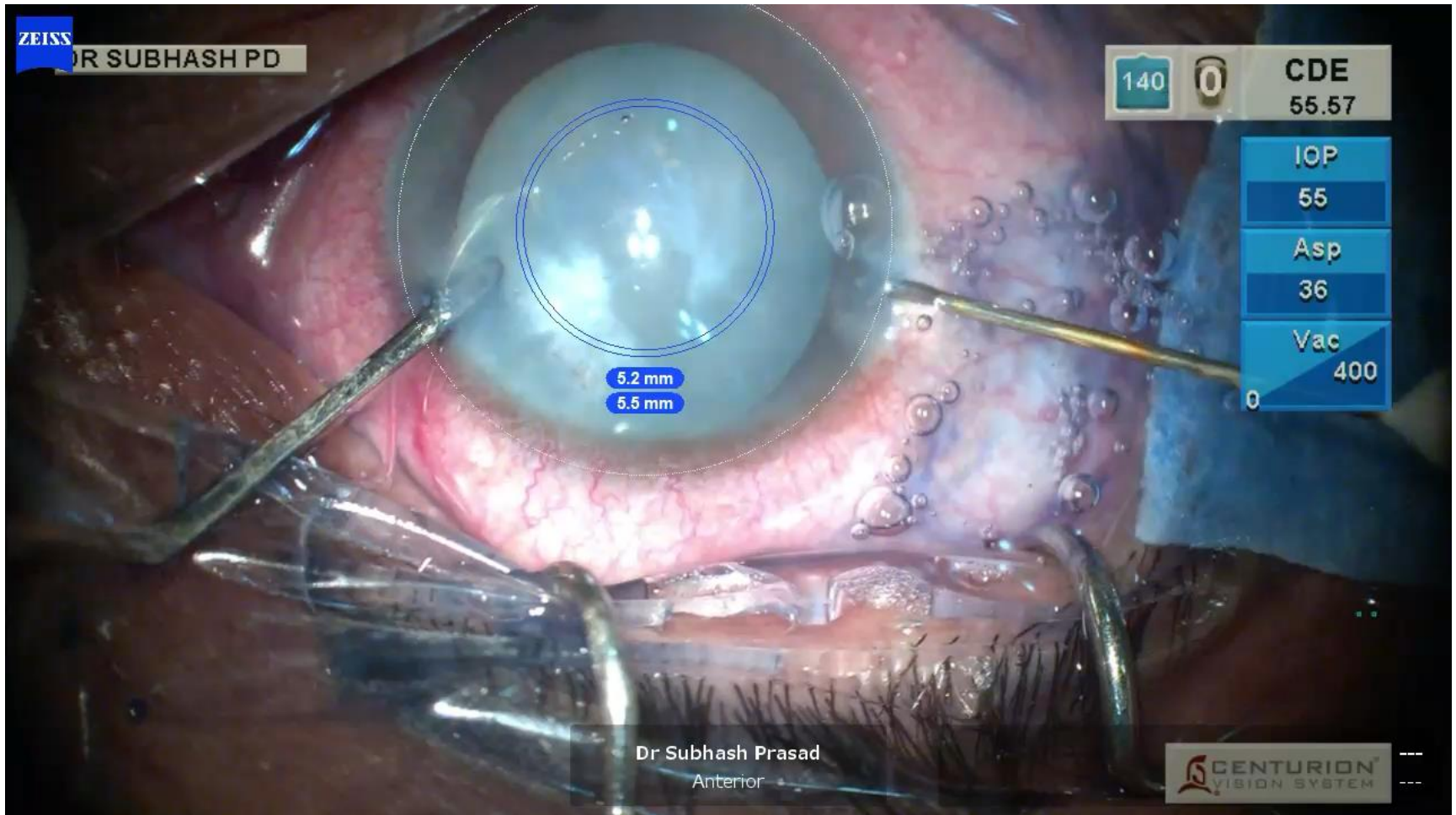




Where to stop ??

Does force matter??





Double Rhexis = Double Safety

Femto

- Femtosecond laser capsulotomy (FSLC)- **high cost**
- Femtosecond laser's **large size and the need for eye docking** create surgical efficiency and **workflow challenges**
- Microadhesions or **incomplete capsulotomy flap, anterior capsular tear**

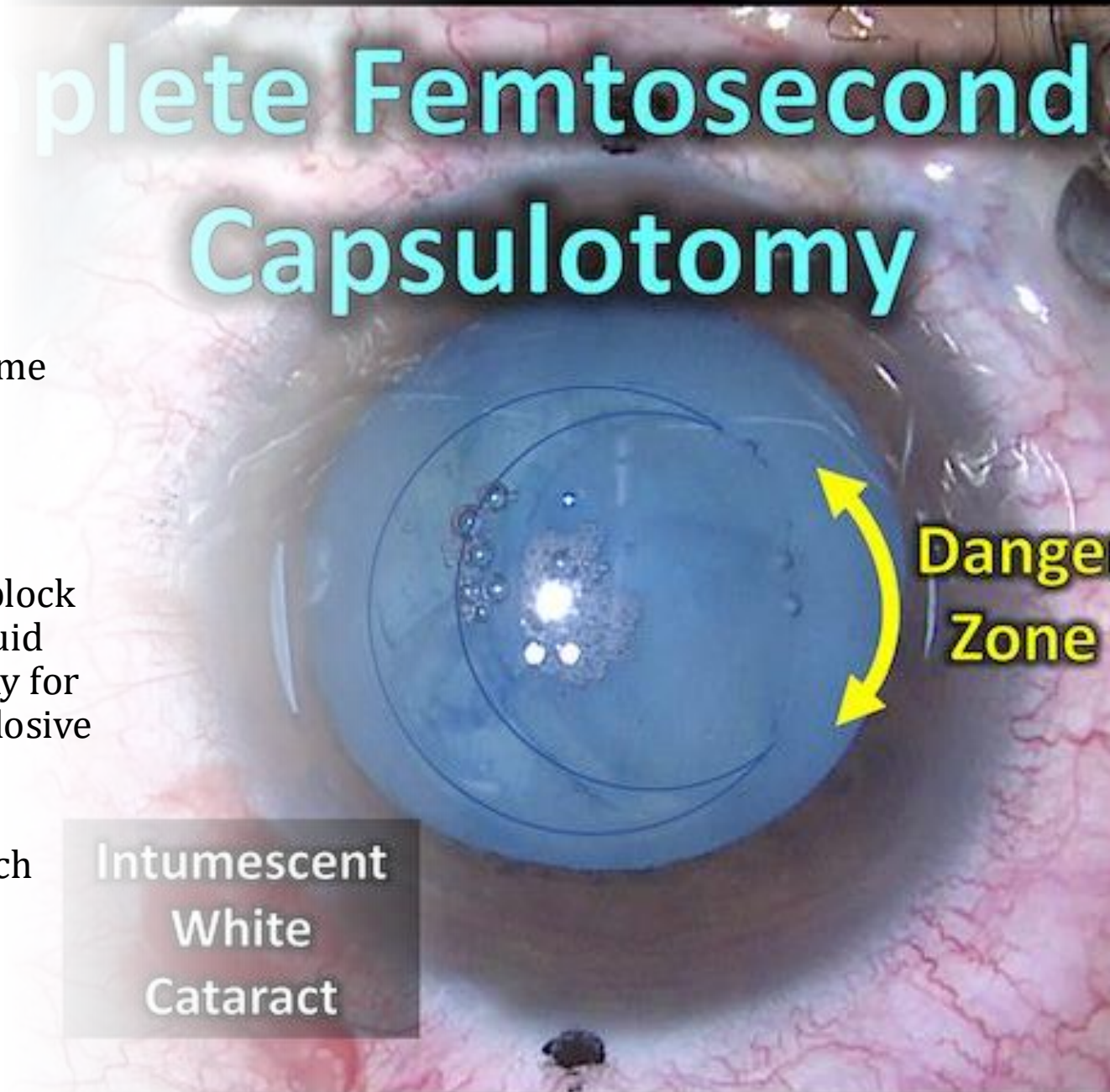
Limitations

- capsular block syndrome (CBS)
- sudden, uninvited movement of the lens nucleus during hydrodissection may block the hydrodissection fluid leaving no exit pathway for the flow, hence an explosive tear in the posterior capsule.
- intracapsular gas which might augments this phenomenon.
- economic concerns

Complete Femtosecond Capsulotomy

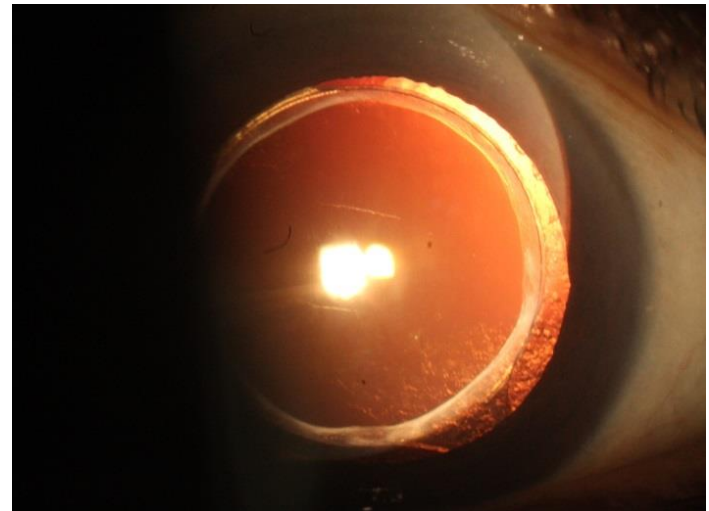
Intumescent
White
Cataract

Danger
Zone



Zepto

- **Zepto** precision pulse capsulotomy (**PPC**) -**precise diameter** all around simultaneously
- Same surgical setup in the **normal surgical sequence**
- **No learning curve**
- CCC edge more smooth
- **PPC edge is stronger, better tensile strength**
- **Cheaper than femto**



