Original Article

# Surgical outcomes, complications and learning curve of glued intraocular lens of a vitreo retinal fellow in training

*Avadhesh Oli, Divya Balakrishnan*

**Purpose:** To evaluate surgical outcomes, complications and learning curve of glued intraocular lens surgery by a vitreoretinal (VR) fellow in training. **Methods:** Analysis of 50 eyes requiring glued intraocular lens (GIOL) surgery for various indications was done. Both the consultant VR surgeon (Group 1) and VR fellow in training (Group 2) operated 25 eyes each. The primary outcome measures were visual acuity at 3 months, and time taken for completion of surgery. Secondary outcome measures were refractive correction, intraocular pressure and intraoperative or postoperative complications. **Results:** The uncorrected visual acuity (UCVA) improved from log MAR 1.54±0.56 (Snellen 20/693) to 0.45±0.26 (Snellen 20/56) and from 1.64±0.53 (Snellen 20/873) to 0.56±0.45 (Snellen 20/72) in group 1 and 2, respectively. The best corrected visual acuity (BCVA) improved from log MAR 0.74±0.61 (Snellen 20/109) to 0.33±0.26 (Snellen 20/42) and from 1±0.68 (Snellen 20/200) to 0.40±0.50 (Snellen 20/50) in group 1 and 2, respectively ($P > 0.05$). The surgical time was significantly less in group 1 when compared to that of group 2 (64.26 vs 107.16 minutes) $P$ value <0.05). The mean time taken for the initial 10 cases and later 15 cases in group 2 were 131.9 and 91.2 minutes, which was statistically significant. The complication rates in both groups were comparable. Transient hypotony (IOP < 11) was seen in 56% (14/25) of eyes in group 2 and 44% (11/25) in group 1 ($P = 0.39$). **Conclusion:** The study results are encouraging for a VR fellow with good short-term visual outcomes and comparable surgical complications. The procedure gives promising results and the learning curve is overcome by a desire to learn and with increasing number of procedures done under supervision.

**Access this article online**

**Website:** www.ijo.in

**DOI:** 10.4103/ijo.IJO_524_19

**Quick Response Code:**

**Key words:** Aphakia, glued IOL, scleral fixated IOL, surgical complications, VR fellow

The visual rehabilitation in cases of insufficient capsular support and or aphakia has varied options. These include spectacles, contact lens, anterior chamber intraocular lens (IOL), iris-claw IOLs, sutured scleral fixated IOLs (SFIOL) and sutureless glued fixated IOL (GIOLs). Depending on a specific case and the surgeon's expertise, the type of procedure can be planned. In the absence of posterior capsular support, scleral fixation of IOL can be done with or without sutures.[1] The SFIOL is one of the popular techniques that is well described, time-tested and widely practised.

The sutureless technique of GIOL was described a few years back and has excellent outcomes.[2] Surgeons have apprehensions regarding the technical complexity, IOL stability and outcomes being a sutureless technique. Many surgeons prefer the sutured technique over GIOL, as most of them had the first-hand experience in the technique during their training.[3,4]

A vitreoretinal (VR) surgeon in training has a steep learning curve as compared to cataract surgeons due to a variety of procedures, complexity of instrumentation and visualization.[5] The situation is further complicated by the lack of training avenues. The learning curve in surgical training is broadly analyzed as the surgical process (time taken or complication rate) and the surgical outcomes (visual acuity, IOP etc.).[6] In an extensive literature search, we could not find any study on the clinical outcomes and learning curve of GIOLs by beginner VR surgeons. To illuminate this unexplored area, we investigated the learning curve of GIOL surgery by assessing the surgical outcomes and rate of complications of a trainee surgeon and comparing it with a proficient VR surgeon.

