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# Management of traumatic dislocation of crystalline lens: Retropupillary iris-claw versus sutureless intrascleral-fixated intraocular lens

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## Abstract:

**PURPOSE:** The purpose of this study was to compare the long-term efficacy and safety of posterior iris-claw lens and scleral-fixated posterior chamber lens for aphakia after traumatic posterior dislocation of the crystalline lens.

**MATERIAL AND METHODS:** Out of 120 evaluated cases, 60 were randomly assigned in each group. A 23G vitrectomy was done and intraocular lens was implanted by two different techniques. Extensive preoperative and postoperative evaluation was performed including optical coherence tomography and Scheimpflug imaging. Follow-up was done on days 1, 7, and 28 at 3 months, 6 months, and 12 months.

**RESULTS:** A significant improvement was found in uncorrected visual acuity in both the groups. Surgical time in iris fixation was significantly less ( $P < 0.001$ ), whereas pupil peaking and pigment release were more. Difference in mean intraocular pressure and change in astigmatism in both the groups were insignificant.

**CONCLUSION:** Both the techniques had similar good visual results. Although operating time was shorter for iris fixation, it had several disadvantages, including immediate postoperative inflammation and ovaling of the pupil. However, scleral fixation had a better outcome in terms of postoperative complications.

## Keywords:

Iris claw, pupil ovaling, sutureless scleral fixation

## Introduction

Blunt trauma leads to compressive forces in anteroposterior direction, which ultimately causes compensatory equatorial expansion and thus disrupts the zonular fibers and dislocates the lens.<sup>[1,2]</sup> Partial disruption of zonules causes subluxation, whereas complete zonular rupture leads to dislocation.<sup>[2]</sup> Besides trauma, lens dislocation is also seen in hereditary disorders such as cystathionine beta-synthase deficiency, Ehlers–Danlos syndrome, congenital aniridia, focal dermal hypoplasia, homocystinuria, Marfan's

syndrome, Weill–Marchesani syndrome, molybdenum cofactor deficiency, and sulfite oxidase deficiency.<sup>[3]</sup> In past, posterior dislocated crystalline lenses were simply treated as aphakia, as it was believed that these dislocated lenses may be well tolerated for years. But nowadays, a number of complications are being recognized such as uveitis,<sup>[4]</sup> leakage of dissolved lens leading to phacolytic glaucoma,<sup>[5]</sup> and impaction in the vitreous and retina causing delayed retinal detachment.<sup>[6]</sup> Therefore, complete removal of the dislocated material is necessary by vitreoretinal surgery in the form of pars plana vitrectomy.<sup>[6]</sup>

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Nowadays, the intraocular lens (IOL) implantation is an evolving treatment option for visual rehabilitation and correction of aphakia in such cases.<sup>[7]</sup> There are a variety of options for the surgical correction of aphakia, such as anterior chamber (AC) IOLs, iris-fixated IOLs, and scleral-fixated IOLs (SFIOLs).<sup>[8]</sup> Placement of the IOL in the posterior, rather than the AC, reduces the risk of damage to AC angle structures and corneal endothelium.<sup>[9]</sup> In the past, fixation of the IOL to the iris was done by fixing the haptics to the anterior surface of the iris such as the Binkhorst lens, but these are of historical importance now.<sup>[10]</sup> Recently, the retropupillary fixations of the iris-claw IOLs (ICIOL) have gain momentum in view of their ease of surgery and relatively good results.<sup>[11,12]</sup>

Suturing the IOL to sclera using nonabsorbable sutures has been the traditionally accepted technique of IOL placements but associated with various complications such as suture-induced inflammation, suture degradation, and delayed IOL subluxation or dislocation due to broken suture.<sup>[13]</sup> Recently, Scharioth *et al.* developed a technique of sutureless scleral fixation of a multipiece IOL.<sup>[14]</sup>

This study aimed to compare the clinical efficacy, safety, and complexity between ICIOL and SFIOL as a procedure for visual rehabilitation after traumatic dislocation of the crystalline lens.