Comparison

- Consistent circular shape
- Consistent size with 360 overlap
- Rolled strong edge
- Visual axis centration
- Surgical flow
- Cost Effective

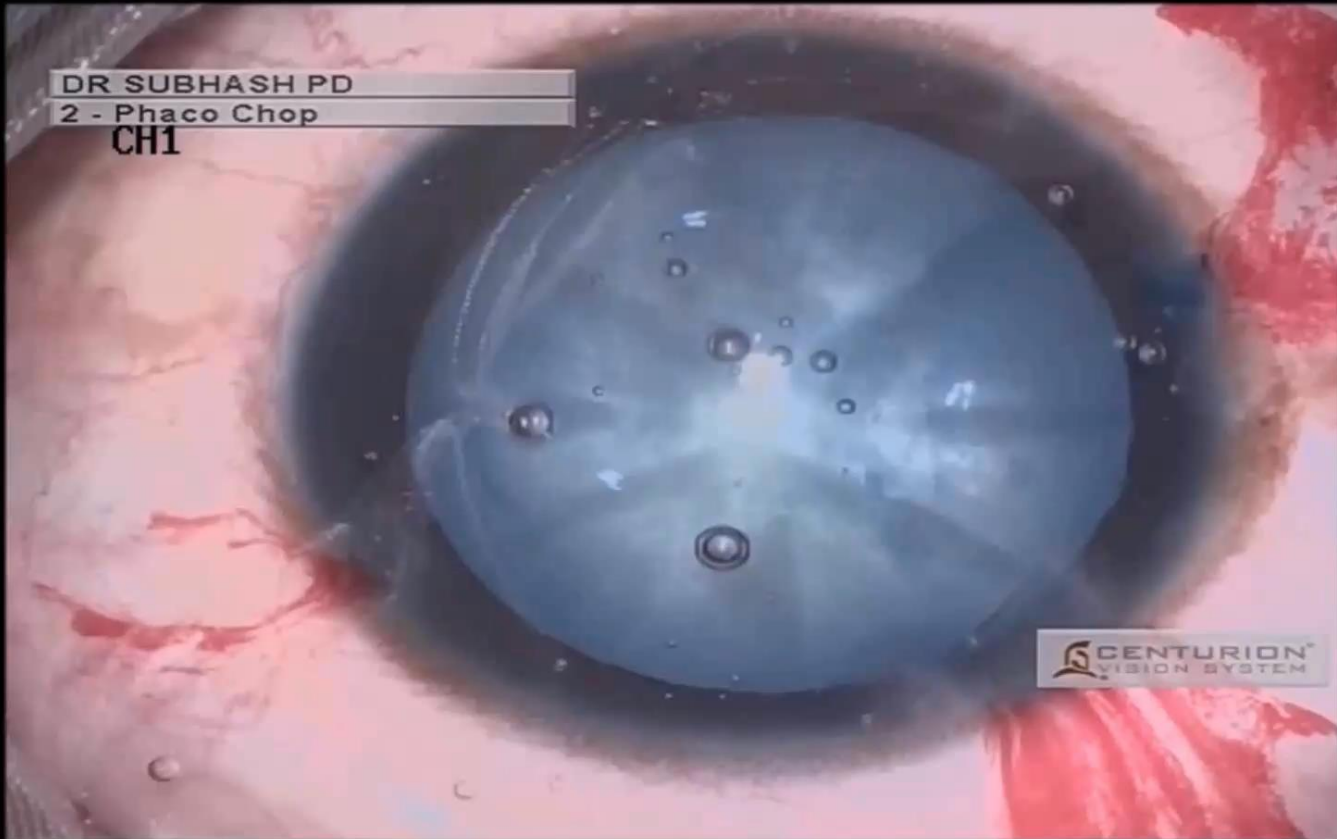
Manual	Flacs	Zepto
X	Y	Y
X	Y	Y
X	X	Y
X	X	Y
Y	X	Y
Y	X	Y

DR SUBHASH PD

2 - Phaco Chop

CH1

CENTURION[®]
VISION SYSTEM



ZEPTO NOT SO PERFECT



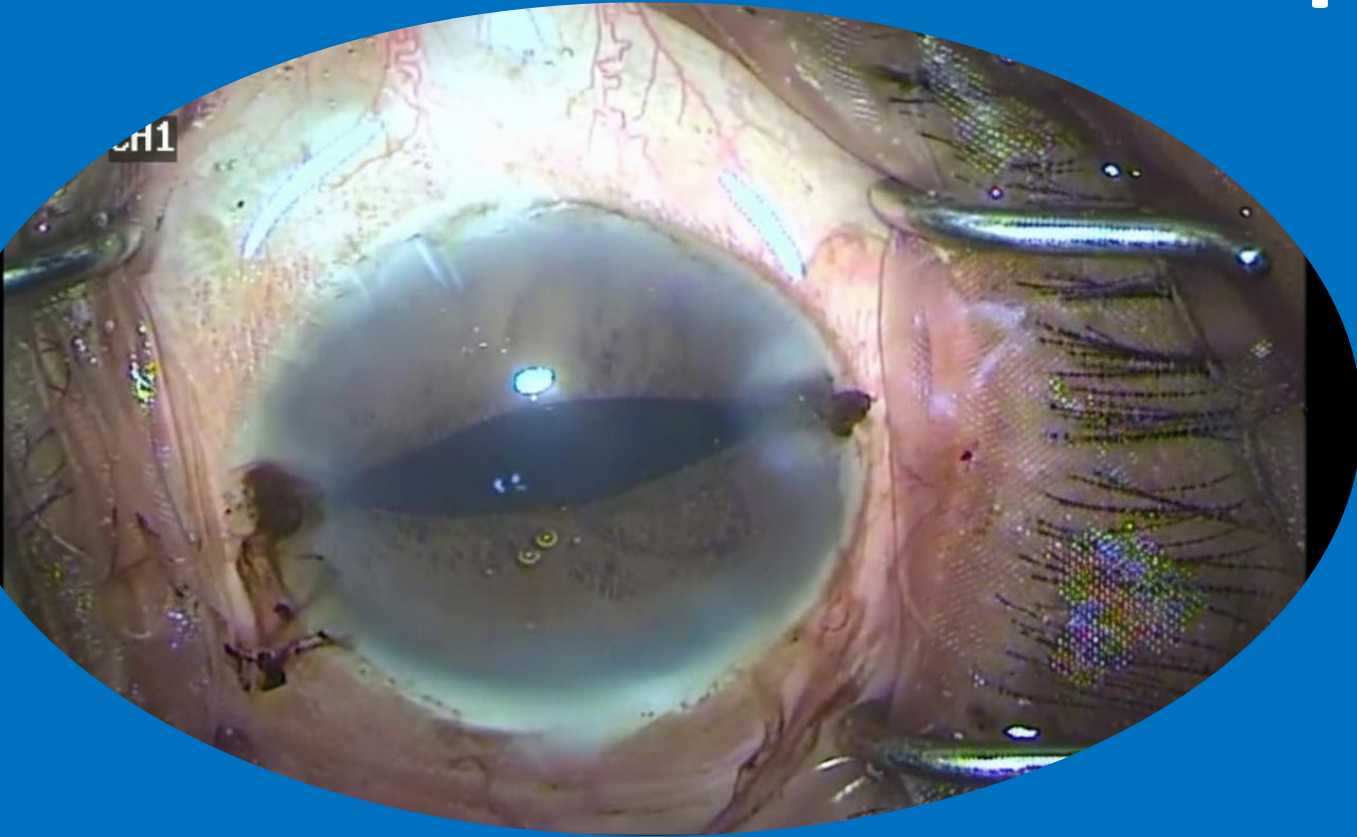
Take-Home Messages

- **Stay Calm:** "Sailing through the storm" requires steady hands.
- **OVD is Your Best Friend:** Maintain AC depth at all costs.
- **Vision First:** Better to have a slightly irregular rhexis than a dropped nucleus.
- **Interactive Insights:** Always review surgical videos to identify the "hinge point" of the tear.



