

# Surgical Outcomes of Retropupillary-Fixated Iris-Claw Intraocular Lens

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## Abstract

**Purpose:** To assess the visual outcome and complications following retropupillary-fixated iris-claw intraocular lens (IOL) implantation.

**Methods:** For this retrospective, non-comparative study, chart review of patients who underwent retropupillary iris-claw IOL implantation for the correction of aphakia from July 2014 to October 2018 and had a minimum postoperative follow-up of 2 months was carried out. Postoperative corrected distance visual acuity (CDVA), intraocular pressure (IOP), and complications were noted.

**Results:** One hundred and twenty-two eyes of 122 patients (mean follow-up:  $7.48 \pm 5.2$  months, range, 2 months-3.5 years) were enrolled in the study. The mean logMAR CDVA improved from  $1.36 \pm 0.52$  preoperatively to  $0.5 \pm 0.42$  postoperatively, at the last follow-up visit ( $P < 0.0001$ ). The final CDVA improved in 110 eyes (90.2%), remained unchanged in 8 eyes (6.6%), and worsened in 4 eyes (3.3%). In cases of pre-existing cystoid macular edema (CME) or excessive intraoperative manipulations, 0.05 ml of 4 mg intravitreal triamcinolone acetonide (IVTA) was injected at the end of the surgery. Twenty eyes (16.4%) had transient ocular hypertension (OHT), 6 eyes (4.9%) had persistent OHT, and 2 eyes (1.6%) progressed to glaucoma. Choroidal detachment was noted in 2 eyes (1.6%), CME in 6 eyes (4.9%), 2 eyes (1.6%) had retinal detachment, 20 eyes (16.4%) had significant ovalization of pupil, 8 eyes (6.6%) had one haptic disenclavation, 1 eye (0.8%) had corneal decompensation, and 1 eye (0.8%) had endophthalmitis.

**Conclusions:** Retropupillary iris-claw IOL provides good visual rehabilitation with a few complications. Its ease of insertion and short surgical time makes it a good option to correct aphakia in patients with an inadequate capsular support.

**Keywords:** Aphakia, Non-comparative study, Retropupillary iris-claw lens, Secondary intraocular lens

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## INTRODUCTION

During a complicated cataract surgery, zonular dialysis or posterior capsule dehiscence can cause an inadequate capsular support and difficulty to implant posterior chamber intraocular lens (PCIOL) in the capsular bag or ciliary sulcus. Angle-supported anterior chamber intraocular lens (ACIOL),<sup>1</sup> anterior chamber (AC) iris-claw lens,<sup>2</sup> retropupillary iris-claw lens,<sup>3,4</sup> and scleral-fixated (SF) intraocular lens (IOL)<sup>5</sup> are the viable options for the surgical correction of aphakia.

Initially, iris-claw IOLs were implanted in the AC (pre-pupillary); however, posterior chamber (retropupillary) iris-claw IOL is gaining popularity because it is technically less challenging and has a shorter learning curve, when compared to the SF IOL.<sup>6</sup> In this implantation technique, the haptics of the poly methyl methacrylate (PMMA) IOL are anchored to the posterior surface of the iris, placing them far from the corneal endothelium and iridocorneal angle, which theoretically lowers the risk for endothelial and trabecular meshwork damage when compared to ACIOL. There is no general consensus about the

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best placement of iris-claw lens; however, a study reported that the AC implantation causes a higher endothelial cell loss (ECL) than the retropupillary one.<sup>7</sup>

The purpose of this non-comparative study was to retrospectively analyze the visual outcome and complications after the retropupillary iris-claw IOL implantation for the correction of aphakia, both as a primary or secondary procedure.

## METHODS

Medical records of 211 patients who underwent retropupillary iris-claw IOL implantation from July 2014 to October 2018 at our institute were reviewed. The study was conducted in accordance with the tenets of the Declaration of Helsinki.

Preoperative data were collected on patient demographics, history of prior ocular surgery, cause for aphakia, associated ocular pathology, uncorrected visual acuity (UCVA), best corrected distance visual acuity (CDVA), refraction, slit-lamp examination (with emphasis on corneal clarity, adequacy of iris tissue, pupillary distortion from prior surgery and absent or inadequate capsular support), intraocular pressure (IOP) measurement with Goldmann applanation tonometry, fundus evaluation, keratometry, A-scan biometry, and optical coherence tomography (OCT), if required, to rule out cystoid macular edema (CME). Postoperative data were obtained on UCVA, CDVA, clinical signs of ECL, IOL position, IOP, pigment dispersion, gonioscopy (whenever required), fundus examination, OCT to rule out CME (whenever required), and complications. Data were analyzed for the patient demographics, pre- and postoperative CDVA, refraction, IOP at the follow-up visits, follow-up duration, and the postoperative complications.