## Methods

The ethical committee of the hospital approved the study and followed the tenets of the Declaration of Helsinki (IRB approval number:14/114). Informed consent was obtained from all patients before surgery. In this randomized control trial, from year 2014 to 2018, 129 eligible cases of traumatic dislocation of lens were taken. Each case of blunt trauma with diminution of vision was evaluated clinically. Ultrasound and computed tomography scan were advised to rule out posterior segment involvement. All the clinically diagnosed cases of traumatic dislocation of the crystalline lens, above 12 years age, who were ready to give consent were included in the study. Exclusion criteria included patients with corneal opacity, glaucoma due to damage of AC angle structures, retinal disorder, optic atrophy, and bleeding disorder, pregnant women, and those who were unwilling to give consent. All the cases underwent 23G pars plana vitrectomy with a 360° endolaser for removal of the crystalline lens from the posterior segment by a single well-experienced surgeon. A gap of minimum 4 weeks was given before IOL implantation so that intraocular reaction and corneal edema resolved before the secondary procedure. Preoperative (before secondary procedure) and postoperative visual acuity, slit-lamp

and fundus examination, applanation tonometry, gonioscopy (to rule out damage of angle structures), keratometry, biometry (Carl Zeiss Meditec IOL Master), and optical coherence tomography (OCT) (TOPCON 3D OCT-2000) were done for extensive evaluation of anterior and posterior segment. Nine cases did not turn up for IOL implantation. Hence, the effective sample size of 120 cases was assigned in two groups (scleral fixation and iris fixation) by “lottery or chit in box method.” Both the groups were operated by a single surgeon.

## Statistical analysis

With the use of software IBM Software SPSS 19.0 (IBM Corporation, Armonk, NY, USA) 19.0, qualitative data were summarized in the form of proportion. Quantitative data were summarized in the form of mean and standard deviation. The significance of difference in proportion was measured by Chi-square test. Group differences in the continuous variables were analyzed using the Student’s *t*-test. The significance of difference in mean was measured by unpaired *t*-test or ANOVA whichever is appropriate.  $P < 0.05$  was considered as statistically significant.

## Surgical technique

### *Iris-claw lens*

Under peribulbar anesthesia, conjunctival peritomy was done and superior sclerocorneal tunnel (5.5 mm long and 5.5 mm wide) incision was made. The pupil was constricted using intracameral pilocarpine. The IOL was inserted into AC with the convex side downward (upside down) holding it in the forceps. With a manipulator, the IOL was brought into the horizontal position from 3 o’clock to 9 o’clock. One haptic was guided below the iris and enclaved in the mid-peripheral iris using a blunt Sinsky hook. The same procedure was repeated for the other haptic. Peripheral iridectomy was performed intraoperatively. Finally, wound integrity was checked.

### *Scleral-fixated intraocular lens*

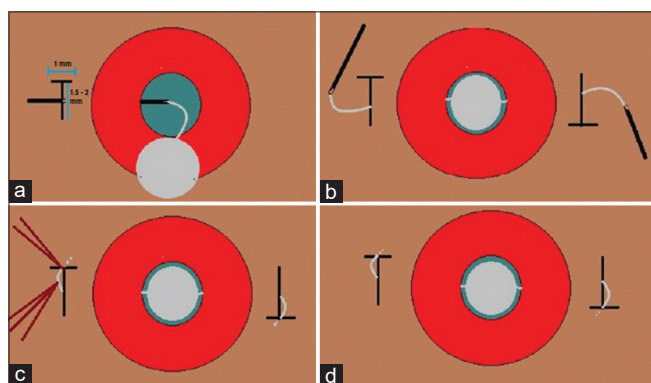
Under peribulbar anesthesia, a 5.0 mm conjunctival peritomy was done at the 2 o’clock and 8 o’clock positions. Then, two T-shaped incisions (1.5–2 mm long) were made 1.5–2.0 mm from the limbus and depth was half of scleral thickness, exactly 180° apart diagonally. An infusion cannula or AC maintainer was inserted. To prevent interference with the creation of the T-shaped incision, infusion cannula should be positioned at 4 o’clock. Sclerotomy was done parallel to the iris at the T-shaped incision with a 23G angled microvitoretinal knife, and a scleral tunnel (3–3.5 mm long) was made parallel to the limbus at the branching point of the T-shaped incision. 2.8 mm keratome was used to make a corneal incision at 10 o’clock for IOL implantation. The overall diameter of IOL was 13 mm and optic diameter was 6 mm (Abbott Sensar AR40e [three-piece foldable

