• Clinical Research •

Intraocular lens exchange or explantation post cataract surgery

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Abstract

● **AIM:** To report incidence, indications, and visual outcomes of intraocular lens (IOL) exchange/explantation surgery.

● **METHODS:** Retrospective analysis of 60 eyes requiring IOL exchange/explantation surgery between 1st January 2017 and 31st December 2022. The overall outcomes as well as comparison between the trainee versus experienced surgeons were analyzed.

● **RESULTS:** Out of 39 778 cataract surgeries (with no preexisting ocular co-morbidities) during a six-year period (2017–2022), 60 (0.15%) needed IOL exchange/explantation. Surgeons-under-training performed 36/60 cases (60%) while 24/60 (40%) were by experienced surgeons. The commonest indication was subluxated IOL in 26 (43.3%), followed by dislocated IOL in 20 (33.3%), postoperative refractive surprise in 7 (11.6%), IOL induced uveitis in five and broken haptic in two eyes. Twenty-four (40%) eyes had intraoperative complications during primary surgery. Posterior chamber IOL (PCIOL) was the commonest secondary IOL in 21 (35%) eyes, scleral fixated in 20 (31.6%), anterior chamber IOL (ACIOL) in 13 (21.6%), iris fixated IOL in three (5%) and three eyes (5%) were left aphakic. The mean time between primary and secondary surgery was 168d (168±338.8). Best corrected visual acuity (BCVA) of >20/60 was obtained in 43 eyes (71.66%), 20/80–20/200 in 14 (23.33%), 20/250 in two and hand movements in one. No statistically significant difference in visual outcome was noted at post-op one month between trainees versus experienced surgeons (UCVA 0.45±0.29 *vs* 0.53±0.32, *P*=0.20, BCVA 0.34±0.25 *vs* 0.37±0.26, *P*=0.69).

● **CONCLUSION:** IOL subluxation as the commonest indication and posterior capsular rupture is the commonest intraoperative risk factor. This complication can be effectively addressed with selection of the appropriate secondary IOL achieving good visual outcomes in over 70% of patients.

● **KEYWORDS:** intraocular lens exchange; subluxated intraocular lens; dislocated intraocular lens; posterior capsular rupture; trainee surgeon; experienced surgeon

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INTRODUCTION

Cataract surgery is one of the most performed ocular surgeries and is associated with high rates of surgical success and safety, with over 85%–95% patients achieving excellent vision of 20/40 or better[1-2]. Surgical success depends on several factors, including pre-existing ocular and comorbid factors as well as surgeon's skill and experience. Intraoperative complications are the leading causes contributing to poor visual outcomes[1]. These are posterior capsular rupture (PCR), zonular dialysis and vitreous loss, which have several implications such as difficulty in placement of the intraocular lens (IOL), inability to place the IOL (leading to surgical aphakia); or sub-optimal placement of the IOL leading to subluxation or even dislocation. Improvement in surgical techniques, instrumentation and newer IOL designs have resulted in an overall decrease in the incidence of these complications[3-5]. However, in some cases IOL-exchange or placement of a secondary IOL is still required in a second sitting. The rates of complications would expectedly be higher in the hand of surgeons-under-training as compared to experienced surgeons. The incidence of PCR in surgeries performed by experienced and trainee surgeons has been reported to range from 0.45%–3.6% and 4.8%–11% respectively[6-7].

Intra-operative complications are not the only cases where secondary IOL placement may be indicated. Other causes include refractive surprise or malpositioned IOLs[3-5].

The purpose of this study is to analyze the incidence, indications, and visual outcomes of IOL exchange at a high-volume cataract center and to compare the outcomes when performed by surgeons-under-training versus experienced cataract surgeons.

SUBJECTS AND METHODS

Ethical Approval This was a retrospective case series. The Institutional Review Board approval was taken bearing approval number: Ref No. LEC-BHR-R-05-24-1233 and the study adhered to the tenets of the Declaration of Helsinki. Data were retrieved from the electronic medical records system. The study was performed at a high-volume tertiary-care urban institute.

All cases of simple cataract seen at our center that underwent cataract surgery with IOL implantation from 1st January 2017 to 31st December 2022 and had a subsequent IOL explantation or exchange during the same time were included. Both small incision cataract surgery (SICS) and phacoemulsification were included. The overall outcomes as well as comparison between the trainee versus experienced surgeons were analyzed.