GOAL OF THIS SESSION—STOP, PIVOT, AND RESCUE

Intraoperative hard eye

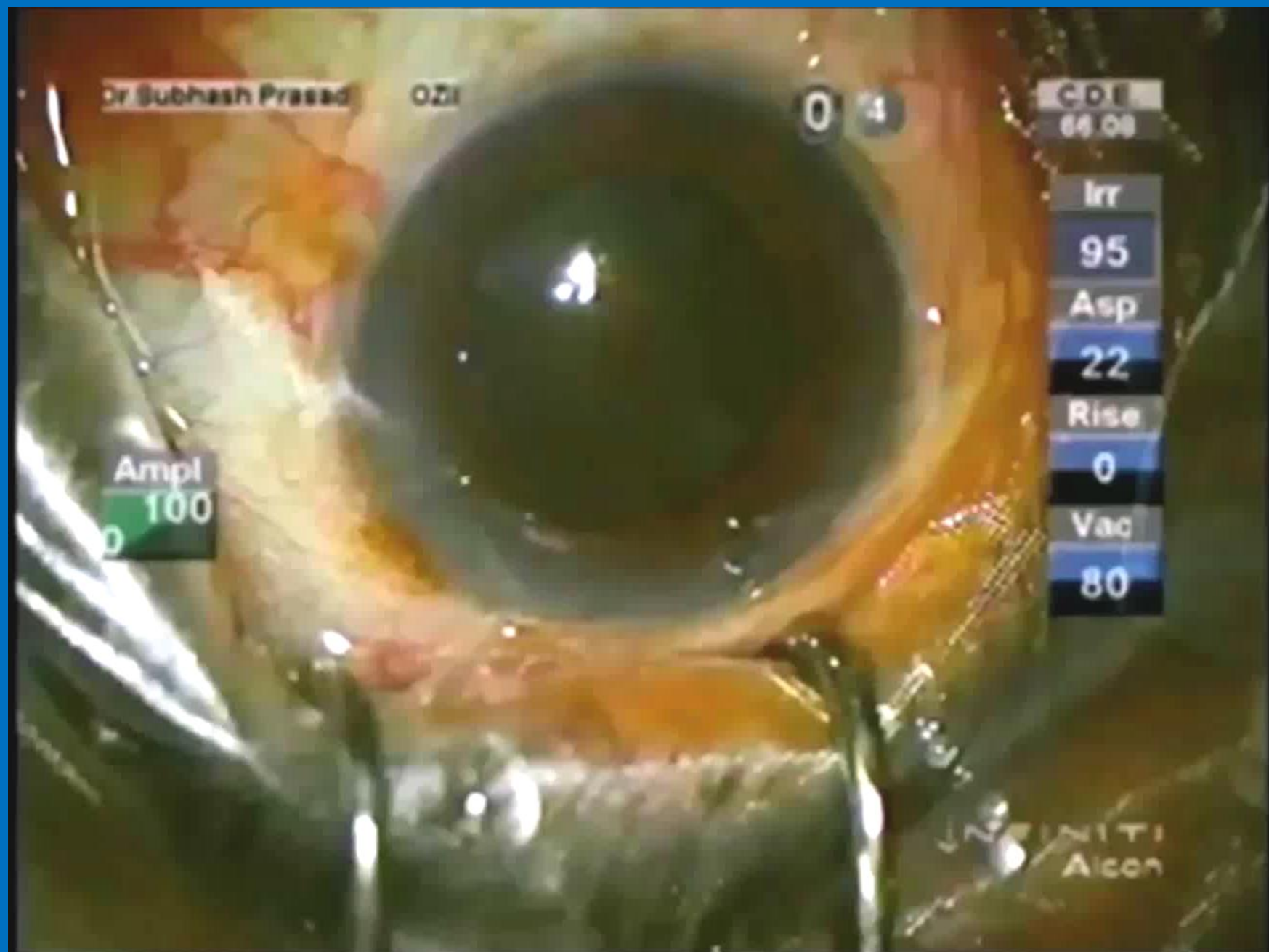


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No financial interest



Acute intraoperative rock-hard eye syndrome(AIRES)*

Hard eye during cortical aspiration

- Shallow AC
- High IOP with firm globe
- Iris prolapse

*Lau OC, Montfort JM, Sim BW, et al
J Cataract Refract Surg. 2014;40:799-804

Fluid deviation/misdirection syndrome

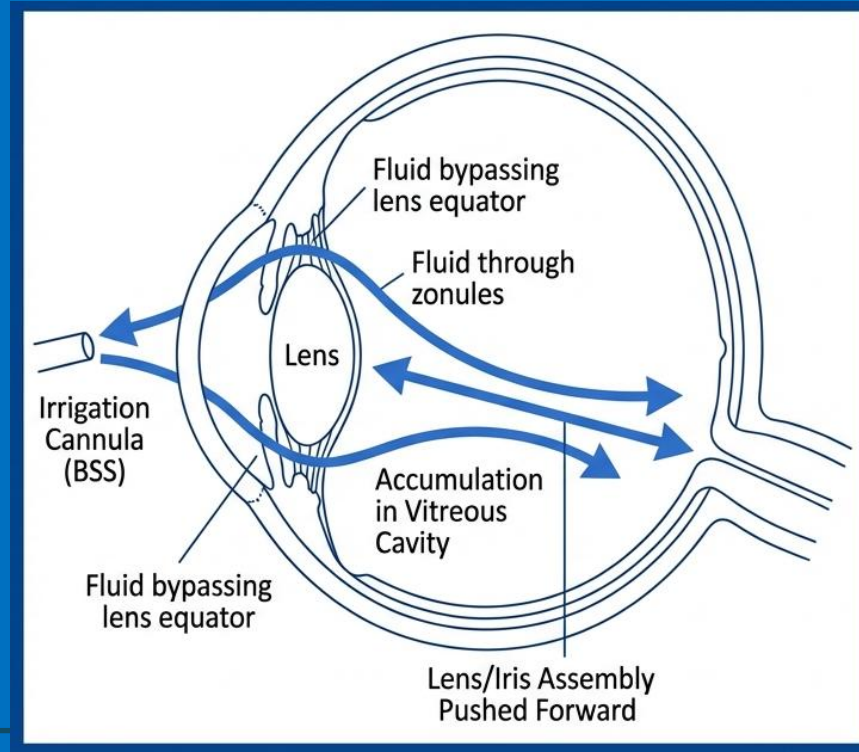
Mechanism

Diversion of aqueous or balanced salt solution behind the zonulocapsular diaphragm into the vitreous –

High pressure within the posterior segment.

Pupillary block and angle closure as the lens and iris shift forward

Assisted by an intact vitreous face, the **zonulocapsular diaphragm acts like a one-way valve**; balanced salt solution gets into the posterior segment and is blocked from reentry into the anterior chamber by the vitreous valve.



Fluid misdirection

Hydrodissection

BSS injected forcefully
through the zonule in
vitreous

BSS trapped behind
the nucleus if excessive
hydrodissection,
particularly the
smaller-than-desired 4-
mm of CCC

PCR with entrapment
in the vitreous

Nucleotomy

Force the fluid
posteriorly if a
cohesive OVD prevents
anterior fluid
circulation

Cortical
aspiration

Risk Factors

High myopia

Glaucoma

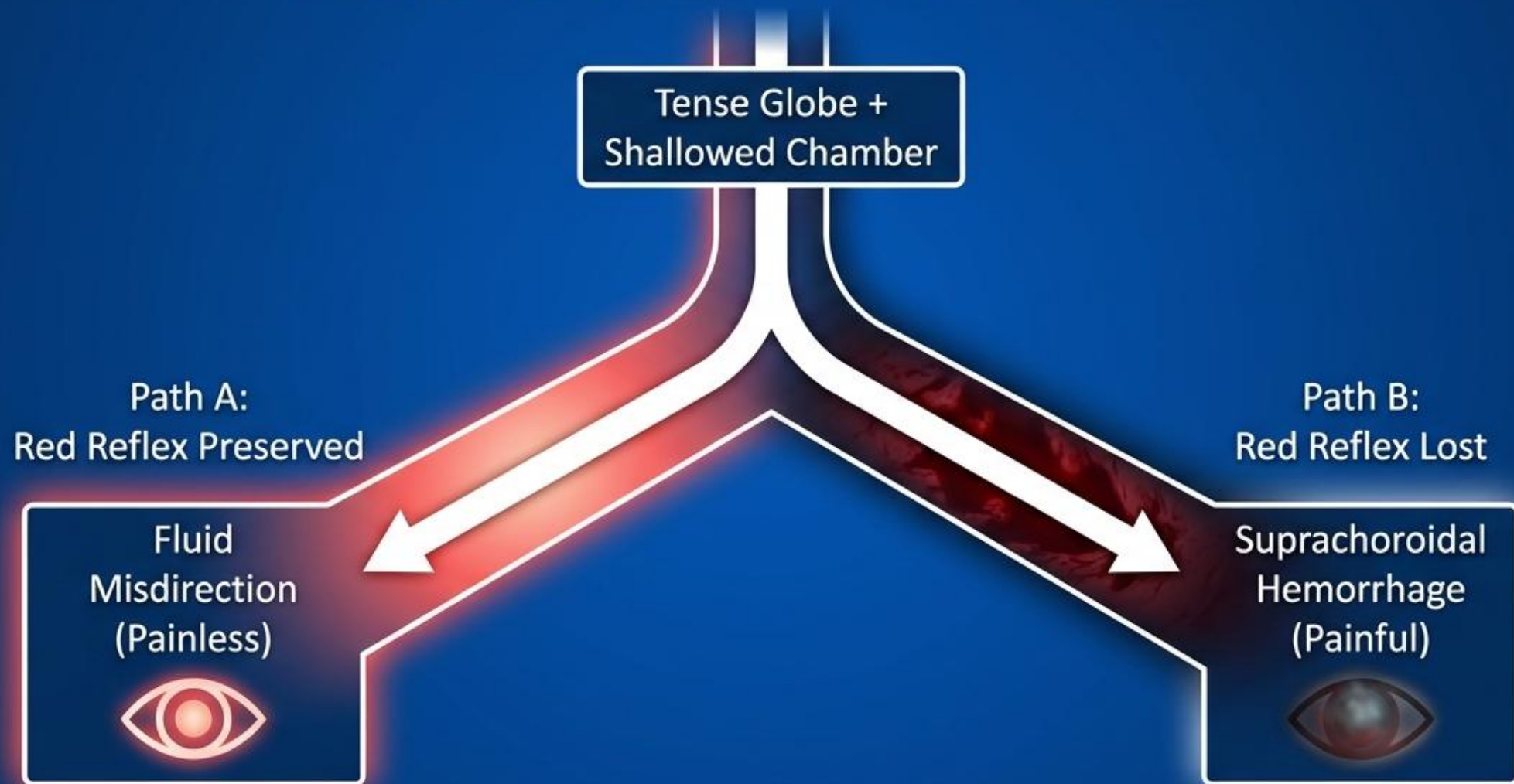
Short axial
length

Hypertension

Elderly
patients

The Diagnostic Fork

Differentiation via Red Reflex & Pain



Management

Proceeding onward with the surgery can lead to

- Risk to PC
- Injuring the iris
- Endothelial injury

Avoid injecting further fluid

Lower the bottle ht

Pin point the possible etiologies quickly and manage

Options:

- **Abort the procedure-**
significant inflammation
- **Reduce the positive vitreous pressure** in some way.

