Original Article

Iris Claw versus Scleral Fixation Intraocular Lens Implantation during Pars Plana Vitrectomy

Fereydoun Farrahi, MD; Mostafa Feghhi, MD; Foad Haghi, MD
Ali Kasiri, MD; Abbas Afkari, MD; Mahmood Latifi, MSc

Department of Ophthalmology, Jundishapur University of Medical Sciences, Ahvaz, Iran

Purpose: To compare the outcomes of iris claw anterior chamber intraocular lens (IC-ACIOL) with that of scleral fixation posterior chamber intraocular lens (SF-PCIOL) implantation during pars plana vitrectomy (PPV) as initial surgery to correct aphakia.
Methods: Twelve patients with complicated cataract surgery or trauma who had suffered nucleus, whole crystalline lens or intraocular lens (IOL) drop into the vitreous cavity, and undergone PPV with IC-ACIOL implantation over a period of one year were evaluated for the purpose of this study. Uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), central corneal thickness (CCT), spherical equivalent (SE) refractive error, astigmatism and complications were recorded. The results were compared to outcomes of another group of 13 patients who had previously undergone PPV with SF-PCIOL implantation.
Results: Mean improvement of UCVA was greater in IC-ACIOL eyes as compared to the SF-PCIOL group (-1.17±0.28 versus -0.89±0.21 logMAR, P=0.01), corresponding values for postoperative BCVA were 0.24±0.17 and 0.44±0.22 logMAR (P=0.041), respectively. Average postoperative SE was comparable in the IC-ACIOL and SF-PCIOL groups at 0.6±1.03 and 0.56±1.23 diopters, respectively (P=0.290). However, 10 (83.3%) IC-ACIOL eyes versus 6 (46.1%) SF-PCIOL eyes had SE within 1 diopter of emmetropia (P=0.048). Mean postoperative increase in CCT was comaparble between the study groups (P=0.126).
Conclusion: In the absence of sufficient capsular support, the use of an IC-ACIOL for correction of aphakia during PPV can be a good alternative and seems to entail better visual outcomes as compared to SF-PCIOL.

Keywords: Iris-Claw Anterior Chamber Intraocular Lens; Pars Plana Vitrectomy; Scleral Fixation Intraocular Lens; Capsular Support; Nucleus Drop; Intraocular Lens Drop

J Ophthalmic Vis Res 2012; 7 (2): 118-124.

Correspondence to: Mostafa Feghhi, MD. Associate Professor of Ophthalmology, Department of Ophthalmology, Imam Khomeini Hospital, Azadegan Ave., Ahvaz, Iran; Tel: +98 916 118 3228, Fax: +98 611 222 8076; email: FeghhiM671@live.com

Received: September 22, 2011 **Accepted:** February 1, 2012

INTRODUCTION

The crystalline lens capsule is an elastic basement membrane which contains the lens substance. The thinnest part of the capsule is located at the posterior pole.[1] One of the goals of modern cataract surgery is to keep the posterior capsule intact and implant a posterior chamber intraocular lens (PCIOL) inside the capsular bag. If the posterior capsule is ruptured but sufficient amounts of capsule remain, implantation of a PCIOL in the ciliary sulcus is technically feasible.[2]

Occasionally, complications during cataract surgery may result in drop of all or part of the nucleus, or PCIOL into the vitreous cavity. Whole crystalline lenses may drop into the vitreous cavity secondary to trauma while PCIOLs can also become dislocated into the vitreous cavity late postoperatively, either spontaneously or secondary to trauma. In all such cases, pars plana vitrectomy (PPV) is required. Treatment and correction of aphakia in these individuals especially in the absence of capsular support for ciliary sulcus PCIOL implantation, requires employing special methods. Various intraocular lenses (IOLs) including angle supported anterior chamber intraocular lenses (ACIOLs), scleral fixation posterior chamber intraocular lenses (SF-PCIOL) and more recently, iris claw anterior chamber intraocular lenses (IC-ACIOLs) have been implanted, during PPV or secondarily, to correct aphakia.[3-6]

Angle supported lenses entail several long-term complications including corneal edema, secondary glaucoma and cystoid macular edema (CME), thus the use of these lenses has dramatically been reduced.[7]

