Retropupillary Iris Claw Lens Implantation – A Prospective Observational Study at a Tertiary Health Care Centre in Jaipur, Rajasthan

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ABSTRACT

BACKGROUND

Visual rehabilitation of aphakic patients include spectacle correction, contact lenses, and primary or secondary intra ocular lens (IOL) implantation. Spectacles are rarely used nowadays because of limited visual field, aniseikonia and peripheral refractive errors. Contact lenses are other options for correcting aphakia but can cause a lot of corneal complications. Options for correction of aphakic patients with lack of adequate capsular support include anterior chamber IOL (ACIOL), scleral fixated IOL (SFIOL), and iris fixated IOL. Implantation of a retropupillary IC-IOL provides the benefits of a PCIOL, and the duration of the surgery is also less. The retropupillary IC-IOL because of its position lowers the risk of endothelial decompensation is a better option. We wanted to evaluate the functional outcomes of retropupillary iris claw lens implantation.

METHODS

Secondary implantation of IC-IOL was done in 50 surgical aphakic eyes as a result of intraoperative posterior capsular rent with zonular dialysis (N = 43, 86 %) & large (> 7 clock hours) zonular dehiscence (N = 7, 14 %). Follow up was done on 1st day, 7th day, 1 month, 3 months and 6 months.

RESULTS

22 males and 28 females in the age group 40 - 78 years were operated. 78 % eyes (N = 39) had vision better than 6 / 12 while only 10 % eyes (N = 5) had < 6 / 60 vision and the remainder 12 % (N = 6) had vision between 6 / 18 & 6 / 36. Complications like acute postoperative iritis (N = 18, 36 %) pupillary distortion (N = 15, 30 %), pigment clumping (N = 10, 24 %), iris chaffing (N = 9, 21 %), secondary glaucoma (N = 5, 12 %) and IOL decentration (N = 3, 7 %) were seen. The mean difference in central endothelial counts before surgery and 6 months after surgery was 109 cell / mm^2 (5.92 %).

CONCLUSIONS

Iris claw lens gives the dual benefit of good visual acuity and less complication rate in aphakic patients with lack of adequate capsular support.

KEYWORDS

Retropupillary Iris Claw Lens, Surgical Aphakia, Secondary implantation, Zonular Dialysis, Aneisokonia

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DOI: 10.18410/jebmh/2021/331

How to Cite This Article:
Geol R, Upadhyay S, Agarwal A, et al. Retropupillary iris claw lens implantation – a prospective observational study at a tertiary health care centre in Jaipur, Rajasthan. J Evid Based Med Healthc 2021;8(22):1752-1757. DOI: 10.18410/jebmh/2021/331

Submission 08-01-2021,
Peer Review 17-01-2021,
Acceptance 16-04-2021,
Published 31-05-2021.

BACKGROUND

The primary aim of a successful cataract surgery is in the bag implantation of a posterior chamber intraocular lens. Sir Harold Ridley was the first surgeon to successfully implant an intraocular lens in 1949. The lens used by him was made of polymethylmethacrylate (PMMA). This lens has very less similarity to the lens used today. They were difficult to implant and associated with many more complications. The idea of implanting intraocular lens came to him while working with Royal Air Force and treating injured people during World War II.

Further advancements in lens design and surgical techniques had made intraocular lens implantation much easier. Secondary intraocular lens implantation means implantation of IOL following primary surgery that may have resulted in aphakia. In aphakic cases with sufficient capsular support, a three piece IOL can be implanted in the ciliary sulcus. In conditions such as complicated cataract surgery with lack of adequate capsular support, subluxated lens as in Marfan syndrome, lens dislocation secondary to trauma, and aphakia following congenital cataract surgery, the loss of the posterior capsule and / or ciliary zonules result in inadequate support for the implantation of a standard posterior chamber intraocular lens (PCIOL).[1] It poses a great challenge to the operating surgeon to manage aphakia occurring secondary to a complicated cataract surgery and above mentioned conditions.

The possible options for a secondary IOL implantation in aphakic patients without adequate capsular support include angle supported anterior chamber IOLs (ACIOL), scleral supported (SFIOL - sutureless versus sutured), and iris-claw (IC) anterior chamber and retropupillary IOLs. Choice of the lens to be used depends on two factors, first is the condition of the patient's eye and second is experience of the operating surgeon.

