• Brief Report •

IOL repositioning using iris sutures: a safe and effective technique

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Abstract

• This retrospective non-comparative consecutive case series study was conducted at Azienda Ospedaliera Universitaria Careggi, Florence, Italy and describes a useful intraocular lens (IOL) repositioning technique using iris sutures. In our study, 41 consecutive cases of posteriorly dislocated IOLs were surgically treated between January 2015 and May 2017. Six of the cases were post-traumatic luxations, and 20 patients had pseudoexfoliation syndrome. All the patients underwent pars plana vitrectomy and same IOL repositioning using iris sutures. The mean follow-up was 12.2mo. The mean preoperative best corrected visual acuity (BCVA) was 0.10±0.15 logMAR, whereas the mean postoperative BCVA was 0.08±0.14 logMAR. The mean postoperative BCVA did not change significantly from the preoperative BCVA. The final mean spherical equivalent was -0.44±0.49 SD. Three lenses (7.31%) were found tilted during post-operative follow-up. Two eyes (4.87%) had postoperative cystoid macular edema. No eyes had endophthalmitis, hypotony, retinal or choroidal detachment. The iris fixation technique seems to be a safe and valid option for the management of dislocated IOLs.

• KEYWORDS: IOL luxation; pars plana vitrectomy; cystoid macular edema

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INTRODUCTION

Intraocular lens (IOL) luxation is a rare and challenging complication and may be spontaneous or associated with traumas. Untreated cases could develop chronic cystoid macular edema (CME), anterior uveitis, or retinal detachment, as Faria *et al*[1] showed. Surgery for IOL luxation is often challenging, and different techniques have been described in the literature: scleral fixation, iris enclavation, anterior chamber IOLs. Many surgeons decide to remove the previously implanted IOL and carry out secondary implantation using anterior chamber IOLs, iris claw IOLs, and scleral fixation IOLs; other surgeons use the same dislocated IOL (either a three-piece IOL or a single piece IOL) suturing it to the iris. Our study focuses on the efficacy and the safety of IOL repositioning using iris sutures.

SUBJECTS AND METHODS

Ethical Approval This is a retrospective non-comparative consecutive case series study. Institutional Review Board (IRB)/Ethics Committee approval was obtained, and the study is following the Declaration of Helsinki. All the patients signed informed consent to participate in the study.

We operated 41 consecutive cases of posteriorly dislocated IOLs between January 2015 and May 2017. All cases lacked sufficient capsule support to allow sulcus placement alone. Six eyes had a post-traumatic luxation, and 20 patients had pseudoexfoliation syndrome (PXS). The patients with diabetes were not excluded except those with diabetic macular edema. We had 2 diabetic patients, one of whom with iridodonesis. Moreover, another non-diabetic patient had an iridodonesis.

All the patients underwent pars plana vitrectomy (PPV) and IOL iris suturing by the same surgeon (Caporossi T). The data collected included demographic information, details on cataract extraction surgery, visual acuity, refraction, endothelial count, intraocular pressure (IOP), ocular biometry (measured using the IOLMaster, Carl Zeiss Meditec AG), information on fixation surgery, macular optical coherence tomography (OCT) examination, assessment of the lens centering using anterior segment OCT, and intraoperative and postoperative complications.

Surgical Technique All surgical procedures were performed using a retrobulbar block with ropivacaine 10% and lidocaine 2%, mixed in equal volumes and with hyaluronidase. The 25-gauge PPV (Alcon surgical Inc.) commenced with core and peripheral vitrectomy, with careful attention to freeing

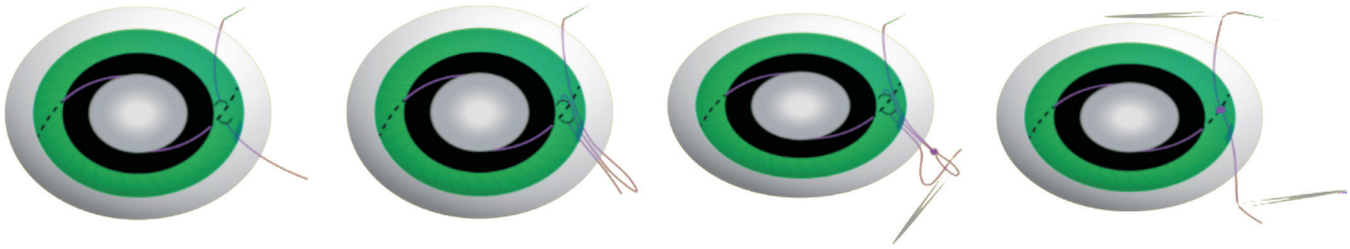

Figure 1 The IOL repositioning technique.