IOL]). The trailing haptic was left outside the incision. The tip of the haptic was then grasped with 24G IOL haptic gripping forceps, pulled through the sclerotomy, and externalized on the left side. The haptic tip of trailing haptic was grasped with a 24G forceps, pulled through the second sclerotomy, and externalized on the right side. The haptic insertion into the AC may be difficult depending on the material or shape of the haptics, which can cause the IOL to rotate clockwise and the leading haptic to slip back into the eye. To prevent such risks, the IOL optic was pushed to the back of the iris and moved to the 2 o'clock position with a push-and-pull hook inserted through the side port at the 1 o'clock position. The tip of the haptic was subsequently inserted into the limbus-parallel scleral tunnel. A single 8-0 vicryl suture is used to fixate the haptic to the scleral bed to prevent it from shifting immediately after surgery [Figure 1].<sup>[15]</sup>

Scheimpflug imaging (OCULUS Pentacam) was done to evaluate the proper centration of IOL. Cross-sectional images were used for decentration calculations.<sup>[16]</sup> Follow-up was done on the 1<sup>st</sup>, 7<sup>th</sup>, and 28<sup>th</sup> postoperative days and at 3 months, 6 months, and 12 months.

## Results

The study population consisted of 120 patients (52 females and 68 males). Thirty-five cases had raised intraocular pressure (IOP) for which medical management was given. After vitrectomy, IOP was normalized in 22 cases, and the rest were continued on medical management. They were under close observation till normalization of IOP. In these cases, IOL was implanted 2 weeks after the discontinuation of medical therapy. Hence, at the time of IOL implantation, IOP was within the normal range without medical therapy in all the cases. A comparison of the baseline demography and preoperative ocular characteristics of patients between eyes with ICIOL and SFIOL is shown in Table 1.

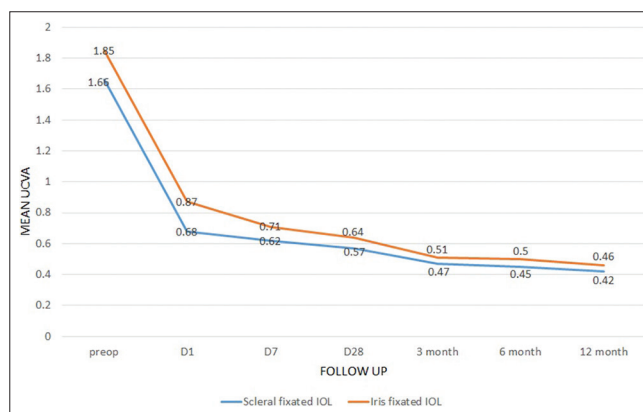


**Figure 1:** (a) T-shaped incision and sclerotomy made 2 mm from limbus and scleral tunnel formed at branching point. (b) Haptics of intraocular lens exteriorized. (c) Haptic tucked and fixed in scleral tunnel. (d) Proper centration after fixation of both the haptics

On comparing the postoperative outcomes, difference in uncorrected visual acuity (UCVA), IOP, and astigmatism was insignificant between both the groups [Table 2]. Surgical time was significantly shorter for the fixation of iris claw.

Change in UCVA in logarithm of the minimal angle of resolution from preoperative value to every follow-up postoperatively was highly significant ( $P < 0.0001$ ) in both the groups [Figure 2]. Corneal topography (K1 and K2) and astigmatism were measured using Scheimpflug imaging. Changes in keratometry (K1 and K2) and astigmatism were found insignificant ( $P = 0.8460$  in scleral fixation and  $0.7934$  in iris fixation), showing that scleral tunnel and corneal incisions made in these techniques do not significantly affect corneal astigmatism.

There were no intraoperative complications noted in either of the surgical groups. Because of surgical manipulation, there were 6 cases of corneal edema and AC reaction in the scleral fixation group while 12 were in the iris fixation group were noted postoperatively. All got resolved by the next follow-up. On day 1, all IOLs were well centered in the scleral fixation group, but 4 IOLs were slightly decentered in the iris fixation group. Slight decentration did not hamper the vision. In SFIOL, marking for sclerotomy and loop retrieval were precise and under direct vision. Iris-claw fixation technique is a partially blind procedure, and it becomes difficult to tuck the iris in the claw of IOL because it is difficult to see through thick, dark brown iris in Indians. On day 7, IOP was found to be raised in 5 cases of the iris fixation group and 2 cases of scleral fixation for which antiglaucoma drugs started and IOP was well controlled after 1 week. In the scleral fixation group, on day 7, there was decentration of 2 IOLs which were recentered surgically. That time tunnel was not fibrosed. Exposed haptic was grasped and pulled to ensure proper centration of IOL and then tucked into the same tunnel, and an absorbable suture was applied to ensure the fixation till the tunnel



**Figure 2:** Logarithm of the minimal angle of resolution uncorrected visual acuity at various follow-up

get fibrosed. At 3-month follow-up, there were 6 cases of cystoid macular edema with SFIOL, whereas 7 cases with ICIOL. All were well managed medically. No case of retinal detachment, vitreous hemorrhage, or endophthalmitis was noted.