SF-PCIOL implantation is technically difficult, it requires considerable operative time and is associated with complications such as IOL tilt, decentration, and displacement into the vitreous cavity, choroidal hemorrhage, retinal detachment, CME and conjunctival erosion secondary to use of trans-scleral sutures.[8-10]

IC-ACIOLs were first introduced in 1986 by Fechner and Worst to correct myopia, but were later used to correct aphakia.[11] The new generation of IC-ACIOLs have good visual outcomes and entail few complications in the treatment of aphakia.[6,11-14] Despite extensive experience with IC-ACIOL implantation for myopic eyes and during complicated cataract surgery, the use of this lens during PPV has been less extensively studied.[3,5,15-19]

The current study compares visual and anatomic outcomes, and complications of IC-ACIOL implantation during PPV with that of SF-PCIOL implantation in the same surgical setting.

METHODS

In this prospective interventional case series, patients who had suffered nucleus, IOL or crystalline lens drop into the vitreous cavity were enrolled. In the absence of capsular support for ciliary sulcus IOL implantation, along with PPV, an IC-ACIOL was implanted at the end of surgery. Patients with history of recurrent uveitis, severe iris damage, corneal edema, uncontrolled glaucoma, proliferative diabetic retinopathy and macular lesions such as macular scar were excluded from the study. From September 2009 to August 2010 a total of 14 patients, who met the inclusion criteria, were enrolled. Two cases were later excluded due to inadequate follow-up; eventually 12 patients served as the case group (IC-ACIOL).

The control group (SF-PCIOL) was selected among cases who had previously undergone PPV and SF-PCIOL implantation from 2008 to 2009 and met the inclusion and exclusion criteria of the study. All of these subjects were recalled for a final examination and ultimately 13 patients who underwent a full examination were enrolled as controls.

Prior to surgery, all patients underwent a full ophthalmic examination including measurement of UCVA and BCVA using an E chart at 6 m distance, slit lamp examination, measurement of intraocular pressure (IOP) by Goldmann applanation tonometry , fundus examination, and central corneal thickness (CCT) measurement by ultrasonic pachymetry; visual acuities were converted to logMAR scores for statistical analysis.

The implanted lens in the study group was the Artisan aphakic IOL (ARTISAN Aphakia, Model 205, Ophtec BV, Groningen, the Netherlands), which is made of polymethylmethacrylate (PMMA), has an overall length of 8.5 mm and an optic diameter of 5.4 mm. The implanted lens in the control group was the scleral fixation IOL (Morcher type 66, Morcher GmbH, Stuttgart, Germany), made of PMMA, with an overall diameter of 13 mm and optic diameter of 6.5 mm. IOL power calculation was performed by A-scan ultrasonic biometry (Tomey UD-6000, Nagoya, Japan) using the SRK/T formula.

The study adhered to the tenets of the Declaration of Helsinki. All patients were informed about the risks and benefits of the surgery and written informed consent was obtained from subjects willing to participate. The study was approved by the Ethics Committee of Jundishapur University of Medical Sciences.

The procedures were performed by two surgeons using the same technique. Initially standard 3-port PPV was performed, dropped whole crystalline lenses or nuclei in the vitreous cavity were removed by phacofragmentation while dislocated IOLs were removed via a posterior limbal incision. After creating a 6 mm posterior limbal incision, the pupil was constricted with acetylcholine and the anterior chamber was filled with methylcellulose ophthalmic solution (OcuCoat, Bausch & Lomb). The IC-ACIOL was inserted into the anterior chamber, thereafter the incision was repaired with interrupted 10-0 nylon sutures. After suitable horizontal positioning of the lens, it was fixed by enclavation of the mid-peripheral iris into the lens haptics using an enclavation needle (Ophtec BV, Groningen, Netherlands); a peripheral iridectomy was performed, the retained methylcellulose solution was removed and vitrectomy was completed.

Patients were visited one and three days, one week, and one, three and six months following surgery and at each visit, complete eye examinations were performed and the results were recorded. All 12 participants were recalled during data collection and examined once again to review the results and possible complications.

