Use of Fibrin Tissue Adhesive and Amniotic Membrane in Conjunctival, Corneal and Refractive Surgery

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I have the following financial interests or relationships to disclose:

- Abbott Medical Optics - C,L,O,P
- Allergan, Inc. - C
- Bausch & Lomb Surgical - C,L,O
- Baxter BioScience - C
- Diopter - C
- Essex Woodlands Health Ventures - C,L
- Glaukos Corporation - S
- I-Therapeutix - C,O,S
- Inspire Pharmaceuticals Inc - L
- IOP Inc - C,L,S
- Ista Pharmaceuticals - C,L
- Ivantis - C
- Ocular Therapeutix - C,L,O,S
- ReVision Optics - C
- Sirion Therapeutics, Inc - C,L
- Transcend Medical - C
- Visiogen, Inc. - C,L,S
- Vista Research - C
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This course contains "off-label" recommendations that arise from the clinical experience of the instructors.

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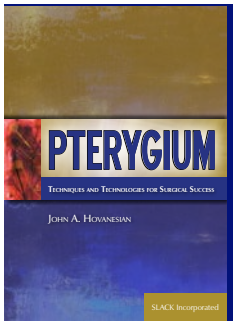

Available now at www.slackbooks.com

See handout on meeting website.

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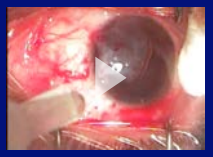
Video at www.bettereyesurgery.com



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Course Outline

Introduction to Fibrin Tissue Adhesive – Dr. Hovanesian
Lasik Flap Complications – Dr. Hardten
Pterygium & Cataract surgery – Dr. Hovanesian
Corneal Surgery– Dr. Kaufman
PCIOL Fixation – Dr. Agarwal

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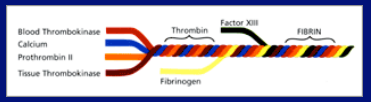
Fibrin Tissue Adhesive

"Tisseel/Artiss" (Baxter Healthcare)
Evicel (Johnson & Johnson)



fibrinogen + aprotinin + thrombin + calcium chloride

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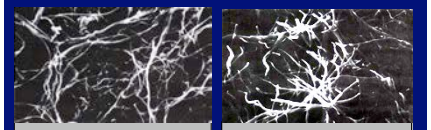
Scanning Electron Microscopy



Fibrin Adhesive "Clot"

Human Plasma Clot

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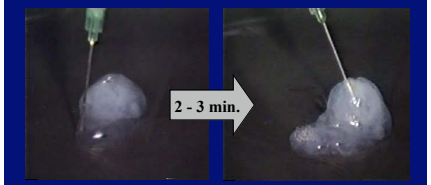
Mechanical Characteristics



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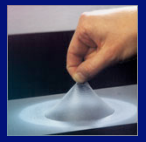
Comparison



- Stronger
- Does not bio-absorb

- Weaker bond
- Absorbs in 7-10 days

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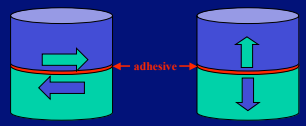
Resistance to Stress

Strong against shear stresses

Weak against tensile stresses



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Ideal Indications

- Low tension wounds
- 7-10 day adhesion
- Rough surfaces (de-epithelialized)
- OK to use between other surfaces

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Preparation and Handling

Artiss (Baxter)

- Pre-loaded in syringe
- Good for 4 hours, maybe more

- ~ $100 USD
- Can NOT use for multiple cases
- www.baxter.com

Evicel (J & J)

- Shipped frozen
- Good for 30 days after thawed if kept in fridge

- ~ $100 USD
- CAN use for multiple cases
- www.evicel.com

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Fibrin Adhesive Pearls

- Less is more
- Thin layer -- squeegee
- Avoid manipulation after polymerized

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Slowing Polymerization

Dilute thrombin (black label) with BSS

- 1:1 10-15 seconds
- 1:10 45-60 seconds
- 1:100 120 seconds +

Does not reduce tensile or shear strength.

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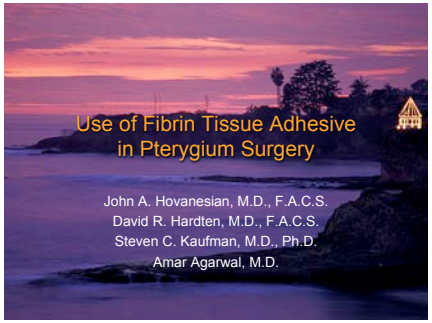

Use of Fibrin Tissue Adhesive in Pterygium Surgery

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Pterygium: 3 Techniques That Work

1 

autograft: easy, 5% recurrence

2 

AM graft + MMC: easy, 5% recurrence

For surgeons doing bare sclera

3 

autograft + subconj AMT: more effort, <1% recurrence

For surgeons doing autografts

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Method 1: Autograft

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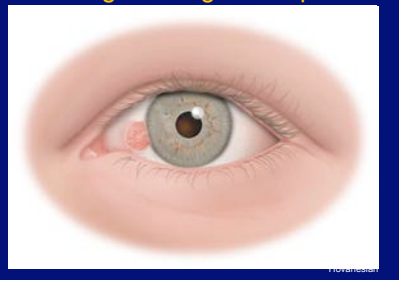
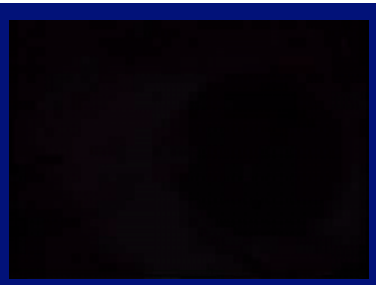
Autograft Surgical Steps





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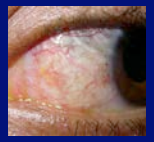
Pearls for Autografts

- Thin graft
- Include limbal tissue
- Expect chemosis
- Nasal dehiscence is well tolerated



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Postoperative Management

- Patch/shield overnight
- Drops
  - Prednisolone acetate 1% QID x 1 month
  - Fluoroquinolone QID x 1 week
  - NSAID x 1 week
- Follow-up 1 week

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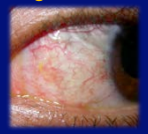
Healing After Autografts

- 1-2 weeks of significant redness
- Progressive healing
- Must monitor for IOP spike
- Continue Pred Forte 1 month



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Method 2: Pterygium/AMT

complete excision of pterygium leaving bare sclera

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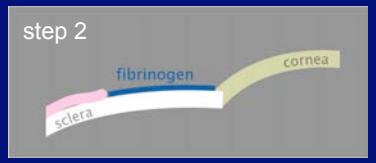
Pterygium/AMT



fibrinogen is sparingly placed on scleral defect

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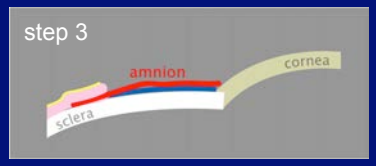
Pterygium/AMT



amnion is placed over defect and 3 to 4 mm under surrounding conjunctiva

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Pterygium/AMT

thrombin is placed on top of the amnion graft

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Mitomycin 0.02%

- use pledgets in subconj area
- avoid exposure to bare sclera
- 2-3 minutes
- irrigate with 30cc of BSS to wash away MMC

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Different Forms of Amniotic Membrane

AMNIOGRAFT

Ambio dry2 Human Amniotic Membrane

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Ambio vs Ambio dry2 Human Amniotic Membrane

- 110 microns (bond paper)
- 90+ days
- Stroma + epithelium

- 35 microns
- 20 - 30 days
- Stroma + epithelium

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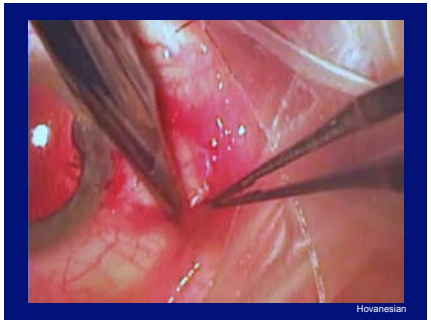

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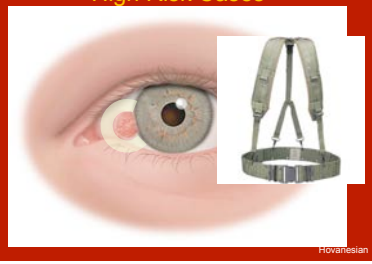
Method 3: Autograft AND Amnion for High Risk Cases



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Video

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Improved Techniques Using Fibrin Adhesive to Manage Recurrences of Epithelial Ingrowth

David R. Hardten, M.D.
Minneapolis, Minnesota

Have done research, consulting, or speaking for:
Allergan, AMO, Calhoun Vision, CXL-USA, ESI, Oculus, Quantel, TLCV
Some of the information may represent off-label uses of approved drugs or devices

Minnesota Eye Consultants, PA www.mn-eye.com Ph: 612-813-3600 Fax: 612-813-3636 D.R. Hardten, M.D.

Epithelial Ingrowth

Complication of LASIK surgery
- Incidence 0.5 to 15%
- Usually observed in first few weeks
- May be nonprogressive or progressive
- In most advanced stage may result in flap melt

Signs

- Isolated nests/sheets of cells
- Decreased UCVA and/ or BCVA
- Induced astigmatism on refraction
- Irregular astigmatism on topography

Treatment - Removal

Removal
- Lifting and scraping epithelial cells
  - Blunt spatula, Merocel sponge
  - Ethanol used to supplement complete removal
  - MMC – has no role in management
  - PTK to remove additional cells can induce significant irregular astigmatism
- Nd:YAG Laser treatment
  - Useful for stable pockets of ingrowth where the elevation of the cornea causing changes in comfort or vision

Treatment – Prevention of Recurrence

Prevention of Recurrence
- Suturing flap edges
  - Induce striae, irregular astigmatism, requires suture removal, longer recovery
- Fibrin adhesive application
  - Useful for recurrent cases
  - Longer recovery

Tisseel Fibrin Glue

Baxter (tissuesealing.com)
- Mixture of:
  - Fibrinogen & Thrombin
  - Also has fibrinolysis inhibitor (bovine)
- Mixed on surface of the eye
- 30-60 seconds to manipulate it
- Thrombin can be diluted to slow the setting time
- 8-10 minutes to dry so BSCL can be placed
- Dissolves in 10-14 days

Fibrin Adhesive for Multiple Recurrences
Soften Epithelium Around Gutter

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Fibrin Adhesive for Multiple Recurrences
Remove Epithelium around Gutter

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Fibrin Adhesive for Multiple Recurrences
Remove Epithelium from Stromal Bed & Gutter

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Fibrin Adhesive for Multiple Recurrences
Remove Epithelium from Back of Flap

D.R. Hardten, M.D.

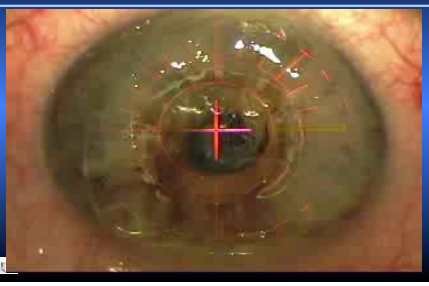
Fibrin Adhesive for Multiple Recurrences
Apply Fibrin Portion of Sealant (Blue/Thick)

D.R. Hardten, M.D.

Fibrin Adhesive for Multiple Recurrences
Apply Thrombin Portion of Sealant (Black/Thin)

D.R. Hardten, M.D.

Fibrin Adhesive for Multiple Recurrences Allow Glue to Dry



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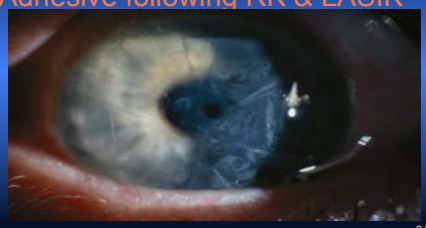
Postoperative Day 1

Fibrin Adhesive following RK & LASIK



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Results in Study of 39 Eyes

Fibrin Glue
- LASIK surgery
- Epithelial ingrowth recurred despite prior removal or enhancement

Risk factors present:
- Following LASIK enhancement: 32 eyes
- Slipped Flap: 1 eye
- S/P RK and LASIK enhancement: 4 eyes
- No obvious risk factors: 2 eyes

Prior Removals
- Up to 5 removal attempts previously
- Mean 1.7 ± 1.3 removal attempts

Success
- 4 clinically significant recurrences (11%)
- One patient combined with 10-0 nylon and 10-0 polyglactin sutures due to high fistula
- Average 23.0 ± 19.1 months follow-up

Combination of MEC & Duke University Eyes

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Results

Eyes with ≥ 3 months follow-up (3 to 66 months):
- 30 eyes (79%) had no evidence of recurrent epithelial ingrowth.
- 5 eyes (13%) had small nests of epithelial cells at the flap edge that to date have not required removal.
- Three eyes (8%) had significant recurrence one of which was due to inadequate application of the fibrin portion of the glue.
- Two eyes underwent flap amputation due to irregular astigmatism.
- BCVA improved from 61% with 20/25 BCVA preop to 76% at 3 months postop and 84% at last follow-up.

