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VARIOUS TECHNIQUES AND RECENT INNOVATIONS IN SCLERAL FIXATED INTRAOCULAR LENS IMPLANTATION

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ABSTRACT

Scleral Fixated intra ocular lens implantation is a procedure of recent origin which is more advancing such that even sutureless technique with foldable IOL has achieved. Placement of IOL in the posterior chamber rather than anterior or iris fixated lenses reduces the risk of various complications, like keratopathy, damage to anterior chamber angle structures, pupillary block glaucoma, hyphaema, uveitis, iris chaffing, dislocation and pseudophakodonesis. Additionally, positioning lens closer to the rotational center of the eye, just anterior to the vitreous face, may reduce the centrifugal forces on the lens and stabilize the ocular contents, thereby decreasing the probability of complications such as iritis, cystoid macular edema (CME) and retinal detachment. Another advantage of positioning the lens closer to the nodal point and center of the eye is the superior optical properties of the lens in this position. In this article we explained in brief the various techniques in scleral fixated intraocular lens implantation.
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.**Keywords:** Scleral suture fixation, posterior chamber intraocular lenses, aphakia, visual acuity.Abbreviation : SFIOL- Scleral Fixated Intraocular Lens ,PCIOL- Posterior Chamber Intraocular lens

1.INTRODUCTION

Although the post-operative correction of surgical aphakia with spectacles or contact lenses remains the standard of care, intraocular lenses (IOLs) have many advantages over both of these techniques. IOLs permit a better elimination of perceptual problems and reduce image size disparity. The implantation of an IOL behind the iris preserves the anatomy of the anterior segment with respect to the position of the natural crystalline lens. If the capsular support is inadequate for the IOL that is to be positioned in the posterior chamber of the eye, sutural fixation of the IOL to the scleral wall becomes a good alternative.[1,2] In addition, scleral fixation is performed not only in patients in whom IOL fixation is required (intracapsular surgery, traumatised eyes, ectopic lenses or paediatric lensectomies), but also in some of the sutureable capsular rings, prosthetic irises and/or lenses or other intraocular drug delivery devices.

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Intraocular Lenses

Commonly used IOLs are the Alcon CZ70BD (Alcon, Fort Worth), Bausch and Lomb 6190B (Bausch and Lomb, California) and Pharmacia U152S (AMO, California), which have one eyelet on each haptic. The Opsia(Chauvin Opsia, France) Grenat IOL has two eyelets on each haptic. Likewise, Teichmann designed an IOL with haptics that have two eyelets drilled 2mm apart.[3,4]

2.SUTURES

The Ethicon TG-160-2, Ethicon CIF-4 (Ethicon, New Jersey) can be used for Ab-interno methods. The Ethicon STC-6 straight needle is used in both methods. In general, 10-0 polypropylene has been the suture material of choice.[5] Ram J in 2013 introduced a new stainless steel Vanadium suture 40 u thick with 26 G straight needle, non magnetic suture with a good ocular biocompatibility and durability

was which ensure long-term stability and centration of the IOL [6]

Placement of Scleral Sutures

Originally, suturing techniques involved passing the needle from inside to outside (abinterno) the eye. Although this method may be quicker and is easier when penetrating keratoplasty is performed concomitantly, but it is a blind procedure.[6] As its name suggests, the outside to inside (Ab-externo) technique involves passing the needle from outside to inside, and was described by Lewis.[7] This is also undertaken blindly in that the intraocular exit point of the needle is unseen, but by knowing the entry point sulcus positioning of the suture is more predictable.[8,9] With the abexterno technique, the anterior chamber can remain closed during needle passes. This avoids collapse of the ciliary sulcus in the hypotonous eye, thus facilitating accurate suture placement.[10]

Ab-Interno Scleral Fixation **Ab-Externo Scleral Fixation:**

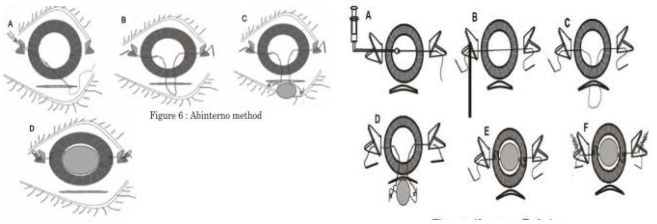


Figure 6 : Abinterno method

Scleral Suture Fixation Techniques

Simple Knotting Over the Sclera

In this technique, IOLs are attached to the sclera with two points of fixation. Formed polypropylene suture knot and suture ends over the sclera are covered by conjunctiva and the Tenon's capsule. However, despite its simplicity with regard to suture technique, conjunctival erosion is very common after this procedure.[11] Serious complications such as endophthalmitis may also be seen.