Anterior chamber angle-supported IOLs carry the main disadvantage of their appropriate sizing. To keep the lens in the correct position and minimize the complication rate, an appropriate diameter of the lens relative to the diameter of the anterior chamber is required. Complications occurring due to incorrect sizing are still common because of limited availability of different sizes of ACIOL's. Shorter diameter of the lens permits rotation and sometimes dislocation which increases the risk of endothelial decompensation and damage to the angle of anterior chamber. The excess pressure on the iris root caused by a large IOL increases the damage to the angle of anterior chamber and can result in peripheral anterior synechiae formation, increased intraocular pressure (IOP), and glaucoma. Other major complications include dyscoria and decentred pupils, chronic uveitis, and cystoid macular oedema. On the other hand, implantation of angle-supported IOLs is easier, with lesser surgical time.[2,3,4,5,6]

The scleral fixation of PCIOL implantation has main advantages like more physiological location in the eyes as an optical system, nearer to the plane of the crystalline lens, and the increased distance from the cornea, which decreases the risk of corneal endothelial decompensation.[7,8] However, serious complications are related to scleral fixation, such as retinal detachment, choroidal haemorrhage, and endophthalmitis related to transscleral sutures.[9,10,11,12,13] In cases where sufficient capsular support is observed intraoperatively, a PCIOL can be implanted in the ciliary sulcus, without the need of scleral sutures.[14]

Prof. Jan Worst developed the IC-IOL attached to the anterior iris in 1972.[15] He introduced a technique to correct the aphakia in the absence of capsular support and without compromising the angle of anterior chamber. However, a major complication associated with it was damage to the corneal endothelium,[16] mainly in patients with narrow anterior chambers and in corneal transplantation. Brasse and Neuhann[17] modified this technique by clipping the lens to the posterior iris, thereby protecting the endothelial layer of cornea, with the A-constant altered accordingly to 117.0. Secondary implantations of retropupillary IC-IOL have been the preferred procedure in cases where iris support is feasible.[18]

The chances of damage to the angle of anterior chamber and the root of iris are nil in case of iris claw lens as it is attached to a point in the mid peripheral area of the iris. The unique enclavation system allows centration of the IOL on the pupillary axis, which is important in eyes with decentred pupils. Also, IC-IOLs do not interfere with iris physiological vascularization or cause distortion of pupil.[19]

The implantation of a retropupillary IC-IOL provides the benefits of a PCIOL and the duration of the surgery is also less. The posterior chamber iris fixated IOL because of their retropupillary position and lower risk of endothelial decompensation proves to be a better option for surgical correction of aphakia with inadequate capsular support.

We wanted to evaluate the pre & postoperative Best Corrected Visual Acuity (BCVA) and complications of retropupillary iris claw lens implantation as secondary procedure.

METHODS

This single-centre prospective study was performed with the approval of the Institutional Ethics Committee and as per the tenets of the Declaration of Helsinki. Written informed consent was obtained from all the patients after giving them a full explanation of the procedure and study. This was a prospective observational study done in the Upgraded Department of Ophthalmology, SMS Medical College and Hospital, Jaipur for over a period of 1 year. From January 2019 to December 2019.

50 aphakic eyes as a result of intraoperative posterior capsular rent with zonular dialysis (N = 43, 86 %) & large (> 7 clock hours) zonular dehiscence (N = 7, 14 %) were selected for secondary implantation of retropupillary IC-IOL and all the cases were operated by a single surgeon. Eyes with underlying intraocular inflammation, pre-existing glaucoma and any posterior segment diseases were excluded. The lens used in our study was Excelens (Excel Optics Pvt. Ltd., Chennai, India) polymethylmethacrylate single piece biconvex iris claw IOL (A-constant - 117.2) with total length of 8 mm and optic size of 5.5 mm. Preoperative best corrected visual acuity (BCVA), detailed slit lamp

examination of cornea and iris tissue, endothelial count assessment using specular microscopy, fundus examination by +90 D lens and indirect ophthalmoscopy were done. Intraocular pressure was recorded by Goldman applanation tonometery. SRK-T formula was used while calculating IOL power. IOL Master (Zeiss Meditec, Jena, Germany) was used for power calculation. All cases were done under peribulbar block. A 5.5 mm scleral tunnel was made using crescent knife. Pilocarpine 0.5 % was injected into the anterior chamber. Two side ports were made at 3 and 9 o'clock positions. Anterior vitrectomy was done in all the cases. Posterior iris fixated IOL was implanted with the help of iris claw IOL holding forceps and Sinskey hook.