the IOL from the surrounding vitreous. In the case of capsular remnants, they were removed with vitreoretinal forceps and vitrectomy probe; when IOL was inside the capsular bag, a chandelier was placed to perform a bimanual technique to remove the IOL from the bag with two vitreoretinal forceps. Once freed from the vitreous and the bag the IOL was manipulated with vitreoretinal forceps to obtain the right anterior to posterior orientation of the optical plate. Then a 25-gauge light probe was placed in contact with the central anterior part of the optical plate to lift the IOL above the iris plane, where the IOL was engaged, then pupillary capture miosis was induced with intracameral acetylcholine, followed by intracameral instillation of dispersive viscoelastic (VISCOAT®, Alcon 5 surgical Inc.). Once the haptic was stabilised, 2 vertical side-ports at 2 and 10 o'clock were performed, and the lens was oriented horizontally for ease of suturing. While raising the IOL upwards by pressing the optic plate with a light probe to emphasize the haptic shape through the iris, a 10-0 polypropylene (Prolene®, Ethicon) suture was then passed through the cornea side-port and the mid-peripheral iris proximal to the haptic and then again through the iris distal to the haptic and out through the cornea (Figure 1).

With a vitreoretinal forceps, the suture was conducted through the side-port to prepare a knot. The tip of a clamp was rotated around the suture and then tied into the proximal end of the suture. Another clamp was used to grab the distal end of the suture and then pull it to tighten the slipknot. This manoeuvre was repeated three times. The second haptic was sutured similarly to achieve a 2-point fixation. The stability of the fixation was then assessed, and the optic plate was gently pushed through the pupil into the posterior chamber. Iridectomy was performed to reduce the possibilities of a post-operative pupillary block. The remnants of VISCOAT® were removed from the anterior chamber and exchanged with a balanced salt solution; the corneal limbal incisions were hydro-sutured. A partial fluid-air exchange was performed, and the PPV trocars were removed. Subtenon dexamethasone and tobramycin were administered.

Statistical Analysis For the statistical analysis, best corrected visual acuity (BCVA) was converted from Snellen to logMAR. Statistical analysis was performed using SPSS software version18.0 (SPSS, Inc., Chicago, IL, USA). The relationship between the preoperative and postoperative BCVA was compared using paired and unpaired Student's *t*-test. The distributions for variables were expressed as a mean±standard deviation (SD). Statistical significance was defined as *P* value <0.05.

RESULTS

Forty-one eyes of 41 consecutive patients were included in this study. Mean age was 70.12±10.16y. The mean follow-up was 12.2mo. Six of the cases were post-traumatic luxations, and 20 patients had PXS. In 2 eyes a capsular tension ring was found inside the bag and was removed through the corneal side port. No IOL was changed during surgery, and all the IOLs were sutured to the iris. The lens characteristics were: *n*=6 mono-piece acrylic IOLs, *n*=27 3-pieces acrylic IOLs, *n*=8 mono-piece PMMA IOLs. The mean preoperative BCVA was 0.10±0.15 logMAR, whereas the mean postoperative BCVA was 0.08±0.14 logMAR (Tables 1 and 2).

In both mono-piece and 3-pieces group, we have not found statistically significant differences between pre and postop BCVA (*P*=0.212 and *P*=0.168 respectively). The differences between postoperative BCVA in the patients with one-piece or 3-pieces IOL were not statistically significant (*P*=0.682).

All eyes improved their uncorrected visual acuity, 9 eyes (21.9%) had final BCVA of 20/20 (0 logMAR), and 38 eyes (92%) had final postoperative BCVA better than 20/40 (>0.30 logMAR). The mean postoperative spherical error was -0.18 diopters (D) ±0.71 SD. Three lenses (7.31%) were found tilted during postoperative follow-up. One patient (with a mono-piece-IOL) had lost the iris suture in one of the haptics and later underwent a second operation to reposition it in the same position. Another patient with a 3-piece acrylic IOL was found with a bent haptic, and he then underwent an IOL change with a new 3- piece acrylic foldable IOL (AR40e®, AMO surgical); the third patient maintained a tilted 3-pieces IOL with a final BCVA of 20/40 (0.30 logMAR). Two eyes (4.87%) had postoperative CME that affected visual acuity recovery: the first patient recovered with non-steroid anti-inflammatory drug (NSAID) eye drops for 2mo; the second, after 2mo of NSAID therapy with no change of CME, underwent Ozurdex (Allergan inc.) implantation with good resolution of the CME and a final visual acuity improvement after 3mo. The 2 diabetic patients did not develop CME.