Patients who required combined surgery for a co-existing corneal, glaucoma or retinal pathology, or had a postoperative follow-up of <2 months were excluded from the study.

Excelens iris-claw lens (PIC 5580 model; Excel optics [p] Limited, Chennai, Tamil Nadu, India) was used for the implantation. It is a monofocal, single piece biconvex PMMA IOL, 8 mm in length and has an optical zone of 5.5 mm. The haptics have fine fissures, in which the iris tissue is enclaved. IOL power was calculated using Sanders-Retzlaff-Kraff-T formula, with an A-constant of 117.2, as per the manufacturer's recommendation. IOL power was chosen for the postoperative refractive aim of emmetropia.

### **Surgical technique**

Under peribulbar anesthesia, all the surgeries were performed by the two experienced surgeons, using the same surgical protocol. After a superior conjunctival peritomy, 5.5–6 mm scleral tunnel was made. In cases of secondary IOL implantation, the pre-existing sclerocorneal tunnel was opened. Standard 3 ports for pars plana vitrectomy (PPV) was made at 3.5–4.0 mm from the limbus. Two side ports at 3 and 9 o' clock were made, and anterior vitrectomy was done to ensure that

there were no residual vitreous strands in the AC or wound. Remnants of anterior and posterior capsule along with the cortex and irido-vitreous adhesions were removed. Peripheral iridectomy (PI) was performed using the vitrector between 11 and 2 o' clock. Using a wide angle viewing system, 20G or 23G PPV was done. Posterior vitreous detachment was induced, and the peripheral vitreous skirt was trimmed. In cases of dropped nucleus, nuclear fragments were removed using the phacofragmentor, and the residual cortex was removed using the vitrector. In cases of dropped IOL, the IOL was held at the optic and haptic junction with end gripping forceps and brought out anteriorly and removed through the scleral tunnel. In cases of intracapsular cataract extraction, anterior vitrectomy was performed. Intracameral 0.1 ml of pilocarpine nitrate 0.5% (Aurocarpine, Madurai, India) was used to constrict the pupil. Viscoelastic (Hydroxy propyl methyl cellulose 2%) was injected into the AC. Using iris-claw holding forceps, iris-claw IOL was introduced in the AC, and the haptics were rotated to 3 and 9 o' clock, using a Sinskey hook. The optic was held in the center of the pupil with forceps, and the haptic was dipped under the iris surface. The bump of the haptic should be visible on the iris surface, and using a Sinskey hook through the side port, the mid peripheral iris was gently tapped at the center of the haptic to enlave the IOL to the posterior iris surface. Once the haptic was enclaved, a dimple was visible on the iris surface, and the other haptic was enclaved in a similar way. After enclavation, IOL was tapped to check for the IOL stability. Viscoelastic was removed, side ports were hydrated, and the vitreous cavity was cleared of viscoelastic using an active/passive suction. Scleral incision was sutured with interrupted 10-0 nylon, and sclerotomies and conjunctiva were sutured with 8-0 polyglactin (Vicryl).

In cases of preexisting CME/excessive intraoperative manipulations, 0.05 ml of 4 mg intravitreal triamcinolone acetonide (IVTA) was injected at the end of surgery. Postoperatively, all the patients were prescribed topical prednisolone acetate 1% and moxifloxacin 0.5% four times/day, tapered over a period of 6 weeks. Patients were asked to come for follow-up at 1 day, 1 week, 1 month, 3 months, 6 months, 1 year, and 6 monthly thereafter.

Statistical analysis was performed using the SPSS version 16 (SPSS/IBM Inc., Chicago, Illinois, USA). Snellen CDVA was converted to logMAR units for the analysis. Visual acuity of hand movement and light perception was assigned the equivalent of 1.7 and 1.8 logMAR units, respectively.<sup>8,9</sup> Descriptive analysis was carried out, and the data were analyzed using paired *t*-test. A value of  $P < 0.05$  was considered statistically significant.

## RESULTS

Of 211 eyes, 56 eyes were excluded because of co-existing corneal and retinal pathology, and 33 eyes were excluded because of the follow-up of less than a month. Finally, data of 122 eyes of 122 patients were analyzed. The

mean age was 61.2 ± 15.0 years (range, 18–85 years), and 55.7% were male [Table 1]. The mean follow-up was 7.48 ± 5.2 months (range, 2 months to 3.5 years).

