Clinical Indications and Outcomes of Intraocular Lens Exchange During a Recent 10-Year Period

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ABSTRACT

Purpose: To evaluate indications and visual outcomes of intraocular lens (IOL) exchange to understand recent changes in this surgery.

Materials and Methods: One hundred twenty seven eyes of 122 patients that underwent surgery to exchange or reposition the IOL between 2009 and 2019 were included in the study. The IOL exchange indications, time between surgeries, treatment parameters, intraoperative and postoperative complications, and pre- and postoperative best-corrected visual acuity (BCVA) were recorded and analyzed. Rates of IOL exchange indications were compared according to IOL exchange 5 year period.

Results: The most frequent IOL exchange indication were IOL dislocation (69 eyes, 54.3%), corneal decompensation (23 eyes, 18.1%), patient dissatisfaction (17 eyes, 13.3%), incorrect lens power (12 eyes, 9.4%). The mean BCVA was improved from 0.72±1.13 Log MAR to 0.23±0.53 Log MAR after the surgery ($p< 0.01$). The most common indication in both duration time was IOL dislocation. But the second frequent indication in the first time period was corneal decompensation while the second frequent indication in the second time period was IOL dissatisfaction.

Conclusion: It was noteworthy that IOL dissatisfaction has increased steadily recently, while IOL dislocation was the most common in the entire study process.

Keywords: Cataract surgery, Intraocular lens exchange, Intraocular lens dislocation, Intraocular lens dissatisfaction.

INTRODUCTION

Cataract surgery is one of the most frequent surgery worldwide, and it is performed more than 20 to 25 million annually.[1] Cataract surgery has great rapidity and dynamic development with new surgical techniques and intraocular lens technologies over the past decades. However, this surgery has very few complications that may be related to the perioperative conditions. The need for intraocular lens (IOL) exchange after primary cataract surgery is unusual, and often seen as a late complication. Some indications including suboptimal visual outcome may lead to exchange the intraocular lenses.

With advance of refractive surgery and IOL technologies, patients have higher visual expectations. IOL power calculation is the most challenging issue to determine the IOL power in patients with history of refractive surgery. Also, multifocal, trifocal IOL are widely implanted for correcting the presbyopia after cataract surgery. Despite the advantages of multifocal IOL, dissatisfaction after multifocal IOL implantation may occur according to glare, halo and reduced contrast sensitivity.[2,3] Incorrect IOL power and multifocal IOL related dissatisfaction have been seen more frequently among the causes of IOL exchange in recent years.

In this study, we aimed to explain the IOL exchange indications, outcomes and surgical interventions during the past ten years. In addition, the indications of IOL exchange between 2009-2014 and between 2014-2019 were compared.

MATERIALS AND METHODS

This retrospective interventional study has been conducted in accordance with the tenets of the Declaration of Helsinki and with the approval of the Local Ethics Committee.

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Cases were identified by searching the electronic medical record system from January 2009 to January 2019 for all patients treated by the same ophthalmologists (A.A and H.S.K) for IOL exchange. The following data were collected from medical records: age, sex, systemic and ocular comorbidities, interval between first cataract surgery and IOL exchange, the type of IOL implanted at the first surgery, best corrected visual acuity (BCVA) and intraocular pressure (IOP) before and after IOL exchange, indication of IOL exchange, type of surgery and secondary IOL implant and surgical complications. BCVA was measured Snellen Chart and converted to the logarithm of minimum angle of resolution (Log MAR) for the statistical analysis.

Dissatisfied patients include those with and without photic symptoms. In the patients with complaints of undesired visual outcomes without photic symptoms (glare, halos, dysphotopsia) or other causative findings (such as lens opacification, dislocation/decentration), the indication for IOL exchange was classified as patient dissatisfaction. If the spherical refractive equivalent was greater than 1.50 D from the intended target, the indication for exchange was classified as incorrect IOL power.

Cases were divided according to their IOL exchange date. The date from 2009 to 2014 was in the group 1 and after 2014 to 2019 was in the group 2. Primary endpoints were the number of explanted IOLs, indications for exchange, the type of secondary implant, visual outcomes, and complications after IOL exchange. Secondary endpoints were comparison of the indications and result of IOL exchange in group 1 and 2.