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Nd:YAG Laser

Epithelial Ingrowth Removal
- Ayala, et. al.: AJO 2008;145:630.
- 0.6 mJ
- Variable number of spots depending on amount of ingrowth
- 40% of cases required 2 or more sessions

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Epithelial Ingrowth

Nd:YAG Laser
30 eyes
Starting in the center of the ingrowth
Average energy 0.6mJ
FML TID 2 weeks postop
Opacities resolve fully in 80%
Mild opacity remained in 20%

Ayala, et. al.: AJO 2008;145:630.

FIGURE 1. Photograph from Case 1 showing very dense epithelial ingrowth with bubbles in the area treated with neodymium:yytrium–aluminum–garnet (Nd:YAG) laser.

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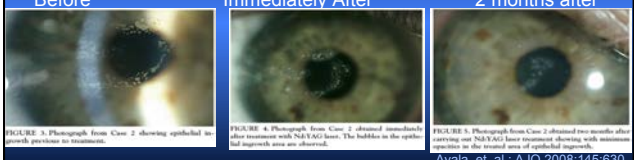
Epithelial Ingrowth

Nd:YAG Laser

Before | Immediately After | 2 months after



Ayala, et. al.: AJO 2008;145:630.

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Conclusions

Fibrin Adhesive

- Tisseel/Artiss may be a useful adjunct in epithelial ingrowth removal in complicated cases
- May reduce incidence of recurrent epi ingrowth
- Tisseel/Artiss is well tolerated and there were no complications associated with its use
- Larger randomized studies would be needed to determine safety and efficacy of this technique as compared to primary removal or sutures
- Nd:YAG may be useful for stable long-standing ingrowth destruction

Anderson, et. al.: JCRS 2003;29:1425 Ayala, et. al.: AJO 2008;145:630

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GLUED PC IOL IMPLANTATION WITH INTRALAMELLAR SCLERAL TUCK IN EYES WITH DEFICIENT CAPSULE

AMAR AGARWAL

INTRODUCTION

Posterior capsular rent (PCR) [1-2] can occur in early learning curve in phacoemulsification. intraoperative dialysis or large PCR will prevent intraocular lens (IOL) implantation in the capsular bag. Implantation of IOL in the sulcus will be possible in adequate anterior capsular support. The first glued PC IOL implantation in an eye with a deficient capsule was done by the authors on 14th of December 2007. In eyes with inadequate anterior capsular rim and deficient posterior capsule, the new technique of IOL implantation is the fibrin glue assisted sutureless IOL implantation with scleral tuck.[3-7]

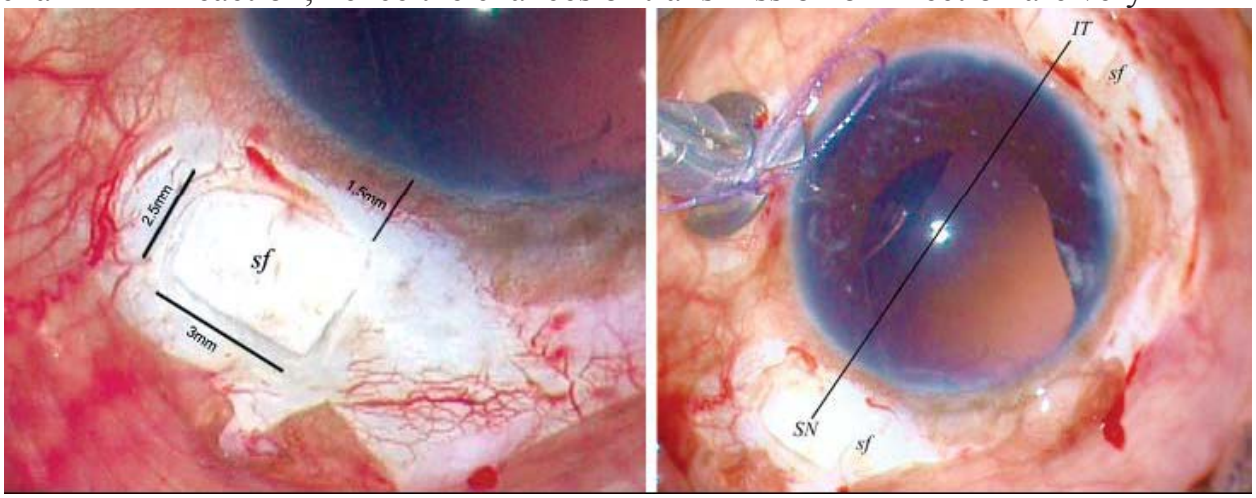
SURGICAL TECHNIQUE

Under peribulbar anesthesia, superior rectus is caught and clamped. Localized peritomy and wet cautery of the sclera at the desired site of exit of the IOL haptics is done. Infusion cannula or anterior chamber maintainer is inserted. If using an infusion cannula, one can use a 23 G sutureless trocar and cannula. Positioning of the infusion cannula should be preferably in inferonasal quadrant to prevent interference in creating the scleral flaps. Two partial thickness limbal based scleral flaps about 2.5 mm × 3 mm are created exactly 180 degrees diagonally apart (**Figures 1A and B)**. This is followed by 23 G vitrectomy via pars plana or anterior route to remove all vitreous traction. Two straight sclerotomies with a 20G/22G needle are made about 1.0 mm from the limbus under the existing scleral flaps. A clear corneal/scleral tunnel incision is then prepared for introducing the IOL. While the IOL is being introduced with the one hand of the surgeon using a McPherson forceps, an end gripping 23 G/25 G microrhexis forceps (Micro Surgical Technology, USA) is passed through the inferior sclerotomy with the other hand. One can use any end opening forceps like a micro rhexis forceps. The tip of the leading haptic is then grasped with the microrhexis forceps, pulled through the inferior sclerotomy following the curve of the haptic **(Figures 2A and B)** and is externalized under the inferior scleral flap. Similarly, the trailing haptic is also externalized through the superior sclerotomy under the scleral flap. Limbal wound is sutured with 10-0 monofilament nylon if it is a sclera tunnel incision. The tips of the haptics are then tucked inside a scleral tunnel made with 26 G needle at the point of extension. Scleral

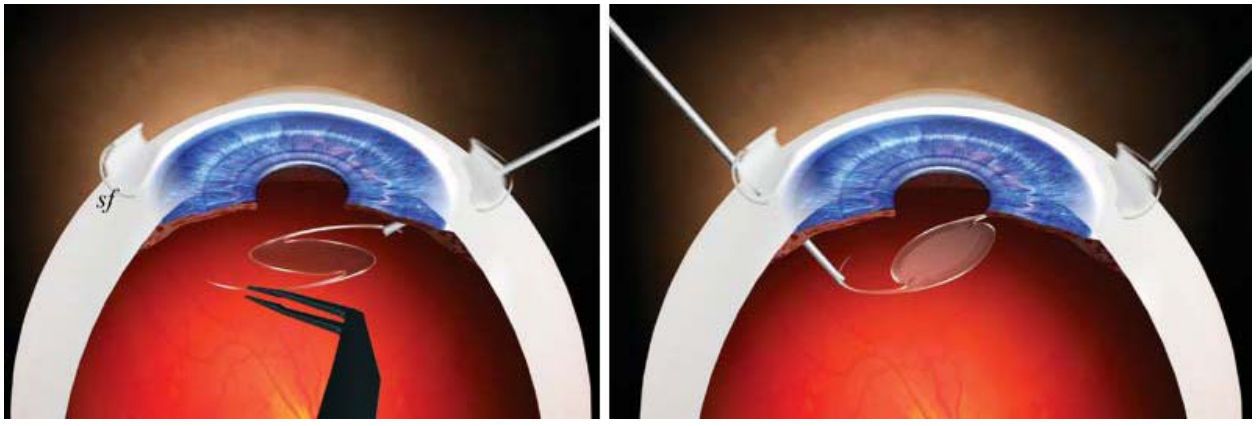
flaps are closed with fibrin glue **(Figures 3A and B).** The anterior chamber maintainer or the infusion cannula is removed. Conjunctiva is also closed with the same fibrin glue **(Figure 4)**

FIBRIN GLUE

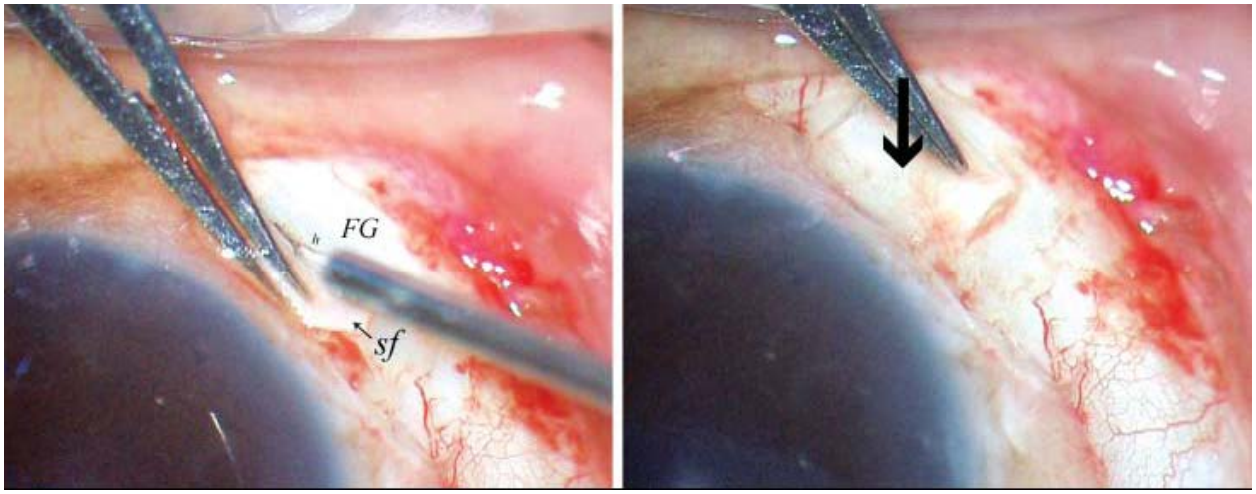
The fibrin kit the author used is Reliseal (Reliance Life Sciences, India). Another widely used tissue glue namely Tisseel (Baxter) can also be used. The fibrinogen and thrombin are first reconstituted according to the manufacturer's instructions . The commercially available fibrin glue that is virus inactivated is checked for viral antigen and antibodies with polymerase chain reaction; hence the chances of transmission of infection are very



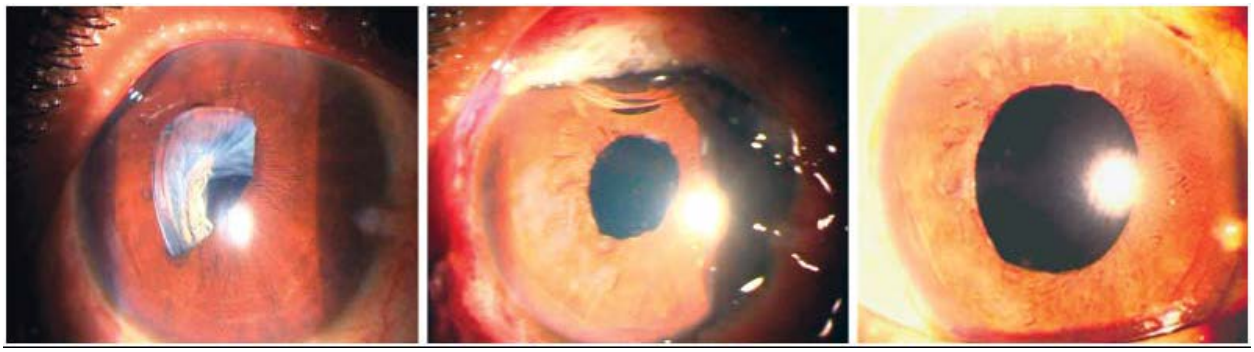
FIGURES 1A and B: *Scleral flaps (sf) of 2.5 x 3 mm made about 1.5 mm from the limbus. Two flaps 180 degrees diagonally apart*



FIGURES 2A AND B: *Image showing sclerotomy made with 22 G needle beneath the flaps Haptics exteriorized by 25 G forceps beneath the scleral flaps (sf)*



FIGURES 3A AND B: *Reconstituted fibrin glue (FG) injected beneath the scleral flaps over the haptics and scleral flaps (sf) closed*



FIGURES 4A TO C: *(A): Preoperative slit lamp image showing anterior subluxated IOL,*
(B) Day one postoperative period, (C) Three months after surgery

low. But with tissue derivatives, there is always a theoretical possibility of transmission of viral infections.

Reconstitution of Reliseal

It is available in a sealed pack, which contains freeze dried human fibrinogen (20 mg/0.5 ml), freeze dried human thrombin (250 IU/0.5 ml), aprotinin solution (1500 kiu in 0.5 ml), one ampoule of sterile water, four 21G needles, two 20 G blunt

application needles and an applicator with two mixing chambers and one plunger guide. First, the aprotinin solution is taken in a 2 ml sterile syringe and mixed with the freeze dried fibrinogen and is then shaken by slow circular motion. The reconstituted vial is then placed in a preheated water bath of 37 degrees for not more than 10 minutes. Next, about 0.5 ml of water for injection is aspirated and injected into the vial of freeze dried thrombin followed by gentle agitation of the vial. Reconstitution is considered complete when no undissolved particles are visible. Both the reconstituted fibrinogen and the thrombin are loaded separately in two 2 ml sterile syringes and mounted on to the Reliseal applicator for use.