This IOL was enclaved on the posterior surface of the iris mid peripherally at 3 and 9 o'clock positions. Peripheral iridectomy was done at 11 or 1 o' clock position. Scleral tunnel was sutured using 10-0 nylon suture. Postoperatively, all the patients were prescribed topical 1 % prednisolone acetate 6 times per day and then tapered over 6 weeks, 0.5 % moxifloxacin four times a day for 2 weeks and homatropine e/d BD for 3 days. Post-operative follow ups were done on 1st day, 1 week, 1 month, 3 months and 6 months. Best corrected visual acuity (BCVA) and intraocular pressure (IOP) were recorded on each follow up. Any complications which occurred post operatively such as anterior chamber reaction, IOL stability, endothelial cell count and IOP were recorded.

Statistical Analysis

The sample size was determined based on a power calculation (Alpha error 0.05 and power 80 %) using standard deviations obtained in former studies.[20] At least 50 eyes were required to be included in the analysis to achieve sufficient power in the statistical calculations. Data were filled in Microsoft Excel worksheet. Quantitative data was presented in the form of Mean ± Standard Deviation (SD). Qualitative data was presented in the form of percentage and proportion.

RESULTS

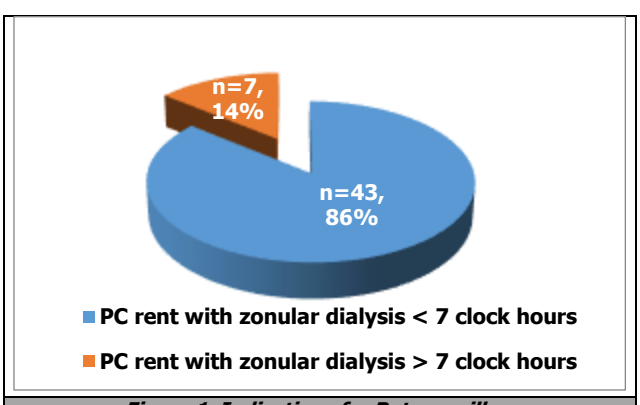

Figure 1. Indications for Retropupillary Iris Claw Lens Implantation

The mean age of the patients selected for the study was 59 ± 12 years. 50 aphakic eyes as a result of intraoperative posterior capsular rent with zonular dialysis, (n = 43, 86 %) & large (> 7 clock hours) zonular dehiscence (N = 7, 14 %) were selected for retropupillary iris claw lens implantation.

Table 1 shows the preoperative and postoperative BCVA for the patients.

BCVA	Number of Eyes	
	Preoperative	Postoperative
1 / 60 to 6 / 60	50	5
6 / 60 to 6 / 36	-	-
6 / 36 to 6 / 18	-	6
6 / 18 to 6 / 12	-	-
6 / 12 to 6 / 6	-	39

Table 1. Preoperative and Postoperative BCVA of the Patients

78 % eyes (N = 39) had vision better than 6 / 12 while only 10 % eyes (N = 5) had < 6 / 60 vision and the remainder 12 % (N = 6) had vision between 6 / 18 & 6 / 36. Table 2 represents postoperative complications.

Sl. No.	Complications	Number of Eyes
1.	Acute postoperative iritis	18
2.	Pupillary distortion	15
3.	Pigment clumping	10
4.	Iris chaffing	09
5.	Secondary glaucoma	05
6.	IOL Decentration	03

Table 2. Postoperative Complications of the Patients

Complications like acute postoperative iritis (n = 18, 36 %), pupillary distortion (N = 15, 30 %), pigment clumping (n = 10, 24 %), iris chaffing (N = 9, 21 %) and IOL decentration (N = 3, 7 %) were seen. Anterior chamber inflammation resolved completely by 1 week postoperatively in 15 patients and by 1 month in 3 patients with topical steroids and cycloplegics. (Figure 2)

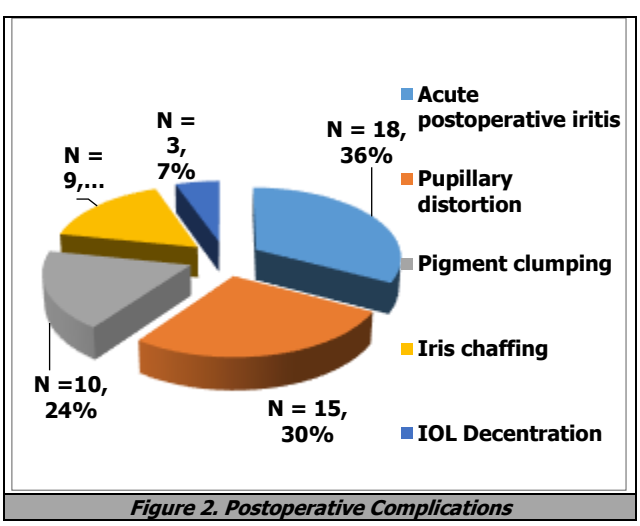

Figure 2. Postoperative Complications

The mean difference in central endothelial counts before surgery and 6 months after surgery was 109 cell / mm^2 (5.92 %).