## Methods

A retrospective data analysis of the patients who underwent GIOL surgery was done. The data was retrieved from the electronic medical record (EMR) using the search word 'GIOL'. The trainee cases were operated between May 2017 and October 2017 and the consultant cases were done between April 2017 and July 17. The study was done at a tertiary care apex-teaching institute. An institutional review board approval was obtained for the study. Ethical committee approval was obtained, Date of approval 15 Apr 17. Patients with inadequate capsular support, subluxated or dislocated IOL or lens were included

Smt. Kanuri Santhamma Centre for Vitreo Retinal Diseases, LV Prasad Eye Institute, Banjara Hills, Hyderabad, Telangana, India

Correspondence to: Dr. Avadhesh Oli, Smt. Kanuri Santhamma Centre for Vitreo Retinal Diseases, LV Prasad Eye Institute, Banjara Hills, Hyderabad - 500 034, Telangana, India. E-mail olieye@rediffmail.com

Received: 18-Mar-2019 Revision: 08-Jul-2019
Accepted: 14-Aug-2019 Published: 19-Dec-2019



**Cite this article as:** Oli A, Balakrishnan D. Surgical outcomes, complications and learning curve of glued intraocular lens of a vitreo retinal fellow in training. Indian J Ophthalmol 2020;68:78-82.

in the study. Subjects with uveitis, uncontrolled glaucoma, micro-cornea, aniridia and mesopic pupil size of more than 4 mm were excluded. The data collected included demographic and clinical details like age, gender, presenting complaints, aetiology, unaided visual acuity (UCVA), refractive error, lens status, intraocular pressure (IOP) and best corrected visual acuity (BCVA). The surgical details were IOL power, IOL type, operating time and complications like vitreous haemorrhage, Descemet's membrane detachment, IOL subluxation, haptic exposure and posterior segment complications like retinal detachment.

The primary outcome measures were final unaided visual acuity and the duration of surgery (time in minutes as recorded in EMR). Secondary outcome measures were surgical complications, refractive error and intraocular pressure. The visual acuity was measured using the Snellen's visual acuity chart and was converted into logMAR for analysis.

The consultant vitreoretinal surgeon (Group 1) was proficient in IOL procedures including cataract surgery. The fellow surgeon (Group 2) was a proficient cataract and phaco surgeon but was a novice to GIOL and other vitreoretinal procedures.

Written informed consent was obtained from all the patients before surgery. A mandatory presurgical checklist was adhered to and IOL power was calculated using IOL master 700 (Carl Zeiss Meditec, AG). Appropriate anaesthesia was administered. A 3-piece foldable hydrophobic acrylic (Alcon, MA60AC) or 3 pieces non-foldable PMMA (Aurolab, B3602) IOL was used.

### Surgical procedure

Two points that are slightly off-axis to the horizontal meridian were marked with the RK marker. A limited peritomy was done at 4 and 10 O'clock meridian. Two triangular scleral flaps (2 × 2 mm) were raised after adequate diathermy. The anterior chamber maintainer (ACM) was inserted and the other ports for vitrectomy were made depending upon the type of combined procedure. A peripheral iridectomy (PI) was done superiorly at the beginning of the surgery. A complete vitrectomy and other combined procedures like IOL explantation and pars plana lensectomy were done as per the individual case requirements. Two sclerotomies with 23 G needle were fashioned under the scleral flaps 1 mm behind the limbus. A superior corneal or scleral incision was made depending on the requirement for the type of IOL, whether foldable or single PMMA to be implanted or explanted.

The leading haptic of the IOL was placed in the anterior chamber and was exteriorized through the sclerotomy under the flap with 25G forceps (GRIESHABER® DSP MAXGRIP® Forceps.). The assistant held the exteriorized haptic gently with a forceps while the trailing haptic was still outside. The trailing haptic was then held with McPherson forceps and taken into the AC and was similarly exteriorized through the other sclerotomy using the Maxgrip forceps. Two scleral tunnels were made parallel to the limbus at the margin of scleral flaps, in line with the sclerotomies, with a 26 G needle. A round iris repositor was used to smoothen the scleral tunnel entry and the haptics were tucked into these tunnels. After adjusting the IOL centration, fibrin glue (Tissel, Baxter) was used to oppose the flaps and conjunctiva.

