Original Article

Peripheral iridectomy for preventing iris-related complications in glued intraocular lens surgery in children

Divya Balakrishnan, Avadhesh Oli, Remya M Paulose, Hasnat Ali[1]

Purpose: To assess the role of surgical peripheral iridectomy (PI) in preventing iris-related complications associated with glued intraocular lens (GIOL) surgery in children with bilateral ectopia lentis. **Methods:** Nonrandomized interventional case series of 34 eyes of 17 children (<15 years of age) who underwent pars plana lensectomy (PPL) and GIOL surgery between January 2013 and December 2016. Eyes with surgical PI (January 2013–June 2015) were compared with those without surgical PI (July 2015–December 2016). The primary outcome measure of the role of surgical PI in GIOL surgery was to account for complications such as optic capture, secondary glaucoma, intraocular lens (IOL) dislocation, or repeat surgery. The secondary outcomes were changes in the best-corrected visual acuity (BCVA). **Results:** The mean age at surgery was 8.8 years (range: 3.5–15 years). Surgical PI was conducted in 15 eyes. Among the 19 eyes without PI, 9 eyes had complications (optic capture –6; rise in IOP –4; IOL subluxation –4; repeat surgery –5). The complications were significantly less in the PI group, $P = 0.02$. There was a statistically significant improvement in BCVA ($P = 0.0001$) in all the patients. The mean presenting BCVA was 0.99 (±0.79) logMAR (Snellen ≈ 20/200) and post BCVA was 0.40 (±0.50) (Snellen ≈ 20/50). The mean preoperative refraction was − 9 D (±8D) (range: −5 D to −23D) and postoperative was −1 (±1.15) D. The mean follow-up was 25.4 months. **Conclusion:** Surgical PI along with GIOL surgery in children undergoing PPL is shown to reduce optic-capture-related complications.

Key words: Ectopia lentis, glued intraocular lens, lensectomy, optic capture, peripheral iridectomy, rise in intraocular pressure, subluxation, surgical complications

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Ectopia lentis is defined as a displacement of the lens. It may be associated with ocular or systemic abnormalities.[1] Untreated cases have the risk of amblyopia and poor visual outcomes.[2] Management ranges from spectacles to surgery, based on the degree of subluxation and associated ocular features. The surgical options are anterior chamber intraocular lens (ACIOL), sutured scleral-fixated intraocular lens (SFIOL), iris-fixated IOLs, Cionni capsular tension ring fixation, and glued intraocular lens (GIOL).[3,4] The literature on GIOL in children is sparse. The complications reported with GIOL are IOL subluxation, pupillary optic capture, pigment dispersion, vitreous hemorrhage, and cystoid macular edema (CME). Surgical peripheral iridectomy (PI) is generally recommended in ACIOL implantation surgery to prevent pupillary block, but there are reports on PI in SFIOL cases with reverse pupillary block.[5] This study seeks to analyze the role of surgical PI in GIOL in children and assess the visual outcomes and complications if any.

Methods

Written informed consent was obtained from the parents of children included in the study. Approval for the study was obtained from the Institutional Review Board and Ethics Committee. The study adhered to the Declaration of Helsinki.

Study design and location

As part of the study, nonrandomized interventional case series were conducted in the retina department of a tertiary eye care institute. Retrospective analyses of the data were conducted. The authors had full access to medical records and the data. Those children who underwent bilateral sequential subscleral flap pars plana lensectomy (PPL), vitrectomy, and GIOL between January 2013 and December 2016 were included. Surgical PI was not done in those eyes that underwent surgery before July 2015. At around that time of the year, the surgeon noticed that one patient who was not part of this study had been subjugated to an accidental, unplanned surgical PI while doing lensectomy. Furthermore, in comparison to eyes that had not undergone a PI, this eye appeared to have less iris flutter, optic capture, and posterior bowing of the iris intraoperatively and continued to enjoy a stable IOL during follow-up.