One of the drawbacks to the study was lack of CCT measurement before surgery in the control group. In these patients, CCT values of the fellow eye were used for this purpose, provided it had no history of intraocular surgery. Some studies have shown that there is no clinically or statistically significant difference between CCTs of fellow eyes within the same individual.[20,21]

Data was analyzed using SPSS software version 17 by employing the independent T-test and chi-square test. Level of significance was set at 0.05.

RESULTS

Twelve eyes of 12 patients underwent IC-ACIOL implantation. These included 6 patients with IOL dislocation into the vitreous cavity due to trauma or spontaneously, 4 patients with complicated cataract surgery and drop of all or part of the nucleus into the vitreous cavity, and 2 patients with whole crystalline lens drop into the vitreous cavity due to trauma. The SF-PCIOL group consisted of 7 patients with IOL drop into the vitreous cavity due to trauma or spontaneously, and 6 others who had complicated cataract surgery with all or part of the nucleus dropped into the vitreous cavity. Tables 1 and 2 represent participants' data before and after the operations.

Table 1. Clinical data for the iris claw anterior chamber intraocular lens group.

Patients	Age	Sex	OD/OS	F/U duration (months)	Preop UCVA	Postop UCVA	Preop BCVA	Postop BCVA	Preop CCT	Postop CCT	Astigmatism	SE	Complications
1	66	F	OS	13	20/1200	20/100	20/100	20/32	528	532	-2.00	+0.75	-
2	45	F	OD	15	20/1200	20/66.6	20/200	20/32	543	546	-3.50	0.00	pigment precipitates
3	51	M	OD	16	20/600	20/66.6	20/200	20/40	524	527	-2.50	-0.75	RD (after 8m)
4	60	F	OD	10	20/1200	20/40	20/100	20/32	532	536	-1.00	-1.00	pigment precipitates
5	69	F	OD	7	20/600	20/100	20/240	20/66.6	548	552	-1.00	-0.50	-
6	60	F	OS	8	20/600	20/100	20/240	20/50	530	532	-3.00	-0.50	pigment precipitates
7	65	M	OS	12	20/1200	20/100	20/300	20/66.6	549	555	-2.00	-0.50	IOP increase
8	62	F	OS	13	20/400	20/40	20/200	20/32	541	543	-1.00	+0.50	haptic disenclavation
9	56	M	OD	8	20/1200	20/32	20/200	20/22.2	530	532	-0.50	+2.25	-
10	58	F	OS	11	20/1200	20/50	20/100	20/32	528	532	-1.00	0.00	-
11	58	M	OD	8	20/1200	20/32	20/100	20/25	531	534	-1.50	-1.75	-
12	21	M	OD	13	20/300	20/20	20/66.6	20/20	536	537	-1.75	+0.75	IOP increase

F, female; M, male; OD, right eye; OS, left eye; F/U, follow-up; Preop, preoperative; Postop, postoperative; UCVA, uncorrected visual acuity; BCVA, best corrected visual acuity; CCT, central corneal thickness;
SE, spherical equivalent; RD, retinal detachment; IOP, intraocular pressure.

Table 2. Clinical data for the scleral fixation posterior chamber intraocular lens group.

Patient	Age	Sex	OD/OS	Preop UCVA	Postop UCVA	Preop BCVA	Postop BCVA	Contralateral CCT	Postop CCT	Astigmatism	SE	Complications
1	68	M	OS	20/1200	20/100	-	20/66.6	531	530	-3.00	-1.00	-
2	56	F	OS	20/600	20/100	-	20/100	-	-	-2.50	-1.75	CME
3	62	F	OD	20/600	20/28.5	-	20/22.5	540	542	-1.25	-1.25	-
4	76	M	OD	20/1200	20/200	-	20/66.6	537	541	-3.50	0.50	-
5	62	M	OS	20/600	20/100	-	20/100	552	556	-1.25	-0.75	Conj erosion
6	63	F	OS	20/400	20/66.6	-	20/50	-	-	-4.25	-1.25	-
7	63	F	OS	20/600	20/50	-	20/32	528	529	-0.50	1.25	-
8	58	M	OS	20/400	20/100	-	20/66.6	532	535	-1.00	1.50	-
9	65	M	OD	20/1200	20/200	-	20/50	-	-	-0.75	-2.75	-
10	50	F	OD	20/600	20/66.6	-	20/40	530	531	-1.50	-1.25	-
11	46	F	OS	20/400	20/40	-	20/28.5	529	531	-2.00	-0.50	-
12	58	M	OS	20/1200	20/100	-	20/100	-	-	-1.50	0.75	-
13	53	M	OD	20/300	20/66.6	-	20/32	-	-	-3.50	-0.75	-

