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ORIGINAL RESEARCH

Outcomes of "Complex" Cataract Surgeries Performed by Long-Term Glaucoma Fellows in a Tertiary Eye Centre from Eastern India

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Purpose: To evaluate the outcomes of operating on "complex cataracts" by the glaucoma fellows.

Patients and Methods: This was a retrospective study done at a tertiary referral eye care centre in eastern India. After obtaining IRB approval, a retrospective chart review of all patients who underwent "complex" cataract surgery by one of four long-term (2 years) glaucoma fellows between January 2016 and November 2020 was conducted. 'Complex' was defined as cataracts complicated with pseudoexfoliation syndrome, phacodonesis with or without blunt ocular trauma, posterior polar cataract, small pupil, co-existent corneal opacity or uveal coloboma, post-glaucoma filtering surgery, post-vitreoretinal surgery, co-existent glaucoma or post-laser iridotomy and monocular patients.

Results: Out of a total of 677 eyes done by the glaucoma fellows during the study period, 83 eyes had complex cataract surgery and completed the six-week post-operative follow-up. Intraoperative surgical complications like posterior capsular rent or vitreous loss were noted in 36 of the cases. Thirty of the eyes were left aphakic. Despite a high rate of complications, the LogMAR best-corrected visual acuity (mean ± standard deviation) improved from the preoperative level of 1.7 (±0.5) to 1.0 (± 0.8) at post-operative six weeks, significant at $p < 0.001$. As far as the surgeon's experience was concerned—less than or more than a year since joining the fellowship—there was statistically no difference in the final visual acuity. The group with greater experience had shorter surgical time and lesser complications though this difference was not statistically significant.

Conclusion: This is the first study in the literature reporting the outcomes of "complex" cataract surgery performed by glaucoma fellows. Though high rates of postoperative complications were noted in this study, the mean best-corrected visual acuity improved significantly in all eyes after the surgery.

Keywords: complex cataract surgery, complicated cataract surgery, glaucoma fellows

Introduction

The leading global causes of blindness in those aged 50 years and older in 2020 included cataract (15.2 million cases), followed by glaucoma (3.6 million cases) which are known to commonly coexist.[1,2] Hence, training and management of these two remain a top priority in various ophthalmic teaching institutions across the globe. It is essential, therefore, that graduating glaucoma fellows should be equipped with efficient complex cataract surgery skills in addition to skills for tackling common clinical scenarios for glaucoma practice. There has been a growing concern over the recent trend of residents not pursuing glaucoma fellowships despite a rapidly increasing prevalence of the disease.[3] There have been several studies evaluating the outcomes during various ophthalmology surgical procedures performed by residents and fellows.[4] When it comes to cataract surgery, fellows and residents have higher complication rates as compared to the attending surgeons.[5–7] Concerns were raised about whether less complicated cases were intuitively chosen for the fellows. One of the biggest challenges for academic institutions is balancing the need for fellowship training in all kinds of surgeries with the necessity to keep postoperative complications at a minimum. Earlier studies have focused

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predominantly on targeted "simple" cataract cases. Here, we attempted to evaluate the surgical skills of glaucoma fellows in our tertiary eye care setup in managing "complex" cataract cases.

Materials and Methods

Post-graduate ophthalmologists (after completing MD/MS/DNB or equivalent) across the globe were eligible to pursue a 2-year long-term fellowship in glaucoma at our tertiary eye care center in eastern India.[8] At the beginning of the fellowship program, they were given dedicated cataract surgery training in a gradual stepwise escalated monitored training program. They were allowed to operate on "complex" cataracts after getting official clearance from their trainers six months from the commencement of the fellowship. After the completion of one year, they were also posted into a rural secondary centre[9] for two months where they independently used to manage (and refer accordingly) all ophthalmology cases—medically and surgically. Thereafter, they returned to the tertiary center until the end of the fellowship at 2 years. During their tenure at the tertiary center, they were allowed to operate on a wide spectrum of surgical cases spanning the entire range of scenarios of clinical glaucoma and cataract. After obtaining the necessary IRB approval, a retrospective chart review was performed of patients who underwent a complex cataract surgery procedure from January 2016 to November 2020 and was performed by a glaucoma fellow at the tertiary eye institute independently or under the guidance of a senior faculty. Data during their 2 months of secondary center posting were not included in the present study. The cataract case was defined as complex[10] if one or more of the following factors were present—