The EyeSmart EMR was used to exclude all cases bearing any of the exclusion criteria as mentioned below in the diagnosis or clinical details.

Exclusion Criteria 1) Primary surgery performed elsewhere; 2) Complicated cataracts: any co-morbid conditions such as lens coloboma, traumatic cataract, uveitic cataract, subluxated cataract, pseudoexfoliation, phacodonesis *etc*. were excluded; 3) Cases with pre-existing corneal/retinal/glaucomatous pathology with potential to affect the visual outcome; 4) Patients with multifocal, phakic IOLs and toric IOLs; 5) Cases requiring combined surgery such as endothelial keratoplasty and IOL exchange.

Terms Used Experienced cataract surgeon: performed >1000 cataract surgeries. Surgeon-under-training: performed <150 cataract surgeries[8]. IOL subluxation: partial displacement of the IOL, with a portion of the IOL being visible in the pupillary area. IOL dislocation: complete displacement of the IOL from the pupillary area and is outside of the hyaloid fossa-is free-floating in the vitreous or in the anterior chamber (AC) or lies directly on the retina[9].

Preoperative Assessment All patients underwent a comprehensive examination in the clinic including dilated examination for cataract grading. Preoperative biometry was performed using the Zeiss IOL Master 700 (Carl Zeiss Meditec, AG Jena, Germany), or applanation ultrasound biometry (PacScan 300 Plus, Sonomed Escalon, NY, USA) in hazy media. Refractive target aimed at was emmetropia or mild myopia (-0.5 or less). The Barrett formula was routinely used for standard IOL calculation. Visual acuity was measured in Snellen format which was converted to logarithm of the minimal angle of resolution (logMAR) for statistical analysis. The IOL power for the exchange was calculated based on IOL Master measurements using the Barrett, Holladay I or SRK/T and adjusted based on residual refractive error after the primary IOL implantation. For sulcus fixation, the IOL power was deducted by 0.5 to 1.0 diopter (D) from that of the in-the-bag power[5]. Preferred locations for IOL placement were bag, followed by sulcus if sulcus was intact and in the absence of sulcus support either anterior chamber IOLs (ACIOLs) or iris-fixated IOLs or scleral-fixated IOLs were implanted.

Techniques of IOL Exchange/Explantation The surgeries were performed under peribulbar anesthesia. Posterior capsular adhesions to optic and haptic were released using visco-dissection. The IOL was mobilized carefully out of the bag and into AC and removed either as a whole or by bisection (in the case of foldable IOLs) with an IOL-cutting scissors and extracting in pieces through the sclero-corneal or corneal tunnel. Anterior vitrectomy was performed in cases of vitreous prolapse. The secondary IOL was positioned either in the sulcus or in the capsular bag, based on the integrity of either structure. Either an iris claw or ACIOL or scleral fixated IOL were placed when the sulcus was not stable. Peripheral iridotomy was performed prior to implantation in cases of ACIOL and iris claw IOL.

Technique of Iris Claw IOL Iris claw IOL (EXCELENS, Excel optics, Chennai, TN, India) with optic diameter of 5.5 mm and overall diameter of 8 mm was introduced through the sclero corneal tunnel. The haptics were oriented horizontally at 3 and 9 o'clock and fixated in a retro-pupillary manner. Gentle forward elevation of the IOL made the imprint of the haptic and the site of enclavation visible on the surface of the iris. The haptics were then enclaved within the mid peripheral iris stroma in a retropupillary manner after a thorough anterior vitrectomy[10].

Technique of ACIOL The PMMA kellman Multiflex Anterior Chamber IOL (ACIOL, Aurolab, Madurai, TN, India) with optic diameter of 5.5 mm and overall diameter of 12.5 mm was implanted through the tunnel and oriented in horizontal manner[11]. Interrupted sutures with 10-0 nylon were placed to close the incision.

Glued IOL Procedure The glued IOL procedure was performed by vitreo-retinal surgeons.

