Scleral fixation of a 4-eyelet foldable intraocular lens in patients with aphakia using a 4-flanged technique

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A 29-gauge model test fine needle is used to create a beveled intrascleral tunnel; with microforceps, a 6-0 polypropylene suture is placed in the bore of the needle, which is used as a guide to pass and externalize the monofilament through the sclera. This maneuver is repeated by passing the suture ends through the intraocular lens (IOL) eyelets. The folded IOL is inserted and centered, the sutures are cut, and the flanges are created by thermocautery and inserted into the scleral tunnel. This technique was performed on 7 patients and visual acuity was recorded. The 4-flanged technique for scleral fixation using a 4-eyelet IOL was an effective and a safe treatment in the setting of aphakia.

A number of options exist for intraocular lens (IOL) implantation in the absence of capsular support. Scleral-fixed posterior chamber IOL implantation avoids the complications associated with anterior chamber IOLs such as iris damage, endothelial decompensation, and uveitis.

Different techniques for scleral fixation have been described.1,2 The priorities of any technique should be minimally invasive, reproducible, and offer long-term IOL stability. Most techniques that use foldable IOLs (such as the well-established Yamane technique) uses a 2-point fixation.3 However, 2-point fixation techniques are susceptible to IOL tilt and even small (5 degrees) of IOL tilt can result in reduced visual acuity and higher-order aberrations, which cannot be corrected with spectacles.4

Another problem associated with scleral-fixed IOL is the instability at the suture/optic junction. Previously described methods of scleral fixation can result in suture slippage and subsequent IOL dislocation.5 However, newer IOLs that have suture eyelets reduce this risk by providing a premade fixation point. This has the additional benefit of simplifying the surgical procedure. In this study, we used the Akreos AO60 IOL (Bausch & Lomb, Inc.), which has 4 suture eyelets, making it a suitable IOL choice for this method.

Furthermore, the IOL is foldable, reducing the need for a large corneal section or scleral tunnel and subsequent postoperative astigmatism.5 There are other comparable IOLs from different manufacturers, which could be used, such as the i-Stream Microflex (MD-Tech) and the Quatrix (Bausch & Lomb, Inc.).

The final problem associated with scleral-fixed IOL is the difficulty of suture attachment to the sclera. Externalized sutures have the potential for conjunctival erosion that might cause chronic irritation and increase the risk of endophthalmitis.6 In this study, we present the results of 7 patients who underwent IOL implantation using a combination of the aforementioned surgical methods to achieve a 4-flanged knotless fixation technique with a 4-eyelet IOL.

SURGICAL TECHNIQUE
All patients were operated under local anesthetic. An initial 3.4 mm incision was placed at the corneal limbus. A 29-gauge model test fine needle was inserted at the 9 o’clock position to form a beveled intrascleral tunnel 2.0 mm posterior and parallel to the limbus; a microforceps was passed through the corneal incision to place a 6-0 polypropylene suture in the bore of the needle inside the eye, and then, this needle was used as a guide to pass and externalize a...
monofilament through the sclera. This maneuver was repeated at the 3 o’clock position to create the first 2 fixation points (Figure 1, A). The remaining 2 free ends of the sutures were each passed (anteroposteriorly) through 2 eyelets, thus passing the sutures through all 4 eyelets. Subsequently, one of the sutures was passed back into the anterior chamber to insert into the bore of the needle and externalized 3 mm from the first fixation point to create the third fixation point (Figure 1, B).

Using a Buratto forceps, the folded IOL was inserted into the anterior chamber through the 3.4 mm corneal incision. The monofilament of the fourth point of fixation was left outside the corneal incision to avoid crossing inside the eye (Figure 1, C). Finally, the needle was used to externalize the monofilament from the fourth scleral fixation point (Figure 1, D). Once the IOL was positioned centrally, the 2 bottom sutures were cut about 2 mm; the first and the second flanges were created by thermocautery and inserted inside the scleral tunnel. Now, the surgeon was able to adjust the position of the IOL in the eye by pulling the upper ends of the monofilament (Figure 1, E). When the position was satisfactory, the suture was cut about 2 mm from its bases, and the upper third and the fourth flanges were heated and then placed in the scleral tunnels. The IOL was in place (Figure 1, F) (Supplemental Digital Content, Video 1, available at http://links.lww.com/JRS/A132).