1. Small pupil
2. Pseudoexfoliation material around the pupil or lens capsule
3. Post-traumatic
4. Post-vitreoretinal surgery
5. Post-glaucoma filtering surgery
6. Central corneal opacity
7. Phacodonesis due to any cause like trauma
8. Co-existent glaucoma or post-laser iridotomy
9. Posterior polar cataract
10. Cataract with uveal coloboma
11. Monocular patient.

The reasons behind the selection criteria were dual—either the co-existing clinical issues that made the cases more difficult to perform surgery or there was a mental pressure build-up to produce a good outcome given other factors limiting vision. Notably, all cataract cases with a pre-existing filtering surgery were done by the consultants and were not included in the study.

The glaucoma faculty used to provide verbal assistance for fellows before and during the surgical procedure, and if the fellow was unable to perform a specific surgical step or in the event of any complication, the faculty took over the surgery, demonstrating how to solve that step. Pupillary dilatation was performed by instilling topical tropicamide-phenylephrine 10% eyedrop every 15 minutes for 1 hour before the surgery. Variations and preferences between surgeons performing cataract surgery, such as the manual small incisional cataract surgery (MSICS) versus phacoemulsification technique and choice of incision position—superior or temporal, were accepted in our center. However, surgical protocols, instrumentation, and techniques were standardized, as were all intraoperative drugs, solutions, ophthalmic devices, blades, and intraocular lens (IOL)s. All the surgeries were performed under peribulbar anesthesia. Phacoemulsification, when performed, used the Infiniti® or the Laureate® phacoemulsifier (Alcon Laboratories Inc, Fort Worth, Texas, USA). The IOLs that were used included a rigid PMMA lens (Revision lens, Auro Lab Pvt. Ltd, India) or a foldable lens (AcrySof® intraocular lens, Alcon Laboratories Inc, Fort Worth, Texas, USA). In the event of any intraoperative complications like posterior-capsular rent or vitreous loss, 0.05mL of intracameral moxifloxacin (Vigamox®) was injected after the surgery.

We defined the major intraoperative complications as posterior capsular rent or tear with or without vitreous loss, zonular dehiscence with or without vitreous loss, any residual lens matter in the anterior chamber or vitreous cavity, inability to implant an IOL or IOL dislocation into the vitreous cavity.

At the conclusion of the surgery, all patients received 0.5% betadine eye drops before patching the eye. After opening the patch on the next day, the patients were started on a routine topical postoperative regimen, consisting of 0.3% ofloxacin eyedrop every 6 hourly combined with 1% prednisolone acetate every 3 to 4 hourly, depending on the clinical status, for the first week. On the seventh postoperative day, this regimen was changed to only 1% prednisolone acetate, which was tapered over 4 to 6 weeks. In case of intraoperative or postoperative complications, patients received appropriate follow-up care in the institute and underwent all necessary treatment.

Statistics

Data was recorded on Microsoft Excel Software version 14.1 (Microsoft Corp., Redmond, WA, USA). Snellen's best-corrected visual acuities were converted to logarithm of the minimal angle of resolution units (LogMAR) to allow for averaging and statistical analysis. BCVA and IOP before and after the surgery were compared using a *t*-test. Statistical analysis was done using SPSS version 22 (SPSS Inc., Chicago, IL). $P < 0.05$ was considered statistically significant.