Corneal Autografts for External Knots

The knots are covered with autologous lamellary corneal patches during the combined keratoplasthy and scleral fixation. The patch is then covered with conjunctiva.[12] In this method, which is safer with regard to sutural erosion, a corneal autograft protuberance is made over the sclera, which is seen as a disadvantage.

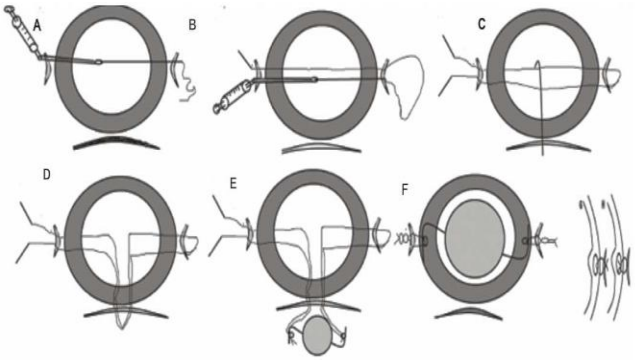
Covering with Fascia Lata or Dura Mater

Autologous fascia lata or lyophilized dura mater are used to cover the external knots. These patches are then covered with conjunctiva, which provides very good protection against suture exposure. However, removing fascia lata or supplying duramater allografts could increase difficulty and cost. Moreover, during the post-operative period,externally recognisable patches on the eye may lead to physiological and cosmetic disturbances.[13,14]

Covering with Scleral Flaps

Covering with scleral flaps appears to be a favourable technique for scleral fixation. First, triangular limbal-based scleral flaps (3x1mm) are fashioned. A previously formed knot on the sclera is placed under a triangular flap, then this flap is closed and remains sutureless at the end of surgery. With this technique the maintenance of knot security within the sclera has benefits with regard to suture exposure, but if the flap is too thin it can easily be dehisced, macerated or punctured. In addition, the knot may reposition through the scleral bed into the eye.[15]

Continuous-loop Fixation Technique



In this technique, the needle is passed through the haptic's eyelet/s and punctures the sclera in two places. One end of the suture is tied to the other end of the suture. The suture knot is then rotated in through the incision and out through the sclera. The knots are then rotated into the eye.[7] Therefore, with this type of arrangement a few knot-related problems are expected to arise. On the other hand, as each haptic requires two points of scleral fixation, a total of four needle punctures need to be made in the sclera, and thus there is a relatively higher risk of developing complications compared with the conventional two-needle punctures. In addition, suture knot rotation may cause IOL torque and tilt

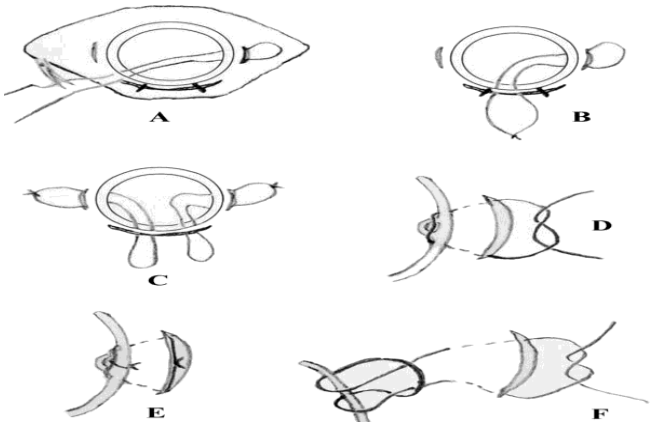
Four Points of Fixation Underneath the Superficial Scleral Flap

Herein, the suture knot is rotated in the same manner as during the previously mentioned procedure. The difference between the two procedures is in the fashioning of an L-shaped scleral flap for covering the suture.[16] This technique minimises the possibility of conjunctival erosion, suture exposure and thinning of sclera, but the longer surgical time is considered to be a disadvantage.

Limbal-groove Incision and Double-suture Fixation

The limbal-groove incision and double-suture fixation method allows for a two-point fixation.[17] Two 3mm scleral grooves are created horizontally at 3 and 9 o'clock, 0.5–0.75mm from the limbus. The suture knot is trimmed and rotated into the scleral groove. This method allows the suture knot to be buried in the eye without the use of scleral flaps. There is a risk of suture knot protrusion.

