Review Article

Glued intrascleral haptic fixation of an intraocular lens

Priya Narang, Amar Agarwal[1]

Glued intrascleral haptic fixation of an intraocular lens (glued IOL) has evolved as a technique with various modifications that are adopted and practiced by several surgeons. With adequate and appropriate haptic tuck, glued IOL imparts a stable IOL fixation and is a secured method of secondary IOL placement with no pseudophacodonesis.

Key words: Double infusion cannula technique, fibrin glue, glued IOL, IOL scaffold, handshake technique, no-assistant technique, pre-Descemet's endothelial keratoplasty, SFT, triumvirate, T-ACM

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Sutureless scleral fixation with a specially designed intraocular lens (IOL) with three equidistant supple loops was first performed by Maggi and Maggi in 1997 wherein pars plana fixation of a posterior chamber (PC) IOL was achieved by the transscleral passage of the haptics.[1] The concept of modern intrascleral haptic fixation of an IOL was first conceived and formulated by Gabor and Pavlidis in 2006.[2] They reported a technique for sutureless fixation of standard 3-piece PC IOLs in the ciliary sulcus with the fixation of the haptics in a limbus-parallel scleral tunnel. The method did not have any scleral flap and the haptics after externalization were tucked intrasclerally at the level of mid-scleral thickness.

Agarwal conceived the concept of scleral flap making and covering the part of the externalized haptic by the scleral flaps that were later sealed with fibrin glue and the technique was hence named as glued intrascleral haptic fixation of an IOL (glued IOL).[3] The first glued PC IOL implantation in an eye with a deficient capsule was done by Agarwal on December 14, 2007.[4]

Principle

The intrascleral haptic tuck forms the most essential component of providing strength and stability to the IOL fixation with glued IOL technique. Therefore, it is extremely important to be sure of the amount of haptic that is being tucked into the scleral pockets. This is especially important in cases with greater white-to-white diameter (WTW) where the amount of haptic externalization is minimal. In addition, in the technique, fibrin glue is used to seal the scleral flaps that have the advantage of preventing ocular hypotony by sealing the flaps.

Preoperative Evaluation

Preoperative evaluation of a patient undergoing glued IOL surgery is extremely essential as there can be various associated features along with surgical trauma. The postoperative outcome of this surgery depends a lot on the proper preoperative evaluation of the case as eyes undergoing glued IOL surgery are often associated with an element of vitritis and cystoid macular edema (CME) or are at times associated with corneal decompensation, following an eventful phacoemulsification surgery. Indirect ophthalmoscopy is a useful technique to allow a wide-angle view of the fundus, to screen for retinal disease, and to examine the peripheral retina. Whenever possible, a B-scan or an ultrasound biomicroscopy (UBM) analysis of the posterior segment should also be performed. Specular microscopy should be performed to assess the corneal status, and WTW diameter should always be measured before the surgery as it directly correlates to the amount of haptic availability for tucking after haptic externalization.

Glued Intrascleral Haptic Fixation of an Intraocular Lens Technique

Under peribulbar anesthesia, corneal marking is done 180° opposite to each other for the creation of scleral flaps at the

Narang Eye Care and Laser Centre, Ahmedabad, Gujarat, [1]Dr. Agarwal's Eye Hospital and Research Centre, Chennai, Tamil Nadu, India

Correspondence to: Dr. Amar Agarwal, Dr. Agarwal's Eye Hospital and Eye Research Centre, 19, Cathedral Road, Chennai - 600 086, Tamil Nadu, India. E-mail: dragarwal@vsnl.com

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proposed site of haptic externalization. Localized conjunctival peritomy and wet cautery of the sclera are done along the corneal marks. A 23G sutureless trocar infusion cannula at pars plana, an anterior chamber maintainer (ACM), or a trocar-ACM[5] is placed in position for fluid infusion inside the eye. Two partial thickness limbal-based scleral flaps about 2.5 mm × 2.5 mm are created exactly 180° apart. Two straight sclerotomies with a 22G needle are made about 1.0 mm from the limbus under the existing scleral flaps. This is followed by the introduction of the 23G vitrectomy cutter through the sclerotomy site to perform adequate vitrectomy and remove all the vitreous from the anterior chamber (AC) and cut down all the vitreous traction. A 2.8-mm clear corneal incision is then framed for introducing the 3-piece foldable IOL. While the IOL is being introduced and slowly unfolded, an end gripping 23G/25G forceps (Micro Surgical Technology, USA) or a glued IOL forceps is passed through the left sclerotomy site. The tip of the leading haptic is grasped with the glued IOL forceps that is then pulled through the sclerotomy site after the entire IOL has unfolded. The assistant holds the tip of the leading haptic to prevent its slippage inside the AC. The trailing haptic is then flexed inside, and the tip of the haptic is grasped and externalized from the other sclerotomy site. A handshake technique can be adopted for safe externalization of the trailing haptic [Fig. 1].[6] The tip of the haptics is then tucked inside a scleral tunnel made with 26G needle. Vitrectomy is performed at the sclerotomy site, the ACM or the infusion cannula is removed, and air is injected inside the AC. The corneal incision is sutured with 10-0 suture and the scleral flaps and the conjunctiva are sealed with the fibrin glue application.

Handshake Technique

The exteriorization of haptics is the key step in glued IOL surgery, and the handshake technique[5] comprises transferring the haptics from the one hand to another till the tip of the haptic is grasped for safe haptic externalization. If the haptic is not grasped or gets accidentally released after grasping it, the situation can be easily resolved using this technique. It is essential to have two glued IOL forceps to perform this technique. The handshake transfer of the haptic between the two-glued IOL forceps is continued till the tip of the haptic is caught by the forceps on the side where the haptic is to be exteriorized. This technique thus allows easy intraocular maneuvering of the entire haptic or IOL within a closed globe system [Video 1].

Correct Shake for Handshake

The correct positioning of a surgeon with respect to the scleral flaps is extremely important due to the fact that the movement of the surgical hands for handshake technique for effective haptic externalization should be assigned correctly. The surgeon should always be positioned perpendicular to the plane of scleral flaps and to the plane of haptic maneuver.[7]

Importance of Fluid Infusion

Fluid is a natural milieu of the eye and it is extremely essential to maintain the globe integrity throughout the glued IOL surgery. Injection of viscoelastic should be avoided as it tends to seep into the posterior segment and create inflammation in the postoperative period. Fluid infusion can be maintained by an ACM, trocar cannula at pars plana, or trocar-ACM. The trocar-ACM creates a transconjunctival biplanar wound that is self-sealing [Fig. 2] and overcomes the shortcomings of an ACM, such as spontaneous extrusion and forced introduction into the eye from variability in the size of the corneal paracentesis incision.[4]

