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Safety, efficacy, and clinical outcomes of transconjunctival intrascleral fixation of an intraocular lens

Mohanna Aljindan[1], Abdu Hamdi[2], Naif Mamdouh Alali[3], Faris Hashem[3*] and Hani Basher ALBalawi[3]

Abstract

Background Implantation of intraocular lens in the capsular bag has become the standard of care in aphakic state. However, in the absence of capsular support, several techniques and intraocular lenses are available. Our study aims to report the safety, efficacy, and clinical outcomes of transconjunctival intrascleral intraocular lens fixation with Yamane's double-needle technique and flanged haptics.

Methods Prospective, observational study with some retrospective data collection. The study enrolled 13 patients (16 eyes) who underwent transconjunctival intrascleral fixation of an intraocular lens with Yamane's technique between June 2017 and April 2019 at Dhahran Eye Specialist Hospital and King Fahd University Hospital. All patients underwent preoperative and postoperative comprehensive evaluation, including uncorrected and best-corrected vision, intraocular pressure, slit-lamp examination, dilated fundus examination, and ultrasound biomicroscopy. We excluded patients with visually significant coexistent pathology such as retinal diseases, glaucoma, follow-up less than three months, and combined surgery such as keratoplasty.

Results The mean preoperative uncorrected visual acuity was 1.50 logMAR, and it improved to 0.60 logMAR. The mean preoperative best-corrected visual acuity was 0.70 logMAR, and it improved to 0.40 logMAR. The median safety index was 2.0, and the median efficacy index was 1.58. The postoperative complications included iris capture by the intraocular lens in one eye (7.7%), haptic extrusion in one eye (7.7%), and transient cornea edema in one eye (7.7%). There were no detected reports during the follow-up period of postoperative retinal detachment, choroidal detachment, elevation of the intraocular pressure (> 25 mmHg), hypotony, hyphema, vitreous hemorrhage, or endophthalmitis.

Conclusions The transconjunctival intrascleral fixation of an intraocular lens is safe and effective with a short learning curve and was not associated with significant intraoperative or postoperative complications.

Keywords Intraocular lens, Safety, Efficacy, Transconjunctival intrascleral fixation

*Correspondence:
Faris Hashem
fhashem@ut.edu.sa
[1]Department of Ophthalmology, College of Medicine, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia
[2]Department of Ophthalmology, Armed Forces Hospital Jazan, Jazan, Saudi Arabia
[3]Division of Ophthalmology, Department of Surgery, Faculty of Medicine, University of Tabuk, Tabuk, Saudi Arabia

Background

The placement of an intraocular lens (IOL) in the absence of the eye's natural lens has become the standard of care. The implantation of a secondary intraocular lens is now frequently carried out. The best position for an implanted lens is within the capsular bag, as it offers a stable fixation close to the eye's nodal point. However, there are situations where this ideal placement is not possible due to factors like inherent weakness of the lens zonules, eye injuries, or issues arising from cataract surgery. In such cases, alternative methods may be needed to ensure successful lens placement and the best visual results [1].

Various techniques and IOL types are available for secondary IOL implantation in the absence of capsular support, which has been accomplished by using an anterior chamber IOL, an iris-fixed IOL, a transscleral suture posterior chamber IOL, a transscleral glued posterior chamber IOL, and a Flanged Intrascleral Intraocular Lens Fixation with Double-Needle Technique. Discussions regarding the most efficacious methods for addressing eyes that lack sufficient capsular support still ongoingly exist [2].

The iris fixation IOL technique requires normal iris anatomy and angle structures. The disadvantages of this technique are the potential pupil distortion if the sutures are not placed peripheral enough and iris capture. Furthermore, since manipulation of the iris is required, uveal irritation and hyphema are possible risks [3, 4].