- **Suprachoroidal Hge(SCH)**
 - Some predisposing factors
 - Occurs little slowly
 - Severe pain
- I/O ophthalmoscopy
- B-scan ultrasound- In the absence of a red reflex
- IV Mannitol- if SCH is suspected, but the pressure-lowering effect may take 30 minutes or longer.

Once suprachoroidal causes are excluded

- Equalizing the posterior and anterior pressure
- **Aspirate collected fluid/ Pars Plana automated ant. vitrectomy**

PP Vit. Tap

23/ 25/27-gauge cutter transconjunctivally,

3.5 to 4.0 mm posterior to the limbus

Angled down toward the optic nerve.

Ensure that the trocar/cutter does not contact the posterior capsule.

If cataract **dense-Mark Vitrectomy tip approximately 10.0 mm from the end of the shaft.**

Insert the cutter tip until the mark is at the pars plana incision

PP Vit. Tap contd...

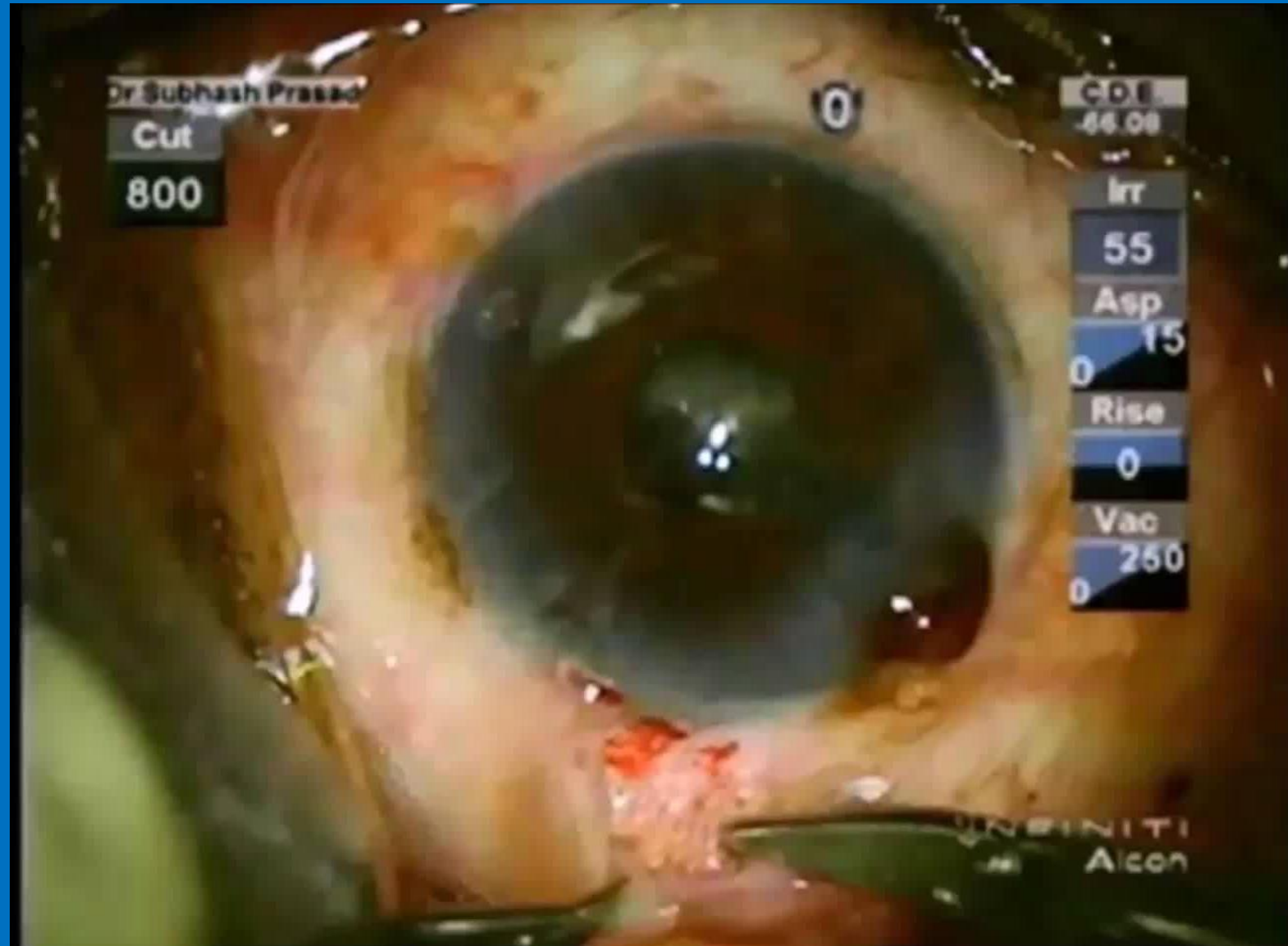
High vitrectomy cutting rate
with a low vacuum setting
without infusion

Aspirate small amount of vitreous (approximately 0.2 cc)

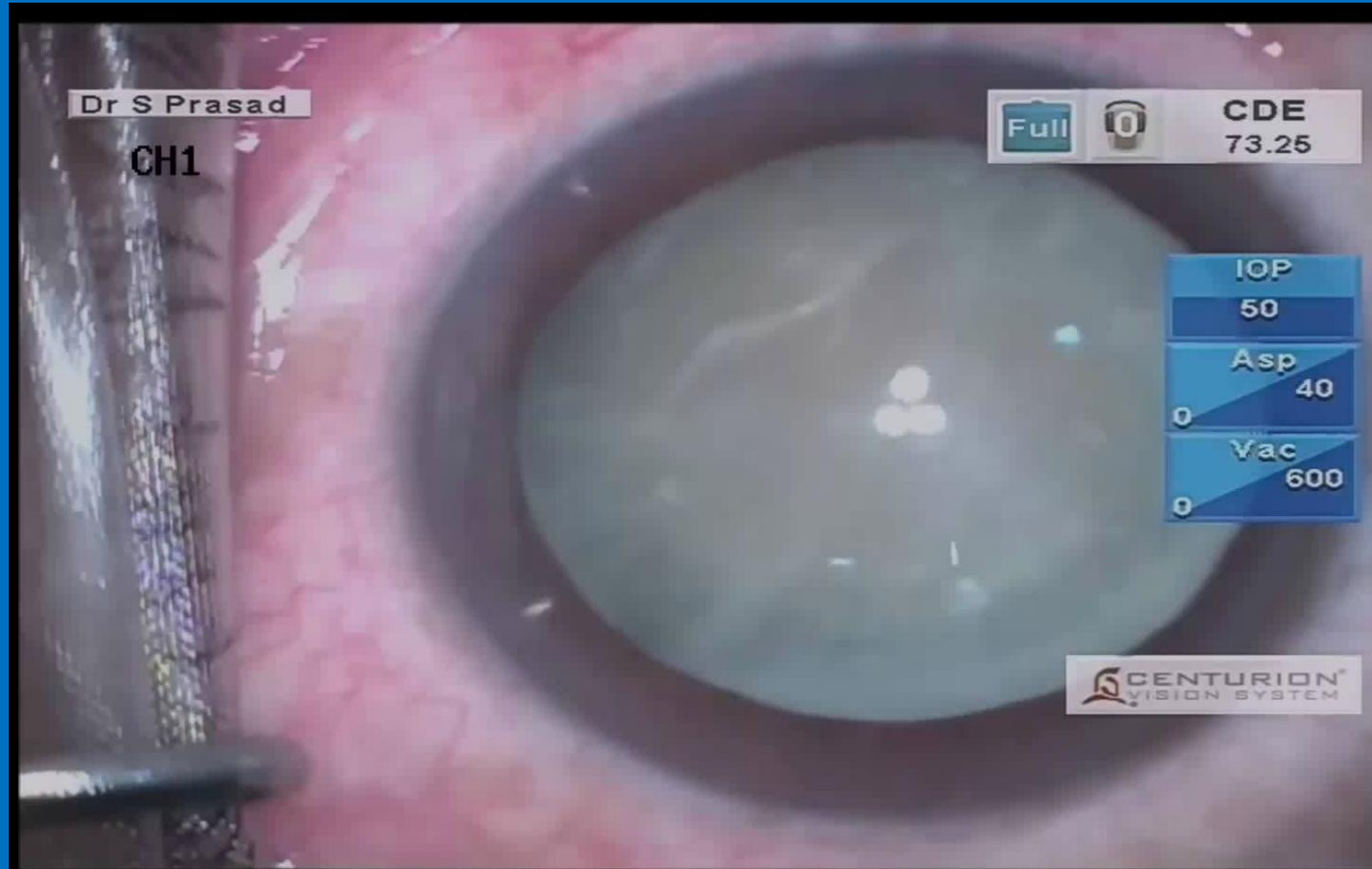
Gentle digital palpation of the globe to verify adequate softening of the globe