Statistical analyses

Descriptive statistics (patient age, preoperative and postoperative visual acuity) were analysed using SPSS for Windows (version 13.0, SPSS, Inc, Chicago, Illinois, USA). Data analysis was based on the number of eyes. Snellen acuity was converted to logarithm of the minimal angle of resolution (log MAR) values. The Student t test was used to evaluate the significance of the difference. Data were expressed as mean ± standard deviation, and a p value < 0.05 was considered statistically significant.

RESULTS

The study included 127 eyes of 122 patients (58 women, 64 men) with a mean age of 72.45±7.84 years (range 41-89 years). The mean follow-up time after IOL exchange was 34.9 months (range 12-84 months). The number of IOL exchange in year between 2009-2014 was 69 and in 2014-2019 was 58. The mean duration time between first cataract surgery and IOL exchange procedure was 33.7±6.8 months (range 1 day-74 months).

The most frequent IOL exchange indication were IOL dislocation (69 eyes, 54.3%), corneal decompensation (23 eyes, 18.1%), patient dissatisfaction (17 eyes, 13.3%), incorrect lens power (12 eyes, 9.4%). The other indications for IOL exchange were capsular phimosis (3 eyes, 2.3%), IOL opacification (2 eyes, 1.5%) and uveitis-glaucoma-hyphema syndrome (1 eye, 0.7%).

The ocular comorbidities at the pre-operative examination, type of implanted IOL in the first surgery and previous ocular surgery were recorded (Table 1). Pseudoexfoliation (PEX) and open posterior capsule were most frequent conditions. Thirty-one patients had previous ocular surgery history.

In patients with IOL dislocation, PEX was observed in 47 eyes, open posterior capsule was observed in 54 eyes in which 14 had history of neodymium–yttriumaluminum-garnet (Nd:YAG) laser posterior capsulotomy after original cataract surgery and zonule weakness or impairment was detected in 14 eyes. The indications seen in patients without posterior capsule or zonule weakness but IOL exchange due to intraocular lens dislocation were as follows, 4 patients had IOL dislocation after pars plana vitrectomy with gas

Table 1: *Preoperative status of eyes with IOL exchange.*

	Eyes (n=127)
Ocular comorbidities	
PEX	63 (49.6%)
Posterior Capsule Rupture	85 (66.9%)
Glaucoma	21 (16.5%)
Retinal Disorders	34 (26.7%)
Type of implanted IOL in previos surgery	
PC Monofocal IOL	87 (68.5)
PC Multifocal IOL	14 (11.02%)
PC Toric IOL	3 (2.3%)
AC Angle supported IOL	19 (14.9%)
AC Iris Claw IOL	4 (3.14%)
Material of implanted IOL in previous surgery	
One-Piece acrylic	83 (65.3%)
Three-Piece acrylic	9 (7%)
Three-Piece PMMA	25 (19.6%)
Three-Piece silicone	4 (3.14%)
Unknown	6 (4.7%)
Previous ocular surgery	
Refractive Surgery	8 (6.2%)
Trabeculectomy	3 (2.3%)
Vitrectomy	4 (3.14%)
Nd YAG Laser Capsulotomy	16 (12.5%)

Abbreviations: **IOL:** intraocular lens, **Nd YAG:** neodymium-yttriumaluminum- garnet, **PC:** posterior capsule, **PEX:** pseudo exfoliation, **PMMA:** polymethylmethacrylate.

tamponed, 6 patients had inappropriate capsulorhexis diameter and intraocular lens diameter, 8 patients were implanted with a broken IOL haptic or damaged IOL in the first cataract surgery. Forty cases of dislocation group were performed by removing IOL and replacing a scleral fixated IOL and IOL replacement were performed in 29 cases of IOL dislocation.

Corneal decompensation was seen in 23 eyes related with anterior chamber IOLs and 4 of them were iris claw IOL and 19 of them were angle supported anterior chamber IOL. All cases with corneal decompensation were treated with IOL removing. Eight patients with corneal decompensation were underwent to penetrating keratoplasty combined with scleral fixated IOL implantation. In ten eyes scleral fixated IOL implantation were planned following keratoplasty and IOL removal. Five patients had improvement with topical treatment and all of them were performed scleral fixated IOL implantation after the corneal healing.