Although anterior chamber IOLs have been found to improve visual acuity, yet, they have also been linked to several complications, including loss of corneal endothelial cells, corneal decompensation, increase in intraocular pressure (IOP), pupillary distortion, cystoid macular edema, and retinal detachment [5]. In complicated cataract cases with inadequate capsule and zonular support, scleral-fixated IOL seemed to provide a more favorable outcome and a lower complication rate than anterior chamber IOL (AC IOL) [6]. The transscleral IOL suture technique offers certain advantages when compared to other techniques that can lead to corneal endothelial cell loss, glaucoma, and peripheral anterior synechiae [7–9]. However, this technique has a risk of suture erosion and breakage. A study found that 27.9% of cases experienced suture breakage six years after IOL suturing with 10−0 polypropylene sutures [10].

A technique for intrascleral IOL fixation was introduced by Gabor and Agarwal et al. to eliminate the need for sutures and reduce the risk of suture-related complications. However, the possible risk of sclerotomy and postoperative hypotony created by 24- or 25-gauge needles is still carried by this technique [11–15].

Flanged intrascleral intraocular lens fixation with the double needle technique was reported by Yamane et al., where the haptics of the IOL are fixed to the sclera without using sutures or glue. In order to decrease the risk of postoperative hypotony, 27 gauge or 30 gauge is used, which happens with a 24- or 25 gauge [2].

In this study, we report this technique's safety, efficacy, and clinical results.

Methods

This is a prospective, observational study with some retrospective data collection. We included 13 patients (16 eyes) who underwent transconjunctival intrascleral fixation of an intraocular lens with Yamane's technique. The surgeries were performed between June 2017 and April 2019 at Dhahran Eye Specialist Hospital and King Fahd University Hospital by the first author, who is an ophthalmology assistant professor and consultant of the cornea, anterior chamber, and refractive surgeries. The study was approved by the Research Committee at Dhahran Eye Specialist Hospital. Informed consent was obtained from all participants, who were told that all their de-identified clinical data would be used for this project. The inclusion criteria were aphakia, dislocated IOL, subluxated crystalline lens, anterior chamber IOL explantation with secondary IOL implant, and traumatic cataracts with weak zonules. The exclusion criteria were retinal disease requiring treatment, preoperative intraocular pressure (IOP) of 25 mmHg or more while receiving treatment with eye drops, age younger than 18 years, follow-up less than three months, and combined surgery such as keratoplasty.

All the patients underwent a standard ophthalmologic examination, including measurements of uncorrected and best-corrected visual acuity (VA), slit-lamp examination, measurement of IOP, and dilated fundus examination at all preoperative and postoperative visits. Postoperative hypotony and IOP elevation were defined as an IOP of less than 10 mmHg and an IOP of more than 25 mmHg, respectively.

Surgical procedure

The subluxated crystalline lens and traumatic cataract were removed through phacoemulsification cataract extraction under general or peribulbar anesthesia. In all cases, including aphakia eyes, anterior vitrectomy was performed. The soft dislocated IOL was cut and removed through a 3.0-mm sclerocorneal incision. An injector was utilized to insert a 3-piece IOL, such as the Sensar AR40e Abbott or MA60AC Acrysoft Alcon, into the anterior chamber while keeping the trailing haptic outside to prevent the IOL from entering the vitreous cavity. Sclerotomy was made through the conjunctiva with 20o angle using a 30-gauge thin-wall needle or 27-gauge needle at 2 mm from the limbus. Then, using a forceps, the leading haptic was then inserted into the needle's lumen. A second sclerotomy was made 180o from the first one, and

Table 1 Comparison of preoperative to postoperative visual acuity (one-month post-op)