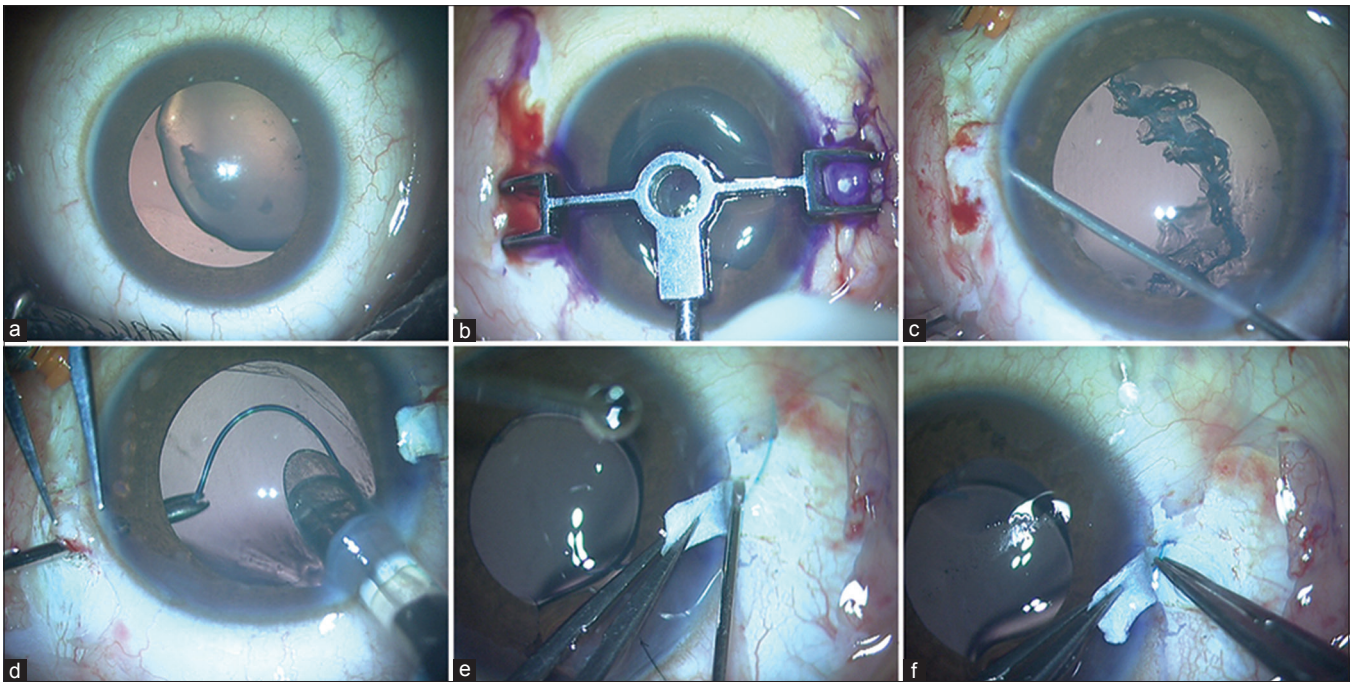

Figure 1: Glued intrascleral haptic fixation of an intraocular lens in Marfan syndrome. (a) Subluxated crystalline lens. (b) Scleral marker for glued intrascleral haptic fixation of an intraocular lens. (c) Lensectomy and vitrectomy done. Peripheral iridectomy done with vitrector. (d) Tip of leading haptic grasped with glued intrascleral haptic fixation of an intraocular lens forceps. (e) Both haptics externalized. 26G needle creates Scharioth pocket. (f) Haptic tucked in scleral pocket

Glued Intrascleral Haptic Fixation of an Intraocular Lens in Large Eyes

In eyes with greater WTW diameter (>12 mm), certain adaptations and modifications are adopted that lead to adequate haptic externalization and the subsequent tuck.

Vertical Glued Intrascleral Haptic Fixation of an Intraocular Lens

The vertical diameter of the cornea is less as compared to horizontal diameter. Therefore, in large eyes, it is preferred to make two partial thickness flaps at 6′ and 12′ o clock position as compared to 3′ and 9′ o clock position.[8] Making vertical flaps has an added advantage of having more haptics externalized as the haptics tend to cross a lesser distance as compared to the horizontal dimension.

Anterior Sclerotomy

Performing an anterior sclerotomy at a distance of 0.5 mm from the limbus beneath the scleral flaps instead of 1.5 mm has an added advantage of shifting the plane of IOL more anteriorly, thereby allowing haptics to traverse a lesser distance and allowing greater haptic externalization.[9]

A careful approach is essential as performing an anterior sclerotomy can lead to iridodialysis due to the 22G needle entering the eye at a 0.5 mm distance from the limbus. Complications associated with hitting the base of the iris can be avoided by performing a prior vitrector-assisted peripheral iridectomy (PI). Although this avoids additional manipulation during the surgery, bleeding and pigmentary disturbance can occasionally occur.

Peripheral Iridectomy for Large Eyes

A vitrector-assisted PI is performed in association with anterior sclerotomy in cases with large eyes undergoing glued IOL fixation [Fig. 1c]. This technique minimizes the chances for iris damage during anterior sclerotomy and facilitates haptic externalization by ensuring a smooth passage of the 22G needle and the glued IOL end opening forceps through the sclerotomy site.[10] To perform a vitrector-assisted PI, the cut rate is maintained at 20 cuts per minute. The cutter is placed at the proposed iridectomy site along the base of the scleral flaps and below the ink-mark line on the corneal surface at the 180° axis. With the aspiration mode at a low setting, the iris tissue is engaged in the cutter probe. A low cutting rate ensures proper aspiration of the iris tissue into the cutter and prevents the accidental aspiration of the entire iris tissue in that quadrant, thereby averting the formation of a complete iridectomy. The iris is therefore cut with the vitrectomy probe in a controlled manner under direct visualization. Subsequently, the PI is also performed at the proposed site of the second sclerotomy site.

Quintet in Glued Intrascleral Haptic Fixation of an Intraocular Lens

The word Quintet suggests a combination of five things; hence, Quintet in glued IOL is a combination of five surgical procedures adopted for glued IOL in large eyes.[11] The techniques that are followed in sequential order are vertical glued IOL (1), introduction of trocar-ACM (2), vitrector-assisted PI (3), anterior sclerotomy (4), and pupilloplasty (5). Performing a pupilloplasty procedure prevents captive iris [Fig. 3] in the postoperative period that may occur due to the entrapment of the iris tissue into the optic of the IOL due to migration of the plane of the IOL anteriorly.