After performing 180° conjunctival peritomy, two partial thickness scleral flaps of 2.5 mm×2.5 mm were created exactly 180° diagonally apart. At around 3.5 mm from the limbus, a 23-gauge infusion cannula was introduced *via* pars plana route. Under the scleral flaps, at 1.5 mm from the limbus, two sclerotomies were made and scleral pocket to hold the haptic was made at the edge of the partial thickness scleral flap. A sclero-corneal tunnel or the clear corneal tunnel was

made depending on the type of IOL being implanted. Anterior vitrectomy was done to clear the AC and pupil of the vitreous strands. The IOL was then inserted through the incision by means of a McPherson's forceps for a rigid IOL or an injector in case of a foldable IOL. An end of the haptic was introduced through the 30 G needle through one of the sclerotomies, which was then externalized under the partial thickness scleral flap. The trailing haptic was externalized through the second sclerotomy, using a second 23-guage micro-rhexis forceps. Tucking of the two haptics into the trans-scleral pockets was done. The reconstituted fibrin glue was placed under the two scleral flaps and sealed. Peritomy was also closed with fibrin glue. The incisions were closed with 10-0 nylon interrupted sutures[12] in patients with sclerocorneal tunnels and with rigid IOLs.

Postoperative follow-ups were on day one, one week and one month after surgery. At each examination, the uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), intraocular pressure was measured and slit lamp examination was performed. Fundus examination was performed at one month post-operatively.

Statistical Analysis Statistical analysis was carried out by using SPSS 19.0 ver software (SPSS, IL, Chicago, USA) for windows. Paired sample *t* test was applied to compare postop visual improvement with that of the preop vision for the data that followed normal distribution. Wilcoxon signed rank test was used for comparison of pre- *vs* post- operative vision for each IOL group. ANOVA was carried out with Bonferroni post hoc correction test for comparison of mean visual acuity between groups. A two-tailed *P* value <0.05 was considered statistically significant.

WHO classification was used for categorizing the visual outcomes (best corrected): good 20/20–20/60, borderline <20/60–20/200, and poor <20/200[13].

RESULTS

There were 34 male and 26 female patients with mean age 63.79±9.24y (range 45–78y). Right:left eye was 32:28. Sixty of a total of 39 778 underwent IOL exchange/explanation (incidence of 0.15%). Twenty-four (40%) had intraoperative complications during primary surgery with PCR (14/24, 58.3%) being the most common complication followed by zonular dialysis in 6 (10%) and extension of the capsulorrhexis in 4 eyes (6.6%).

The commonest indication for IOL exchange was subluxated IOL (Figure 1) in 26 eyes (43.3%) followed by dislocated IOL in 20 (33.3%), postoperative refractive surprise in 7 (11.6%), IOL-induced uveitis in 5 eyes (which included uveitis-glaucoma-hyphema (UGH) syndrome in one case each with blunt trauma and broken haptic. Figure 2 shows the indications for IOL exchange.

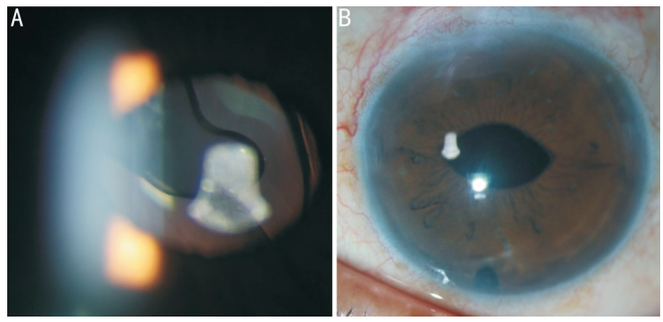

Figure 1 A 65-year-old male presented 2mo post cataract surgery in left eye, with this clinical picture of IOL subluxation A: Slit lamp image taken in retroillumination of the patient with inferonasally subluxated posterior chamber IOL in left eye with vitreous in the anterior chamber and zonular dialysis from 10 to 7 o'clock position; B: Diffuse slit lamp image post IOL exchange showing horizontally oval pupil and retropupillary iris claw and a peripheral iridotomy inferiorly. IOL: Intraocular lens.

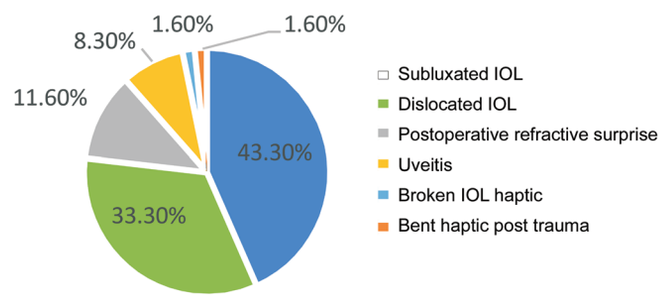

Figure 2 Indications for IOL exchange IOL: Intraocular lens.