Then, the reconstituted fibrin glue thus prepared is injected through the cannula of the double syringe delivery system under the superior and inferior scleral flaps. Local pressure is given over the flaps for about 10–20 seconds for the formation of fibrin polypeptides.

Special Situations

In case of those patients who had a luxated IOL, similar lamellar scleral flaps as described earlier are made and the luxated IOL haptic is then grasped with the 23/25 gauge rhexis forceps and externalized and glued under the sclera flaps **(Figures 5A and B)**.

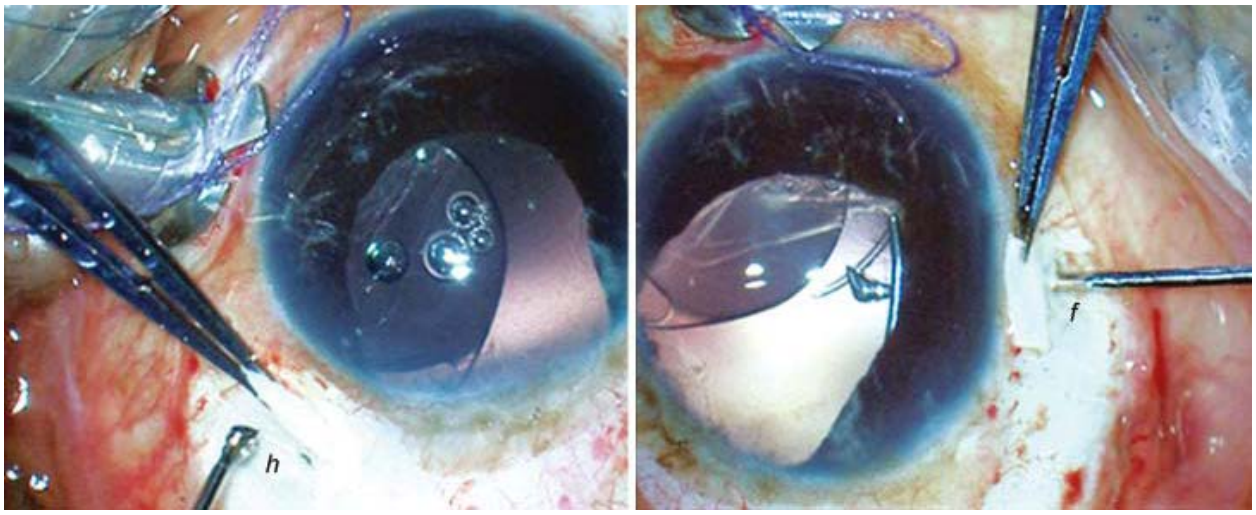
Advantages

This fibrin glue assisted sutureless PCIOL implantation technique would be useful in a myriad of clinical situations where scleral fixated IOLs are indicated, such as luxated IOL, dislocated IOL, zonulopathy or secondary IOL implantation.

No special IOLs: It can be performed well with rigid PMMA IOL, 3 piece PC IOL or IOLs with modified PMMA haptics. One, therefore, does not need to have an entire inventory of special SFIOLs with eyelets, unlike in sutured SFIOLs. In dislocated posterior chamber PMMA IOL, the same IOL can be repositioned, thereby reducing the need for further manipulation. Furthermore, there is no need for newer haptic designs or special instruments other than the 25 gauge forceps.

No tilt: Since the overall diameter of the routine IOL is about 12–13 mm, with the haptic being placed in its normal curved configuration and without any traction, there is no distortion or change in shape of the IOL optic **(Figure 6)**. Externalization of the greater part of the haptics along its curvature stabilizes the axial positioning of the IOL and thereby prevents any IOL tilt.[8]

***Less pseudophacodonesis*:** When the eye moves, it acquires kinetic energy from its muscles and attachments and the energy is dissipated to the internal fluids as it stops. Thus,



FIGURES 5A AND B: *Haptics (h) exteriorized by 25G forceps (f) beneath the scleral flaps (sf) in dislocated IOL*

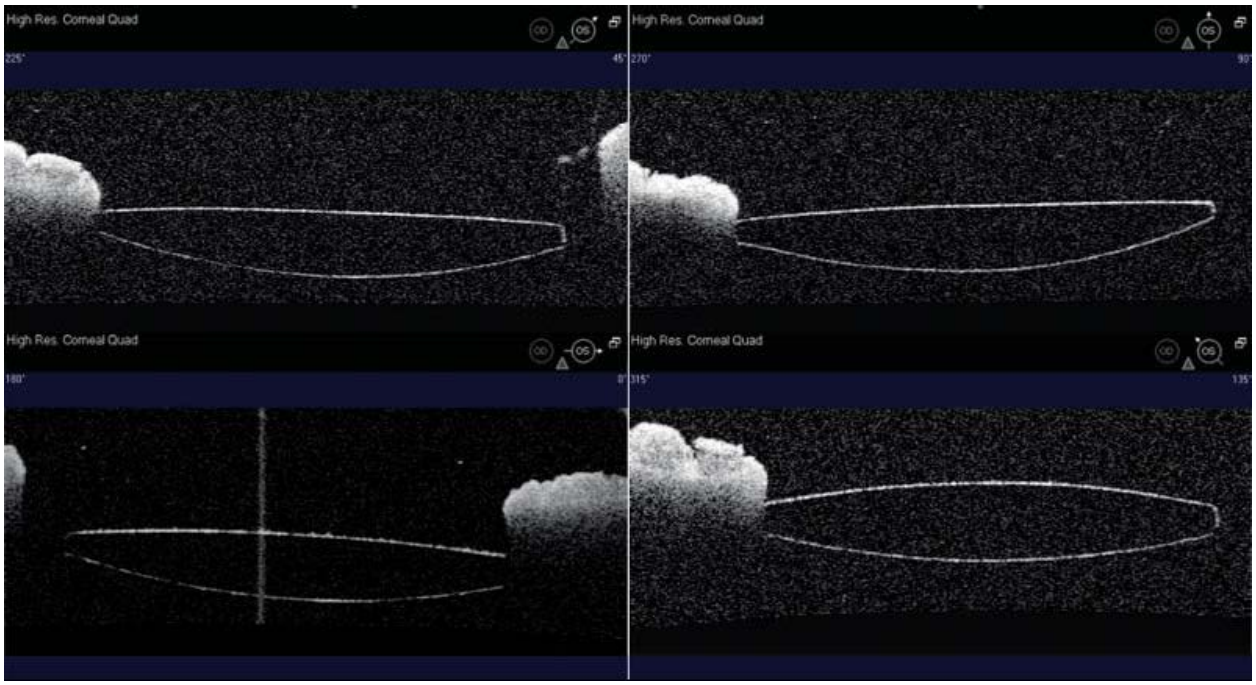


FIGURE 6: *Anterior segment OCT showing 360 degrees good centration of the IOL*

pseudophacodonesis is the result of oscillations of the fluids in the anterior and posterior segment of the eye. These oscillations, initiated by movement of the eye, result in shearing forces on the corneal endothelium as well as vitreous motion lead to permanent damage. Since the IOL haptic is stuck beneath the flap, it would prevent the further movement of the haptic and thereby reducing the pseudophacodonesis.[9]

Less UGH syndrome: The authors expect less incidence of UGH syndrome in fibrin glue assisted IOL implantation, as compared to sutured scleral fixated IOL. This is because; in the former, the IOL is well stabilized and stuck onto the scleral bed and thereby, has decreased intraocular mobility, whereas in the latter, there is increased possibility of IOL movement or persistent rub over the ciliary body.

No suture related complications: Visually significant complications due to late subluxation[10] which has been known to occur in sutured scleral fixated IOL may also be prevented as sutures are totally avoided in this technique. Another important advantage of this technique is the prevention of suture related complications,[11,12] like suture erosion, suture knot exposure or dislocation of IOL after suture disintegration or broken suture.

Rapidity and ease of surgery: All the time taken in SFIOL for passing suture into the IOL haptic eyelets, to ensure good centeration before tying down the knots, as well as time for suturing scleral **flaps** and closing conjunctiva are significantly reduced. The risk of retinal photic injury[13] which is known to occur in SFIOL would also be reduced in this technique due to the short surgical time. Fibrin glue takes less time [Reliseal (20 seconds)/Tisseel (3 seconds)] to act in the scleral bed and it helps in adhesion as well as hemostasis. The preparation time can also be reduced in elective procedures by preparing it prior to surgery as it remains stable up to four hours from the time of reconstitution. Fibrin glue has been shown to provide airtight closure and by the time the fibrin starts degrading, surgical adhesions would have already occurred in the scleral bed. This is well shown in the follow-up anterior segment OCT **(Figure 7)** where postoperative perfect scleral flap adhesion is observed.

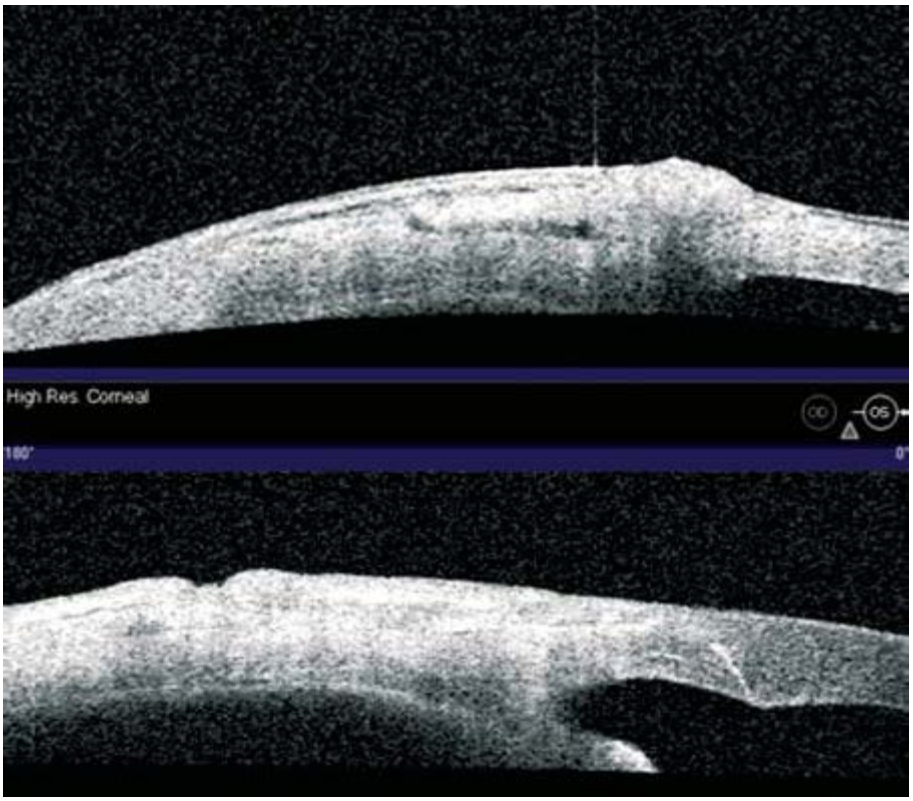
Stability of the IOL Haptic

As the flaps are manually created, the rough apposing surfaces of the flap and bed heal rapidly and firmly around the haptic, being helped by the fibrin glue early on. The major uncertainty here is the stability of the fibrin matrix *in vivo*. Numerous animal studies have shown that the fibrin glue is still present at 4–6 weeks. Because postoperative fibrosis starts early, the flaps become stuck secondary to fibrosis even prior to full degradation of the glue **(Figures 8A to D)**. The ensuing

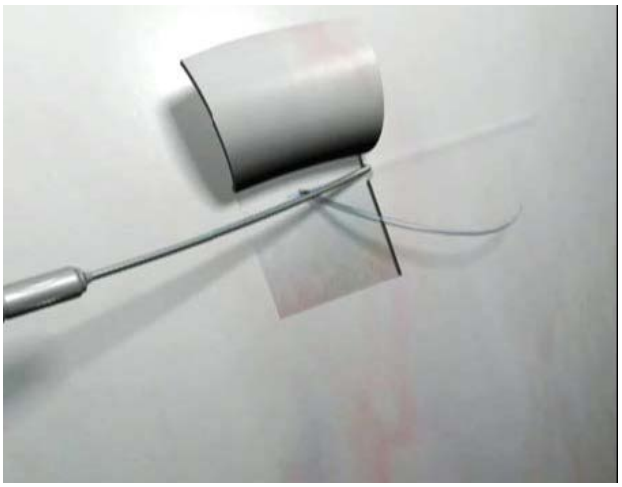
fibrosis acts like a firm scaffold around the haptic which prevents movement along the long axis **(Figure 9A)**. To further make the IOL rock stable, the author has started tucking the haptic tip into the sclera wall through a tunnel. This prevents all movement of the haptic along the transverse axis as well **(Figure 9B)**. The stability of the lens first comes through the tucking of the haptics in the scleral pocket created. The tissue glue then gives it extra stability and also seals the flap down. Externalization of the greater part of the haptics along its curvature stabilizes the axial positioning of the IOL and thereby prevents any IOL tilt.