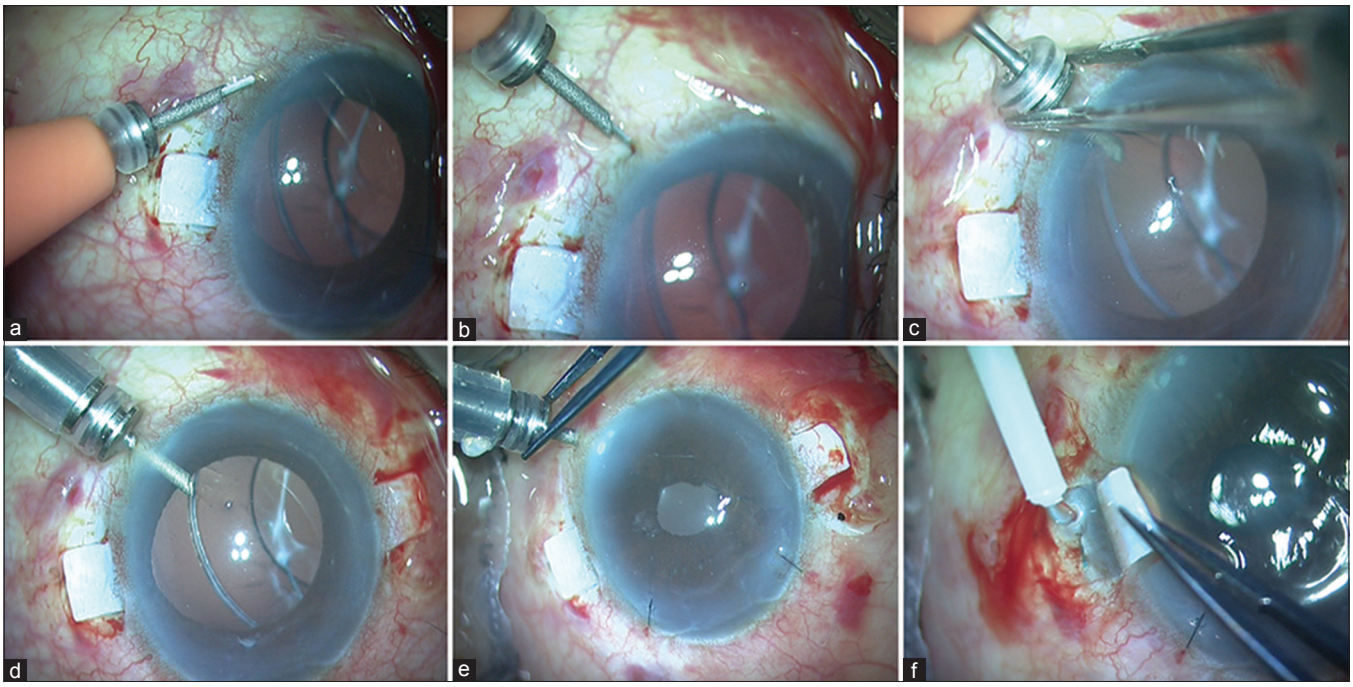

Figure 2: Trocar anterior chamber maintainer. (a) Trocar anterior chamber maintainer introduced 0.5 mm from the limbus. (b) Trocar anterior chamber maintainer is turned 90° to enter anterior chamber. (c) Trocar is removed. (d) Infusion cannula fixed. (e) Haptics are tucked and trocar anterior chamber maintainer is removed. (f) Air is put in anterior chamber and fibrin glue applied on scleral beds to seal flaps

Modifications in Glued Intrascleral Haptic Fixation of an Intraocular Lens Surgery

No-assistant technique

The technique of no-assistant technique (NAT) was developed by one of the authors Dr. Narang and it works on the principle of the vector forces. The mid-pupillary plane is the major contributor to the success of this technique.[12]

Under normal scenario, after externalization of the leading haptic, there is a tendency of the haptic to slip back into the AC due to vector forces acting along the axis of the IOL. Hence, an assistant is needed to hold the haptic and prevent it from slipping inside the eye. However, in NAT, after the externalization of the leading haptic, when the trailing haptic is flexed inside the eye and it crosses the mid-pupillary plane close to nearly at 6'o clock position, the vector forces act in a way that causes further extrusion of the leading haptic from the sclerotomy site with virtually no chance of slippage of leading haptic into the AC [Fig. 4]. The technique of NAT prevents less haptic-related issues as an assistant does not grasp the haptics and the surgery becomes totally surgeon dependent.[12,13]

Beiko–Steinert technique

The glued IOL technique requires an assistant to hold the haptics of the IOL once they have been externalized through the sclerotomies. If an assistant is not available, it is likely that the externalized haptic will be pulled into the eye once the second haptic is externalized. To prevent the migration of the first haptic into the eye, it is possible to use a silicone tire of iris hooks as suggested by Beiko and Steinert.[14] This silicone tire is readily available from a Mackool Capsular Support System (Impex Surgical) or MST Capsular Support (Microsurgical Technology Inc.). Placing the silicone tire on the haptic provides support for the haptic and prevents its slippage in to the AC while the other maneuvers are being performed. Steve Safran has worked on the same principle using a small cut cross-section of an intravenous tubing that can be tucked like the silicon tire to the haptic.[15]

Ohta's technique

Toshihiko Ohta from Japan started a simplified and safer method of Y-Fixation technique for sutureless intrascleral PC IOL fixation.[16] With this technique, a Y-shaped incision is made in the sclera and a 23G microvitreoretinal knife is used to create the sclerotomy instead of a needle. The Y-shaped incision eliminates the need to raise a lamellar scleral flap. The concept is to create two Y-shaped incisions 2 mm from the limbus exactly 180° apart diagonally. A scleral tunnel is made parallel to the limbus at the end of the Y-shaped incision. This helps improve wound closure.

Combined Surgeries

Glued intrascleral haptic fixation of an intraocular lens scaffold

This technique[17,18] essentially comprises the combination of the glued IOL[3,8-13] with IOL scaffold[19,20] procedure and is adopted in cases with deficient sulcus support with nonemulsified nuclear material. Following a posterior capsule rupture, the nuclear fragments are pushed aside in the AC, a 3-piece IOL is injected beneath the fragments, and the tip of the haptics is externalized as in a glued IOL procedure. After the haptic tuck, the nuclear pieces are emulsified with the phaco probe introduced inside the AC [Fig. 5].

Triumvirate technique

This procedure[21] comprises the combination of a modified posterior-assisted levitation (PAL) along with IOL scaffold and

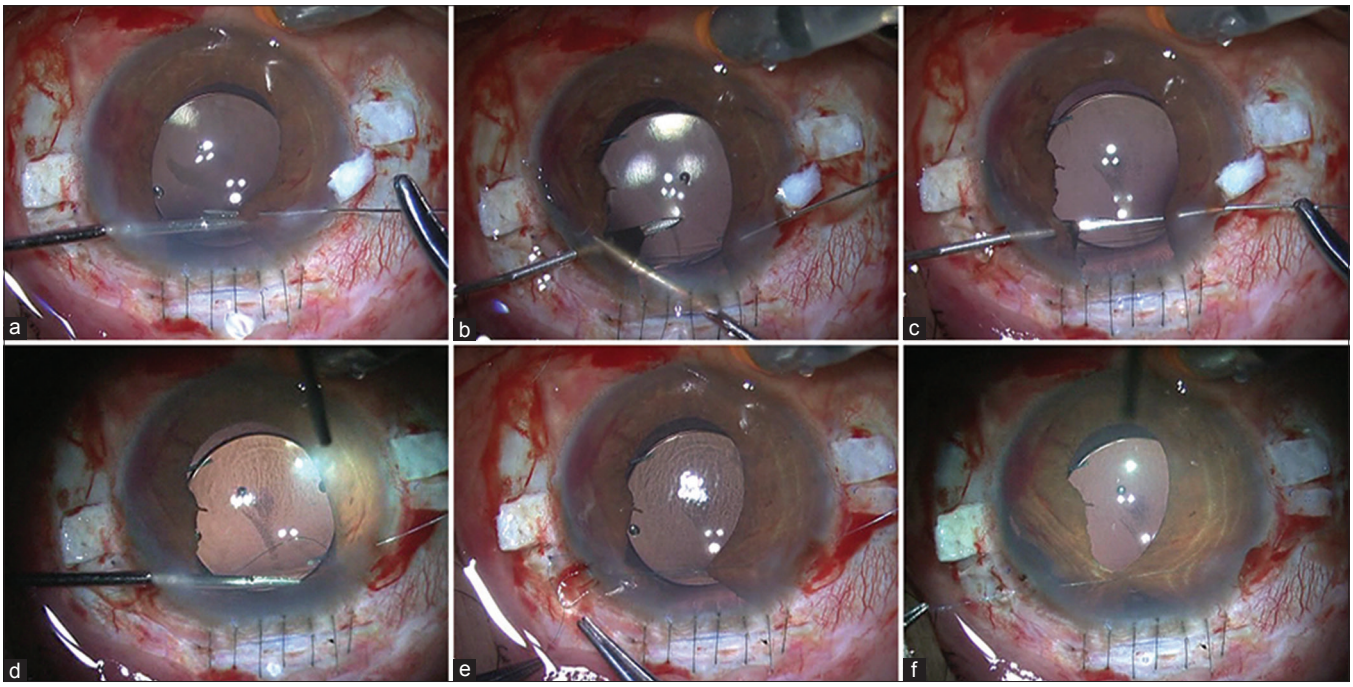

Figure 3: Single-pass 4-throw pupilloplasty. (a) 10-0 suture passed through proximal iris tissue. (b) A 26G needle introduced from opposite quadrant. (c) The 10-0 needle docked into 26G needle. (d) Loop of suture withdrawn. (e) The suture end passed from loop four times. (f) Both suture ends pulled; knot slides inside eye

glued IOL in cases with deficient sulcus support and sinking nuclei [Fig. 6].