F, female; M, male; OD, right eye; OS, left eye; F/U, follow-up; Preop, preoperative; Postop, postoperative; UCVA, uncorrected visual acuity; BCVA, best corrected visual acuity; CCT, central corneal thickness;
SE, spherical equivalent; CME, cystoid macular edema; Conj, conjunctiva.

The two groups were matched in terms of the involved eye (P=0.543), gender (P=0.543) and age, the mean of which was 55.91±12.78 (range, 21 to 69) years versus 60.00±7.85 (range, 46 to 76) years in IC-ACIOL and SF-PCIOL groups, respectively (P=0.342); mean follow-up was 11.17±2.98 (range, 7 to 16) months and 21.54±6.26 (range, 16 to 32) months, in the same order. UCVA prior to surgery was 1.60±0.21 and 1.50±0.21 logMAR, in the IC-ACIOL and SF-PCIOL groups, respectively (P=0.230).

UCVA at the last postoperative visit was better in IC-ACIOL eyes as compared to SF-PCIOL eyes (0.44±0.24 versus 0.61±0.25 logMAR) however this difference failed to reach statistical significance (P=0.09). The average amount of improvement in UCVA however, was significantly greater (-1.17±0.28 versus -0.89±0.21 logMAR) in the IC-ACIOL group (P=0.01). At final examination, 5 (41.7%) patients in the IC-ACIOL group and 2 (15.4%) patients in the SF-PCIOL group had UCVA ≥20/40 (P=0.144).

The IC-ACIOL group fared better than the SF-PCIOL group in terms of postoperative BCVA at final follow-up which was 0.24±0.17 versus 0.41±0.22 logMAR respectively (P=0.041); BCVA ≥20/40 was present in 9 (75%) IC-ACIOL patients versus 5 (38%) SF-PCIOL subjects (P=0.027).

The two groups were comparable in terms of postoperative spherical equivalent (SE) refractive error which was 0.6±1.03 and 0.56±1.23 diopters (D) in the IC-ACIOL and SF-PCIOL groups, respectively (P=0.290). At final examination, 10 (83.3%) versus 6 (46.1%) eyes in the IC-ACIOL and SF-PCIO groups had SE between -1 and +1 D, (P=0.048). Corresponding values for mean postoperative astigmatism were 1.73±0.91 D versus 2.04±1.20 D in the same order respectively (P=0.478). Mean increase in CCT after surgery was 3.17±1.34 µversus 2.00±1.69µ in the IC-ACIOL and SF-PCIOL groups respectively (P=0.126).

Complications in the IC-ACIOL group included pigment deposition on the lens surface in three eyes which resolved spontaneously in all, raised IOP (>20 mmHg) in two patients which was controlled with one or two topical medications, retinal detachment in one eye 8 months after surgery treated with repeat PPV and scleral buckling, and disenclavation one of the lens haptics 11 months after surgery in one patient which was managed by repeat enclavation.

Complications in the SF-PCIOL group included CME in one patient, conjunctival erosion induced by the scleral sutures in one patient, and raised IOP in two patients which was controlled with one topical medication.