A literature search revealed that reverse pupillary block can cause optic captures and pigment dispersion in SFIOLs, for which the treatment being given was YAG PI. Therefore, it was decided to henceforth do surgical PI planned along with GIOL surgery. The opportunity was also seized to draw

Smt. Kanuri Santhamma Centre for Vitreo-Retinal Diseases, [1]Department of Biostatistics, L V Prasad Eye Institute, Hyderabad, Telangana, India

Correspondence to: Dr. Divya Balakrishnan, L V Prasad Eye Institute, L V Prasad Marg, Banjara Hills, Hyderabad - 500 034, Telangana, India. E-mail: drdivyabalu@gmail.com

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comparisons between these eyes and the eyes that had earlier undergone such surgery without PI. A surgeon with 10 years of experience (DBK) performed all the surgeries. The inclusion criteria were as follows: (1) children less than 15 years of age, with bilateral ectopia lentis. (2) All eyes that sequentially underwent subscleral flap PPL, vitrectomy, and GIOL. The exclusion criteria were as follows: (1) GIOL implantation conducted as a secondary procedure or as refixation in either one or both eyes. (2) Sutured scleral-fixated IOL implantation in either one or both eyes. (3) Lensectomy did through nonsubscleral flap sclerotomies.

The data collected were age, gender, preoperative and postoperative best-corrected visual acuity (BCVA), refraction, etiology, intraocular pressure (IOP), and surgical complications, including optic capture, glaucoma, vitreous hemorrhage, CME, and retinal detachment.

Outcome measures

The primary outcome measure was the role of surgical PI, in possibly reducing related surgical complications due to optic capture such as secondary glaucoma, IOL dislocation, and need for resurgery in GIOL. The secondary outcome measures were visual outcomes. The visual acuity was assessed using the Snellen visual acuity chart and converted to logMAR for the statistical analysis. A subgroup analysis of children under 7 years was also done.

Intervention

Surgical procedure: Surgery was initiated by marking two points at the limbus using a radial keratotomy marker. After limited peritomy, two triangular scleral flaps of 2.5 mm width were made and an anterior chamber maintainer was placed. Sclerotomies were made using a 24-G needle at 0.75–1 mm from the limbus under the scleral flaps. Vitrectomy and lensectomy were conducted using a 25-G cutter through these sclerotomies. Any peripheral retinal lesions such as lattice degeneration or retinal breaks were treated with either laser or cryotherapy. A three-piece foldable IOL (Acrysof, Alcon or Tecnis, AMO) was injected into the anterior chamber through a superior clear corneal incision. The leading haptic was exteriorized using a 25-G Maxgrip forceps (Alcon/Grieshaber) through the sclerotomy. Maxgrip forceps were then introduced through the second sclerotomy. The trailing haptic was inserted into the forceps using a McPherson forceps and exteriorized. The handshake technique described by Kumar and Agarwal was used in cases where the anterior chamber collapsed during manipulation through the superior tunnel.[6] The surgical PI was made before lensectomy as it allowed the bleeding to settle down. Two scleral tunnels were made parallel to the limbus with a 26-G needle coated with marker pen ink and connected to a viscoelastic-filled syringe. The tucking of haptics into these tunnels was easier as the viscoelastic kept the scleral fibers away from the tunnel entrance. The scleral and conjunctival flaps were closed with fibrin glue (Tissel, Baxter). The details of the technique have been elucidated previously.[7] The IOL power for children under 7 years was calculated using Enyedi's rule of 7.[8]

Statistical analysis

All statistical analyses were performed using the R software (version 2.12). A Wilcoxon signed-rank test was used to compare the preoperative and final BCVA. A linear regression model was used to assess the effect of the pre-operative characteristics such as age (<7 or >7 years), sex, and presence of glaucoma on predicting a difference in VA (from final to preoperative VA). A logistic regression model was used to assess the effect of the preoperative characteristics on predicting complications (yes vs. no). The two-sample *t*-test was used to compare the BCVA outcomes and Fisher's exact test was used to compare the complications in two groups (PI vs. no PI). *P* value <0.05 was taken as statistically significant.