Following flap making and the sclerotomy incision, a rod or a spatula is passed through the sclerotomy site created for glued IOL surgery, and all the nuclear fragments are levitated into the AC as against a conventional PAL technique[22] where the sclerotomy incision is made at a distance of 3 mm from the limbus. The additional advantage with performing a modified PAL[21] is that two sclerotomy sites can be availed for nuclear levitation beneath each scleral flaps and also the sclerotomy site gets covered by the scleral flaps at the end of

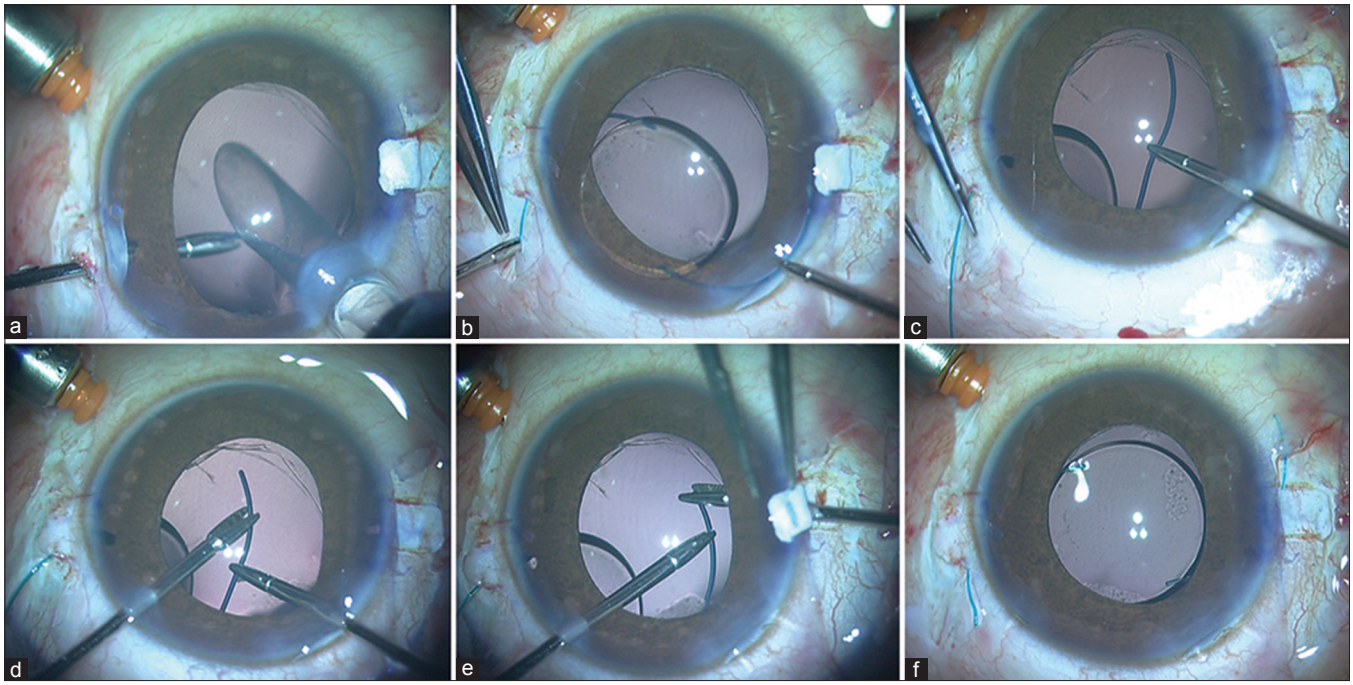

Figure 4: No-assistant technique. (a) The glued intrascleral haptic fixation of an intraocular lens forceps grasps haptic tip. (b) Leading haptic externalized. (c) Surgeon holds the leading haptic with left hand and trailing haptic passed into anterior chamber towards 6'0 clock position. (d) Leading haptic does not slip. (e) Tip of trailing haptic grasped. (f) Both haptics externalized

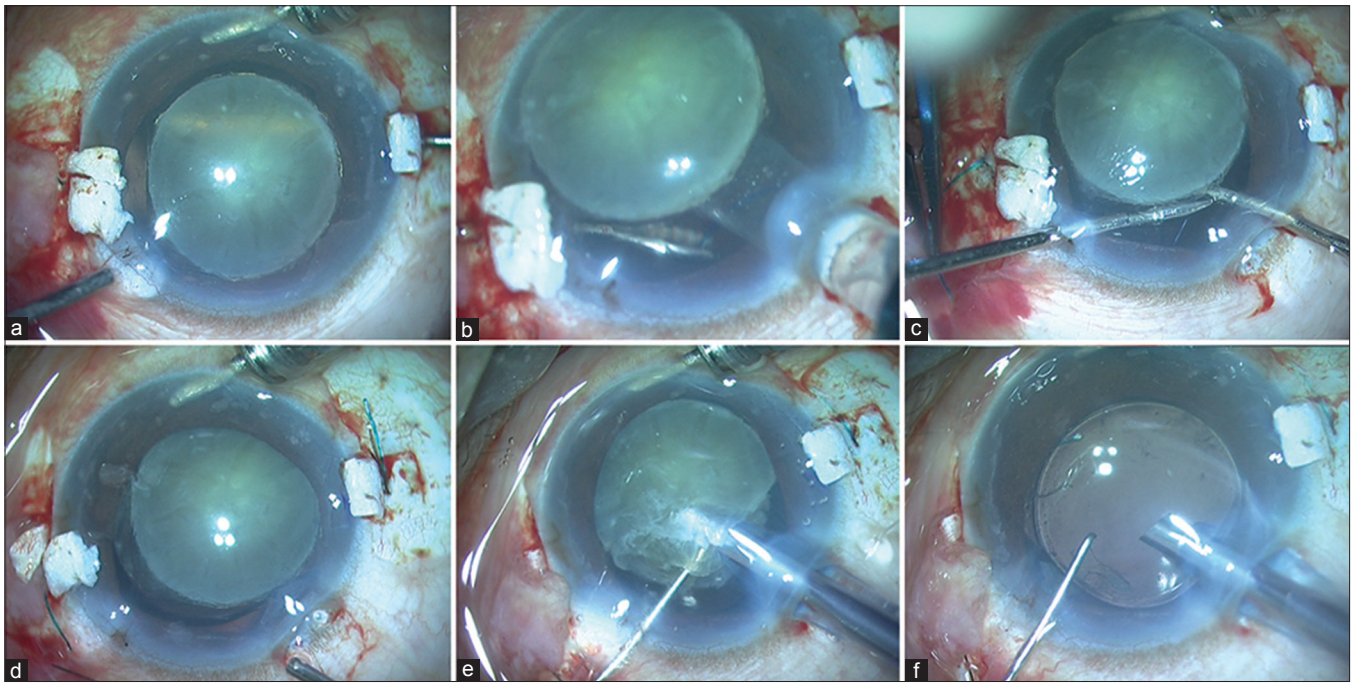

Figure 5: Glued IOL scaffold. (a) Modified posterior assisted levitation technique is performed. (b) Intraocular lens unfolded beneath the nucleus and the tip of haptic grasped. (c) Handshake technique done under nucleus. (d) Both haptics are externalized. (e) Haptics tucked in the Scharioth pocket. (f) Nucleus emulsified

