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CLINICAL STUDY

Glued posterior chamber IOL in eyes with deficient capsular support: a retrospective analysis of 1-year post-operative outcomes

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Abstract

Purpose **To evaluate the post-operative outcome of fibrin glue-assisted posterior chamber intraocular lens (IOL) implantation in eyes with deficient capsular support after 1 year.**

Methods **Eyes operated with fibrin glue-assisted posterior chamber IOL implantation from December 2007 to May 2008 were included. The post-operative best spectacle-corrected visual acuity (BCVA), uncorrected visual acuity (UCVA), intraocular pressure (IOP), central macular thickness, and specular count were evaluated. IOL position and centration at 1 year was determined. The 1-year post-operative complications were analysed.**

Results **A total of 53 eyes of 53 patients were analysed. There was significant improvement in UCVA ($P = 0.000$) and BCVA ($P = 0.000$). There was no significant change ($P = 0.447$) in IOP from the pre-operative value. The early post-operative complication was decentration (5.6%). The late complication was pigment dispersion (3.7%) and healed macular oedema (7.5%). No vision threatening complications such as retinal break, retinal detachment, or endophthalmitis were seen. The percentage (%) loss of endothelial cells was $5.23 \pm 3.4\%$ at 1-year follow-up. No pseudophakodonesis was seen in the follow-up visits.**

Conclusion **Results obtained at 1 year after fibrin glue-assisted posterior chamber IOL implantation showed a good visual outcome with minimal complications in eyes with deficient capsular support.**

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Keywords: glued IOL; sutureless IOL; IOL in deficient capsule

Introduction

Intraocular lens (IOL) implantation in eyes with deficient capsular support has been at the forefront of surgical research for many years now. IOL implantation in the ciliary sulcus is possible in eyes with adequate anterior capsular support.[1] However, in eyes with deficient anterior capsular rim, anterior chamber (AC) IOL, iris claw lenses, or sutured scleral-fixated (SF) IOL are usually performed.[2–8] Fibrin glue-assisted posterior chamber (PC) IOL implantation is a new technique started in December 2007 in eyes with deficient capsular support.[9–12] The purpose of this article is to evaluate the post-operative outcome, namely, visual prognosis and complication profile, of eyes operated using this technique at the end of 1 year.

Materials and methods

In this retrospective case series, 53 eyes of 53 patients who underwent fibrin glue-assisted posterior chamber IOL implantation[9] were analysed after 1 year. All eyes operated using this procedure from December 2007 to May 2008 were included and followed up for 12 months. The selection criteria was eyes with deficient capsular or sulcus support in which implantation of PC IOL was not possible, >180 degrees subluxated cataract, and aphakia.

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The study was approved by our institutional review board.

On each follow-up visit (1, 3, 6, and 12 months), the following parameters were assessed: uncorrected visual acuity (UCVA) and best spectacle-corrected visual acuity (BCVA), refraction, intraocular pressure (IOP, non-contact tonometry), slit lamp biomicroscopy, dilated fundus examination, specular microscopy (SP-2000P, Topcon, Tokyo, Japan), and AC cellular reaction grading with SUN (Standardization of Uveitis Nomenclature) classification.[13] All the pre-operative parameters were compared with 1-year post-operative parameters. Ultrasound biomicroscopy (UBM) (Appasamy associates, Chennai, India) was carried out to document the IOL position and sclerotomy ports. A line was drawn along the limbus, marking it as the plane of reference for the optic position in the UBM and a second line was drawn along the long axis of the IOL optic. The optic was considered to be not tilted when the reference line along the limbus and the IOL optic were parallel.[14] According to the equation of straight line, $y = mx + c$, the slope of the line through limbus and IOL was determined.