Limbal-groove Incision and Four Points of Fixation



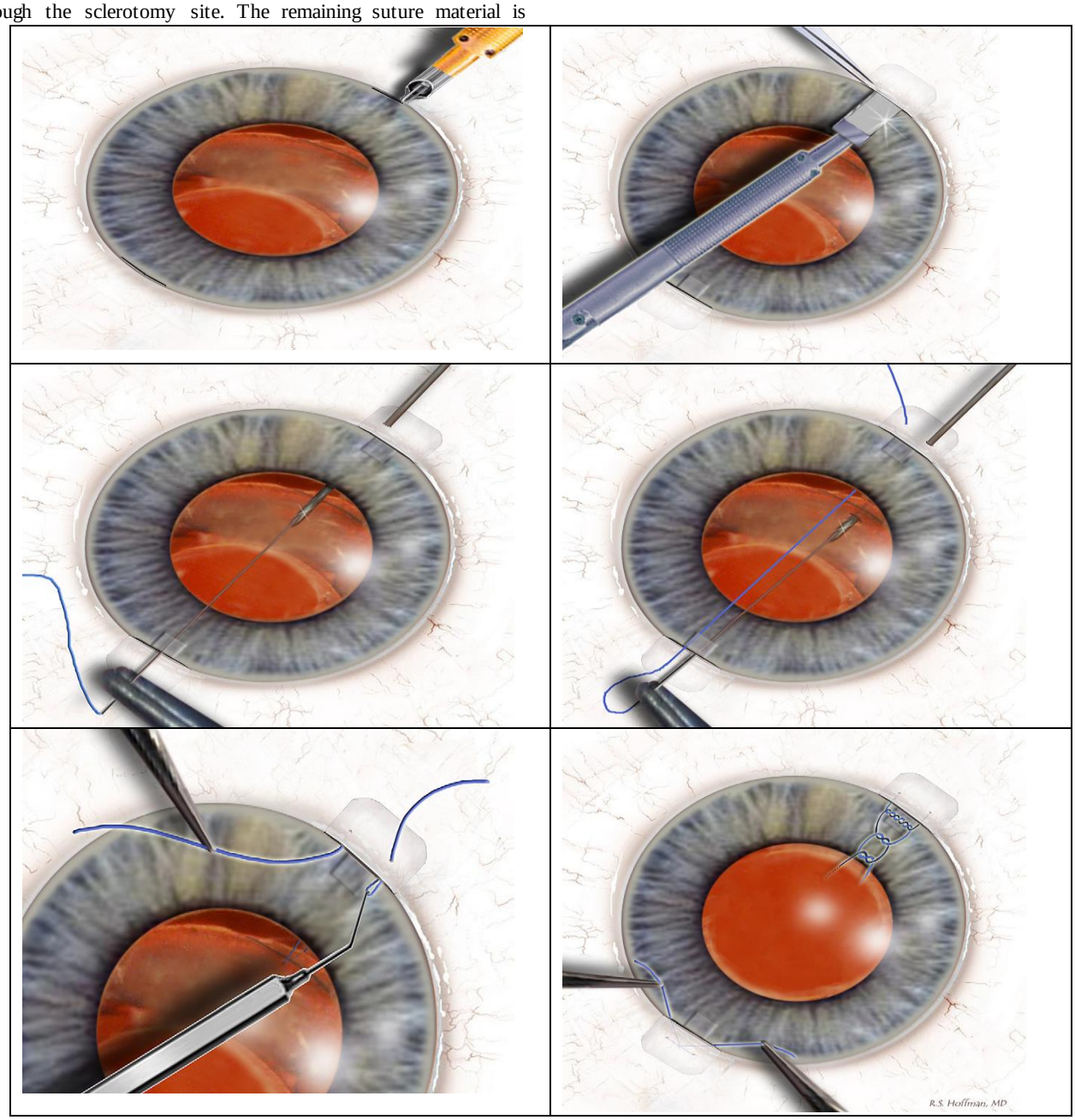
The limbal-groove incision and four points of fixation method entails the creation of four 3mm scleral grooves. This method allows stable four-point fixation with precise lens placement using only two sutures. It also allows the suture knot to be buried in the eye without the use of sclera flaps.[18] A longer surgical time, an increased number of needle punctures and the risk of suture knot protrusion are drawbacks of the procedure.