Table 1 Patient characteristics (mono-piece IOL)

Patient	Age	PXS	IOL type	Capsular tension ring	Preop. IOP	Postop. IOP	Preop. BCVA logMAR	Postop. BCVA logMAR	Postop. spherical refractive error	Postop. cylindrical error
4	55	No	Acryilic mono-piece in the bag	No	11	17	0.10	0.10	0.00	0.50
5	45	No	Acryilic mono-piece in the bag	No	10	15	0.00	0.00	-1.50	-1.00
7	76	No	PMMA mono-piece in the sulcus	No	14	13	0.30	0.00	0.00	-1.50
12	76	No	PMMA mono-piece in the sulcus	No	13	17	0.00	0.00	-1.00	0.50
14	55	No	PMMA mono-piece in the sulcus	No	11	16	0.30	0.30	-1.00	0.00
15	67	No	Acryilic mono-piece in the bag	No	12	18	0.00	0.00	-1.75	3.00
16	57	Yes	Acryilic mono-piece in the bag	No	10	15	0.40	0.40	0.00	0.50
18	67	Yes	PMMA mono-piece in the sulcus	No	14	13	0.10	0.00	0.00	2.00
23	65	No	PMMA mono-piece in the sulcus	No	10	15	0.00	0.00	0.00	-1.50
24	67	No	Acryilic mono-piece in the bag	No	12	15	0.10	0.10	-0.25	0.00
25	78	No	PMMA mono-piece in the bag	No	13	15	0.00	0.00	0.00	2.00
28	65	No	PMMA mono-piece in the bag	No	12	14	0.00	0.00	-0.50	0.50
35	67	No	PMMA mono-piece in the bag	No	13	18	0.00	0.00	-0.25	-3.00
39	76	No	Acryilic mono-piece in the bag	No	12	12	0.00	0.00	0.00	-0.25
Mean	65.42						0.09	0.06	-0.45	0.13

Table 2 Patient characteristics (3-pieces IOL)

Patient	Age	PXS	IOL type	Capsular tension ring	Preop. IOP	Postop. IOP	Preop. BCVA logMAR	Postop. BCVA logMAR	Postop. spherical error	Postop. cylindrical error
1	65	0	Acrylic 3-pieces in the bag	No	15	18	0.10	0.10	0	0.5
2	67	No	Acrylic 3-pieces in the bag	No	12	22	0.00	0.10	-0.5	-1
3	63	No	Acrylic 3-pieces in the bag	No	12	14	0.10	0.00	0.5	-1
6	88	0	Acrylic 3-pieces in the bag	Yes	11	14	0.00	0.00	-1	0
8	83	0	Acrylic 3-pieces in the bag	No	11	13	0.30	0.00	0	-1
9	76	0	Acrylic 3-pieces in the bag	No	14	15	0.10	0.00	-1	0.5
10	74	0	Acrylic 3-pieces in the bag	No	12	15	0.50	0.50	0	-1.5
11	72	0	Acrylic 3-pieces in the bag	No	15	28	0.00	0.00	-1	-1.5
13	54	0	Acrylic 3-pieces in the bag	No	12	16	0.10	0.10	0.5	0
17	65	0	Acrylic 3-pieces in the bag	Yes	11	14	0.00	0.00	-0.75	0
19	87	0	Acrylic 3-pieces in the bag	No	11	11	0.50	0.50	1	-2
20	65	1	Acrylic 3-pieces in the bag	No	14	15	0.00	0.00	-0.5	0.5
21	45	1	Acrylic 3-pieces in the bag	No	12	14	0.30	0.30	2	0
22	75	0	Acrylic 3-pieces in the bag	No	11	15	0.00	0.00	-0.25	-0.25
26	76	0	Acrylic 3-pieces in the bag	No	12	12	0.00	0.00	-0.25	0.5
27	84	0	Acrylic 3-pieces in the bag	No	10	15	0.00	0.00	0	2
29	78	0	Acrylic 3-pieces in the bag	No	11	14	0.00	0.00	0	2
30	71	0	Acrylic 3-pieces in the bag	No	11	14	0.10	0.10	-0.5	0.5
31	65	1	Acrylic 3-pieces in the bag	No	14	15	0.00	0.00	0	-1.5
32	76	0	Acrylic 3-pieces in the bag	No	12	14	0.00	0.00	1	-0.25
33	84	0	Acrylic 3-pieces in the bag	No	14	18	0.00	0.00	0	-1
34	75	0	Acrylic 3-pieces in the bag	No	12	18	0.00	0.00	0.5	-1
36	76	0	Acrylic 3-pieces in the bag	No	11	12	0.30	0.30	-1	0
37	66	0	Acrylic 3-pieces in the bag	No	14	18	0.00	0.00	-0.5	2
38	78	1	Acrylic 3-pieces in the bag	No	12	15	0.00	0.00	-0.5	0
40	76	0	Acrylic 3-pieces in the bag	No	14	15	0.10	0.00	1	-0.25
41	75	0	Acrylic 3-pieces in the bag	No	15	15	0.30	0.30	0	-0.25
Mean	72.55						0.10	0.09	-0.04	-0.14

