

Scleral Fixation Techniques

a report by

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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 better preserves the anatomy of the anterior segment with respect to the position of the natural crystalline lens. In the presence of little or no capsular support, the surgeon has the following options for lens implantation: an angle-supported or iris-fixated anterior chamber IOL, a posterior chamber IOL (PCIOL) over a residual capsule, an iris-sutured PCIOL, posterior iris fixation of the iris-fixated IOL or a trans-sclerally sutured PCIOL. If the capsular support is inadequate for the IOL that is to be positioned in the posterior chamber of the eye, suture 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.

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}

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

Placement of Scleral Sutures

Originally, suturing techniques involved passing the needle from inside to outside (*ab interno*) the eye. Although this method may be quicker and is easier when penetrating keratoplasty is performed concomitantly, 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 *ab externo* 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

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 keratoplasty 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 lyophilised *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 *dura mater* 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}

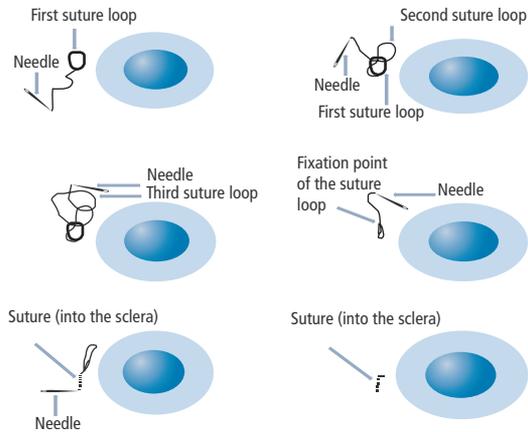
Covering with Scleral Flaps

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.

Figure 1: Baykara Suture Burial Technique Sequence



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 scleral 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 each other. In addition, scleral suturation 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 scleral 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 scleral 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 dehiscenced, macerated or punctured with suture knot.

Knotless Scleral Fixation

Knotless scleral fixation describes the technique for implanting an IOL by scleral fixation sutures. This has the advantages of knotless fixation of the haptics and an out-in approach for passing the needle through the sclera.²³ Probably the worst complication with this procedure is suture loosening, which could result in IOL decentration and tilt.

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

Knot and suture burying in the sclera without flap, tunnel, incision or groove is my preferred procedure. 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 (see Figure 1).²⁴ We evaluated the scleral-sutured free 150 suture ends after a minimum 24 months of follow-up in 75 eyes of 75 patients and observed no intra-operative or post-operative complications related to the suture burial technique itself.²⁵

Apart from the above-mentioned sutured scleral fixation, a new technique was reported in eyes without capsule support for sutureless fixation, describing fixation of the haptics in a limbus-parallel scleral tunnel.²⁶ Long-term follow-up results must be published before we can judge the usefulness of this technique.

Many methods have been described to allow scleral fixation. Experienced surgeons have achieved excellent results with

trans-sclerally sutured PCIOLs. 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 post-operative problems and 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 *ab interno* suture techniques and move towards the *ab externo* approach, mirror systems, trans-illumination and endoscopy.^{27,28}

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. ■

1. Stark WJ, Gottsch JD, Goodman GL, Prutzer K, *Arch Ophthalmol*, 1989;107:1078-83.
2. Malbran ES, Malbran E, Negri I, *Int Ophthalmol*, 1986;9:151-60.
3. Cordoves L, Gomez A, Mesa CG, Abreu JA, *J Cataract Refract Surg*, 1999;25:156-7.
4. Teichmann KD, Teichmann IA, *J Cataract Refract Surg*, 1998;24:889.
5. Pannu JS, *Ophthalmic Surg*, 1997;19:751-4.
6. Apple DJ, Price FW, Gwin T, et al., *Ophthalmology*, 1989;96:1241-7.
7. Lewis JS, *Ophthalmic Surg*, 1991;22:692-5.
8. Arkin MS, Steinert RF, *Int Ophthalmol Clin*, 1994;34:67-85.
9. Duffrey RJ, Holland EJ, Agapitos PJ, et al., *Am J Ophthalmol*, 1989;108:300-309.
10. Althaus C, Sundmacher R, *Refract Corneal Surg*, 1993;9:333-9.
11. Özmen AT, Dogru M, Ertürk H, Özçetin H, *Ophthalmic Surg Lasers*, 2002;33(5):394-9.
12. Bucci FA Jr, Holland EJ, Lindstrom RL, *Am J Ophthalmol*, 1991;112:353-4.
13. Bashshur Z, Ma'luf R, Najjar D, Nouredin B, *Ophthalmic Surg Lasers*, 2002;33:445-9.
14. Anand R, Bowman RW, *Arch Ophthalmol*, 1990;108:1205-6.
15. Holland EJ, Daya SM, Evangelista A, et al., *Am J Ophthalmol*, 1992;114:182-7.
16. Rao SK, Gopal L, Fogla R, et al., *J Cataract Refract Surg*, 2000;26:9-10.
17. Bergren RL, *Arch Ophthalmol*, 1994;112:1485-7.
18. Friedberg MA, Berley DK, *Ophthalmic Surg*, 1992;23:17-21.
19. Youn-Seok In, Joon-Hyun K, Byung-Joo S, *J Cataract Refract Surg*, 2004;30:1163-6.
20. Monteiro M, Marinho A, Borges S, et al., *J Fr Ophthalmol*, 2006;29(10):1110-17.
21. Hoffman RS, Fine IH, Packer M, *J Cataract Refract Surg*, 2006;32(11):1907-12.
22. Han Q, Chu Y, *J Cataract Refract Surg*, 2007;33(8):1362-5.
23. Szurman P, Petermier K, Congress of the ESCRS, 2006;144.
24. Baykara M, *J Cataract Refract Surg*, 2004;30:957-9.
25. Baykara M, *Eur J Ophthalmol*, 2008;18:368-70.
26. Gabor SG, Pavlidis MM, *J Cataract Refract Surg*, 2007;33(11):1851-4.
27. Hannush SB, *Curr Opin Ophthalmol*, 2000;11(49):233-40.
28. Rajpa RK, Carney MD, Weinberg RS, et al., *Ophthalmology*, 1991;98:144.

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