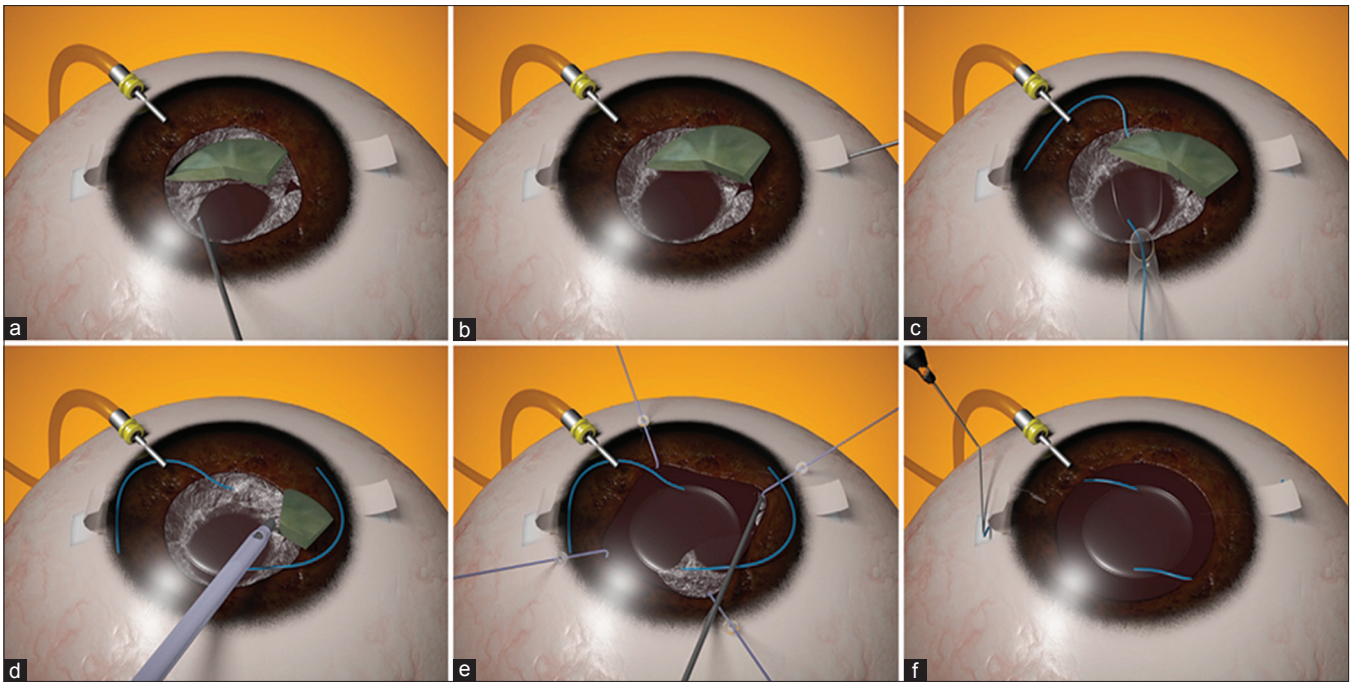

Figure 6: Animated demonstration of Triumvirate technique. (a) Posterior capsule rupture with nuclear fragments into anterior chamber. (b) Modified posterior assisted levitation performed. (c) Three-piece intraocular lens is injected; haptics are placed on anterior surface of iris. (d) Intraocular lens scaffold being performed. (e) Iris hooks applied. (f) The haptics are externalized and tucked into scleral pockets

the procedure, thereby avoiding and negating any incidence of sclerotomy site leakage or exposure to the external environment. Once the nuclear pieces are levitated with modified PAL technique, IOL scaffold procedure is performed with the haptics being placed on the anterior surface of the iris, followed by shifting these haptics behind the iris and performing a glued IOL procedure once the nuclear pieces are emulsified.

Glued intrascleral haptic fixation of an intraocular lens with keratoplasty

In patients with predominantly endothelial damage, an endothelial keratoplasty (EK) may be performed, instead of a penetrating keratoplasty (PK). This has advantages over PK of being a closed chamber technique with faster visual recovery, better quality of vision, lesser induction of irregular astigmatism, lesser chances of rejection, and less surface and suture-related problems. There is also likely to be less postoperative refractive surprise with EK as compared to PK. Glued IOL can be combined with Descemet's stripping automated EK,[23] Descemet's stripping EK,[24] or pre-Descemet's EK.[25] It may also be done as a staged procedure performing the glued IOL first and the EK in a second sitting.

Glued IOL surgery can also be performed with PK procedure. Femtosecond laser-assisted PK with AC IOL explantation and glued IOL has been performed by us and has been documented in peer-reviewed journal, wherein the creation of the donor and host corneal button is achieved with femtosecond laser.[26]

Double infusion cannula technique

The double infusion cannula technique facilitates an EK procedure in pseudophakic or aphakic eyes that need either a secondary IOL primary placement or an IOL explantation with placement of a new IOL with secondary fixation procedure. In this technique, two trocar cannulas are placed in position; the first trocar infusion cannula is placed at pars plana as in a glued IOL procedure. Once the IOL is fixed and pupilloplasty procedure is performed, a second trocar infusion cannula is placed anteriorly at a distance of 0.5 mm away from the limbus. The anteriorly placed trocar is utilized for air infusion during the procedure of EK that facilitates descemetorhexis under air, followed by stoppage of air infusion during the procedure of graft insertion.

Glued IOL can be performed for complicated cases with subluxated bag-IOL complex [Fig. 7] and also for cases with associated Soemmering ring formation [Fig. 8].

Visual Outcomes and Results after Glued Intrascleral Haptic Fixation of an Intraocular Lens

Ever since the introduction of glued IOL for deficient capsular support, the postoperative outcomes and the surgical results for short-, interim-, and long-term have been satisfactory [Fig. 9].[3-13,26-41] In the 1-year follow-up study of 53 eyes, there was a significant improvement in uncorrected distance visual acuity (UDVA) and spectacle best-corrected distant visual acuity (BDVA).[30] In our earlier report on the interim results of rigid glued IOL (n = 152), there was a significant improvement in UDVA and BDVA. Fifty-two per cent gained 20/20 BDVA postoperatively.[31] In pediatric eyes study, the mean postoperative BDVA was 0.43 ± 0.33, and there was a significant change noted ($P < 0.001$).[29] Postoperatively, 20/20 and greater than 20/60 BDVA was obtained in 17.1 and 46.3% of eyes, respectively.[29] BDVA improvement more than one line was seen in 53.6% of eyes. Prakash *et al*. reported three