Steps of Surgery for a Glued IOL

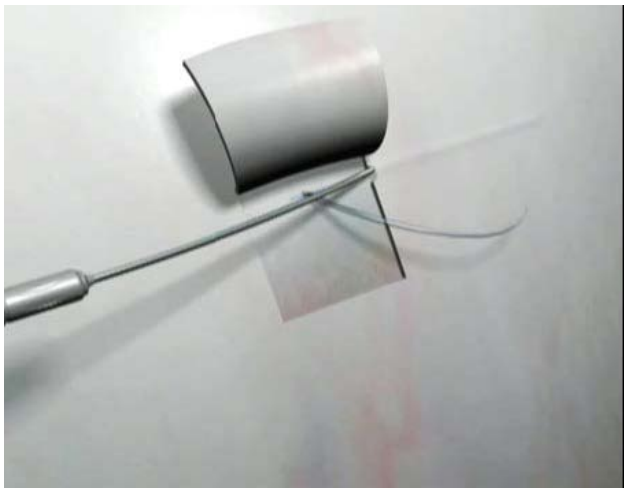
It is to look at the various steps of surgery for a glued IOL **(Figures 10 to 38)**. This shows the way that an injectable foldable IOL can be glued into an eye with no capsules.



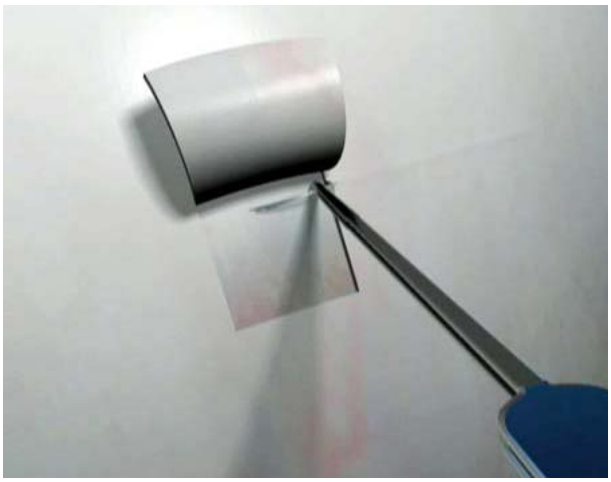
FIGURES 7A AND B: Anterior segment OCT showing the scleral flap placement on day 1 (A) and adhesion well maintained till six weeks (B)



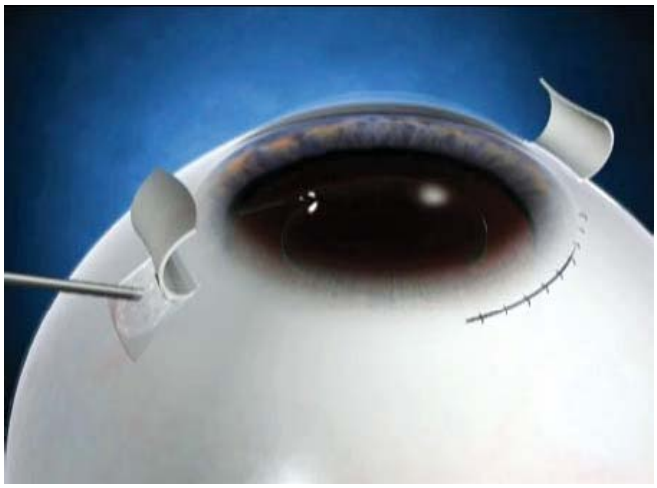
(A)IOL haptic grasped with a microsurgical technology MST forceps(USA)



(B) 26 gauge needle creates a scleral pocket at the edge of the flap

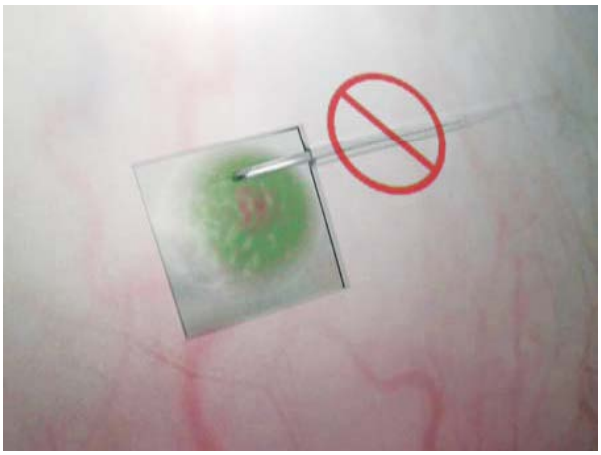


(C) IOL haptic tucked into the scleral pocket

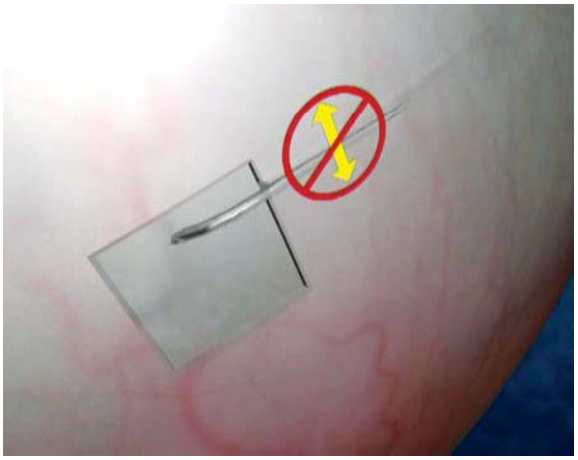


(D) Fibrin glue applied under the scleral flaps

FIGURES 8A TO D: Surgical technique of the glued IOL



(A)Long axis movement is prevented by the tissue glue



(B) Transverse axis movement is prevented by the scleral tuck

FIGURES 9A AND B: Stability of the IOL

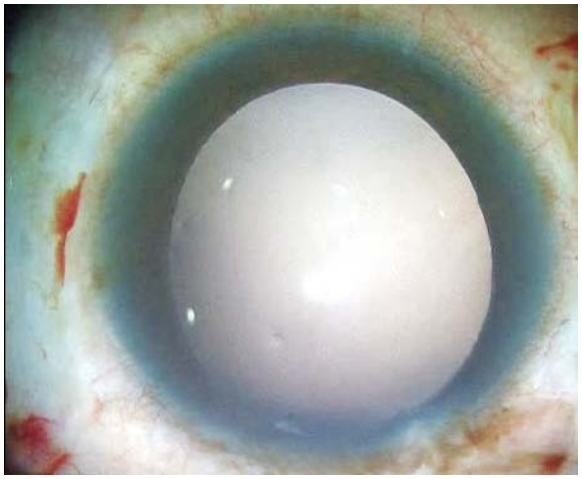


FIGURE 10: *Aphakic case. No capsule seen*

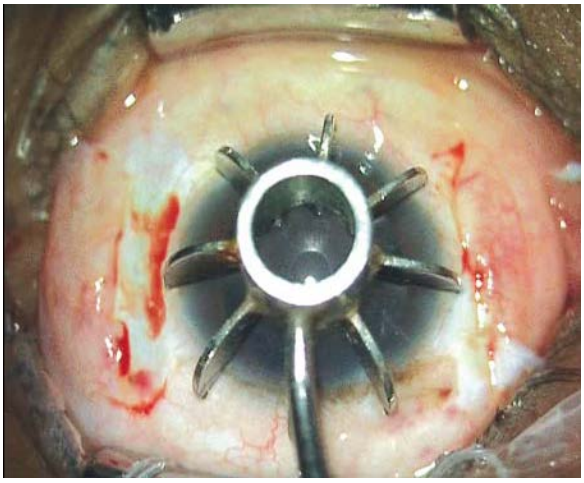


FIGURE 11: *Scleral markers applied on the cornea. This will help to get marks created on the cornea 180 degrees apart to make sclera flaps*

FIGURE 12: Marks made on the cornea. Conjunctiva cut on either side of the marks

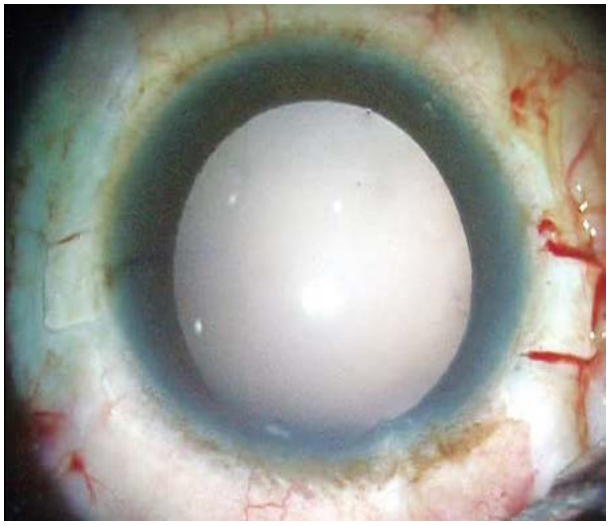


FIGURE 13: Scleral flaps made 180 degrees apart

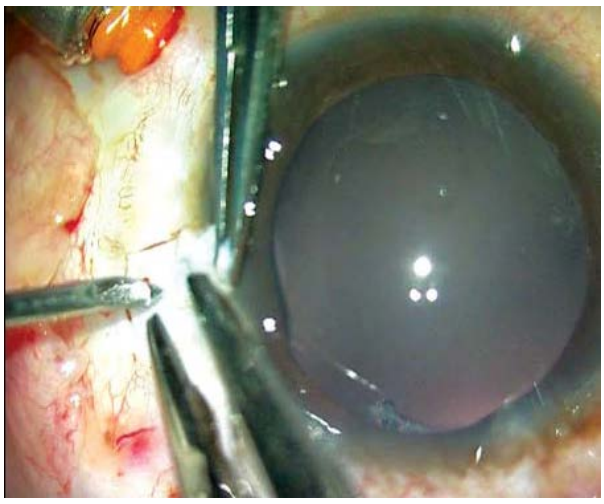


FIGURE 14: Sclerotomy made 1 mm from the limbus under the sclera flap using a 20 G needle

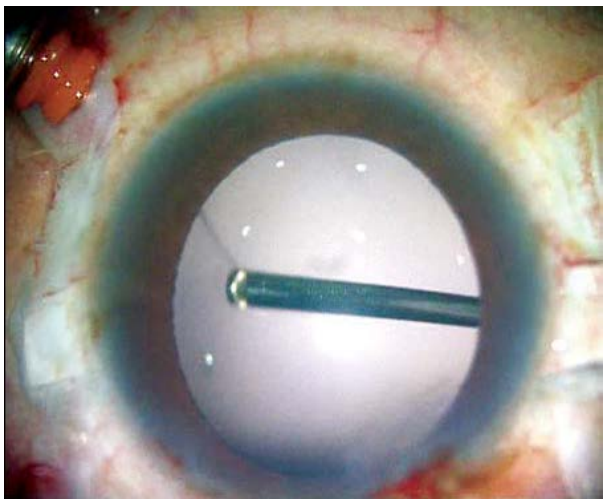


FIGURE 15: 23 G vitrectomy to remove anterior and midvitreous

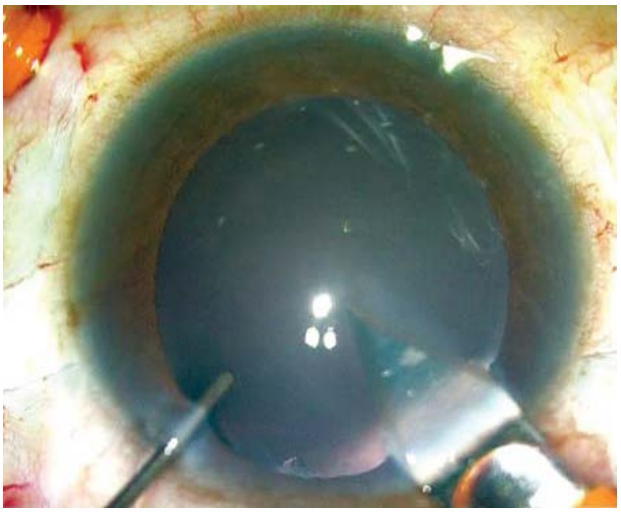


FIGURE 16: *Clear corneal incision*

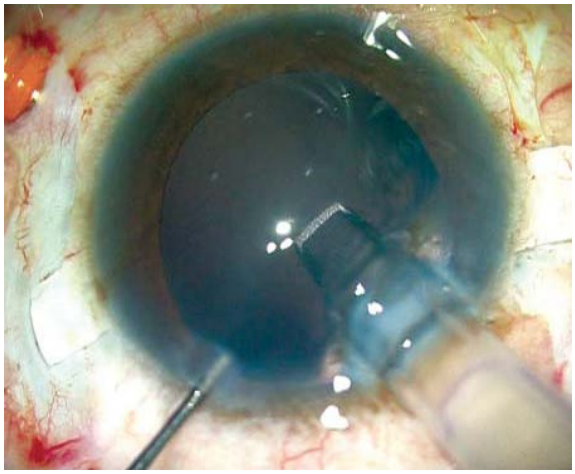


FIGURE 17: *Foldable 3 piece IOL being injected slowly. It is to note the cartridge is inside the eye. One should not do wound assisted as the injection might happen too fast. This can either break the IOL or push it so fast that it might go into the vitreous cavity*

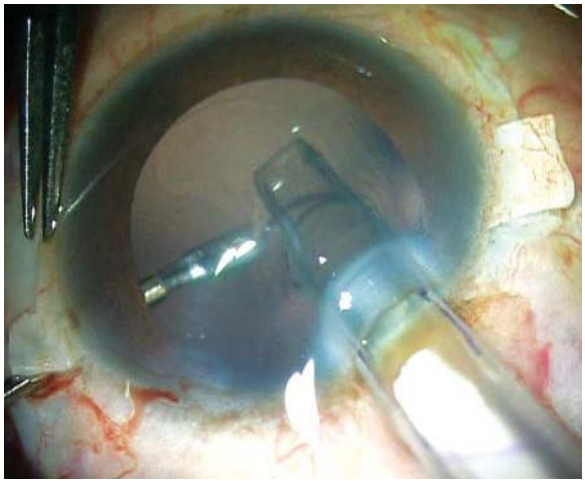


FIGURE 18: Foldable IOL injection continued with one hand. This injector has a pushing mechanism so one hand can be used. The other hand holds an end opening microrhexis forceps (23 G) and is passed through the sclerotomy under the sclera flap and is ready to grab the haptic