Two eyes (4.87%) had postoperative vitreous bleeding: one had spontaneous resolution after 2wk of observation, but the second needed a second PPV to resolve it. Mean preoperative IOP was 12.24 mm Hg and mean postoperative IOP was 15.41 mm Hg 1wk after surgery (P<0.001; Tables 3 and 4).

In the mono-piece IOLs group, the difference between the preoperative IOP and the postoperative IOP was statistically significant (P<0.05). We had numerous cases of 1wk IOP elevation although no ocular hypertension (defined as IOP>21 mm Hg) cases.

In the 3-pieces IOLs group the difference between the pre-operative IOP and the postoperative IOP were statistically significant (P<0.05). We had numerous cases of one-week IOP elevation although only in two cases we have ocular hypertension (22 and 28 mm Hg). These 2 cases were normalised with topical hypotensive therapy. One eye had postoperative anterior uveitis that was resolved with steroidal topical treatment, and the final visual acuity was 20/50 (0.4 logMAR). No eyes had endophthalmitis, hypotony, retinal or choroidal detachment.

Table 3 Postoperative complications (mono-piece IOL)

Patient	IOP elevation	Iridocyclitis	Cystoid macular edema	Postop. IOL dislocation
4	No	No	No	No
5	No	No	No	No
7	No	No	No	No
12	No	No	No	No
14	No	No	No	No
15	No	No	No	Yes
16	No	No	No	No
18	No	No	No	No
23	No	No	No	No
24	No	No	No	No
25	No	No	Yes	No
28	No	No	No	No
35	No	No	No	No
39	No	No	No	No

Table 4 Postoperative complications (3-pieces IOL)

Patient	IOP elevation	Iridocyclitis	Cystoid macular edema	Postop. IOL dislocation
1	No	No	No	No
2	Yes	Yes	No	No
3	No	No	No	No
6	No	No	No	No
8	No	No	No	No
9	No	No	No	No
10	No	No	No	No
11	Yes	No	No	No
13	No	No	No	Yes
17	No	No	No	No
19	No	No	No	No
20	No	No	No	No
21	No	Yes	Yes	Yes
22	No	No	No	No
26	No	No	No	No
27	No	No	No	No
29	No	No	No	No
30	No	No	No	No
31	No	No	No	No
32	No	No	No	No
33	No	No	No	No
34	No	No	No	No
36	No	No	No	No
37	No	No	No	No
38	No	No	No	No
40	No	No	No	No
41	No	No	No	No

DISCUSSION

In this retrospective study, we have included cases of luxated IOLs where we performed the repositioning of the same IOL using iris suture fixation. Our paper, compared to the article by Faria *et al*[1], who has already described this technique, has the added value that we have also used this technique in one-piece IOLs. We have described and discussed the results in a differential manner in the two groups mono-piece IOLs and 3-pieces IOLs. We have registered a BCVA improvement and IOL stability in most of the patients. The management of a luxated IOL is challenging, and surgeons have performed different techniques. Anterior chamber IOLs are very simple to implant, but they could cause secondary glaucoma, chronic inflammation or endothelial decompensation as Evans *et al*[2], Kumar *et al*[3], Kavuncu *et al*[4] and Neuhann *et al*[5] showed. Iris-claw lenses are often implanted but large corneal incisions (about 6 mm), which may increase corneal astigmatism, are necessary; furthermore, you could have lens stability problems related to iris atrophy[6-8]. Our technique does not require a large corneal incision, and we have found a low postoperative cylindrical error. Dick and Augustin[9], Zhang *et al*[10], Can[11] and Agarwal *et al*[12] showed that in glaucomatous eyes, or in the case of shallow anterior chambers, scleral-sutured posterior chamber IOLs are more adequate options due to a lesser endothelial loss and lower rate of IOP increase. However scleral fixation IOLs could require a larger corneal incision and could cause some complications, including haemorrhage, suture extrusion, endophthalmitis, and IOL tilting. Siegel and Condon[13] have described cases of pigment dispersion or uveitis-glaucoma-hyphema syndrome after iris-sutured IOL technique. Soiberman *et al*[14] reported 27 eyes of iris-sutured IOLs with a percentage of complications similar to our report. However, they preferred to substitute mono-