Serial digital slit lamp images of the eye with full pupillary dilatation were taken to assess IOL centration. An image processing with Matlab version 7.1 (Mathworks Inc, Natick, MA, USA) was carried out to quantify decentration. The geometric centre of the limbus (a) (Figure 1) and the IOL optic (a1) was deducted. The distance (r) between the two geometric points was calculated in mm on each visit. The amount of decentration of the geometric center of the IOL optic with respect to the x axis and y axis of a two dimensional Cartesian system (the coronal plane) was determined.[15] If there was a significant change in the geometric centre of the IOL optic and the limbus in the follow up visit, the IOL was considered as decentered. Central macular thickness (CMT) was measured using posterior segment Stratus Optical Coherence Tomography (OCT) (Carl Zeiss Meditec, Dublin, CA, USA). The distance between the iris and the IOL optic was calculated using the anterior segment Visante OCT (Carl Zeiss Meditec). A serial slit lamp examination at $\times 20$ magnification under retro illumination in a dilated pupil with the patient's gaze focussed at a fixation target was performed to evaluate pseudophakodonesis.

Statistical analysis

Data were entered in a Microsoft Excel Sheet (Microsoft: Microsoft Corp, USA), and was analysed using SPSS version 16.1 (SPSS, SPSS Inc, Chicago, Illinois). Differences were considered statistically significant at $P < 0.05$. Wilcoxon signed-rank test for related samples, Mann–Whitney U-test for comparing two groups, and Kruskal–Wallis to analyse more than two groups were used.

Results

Out of 53 patients, there were 23 female and 30 male patients. The mean age in years was 50.63 ± 15.75. In total, 35 (66%) and 18 (33.9%) out of 53 eyes underwent the surgery as primary and secondary procedure, respectively. The most common indication was intraoperative posterior capsular rupture with absent sulcus support (35.8%) followed by aphakia (33.9%) and subluxated cataract (30.1%). A single-piece PMMA IOL (Appasamy associates), with optic size 6.5 mm and overall diameter of 13 mm, was implanted in all the eyes.

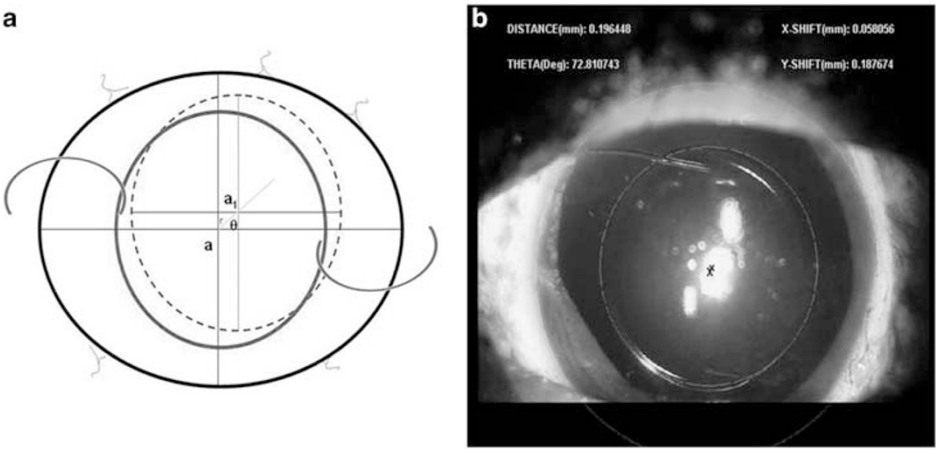

Figure 1 (a) Decentration of the geometric center of the IOL optic (a_1) with respect to limbus (a) was determined as r (mm). (b) Mild decentration detected in an eye in the early post-operative period.

SRK II formula was used for IOL power calculation. Post-operative refractive error was targeted for emmetropia.