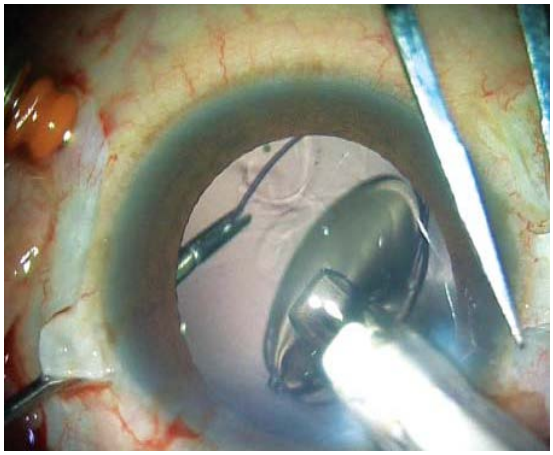


FIGURE 19: End opening forceps grabs the haptic tip

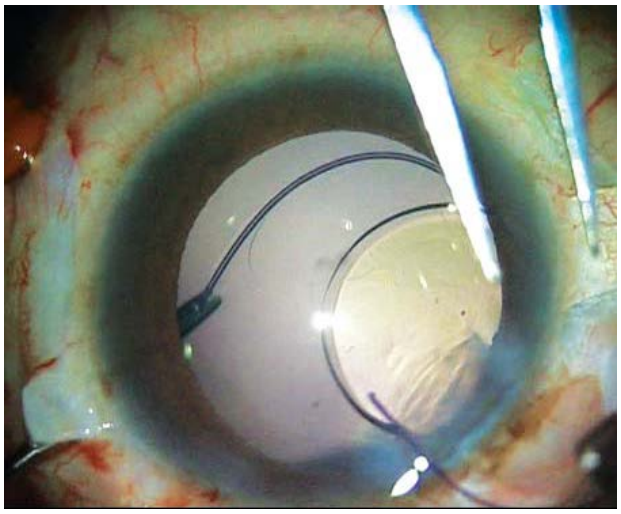


FIGURE 20: Forceps pulls the haptic while injection of the foldable IOL is continued

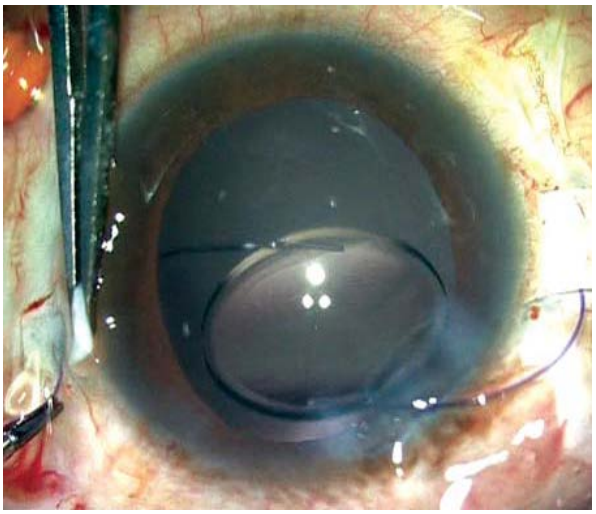


FIGURE 21: Haptic externalized

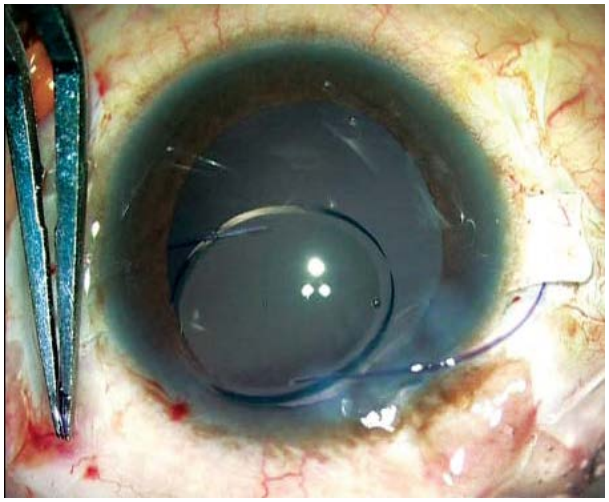


FIGURE 22: Assistant holds the haptic which is externalized

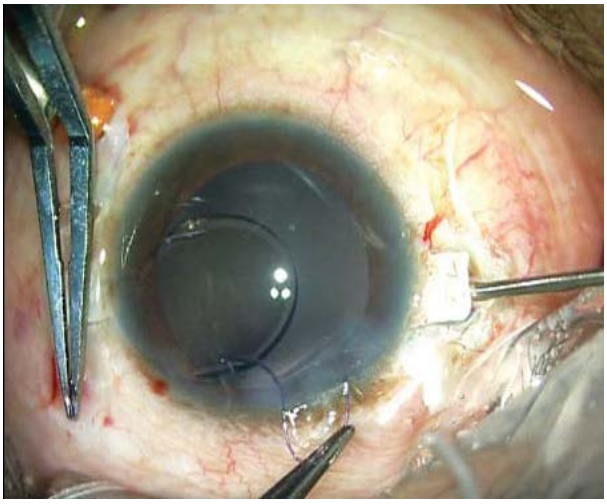


FIGURE 23: Trailing haptic is flexed into the anterior chamber. The other hand holds the end opening microrhexis forceps and is passed through the other sclerotomy under the sclera flap

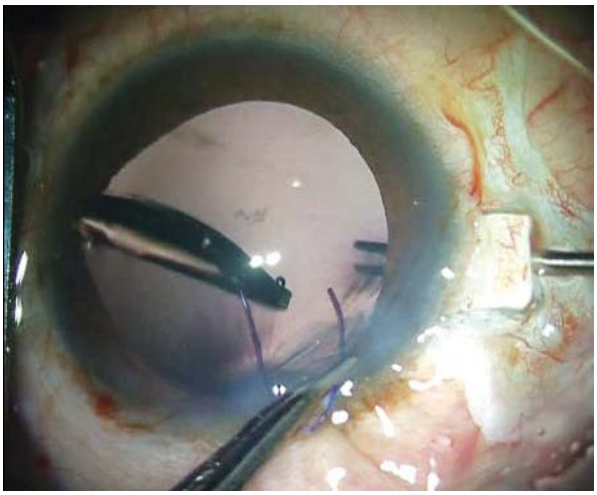


FIGURE 24: End opening forceps ready to grab the haptic tip

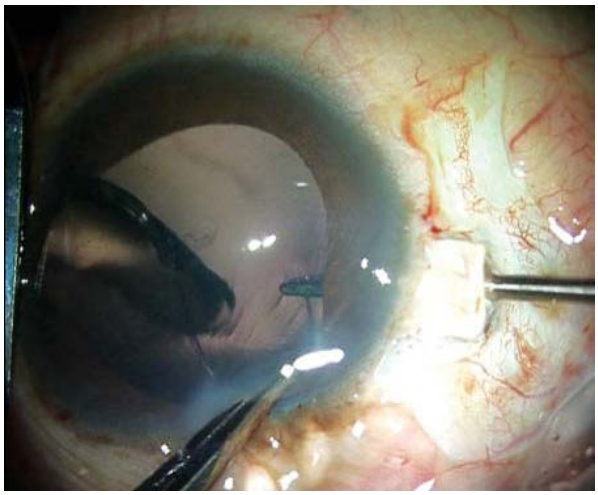


FIGURE 25: Haptic caught

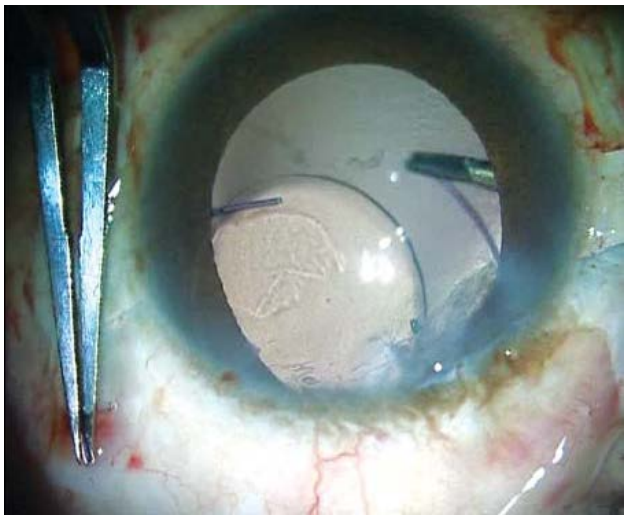


FIGURE 26: Haptic is gradually pulled towards the sclerotomy

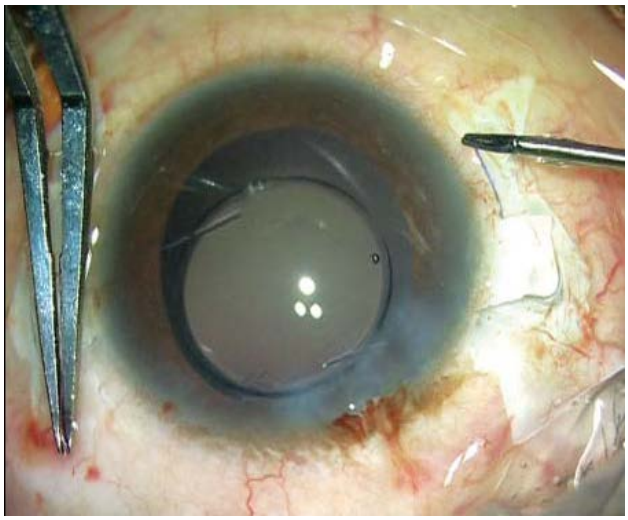


FIGURE 27: Haptic externalized

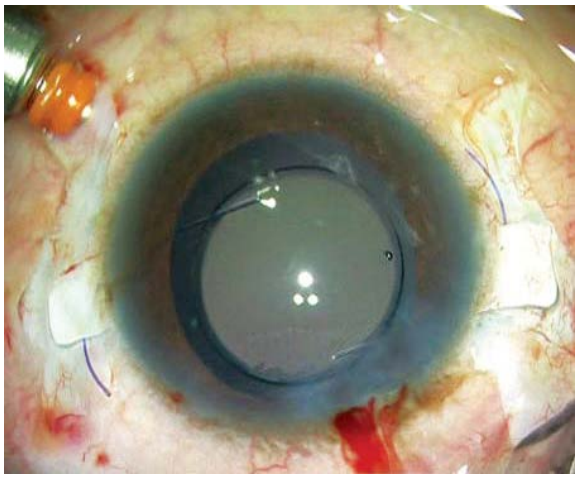


FIGURE 28: Both haptics externalized and can be seen lying under the sclera flaps

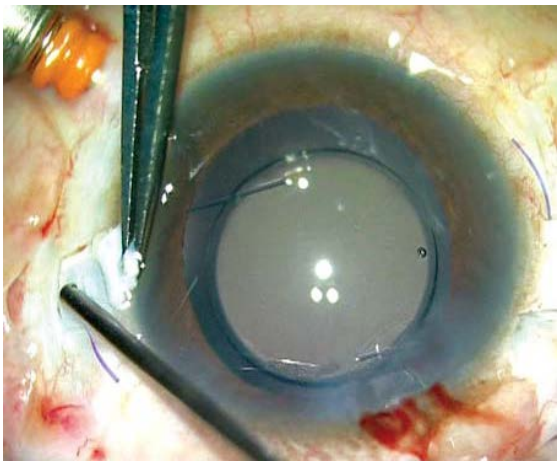


FIGURE 29: Vitrectomy done at the sclerotomy site

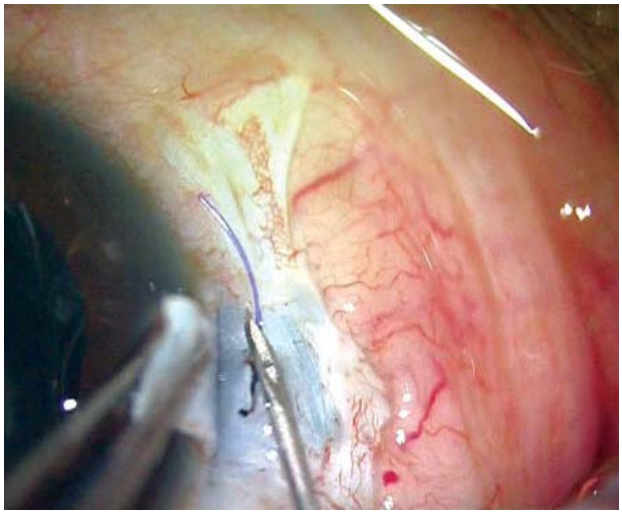


FIGURE 30: 26 G needle makes a sclera pocket at the edge of the flap where the haptic is seen