Viscoelastic through the paracentesis to deepen the AC

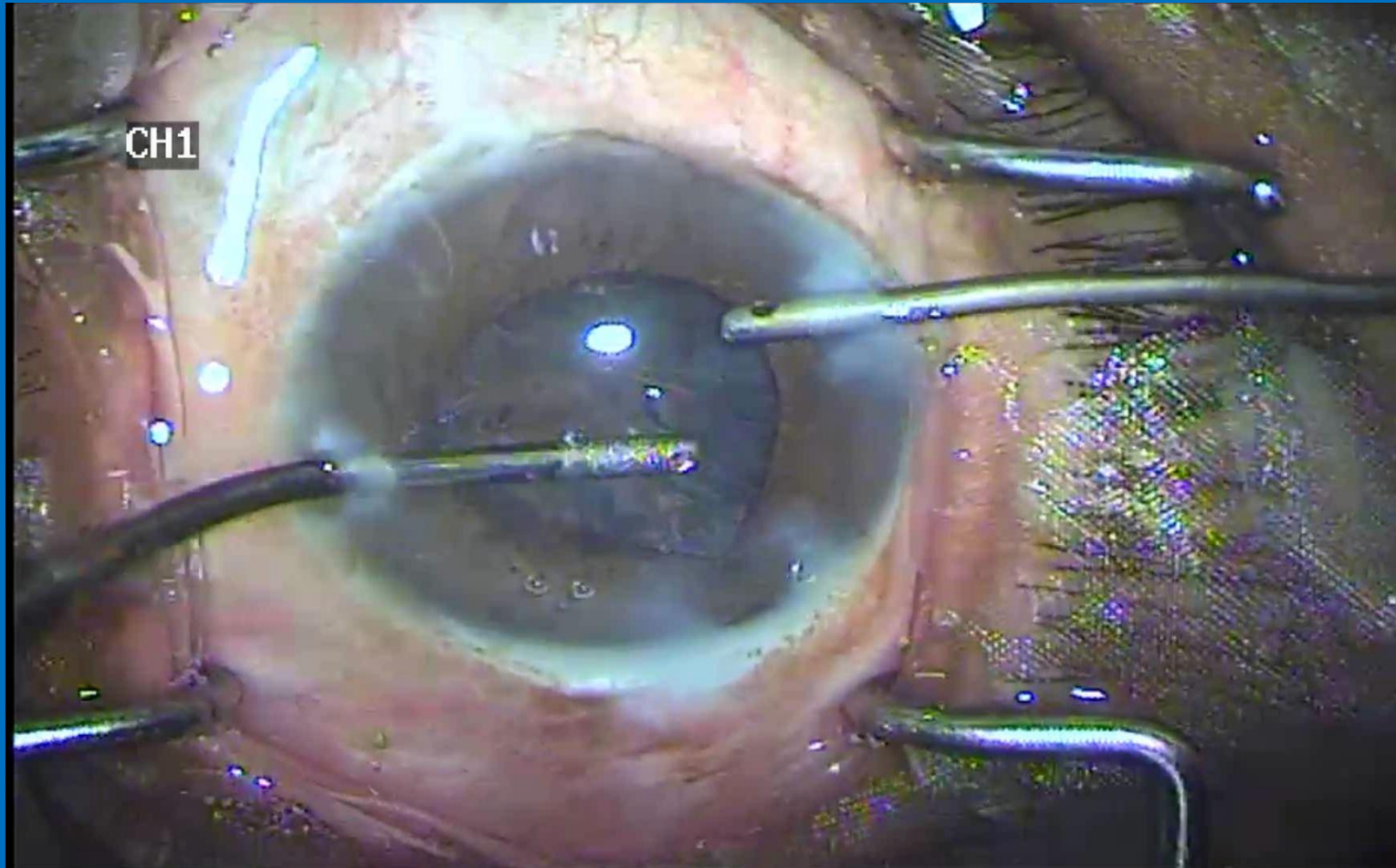
PP Vitreous Tap



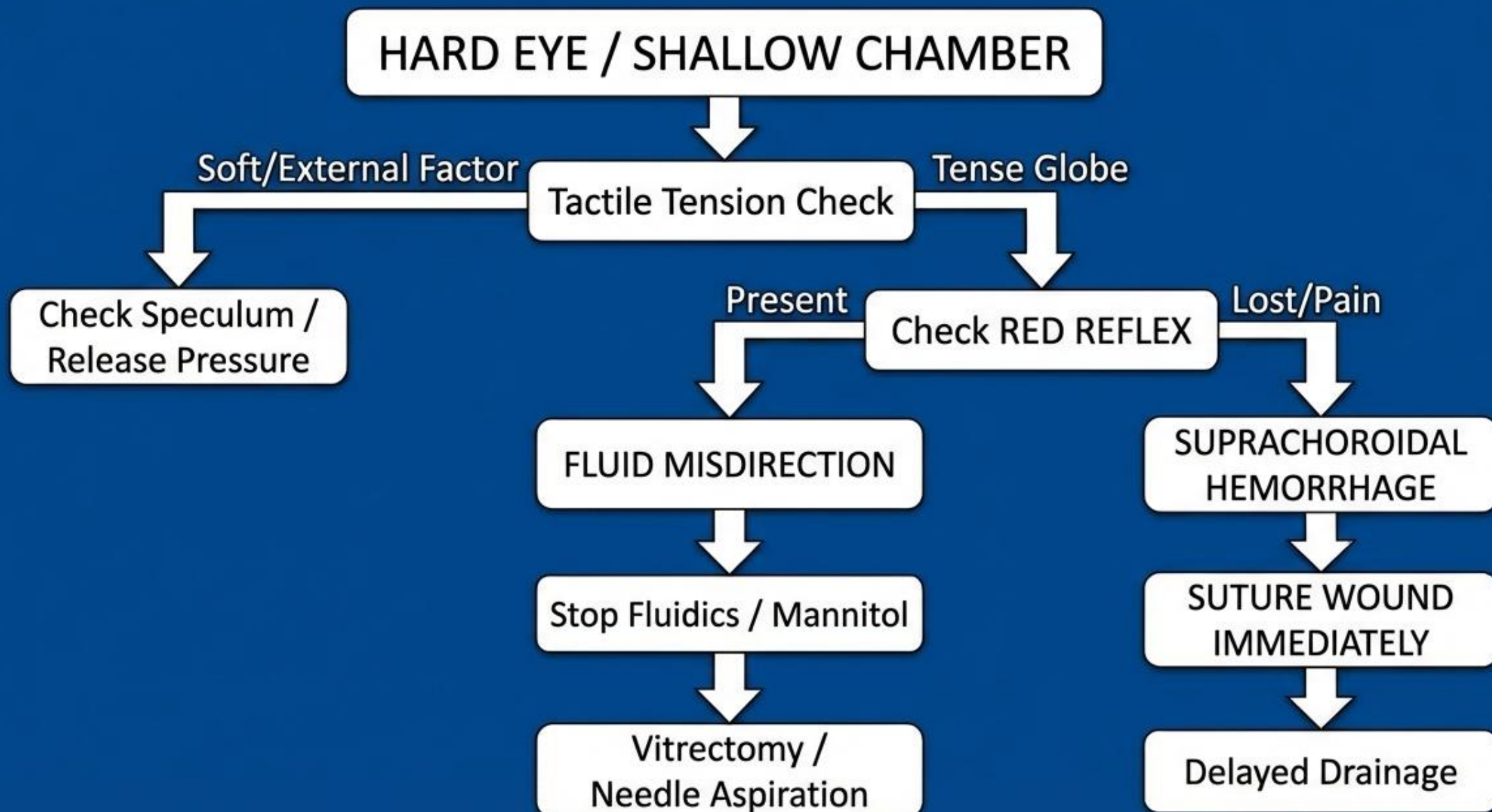
Shallow AC during I/A



Hard Eye during I/A



The Surgical Crisis Algorithm



Summary

- Hard eye-challenging situation
- Timely intervention can prevent complication
- Suprachoroidal hemorrhage
- PP vitreous tap-if no SCH

THANK YOU

POSTERIOR CAPSULAR RENT (PCR)

- **Dr. Vidhata Vidhu**
- **MBBS(GOLD MEDALIST), MS Ophthal (Kolkata), FVRS(SNC, Chitrakoot,MP), MRCS (Edinburgh)**
 - **VR Observer Moorfield Eye Hospital, London UK**
 - **Clinical Attachment, East Sufflok Hospital, Ipswich, UK**
 - **Ex Senior Consultant, SNC Chitakoot**
 - **Consultant, Retina & Uvea Services, Divyadrsti Eye Centre,Patna**

INTRODUCTION

- Posterior capsular rent (PCR) is a breach in the posterior capsule during cataract surgery.
 - It may lead to vitreous prolapse and dropped nucleus.
 - Significant cause of surgical morbidity.

INCIDENCE

- Reported incidence: 0.5–3% (varies with surgeon experience).
 - Higher in complicated cataracts.
 - Decreasing trend with phacoemulsification advancements.