The patients were followed up on day 1, 7, 30 and 90. The ophthalmic evaluation done at every visit included visual acuity, slit-lamp examination, IOL centration or optic capture, intraocular pressure and fundus evaluation. The IOL was considered centered if the IOL position covered the full pupillary axis. Optic capture was defined as any part of IOL seen anterior to the pupillary margin. The postoperative complications documented were vitreous haemorrhage, retinal break, retinal detachment, endophthalmitis, cystoid macular oedema and glaucoma. The refraction was done at 1 month, following which spectacles were prescribed.

The data was collected in MS Excel Office 2013 and was analysed using SPSS v 22. The Shapiro-Wilk test was used to ascertain the normalcy of the data. For categorical data, Chi-Square or Fisher exact test was used and for continuous variables, independent sample *t*-test was used.

## Results

A total of 67 eyes of 65 patients underwent GIOL surgery. Of these, 17 eyes were excluded as they did not meet the study criteria. Finally, 25 eyes operated by the consultant (Group 1) and 25 eyes operated by the fellow (Group 2) were included for the analysis.

The mean age of patients was 46.04 (23.92) years and 34.96 (20.93) years in Group 1 and 2, respectively ($P = 0.08$). In Group 1, 84% (21/25) were males, and in Group 2, 68% (17/25) were males ($P = 0.185$). The right eye was involved in 56% (14/25) in group 1 and 44% (11/25) in group 2 ($P = 0.396$). 18 patients in each group were operated under local anaesthesia and the others were under general anaesthesia ($P = 1$).

The baseline characteristics like aetiology, lens status, type of surgery, IOL implanted, axial length and IOL power were comparable between group 1 and 2 [Table 1]. The total duration of follow up for both the groups was comparable.

### Primary outcome measures

The unaided visual acuity (UCVA) at baseline was comparable in both the groups as shown in Table 2. The UCVA improved from log MAR 1.54±0.56 (Snellen 20/693) to 0.45±0.26 (Snellen 20/56) and from logMAR 1.64±0.53 (Snellen 20/873) to 0.56±0.45 (Snellen 20/72) in Group 1 and Group 2, respectively. The BCVA in group 1 improved from log MAR 0.74±0.61 (Snellen 20/109) to 0.33±0.26 (Snellen 20/42) and in Group 2 from 1±0.68 (Snellen 20/200) to 0.40±0.50 (Snellen 20/50). One patient in each group had preoperative UCVA better than 20/60. The postoperative UCVA was better than 20/60 in 18 and 17 patients in Group 1 and Group 2, respectively.

The time taken for the surgical procedure was more in Group 2, which was statistically significant [Table 2]. The mean time taken to complete the first 10 cases by fellow was 131.10 min and later 15 cases were 91.20 min. This difference was statistically significant ($P < 0.001$). The mean time taken was 63 and 65 min for consultant and this difference was statistically not significant ($P = 0.81$).

### Secondary outcome measures

The spherical and or cylindrical correction requirement for distance and near was comparable in both the groups as shown

**Table 1: Baseline characteristics in both group 1 and group 2 (IOL intra ocular lens, PI peripheral iridectomy Congenital causes like Marfans and hyper homocystenemia)**

| | Consultant (group 1) | Fellow (group 2) | *P* |
|---|---|---|---|
| Etiology (No.) | | | *P*=0.23 |
| Trauma | 5 | 8 | Chi square Yates correction |
| Surgical | 14 | 8 | |
| Congenital (Marfans and hyper homocystenemia) | 6 | 9 | |
| Lens status (No.) | | | *P*=0.65 |
| Aphakia | 11 | 11 | Chi square Yates correction |
| Dislocated lens | 10 | 12 | |
| Dislocated IOL | 4 | 2 | |
| IOL implanted (No.) | | | *P*=0.02 |
| Foldable | 24 | 18 | |
| Non Foldable | 1 | 7 | |
| Type of surgery (No.) | | | *P*=0.76 |
| Only GIOL | 9 | 8 | |
| Combined VR | 16 | 17 | |
| Axial length (mm) | | | *P*=0.85 *t*-test |
| Mean, (SD) | 24.03, (1.98) | 23.65, (1.68) | |
| IOL power (D) | | | *P*=0.50 *t*-test |
| Mean, (SD) | 19.98, (4.36) | 20.78, (4.07) | |
| Surgical PI done (No.) | 25 | 24 | *P*=0.31 Fischer exact |
| Total follow up (Months) Mean, (SD) | 6.48, (3.00) | 7.56, (2.84) | *P*=0.198 *t*-test |