The IOL was implanted during primary cataract surgery in 41 eyes (33.6%) and as a secondary procedure in 81 aphakic eyes (66.4%). Indications for the primary surgery were absorbed cataract (n = 1), intraoperative posterior capsule dehiscence (n = 8), zonular dialysis (n = 21), intraoperative nucleus drop (n = 3), and subluxated lens (n = 8, Marfan syndrome: 4, trauma: 4). For the secondary IOL implantation, the indications were aphakia due to complicated cataract surgery (n = 36), dropped nucleus (n = 13), dropped PCIOL (n = 24), and IOL exchange for the subluxated IOL (n = 8). Anterior vitrectomy was performed for 26 eyes during primary surgery (absorbed cataract: 1, subluxated lens in Marfan syndrome: 4 and 21 eyes with zonular dialysis). The rest of all the eyes (n = 96) underwent PPV.

There were no significant intraoperative complications, except for the minor iris bleed.

In all the eyes, the mean CDVA improved from preoperatively 1.36 ± 0.52 logMAR to 0.5 ± 0.42 logMAR postoperatively at the last follow-up visit (P < 0.0001) [Table 2]. Compared to the mean preoperative CDVA, a significant improvement in the mean postoperative CDVA was noted at the first postoperative week and at all the follow-up visits (P < 0.0001) [Table 2]. At

the last follow-up, 44 eyes (36%) had logMAR CDVA better than 0.30, 59 eyes (48.4%) had logMAR CDVA between 0.3 and 1, and 19 eyes (15.6%) had logMAR vision >1. The final CDVA was better than preoperatively CDVA in 110 eyes (90.2%), remained unchanged in 8 eyes (6.6%), and had worsened in 4 eyes (3.3%).

Overall, the postoperative mean residual spherical equivalent (MRSE) was - 0.94 ± 1.49 D (range, -4 to 4.75 D). Postoperative mean spherical correction was 0.076 ± 0.09 D (range, 4 to -4 D), and mean cylinder was - 2.29 ± 2.27 D (range, 1 to -6 D).

All the postoperative complications are shown in Table 3. Twenty eyes (16.4%) had transient increase in IOP (defined as IOP > 22 mmHg) between day 1 and 1 week postoperatively and were managed with a short-term use of anti-glaucoma medications (AGM). Six eyes (4.9%) had persistent ocular hypertension (OHT) which required long-term use of AGM. Two eyes progressed to glaucoma, and 1 eye lost vision due to glaucomatous optic neuropathy. There was no difference in the mean IOP preoperatively (13.68 ± 4.18 mmHg) and at all follow-up visits [Table 2]. Nine eyes (7.4%) had transient postoperative hypotony, and 2 eyes (1.6%) had prolonged hypotony due to choroidal detachment.

The incidence of postoperative CME was 4.9% (6 eyes) and required subsequent IVTA. The incidence was 16.7% (1/6 eye) in a patient with diabetes and 83.3% in 5 patients without diabetes. All these eyes had received IVTA at the inclusion of the surgery.

Hyphema was seen on the first postoperative day in 7 eyes (5.7%), which resolved with medical management. Retinal detachment (RD) was noted in 2 eyes (1.6%) at 1 week after the surgery, which required surgical intervention. Preoperative mild irregularity of pupil was seen in 60 eyes (49.2%), which persisted postoperatively, and significant ovalization of pupil was seen in 20 eyes (16.4%). Eight eyes (6.6%) had one haptic disencavation, requiring re-surgery to re-enclave the IOL haptic. Thirty eyes (24.6%) had corneal edema before surgery which persisted in 1 eye (0.8%) due to corneal decompensation. One eye (0.8%) developed endophthalmitis a week after the surgery, which responded to intravitreal antibiotics.

**Table 1: Summary of patients demographics and clinical parameters (n=122)**

Parameters	Values
Age (years)*	61.16±15.04
Gender (male/female)	68/54
Laterality of the eye (right/left)	67/55
Diabetes mellitus/systemic hypertension	34/43
Primary/secondary iris-claw lens implantation	41/81
Follow-up duration (months)*	7.48±5.2
Preoperative CDVA (logMAR)*	1.36±0.52
Preoperative IOP (mmHg)*	13.68±4.18
Mean manifest refraction spherical equivalent at the final follow-up (D)*	-0.94±1.49

\*Values are given in mean±SD. CDVA: Corrected distance visual acuity, IOP: Intraocular pressure, SD: Standard deviation

**Table 2: Comparison of preoperative and postoperative corrected distance visual acuity and intraocular pressure (IOP) over a period**