In the eyes with IOL dissatisfaction, there were 14 eyes with multifocal IOLs and 3 eyes with toric IOLs. Asthenopia (8 eyes, 47.0%), glare or halos (7 eyes, 41.0%), and visual distortion (2 eyes, 12.0%) were main reasons for IOL exchange. Of the 14 cases of multifocal IOL dissatisfaction, 4 cases had open posterior capsule, 4 cases were high myopic patients, 2 cases had traumatic corneal and iris sequela. All patients with multifocal IOL dissatisfaction were underwent to IOL exchange and implanted posterior chamber monofocal IOL into the bag or capsular sulcus. Two patients with toric lens dissatisfaction were applied IOL replacement, and one was IOL removing and was implanted monofocal posterior chamber IOL.

In 12 eyes with incorrect lens power, 8 eyes had refractive surgery experience, 2 of them had miscorrect biometer measurements related with hypermature cataract with short axial length and 2 of them had corneal ectasia. All patients were performed IOL removing and implanted appropriate posterior chamber IOL.

The mean BCVA before the IOL exchange was 0.72±1.13 Log MAR and it was improved to 0.23±0.53 Log MAR at the last visit (p=0.00). The mean IOP was 17.57±3.68 mm Hg before the IOL exchange and was 15.89±2.76 mm Hg at the last visit. There was no significant difference between preoperative and postoperative IOP (p=0.24).

Ninety-five eyes were treated with IOL removing and 32 eyes were treated with IOL replacement. In IOL removing group, 64 eyes were performed scleral fixated IOL implantation, 31 eyes were performed posterior chamber IOL implantation.

Table 2 shows the most frequent IOL exchange indications between 2009-2014 and 2014-2019. The most frequent indication in both duration time was IOL dislocation. But the second frequent indication in the years between 2009-2014 was corneal decompensation while the second frequent indication in the year between 2014-2019 was IOL dissatisfaction.

There were some complications according to surgical approach or initial conditions. Eight patients were treated for cystoid macular oedema and 2 patients were treated for high corneal astigmatism. One patient underwent rhegmatous retinal detachment surgery after 6 months IOL exchange surgery.

DISCUSSION

In the recent study, we evaluated the indications of IOL exchange during last ten years period and compared the indications between first five years period and last five years period. Intraocular lens dislocation was the most frequent indication in both time periods but the second and third frequent indications were different in two periods.

By means of the continuous and rapid development in cataract surgery and IOL technology, the indications, and the outcomes of IOL exchange continue to evolve. The

Table 2: *Indications of IOL exchange in the years between 2009-2014 and in the years between 2014-2019.*

	Indication of IOL exchange 2009-2014 (n= 68)	**Indication of IOL exchange 2014-2019 (n= 59)**
IOL dislocation	38 (55.8%)	31 (52.5%)
Corneal decompensation	18 (26.4%)	5 (8.4%)
IOL dissatisfaction	3 (4.4%)	14 (23.7%)
Incorrect IOL power	4 (5.8%)	8 (13.5%)
Capsular phimosis	2 (2.9%)	1 (1.6%)
UGH syndrome	1 (1.4%)	None
IOL opacification	2 (2.9%)	None

Abbreviations: **IOL:** intraocular lens, **UGH:** uveitis-glaucoma-hyphema

incidence of IOL exchange is very rare (0.26% to 0.77%), the number of patients being operated cataract surgery is very large and even rare complications may have a significant effect on ocular health and create a significant burden.[4-6] A more recent study evaluated the incidence and risk factors of IOL exchange during the 2010-2017 and they revealed that their incidence of IOL exchange was 2 per 1000 cases and the risk factors were adverse event during first cataract surgery and a pre-existing ocular comorbidity (glaucoma, myopia, pex etc.).[4]

IOL dislocation was found the most common reason of the IOL exchange in many studies. Our study correlates well with other studies and the latest survey update, which found that the most frequent indications of IOL exchange were IOL dislocation.[7-9] IOL dislocation can be classified as early (within 3 months cataract surgery) and late (more than 3 months cataract surgery) and also IOL dislocation can be observed in-the-bag or out-of-the-bag. In the bag IOL dislocation generally is associated with insufficient support of the capsular bag and/or zonular weakness. In our study, mean duration time for IOL exchange was 33.7±6.8 months, but in IOL dislocation group, duration time was 54.5±7.2 months. In previous studies, there was also an incidence of in-bag IOLs, approximately 2000 days after cataract surgery, like the long time between surgeries in our case series.[8,10] The mean duration time was significantly longer than the interval for the next 2 frequent etiologies for IOL exchange. Eyes with these late IOL dislocations frequently had PEX and/or zonular weakness, and this study confirms PEX as the most important risk factor for IOL dislocation (30.6% of dislocation cases).[10,11]