Results

Thirty-four eyes of 17 children were included. Ten were boys, while the remaining 7 were girls. The mean age at presentation was 7.8 years (range: 3–15 years). The mean age at surgery was 8.8 years (range: 3.5–15 years). In 82%, the most common presenting symptom was a decrease in vision (14/17). The other symptoms were squint (2), holding objects close to the face (2), and diplopia (2). Eight patients had microspherophakia (five Weill–Marchesani, one Marfan syndrome, and two idiopathic). Nine others had ectopia lentis due to Marfan syndrome ($n = 6$; 35%) and idiopathic ($n = 3$; 17%) causes. The mean interval of surgery between the two eyes was 13 weeks (range: 5–36 weeks). The mean follow-up of patients was 25.4 months (median 21.5 months; range: 10–60 months). The mean follow-up in PI group was 17.6 months and that in no PI was 31 months.

Surgical PI was conducted in 15 eyes and was not done in 19 eyes [Table 1]. Complications such as optic capture, rise in IOP, and IOL subluxation were seen in nine eyes (24%) [Table 1]. All these were seen in the group with no PI and none of the eyes in the PI group developed any of these complications except for vitreous hemorrhage in one eye. Of the nine eyes, six eyes (17%) developed optic capture. Of these, two presented with an acute rise in IOP associated with pain and blurred vision, two presented with rise in IOP, and two with intermittent optic capture though asymptomatic. The two symptomatic patients underwent surgical PI and optic capture release and others were managed conservatively. Four (11.7%) patients had IOL subluxation and one was the same child who underwent surgical PI for optic capture and rise in IOP. In three of these cases, the same IOL was refixed along with a surgical PI, and in one the IOL exchange along with surgical PI was done. The mean axial length in the group with no PI and with PI was 23.82 ± 2.34 mm and 23.72 ± 2.36 mm. Two eyes with optic capture had an axial length greater than 25 mm. Two eyes with prior YAG PI did not develop any complications. The follow-up period of complications varied from 5 months to 1 year. No other posterior segment complications such as CME or retinal detachment were noticed. The immediate surgical complications were vitreous hemorrhage (one eye in each group), which resolved spontaneously.

The mean [± standard deviation (SD)] presenting BCVA was 0.99 (±0.79) logMAR (Snellen 20/200). The mean (±SD) postoperative BCVA was 0.40 (±0.50) (Snellen 20/50). There was a statistically significant improvement in BCVA ($P < 0.001$). The near vision improved in all the children to N6 with glasses, except one who had amblyopia (N18). The mean (±SD) preoperative refractive error was − 9.00D (±8.00D) (range: −5.00D to −23.00D) and the mean (±SD) postoperative refractive error was sphere −1.00 (±1.15) D and the mean postoperative astigmatism was −1.11D (±1.1).

Table 1: Demographic details and outcomes of eyes with and without surgical PI

Demographic and clinical details	With surgical PI	Without surgical PI	*P*-value
No. of eyes	15	19	
Age at surgery (years)	10.14	8.35	*P*=0.16 (CI−0.80-4.57°)
Associated glaucoma	6	4	*P*=0.40
Pre-BCVA (logMAR), mean (SD)	0.85 (0.53) ≈ 20/160*	1.11 (0.94) ≈ 20/250*	*P*=0.35 (CI 0.815-0.301°)
Final BCVA (logMAR), mean (SD)	0.29 (0.18) ≈ 20/40*	0.49 (0.64) ≈ 20/63*	*P*=0.25 (CI 0.554-0.151)
No. of eyes with complications	1	9	*P*=0.02
Optic capture	0	6	
Pupillary block and rise in IOP	0	4	
IOL subluxation	0	4	
Vitreous hemorrhage	1	1	
Resurgery (no. of eyes)			*P*=0.05
Total	0	5	
Surgical PI	0	2	
IOL Repositioning	0	4	