**Table 2: Primary outcome measures in GROUP 1 and GROUP 2 groups (UCVA Uncorrected visual acuity, SD Standard deviation, BCVA Best-corrected visual acuity, GIOL Glued IOL)**

| | Consultant (group 1) | Fellow (group 2) | *P* (*t*-test) |
|---|---|---|---|
| UCVA (log MAR) Mean, (SD) | | | 0.49 |
| Pre | 1.54, (0.56) | 1.64, (0.53) | 0.31 |
| Post | 0.45, (0.26) | 0.56, (0.45) | |
| BCVA Mean (SD) | | | |
| Pre | 0.74, (0.61) | 1.00, (0.68) | 0.15 |
| Post | 0.33, (0.26) | 0.40, (0.50) | 0.48 |
| Time taken Mean (SD) in Min | | | |
| Total | 64.26, (20.50) | 107.16,(32.06) | 0.00 |
| GIOL | 49.67, (14.46) | 82.50, (23.45) | 0.005 |
| Combined | 72.44, (19.02) | 118.76, (29.22) | 0.005 |

in Table 3. The postoperative spherical equivalent reduced significantly ($P = 0.00$). The complications in the two groups were comparable and are shown in Table 4. While manipulating the IOL in the 2nd case in Group 2, the haptic broke and was replaced by another IOL. One of the cases in Group 2 had a Descemet's membrane detachment, which probably occured during the insertion of ACM and did well in the follow up period after C3F8 descemetopexy.

Transient hypotony, (IOP < 11) was seen in 56% (14/25) of eyes in group 2 and 44% (11/25) in group 1 ($P = 0.39$). On further analysis, eyes that underwent combined surgery had more chances of hypotony. 12 out of 17 (70.5%) and 7 out of 16 (43.75%) eyes had hypotony in Group 2 and Group 1, respectively, but the difference was not significant statistically ($P = 0.39$).

## Discussion

The present study focuses on the learning curve and surgical outcomes of glued IOL performed by VR fellow. Using the traditional method of training under supervision, the visual outcomes and the complication rates were almost comparable between the VR fellow and the consultant.

The visual acuity improvement after glued IOL implantation in this study correlated well with the existing studies. The final BCVA after GIOL was logMAR 0.42 in a comparative study on sutured and sutureless SFIOL[7,8] Both the groups in this study reported a statistically significant improvement in postoperative visual acuity. The glued IOL implantation actually made these patients less dependent on spectacles, which is important in a rural setting where the majority are manual labourers and are not comfortable to wear glasses while at work. This is the reason why unaided visual acuity was taken as one of the primary outcome measures.

The surgical outcome is one of the established objective methods to assess skill transfer. The trainee attains a comparable outcome with the consultant after a reasonable number of cases and considers it as positive feedback and the results of this study confirmed the same. In the current study, the VR fellow took more time to perform the GIOL surgery as compared to that of the consultant, however, no correlation was found between the time taken to perform the surgery and the final visual outcome. The time taken by fellow for the initial 10 cases was more, which reduced with the additional number of cases which probably indicates the normal learning curve. Eighteen patients in Group 2 were combined cases of glued IOL with various VR procedures, so fellow being a novice to VR surgery took longer time. This aspect should be considered during the initial case selection as the effect of peribulbar anaesthesia decreases with time and