RISK FACTORS

- Hard/Brunescent cataract
 - Pseudoexfoliation
 - High myopia
 - Small pupil
 - Posterior polar cataract
 - Inexperienced surgeon

INTRAOPERATIVE SIGNS OF PCR

- Sudden deepening of anterior chamber
 - Loss of red reflex
 - Sudden difficulty in nucleus rotation
 - Excessive mobility of nucleus fragment
 - Vitreous in anterior chamber

IMMEDIATE MANAGEMENT

- Stop phaco immediately
 - Maintain chamber with OVD
 - Avoid sudden withdrawal of instruments
 - Perform anterior vitrectomy if vitreous prolapse present

ANTERIOR VITRECTOMY PRINCIPLES

- Use high cut rate, low vacuum
 - Remove vitreous from wound and anterior chamber
 - Triamcinolone-assisted vitrectomy if needed
 - Avoid traction on vitreous base

IOL IMPLANTATION OPTIONS

- In-the-bag IOL (if small rent & adequate support)
 - Sulcus placement with optic capture
 - Three-piece IOL in sulcus
 - Anterior chamber IOL (if no posterior support)
 - Scleral-fixated or iris-fixated IOL

COMPLICATIONS OF PCR

- **Dropped Nucleus**
 - Cystoid macular edema
 - Retinal detachment
 - Endophthalmitis
 - IOL decentration

POSTOPERATIVE CARE

- Close follow-up
 - Topical steroids and NSAIDs
 - IOP monitoring
 - Retinal evaluation if nucleus drop suspected

PREVENTION

- Proper case selection
 - Adequate capsulorhexis
 - Controlled hydrodissection
 - Gentle phaco techniques
 - Adequate training and supervision

CONCLUSION

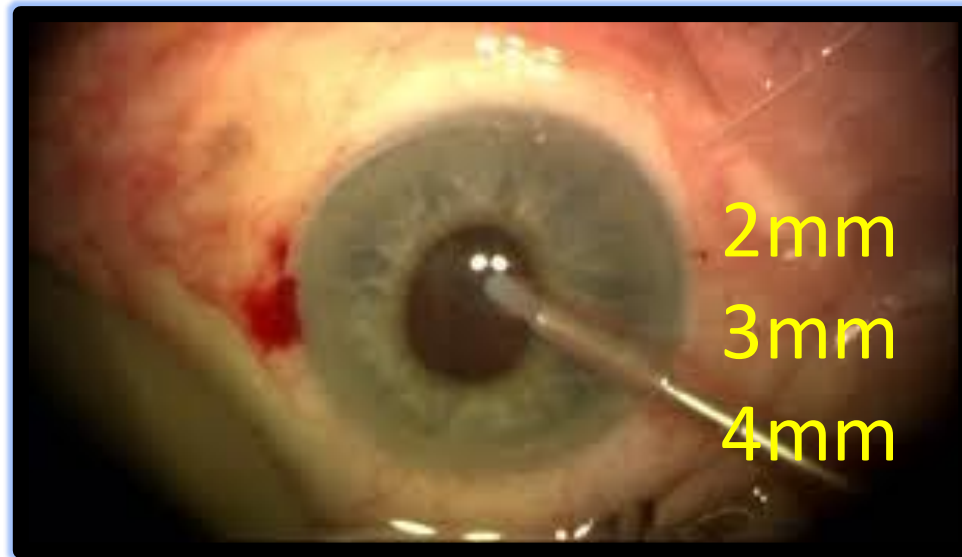
- PCR is manageable with prompt recognition and proper technique.
 - Systematic approach minimizes complications.
 - Good surgical judgment ensures optimal visual outcomes.

PHACOEMULSIFICATION IN SMALL PUPIL (INTRAOPERATIVE MIOSIS)

**DR BIBHUTI P SINHA
PROFESSOR & HEAD
R.I.O, IGIMS
PATNA**

NO FINANCIAL DISCLOSURES

CRITICAL DIAMETER FOR PUPIL TO BE CONSIDERED SMALL



PUPIL SIZE IS RELATIVE TO

SURGEON'S SKILL AND
TECHNIQUE

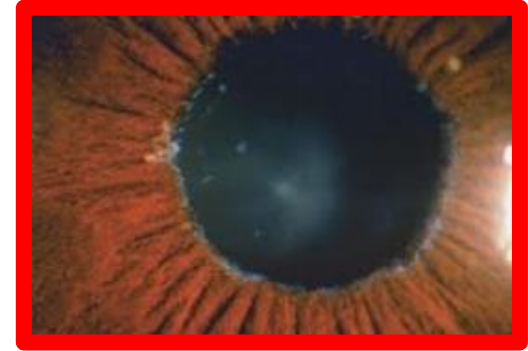
INTRAOPERATIVE
SITUATION

IRIS TISSUE PROPERTIES

REMEMBER THE CAUSE

CAUSES :

- a) Pseudo-exfoliation syndrome
- b) Past miotic use
- c) Uveitis
- d) IFIS



Other causes include

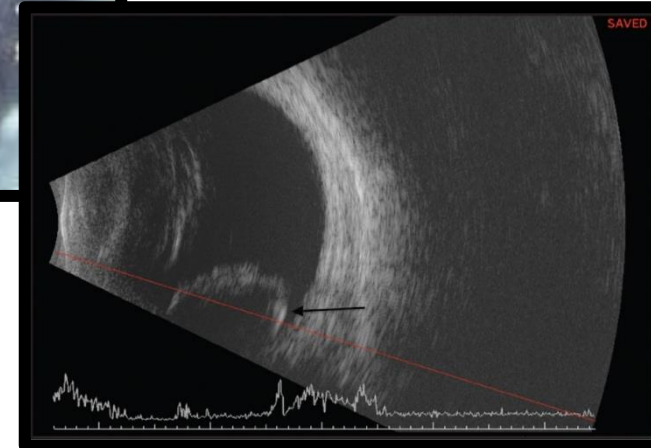
1. Previous trauma with an associated iridodialysis (again with possible zonular loss),
2. Iridoschisis,
3. Anterior segment dysgenesis,
4. And previous ocular surgery/laser or iris sphincter fibrosis



CHALLENGES IN SMALL PUPIL PHACO

- Reduced red reflex
- Increased risk of iris damage
- Iris bleeding
- Iris prolapse from wound(s)
- Small anterior capsulorhexis size
- Anterior capsule damage (chopper, us tip) - higher risk of postop capsular Phimosi
- Incomplete evacuation of the cortical material
- Problems in ensuring in-the-bag IOL placement
- Issues with proper alignment of Toric IOLs

IMPACT OF SMALL PUPIL



Proper Preop Evaluation can safely guard you

THE PHACOEMULSIFICATION TECHNIQUE: TAKE PRECAUTIONARY MEASURES

- A longer clear corneal temporal incision
(to reduce iris prolapse)
- Try to stay anterior rather posterior
- High molecular weight viscoelastics
- An endo-capsular, vertical chopping Phaco-technique



SMALL PUPIL MANAGEMENT IN CATARACT SURGERY

Current approaches to pupillary enlargement include

- Pharmacological
- Surgical techniques.

Surgical pupil management may be classified into

- Synechiolysis
- Iris stretching,
- Iris cutting
- Iris-retaining devices.

PHARMACOLOGICAL APPROACH

Pre-op:

- The proper preoperative assessment
- Proper counselling
- OR ready for all complication management
- On the operative day, the patient receives a regimen of phenylephrine 2.5%, cyclopentolate 1%, and NSAID
- Atropine: greater role in IFIS

Operative:

- Nonpreserved epinephrine 0.5 mL in 500 mL of BSS is used for infusion during surgery
- Intracameral epinephrine: 1/3000 or 1/10000
- Intracameral lidocaine 1%

**REMEMBER: MANY CHEMICAL AGENTS CAN BE
A SOURCE OF TASS**



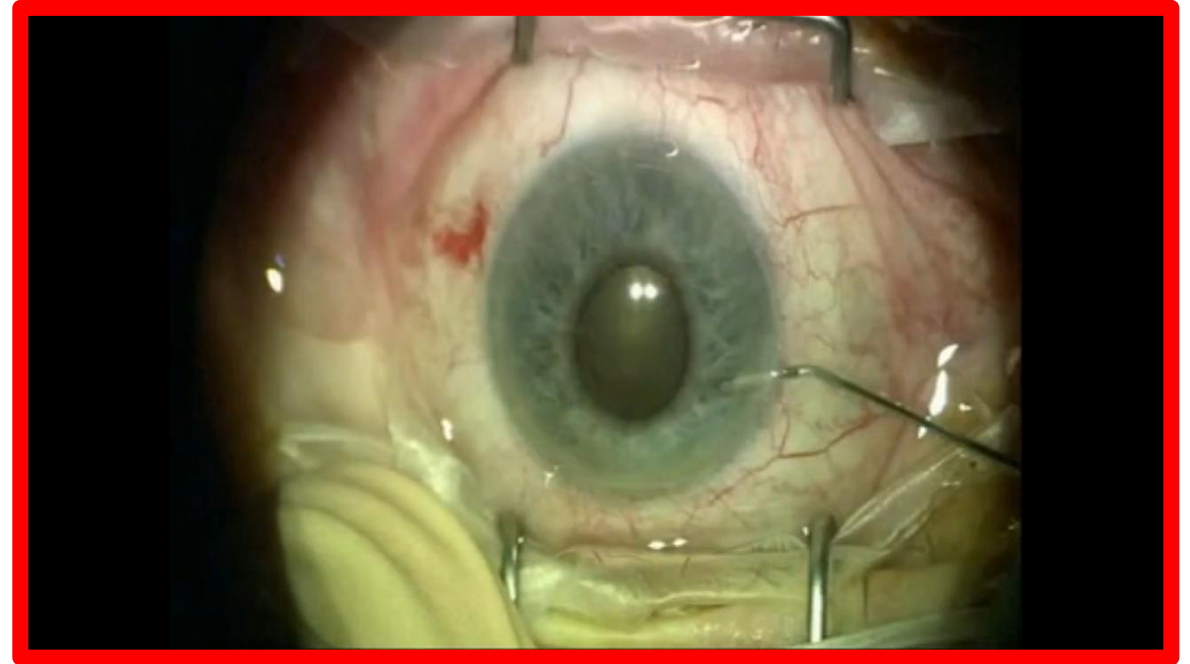
- **USE VISCOADAPTIVE OVDs**
- **DECREASE FLUIDIC PARAMETERS**
- **UTILIZE CHOP**
- **MANIPULATE IN THE PUPILLARY CENTER**
- **USE BIMANUAL IA**