Follow-up visit	CDVA (logMAR)	Mean difference and P value (comparison of pre- and postoperative BCVA)	IOP (mmHg)	Mean difference and P value (comparison of pre- and postoperative IOP)
One day (n=122)	1.05±0.49	0.31 (<0.0001)	12.89±5.96	0.79 (0.6)
One week (n=119)	0.69±0.58	0.67 (<0.0001)	16.37±10.03	-2.68 (0.3)
Two months (n=122)	0.46±0.40	0.90 (<0.0001)	13.37±2.48	0.32 (0.8)
At last follow-up visit (n=122)	0.50±0.42	0.87 (<0.0001)	13.16±2.77	0.53 (0.6)

All values are shown as mean±SD. CDVA: Corrected distance visual acuity, BCVA: Best corrected visual acuity, IOP: Intraocular pressure, SD: Standard deviation

**Table 3: Summary of postoperative complications**

Complications	Number of eyes (%)
Corneal decompensation	1
OHT	26
Ovalization of pupil/iris atrophy	20
Disenclavation of haptic	8
Tilted iris-claw lens	3
High astigmatism (>3 D)	4
Choroidal detachment	2
RD	2
CME	6
Endophthalmitis	1
Hyphema	7
Secondary glaucoma	2
Hypotony	9
Iris atrophy	8

OHT: Ocular hypertension, RD: Retinal detachment, CME: Cystoid macular edema

## DISCUSSION

Surgically, aphakia can be corrected by ACIOL, SF IOL, or prepupillary and retropupillary iris-claw lens. Insertion of ACIOL is easy and takes less surgical time but has a potential risk to cause corneal edema due to ECL, bullous keratopathy, and secondary glaucoma.<sup>10</sup> Implantation of SF IOL is time consuming and has a steep learning curve. Postoperatively, it can cause IOL decentration, pigment dispersion, chronic inflammation, vitreous incarceration, RD, suture-related complications, and endophthalmitis.<sup>9</sup> Prepupillary IOL implantation can cause greater ECL and earlier onset of CME.<sup>11</sup> Retropupillary iris-claw IOL is gaining popularity because of its ease of insertion and better safety profile. In this study, we describe our experience with retropupillary implantation of Excelens iris-claw IOL for the correction of aphakia in patients with inadequate capsular support.

In a study of primary retrofixation of iris-claw IOL (Excelens) with IVTA in 104 eyes of 102 patients, Kelkar *et al.*<sup>3</sup> reported that the final mean CDVA improved from  $1.36 \pm 0.64$  logMAR preoperatively to  $0.36 \pm 0.32$  at 1-year follow-up. At the last follow-up, 71% eyes had CDVA better than 0.3, 85.6% had CDVA better than 0.48, and 90.4% had BCVA better than 0.6. Using iris-claw IOL (Excelens), another study<sup>12</sup> has reported improvement in CDVA from  $1.66 \pm 0.3$  logMAR preoperative to  $0.53 \pm 0.5$  logMAR ( $P = 0.00001$ ) postoperatively, at 1 year. In our study, the final mean CDVA improved significantly from  $1.36 \pm 0.52$  logMAR preoperatively to  $0.5 \pm 0.42$  postoperatively, at the last follow-up visit. LogMAR CDVA better than 0.30 was noted in 36% of eyes, 48.4% had BCVA between 0.3 and 1, and 15.6% eyes had logMAR vision >1. The final logMAR CDVA was better than preoperatively in 90.2%, was unchanged in 6.6%, and had worsened in 3.28% of eyes. The final visual outcome in our study participants, though similar to the one in a previous study,<sup>12</sup> cannot be directly compared, due to the difference in preoperative patient profile and co-existing ocular pathology.

Improper intraoperative enclavation of haptics or postoperative trauma can lead to the dislocation of the iris-claw IOL into the vitreous cavity. Previous studies have reported a disenclavation/dislocation rate of 0%<sup>12</sup> at 1 year to 8.7% at 3.3 months.<sup>13</sup> In our study, 8 eyes (6.6%) had one haptic disenclavation, requiring re-surgery to enlave IOL haptic, at a mean postoperative follow-up of 7 months. The series of haptic disenclavation in the 8 eyes were noted in the year 2015, with a particular batch of IOL, and on retrospection, faulty haptic fissures were noted with the particular batch of IOL. After change of the IOL batch, no further cases of haptic disenclavation were noted. Iris atrophy at the enclavation site was noted in 6.6% of eyes, and none of the eyes had IOL dislocation. Iris atrophy indicates intraoperative difficulty to enlave the IOL haptics to the iris. Progressive iris atrophy at the site of enclavation can increase the risk for disenclavation.