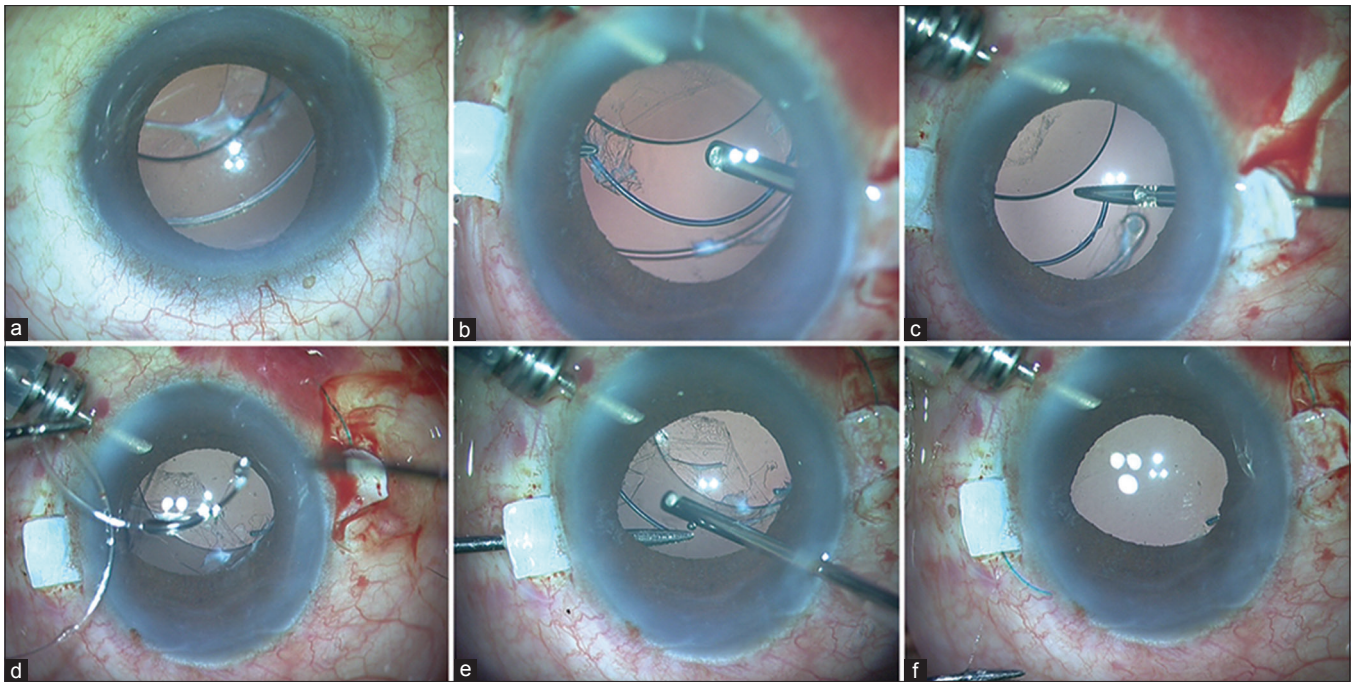

Figure 7: Subluxated capsular bag-intraocular lens complex with endocapsular ring to glued intrascleral haptic fixation of an intraocular lens. (a) Subluxated capsular bag-intraocular lens complex with endocapsular ring. (b) Trocar anterior chamber maintainer fixed; vitrectomy performed through sclerotomy. (c) Glued intrascleral haptic fixation of an intraocular lens forceps grasps tip of haptic. (d) Endpocapsular ring explanted. (e) Glued intrascleral haptic fixation of an intraocular lens forceps grasps tip of other haptic. (f) Both haptics externalized

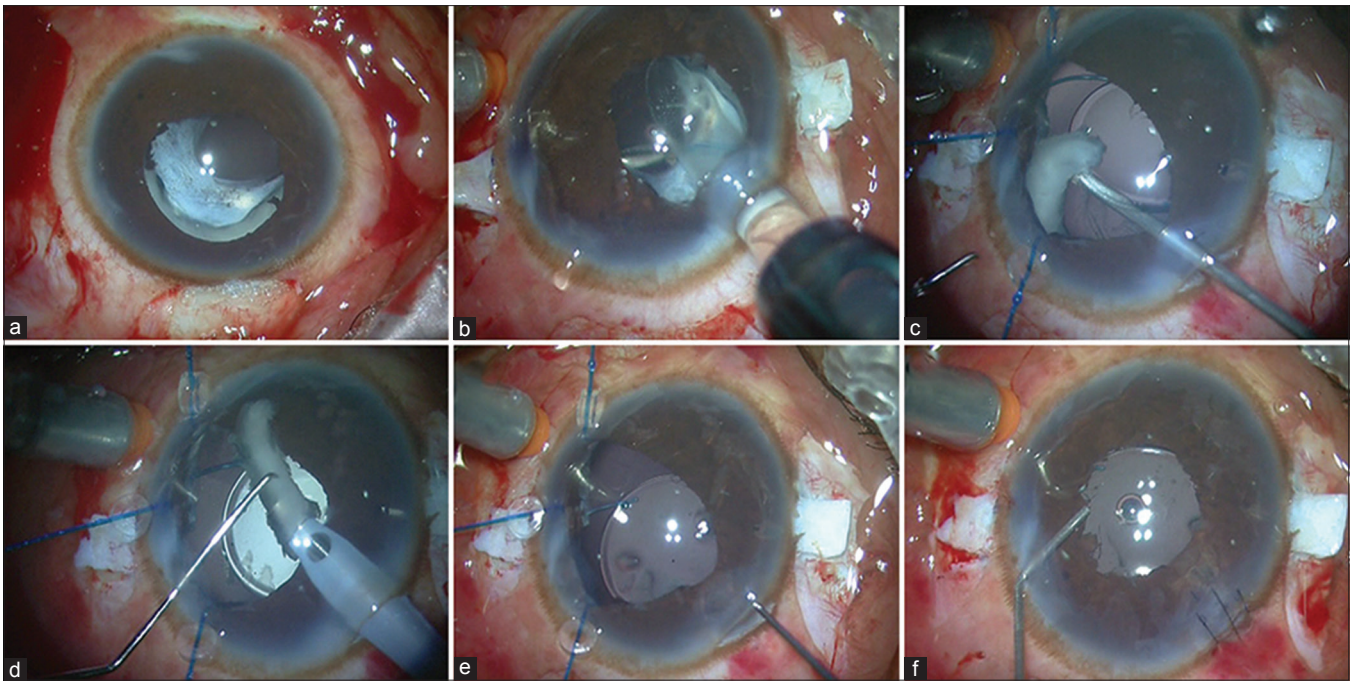

Figure 8: Soemerring ring management. (a) Soemmering ring with aphakia. (b) Scleral flaps made for glued intrascleral haptic fixation of an intraocular lens surgery; 3-piece intraocular lens injected inside anterior chamber. (c) The Soemmering material manipulated above intraocular lens optic. (d) The Soemmering material emulsified with phaco probe. (e) Soemmering material emulsified. (f) Iris hooks are removed, corneal incision sutured

eyes in which the same PC IOL was translocated from AC to PC without complications.[32] Sinha *et al*. reported the outcomes after repositioning the decentered PC IOL in the PC using the same IOL by glued IOL method and showed good results.[42] In another retrospective analysis of visual outcomes, which included 735 eyes, there were 486 rigid glued IOL, 191 foldable IOL, 10 glued iris prosthesis, 16 glued IOL with pupilloplasty, and 32 glued IOL with PK.[34] The

mean postoperative UDVA and BDVA were 0.19 ± 0.19 and 0.38 ± 0.27, respectively, in rigid IOL (Single-piece PMMA IOL, Appasamy Associates, Chennai, Tamil Nadu, India). The most common indication was PCR and aphakia in that report of 735 eyes. There was a significant improvement in UDVA and BDVA (paired *t*-test, $P = 0.000$).[34] An additional interim results on rigid glued IOLs (PMMA) ($n = 152$), with a mean follow-up of 9.7 ± 3.2 months, where 38.8% eyes completed >12 months follow-up also showed satisfactory outcomes.[31]

In a recent study of glued IOL in US population, McKee *et al*. have shown mean visual acuity improvement from 20/200–20/50 postoperatively.[43] Narang and Narang showed that about 84% of the eyes had a gain in one or more lines after glued IOL in eyes with inadequate capsules.[39] Postoperatively, there was a significant improvement in the UDVA ($P < 0.05$) and in the BDVA ($P < 0.05$). Serial digital slit lamp images of the eye with full pupillary dilatation showed good IOL centration [Fig. 10].[31]