SMALL PUPIL PHACO TECHNIQUE

OPHTHALMIC VISCOSURGICAL DEVICE STRATEGIES

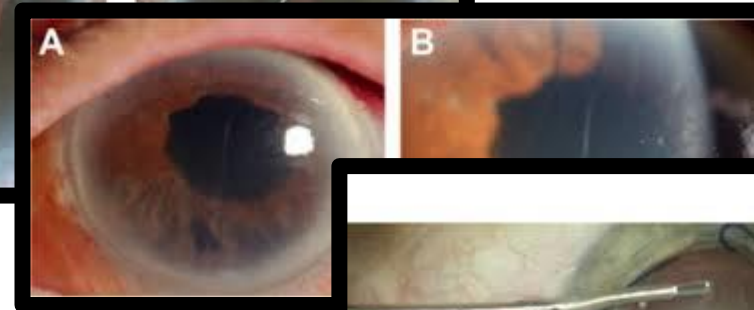
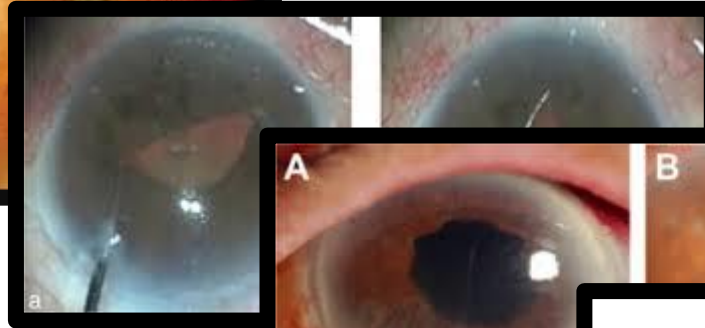
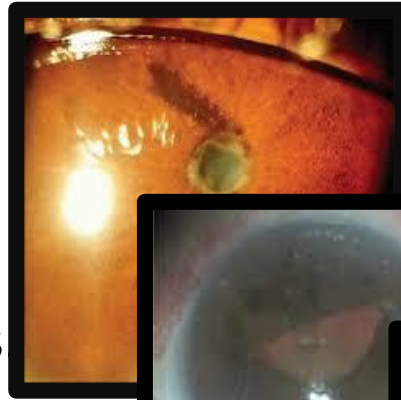
- **Healon5 (Sodium hyaluronate 2.3%):** Prolapse
Viscomydriatic ability (less suitable if high
vacuum settings are desired for denser nuclei
or if the surgeon is inexperienced with its
use!!)
- **IFIS ultimate soft-shell technique (Arshinof)**
- **DisCoVisc (hyaluronic acid 1.6%—chondroitin
sulfate 4.0%)**



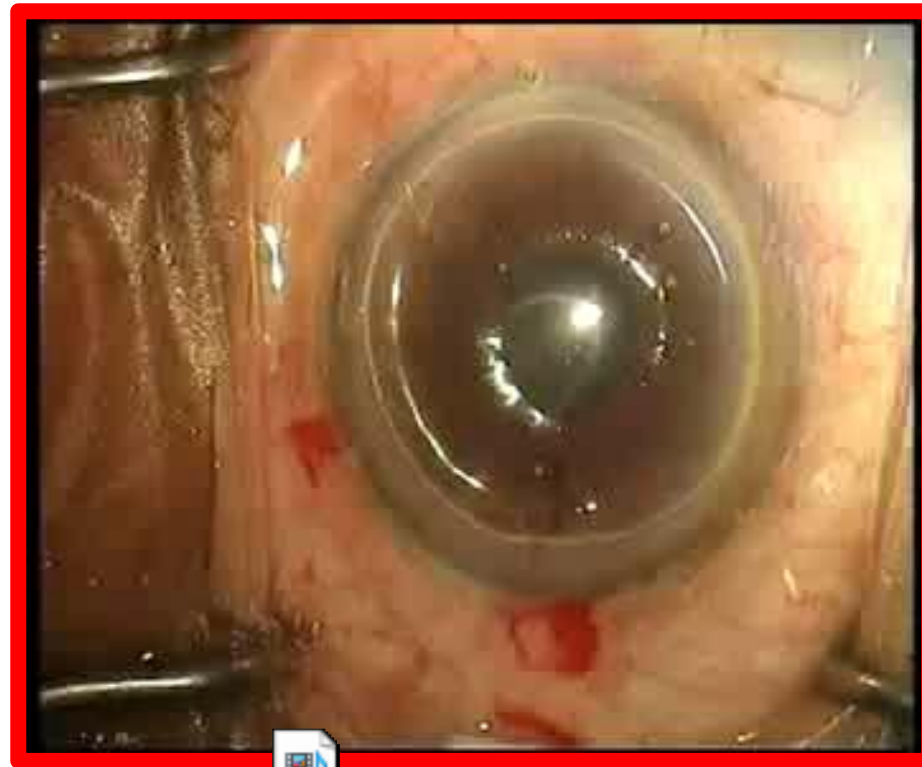
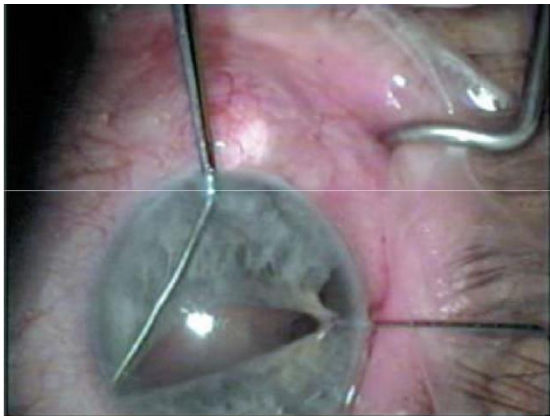
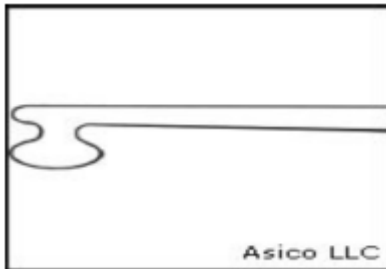
SURGICAL TECHNIQUES

Surgical methods to enlarge the pupil can be classified into

- Synechiolysis
- Iris stretching,
- Iris cutting
- Iris-retaining devices



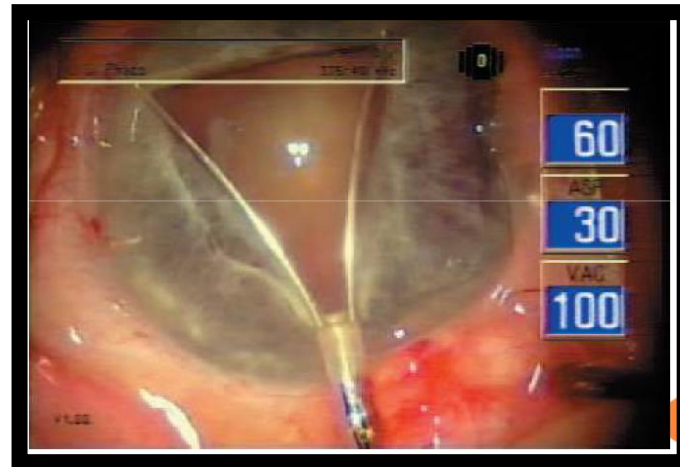
PUPIL STRETCHING



iris retraction-2.mpg

PUPIL STRETCHING

- Alternatively, a two- or three-hook Beehler
- Keuch pupil dilator can be used as is shown in



Complications:

Atonic pupil
Chr. inflammation
CME
Pupillary capture
Pigment deposition

Don't try in IFIS/ Iridoschisis

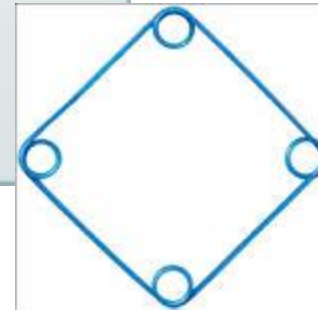
IRIS CUTTING

- Iris cutting usually involves a multitude of mini-Sphincterotomies with either
 1. A pair of Vanessa scissors or
 2. A retinal scissor

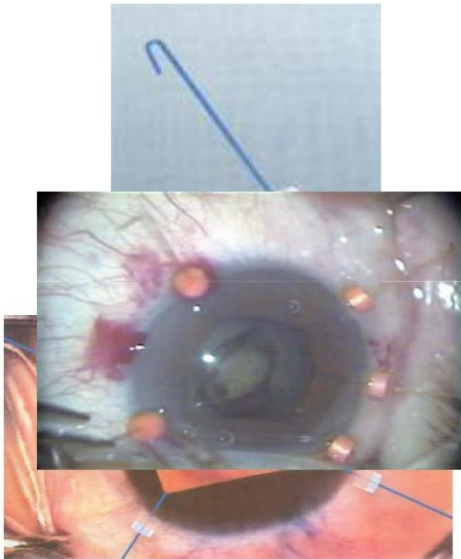


IRIS RETAINING

- Over the last few years, several iris-retaining devices have come on the market. They come in One of two categories.
 1. First there are the iris retractors
 2. Second there are iris-retaining rings.