The mean pre-operative UCVA in LogMAR was -0.90 ± 0.70 and the mean post-operative UCVA was -0.23 ± 0.13. The mean post-operative BCVA was -0.13 ± 0.15. There was significant improvement in UCVA (Wilcoxon signed-rank test, $P = 0.000$) and BCVA ($P = 0.000$). The mean spherical equivalent at 1-year follow-up was -0.46 ± 1.2 D and the mean prediction error was 0.46 ± 1.2 D. The average post-operative astigmatism was -1.6 ± 1.4 D. A total of 27 (50.9%) out of 53 eyes showed improvement, as compared with pre-operative BCVA (Figure 2). Loss of BCVA ($\leqslant 2$ lines) was seen in six (11.3%) eyes (Figure 2). The documented loss of BCVA in the 1-year post-operative period was due to macular pathology such as healed macular oedema or age-related macular degeneration changes. There was no significant difference in post-operative (1 year) BCVA between primary and secondary procedures (Mann–Whitney *U*-test, $P = 0.279$). There was significant difference (Kruskal-Wallis, $P = 0.002$) in post-operative BCVA (1 year) between the three groups (that is, PCR, subluxated, and aphakia).

The central hexagonal endothelial cells were analysed. The mean area analysed was $434.9 \pm 163\,mm^2$ pre-operatively and $442.9 \pm 161\,mm^2$ post-operatively. The mean pre-operative and post-operative specular count was 2217 ± 320.1 and 2099 ± 318.7 cells per mm^2 respectively. There was significant reduction in post-operative specular count (Wilcoxon signed-rank test, $P = 0.000$). The percentage (%) loss of endothelial cells from the pre-operative to 1-year post-operative (1 year) period was $5.23 \pm 3.4\%$. The mean coefficient of variation (CV) pre-operative and post-operative was 19.1 and 19.7, respectively. No significant difference ($P = 0.964$) in CV was noted. The mean IOP recorded at post-operative 1 year period was 14.37 ± 3.6 mm Hg. There was no statistically significant difference (Wilcoxon signed-rank test, $P = 0.447$) in IOP observed from the pre-operative to the post-operative (1 year) period. A grade II AC cellular reaction resolving within 48 h of medical management was seen in 3 out of 53 eyes on day 1 of the post-operative period. No recurrent uveitis was recorded in any of the operated eyes in the follow-up. There were no signs of clinically active uveitis (AC cells, flare, or keratic precipitates) observed at the follow-up. Iridodonesis was seen in 18.8% of the eyes (10 out of 53 eyes) and clinical pseudophakodonesis was not observed in any of the eyes. UBM showed no vitreous incarceration or uveal tissue prolapse in the sclerotomy ports. The post-operative mean CMT at 1 year was $190.8 \pm 5.9\,\mu m$. There was no post-operative vitritis or endophthalmitis seen in any of the patients. No retinal break or retinal detachment was documented on serial fundus examination. Table 1 shows the post-operative profile of all the eyes at 1 year.

The absolute mean slope of the line through the limbus was 0.03 ± 0.09 and the absolute mean slope of the line

Table 1 Complications of glued IOL

Complications profile	*1-year follow-up* (n = *53*)
Intra operative; n *(%)*	
Hyphema	2 (3.7%)
Post-operative; n *(%)*	
Early(<2 months)	
Decentration	3 (5.6%)
Post-operative glaucoma	0 (0.0%)
Late (>2 months)	
Pigment dispersion	2 (3.7%)
Retinal tear	0 (0.0%)
Retinal detachment	0 (0.0%)
Non-resolving vitreous haemorrhage	0 (0.0%)
Recurrent uveitis	0 (0.0%)
Healed macular oedema	4 (7.5%)
Pseudophakic bullous keratopathy	0 (0.0%)