**Table 3: Secondary outcome measures between 2 groups (IOP Intra ocular pressure)**

| | Consultant (group 1) | Fellow (group 2) | Remarks |
|---|---|---|---|
| Spherical correction (Absolute) Mean (SD) | | | |
| Pre | 8.39, (5.7) | 10.02, (5.8) | *P*=0.32 *t* test |
| Post | 0.65 (0.74) | 0.88 (0.97) | *P*=0.35 *t* test |
| Cylindrical correction (Absolute) | | | |
| Pre | 0.55, (0.98) | 0.34, (0.64) | *P*=0.37 *t* test |
| Post | 0.64, (0.97) | 0.68, (0.90) | *P*=0.88 *t* test |
| Near Add | 2.53, (0.57) | 2.72, (0.42) | *P*=0.18 *t* test |
| IOP (mmHg) | | | |
| Baseline | 16.92, (5.03) | 15.68, (5.91) | *P*=0.42 *t* test |
| Day 1 post-op | 12.20, (4.16) | 10.80, (4.23) | *P*=0.24 *t* test |
| Final | 14.16, (3.49) | 15.04, (4.30) | *P*=0.43 *t* test |

**Table 4: Complications in two groups (Op Operative, VH Vitreous haemorrhage, DMD Descemet's membrane detachment)**

| | Consultant (group 1) | Fellow (group 2) | Remarks (*P*) |
|---|---|---|---|
| Intra op VH | 8%, (2/25) | 20%, (5/25) | 0.22 |
| Post Op VH | 4%, (1/25) | 20%, (5/25) | 0.08 |
| IOL decentration | 0% | 0% | 1 |
| Optic capture | 4%, (1/25) | 4%, (1/25) | 1 |
| Resurgery | 0 | 4%, (1/25) | DMD 0.31 |
| Pigments on IOL | 32%, (8/25) | 36%, (9/25) | 0.68 |
| Haptic exposure | 0% | 0% | 1 |
| IOL dislocation | 0% | 0% | 1 |
| IOL haptic breakage | 0% | 4%, (1/25) | 0.31 |

the patient can become uncooperative, adding to the stress of the trainee surgeon.

The trainee's previous surgical experience is another factor that can affect the outcome. His previous microsurgical skills of handling tissues and IOLs will help bring better surgical outcomes. The complication rate is a surrogate marker of surgical safety, and the results of this study indicate that the complication rates for VR fellow were comparable with that of the consultant. The fellow had difficulty in tucking the leading haptic in the scleral tunnel, as the direction of the tunnel was towards the 12'o clock. He innovatively used rounded iris repositor to smoothen the inner wall of the tunnel made by 26 G needle and manipulated adjusting his chair slightly temporally.

While managing aphakia in posterior capsular dehiscence, zonular dialysis or traumatic dislocation of the lens scleral fixation of the IOL is one of the preferred options.[7,9] The actual hands-on training in vitreoretinal procedures in general and GIOL, in particular, is very limited. This study recommends the traditional method of skill transfer starting with observation, assisting, doing step by step and finally doing independently as in a time-tested approach.[10]

The most common complication in both the groups was transient hypotony, which subsided in 1 week. The hypotony could be either due to the microleak through the sclerotomy under the scleral flaps, which was opposed using fibrin glue or due to the temporary ciliary shut down due to manipulation through the ciliary body. The results of other studies also showed hypotony in the early postoperative period which resolved spontaneously.[4,8]

Self-resolving vitreous haemorrhage was probably caused due to hypotony or bleeding from the scleral tunnel or variation in sclerotomy entry (more anterior). To avoid this complication it is advisable to achieve thorough hemostasis of scleral bed.

The fragile property of the 3 piece IOL haptics should always be borne in mind as haptic of one IOL broke while exteriorizing. Only the tip of haptic should be held with the Maxgrip forceps jaws. It is advisable to keep a standby IOL of the same power, especially in cases of abnormally high or low powers, expecting this complication. It is important to mark the points of sclerotomies and scleral pockets related to haptic externalization and tucking for long term stability and IOL centration. In this study, IOL decentration and haptic exposure were not encountered as all the incisions and tunnels were made after proper measurements and markings. The IOL related complications and repeated interventions were fewer in the present study as contrary to that reported in the literature.[11]

The follow-up period was smaller, but it addressed the short-term outcomes of trainee surgeon's learning curve. No sight-threatening complication like retinal detachment was reported in any of the groups during the follow-up period. A few patients with co-existent, mostly traumatic mydriasis may require pupilloplasty to avoid optic capture, glare or diplopia in the postoperative period.[12]