Results

There were 677 cataract surgeries done by glaucoma fellows between January 2016 and November 2020. Out of these, 98 eyes were of complex cataracts as defined in the methodology section. There were 579 eyes with "simple" cataract surgeries out of which 55 eyes had recorded an intraoperative complication (ie, rate of 9.5%)—but these were not included in the study. Of the 98 eyes, 83 eyes completed the 6-week follow-up period and were taken into the study. Figure 1 shows how the sample was chosen. There was a total of four glaucoma fellows operating during the study period. Table 1 illustrates the fellow doctors' characteristics. The mean age of the fellow doctors was 32.5 years. The mean duration of surgical experience after post-graduation on the day of the surgery was 359, ie, more than a year. A total of 83 eyes completed the postoperative 6-weeks follow-up in the institute. Table 2 illustrates the patients' characteristics. The mean age of the patients was 61 years. The mean preop LogMAR visual acuity was 1.7 which corresponds roughly to 20/800 in Snellen. The mean IOP was 19.2mm Hg. As described in the methods, all eyes had a "complex" cataract. Table 3 illustrates the different types of complexities of the cataract.

The three most common co-existing pathologies were pseudoexfoliation syndrome (n = 32), subluxated cataracts (from weak zonules or post-trauma; n = 16), and lens-induced glaucoma (n = 12).

Table 4 illustrates the type of cataract surgeries performed and intraoperative details.

Manual SICS was the most performed cataract surgery. Thirty six of the cases (ie, 43.4% of the cases) were complicated by intraoperative vitreous loss which was managed accordingly. The most common of the cases which were complicated were that of pseudoexfoliation syndrome, followed by weak zonules and lens-induced glaucoma, etc. One-third of the cases were left

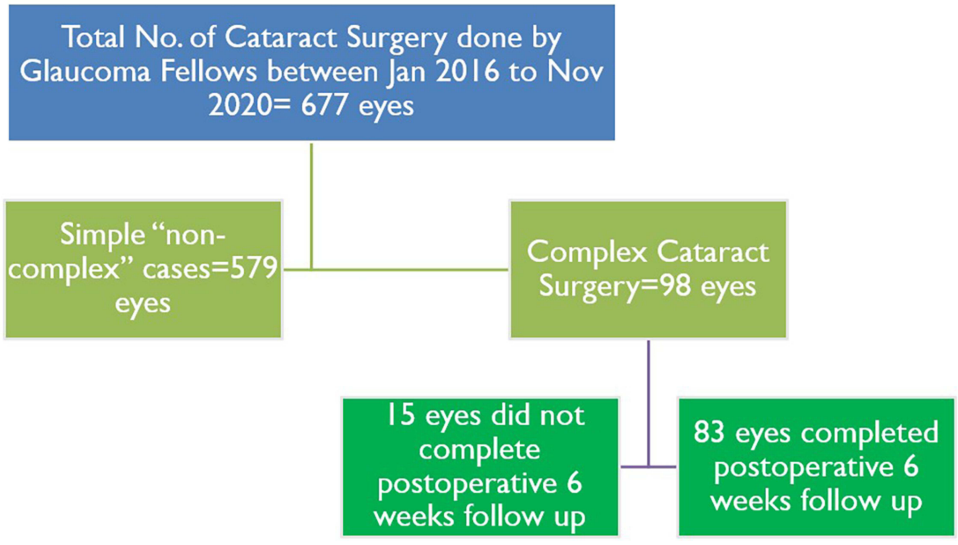

Figure 1 Flow chart of the number of eyes operated during the study period.

Table 1 Fellow Doctors' Characteristics

	Minimum	Maximum	Mean (± SD)
Age (years)	28	41	32.5 (± 4.7)
Post-PG experience (days) on the date of surgery	51	669	359 (±183)
Gender (M: F)	1	3	

Abbreviation: PG, post-graduation.