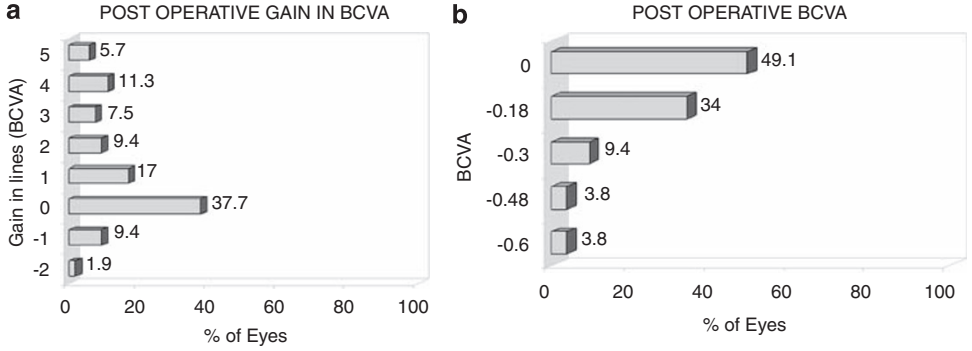

Figure 2 (a) Bar diagram showing the gain in post-operative BCVA. (b) Bar diagram showing the distribution of 1-year post-operative BCVA.

through the IOL optic was 0.03 ± 0.1. The mean ratio of the slope was 1.04 ± 0.28 mm. The mean distance between the iris and the IOL was 0.99 ± 0.2 mm in OCT. On calculating the distance (*r*) between the two geometric points of the limbus and IOL optic, the mean *r* at last follow-up was 0.09 ± 0.2 mm. The mean *x* and *y* axis shift was 0.091 ± 0.19 mm and 0.019 ± 0.05 mm, respectively. There was no significant change in *x* axis shift in the follow-up in the post-operative period (Wilcoxon signed-rank test, $P = 1.00$).

Discussion

There have been sutureless scleral fixation techniques[16,17] for PC IOL implantation in eyes with inadequate support in the recent past. Our technique differed from other sutureless methods by the externalisation of haptics under the scleral flaps instead of sclerotomy[16] and also the use of fibrin glue. We preferred biological glue to stick the flaps, as it prevents formation of subconjunctival bleb, which may happen when the scleral flaps are sutured. The risk of bleb-related endophthalmitis[18] and suture-related complications[19–21] are less when the flaps are closed with fibrin glue. Moreover, this method can be performed in both rigid and three-piece foldable IOL. Hence, there is no need for specially designed SF IOL. We now prefer to use a three-piece foldable or non-foldable IOL, as the optic haptic junction does not break, which can happen when implanting a single-piece non-foldable IOL. With a three-piece foldable IOL, the incision size is reduced as the IOL can be injected.

Evereklioglu *et al*[22] reported that sutured scleral-fixated PC IOL seemed to provide a more favourable outcome and a lower complication rate than the open-loop AC IOL in complicated cataract cases. A study by Donaldson *et al*[23] has shown no significant differences in outcome on comparing AC IOLs with sutured PC IOLs in complicated cataract extraction with poor capsular support. Bellucci *et al*[24] have shown a complication rate of 6% in both AC IOL and sutured SF IOL, whereas more intraoperative and post-operative complications in SF IOL. Two separate reports from Kwong *et al*[25] and Dadeya *et al*[26] showed satisfactory outcome by AC IOL. On historical comparison with AC IOL, complication rate of 49 and 32% in primary and secondary implantation, respectively, of flexible open-loop AC IOLs was reported by Bayramlar *et al*.[27] There are also reports showing endothelial loss and glaucoma after AC IOL implantation in the long-term follow-up.[28,29]

The haptics of the sulcus-fixated IOL in direct contact with the posterior surface of the overlying iris can cause focal iris atrophy and pigment dispersion.[30] The IOL rotation and recurrent irritation of the iris are known to cause late UGH syndrome.[31–33] Moreover, rubbing between the IOL optic and iris seems to contribute to the high flare counts in eyes with a sulcus-to-sulcus IOL fixation.[33] In our series, consistent vault is maintained between the iris and the IOL, which we consider as one of the reasons for less post-operative uveitis and pigment dispersion. The pseudophakodonesis due to the oscillations of the fluids in the anterior and posterior segment is known to cause permanent damage on the corneal endothelium.[34,35] However, there was no clinical pseudophakodonesis observed in our series and the endothelial cell loss was not more than any phacoemulsification procedure[36] and less than an AC IOL implantation.[29]