Trans-scleral Fixation of Intraocular Lenses Through Sclerotomy

In vitrectomy surgery, after the haptic is pulled close to the sclerotomy site, a suture is tied to the haptic of IOL from outside through the sclerotomy site. The remaining suture material is buried within the sclerotomy lips. Therefore, the risk of suture exposure is minimised. In this procedure of IOL fixation, the haptics should be situated symmetrically opposite to each other. In addition, scleral suturing may cause damage to the retina.[19]

Scleral Incision Technique

During this procedure, a radial scleral incision is made and sutured with the knot buried within the incision. Problems associated with depth of incision and suture exposure are sometimes seen.[20]



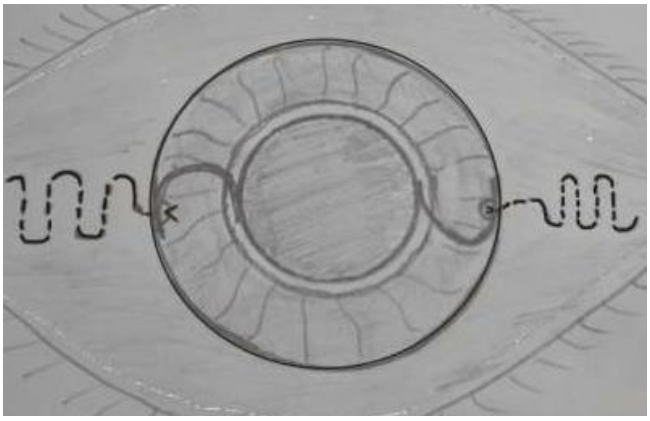
Scleral Fixation without Conjunctival Dissection

This technique is a variation of the traditional triangular scleral flap for scleral fixation, and involves performing a conjunctival peritomy and dissecting a scleral flap anteriorly from a position 2–3mm posterior to the limbus. Surgery begins in clear cornea and dissects a sclera pocket posteriorly, avoiding the need for scleral cautery. Conjunctival dissection is also avoided and sutured wound closure is unnecessary. A larger surface area can be created for suture passes than with triangular sclera flaps or scleral grooves.[21] However, scleral dissection and suture management are incredibly intricate.

Scleral Tunnel Technique

This is also a modified scleral flap technique. After dissecting conjunctiva, a conventional scleral tunnel is fashioned with a crescent blade. Passage of a double-armed suture through the roof of the scleral tunnel with subsequent retrieval of the suture ends through the external incision for tying facilitates scleral fixation.[22] However, the technique seems to be logical for preventing suture exposure, as a thin flap can easily be dehisced, macerated or punctured with suture knot.

Knotless Scleral Fixation

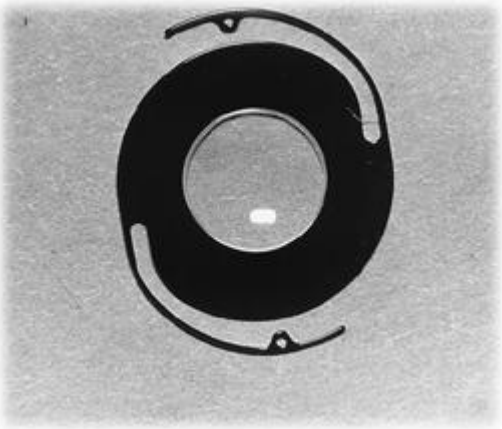


In this technique after finishin Ab externo procedure were bent and 'Z' shaped intrascleral passes with at least five indentations were made to secure the IOL. The suture was then cut without making any knot and covered by the conjunctiva.[24]

Knot and Suture Burying into the Sclera without Flap, Tunnel, Incision or Groove:

The needle is passed through the sclera in a lamellar fashion next to where the suture protrudes from the sclera. Afterwards, the free end with the needle and the other end are tied using a classic suture-tying method. As the suture is being tied, a free end with the needle and a second piece in the form of a loop appear. A very small loop is required for the burial technique. Thus, when the suture is being tied, the suture attached to the IOL should be gripped at the point closest to the scleral entry and knotted. Thus, the suture loop becomes smaller. For the burial procedure, the free-stranded needle is passed through the loop and passed again in the same direction so a secondary loop is made over the first one. The free end is passed through the recently formed loop once more. Thus, the free needle grips the loop bound to the sclera. The needle is inserted into the sclera at the point closest to the pre-formed knot, and advanced in a lamellar fashion. The needle is retrieved after it is advanced more than the length of the loop onto which the sutures are held. The loop tied to the pulled suture is rotated and buried in the sclera. The suture mounted on the needle is seen at the scleral wound. If the suture is cut at the exit site, its end is retained in the sclera, providing entire burial of the loop and the end mounted on the needle.[25,26]