The mean corrected distance visual acuity (CDVA) improved from 0.43 (logarithm of the minimum angle of resolution [logMAR]) to 0.18 logMAR, with an average gain of 0.25 logMAR. Two patients did not experience any CDVA improvement, and none has lost any. The intraocular pressure was stable from preoperatively 16.1 mm Hg to postoperatively 17.2 mm Hg. The specular microscopy went from preoperatively 2035 cells/mm³ to postoperatively 1790 cells/mm³ (Table 1).

We encountered complications in 1 patient 1 month postoperatively because 1 of the flanges was too large and outside of the scleral tunnel. Subsequently, the eye developed hyperemia and conjunctival degradation (Figure 2, A). It was treated with moxifloxacin for 7 days every 3 hours. At the end of the treatment, the eye was healed of hyperemia or conjunctival inflammation. Subsequently, we surgically reduced the size of the flange and reinserted it inside the scleral tunnel. Three months postoperatively, no complications were encountered (Figure 2, B). We did not encounter any complications in the remaining six patients. Table 1 summarizes visual acuity results.

**CASE REPORTS**

**Case Report 1**

A 68-year-old man presented with aphakia in right eye after phacoemulsification 2 months earlier, whose preoperative CDVA was 0.30 logMAR. After examination of the anterior

### Table 1. Intraocular pressure and corrected distance visual acuity results.

<table>
<thead>
<tr>
<th>Patients</th>
<th>Preop IOP</th>
<th>Postop IOP</th>
<th>Preop CDVA (Snellen)</th>
<th>Preop CDVA (logMAR)</th>
<th>Postop CDVA (Snellen)</th>
<th>Postop CDVA (logMAR)</th>
<th>Follow-up (mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X01</td>
<td>12</td>
<td>14</td>
<td>20/40</td>
<td>0.3</td>
<td>20/20</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>X02</td>
<td>17</td>
<td>19</td>
<td>20/60</td>
<td>0.5</td>
<td>20/30</td>
<td>0.2</td>
<td>9</td>
</tr>
<tr>
<td>X03</td>
<td>11</td>
<td>10</td>
<td>20/200</td>
<td>1</td>
<td>20/40</td>
<td>0.3</td>
<td>6</td>
</tr>
<tr>
<td>X04</td>
<td>15</td>
<td>18</td>
<td>20/50</td>
<td>0.4</td>
<td>20/25</td>
<td>0.1</td>
<td>5</td>
</tr>
<tr>
<td>X05</td>
<td>14</td>
<td>14</td>
<td>20/25</td>
<td>0.1</td>
<td>20/25</td>
<td>0.1</td>
<td>3</td>
</tr>
<tr>
<td>X06</td>
<td>16</td>
<td>18</td>
<td>20/40</td>
<td>0.3</td>
<td>20/30</td>
<td>0.2</td>
<td>2</td>
</tr>
<tr>
<td>X07</td>
<td>28</td>
<td>28</td>
<td>20/50</td>
<td>0.4</td>
<td>20/50</td>
<td>0.4</td>
<td>2</td>
</tr>
</tbody>
</table>

CDVA = corrected distance visual acuity; logMAR = logarithm of the minimum angle of resolution; postop = postoperative; preop = preoperative
chamber, we concluded that there was no bag support to implant the IOL in the sulcus, and we decided to perform the 4-flanged technique with the Akreos AO60 IOL. Peribulbar anesthesia was performed using 4 mL of lidocaine. A posterior maintainer was inserted at 3.5 mm from the limbus in the nasal quadrant with no irrigation—the irrigation was performed only when the eye was in hypotony during the procedure. An anterior vitrectomy was performed through a 1.8 mm corneal incision to remove all the anterior vitreous to avoid vitreous loss and retinal detachment. The 4-flanged technique was performed as described in the Surgical Technique section (Figure 3, A–D). Nine months postoperatively, the right eye CDVA improved to 0 logMAR, thus a normal vision, and the intraocular pressure increased from 12 to 14 mm Hg. The IOL was well centered, the 4 flanges were inserted inside the 4 scleral tunnels, and we observed no complications, namely no scleral degradation or polypropylene suture photodegradation.