Case no.	Diagnosis	Baseline UCVA logMAR	Baseline BCVA logMAR	Post op* UCVA logMAR	Post op* BCVA logMAR	Post op Refraction
Case 1	Aphakia	2.40	0.70	1.30	0.50	-2.25-2.75×170
Case 2	Subluxation Crystalline lens	1.20	0.40	0.20	0.10	+1.50-1.25×20
Case 3	Subluxation Crystalline lens	0.80	0.40	0.20	0.10	+1.75-1.25×5
Case 4	Subluxation Crystalline lens	1.30	0.30	0.10	0.00	-1.00-0.75×70
Case 5	Subluxation Crystalline lens	0.60	0.40	0.20	0.10	-0.25-2.00×35
Case 6	Traumatic Cataract	2.00	2.00	0.70	0.40	+0.75-5.00×20
Case 7	Anterior chamber IOL explantation + secondary IOL implant	2.00	1.30	1.30	0.90	+2.00-3.00×75
Case 8	Aphakia	1.30	0.90	0.90	0.90	-2.25-5.00×170
Case 9	Aphakia	1.60	0.40	0.50	0.50	+0.25-3.00×30
Case 10	Subluxation Crystalline lens	1.30	0.40	0.40	0.30	-1.00-2.25×80
Case 11	Aphakia	2.00	0.90	0.90	0.70	+1.50-1.25×75
Case 12	Aphakia	2.00	1.00	0.70	0.10	-0.50-2.00×125
Case 13	Subluxation Crystalline lens	1.00	0.40	0.20	0.10	+0.75-1.50×60

*post-op: one month after the surgery

the trailing haptic was threatened into the lumen of the second needle. Both haptics were externalized onto the conjunctiva with the double-needle technique. A flange with a diameter of 0.3 mm was created when the haptics' ends were cauterized using an ophthalmic cautery device. The flange of the haptics, at the end, was pushed back and secured into the scleral tunnels [2].

An additional movie file shows the surgical technique used in more detail [see Additional file 1].

Intraocular lens tilt measurements

Around three months after the surgery, the degree of inclination of the IOL was measured using Ultrasound Biomicroscopy. The IOL tilt was evaluated using vertical and horizontal images. A reference line was established by drawing a straight vertical line through the iris and the center of the cornea. Also, to determine the IOL tilt, the angle between the reference line and the horizontal axis of the IOL was calculated. The IOL tilt was measured in both the vertical and horizontal planes. The mean IOL tilt was defined as the average of the IOL tilt in the vertical and horizontal planes [2].

Table 2 The participants' demographics and clinical characteristics

Patient's Characteristics	Number (%) / Mean (SD)
Age (years)	39.62 (29.2)
Gender	
- Male	4 (31%)
- Female	9 (69%)
Diagnosis	
- Aphakia	5 (38%)
- Subluxated crystalline lens	6 (46%)
- Anterior chamber IOL explantation with secondary IOL implantation	1 (8%)
- Traumatic cataract with weak zonules	1 (8%)
Axial length (mm)	22.16 (0.10)
Baseline UCVA (logMAR)	(0.45)
Baseline BCVA (logMAR)	(0.49)
Postoperative UCVA (logMAR)	0.60 (0.3)
Postoperative BCVA (logMAR)	0.40 (0.23)
IOL power (D)	24.5 (2.5)
Follow-up (months)	6.9 (5.1)

BCVA: best-corrected visual acuity; IOL: intraocular lens; logMAR: logarithm of the minimum angle of resolution

Results

Sixteen eyes from 13 patients were included in this prospective interventional case series enrollment with some retrospective data collection. Three eyes (3 patients) that underwent surgery during the study period were excluded because of combined surgery with penetrating keratoplasty (one eye), active proliferative diabetic retinopathy (one eye), and uveitis "Vogt-Koyanagi-Harada Disease" (one eye). The mean patient age at the time of surgery was 39.6+/-29.2 years (range: 21–81 years). Four eyes from men and nine eyes from women. There were five aphakic eyes, six subluxated crystalline lenses, one anterior chamber IOL explantation with a secondary IOL implant, and one traumatic cataract with weak zonules. The mean follow-up duration was 6.9+/- 5.1 months (range: 3.10–21.70 months). The mean preoperative uncorrected VA was 1.50 logMAR, which improved to 0.60 logMAR.

The mean preoperative best-corrected VA was 0.70 logMAR, which improved to 0.40 logMAR. The mean axial length was 22.16+/-0.10 (range: 19.56–23.80). Two models of IOLs were used in this study, Sensar AR40e Abbott and MA60AC Acrysoft Alcon; the mean IOL power was 24.5 D (range: 20–30 D). Tables (1–2).

