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Evaluating complications in cataract surgeries performed by resident trainees at a tertiary care hospital in Rajkot district of Gujarat

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ABSTRACT

Background: Cataract surgery is an important part of the ophthalmology residency program. By providing residents with the opportunity to develop surgical skills, ophthalmology programs can ensure that their residents are well-prepared for successful careers in the field. While most cataract surgeries are successful, complications can occur like infection, inflammation, corneal edema, and posterior capsule opacification, however, rates may differ with surgeon's experience. This study aims to determine the types and rates of various complications in cataract surgery performed by resident trainees.

Materials and Methods: This was a retrospective hospital based observational study that included patients operated for cataracts by manual SICS at a Tertiary care hospital in Rajkot. Postoperative outcomes were evaluated into three groups: surgeries performed during residents in the first year of training (group 1), surgeries performed during the second year (group 2), and surgeries performed during the third year (group 3). The outcome was the rate of postoperative complications in each group and collected data were entered in a Microsoft Excel sheet. Qualitative data were presented as frequency and percentages and compared by the chi-square test. The P-value of ≤0.05 was considered significant.

Results: A total of 492 patients were evaluated in the study, in which 102 patients (20.7%) were operated on by first-year residents (group1), 189 patients (38.4%) were operated on by second-year residents (group 2) and 201 patients (40.9%) were operated by third-year residents(group3). The overall rate of the intraoperative complication in our study was 32.3% with the incidence of intraoperative complications being 17.4%(n=86/492) and postoperative complications being 14.8% (n=73/492). The most common intraoperative complication was PCR with vitreous loss (10.4%) and the most common postoperative complication was corneal edema seen in 6.5% of patients.

Conclusions: Resident trainees showed a better performance in the form of decreased postoperative complications and surgical competency was also found to improve as surgical experience increased. Incorporating surgical training as part of a routine curriculum can improve the residents' learning curve.

1. Introduction

Cataract surgery, which consists of removal of the opaque lens and then implanting an intraocular lens, is one of the most common surgeries performed worldwide. For these reasons, cataract surgery is integral to ophthalmology residents' training. The current surgical approach to ensure the greatest outcomes for resident trainees is manual small incision cataract surgery, although this technique is learned on a learning curve that is influenced by greater familiarity with the equipment and the development of surgical abilities. [1–3]

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Medical residency programs all over the world have discussed the best ways to appropriately teach and train residents in such critical surgical techniques.[4–9] Various methods have been used to assess surgical learning curves in medical residents. The majority of authors define success rate by final surgical outcomes; in the instance of cataract surgery, these outcomes include patients' ultimate visual acuity as well as the rate and type of complications.[10–12] Cataract surgery is known to cause endothelial cell loss. Although a small incision is a safe procedure, the intraocular maneuvers involved increase the risk of endothelial cell loss.

In this study, the surgical results of resident trainees at a tertiary care hospital in Rajkot were compared during the period of 12 months of training (January 2021 to January 2022). We compared outcomes among residents with varying levels of training by retrospectively analyzing postoperative problems as well as, intraoperative complications. Previous research on small incision cataract surgery, and learning curves has examined the rate of complications.[11] The aforementioned factors are also extremely significant but rarely examined in studies of ophthalmology residents' surgical skills; thus, they were added in this study to better support any conclusions on the impact of surgeon experience on outcomes.

Assessing and analyzing the complications related to cataract surgery can be a valuable tool to benchmark performance and to help a residency program improve resident surgical training.[5]

2. Materials and Methods

This was a retrospective hospital based observational study that included patients operated for cataracts by manual SICS by the resident trainee at a Tertiary care hospital in Rajkot from January 2021 to January 2022. The study was performed after approval from the Institutional Ethics Committee and was conducted in accordance with the tenets of the Declaration of Helsinki and current legislation on clinical research. Informed consent was obtained from the head of the department as well as from individuals participating in the study.

The presence of cataracts having an indication for manual SICS and a minimum age of 45 were the inclusion criteria. All the surgeries that were included in this study were evenly distributed among the three groups. The exclusion criteria were difficult cataract cases like a small non-dilating pupil, traumatic cataracts, zonular dehiscence, combined procedures (penetrating keratoplasty, glaucoma shunt, trabeculectomy) vitreoretinal surgery.