In the recent series of foldable glued ($n = 208$), the mean UDVA was 1.20 ± 0.5 logMAR preoperatively and 0.99 ± 0.5 logMAR postoperatively.[27] There was a significant improvement in UDVA ($P = 9.67$ E-9, Wilcoxon signed-rank test) and CDVA ($P = 5.14$ E-8) in the operated eyes. In another review of foldable-glued IOL ($n = 191$), with a mean follow-up of 16.6 ± 8.8 months (range 6–48 months), the mean postoperative BDVA and UDVA was 0.39 ± 0.29 and 0.22 ± 0.23, respectively.[34] In the long-term follow-up study, the mean postoperative BDVA was 0.63 ± 0.2 decimal equivalent.[38] The overall mean corneal astigmatism was 1.48 ± 1.1 D. Corneal astigmatism was noted to be higher ($P = 0.007$) in the rigid IOL group (1.7 ± 1 D) compared with the foldable IOL group (0.98 ± 1.2), and there was no correlation ($P = 0.080$; $r = -0.228$) noted between the corneal astigmatism and visual acuity.[38]

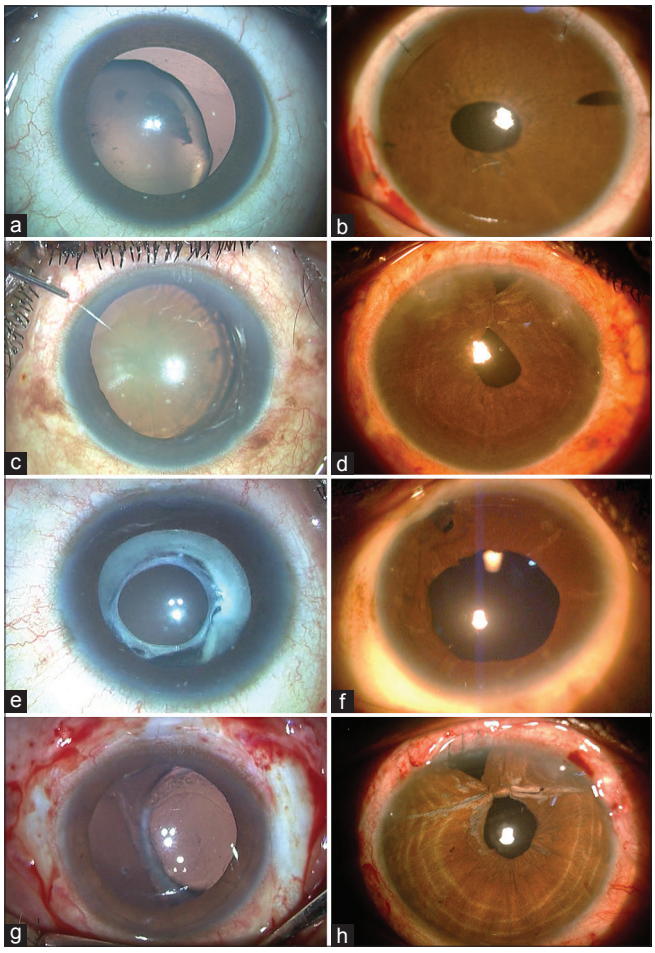

Figure 9: Preoperative and postoperative images of patients of glued intrascleral haptic fixation of an intraocular lens

Complications of Glued Intrascleral Haptic Fixation of an Intraocular Lens

Intraoperative – Scleral flap issues

The scleral flap issues can range from nondiagonal flaps to torn scleral flaps. Too small or large scleral flaps too have an issue that needs to be dealt carefully. Scleral flaps should be 180° diagonally apart. Nondiagonal flaps about 5°–10° also can affect the final positioning of the IOL. Surgery should not be proceeded with eccentric flaps as sclerotomy is to be done beneath these flaps and a path is created for the externalization of haptics. This eventually leads to decentration of the IOL. A fresh flap should be created diagonally opposite to the previous one and then the surgery should be proceeded to the next level. Too narrow flaps should be avoided as it may be difficult to create the scleral pocket next to the sclerotomy. When too wide or large flaps are created, the length of haptic underneath the flaps is more than that in the scleral tunnel. This should be avoided as a greater amount of haptic length is wasted from the sclerotomy site to the entry point of the scleral pocket. As a result, the proportion of haptic tucked is less. Disproportionate flap size can give rise to disproportionate haptic tuck that can give rise to torsional instability. Symmetrical graft size on either side is crucial in the prevention of this complication. Superficial thin flaps can lead to postoperative thinning or erosion of haptics. Intraoperatively, obtaining the exact depth of flaps and proper dissection plane can prevent this.

Sclerotomy issues

Anterior sclerotomy

Anterior sclerotomy is often adopted for eyes with greater

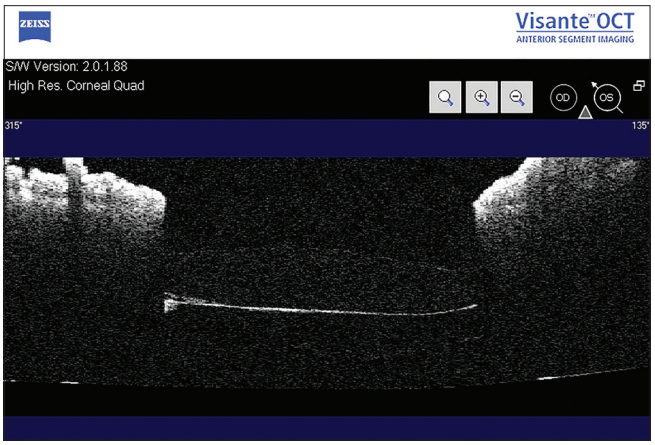

Figure 10: Anterior segment optical coherence tomography of glued intrascleral haptic fixation of an intraocular lens. Anterior segment optical coherence tomography image of glued intrascleral haptic fixation of an intraocular lens *in vivo* taken in corneal high-resolution raw mode across the intraocular lens showing good centration without tilt

WTW diameter. An anteriorly placed sclerotomy can damage the iris base and lead to iridodialysis and hyphema. To prevent this, the 22G needle should be introduced a bit vertical rather than horizontal from the scleral site with the direction toward the mid-vitreous cavity.

Posterior sclerotomy

Sclerotomy placed more than 2 mm behind the limbus has the risk of having less haptic available for tucking that can lead to IOL destabilization and tilt. In such a situation, the haptic should be reinternalized and new sclerotomy should be made at 1.0 mm distance from the limbus and the haptic should be reexternalized.

Vitrectomy-related issues

During the learning curve, vitrectomy-related challenges might be encountered in glued IOL surgery. Incomplete vitrectomy and iris damage can happen during vitreous cutting. Undue traction or excess suction can be better avoided. Triamcinolone can be used to stain the vitreous; this ensures that no vitreous strand is present in the AC and the pupil is totally free from vitreous. The vitreous is removed up to a level just posterior to the capsule making the retropupillary space and the AC totally free from vitreous. Improper vitreous removal can lead to pupil peaking and late retinal traction.

Intraoperative hyphema

Inadvertent damage to iris or inflamed eye with previous neovascularization can lead to intraoperative hyphema. Forceful, sudden entry through the iris root during anterior sclerotomy can also be the cause at times. Patients with proliferative eye disease such as diabetes, neovascular glaucoma or patients on anticoagulants are predisposed and utmost care and due precautions should be exercised.