In the iris fixation group, problem of ovaling (loss of round shape) of the pupil was seen in 12 cases in contrast to no ovaling in the SFIOL group. Pupil ovalization can occur if the fixation of the haptics is performed asymmetrically or too tightly.

At the end of 12 months, majority of the patients had well-centered IOL as seen on slit-lamp examination [Figure 3] and Scheimpflug imaging [Figure 4].

## Discussion

Blunt trauma causes structural changes in the eye which leads to dislocation of the crystalline lens.<sup>[1]</sup> Due to damage of zonular fibers, it is quite impossible to place IOL at usual position. Our study reported that the management of traumatic dislocated crystalline lens has promising visual outcomes with majority of the cases regaining “functional normal vision.” However, close monitoring for a long time is advised considering the complications even after successful management. This

study included the cases with dislocated crystalline lens without any other anterior or posterior segment complication of blunt trauma.

In this study, in initial postoperative period, visual outcomes in the iris-claw group were slightly poor as compared to SFIOL, but this difference did not persist after 1 month. Madhivanan *et al.*<sup>[17]</sup> and Kim and Kim<sup>[18]</sup> also claimed good visual outcome by both the procedures. According to them, this difference in initial period can be due to the rubbing of haptic against the pigment epithelium of the iris during tucking of IOL haptic and releasing pigments into the AC which activate the inflammatory process. As a result clarity of the AC hampers, which ultimately have a negative impact on vision in the iris fixation group. Postoperatively, IOP was slightly higher in the iris-claw fixation group in comparison to the scleral fixation group perhaps due to residual viscoelastic substance and more postoperative inflammation in iris-claw fixation technique. No significant differences were noted in the mean IOP between the iris-claw fixation and the scleral fixation groups as consistent with other studies.<sup>[19,20]</sup> None of the postoperative complications resulted in a significant worse mean visual acuity.

The purpose of visual rehabilitation by IOL implantation is to achieve minimum refractive error. This study

**Table 1: Baseline demography**

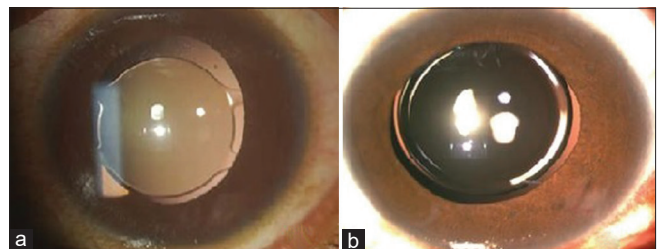
Variable	Scleral fixation	Iris fixation	P
Age (years)	41.73±15.81	44.23±10.48	0.3094
Sex (male/female)	31/29	37/23	0.27
Laterality (OD/OS)	38/22	35/25	0.5751
Preoperative UCVA	1.66±0.46	1.85±0.61	0.0565
Preoperative IOP	14.20±3.00	14.93±2.49	0.1496
Mean preoperative astigmatism	1.73±1.15	1.43±1.12	0.1504

\*Preoperative data taken after vitrectomy. UCVA=Uncorrected visual acuity, IOP=Intraocular pressure, OD=Right eye, OS=Left eye