Uthoff *et al*[37] showed suture erosion (17.9%), cystoid macular oedema (5.8%), retinal detachment (1.4%), vitreous haemorrhage (1.0%), and uveitis (0.5%) in a 1-year post-operative outcome of sclera-fixated IOL. Vote *et al*[38] showed the high risk of repeat surgeries in sutured SF IOL due to suture-related complications. It was noted that none of the intraoperative complications in our patients affected the final functional outcome. It has been shown that the overall length (12.5–14.0 mm) of the IOL

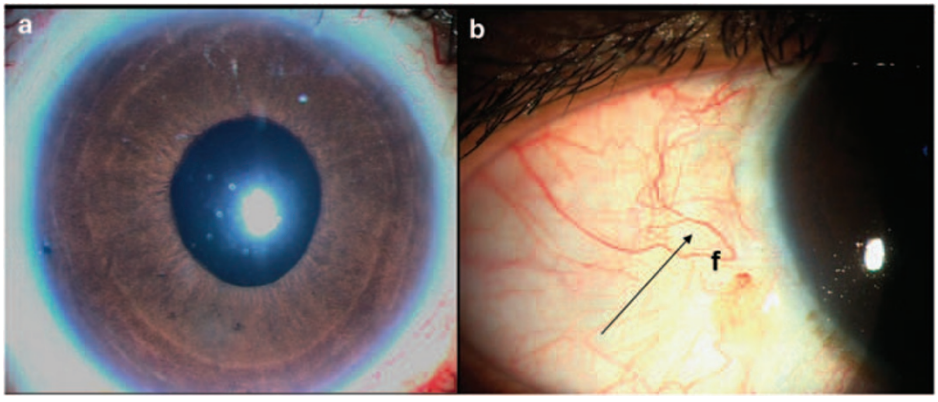

Figure 3 The 1-year post-operative clinical photograph showing (a) good IOL centration, (b) flap (f) apposition (shown with an arrow mark) and no haptic extrusion.

helps ensure firm, stable fixation in the posterior chamber behind the iris, wherein the average diameter in emmetropic eyes is ~13.0 mm.[39] In addition, the large optics lowers the risk of clinically significant post-operative decentration. As the overall diameter of the routine IOL is about 12–13 mm, with the haptic being placed in its normal curved configuration and without any traction, there is no distortion or change in the shape of the IOL optic. The externalisation of the greater part of the haptics into the scleral tunnel along its curvature stabilises the axial positioning of the IOL preventing tilt.[40] This is well shown by our 1-year follow-up results showing no haptic extrusion and good flap apposition (Figure 3).

The limitations of the study are: (1) we have analysed only the rigid IOLs and the post-operative outcomes of other IOL types need to be reported. (2) The follow-up is only 1 year and a longer follow-up might be required to confirm the long-term outcome. (3) A randomised control trial with SF and AC IOLs would be interesting in future, as the current study lacks a control group. Nevertheless, from the current study, it is considered that 1 year results of fibrin glue-assisted posterior chamber IOL implantation provided good visual prognosis with minimal complications in eyes with deficient capsular support. However, long-term follow-up would be required to determine the functional and anatomical results of the procedure.

Summary

What was known before

- Glued IOL surgical technique: Surgical technique with 6 weeks post-operative results were reported previously.
- Combined surgeries: Glued IOL with penetrating keratoplasty as a triple procedure in aphakic eyes with corneal pathology has been reported.

What this study adds

- Complication rate: Intra and post-operative complications in eyes with fibrin glue-assisted posterior chamber IOL implantation in long-term were studied.
- IOL centration analysis: IOL centration analysis of glued posterior chamber IOL was carried out using Matlab.
- Visual outcome: Analysis of post-operative visual outcome after 1 year in eyes with glued IOL implantation was carried out.

Conflict of interest

The authors declare no conflict of interest.

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