Case Report 2
A 64-year-old man presented with aphakia in the left eye after phacoemulsification 1 month earlier, whose preoperative CDVA was 0.30 logMAR. The result of the preoperative examination of the anterior chamber and the procedure to fixate the Akreos AO60 IOL was as described in case 1 (Figure 4, A–D). Three months postoperatively, the left eye CDVA improved to 0.2 logMAR, and the IOP increased from preoperative 16 to 18 mm Hg. No complication occurred. The IOL was well centered, the 4 flanges were inserted inside the 4 scleral tunnels, and no scleral degradation or polypropylene suture photodegradation was observed. The ultrasound biomicroscopy images (Figure 5, A and B) shows that the 6-0 polypropylene suture is in the longitudinal 9 o'clock position and the IOL in the longitudinal 3 o'clock position.

DISCUSSION
Secure placement of an IOL in the setting of zonular and IOL–capsular bag instability presents several challenges. There have been a number of surgical methods described to date, which predominantly use a 2-point fixation. In 1986, Malbran et al. proposed a scleral fixation technique of IOL with a 10-0 polypropylene suture. In 1991, Lewis described a method of burying the ab externo polypropylene suture within scleral flaps. For years, this technique was considered the classical scleral fixation technique with scleral flaps and is still used with good results. However, it presents complications such as tilt, postoperative IOL decentration, and suture breakage.

To address these suture-related problems, Scharioth et al. described a technique of sutureless intrascleral fixation of a 3-piece posterior chamber IOL in the ciliary sulcus. Agarwal et al. introduced their own modification by using a glued fixation technique. Finally, Yamane et al. simplified this method and proposed to fixate the IOL to the sclera using flanges created by thermocautery. A number of modifications of these methods have been described to address monofilament-related complications such as the use of Gore-Tex (W.L. Gore & Associates), which has been proven safe for ophthalmologic use and does not seem to expose the...
formed closed holes within its haptics. This IOL is, to address potential tilts.

techniques and combine the benefits of flanged methods and the goal is to maximize the experience collected with other techniques using a 4-point fixation using a 4-eyelet IOL. The 6 mm. foldable IOL, which requires a corneal or scleral incision of the optical zone, are rigid. This also helps reducing IOL tilt. The main limitation of this technique is the use of a non-foldable IOL, which requires a corneal or scleral incision of 6 mm.

In this study, we present a modification of the 4-flanged technique using a 4-point fixation using a 4-eyelet IOL. The goal is to maximize the experience collected with other techniques and combine the benefits of flanged methods and to address potential tilts.

This method uses the Akreos AO60 IOL that has 4 pre-formed closed holes within its haptics. This IOL is, therefore, ideal for a 4-point fixation method, which reduces the risk of IOL tilt inherent in a 2-point fixation technique and reduces roll movement about the long axis of the IOL and tilt at the scleral fixation site. In addition, the IOL is foldable, which allows insertion of the lens through a 3.4 mm corneal incision rather than a 6 mm scleral tunnel. This minimizes postoperative astigmatism and reduces recovery time.

In 2010, Fass and Herman described a technique using the same Akreos AO60 IOL inserted through a 3 to 3.4 mm incision and fixed on 4 points attached with a 10-0 polypropylene suture. Compared with the study by Fass and Herman, with the same incision size, our method avoids the creation of flaps or knots. Besides that, the 6-0 polypropylene monofilament that we use, which has been proven safe for ophthalmologic use, is 3.5 times thicker than the 10-0 polypropylene suture, ensuring longer stability and less risk of erosion.

We have performed this method on 7 patients and demonstrated the technique to be safe and effective in fixing an IOL in the setting of zonular instability and capsular bag compromise with good and stable visual acuity results up to 9 months.

Scleral fixation of an IOL in the setting of aphakia using the 4-flanged method seems to be a safe and an effective method for ensuring medium- to long-term IOL stability. However, because it is a new technique, further studies with more patients and longer follow-ups are necessary to assess the exact outcomes including potentials risks of opacification.

WHAT WAS KNOWN

- Double-flanged techniques are safe and used to reduce complications for scleral fixation.
- Two-point fixation can induce IOL tilt.

WHAT THIS PAPER ADDS

- Four points of fixation added further stability to the IOL fixation.
- A thicker suture monofilament was safe for ophthalmology use and did not expose the patient to the risk of late suture erosion and breakage.
- The 4-flanged technique using a 4-eyelet IOL was stable in the medium term; further studies with longer follow-ups are necessary to assess the exact outcomes in the long term.

REFERENCES


Disclosures: None of the authors has a financial or proprietary interest in any material or method mentioned.