With Iris Diaphragm intra ocular lens:



The procedure was done with Ab-Externo technique. If residual iris presents, then the suture should be passed behind the iris remnant. By placing the haptics just posterior to ciliary sulcus prevent direct compression of trabecular meshwork which may prevent the occurrence of secondary glaucoma [27]

Scleral fixation of one piece intraocular lens by injector implantation

Suture end was grasped with a micro forceps and threaded into the IOL cartridge, and tied to the leading haptic of IOL with a hitch-cow knot. The IOL was then inserted into the cartridge with leading haptic tied with the suture extending through the cartridge. The needle was passed through the tip of injector and then IOL was loaded.the needle was introduced in Ab-interno fashion. Then the leading haptic and the optic were inserted into the eye through the clear corneal incision site using the injector. Trailing haptic was left outside the eye intentionally and secured with the other suture with hitch-cow knot. The needle was passed through the sclera 1-1.5 mm posterior to the corneal limbus at the 3-0'clock position parallel to the back side of the iris and IOL was inserted into the PC. After IOL centration and tension were adjusted, each suture was tied to the sclera[28]

Sutureless intrascleral PC IOL fixation:

Two straight sclerotomies Ab-Externo are prepared with a sharp 24G canula, located 1.5 to 2 mm post limbal and exactly 180° from each other. The cannulas are then used to create a limbus-parallel tunnel at approximately 50% scleral thickness, starting from the ciliary sulcus sclerotomies and ending with externalization of the cannula after 2 or 3 mm. A standard three-piece IOL with a haptic design fitting to the diameter of the ciliary sulcus is implanted with an injector, and the trailing haptic is fixated in the corneal incision. The leading haptic is then grasped at its tip and pulled through the sclerotomy, and left externalized . With the same forceps, the haptic is then introduced into the intrascleral tunnel. The same maneuvers are performed with the tailing haptic. The ends of the haptics are left in the tunnels[29]

Scleral Fixation Of Dislocated Posterior Chamber Intraocular Lenses Using A 9/0 Microsurgical Polypropylene Snare

The snare consists of three components: a titanium handle containing a sliding piston under fingertip control via a set-screw, a 23 gauge stainless steel Luer-lock cannula and a 9/0 polypropylene suture snare crimped into a fine steel tube. The cannula locates on the tapered tip of the handle and the snare is fed through it into the piston and locked in place by tightening the screw. The snare can now be opened and closed by sliding the fingertip control in either direction. With the snare in the open position it is looped around the lens haptic (Fig. 2). It is then closed, thereby tightening the snare loop around the haptic and securing the IOL[30].

Removal of silicone oil and trocar assisted sutureless scleral fixated intraocular lens implantation
Modified technique of sutureless sclera fixated PC-IOL implantation in which 25 gauge transconjunctival sutureless vitrectomy (TSV) trocars for scleral tunnel preparation is used thus shortening the duration of operation and causing less trauma to the surrounding tissues and also the removal of silicone oil along with this implantation technique, was performed using 16 gauge Peyman cannula was entered from clear corneal incision behind iris and silicone oil was actively aspirated[31].

Cauterization technique for suture erosion

The tip of a glass rod was heated over a spirit lamp. The hot tip was immediately applied to touch and cauterize the area of the suture end until the suture knot melted down flat. Try carefully and gently cauterizing the knot, and make sure the 10-0 polypropylene suture end retracted beneath conjunctiva without breaking the knot. Even if the suture knot becomes loose by cauterizing, the residual end of enlarged suture knot can still be firmly fixed within the sclera[32].

Implantation of Scleral-Fixated Lens in Aphakia Via 23 Gauge Trocar System

The IOL implantation was performed by using a 23 G trocar and forceps instead of conventional methodology. A regular 9/0 polypropylene suture with free-ends was passed through the 23 G trocar and fixated to the haptic holes of the IOL. Then the IOL was implanted into the ciliary sulcus region via the previously prepared scleral tunnel It needs only one suture material with a double-armed regular needle, no needle guide is necessary and there is no need for scleral flap preparation. In addition, this technique provides vitreoretinal surgeons with a good option to perform SFIOL fixation immediately following 23 G or 25 G posterior segment surgery or for cataract surgeons a chance to perform anterior and/or posterior vitrectomies when needed[33].