piece acrylic IOLs with three-pieces acrylic IOLs to avoid the potential risk of pigmentary dispersion glaucoma. We have not reported cases of anterior pigmentary dispersion syndrome in eyes where we sutured a mono-piece acrylic IOL to the iris. Garcia-Rojas *et al*[15] reported 30 consecutive aphakic eyes surgically treated with iris fixation sutures of 3-pieces IOLs without PPV: he found good functional outcomes and no post-operative complications. Condon *et al*[16] reported 47 eyes with foldable three-pieces IOLs sutured to the iris in aphakic eyes without PPV, and he declared that a closed anterior chamber facilitates surgery and causes less fluctuation of IOP. We agree with him, we have not registered any relevant anterior chamber fluctuation during the surgical operations. The haptics of an IOL in the ciliary sulcus can rub against the iris pigment epithelium, releasing pigments into the anterior chamber.

Furthermore, the penetrating needle through the iris stroma damages its microvascular structure causing extravasation of inflammatory mediators. Cohen *et al*[17] conducted a review of patients with CME following PPV for retained lens pieces and revealed that 8% of eyes with a sulcus-fixated posterior chamber IOL implanted after cataract extraction developed CME. In our study, we found only 2 cases (4.8%) of CME, in both of the cases it was resolved with medical therapy. Comparing the latest reviews of scleral-sutured IOL outcome, CME has been reported as an early postoperative complication between 6.4%-12% as Lockington *et al*[18] and Sindal *et al*[19] respectively showed. However, when using anterior chamber IOLs implants, that may be associated with IOP elevation and glaucoma development, posterior-chamber iris sutured IOLs seem to be better tolerated. In our series, we found only two patients with postoperative IOP elevation that was resolved with topical therapy. Sindal *et al*[19] wrote that, in literature, retinal detachments ware reported as a complication in 4.5% of the patients that underwent a secondary IOL implantation. We had no cases of retinal detachment in our study, in fact, we performed a careful vitreous base shaving vitrectomy with triamcinolone staining to avoid vitreal traction, which may cause the development of retinal tears, during the IOL repositioning manoeuvres.

Furthermore, we performed argon laser retinopexy in the case of retinal tears. Regarding the sulcus IOLs the haptics are positioned in a virtual space between the anterior bag and the posterior surface of the iris; moreover, the lack of fixation and the length of the haptics, that in a mono-piece IOL hardly covers the white to white (WTW) distance, facilitates the movement and the iris rubbing. However, by fixing the IOL to the iris, we do have not only stabilisation of the IOL movements but also an iris sphincter movement reduction with less shrinking of the iris against the edge of the IOL haptics.

Furthermore, we had an expected post-operative myopic error due to the more anterior position of the IOL: the mean postoperative spherical equivalent was -0.44±0.49 SD. The more anterior position of the lens caused a myopic shift, which was acceptable for all the patients.

Faria *et al*[1] published this technique before us, although they used only in the case of 3-pieces IOLs. Similarly to us, they had a myopic shift in all the patients. Differently from us, they reported a higher percentage of ocular hypertension (16.6%) and a case of postoperative hyphema. As in our paper, they[1] have not found any case of endothelial dysfunction or synechiae. Conversely, they have not reported postoperative dislocation, whereas we reported 3 cases (1 patient with a mono-piece IOL and 2 patients with a 3-pieces-IOL). Differently, from Faria *et al*[1] we have not found any retinal complications such as retinal detachment or epiretinal membranes.

In conclusion, related to our report the iris fixation technique seems to be a safe and valid option for the management of luxated IOLs. In our experience the functional outcomes are outstanding: we did not have intraoperative complications, endothelial dysfunction, and pigment dispersion. We had IOL stability after 12.2mo, no surgically-induced astigmatism increasing, and we experienced a definite advantage of using the same IOL in a closed eye without new corneal incisions.

Our technique does not require large corneal incisions, and for that, we found very encouraging visual and refractive outcomes. We observed a small percentage of complications, which were manageable. We also described mono-piece acrylic and PMMA IOL suturing to the iris, and we reported good results concerning visual acuity and avoiding complications.

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