DISCUSSION

Correction of aphakia in patients with complicated cataract surgery or trauma and inadequate capsular support is a debatable issue. These patients often require PPV to remove a dislocated crystalline lens, nucleus or IOL. In the absence of capsular support, SF-PCIOL and more recently IC-ACIOLs are used to correct aphakia. Implantation of aphakic IC-ACIOLs in vitrectomized eye is usually performed in a second operation, but in the current series both procedures were performed simultaneously. Scleral fixation is a more demanding procedure technically; it requires longer operative time and is associated with complications such as retinal detachment, cystoid macular edema, and IOL dislocation and tilt.[8-10] Degradation of the polypropylene sutures may lead to conjunctival erosion and eventually IOL malposition; this complication has been reported in 27.9% of eyes in one study with 6 years of follow-up and in 24% of cases in another study with 7 years of follow-up.[9,22]

In our study no intraoperative complications occurred during PPV and IC-ACIOL implantation. At the beginning, iris-claw ACIOL implantation was rather challenging due to lack of vitreous support. Significant IOL decentration was not observed during the follow-up period.

In the current series IC-ACIOL implantation entailed superior visual outcomes in terms of UCVA and BCVA as compared to SF-PCIOLs. Improvement in UCVA was more marked with IC-ACIOLs which can be related to the fact that SE refractive error was closer to emmetropia in this group of eyes. The lower percentage of eyes close to emmetropia in SF-PCIOL eyes is probably because the position of SF-PCIOLs cannot be exactly determined preoperatively. IC-ACIOLs however are more predictable in terms of postoperative position which can be considered as one of their advantages.

Increase in CCT in both groups was not significant. These results showed that the risk of corneal edema with IC-ACIOLs is not higher than SF-PCIOLs, however it is inappropriate to use this parameter as a surrogate for specular microscopy.

Early postoperative complications were mild and transient in the IC-ACIOL group; three patients had pigment deposits on the lens and two had raised IOP. Serious late complications were seen in only two patients, these included retinal detachment (RD) in one case 8 months following the operation, and disenclavation of one of the haptics in another patient. The RD case had sustained crystalline lens drop into the vitreous cavity due to trauma, therefore trauma may have been the underlying cause of RD.

Favorable results were reported by van der Meulen et al following implantation of IC-ACIOLs during PPV in 13 patients with nucleus drop into the vitreous cavity during cataract surgery.[5] This study is similar to our report in that IOL implantation was performed at the same session as PPV, but retrospective in nature. In another study, Riazi and colleagues reported the results of secondary IC-ACIOL implantation in 17 aphakic patients who had previously undergone deep vitrectomy and lensectomy due to trauma.[14] Similarly, Acar and coworkers described the results of secondary IC-ACIOL implantation in vitrectomized eyes.[6] The percentage of patients with UCVA $\geq$20/40 after IC-ACIOL implantation were 62%, 41.2% and 8.3% in the above-mentioned studies, respectively; the corresponding figure was 41.7% in the current series. The percentage of eyes with BCVA $\geq$20/40 was not mentioned in the study by van der Meulen et al, 58.8% in the Riazi study, 50% in the Acar study and 75% in the current series. The percentage of eyes within 1D of emmetropia was 58.1% in the report by Riazi et al and 83.3% in our series; other studies did not evaluate this value. CCT was compared before and after surgery only by Acar et al and similar to ours, these authors found no significant increase in CCT postoperatively.

Retinal detachment was reported in one patient in the van der Meulen study but not observed in the Riazi and Acar studies. Since IC-ACIOL implantation in the latter two studies was secondary, RD in the report by van der Meulen et al and our study may be the complication of vitrectomy or due to the underlying condition.

Disenclavation of the IC-ACIOL was observed in one patient in the Acar study, as well as one eye in our series; this complication could be minimized with adequate surgical experience.

Limitations of the current study can be summarized as being a non-randomized study, selection of an external control group, limited number of cases, use of CCT instead of specular microscopy, and follow-up duration of just less than one year which is shorter than studies by van der Meulen et al[5] (28.9 months), Riazi et al[14] (14.65 months) and Acar et al[6] (15.58 months).

In conclusion, it seems that in patients who are undergoing PPV and lack adequate capsular support for ciliary sulcus IOLs, implantation of an IC-ACIOL for correction of aphakia is a good surgical option. This lens may entail superior visual outcomes as compared to SF-PCIOLs.

Acknowledgements

The authors thank Jundishapur University of Medical Sciences; Deputy for Research and Technology for providing the grant.

Conflicts of Interest

None.

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