**Table 2: Postoperative outcomes**

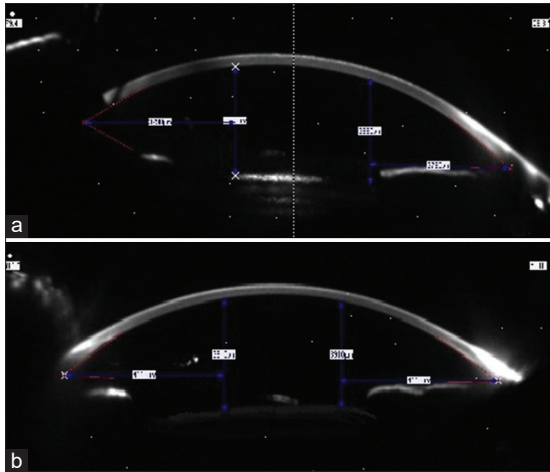
Variable	Scleral fixation	Iris fixation	P
Mean UCVA at final follow-up (LogMAR)	0.42±0.17	0.46±0.21	0.2538
Mean IOP at final follow-up (mmHg)	15.20±2.06	15.88±2.13	0.0781
Mean astigmatism at final follow-up	1.69±1.10	1.38±0.96	0.1027
Surgical time	42.67±3.02	18.67±1.48	<0.0001
Complications (%)			
Corneal edema/iritis/AC flare	6 (10)	12 (20)	0.132
Raised IOP	2 (3.33)	5 (8.33)	0.258
Decentration	2 (3.33)	4 (6.66)	0.411
Cystoid macular edema	6 (10)	7 (11.66)	0.769
Corneal decompensation	0	0	1.000
Retinal tear	0	0	1.000
Retinal detachment	0	0	1.000
Choroidal hemorrhage	0	0	1.000
Endophthalmitis	0	0	1.000

UCVA=Uncorrected visual acuity, IOP=Intraocular pressure, AC=Anterior chamber, LOGMAR=Logarithm of the minimal angle of resolution



**Figure 3:** Well-centered iris-claw-fixed intraocular lens (a) and scleral-fixed intraocular lens (b) as seen on slit lamp





**Figure 4:** Well-centered iris-claw-fixedated intraocular lens (a) and scleral-fixedated intraocular lens (b) as seen on Scheimpflug imaging

reported that the tunnel and corneal incisions made in both the procedures had no significant effect on corneal astigmatism. Tunnels are small enough and at considerable distance from limbus to generate surgical induced astigmatism. Some previous studies also quoted the same results.<sup>[21]</sup>

With technical point of view, enclaving the ICIOL to the posterior surface of the iris is much easier as compared to implanting the SFIOL using sutureless technique. And also, the ICIOL fixation is less time-consuming than the SFIOL.<sup>[19]</sup> In our study also, surgical time was significantly less in the iris-claw fixation group as iris-claw implantation was less demanding in view of surgical skills than SFIOL. Scleral incision, retrieval of IOL, and tucking the loop in tunnel needed more surgical skills and time. However, in case of decentration, SFIOL is easy to recenter because the tunnels and haptics can be easily assessed and manipulated. However, in ICIOL, this procedure is more invasive and difficult. Ovalization of the pupil is a well-documented complication of iris-fixedated IOL.<sup>[22-24]</sup> Distortion of the pupil may compromise the quality of vision regained by patients.<sup>[25]</sup> In addition, localized or generalized atrophic changes in the iris start appearing because of enclavation of iris tissue in haptics which ultimately affect the physiological functioning of the pupil.<sup>[26]</sup> These atrophic changes hampered the constriction of the pupil in bright light, causing photophobia.

Previously published studies dealing with comparison of ICIOL and SFIOL were mainly of retrospective nature.<sup>[17-19]</sup> Moreover, only a few studies used the technique of sutureless rather than sutured scleral fixation for comparison.<sup>[17]</sup> This randomized clinical trial, by sutureless scleral fixation technique, with a larger sample size and longer follow-up is definitely an add-on in existing literature. Previous studies dealt

with the aphakia because of the complications during the cataract surgery.<sup>[17,18,22]</sup> We successfully evaluated the two methods of IOL implantation in such cases. Moreover, this study added the valuable Scheimpflug imaging-based information about the effect of tunnels and incisions on corneal astigmatism.

Based on the current randomized clinical trial, for visual rehabilitation after traumatic dislocation of the crystalline lens, iris-claw fixation technique could have been an alternative to scleral fixation because of less surgical time and easy technique, but because of more postoperative complications, mainly iritis, scleral fixation technique is better than iris-claw fixation technique. Although long-term visual outcome is satisfactory and comparable for both the groups, visual rehabilitation following ICIOL might take longer than SFIOL and ovalization of the pupil is the most common adverse effect reported with this type of IOL design. Finally, as SFIOL implantation is much more technically challenging with a longer learning curve compared to ICIOL, the choice of IOL depends on the surgeon's expertise and previous exposure.

The drawbacks of our study are lack of data regarding endothelial cell counts and documentation of changes in the iris architecture and pupil dynamics over the follow-up period. Assessment of ocular aberrations due to pupil ovalization is also lacking in our study.

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Nil.

### Conflicts of interest

The authors declare that there are no conflicts of interests of this paper.

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