DISCUSSION

Sir Harold Ridley successfully implanted first intraocular lens on 29 November 1949, at St Thomas' Hospital at London.[21] This lens was made by the Rayner company of Brighton, East Sussex, England from polymethylmethacrylate (PMMA)

made by ICI (Imperial Chemical Industries). The idea of implanting an intraocular lens came to him when an intern asked him why he was not replacing the lens he had removed during cataract surgery. He chose this material as it was inert after seeing RAF (Royal Air Force) pilots of World War II with pieces of shattered canopies in their eyes.

The intraocular lens did not become popular in cataract surgery until the 1970's as there were further developments going on in lens design and surgical techniques.

The number of IOL's used were estimated by the World Health Organization to have increased to 20 million annually worldwide by 2010 (for cataract surgery), and has projected increased IOL surgeries to reach 32 million worldwide by 2020.[22]

Polymethylmethacrylate (PMMA) was the first material to be used successfully in intraocular lenses. A study found that patients with previous history of uveitis when treated with hydrophobic acrylic IOLs were over 2 times more likely to have a good best corrected visual acuity of 20 /40 or more, compared to eyes treated with silicone IOLs.[23,24]

Evolution of intraocular lens has come a long way. They have been divided into eight generations. First generation intraocular lens includes Ridley lenses, these were primitive lenses. Second generation IOL includes rigid and semi rigid anterior chamber IOL, they lie entirely in front of iris and supported in angle of anterior chamber. They can be implanted after intra capsular cataract extraction or extracapsular cataract extraction. They are also used for secondary lens implantation in cases with no posterior capsule support. Common complications associated are corneal decompensation and UGH syndrome. Third generation intraocular lens consist of iris supported lens. There are two types - prepupillary iris claw lens and retropupillary iris claw lenses. Fourth generation intraocular lens consist of modern anterior chamber lens with flexible loops and multiple point fixation. They have the advantage of being more stable with better design. Disadvantage being that anterior chamber is still not the physiological site for IOL implantation. Rigid posterior chamber IOL (PCIOL) belongs to fifth generation. Foldable intraocular lens falls in sixth generation. Foldable IOL are available in many designs and are made up of silicone, acrylic or hydrogel. Acrylic IOL are commonly used nowadays. They can be of two types Hydrophilic and Hydrophobic. Hydrophilic IOL have higher rate of posterior capsular opacification, whereas hydrophobic material does not move easily in bag, once implanted adheres to capsule reducing the rate of posterior capsular opacification. Multifocal intraocular lens is seventh generation lens and phakic refractive lenses and accommodative intraocular lens belong to eighth generation.

Pseudophakic intraocular lenses are the lenses which are implanted after cataract surgery; monofocal IOLs being the most commonly used lenses. These lenses focus on one particular distance but they do not accommodate. Multifocal intraocular provides good vision for distance and near. People may experience adverse effects such as glare, halos and decrease in contrast sensitivity. Accommodating IOL aims at providing some partial focusing ability in order to change focus from distance to near. It has slightly higher risk of developing posterior capsule opacification.[25] Posterior capsule opacification is a common side effect of many cataract surgeries and is easily treatable with laser capsulotomy procedure. Toric IOL is used in patients with corneal astigmatism. Toric intraocular lens have different powers in different meridian of lens and they must be positioned on correct meridian to correct pre-existing astigmatism. Toric lens are usually monofocal but they can be multifocal too. These lenses correct pre-existing astigmatism. Phakic intraocular lenses are those lenses which are placed in eyes but still contains crystalline lens. These lenses can be either spheric or toric. Depending on their site in eyes they are divided into three categories.[26] Angle supported phakic IOL - they are placed in the anterior chamber. Iris fixated PIOLs - these are attached by claws to the mid peripheral iris by a technique called enclavation. It causes less damage to the corneal endothelium. Sulcus supported PIOLs are placed in front of crystalline lens. These type of lenses have special vaulting to prevent any contact with normal lens. Cataract formation is the main complication of these lenses.