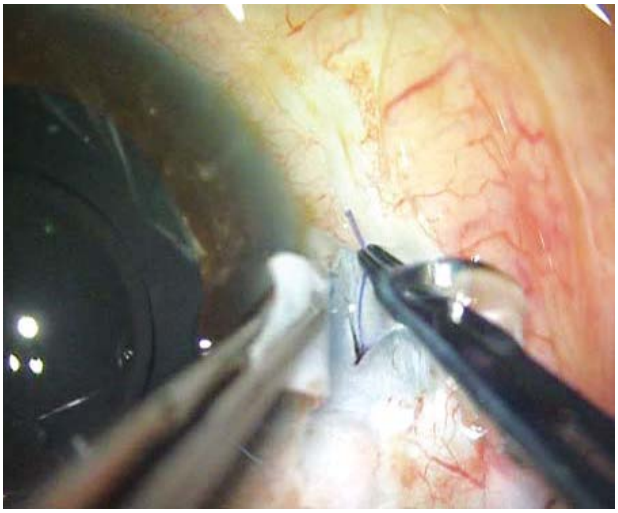


FIGURE 31: Forceps holds the haptic and flexes it to tuck it inside the scleral pocket

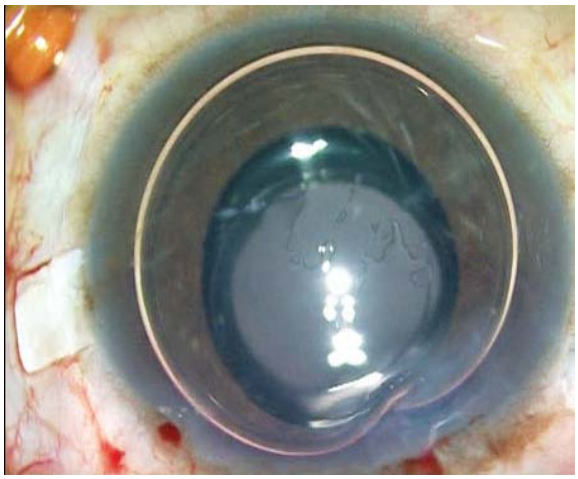


FIGURE 32: Haptic in the sclera pocket

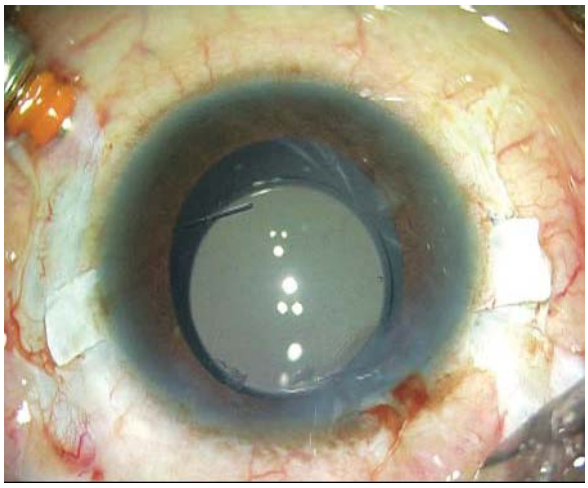


FIGURE 33: PC IOL stable

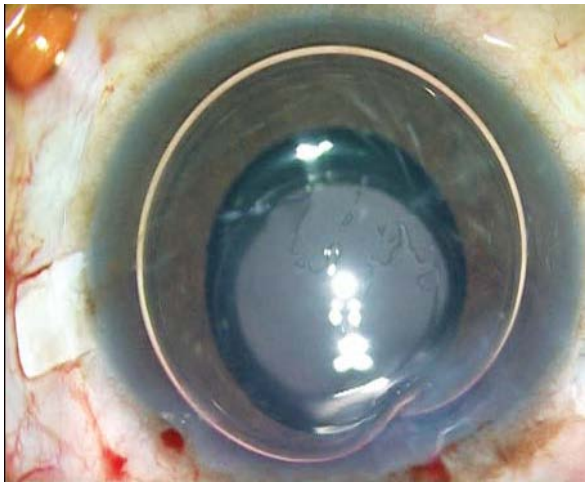


FIGURE 34: Infusion cut off and air fills the anterior chamber

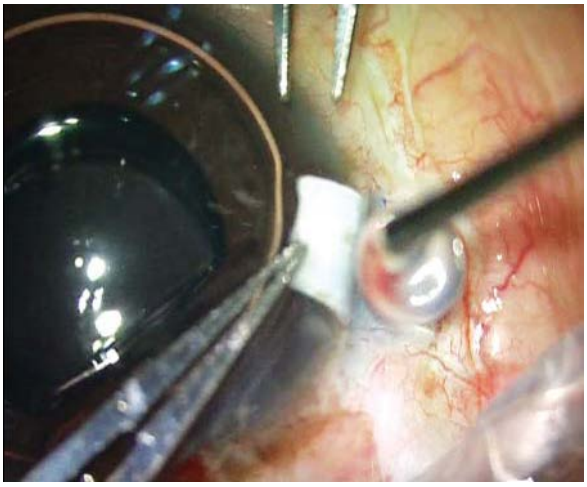


FIGURE 35: Fibrin glue (Tiessel, Baxter) application

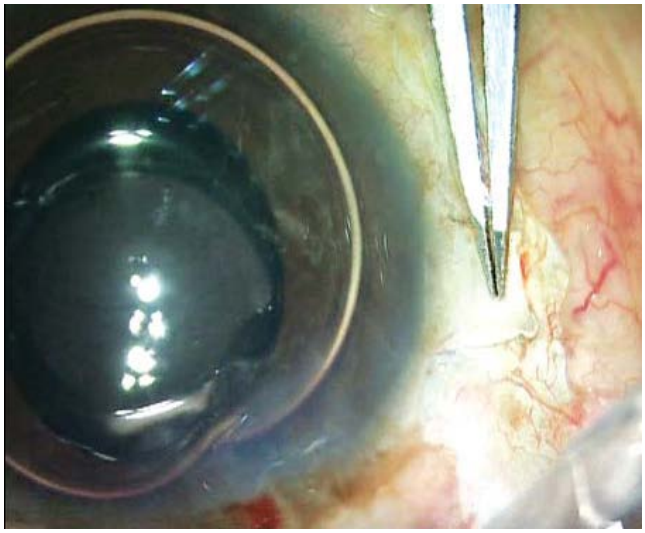


FIGURE 36: Scleral flap sealed

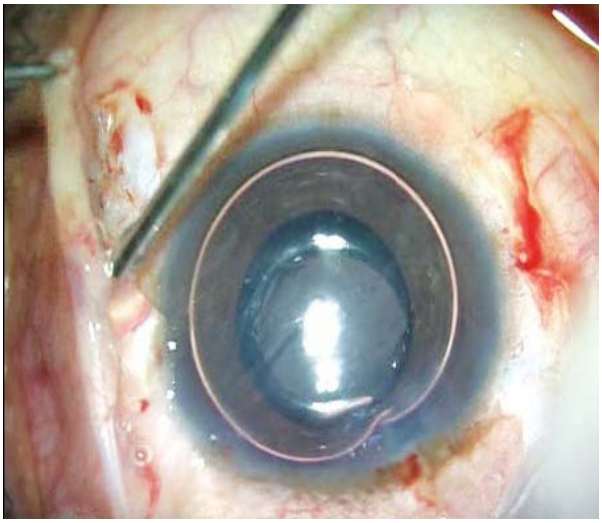


FIGURE 37: Fibrin glue applied on conjunctiva and clear corneal incison to seal them

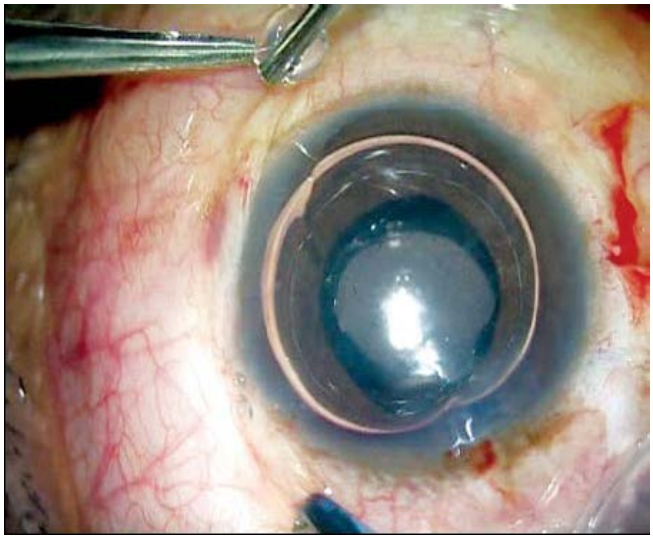


FIGURE 38: Immediate postoperation on table

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Posterior Capsular Rupture

AMAR AGARWAL & ATHIYA AGARWAL

INTRODUCTION

Any breach in the continuity of the posterior capsule is defined as a posterior capsule tear. Intrasurgical posterior capsule tears are the most common and can occur during any stage of cataract surgery. [1-3] The incidence of posterior capsule complications is related to the type of cataract and conditions of the eye, increases with the grade of difficulty of the case, and furthermore is influenced by the surgeon's level of experience. Timely recognition and a planned management, depending upon the stage of surgery during which the posterior capsule tear has occurred, is required to ensure an optimal visual outcome.

COMMON RISK FACTORS FOR POSTERIOR CAPSULAR RUPTURE (PCR)

- Intraoperative factors causing variation in anterior chamber depth
- Type of cataract
- Extended rhexis.

INTRAOPERATIVE FACTORS CAUSING VARIATION IN ANTERIOR CHAMBER DEPTH

Intraoperative shallow anterior chamber could be due to various reasons. It may be a tight lid speculum, tight drapes or pull from the recollecting bag. In all the above cases, one needs to remove the precipitating factors (to remove the speculum pressure and the tight drapes and collecting bags). Variation in the amount of space in the anterior and posterior chambers may result from changes in the intraocular pressure (IOP) due to an alteration in the equilibrium between inflow and outflow of fluid. Diminished inflow may be secondary to insufficient bottle height, tube occlusion or compression, bottle emptying, too tight incisions compressing the irrigation sleeve or the surgeon moving the phaco tip out of the incision, making the irrigation holes come out of the incision. Excessive outflow may be caused by too high vacuum/flow parameters or too large incisions with leakage. Another

cause is the postocclusion surge. Use of air pump or gas forced infusion solves most of these problems of intraoperative shallow anterior chamber. [1]

TYPE OF CATARACT

A higher incidence of posterior capsule tear with vitreous loss is associated with cataract with pseudoexfoliation, diabetes mellitus and trauma. Missing the diagnosis in a posterior polar cataract **(Figure 1)** can be catastrophic to the surgeon and the patient. It is frequently

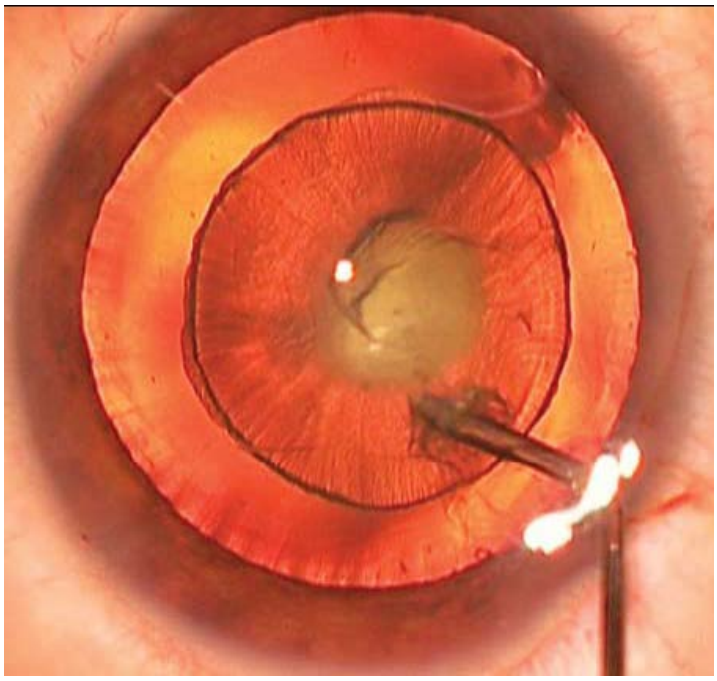


FIGURE.1: Hydrodelineation being performed in a posterior polar cataract

associated with a weakened or deficient posterior capsule. Posterior lenticonus, cataracts with persistent primary hyperplastic vitreous, cataracts following vitreoretinal surgery and morgagnian cataracts are some of the other types. In any intraoperative diagnosis of posterior polar cataract, it is to avoid hydrodissection with balanced salt solution (BSS). Hydrodissection may cause hydraulic perforation at the weakened area of the capsule, hence only a careful controlled hydrodelineation is preferred. One can also make multiple pockets of viscoelastic injection around the nucleus. If a capsular tear does occur, a closed system should be maintained by injecting viscoelastic before withdrawing the phaco tip. This helps to tamponade the vitreous backwards where a capsular dehiscence is present.