IRIS RETAINING



IRIS-RETAINING DEVICES

- when IRIS RETRACTORS fail then iris-retaining rings can be used

Advantage: *maintaining pupil shape as well as sphincter function.*

Disadvantage: *Use is difficult at times.*

IRIS-RETAINING DEVICES

- Four different devices have been described in this category

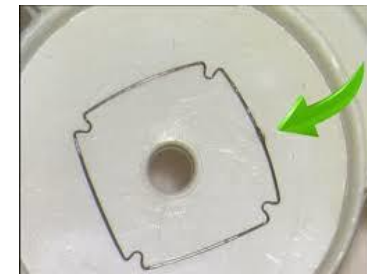
I. Pupil dilator ring from Morcher (PMMA)

II. Graether pupil dilator(silicone)

III. Perfect Pupil device(polyurethane material)

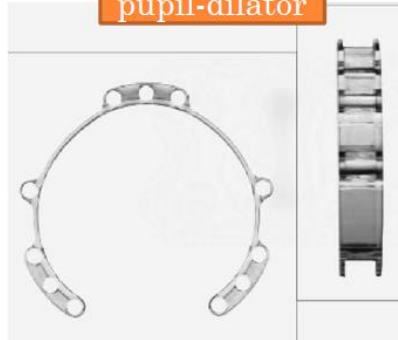
IV. The Malyugin Ring(5/0 polypropylene)

BHATTARJEE B-HEX RING



IRIS-RETAINING DEVICES

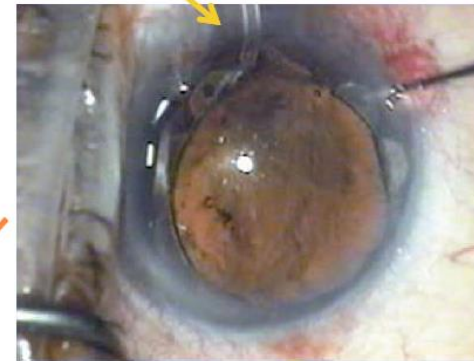
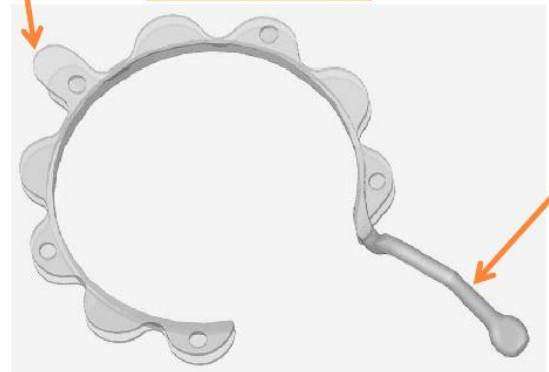
morchers-
pupil-dilator



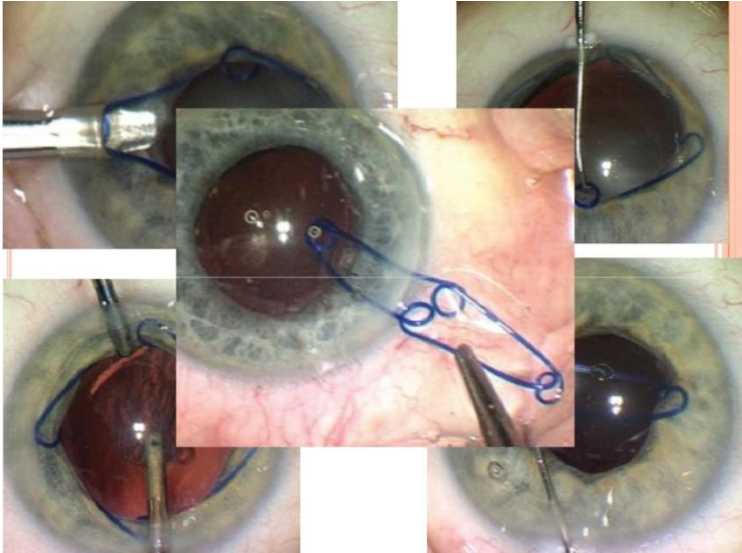
Graether
pupil ring



Perfect Pupil
Device



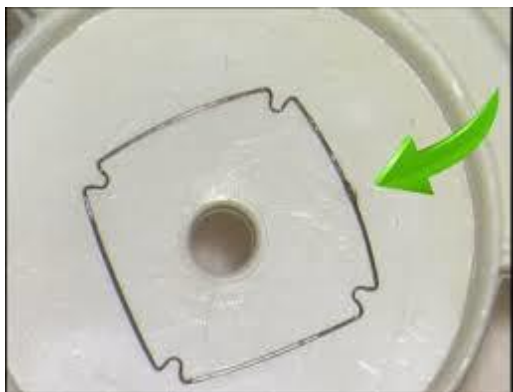
IRIS-RETAINING DEVICES



Malyugin ring.mpg

MALYUGIN RING

BHATTARJEE B-HEX DEVICE



IFIS

- First described in 2005 by Chang and Campbell
- The authors listed a triad of intraoperative signs that characterized classic IFIS:
 - (1) billowing of a flaccid iris stroma,
 - (2) iris prolapse toward the phaco and side-port incisions, and
 - (3) progressive intraoperative miosis

CAUSES OF INTRAOPERATIVE FLOPPY-IRIS SYNDROME

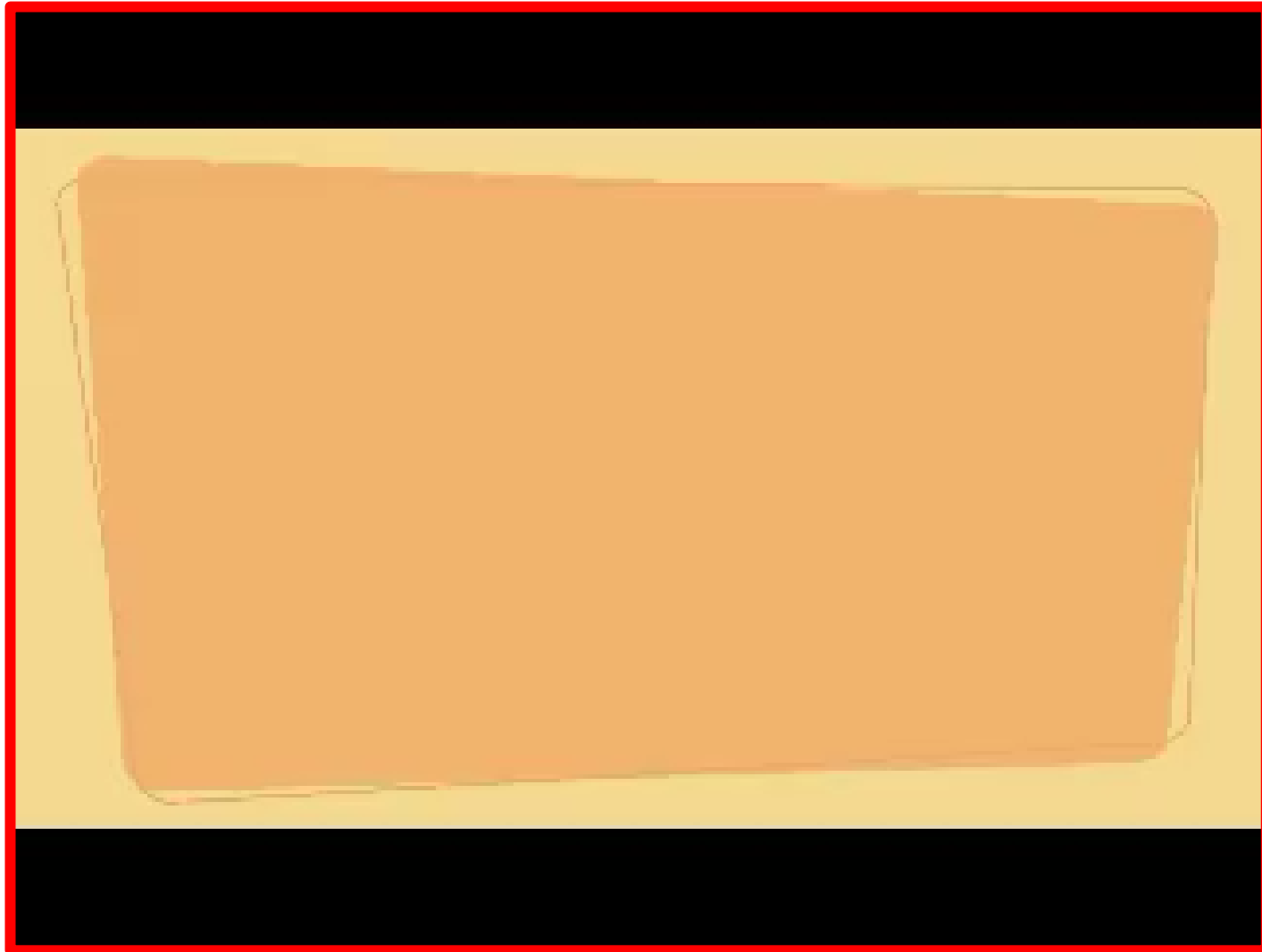
- Nonselective α_1 -antagonists / entire class of drugs
- Treatments for BPH, such as finasteride ,herbal BPH remedy
- Antipsychotic drugs that may possess some α -antagonistic effects.

IT IS IMPORTANT TO REMEMBER THAT IFIS CAN ARISE IN EITHER SEX

DURATION:

- Can cause IFIS almost immediately.
- Case Report: only 2 days- only 2 weeks
- Pathogenesis: systemic tamsulosin blocked contraction of the iris dilator smooth muscle deficient muscle tone
- Poor pupil dilation, iris floppiness, propensity to prolapse.

A Tale Of Two Pupil:



CONCLUSION;

- Follow step wise approach
- Always give importance to
 - Size of pupil
 - Biomechanical properties of iris
- Prepare your patients mentally for prolonged surgical time
- Stay in Centre
- Reduce the no of entry and exit
- Modulate your technique/parameters (low flow).
- Try to avoid touching the iris as far as possible
- Try not to do blind procedures as far as possible.

THANK-U FOR
YOUR
ATTENTION