Table 1 Postop. visual outcome

Entity	Visual acuity, logMAR	*P*
Preop. UCVA	1.0500±0.66600	
Postop. UCVA at 1mo	0.4867±0.32073	<0.0001
Preop. BCVA	0.6600±0.65022	
Postop. BCVA at 1mo	0.3533±0.26133	<0.0001

UCVA: Uncorrected visual acuity; BCVA: Best corrected visual acuity.

Sulcus-implanted IOL was the most common secondary IOL in 21 eyes (35%) followed by scleral fixated in 20 (31.6%), ACIOL in 13 (21.6%), iris claw lens in three (5%) and three (5%) were left aphakic.

The mean time interval between primary and secondary surgery was 168d (168±338.8d) and the mean follow-up period was 24wk (3–160wk) post IOL exchange.

Visual Outcome Final BCVA of 20/20–20/60 was obtained in 43 eyes (71.66%), <20/60–20/200 in 14 (23.33%), 2 had BCVA of 20/250, one patient had hand movement vision. The mean logMAR UCVA was 1.0500±0.666 prior to IOL exchange which improved significantly to 0.4867±0.32073, *P*<0.0001 at one-month postoperative. The BCVA preoperative was 0.6600±0.650 which improved to 0.3533±0.261, *P*<0.000. Table 1 summarizes the visual results.

Complications These were noted in 6 eyes: cystoid macular edema in two eyes, recurrent AC inflammation in one, non-

resolving corneal edema (corneal decompensation) after IOL exchange, one recurrent subluxation and vitreous hemorrhage in one case of a glued IOL, which eventually lost to follow-up post pars plana vitrectomy. Three patients had second surgical intervention which included endothelial keratoplasty, IOL repositioning and pars plana vitrectomy in one case.

IOL Type Versus Vision ANOVA was used to analyze the influence of IOL position on the refractive outcome at each visit. The UCVA showed significant variation in between the types of IOL at 1wk (but not at one day or one month postoperatively). Further, Bonferroni test was applied for multiple comparisons to know which IOL fared better at each visit. At postoperative 1wk, UCVA in posterior chamber IOL (PCIOL; 0.50±0.45) and glued IOL (0.78±0.46) groups improved significantly over ACIOL (P=0.003) but not in iris fixated group (ACIOL 0.95±0.65 *vs* iris fixated IOL 0.50±0.45, P=1). However, no significant variation was noted in the outcomes based on the types of IOL at one month postop.

Surgeons-Under-Training *vs* Experienced Surgeons In thirty-six eyes (60%) needing IOL exchange initial cataract surgery was performed by trainees and 24 (40%) by experienced surgeons. On comparison of the visual outcomes between the two groups, final UCVA and BCVA were significantly better at one-week, but no difference was noted at one month between the two groups (UCVA 0.45±0.29 *vs* 0.53±0.32, P=0.20; BCVA 0.34±0.25 *vs* 0.37±0.26, P=0.69).

DISCUSSION

The current study reports the indications and outcomes of IOL exchange surgery, performed at a multi-specialty high volume tertiary eye care center. Similar to our study (0.15%), the incidence of IOL exchange has been reported to be low and ranged from 0.05%–0.77%[3-5,14]. Such a low incidence of IOL exchange in our study can be attributed to a stringent exclusion of patients with any ocular comorbidity or ocular pathology which would have increased the surgical complexity. We excluded patients needing IOL repositioning, whereas some of the published studies included repositioning as well.

The wide variation of incidence among studies is also partly due to the variation in timeline of presentation with dislocation, as a few studies focused specifically on late IOL dislocations[14]. Monestam[15] studied 810 patients for a decade after cataract surgery and reported an incidence of 0.6%. The cumulative risk of late in-the-bag IOL dislocation was shown to be 0.09% and 0.55% over 5y and 10y, respectively and IOL dislocation of 1.0% over a period of 20y[16-17].

Various studies report IOL dislocation/decentration as the leading cause for IOL exchange[18-20]. Most published studies agree on refractive error also being one of the main indications for IOL exchange[20].