Table 2 Patients' Characteristics

	Minimum	Maximum	Mean (± SD)
Age (years)	12	85	61 (±14.3)
Gender (M: F)	51	32	
Preop BCVA in LogMAR	1	2.3	1.7 (±0.5)
Preop IOP (mm Hg)	4	62	19.2 (±11.8)

Abbreviations: BCVA, best-corrected visual acuity; LogMAR: Logarithm of minimal angle of resolution; IOP, Intraocular pressure.

Table 3 Complexities of the Cataract

Complexity	N=83	%
Pseudoexfoliation materials on the lens or pupil	32	38.6
Subluxated cataracts or weak zonules with or without a history of trauma	16	19.3
Lens-induced glaucoma—phacomorphic or phacolytic	12	14.5
Other co-existing glaucoma or raised IOP	8	9.6
Small pupil (≤3mm)	5	6
Monocular patient	3	3.6
Posterior polar cataract	3	3.6
Deep socket	1	1.2
Cataract with uveal coloboma	1	1.2
Post-uveitic cataract	1	1.2
Post-vitreoretinal surgery	1	1.2

Abbreviation: IOP, Intraocular pressure.

aphakic on the table owing to the non-availability of adequate support or other association precluding IOL insertion anteriorly. All the complex cases were supervised start to finish by the consultants by watching through the side-scope of the operating microscope. Whenever, complications were encountered, fellows were asked if they need any verbal or physical help. But all of them managed the complications themselves. The supervising faculty need not intervene actively in any of the cases.

As far as the visual outcomes of cataract surgery were concerned, the LogMAR BCVA (mean ± standard deviation) improved from the preoperative level of 1.7 (±0.5) to 1.0 (± 0.8) post-operative six weeks. The mean LogMAR acuity improved up to 1 which corresponds to 20/200 in the Snellen. The mean (± SD) follow-up period (months) was 4.9 (±2.8). The improvement in LogMAR BCVA in postop vs preop was statistically significant (0.69 ±0.86); $p < 0.001$ by paired samples *T*-test.

Table 4 Type of the Cataract and the Cataract Surgery Performed

Cataract Surgery Performed	**N=83**	**%**
SICS (± IOL)	72	86.8
Phaco (± IOL)	11	13.2
Outcomes of cataract surgery	**N=83**	**%**
Eventful (eg, PCR, VL)	36	43.4
Anterior Vitrectomy needed	31	37.3
IOL could not be placed	30	36.1
2nd surgeon needed to be scrubbed and take-over	0	0
Uneventful	47	56.6

Abbreviations: SICS, Small Incisional Cataract Surgery; IOL, Intraocular Lens; PCR, Posterior Capsular Rent; VL, Vitreous Loss.

Table 5 Surgical Outcomes Based on the Surgeon's Experience

	Surgical Experience (Days)	**Number of Eyes (N)**	**Mean ±SD**	**Significance of the Difference***
Change in LogMAR acuity in postop vs preop	<365	44	0.69 (±0.76)	*p*=0.99
	≥365	39	0.69 (±0.96)	
	Number of eyes (N)	**Minimum**	**Maximum**	**Mean ± SD**
Overall Surgical Time taken (minutes)	83	5	82	37.4 (±15.7)
	Surgical experience (days)	**Number of eyes (N)**	**Mean ±SD**	**Significance of the difference***
Surgical time (minutes) in between two groups based on experience	<365	44	42.3 (±16.6)	*p*=0.11
	≥365	39	33.1 (±13.6)	
Number of surgical complications (N=36)	<365	22		*p*=0.08
	≥365	14		

Note: *Independent Samples *T*-test.

Table 5 compares the surgical outcomes based on the surgeon's experience—less than or more than a year since joining the fellowship program. This distinction between less than and more than a year was made based on the complex and variable schedule of the fellows. There was statistically no difference in the final visual acuity in both groups. The group with greater experience had shorter surgical time and lesser complications though this difference was not statistically significant.