EXTENDED RHEXIS

Extension of anterior capsule can occur as a complication in MICS also. During capsulorhexis, anterior capsular tears can cause posterior capsule tear by extending to the periphery. In a new method of managing this situation, a nick is made from the opposite side of the rhexis using a cystitome or vannas and the capsulorhexis is completed. The viscoelastic in the anterior chamber (AC) is then expressed out to make the globe hypotonous, following which a gentle hydrodissection is done at 90° from the tear, while pressing the posterior lip of the incision to prevent any rise in intraocular pressure (IOP). No attempt is made to press on the center of the nucleus to complete the fluid wave. The fluid is usually sufficient to prolapse one pole of the nucleus out of the capsular bag; else it is removed by embedding the phacoemulsification probe, making sure not to exert any downward pressure and then gently pulling the nucleus anteriorly. The whole nucleus is brought out into the AC and no nuclear division techniques are tried in the bag. The entire nucleus is prolapsed into the anterior chamber and emulsified.

STEPS FOR MANAGEMENT OF PCR

Surgeon should be aware of the signs **(Table 1)** of posterior capsular tear. Posterior capsule tears can occur during any stage of phacoemulsification surgery. They occurred most frequently during the stage of nuclear emulsification, as reported by Mulhern et al[4] (49%) and Osher et al[5] and during irrigation–aspiration, as reported by Gimbel et al. [6] diminishing turbulence inside the eye. If the nucleus is soft, only a small residual amount remains, and there is no vitreous prolapse, the procedure may be continued. If vitreous is already present, special care must be taken for preventing additional vitreous prolapse into the anterior chamber or to the wound. Small residual nucleus or cortex can be emulsified by bringing it out of the capsular bag and can be emulsified in the anterior chamber with viscoelastic underneath the corneal endothelium. In case of a small PCR and minimal residual nucleus **(Figure 2)**, a dispersive viscoelastic is injected to plug the posterior capsule tear. Subsequently, the nuclear material is moved into the anterior chamber with a spatula and emulsified. The recommended parameters are low bottle height (20–40 cm above the patient's head), low flow rate (10–15 cc/ min), high vacuum (120–200 mm Hg) and low ultrasound (20–40%).

TABLE 1 **Signs of posterior capsular rupture**

- Sudden deepening of the chamber, with momentary expansion of the pupil
- Sudden, transitory appearance of a clear red reflex peripherally
- Apparent inability to rotate a previously mobile nucleus
- Excessive lateral mobility or displacement of the nucleus
- Excessive tipping of one pole of the nucleus

- Partial descent of the nucleus into the anterior vitreous space
- 'Pupil snap sign' – sudden marked pupil constriction after
- hydro-dissection

Three possible situations can happen in a posterior capsule rent namely: [7]

- Posterior capsule tear with hyaloid face intact and nuclear material present
- Posterior capsule tear with hyaloid face ruptured without luxation of nuclear material into vitreous
- Posterior capsule tear with hyaloid face ruptured and luxation of nuclear material into vitreous.

Immediate precautions are to be taken not to do further hydrate the vitreous and not to increase the size of the PCR. The conventional management consists of prevention of mixture of cortical matter with vitreous, dry aspiration and anterior vitrectomy, if required. In addition, during phacoemulsification, low flow rate, high vacuum and low ultrasound are advocated if a posterior capsule tear occurs.

REDUCE THE PARAMETERS

Lowering aspiration flow rate and decreasing the vacuum will control surge and will allow the bottle to be lowered, diminishing turbulence inside the eye. If the nucleus is soft, only a small residual amount remains, and there is no vitreous prolapse, the procedure may be continued. If vitreous is already present, special care must be taken for preventing additional vitreous prolapse into the anterior chamber or to the wound. Small residual nucleus or cortex can be emulsified by bringing it out of the capsular bag and can be emulsified in the anterior chamber with viscoelastic underneath the corneal endothelium. In case of a small PCR and minimal residual nucleus **(Figure 2)**, a dispersive viscoelastic is injected to plug the posterior capsule tear. Subsequently, the nuclear material is moved into the anterior chamber with a spatula and emulsified. The recommended parameters are low bottle height (20–40 cm above the patient's head), low flow rate (10–15 cc/min), high vacuum (120–200 mm Hg) and low ultrasound (20– 40%).

DRY CORTICAL ASPIRATION

If there is only a small amount or no vitreous prolapse in the presence of a small capsular rent, a dry cortical aspiration with 23 G cannula can be performed.

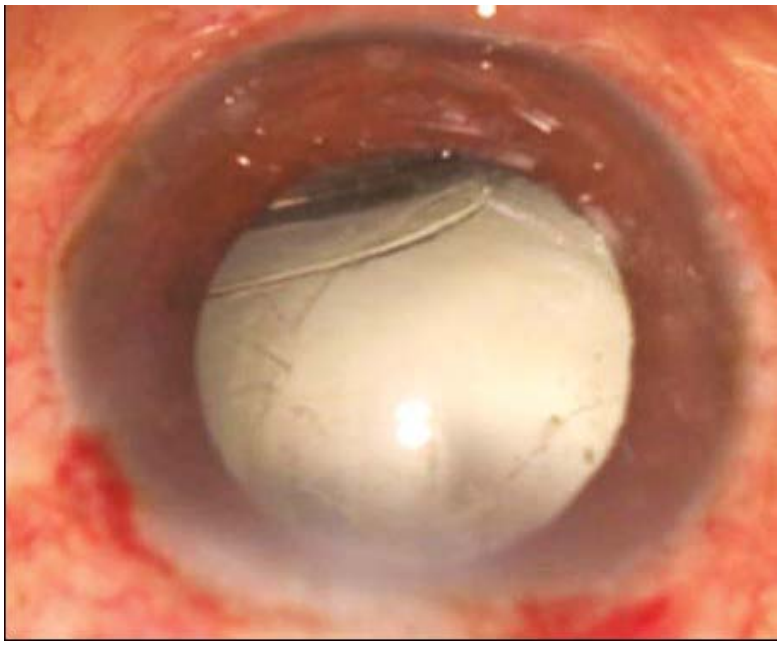


FIGURE 2: *Posterior capsular rupture. It is to be noted that the IOL sinking into the vitreous cavity. The white reflex indicates nuclear fragments also in the vitreous cavity. This patient was managaed by vitrectomy, FAVIT (removal of the nuclear fragments) and the IOL repositioned in the sulcus*

VISCOEXPRESSION

It is a method of removal of the residual nucleus by injecting viscoelastic underneath the nucleus to support it and the nucleus is expressed along with the viscoelastic.

CONVERSION TO EXTRACAPSULAR CATARACT EXTRACTION (ECCE)

If there is sizeable amount of residual nucleus, it is advisable to convert to a large incision ECCE to minimize the possibility of a dropped nucleus.

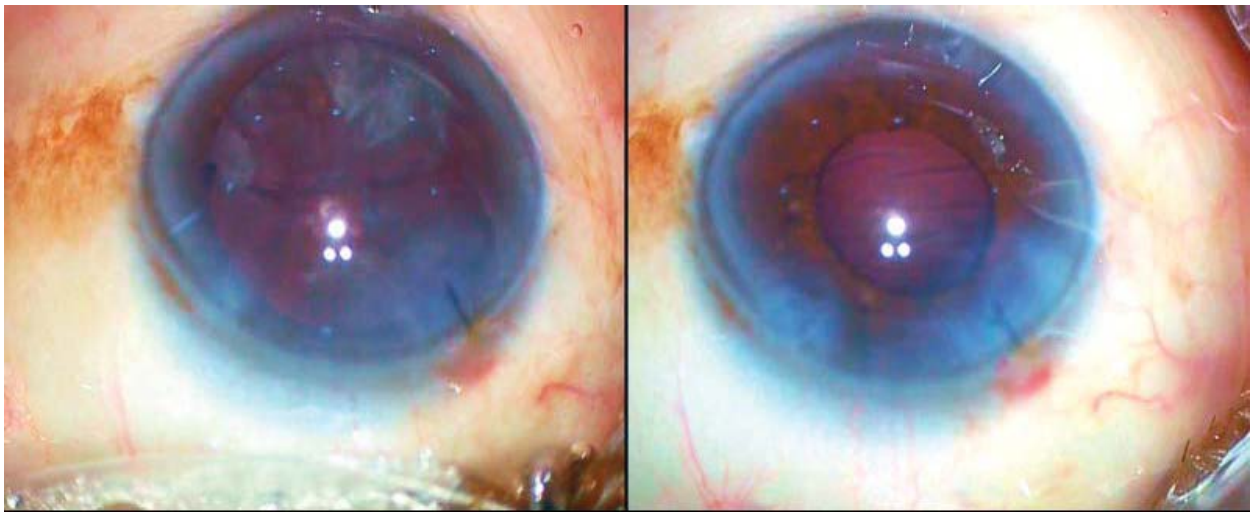
ANTERIOR BIMANUAL VITRECTOMY

Bimanual vitrectomy **(Figure 3)** is done in eyes with vitreous prolapse. Use 23 G irrigating cannula via side port after extending the side port incision. The irrigation bottle is positioned at the appropriate height to maintain the anterior chamber during vitrectomy. Vitrectomy should be performed with cutting rate (500–800 cuts per minute), an aspiration flow rate of 20 cc/min and a vacuum of 150–200 mm Hg.

FIGURE 3: Bimanual vitrectomy is being performed in a posterior capsular tear with vitreous prolapse

ANTERIOR CHAMBER CLEARED OF VITREOUS

Vitrectomy is continued in the anterior chamber and the pupillary plane. A rod can be introduced into the anterior chamber to check the presence of any vitreous traction and the same should be released. Complete removal of the vitreous from the anterior chamber can be confirmed if one sees a circular, mobile pupil **(Figures 4A and B)** and complete



FIGURES 4A and B: *Clinical photographs showing the change in the anterior chamber after complete removal of the vitreous from the anterior chamber. (A) Before vitrectomy, (B) After vitrectomy*

air bubble in the anterior chamber. The usage of the fiber of an endoilluminator, dimming the room lights and microscope lights, may be useful in cases of doubt, in order to identify vitreous strands. Another useful measure is the use of purified

triamcinolone acetate suspension (Kenalog) to identify the vitreous described by Peyman. [8] Kenalog particles remain trapped on and within the vitreous gel, making it clearly visible.[9]

SUTURE THE WOUND

In cases with vitreous loss with PCR, it is recommended to suture the corneal wound as a prophylaxis to prevent infection. One should remove any residual vitreous in the incision site in the main and side port with vitrector or manually with Vannas scissors. If necessary, one needs to insert a rod via the side port and pass it over the surface of the iris, to release them.

IOL IMPLANTATION

Depending upon the state of the capsular bag and rhexis, IOL is implanted **(Table 2).**

TABLE 53.2 - IOL implantation in PCR

- Insertion and rotation of IOL should always be away from the area of capsule tear

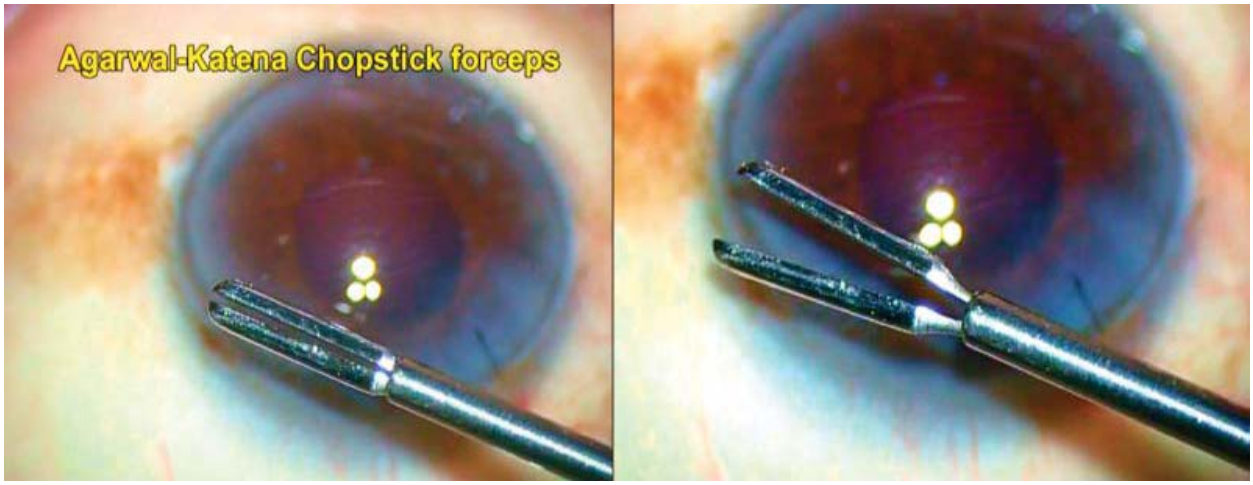
- The long axis of the IOL should cross the meridian of the posterior capsule tear
- Eyes with (< 6 mm) PCR with no vitreous loss, IOL can be placed in the capsular bag
- In the presence of a posterior capsule tear(>6 mm) with adequate anterior capsule rim, an IOL can be placed in the sulcus In deficient capsules, Glued IOL is a promising technique without complications of sutured scleral fixated or anterior chamber IOL

IN THE BAG

In the presence of a posterior capsule tear with good capsular bag, the IOL can be placed in the bag. Small PCR with no vitreous loss and good capsular bag, foldable IOL can be placed.