Similar results were noted in our study, with the commonest indication for IOL exchange being subluxated IOL, followed by dislocated IOL, together accounting for almost 77% and postoperative refractive surprise accounting for 11%. We encountered 7 eyes with postoperative refractive surprise that needed IOL exchange. Of these, 4 eyes had axial length measurement errors and 3 eyes had wrong IOL implantation. In 1 out of the 3 eyes with wrong IOL implantation, IOL power of the contralateral eye was implanted mistakenly. The eyes with error in axial length measurement, had mature cataract and had preoperative axial length measurement using ultrasound biometry instead of optical biometry. The globe tends to get compressed during the ultrasound biometry examination which leads to an underestimation of the correct axial length and subsequent overestimation of the correct IOL power. None of the patients in our series had a history of undergoing any refractive surgery. Jin *et al*[3] focused on IOL exchange due to postoperative refractive error and found that incorrect corneal power estimation, followed by error in measurement of axial length and inserting a wrong IOL were the most common reasons for IOL exchange in their study.

One of the eyes in our study had UGH syndrome with pigment dispersion, chronic inflammation, hyphema and high intraocular pressure. The outcome improved significantly post IOL exchange in this eye with UGH syndrome as well, as noted by Elhusseiny *et al*[21], on surgical management of UGH[21].

In our study, 40% cases had complications intraoperatively, with PCR being the most common complication encountered. This correlates well with other studies where intraoperative vitreous loss necessitating anterior vitrectomy strongly correlated with perioperative risk factors for IOL exchange[4-5]. Thevi and Abas[22], in their study reported highest number of PCRs during cortex removal -35.2% (n=68) followed by segment removal in 25.4%[22]. In our series, most PCRs occurred during the last nuclear segment removal 35.7% (5/14) followed by 28.5% (4/14) during chopping, 21.4% (3/14) at removal of epinuclear sheet and 14.2% (2/14) while cortical aspiration. The 4 of the 14 cases with PCR in our series had vitreous loss, accounting for 28.5%, which is much higher than the rate of 1.3%–14.7% described in the literature[7]. This can be attributed to multiple factors like, our study includes surgeons at various level of expertise, differences in the demographic and clinical profile of patients being operated. Minor variations in the surgical technique of cataract surgery being one of the other contributing factor.

Lee and Webster *et al*[23] described a technique of foldable IOL exchange, in which the foldable IOL is explanted with optic intact without cutting the optic facilitated by internal wound enlargement which enables IOL removal in one piece using hand over hand technique with Kelman forceps so that

one hand is always holding the optic with forceps; followed by implantation of alternative foldable IOL. Our technique differed from the above–in a way that in certain cases we explanted the IOL in toto, while we had to cut the optic of IOL and explant in pieces in few, based on the type of IOL being explanted.

Most studies have reported PCIOL to be the most commonly implanted IOL during exchange. Placing an IOL in the sulcus is the most physiological position and is a preferred location over ACIOL. With scleral fixated IOLs having excellent outcomes when performed by skilled surgeons, this modality should ideally replace ACIOLs. Iris claw IOL too has been reported to be highly successful[10]. The simple technique, with its short learning curve, makes this the most popular choice for several surgeons. In our study, while in the early post-operative period the visual outcomes were better for the PCIOL and scleral fixated IOL groups, at the end of one month, there was no significant difference. Cystoid macular edema was the most common postoperative complication encountered in our series similar to previous studies[1]. However the complication rate post IOL exchange (8.3%) was much lower in our series compared to previous studies and could be attributed to the variations in patient profile, surgical technique and expertise[1,3]. Re-surgery was necessary in three patients: one developed corneal decompensation needing endothelial keratoplasty and one patient had IOL dislocation which could be successfully repositioned. One patient with vitreous hemorrhage underwent pars plana vitrectomy at one month post operatively but was lost to further follow up.

Although the number of cases needing IOL exchange was higher in the surgeons-under-training (36/60, 60%) group, no significant difference in the final visual outcome was noted. This can be explained by the fact that while the initial surgery was performed by the trainee surgeons, the IOL exchange procedure was eventually performed by experienced surgeons only.

The limitations of the current study are of course its retrospective nature and selection bias, which implies that the incidence of this complication may be higher if all comorbid factors are also combined. Variations in surgical technique of the primary surgery and intra-operative management of complications are also confounders. Duration of follow up was variable and long-term outcomes were not analyzed in this cohort.

Overall, our results compare favorably with the other studies with respect to visual outcomes with a final BCVA of 20/60 and better in 71.66% of eyes. Our study provides new information on the low incidence of this complication despite the high volume. It is reassuring that this is not more frequent in novice surgeons.

To conclude, the incidence of IOL exchange is very low in uncomplicated cataract whether performed by novice or experienced surgeons. The final visual outcome is good in over three-fourths patients. The appropriate IOL for replacement should be selected based on the condition of the eye and support available to achieve good outcomes.

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