Various studies on surgical training of residents and fellows have proved the utility of simulators and wet labs to develop dexterity, improve performance and ultimately reduce complications and ease out the learning curve. Development and wide availability of these facilities for various VR surgeries and glued IOL would facilitate the faster learning of the procedure before working on actual patients.[13,14]

## Limitations

The study is retrospective in nature. An ideal scenario would be a prospective study with detailed scoring and timing of each surgical step. The IOL used in the study were of two different designs, which could affect the final visual outcomes. The IOL tilt and decentration were determined clinically, however, the use of more objective methods like aberrometer would

have been better. Long-term follow up is required to look for sight-threatening complications like IOL dislocation and retinal detachment.

## Conclusion

This study compared the outcomes of glued IOL surgery by a VR fellow to that of a consultant VR surgeon and showed encouraging results in terms of the learning curve, visual outcomes and comparable surgical complications. The procedure seems to give promising results and supervised training help to overcome the learning curve.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

## References

1. Lee VY, Yuen HK, Kwok AK. Comparison of outcomes of primary and secondary implantation of scleral fixated posterior chamber intraocular lens. Br J Ophthalmol 2003;87:1459-62.
2. Kumar DA, Agarwal A, Agarwal A, Prakash G, Jacob S. Glued intraocular lens implantation for eyes with defective capsules: A retrospective analysis of anatomical and functional outcome. Saudi J Ophthalmol 2011;25:245-54.
3. Agarwal A, Agarwal A, Jacob S, Narang P. Comprehending IOL signs and the significance in glued IOL surgery. J Refract Surg 2013;29:79.
4. Kumar DA, Agarwal A. Glued intraocular lens: A major review on surgical technique and results. Curr Opin Ophthalmol 2013;24:21-9.
5. Vergmann AS, Vestergaard AH, Grauslund J. Virtual vitreoretinal surgery: Validation of a training programme. Acta Ophthalmol 2017;95:60-5.
6. Hopper AN, Jamison MH, Lewis WG. Learning curves in surgical practice. Postgrad Med J 2007;83:777.
7. Balakrishnan D, Mukundaprasad V, Jalali S, Pappuru RR. A comparative study on surgical outcomes of glued intraocular lens and sutured scleral fi xated intraocular lens implantation. Semin Ophthalmol 2018;33:576-80.
8. Ganekal S, Venkataratnam S, Dorairaj S, Jhanji V. Comparative evaluation of suture-assisted and fibrin glue-assisted scleral fixated intraocular lens implantation. J Refract Surg 2012;28:249-52.
9. Kokame GT, Yanagihara RT, Shantha JG, Kaneko KN. Long term outcome of pars plana vitrectomy and sutured scleral-fixated posterior chamber intraocular lens implantation or repositioning. Am J Ophthalmol 2018;189:10-16.
10. Golnik C, Beaver H, Gauba V, Lee AG, Mayorga E, Palis G, *et al*. Development of a new valid, reliable, and internationally applicable assessment tool of residents' competence in ophthalmic surgery (an American Ophthalmological Society thesis). Trans Am Ophthalmol Soc 2013;111:24-33.
11. Kumar DA, Agarwal A, Packiyalakshmi S, Jacob S, Agarwal A. Complications and visual outcomes after glued foldable intraocular lens implantation in eyes with inadequate capsules. J Cataract Refract Surg 2013;39:1211-8.
12. Narang P, Agarwal A. Pupilloplasty for pupil size attenuation to prevent pupillary capture: Theory of quintet in glued IOL. J Cataract Refract Surg 2017;43:3-7.
13. Feudner EM, Engel C, Neuhann IM, Petermeier K, Bartz-Schmidt KU, Szurman P. Virtual reality training improves wet-lab performance of capsulorhexis: Results of a randomized, controlled study. Graefes Arch Clin Exp Ophthalmol 2009;247:955-63.
14. Belyea DA, Brown BS, Rajjoub LZ. Influence of surgery simulator training on ophthalmology resident phacoemulsification performance. J Cataract Refract Surg 2011;37:1756-61.