The mean IOL tilt was 5.29o. The mean postoperative refractive error was 0.10+/-1.50. The median safety index (post-op BCVA / pre-op BCVA) was 2.0 (0.80–40.0), and the median efficacy index (post-op UCVA / pre-op BCVA) was 1.58 (0.25-20.0). The postoperative complications included iris capture by IOL in one eye (7.7%), haptic extrusion in one eye (7.7%), and transient corneal edema in one eye (7.7%). There were no reports of postoperative retinal detachment, choroidal detachment, elevation of IOP (>25 mmHg), hypotony, hyphema, vitreous hemorrhage, or endophthalmitis were detected during the follow-up period.

Discussion

Many techniques for secondary intraocular lenses have been reported. The scleral fixated intraocular lens is the most preferred technique regarding safety, efficacy, and risk of complications. The transconjunctival intrascleral fixation of an intraocular lens technique differs from scleral flaps, sutures, and fibrin glue. However, a 30-gauge or 27-gauge scleral incision is the minimum requirement for fixation [16, 17].

The median safety index in our study was 2.0, in which 61.3% gained three lines or more, 15.4% gained two lines, 7.7% gained one line, 7.7% had no change, 7.7% lost one line, and no patients lost two or more lines in comparison of preoperative uncorrected visual acuity to postoperative best-corrected visual acuity. The median efficacy index was 1.58 compared to preoperative and postoperative best-corrected visual acuity.

The postoperative haptic extrusion and IOL decentration in our study was 7.7%, similar to those reported in previous studies of transscleral IOL suture and intrascleral IOL fixation [18]. This mainly happened as a result of not enough cauterization of the end of the one haptic to make a flange. One eye with microcornea and a short axial length of 19.56 mm, despite difficult surgical maneuver, developed transient cornea edema needed add hypertonic saline 5%; during 6 weeks of follow-up, the cornea was cleared, and the outcome was not affected. Iris capture by the IOL developed in one eye, which was presented by clinical intraocular lens tilt, measured 16o by UBM result from asymmetrical two opposite points of haptic externalization.

Two models of 3-piece intraocular lenses for flanged IOL fixation, Sensar AR40e Abbott and Acrysoft Alcon MA60AC, were used in our study, which show no difference in intraoperative and postoperative complications. The IOL tilt mean was 5.29o, and the mean postoperative refractive error was 0.10+-1.50, similar to those reported in the previous transconjunctival intrascleral IOL fixation study [2]. Future studies are required with a larger sample and a longer duration of follow-up with a control group to understand data regarding IOL stability and long-term complication rate.

An additional table shows a comparison between Yamane's technique and other lens fixation techniques, highlighting the reported complications for each technique. [see Additional file 2].

Conclusions

In conclusion, transconjunctival intrascleral fixation of an intraocular lens is safe and effective. It provides good IOL fixation independent of scleral flaps, tunnels, sutures, and fibrin glue with a short learning curve and was not associated with significant intraoperative or postoperative complications.

Abbreviations

AC Anterior chamber
IOL Intra-ocular lens
IOP Intra-ocular pressure
VA Visual acuity

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12886-024-03656-7.

Supplementary Material 1: Intra-operative short video of the surgery. Description of data: A short movie of transconjunctival intrascleral intraocular lens fixation with Yamane's double-needle technique and flanged haptics.

Supplementary Material 2: Comparison of Yamane's technique with other lens fixation techniques highlighting the reported complications for each technique. Description of data: A table comparing Yamane's technique with other lens fixation techniques highlighting the reported complications for each technique

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Author contributions

Conceptualization, AH and MA; data analysis, NMA; writing—original draft preparation, AH and HBA; writing—review and editing, FH; supervision, MA and HBA. All authors read and approved the final manuscript.

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Data availability

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was performed in accordance with the Declaration of Helsinki and was approved by the Research Committee at Dhahran Eye Specialist Hospital. All participants gave informed consent to use de-identified clinical data for this project.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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