Implantation of foldable posterior chamber intraocular lens in aphakic vitrectomized eyes without capsular support

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ABSTRACT

Purpose: To evaluate the outcomes of three different surgical techniques for foldable posterior chamber intraocular lens (PCIOL) implantation in vitrectomized eyes without capsular support.

Methods: A total of 60 patients with aphakic and vitrectomized eyes without capsular support were enrolled. All patients underwent three-piece foldable PCIOL implantation into the posterior chamber through a small corneal incision. Transscleral fixation (TSF), iris fixation (IF), and intrascleral tunnel fixation (ISF) surgical techniques were performed.

Results: Postoperative PCIOL subluxation or dislocation occurred in one case in the TSF group and two cases in the ISF group. Intraoperative PCIOL dislocation occurred in two patients in the IF group. The incidence of temporary postoperative complications, such as mild intraocular hemorrhage and cystoid macular edema, was higher in the ISF group. No statistically significant difference in PCIOL-related astigmatism was observed between groups. Visual acuity improved in all groups.

Conclusions: Postoperative outcomes were comparable between TSF, IF, and ISF for PCIOL in vitrectomized eyes without capsular support.

Keywords: Lens implantation, intraocular/methods; Iris/surgery; Suture techniques; Aphakia

INTRODUCTION

The capsule of the crystalline lens, if sufficiently present, is used as a support tissue for intraocular lens (IOL) implantation surgery performed on vitrectomized eyes. Eye trauma or iatrogenic damage during complicated cataract surgery, loss of position and zonule connections of the crystalline lens, and IOL via dislocation may cause loss of support tissue for lens capsule implantation prior to pars plana vitrectomy (PPV). During PPV, the iatrogenic removal of the lens capsule may be required depending on the etiology and severity of the vitreoretinal disease. Posterior chamber IOL implantation may be performed via posterior chamber transscleral fixation(6-7), iris fixation(8,11), intracapsular fixation(12,20), angle supported anterior chamber IOL(23,24), or iris claw IOL implantation(25,26).

Advantages of PCIOL fixation include the distant position from anterior segment structures, such as the corneal endothelium, and proximity to the focal point of the eye where the lens is naturally situated. However, the lack of the volume creation and supporting effect of the vitreous, and the fact that the surgery is generally performed under irrigation fluid, may complicate PCIOL fixation in vitrectomized eyes. In these cases, a small corneal tunnel incision may be used to create a closed and more stable surgical space. In cases with no capsular support, the implantation of a foldable IOL can be performed through a small corneal incision into the posterior chamber with suture fixation to the sclera or iris(14,11). Alternatively, IOL implantation can be performed through a small incision to the posterior chamber with sutureless intrascleral fixation(12,22).

In the present study, we evaluated three separate groups of patients with vitrectomized aphakic eyes lacking capsular support in whom foldable IOL were implanted through a small corneal incision using either transscleral fixation, iris fixation, or intrascleral fixation. Outcomes and complications were compared between the surgical methods.
Implantation of foldable posterior chamber intraocular lens in aphakic vitrectomized eyes without capsular support

METHODS
We performed a retrospective observational case-controlled study of vitrectomized aphakic eyes in patients who had undergone foldable intraocular lens implantation into the posterior chamber. Patients lacking capsular support were divided into three groups according to the surgical intervention received between January 2008 and December 2014. Transscleral fixation was performed between January 2008 and June 2010 (TSF group), iris fixation between April 2010 and May 2012 (IF group), and intrascleral fixation since April 2012 (ISF group). In the ISF group, we did not include the initial eight cases of IOL implantation using folding method rather than injection during the learning period. We included consecutive cases that had undergone surgery between August 2012 and December 2014. Ethical approval for present the study was obtained from the local ethics committee. Detailed informed consent was obtained from each patient. The present study followed the tenets of the Declaration of Helsinki.

Ophthalmic examinations, including best-corrected visual acuity (BCVA) and intraocular pressure (IOP) measurements, dilated intraocular slit-lamp examination, autorefractometry, keratometry, and spectral domain optical coherence tomography (SD-OCT) (Optovue Inc., Fremont, CA) evaluation were performed during preoperative and postoperative study visits. Preoperative ocular condition, and intraoperative, and postoperative complications were evaluated. Astigmatism related to IOL was detected using “power vector analysis (PVA)” with the consideration of preoperative and final examination keratometry values. The incidence of postoperative astigmatism related to IOL and BCVA was compared between groups. Patients with a follow-up period of <3 months or with preoperative corneal opacity were excluded from the study.