The incidence of CME with retropupillary iris-claw IOL has been reported to be 1.9%<sup>4</sup> to 11.5%.<sup>12</sup> In our study, 4.9% of eyes had CME, and all these eyes had secondary IOL implantation for either a nucleus drop or PCIOL dislocation during the primary cataract surgery and had increased postoperative inflammation, which might have played a role in the development of CME. These eyes had received IVTA at the time of surgery and required subsequent IVTA.

Nine eyes (7.4%) had transient postoperative hypotony and were managed with topical steroids. Two eyes (1.6%) had prolonged hypotony due to choroidal detachment and required oral steroids. Previous studies have reported 0%<sup>12</sup> to 12.5%<sup>14</sup> incidence of RD after retropupillary iris-claw IOL. In our study, RD was noted in 1.6% of eyes, observed at 1 week after the secondary IOL implantation, which was attributed to the excessive intraocular and vitreous manipulations during the primary procedure and may not be related to the implantation of iris-claw IOL *per se*. These eyes were successfully managed surgically and had good anatomical outcome and favorable visual outcome.

ECL after IOL implantation could be due to surgical trauma, or to the type of IOL implanted. Jayamadhury *et al.*<sup>12</sup> reported a mean ECL of 11.8% at the end of 1 year in the eyes following retropupillary iris-claw IOL. Using same model, another study<sup>4</sup> reported a decrease in the endothelial cell count (ECC) at the end of 1 year; however, it was not statistically significant ( $P > 0.05$ ), and they had no case of corneal decompensation. A mean ECL of  $11.9\% \pm 2\%$  was reported in 16 cases of retropupillary Artisan iris-claw IOL (Ophtec BV, Groningen, Netherlands) at the end of 2 years, and the authors concluded the relative corneal ECC safety with retropupillary-fixated iris-claw IOL.<sup>15</sup> Unfortunately, the ECC measurement was not obtained for our study patients as 24.6% of the patients had corneal edema at the time of presentation and, also, due to non-affordability and non-availability of specular microscopy, and the majority of the patients were referred from other practitioners outside the institute. However, patients with the clinical signs of corneal decompensation



were excluded from this study and were referred to the cornea department for appropriate management.

Various studies have reported postoperative IOP elevation in 4.3%<sup>13</sup>–6%<sup>16</sup> of eyes following iris-claw IOL implantation. In our study, no case of pupillary block was observed during the follow-up period, which could be because of the fact that intraoperative PI was performed for all the eyes. Transient OHT was noted in 16.4% of the eyes between day 1 and 1 week postoperatively, which was attributed to the retained viscoelastic, IVTA, increased inflammation, and the IOP was controlled with short-term use of AGM. Six eyes had prolonged OHT and required long-term use of AGM, and none of the eyes required surgery for control of IOP. Persistent OHT could be due to low-grade anterior uveitis, preoperative OHT, excessive pigment dispersion, and steroid response. Two eyes progressed to glaucoma, and one patient lost vision due to glaucomatous optic atrophy. These patients were lost for follow-up and presented to us at 3 months and 1 year, respectively, after the initial 2 weeks follow-up after the IOL implantation, and had discontinued the use of AGM.

Persistent pupil ovalization after the posterior iris-claw IOL implantation is reported in 10.6%<sup>4</sup>–32.2%<sup>16</sup> of eyes. In our study, 16.4% of eyes had round circular pupil, and 67.2% had minimal pupillary distortion or pupillary peaking, which was documented preoperatively in these eyes. At the final follow-up, significant pupil ovalization was documented in 16.4% of the eyes, which can be attributed to either the IOL haptic fixation being too tight or asymmetric enclavation of the haptics.

Limitation of our study includes its retrospective design, lack of control group (as it was non-comparative study), variable, and short duration of follow-up. Furthermore, corneal ECC was not measured; however, we feel that the retropupillary position of the iris-claw IOL and its distance from the endothelium theoretically limits the risk of injury to corneal endothelium.<sup>4</sup>

To conclude, our study reports good visual outcome and complication profile in Asian-Indian eyes following retropupillary iris-claw IOL implantation for aphakia for a wide range of primary and secondary indications. Despite limitations of the study, we believe that the retropupillary iris-claw IOL is a good surgical option in patients with aphakia and inadequate capsular support, as it is cost-effective, provides good visual rehabilitation, has a short learning curve, and takes less surgical time. However, patients should be informed of the potential benefits and possible complications preoperatively. Future prospective studies are required to evaluate the ECL and stability of the iris-claw IOL in the long-term follow-up.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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