Discussion

There have been several studies evaluating resident and fellow outcomes during various ophthalmology-related surgical procedures.[3] When it comes to cataract surgery, fellows and residents have a higher complication rate as compared to the attending surgeons.[4–6] The outcomes of cataract surgeries by the fellows in complex cases as defined earlier are not widely known, as most of the cataract surgery studies described in the literature targeted "simple" cataract cases. Traditionally, cataract surgeries with complexities or ocular associations have been conveniently excluded from most of the earlier

studies.[4,10,11] Here, we had specifically targeted the difficult "complex" cataract surgeries where the performances of the fellows were not evaluated in the literature so far.

Manual SICS was the most commonly performed surgery in our cohort as this was known to be safer among the inexperienced cataract surgeons in the developing world, compared the phacoemulsification.[4,12] Studies have revealed that MSICS is a useful alternative in difficult clinical situations with fair surgical outcomes compared to phacoemulsification.[13,14] Studies have reported conflicting results of complication rates between residents versus consultants from Canada,[15] Portugal,[16] and South India.[5] We did not compare the results of fellows versus consultants since that difference, if any, may be obvious and understandable given the years of experience of the latter.

Our complication rates of 43.4% were quite high from the overall rates of surgical complications reported in the literature ranging from 1.8% to 27.4%.[10] This is attributed to our cohort being comprised of complex cataract cases which are likely to have greater rates of complications. In a retrospective study by Melega et al[11] analyzing the outcomes of cataract surgeries by ophthalmology residents, the complication rates gradually decreased from (23.53%) in the first-semester group, 20.93% in the second-semester group, and 11.31% in the third and final semester group. However, we did not find any such difference in the complication rates as far as surgical experiences were concerned.

Previous studies[11] have been unable to record the data knowing whether the surgery was entirely or only partially performed by the fellow. Our precise documentation allowed us to conclude that the fellows were able to complete all the surgeries on their own. Visual acuity significantly improved in all, despite a high rate of complications—this result concurs with the observations of a retrospective study from the USA.[17] This reiterates the importance of proper management of complications.

Our study highlights the outcomes of complex cataract surgery by the glaucoma fellows. The important role of "lens and cataract surgery" in "glaucoma management" cannot be over-emphasized. Cataract surgery has been advocated as the treatment of choice in many types of glaucoma—notably the lens-induced glaucoma[18] and primary angle closure glaucoma.[19] Our study showed that glaucoma fellows if trained properly in cataract surgery and guided accordingly, can achieve decent success in cataract surgery, even in complex and difficult scenarios and encountering complications. Our training protocols and teaching curriculum can be followed and extrapolated in other developing parts of the world where there is a mismatch in the availability of cataract surgeons and a high prevalence of the cataract and glaucoma.

Limitations of this study include its retrospective nature and the relatively small number of patients. There was paucity of data on other clinical parameters like pupil size or zonular status in relatively larger patient cohorts like pseudoexfoliation syndrome. Additional parameters not evaluated herein, such as axial length, anterior chamber depth, phacoemulsification time or ultrasound power used would enrich an analysis such as this one. The lack of information on subjective patient satisfaction and fellows' feedback are the other limitations of the study.

Conclusion

To our knowledge, this is the first study to report the outcomes of "complex" cataracts performed by glaucoma fellows under the supervision of one experienced faculty. In this study, mean best-corrected visual acuity improved significantly in all eyes after the surgery. Postoperative complications were observed in 43.4% of cases. We believe that training on surgical simulators, which are as yet unaffordable for our institution, could help to improve this factor. There was no difference in the visual acuity gain or surgical complication rates among surgeons of varying experiences.

Ethical Statement

Approved by the Institutional Review Board: Ethics committee of L.V Prasad Eye Institute, MTC campus, Bhubaneswar. Informed consent was waived by the ethics committee since it was a retrospective study and patients' consent to review their records was not needed by the IRB.

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Disclosure

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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