SURGICAL METHODS
All surgeries were performed by one surgeon (G.E). Retrobulbar anesthesia was performed in all patients. Continuous anterior chamber or pars plana infusion was used during surgery. A three-piece IOL (Sensa AR40e; Abbott Medical Optics, USA) was inserted through a superior clear corneal incision in all techniques. In cases with a dislocated IOL, exchange was performed if a single-piece IOL was present. However, the primary IOL was used for fixation if a three-piece IOL was present.

TRANSSCLERAL FIXATION TECHNIQUE
Transscleral fixation of foldable PCIOL was performed using the method described by Lewis(8). Local conjunctival peritomies were performed on quadrants 3 and 9 followed by formation of the limbus-based partial-thickness triangular flaps at 180°. A straight needle carrying 10-0 polypropylene was inserted into the posterior chamber under a scleral flap and was removed from beneath the opposite scleral tissue with the guidance of a 27-gauge needle. A 3.5-mm corneal incision was performed superiorly. The suture traversing the posterior chamber was pulled under the pupil with the assistance of a hook and removed from the main incision, cut, and then tied to the IOL haptics. The IOL was folded on the 6 o’clock and 12 o’clock axis and placed into the anterior chamber. Sutures were gently pulled to centralize the IOL. The polypropylene sutures were tied under the scleral flaps and the conjunctiva was closed using an 8-0 polyglactin suture.

IRIS FIXATION TECHNIQUE
Iris fixation of foldable PCIOL was performed using the method described by Condon(9). Pupillary constriction was provided by preoperative application of 4% topical pilocarpine. Paracentesis was applied with a 23-gauge MVR at 3, 6, and 9 o’clock. The IOL was folded into the desired shape, such that the haptics were in a mustache configuration, and placed through the corneal incision at 12 o’clock into the anterior chamber in a captured position with both haptics placed into the posterior iris extending into the 3 and 9 o’clock quadrants. In order to prevent posterior dislocation of the lens, the optic body was posteriorly supported with a spatula inserted at 6 o’clock. The optic was mildly elevated superiorly with a spatula to visualize the haptic under the iris. Using a modified McCannel-type technique, a 10-0 polypropylene suture was passed under the haptic and retrieved through the proximal paracentesis before the haptic was fixed to the peripheral iris. Similarly, the other haptic was sutured, with the optic manipulated into the posterior chamber.

INTRASCLERAL FIXATION TECHNIQUE
Intrascleral fixation of foldable PCIOL was performed via injection using a similar method as described by Gabor and Pavlidis(12). The conjunctiva was opened at two clock-hour in the superior and inferior quadrants prior to cataract surgery. Scleral tunnels of 3 mm length were formed 1.5 mm from, and parallel to, the limbus using a 25-gauge trocar blade at the 6 o’clock and 12 o’clock positions. Infusions were then instilled into the anterior chamber or pars plana. A clear incision of 3 mm was made superiorly before the creation of a side port incision at 3 o’clock using a 23 MVR blade at the cornea. The leading haptic at the edge of the cartridge was grasped using 25-gauge forceps in the inferior scleral tunnel. The optic was then opened in the anterior chamber gradually while the cartridge was withdrawn and the trailing haptic unfolded outside the anterior chamber through the corneal incision. The leading haptic was externalized from the inferior scleral tunnel. Consequently, the trailing haptic was transferred from the superior corneal incision to the 23-gauge forceps in the side port at the 3 o’clock position and later grasped by the 25-gauge forceps in the superior scleral tunnel using the handshake technique(2) and externalized. The haptics were fixed by suturing around the scleral tunnels with 8-0 polyglactin suture and the conjunctiva was closed.