The second frequent IOL exchange indication in our first study group was corneal decompensation related with AC IOLs or iris claw IOLs. However, we found that the incidence of cornal decompensation decreases over time. In our study group, the number of corneal decompensation cases due to the AC IOL were 19 in the first 5-year period, and 6 cases in the last 5-year period. Similarly, Marques reported one-third of IOLs explanted to be AC IOLs in a series from 1986 to 2002.[12] They performed three retrospective case series at different time intervals in the same clinic and they pointed out that an important decrease in the rate of IOL explantation of AC IOLs from 54.45% in 1990 to 7.01% in 2011.[8,13] We believe that the use of anterior chamber lens and associated corneal decompensation are decreasing with developing intraocular lens technology and new surgical techniques for aphakia.

Over the last years, the outcomes of cataract surgeries have changed to include refractive expectetions driven by increased patient and physician concerns for refractive results and the desire for glasses independence. In this context, the multifocal IOLs were developed the refractive outcomes of cataract surgery by improving near vision. Despite advantages of multifocal IOL implantation, these IOLs have been associated with dissatisfaction of cataract surgery related with some undesirable effects including decreased visual acuity, reduced contrast sensitivity, and visual aberrations such as glare, halos, and dysphotopsias[14,15]. Jones et al. reported that an increase in the proportion of IOL exchanges (7.8% in 2005 and 21% in 2014) due to dissatisfaction in 2 studies at the same clinic.[8] Similarly, in our study, it was detected that IOL exchange gradually increased due to dissatisfaction with the multifocal IOLs. Recent study, we compared the causes of IOL exchange in the first five years and the next five years in a 10-year period. The second frequent indication in the year between 2014-2019 was IOL dissatisfaction. IOL dissatisfaction due to multifocal and toric IOLs was found more frequent in the second time period. The reason for this result may be the increasing use of these IOLs after 2014. We performed IOL exchange and implanted monofocal IOL for all multifocal IOLs dissatisfaction cases.

Over the past couple of years, refractive surgery is increasingly accepted and welcomed by the worldwide. Some of the patient group with high refractive expectations consists of patients who have undergone refractive surgery and are candidates for cataract surgery. Despite of good IOL power calculation formulas, determination of IOL power in patients with refractive surgery history continues to be a therapeutic challenge for clinicians. Aramberri explained that inaccurate estimation of corneal power and inaccurate calculation formula were two main challenges in IOLs power calculation after refractive surgery.[16] In our study, 75% (8/12) of the eyes with incorrect power had previous refractive surgery. Similarly, Jones et al. revealed that 62% of the eyes with incorrect IOL power had previous refractive surgery and all of the prior refractive surgeries were myopic LASIK.[8] To solve the IOL power prediction problems in these patients, various methods should be applied and compared, and the values that tend to cluster around a mean should be used.[17]

In our study, 95 patients were treated with IOL removal, whereas 32 patients only performed IOL reposition. In IOL removing group, 31 eyes which have adequate capsular support were treated with PC IOL implanation while 64 eyes were treated with PC scleral fixated IOL implantation. Suture fixation of a PC IOL to the iris is growing increasingly popular in cases with no or severely compromised capsular support. Jones et al. found that iris suture fixation IOLs had similar visual outcome and complication rate in cases with IOL dislocation and insufficient capsular support as AC IOLs or PC IOLs with

scleral fixation.[8] In our opinion, the choice of an IOL for lens exchange in cases of absent capsule support is mostly determined by surgeons'preference and their experience based on the clinical features of an individual case.

This study has some limitations; first: this study had retrospective design and did not give an information about incidence of IOL exchange, second: our study shows the results of patients referred to only one tertiary hospital. A sufficiently large multi-center prospective study is warranted to more accurately estimate the true incidence of IOL exchange/removal and other rare complications of cataract surgery and to examine their risk factors and visual outcomes.

In conclusion, IOL exchange is a rare condition after cataract surgery but it could be well managed without any undesirable effects. In our series, IOL exchange is most frequently used to manage dislocated IOLs, corneal decompensation and patient dissatisfaction with current IOLs (including symptoms such as asthenopia, dysphotopsia and remaining refractive error). Improvement in IOL design and advance in the in IOL power calculation technology such as swept source biometries, lens formulas could change the underlying reasons and patient expectations for IOL exchange over time.

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