Iridodialysis

Forceful sclerotomy entry at the limbus can lead to detachment of the iris from its root and hence an iridodialysis. Any resistance encountered during the procedure of sclerotomy should be taken as a warning sign, and the needle should be withdrawn. Once resistance is felt at the entry site, it is better to withdraw the needle and reenter in the adjacent site. Large iridodialysis needs to be surgically repaired and sutured intraoperatively.

Haptic-related issues

A haptic kink or break can be induced if the surgeon exerts undue pressure while holding the haptic during the various maneuvers that are performed intraocularly during the haptic externalization procedure. Haptic breakage might often necessitate explantation of the IOL due to inadequate haptic left for tucking. The foldable-glued IOL study reported haptic deformation in 0.9% cases and 0.4% incidence of haptic breakage that necessitated an IOL replacement with another IOL.

Intraocular lens drop

IOL drop is usually encountered in the early stages of the learning curve of a surgeon. As there is no posterior capsule available for support, any error on the part of the surgeon during the handling of the IOL can lead to an IOL drop. Sudden and uncontrolled unfolding of the IOL during injection can cause this, and therefore, unfolding of the IOL should always be gradual and slow. Improper handling of the haptics by a surgeon or failure of the assistant to hold the externalized haptic causes the haptic to slip back in to the eye and may often lead to an IOL drop.

Decentered and tilted intraocular lens

It is essential to create the partial thickness scleral flaps exactly 180° opposite to each another. Eccentric flaps lead to decentered IOL as the haptics are externalized beneath the flaps from the sclerotomy site. As the IOL is not positioned along its long axis, continuous stress on the haptics leads to decentration. Under such a scenario, fresh flaps should be made exactly opposite to each other and the haptic on the one side should be reinternalized followed by reexternalization and a tuck. IOL tilt can occur due to defective positioning of the sclerotomy sites on either side leading to astigmatism and compromised visual acuity.

Postoperative Complications

Corneal decompensation

This usually results from excessive intraoperative manipulation and damage to the corneal endothelial cell. Depending on the amount of trauma to the endothelial cells, the inflammation resolves over a period of time, and in worse case scenarios, when it is associated with secondary glaucoma, it can lead to permanent corneal damage.

Intraocular lens tilt

IOL tilt is one of the components of malposition that can lead to astigmatism, change in optical higher-order aberrations, and loss of best-corrected visual acuity. The symmetrical positioning of the sclerotomy is one of the key steps in the glued IOL stability. An UBM analysis of postoperative glued IOL's demonstrated microscopic tilt in 17.4% of eyes.[27] The optic tilt noted in our study was less than the tilt seen in scleral fixated IOL as reported by Loya *et al*. and Swelam *et al*.[44,45]

Intraocular lens decentration

Asymmetric scleral flaps, non-diagonal flaps, and unequal haptic tucking are the common causes for early postoperative IOL decentration. Immediate IOL repositioning in the operating room is advised under such situation. In our foldable-glued IOL series, IOL decentration was seen in 3.3% of cases.[28] Unequal haptic tuck on both scleral tunnels will lead to late IOL decentration. The overall diameter of the IOL can also affect the centration of the IOL.

Haptic extrusion

Improper haptic tuck and too thin scleral flaps can lead to haptic extrusion. Eyes with too thin flaps, excessive use of scleral cautery, and scleral thinning disorders such as rheumatoid arthritis are more prone for such complication. Under this situation, tucking has to be reperformed with proper conjunctival apposition.

Secondary glaucoma

Secondary glaucoma can develop due to inadequate vitrectomy and often due to the induced traumatic changes into the angle structures due to the previous episode of trauma that probably led to lens subluxation or dislocation. High-risk patients for postoperative secondary glaucoma are those with previous uveitis, trauma, and steroid responders. Therefore, IOP needs to be continuously monitored in all the cases that undergo glued IOL surgery.

Cystoid macular edema

Complicated cataract surgery and prolonged surgical manipulation with vitreous loss can predispose to the development of CME. In our series, the loss of CDVA due to CME occurred in 1.9% of eyes with foldable-glued IOL postoperatively.[28] In pediatric age group, the incidence of postoperative macular edema was 4.8%.[29] Another report showed that 7.5% healed macular changes after glued IOL on 1-year follow-up.[45]

Retinal detachment

Inadequate or improper vitrectomy across the pupillary plane and sclerotomy port leads to postoperative retinal traction and breaks. Vitrectomy at the sclerotomy site is very crucial in preventing postoperative retinal traction. Eyes with congenital conditions with retinal degeneration-like Marfan syndrome should undergo proper preoperative retinal screening and any predisposing conditions such as lattice or holes should be lasered.

Hypotony

Improper scleral flap sealing or wound leak can lead to postoperative hypotony. Intraoperatively, continuous fluid infusion prevents any hypotony and postoperatively proper sealing of the scleral flaps with fibrin glue helps avert hypotony.

Detection of pseudophacodonesis: High-speed photography and slow motion video

The authors have documented that the element of pseudophacodonesis is absent in glued IOL fixation procedure provided the haptics have been adequately tucked.[46] Subtle intraocular movements such as iridodonesis, phacodonesis, and pseudophacodonesis are often not appreciated or go unnoticed by a human eye. Human eyes are accustomed to videos that are played at 24–30 fps. Slow motion captures a series of pictures very fast and adjusting the smartphone camera to 120 fps (iPhone 5s) or 240 fps (iPhone 6) sets the recording of at least 120 images/240 images per second or more, respectively. When this video runs, it typically plays back at eyeball friendly 24–30 frames a second. In other words, 120 fast images are played at the speed human eye is receptive to. The huge excess of 120 images that have been filmed in 1 s of real shooting lasts for around 4 s or more (30 × 4 = 120) on the screen. Thus, slow motion is derived. Detection of pseudophacodonesis is another important aspect of "Slo-Mo" recording. It has a clinical implication of explaining the process of subsequent vitreous disturbance and CME. The demonstration of the slow displacing movement of the IOL in the eye with ocular movement in cases of an AC IOL and iris claw IOL may lead to rubbing of the IOL on iris surface or a hammock-like movement. Potential movement of the IOL is subjected to cause disturbance in the vitreous cavity or in cases of AC IOL it may cause release of inflammatory tissue from the iris leading, to prolonged CME. High fps recording of glued IOL does not demonstrate pseudophacodonesis. The authors conceptualize that this can be because of the intrascleral tucking of the haptics that prevents any movement of the IOL. Postoperative detection of pseudophacodonesis in glued IOL may be present in cases with improper tucking. Under such a scenario, the scleral flaps of glued IOL surgery should be lifted and proper tucking should be done afresh.

Recent Developments

Flanged haptic externalization (Yamane's technique)

In 2014, Yamane *et al*. reported a new technique with a 27G needle guided intrascleral fixation of PC IOL that provided good IOL fixation with reliable wound closure without the use of any sutures. The haptics of the IOL were externalized with a 27G needle passed through the ciliary sulcus using the double needle technique.[47] In 2017, Yamane *et al*. again presented a flanged haptic fixation technique where two angled incisions parallel to the limbus were made by 30G thin-wall needles. Haptics of the IOL were externalized with the needles and cauterized to make a flange of the haptics. The flange of the haptics was then pushed back and fixed into the scleral tunnels.[48]

Conclusion

The technique of glued intrascleral haptic fixation provides a simple, secure and effective option for placement of a stable secondary IOL in patients with deficient posterior capsule.

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Conflicts of interest

There are no conflicts of interest.

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