STATISTICAL ANALYSIS
NCSS (Number Cruncher Statistical System) 2007 & PASS (Power Analysis and Sample Size 2008 Statistical Software, Utah, USA) were used for statistical analyses. BCVA values were converted to logarithm of the minimum angle of resolution (logMAR) units in all patients. The Kruskal-Wallis test was used to compare three and more groups demonstrating abnormal distributions. The Mann-Whitney U test was used to compare qualitative data between groups. The Wilcoxon signed rank test was used intra-group comparisons of parameters demonstrating an abnormal distribution. P-values of <0.05 were considered statistically significant.

RESULTS
The present study included 60 patients (60 aphakic vitrectomized eyes) without sufficient capsular support. No significant difference in patient age was observed between groups (P=0.50). Table 1 summarizes the demographic characteristics of the study population. Ocular conditions prior to IOL implantation are shown in table 2.

Table 3 presents the timings of IOL implantation. BCVA changes before and after surgery are provided in table 4. Statistically significant increases in visual acuity were observed postoperatively in all groups, aside of last group which there was a trend toward increased BCVA postoperatively (P=0.092). No significant differences in preoperative VA were observed between groups (P=0.123); however, postoperative values were found to differ significantly between groups (P=0.003). Postoperative VA values were highest in the IF group. No significant difference in BCVA was observed between groups (P=0.790).

Intraoperative complications were observed only in the IF group. Intraoperative IOL dislocation occurred in two patients, with one instance of recurrence observed in one of these patients. Postoperative complications are summarized in table 5. Mild temporary intraocular...
hemorrhage (IOH), which resolved in 1-3 weeks, and postoperative cystoid macular edema (CME), demonstrated by optical coherence tomography, were more common among patients in the ISF group.

**Table 1. Baseline characteristics and ophthalmic data**

<table>
<thead>
<tr>
<th>Number of eyes</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yrs (mean ± SD)</td>
<td>65.6 ± 12.2</td>
</tr>
<tr>
<td>Male/female</td>
<td>53/36</td>
</tr>
</tbody>
</table>

**Table 2. Ocular conditions prior to IOL implantation**

<table>
<thead>
<tr>
<th>Conditions</th>
<th>TSF group</th>
<th>IF group</th>
<th>ISF group</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOL subluxation/dislocation</td>
<td>1</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Crystalline lens subluxation/dislocation</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Dislocated lens fragments during cataract surgery</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Capsular damage during cataract surgery</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Trauma/intracocular foreign body</td>
<td>1</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 3. Timing of IOL implantation**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Time of IOL implantation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>During PPV, n (%)</td>
</tr>
<tr>
<td>All groups</td>
<td>16 (27)</td>
</tr>
<tr>
<td>TSF group</td>
<td>3 (23)</td>
</tr>
<tr>
<td>IF group</td>
<td>4 (23)</td>
</tr>
<tr>
<td>ISF group</td>
<td>9 (30)</td>
</tr>
</tbody>
</table>

**DISCUSSION**

The vitreous humor plays an important role in providing structure and volume due to its semi-solid gel-like properties. In a proportion of vitrectomized eyes, in addition to reduced amounts of vitreous humor, the eye anatomy may be altered due to surgery, trauma, inflammation, and natural events such as old age and myopia, leading to decreased scleral rigidity. The creation of a stable surgical environment in vitrectomized eyes during anterior segment surgery is typically challenging, and IOP regulation may be provided via anterior chamber or pars plana continuous fluid infusion.

In order to maintain stable and consistent vitreal volumes, low-fluctuating IOP (i.e., a balance between entering and exiting fluids) is required. As the incision is extended, it becomes more difficult to maintain stable and maintained IOP. Further, fluid regurgitation, sudden pressure drops, and risk of collapse all increase with surgical manipulations. Young et al. (28) attempted to overcome these challenges using a scleral tunnel incision rather than a corneal incision. Further, the use of bridle sutures in the rectus muscle reportedly have utility in preventing globe collapse intraoperatively (28).

The presence or absence of capsular support in vitrectomized eyes is important in determining the most appropriate surgical approach. While the surgical method is simple and evident in eyes with capsular support, the lack of a capsule requires the use of more complex surgical procedures. Posterior chamber implantation has many advantageous over anterior chamber implantation - the IOL is distant from the sensitive anterior chamber structures, aqueous flow...
samples may provide further information regarding the relative efficacy of these techniques.

REFERENCES