PI: peripheral iridectomy; CI: confidence interval; BCVA: best-corrected visual acuity; SD: standard deviation; IOP: intraocular pressure; IOL: intraocular lens.
*Snellen equivalent

Ten eyes of five patients had glaucoma and all these had microspherophakia. Four of these had Weill-Marchesani syndrome and one was idiopathic. Prior to the lensectomy procedure, trabeculectomy was done in one eye and laser PI in both the eyes of another patient. Preoperatively, two or more antiglaucoma medications (AGMs) were used in all these eyes. The mean preoperative IOP was 16 mmHg (SD 10.8 mmHg). The mean (±SD) postoperative IOP was 14.5 (±5) mmHg. Postoperatively, all of them required AGM with a maximum of two medications. Gonioscopy could be performed in four patients and the angles were closed in one and grade 1 to 2 in others.

A linear regression analysis showed that age (<7 years) (P = 0.42), gender (P = 0.58), or the presence of glaucoma (P = 0.53) had no influence on the visual outcomes of these patients. A logistic regression analysis, too, showed no influence of these factors (age: P =0.26; gender: P =0.5; glaucoma: P =0.28) on the occurrence of one or more complications.

Discussion

The results of this study showed that surgical PI along with GIOL and vitrectomy for congenital lens subluxation reduced the postoperative complications compared with the group without PI on follow-up. GIOL implantation along with vitrectomy and lensectomy through subscleral flap sclerotomies has good visual outcomes in children with not so severe complications. This study also showed that the complications were comparable even in children under the age of 7 years and also in the presence of glaucoma.

Ectopia lentis in children poses a unique challenge to its management. Its systemic associations, as in cases of Marfan syndrome and homocysteinemia, should be evaluated.[1] Family screening could be considered due to its familial occurrence.[9] Conservative management with spectacles was found to be ambylogenic in most of them and early surgical intervention is indicated in these children.[2]

None of the surgical techniques has been proven to be the best.[10] The technique in a particular situation is decided depending on the expertise of the surgeon and the associated ocular features.[11] The most common surgery done in children was lensectomy or lens aspiration with aphakic glasses or contact lens.[12] A study by Khokhar *et al.* on 26 eyes of spherophakia in children found that lensectomy along with implantation of ACIOL or SFIOL was a safe method.[13] Corneal decompensation, glaucoma, endothelial cell loss (ECL), and peripheral synechiae are some of the complications with ACIOL. The disadvantages of SFIOLs are the large scleral tunnel, delayed suture break, or slippage. A higher rate of complications with SFIOL in children was reported by Asadi *et al.*[14] Kavitha *et al.* had shown good outcomes with iris-claw IOLs in traumatic cataract in children.[4] Posterior iris-claw IOLs provided good visual outcomes with favorable complications in various studies, but the risk of ECL with iris-claw IOLs is still debatable.[3,15] Various studies have reported good visual outcomes with GIOL surgeries and comparable complications with procedures such as SFIOL.[6,16,17]

In this study, only outcomes of glued IOLs were considered. The BCVA improved for both distance and near vision in all children. This result is comparable with that of other studies.[6,7,15,16,18,19] Most of the literature on GIOL outcomes is in adults. A study by Kumar *et al.* showed that 46% achieved >20/60 vision after GIOL surgery in pediatric eyes with traumatic lens subluxation.[20] Some children managed near-vision tasks without bifocals or with minimal near-add spectacles. Various concepts were proposed, attributing the apparent accommodation to the depth of focus, pupil diameter, or degree of corneal astigmatism.[21,22]