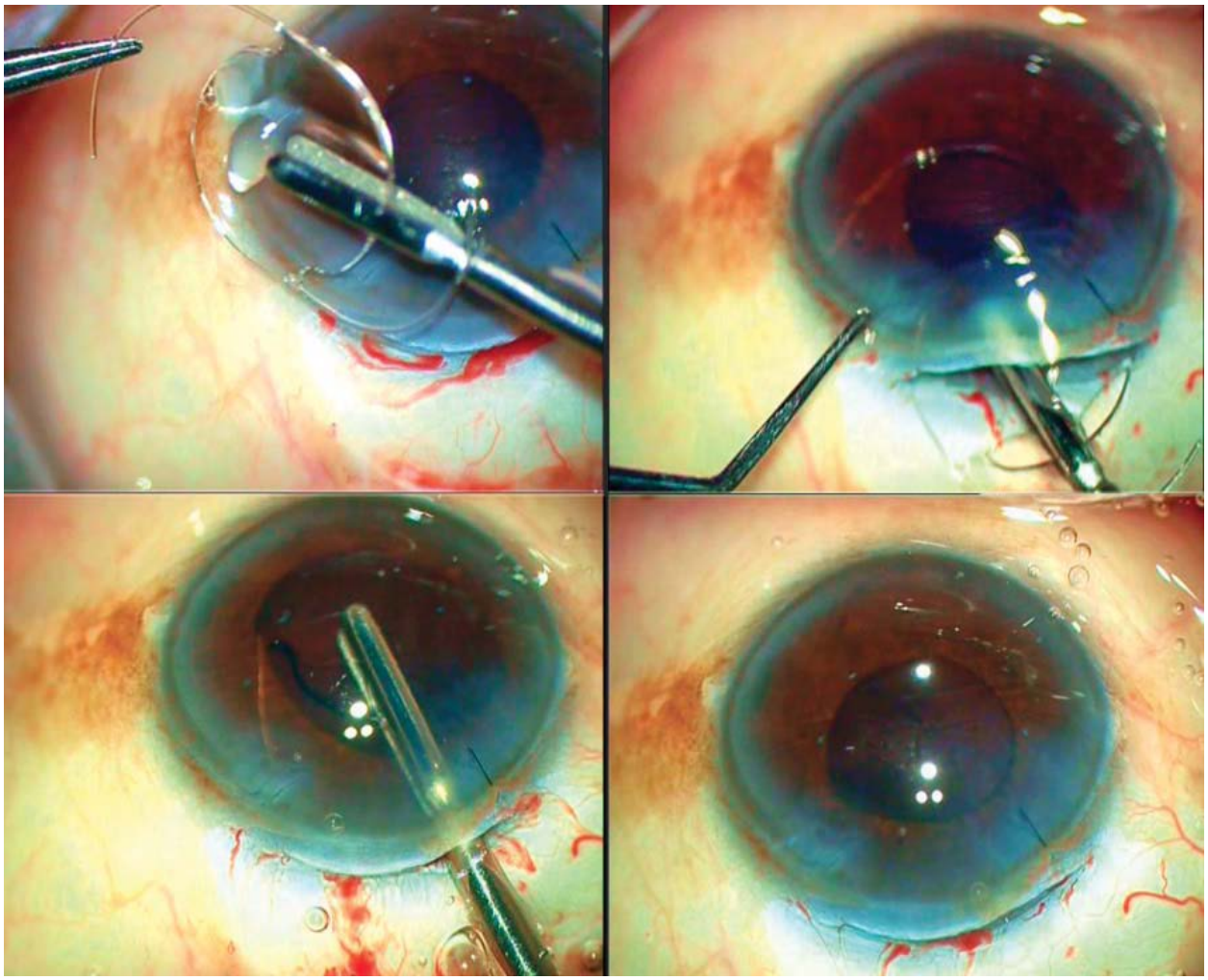
IN THE SULCUS

If the rent is large, if the capsular rim is available, then the IOL can be placed in the sulcus. The rigid IOL can be placed in the sulcus in large PCR over the residual anterior capsular rim with Mc Person forceps holding the optic. The "chopstick technique" is another method of placing IOL in sulcus. In this new chopstick forceps namely, 'Agarwal- Katena forceps' **(Figures 5A and B)** is used for IOL implantation.



FIGURES 5A AND B: *(A) Photograph of an 'Agarwal- Katena' forceps. (B) Reverse opening shown (Katena, USA)*

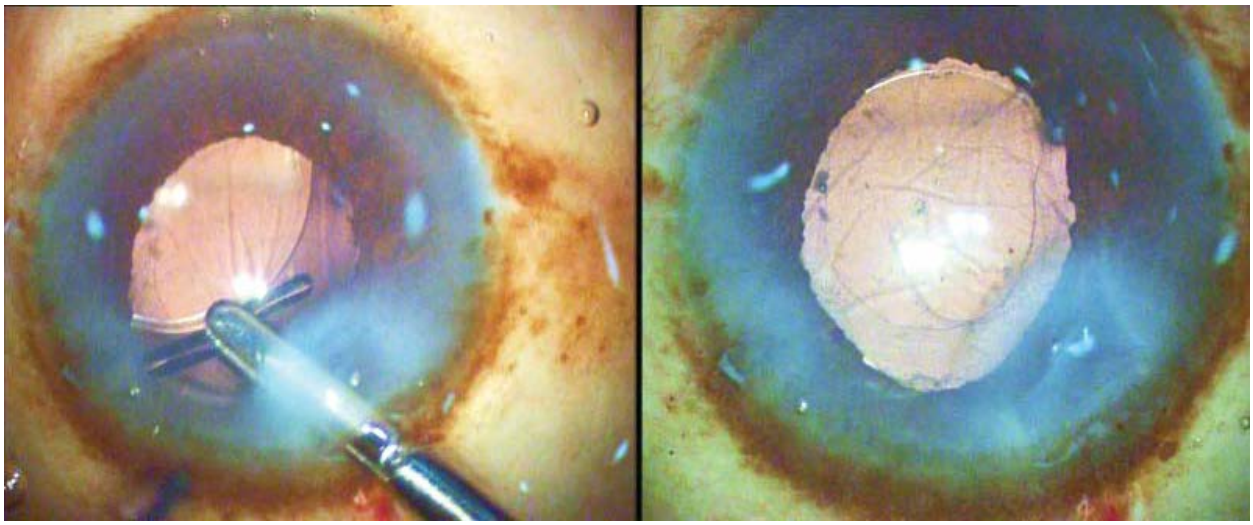
This chopstick technique refers to the IOL being held between two flangs of the forceps. The advantage is the smooth placement of the IOL in the sulcus without excess manipulation. Moreover, the IOL implantation is more controlled **(Figures 6A to D)** with the forceps as compared to other methods. Small PCR with no vitreous loss and good capsular bag, foldable IOL can be placed **(Figures 7A and B).** In eyes with intraoperative miosis with PCR, IOL can be implanted with the pupil expansion with "Agarwal's modified Malyugin ring" method **(Figures 8A and B).** In this method, [10] a 6-0 polyglactic suture is placed in the leading scroll of the Malyugin ring and injected into the pupillary plane **(Figures 9A and B).** The end of the suture stays at the main port incision. Once in place, the ring produced a stable mydriasis of about 6.0 mm. Hereby, IOL can be implanted easily in the sulcus with visualization and this prevents the inadvertent dropping of the iris expander into the vitreous during intraoperative manipulation.



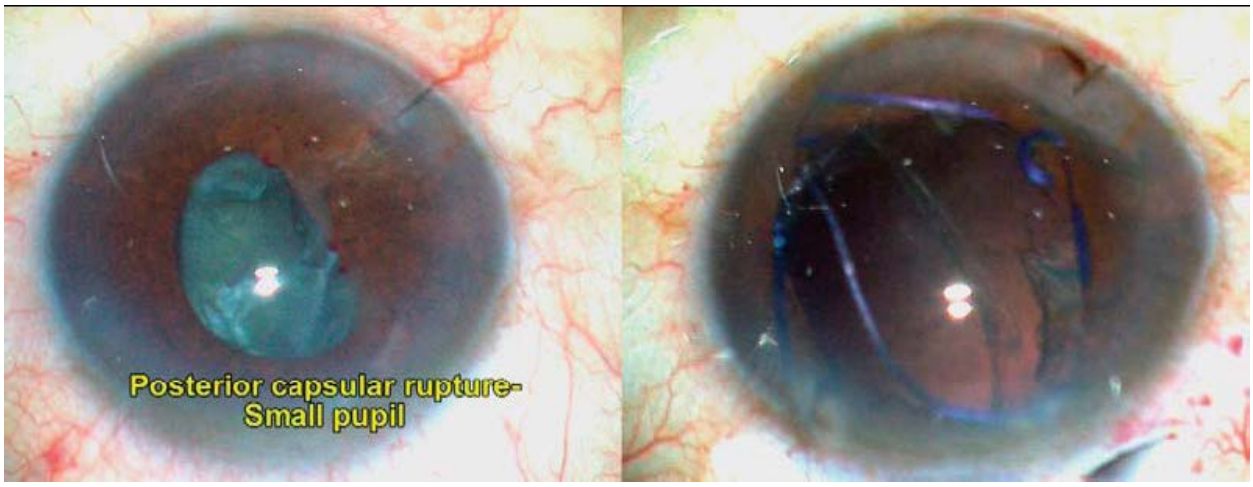
FIGURES 6A TO D: *(A) The 6.5 mm PMMA rigid IOL being held between two flangs of the forceps. (B) IOL is being introduced through the limbal incision. (C) IOL is positioned in the sulcus. (D) IOL is well centered*

DEFICIENT POSTERIOR CAPSULE

Now recently Glued IOL [11-13] is easily performed in such cases with deficient posterior capsules. Scleral fixated posterior chamber lenses and anterior chamber IOLs [14,15] can also be implanted when the posterior capsule tear is large.



FIGURES 7 A AND B: *(A) Foldable IOL is placed with 'Agarwal-Katena' forceps into the sulcus, (B) IOL well centered on the capsular rim*

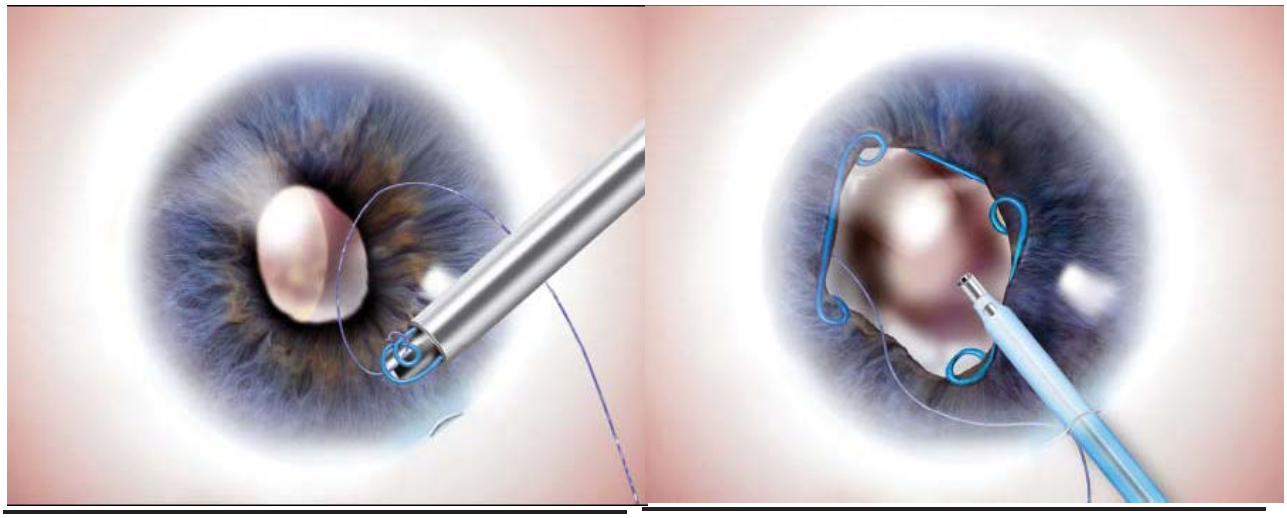


FIGURES 8A AND B: (A) Intraoperative miosis with posterior capsular tear. (B) Agarwal's modification of the Malyugin ring iris expansion: A 6-0 polyglactic vicryl suture passed in the leading scroll of the ring and injected. The end of the suture stays at the main port incision

SQUELAE AFTER POSTERIOR CAPSULAR RUPTURE

Vitreous Traction

Incomplete vitrectomy can produce dynamic traction on the retina leading to retinal breaks.



FIGURES .9 A AND B: Illustration depicting the Agarwal modification of the Malyugin ring for cases with small pupil with a posterior capsular rupture. (A) 6/0 suture tied to the ring. (B) Malyugin ring in place in the pupil. The suture can be pulled at if the ring begins to fall into the vitreous

Retinal Detachment

Undetected long standing vitreous traction progresses to retinal break and detachment.

Macular Edema

Manipulation of vitreous will increase not only the traction transmitted to the retina but also the inflammation in the posterior segment and the risk of macular edema.

Vitritis

Over-enthusiastic use of viscoelastic into the vitreous can lead to sterile inflammation. Dropped minimal residual cortex can also present with postoperative vitritis.

IOL RELATED COMPLICATIONS

Improperly placed IOL in the sulcus can lead to lens induced astigmatism and tilt.

CONCLUSION

The occurrence of a posterior capsule tear during cataract surgery is one of the most serious complications. It is important for a surgeon to diagnose the occurrence of a posterior capsule tear at an early stage, to avoid further

enlargement of the tear and associated vitreous complications. The primary goal of all the maneuvers is to remove the remaining nucleus, epinucleus, and as much as cortex possible without causing vitreoretinal traction.

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