Aphakia is no more an acceptable option in the current ophthalmological practice. In the present scenario, visual rehabilitation of aphakic patients include spectacle correction, contact lenses and primary or secondary IOL implantation. Spectacles are rarely used nowadays because of limited visual field, prismatic effect, aniseikonia (unilateral aphakia) and peripheral refractive errors. Moreover, it is also troublesome for the patients to wear so thick glasses. Spectacles cannot be prescribed in cases of unilateral aphakia because they can cause troublesome diplopia in such cases. Contact lenses are a good option for correcting aphakia from the point of restoring good visual acuity but can cause a lot of corneal and conjunctival complications. The major drawback of contact lenses is that they cause corneal hypoxia.

Surgical correction of aphakia is always superior to other options like spectacle correction and contact lenses. Most ophthalmologists agree that IOL implantation is the most appropriate treatment for visual rehabilitation and correction of aphakia. Due to high rate of conditions such as endothelial cell loss,[27] secondary glaucoma, and severe uveitis,[28] AC-IOL's are fading out from the field gradually. The IC- or lobster-claw (LC)-IOL (a biconvex PMMA IOL) was presented by Worst et al. in 1972[29] and was first used to treat myopia. Jan Worst noticed on his visit to regional hospital in Taxila, Pakistan that cataract patients were being sent back home without proper corrective glasses and intraocular lens implantation models used at that time were not practical for these patients. During one of his surgery he noticed that iris tissue trapped in hepatics of intraocular lens was not harmed and also leaving iris tissue in same condition was causing no problem. He attempted to develop new intraocular lens design which could be fixated to iris tissue. Artiflex, Verisyse, and Artisan were designed and brought into the market for visual rehabilitation, and also used to correct aphakia with satisfactory results.[30] The convex / concave model of the iris claw lens (Artisan Aphakia Model 205; Ophtec BV, Groningen, The Netherlands) is very commonly used for aphakia nowadays.

Iris Claw Intraocular Lens(IC-IOLs) are classified into anterior chamber ICIOLs and retropupillary IC-IOLs.[31] The anterior position of the IOL has the advantage of technically straightforward insertion and enclavation but puts the corneal endothelium at risk.[16] The posterior chamber placement as introduced by Brasse and Neuhann,[17] protects the endothelium from the IOL. Iris tissue thickness should be adequate for enclavation and a blunt instrument like a Sinskey hook is useful to reduce perforation of iris. The implantation IC-IOL is not advised in cases of ocular trauma involving extensive damage to the iris or when the pupils are widely dilated. The posterior placement of IC-IOLs has the advantage of a simpler procedure, positioning near the nodal point without the use of extra sutures or glue.[32] Various studies have advocated the use of IC-IOL in aphakic patients with inadequate capsular support.[1,19,33,34,35] ICIOL implantation saves a lot of time of the surgery with low intrusiveness, and the operating technique is much simpler as compared to SF-IOL implantation. SF-IOL implantation has steep learning curve and is associated with more complications. The implantation of a retropupillary IC-IOL combines the advantages of a PCIOL and a short operation time as well as an easy operation technique; both advantages are accepted by many surgeons.[35]

In our study, 78 % eyes (N = 39) had vision better than 6 / 12 while only 10 % eyes (N = 5) had < 6 / 60 vision and the remainder 12 % (N = 6) had vision between 6 / 18 & 6 / 36. Complications like acute postoperative iritis (N = 18, 36 %), pupillary distortion (N = 15, 30 %), pigment clumping (N = 10, 24 %), iris chaffing (N = 9, 21 %), secondary glaucoma (N = 5, 12 %) and IOL decentration (N = 3, 7 %) were seen. The mean difference in central endothelial counts before surgery and 6 months after surgery was 109 cell / mm^2 (5.92 %).

The implantation of a SFIOL demands higher experience curve and skill on part of the surgeon with a long operation procedure. The chances IOL decentration, suture erosion, and macular oedema are higher in patients with SF-PCIOL implantations. So, the primary choice of majority of the surgeons is the IC-IOLs first, and then SF-PCIOLs as an acceptable alternative in aphakic patients without adequate capsular support.

CONCLUSIONS

Retropupillary IC-IOL implantation in aphakic eyes without adequate capsular support is a safe, predictable, and effective procedure which provides a good visual outcome to the patient and is associated with a lesser complication rate. Implantation of IC-IOL is a simple procedure and has a shorter learning curve.

Limitations

This study was limited by its small sample size and shorter follow-up time. Studies with larger sample size and longer follow-up time can better demonstrate the superiority of IC-IOLs and the possible long-term complications.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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