This study highlights the role of surgical PI in preventing pupillary optic capture and related complications. In their previous publication, the authors had suggested that reduced complications with surgical PI were likely.[7] In this study, none of the eyes with a surgical PI had developed complications related to optic capture, whereas the eyes that had not undergone PI were seen to have such complications. Narang and Agarwal reported that there was more likelihood of optic capture due to the use of 6-mm optic foldable lenses and large white-to-white diameter eyes.[23] There are greater chances of optic capture when the IOL is placed anteriorly and the iris is in close approximation to the IOL as in large white-to-white

diameter eyes or highly myopic eyes. Optic capture can cause glare, photophobia, chronic uveitis, pigment dispersion, and glaucoma. Higashide *et al.* reported reverse pupillary block as a cause for postoperative pupillary optic capture in sulcus placed IOLs, especially in postvitrectomy eyes.[24] SFIOL and GIOL are more anteriorly placed than the PCIOL and have an inherent risk similar to that resulting from the use of a sulcus IOL. Hence, planning a PI at the first surgical intervention is the ideal approach to avoid repeat intervention and associated complications. Pupillary optic capture was seen in six eyes (17%), which is comparable to that seen in other studies. The incidence of optic capture varied from 2.9% to 14% in various studies on SFIOLs.[20,25] In none of these cases was the IOL adherent to the iris, or anteriorly Placed:an anterior segment OCT would have helped document any ensuing optic capture. Two of the six eyes that had developed optic capture had an axial length greater than 26 mm. It has been reported that there is a higher chance of optic capture in eyes having long axial length and also that recurrent optic capture increases the likelihood of optic capture, irrespective of whether the IOL repositioning is accompanied by a PI.[24] Pupilloplasty is required in such cases to avoid further occurrence.[23] Thus, a peripheral PI is likely to reduce the risk of optic capture and related complications in GIOL by eliminating the chance of reverse pupillary block.

A literature review showed that the chances of IOL subluxation in eyes with ectopia lentis had higher chances of IOL subluxation compared with other causes.[18] In our series, 11.7% had IOL subluxation, which was more when compared with the GIOL study by Kumar *et al*. (4.4%), but their group had cases of varied etiology.[20] The incidence of IOL subluxation after SFIOL or iris-fixated IOLs in children varied from 19% to 25% in various studies.[14,18] Even though the IOL subluxation was not noted in the PI group, a long-term follow-up is needed to assess the same. The reduced iris flutter and fewer chances of intermittent optic capture could be the possible explanation for reduced IOL subluxation in the PI group. This needs to be studied by a randomized control trial.

Lens subluxation in pediatric eyes may lead to pupillary block glaucoma. The method of GIOL adopted by these authors addressed both the issues of lens subluxation and glaucoma due to pupillary block. Lensectomy with PI in this case series also led to control of IOP with the reduction in AGMs. None of the patients in this series required glaucoma surgery after the lensectomy procedure. The use of the same subscleral flap sclerotomy, for both lensectomy and exteriorization of the haptics, not only decreases the number of entry points into the eye but also reduces the risk of wound leak, infection, and spare conjunctiva.

Although the complications reported in this study were not sight-threatening, potential complications, such as endophthalmitis or retinal detachment, should always be borne in mind. Undoubtedly, an increase in axial length or trivial trauma increases the risk of IOL subluxation.

The limitations of this study are its small sample size, nonrandomized study, and the absence of long-term follow-up. Minimizing these limitations in further studies could help assess the delayed complications of GIOL in children. The use of ultrasound biomicroscopy (UBM) or anterior segment OCT could have been done for better documentation for anterior chamber (AC) depth, IOL, and iris position. A randomized control trial with long-term follow-up is further needed.

Conclusion

This study, despite the small sample size, shows that the PI along with GIOL reduces the optic-capture-related complications in children with congenital lens subluxation undergoing PPL and vitrectomy and may be considered along with GIOL surgery.

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Conflicts of interest

There are no conflicts of interest.

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