Sutureless Intrascleral Pocket Technique of Transscleral Fixation of Intraocular Lens in Previous Vitrectomized Eyes

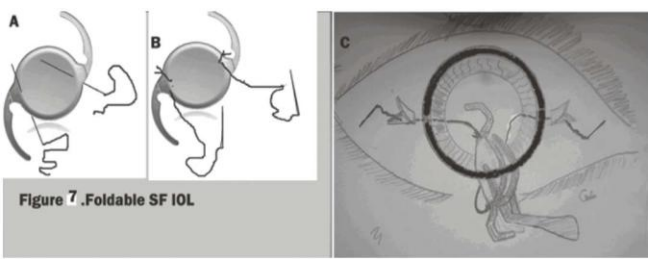


Figure 7 .Foldable SF IOL

Two points 180° apart were marked at the limbus. A 2-mm-sized intrascleral pocket was created by lamellar dissection using a crescent blade without conjunctival dissection. A 2.8-mm clear corneal incision (CCI) was made using a keratome. Prolene sutures were exteriorized through the CCI pocket and a three-piece foldable acrylic IOL was injected via CCI and the ends of the haptics were exteriorized through the CCI and sutured in the respective intrascleral pocket bed with knots buried under scleral flaps[34].

Simplified technique of introducing suture

Straight needle on 10-0 prolene is broken into half for easy manipulation and is docked into the lumen of the 26G 1.5 inch needle "outside" the eye.This is passed through the temporal scleral bed e to emerge at the nasal scleral bed 1mm posterior to limbus exactly at 180^{o} . This delivery becomes easier as the length of the straight needle has been reduced to half of its original size before docking[35].

Glued intrascleral fixation of IOL

After creating sclerotomy foldable IOL is slowly injected into the eye. Once the entire IOL has unfolded, pull and externalize the tip of the leading haptic. The assistant holds the leading haptic to prevent its slippage into the eye. Flex the trailing haptic with the glued IOL forceps in the right hand and introduce it into the eye. Then, reintroduce the glued IOL forceps in the left hand from the side-port incision into the eye. Transfer the haptic from the right glued IOL forceps to the left hand. Withdraw the right glued IOL forceps from the eye and reintroduce it from the right sclerotomy site. Transfer the trailing haptic from the left hand to the right hand ("handshake" technique again). Hold the haptic from its tip and pull it to externalize it. Create a scleral pocket and tuck the haptics . Then apply glue to seal the flaps. Fibrin glue can also be used to seal all the conjunctival peritomy sites and corneal incisions[36].

3.COMPLICATIONS

Common to all scleral fixation techniques is the need to cover, bury or rotate suture knots to prevent overlying conjunctival erosion and subsequent endophthalmitis. Each of these is different with regard to technical difficulty, potential postoperative complications. For example, the sutures may erode through the scleral flaps and cause irritation. They may also loosen or break and cause either tilting or dislocation of the optic. In addition, a persistent suture extending between intraocular and extraocular environments may provide a track for bacteria to enter the eye and establish endophthalmitis.

A choroidal haemorrhage and detachment can occur from inadvertent injury to the ciliary body. The incidence of suprachoroidal haemorrhage is a function of procedure duration and intra-operative manipulation. Factors that increase the risk of haemorrhage include older age, history of hypertension, peripheral vascular disease, glaucoma, aortic stenosis, emphysema, prior eye surgery (risk increases with more procedures) and a need for excessive intra-

operative manipulation (e.g. if concomitant procedures such as removal of residual lens material, extensive vitrectomy, repair of large iris defects or iridoplasty are needed). Moreover, traction on the peripheral retina or vitreous during suture placement in the sulcus may increase the risk of retinal detachment. Numerous suggestions have been made to improve the accuracy of sulcus penetration, move away from abinterno suture techniques and move towards the abexterno approach, mirror systems, trans-illumination and endoscopy.[37,38]

In conclusion, I think surgeons should be experienced in their particular scleral fixation technique and receive continual training in all of the techniques. This represents great savings in terms of time, supply costs and improved patient and surgeon satisfaction in both the short and long term.

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