Regardless of the resident's level of training, all cataract surgeries were performed by ophthalmology residents and a senior surgeon with a lot of experience in the field. The attending surgeon gave the trainee resident verbal directions during the surgery, and if the trainee resident was unable to perform a particular step or any complication occurred, the attending surgeon assumed control over the rest of the surgery, exhibiting how to tackle that step. In our department, it is acceptable for surgeons performing cataract surgery to have different preferences, such as the position of the incision or the method of SICS. However, all intraoperative drugs, solutions, ophthalmic devices, blades, and IOLs were standardized, as were surgical protocols, instrumentation, and techniques. All medical procedures were performed with peribulbar block. Instruments that were in supply and provided by the institute were used.

The surgeries included were then divided into 3 groups by attending surgeons present in the operation theatre on a particular day, based on the expertise of the resident trainee. The three groups were as follows: Group 1 which included the first-year resident trainee, Group 2 which included the second-year resident trainee and Group 3 which included the third-year resident trainee. The protocol for training for cataract surgery in our institute is as follows:- In the first year, for the first 2 months, residents get washed with the senior surgeon performing SICS to assist them and carefully observing the steps, and then they are allowed to perform the initial few steps of the SICS like taking superior rectus bridle suture, performing Conjunctival peritomy and putting scleral incision, side port entry and allowed to attempt capsulorhexis under supervision. In the Second year, the resident trainee learns to perform later steps of SICS like capsulorhexis, making of scleral tunnel and pockets, nucleus prolapse and delivery, lens matter wash, and IOL placement in the bag under the supervision of the attending surgeon. In the third year, the resident based on his/her confidence is allowed to perform SICS independently under the supervision of the attending surgeon and guides if the resident finds any difficulty in tackling any step.

The operative steps of each resident were recorded and reviewed in detail by both the operating resident and the attending surgeon and compared with others. All intraoperative and postoperative complications were recorded in the datasheet separately. After discharge post-operatively patients were reviewed on the 2^{nd} week and then on the 4^{th} week by the same operating resident and attending surgeon. Following complications were noted: - posterior capsule rupture (PCR), vitreous loss, aphakia, dropped nucleus, tunnel site burn, Descemet's membrane detachment, iris prolapse, subluxation/decentration of IOL, hyphema, shallow anterior chamber.

Before being bandaged, patients received 0.5% moxifloxacin and 0.1% dexamethasone eye drops in the immediate postoperative period. In a similar, the topical postoperative regimen consisted solely of waking hours for seven days of 0.5% moxifloxacin and 0.1% dexamethasone administered every three hours. This regimen was changed to only 0.1% dexamethasone on the fourteenth postoperative day, and it was tapered off over three weeks. Patients underwent all necessary treatment

in the institute in case of intraoperative or postoperative complications.

Statistical analysis:- Descriptive statistical analyses were employed in the presentation of the results using central tendency and variance measurements. The groups' continuous variables were compared using the t-test. Statistical analyses of the categorical variables were performed using Fisher's exact test or the chi-squared test. Analyses were performed using STATA 14.0 (StataCorp LP, College Station, TX, USA). Statistical significance was established when $p \leq 0.05$.

3. Results

A total of 492 surgeries were performed during the study period by the three groups out of which 66.7% (n=328) were males and 33.3% (n=164) were females. The average age of the patients operated was 60.45±7.43 years. In 48% of patients (n=236/492), the right eye was operated while in 52% of patients (n=256/492) left eye was operated.

A total of 20.7% (n=102/492) surgeries were from Group 1 (First year residents), 38.4% (n=189/492) surgeries were from Group 2 (Second year residents), and 40.9% (n=201/492) surgeries were from group 3 (Third year residents) respectively. The overall rate of the intraoperative complication in our study was 32.3% with the incidence of intraoperative complications being 17.4% (n=86/492).(Table 1) In Group 1, the incidence of intraoperative complication was 3.8% (n=19/492), and it increased to 7.7% (n=38/492) in Group 2 and 6.9% (n=34/492) in Group 3.

Table 1: Shows the distribution and rates of various intraoperative complications

Intraoperative Complications	Rate of the complications (n=86/492)
Posterior Capsular Rent with Vitreous loss	10.4% (n=51)
Iris prolapse	4.3% (n=21)
Descemet Membrane detachment	2.2% (n=11)
Iridodialysis	0.6% (n=3)
Tunnel site burn	0.8% (n=4)
Lens drop	0.2%(n=1)

The most common intraoperative complication was PCR with vitreous loss (10.4%). In our study all the posterior capsular rent were accompanied with vitreous loss, so manual vitrectomy was done in all the cases and if rent was small, then an attempt was made to place the IOL in the bag, but if it was not stable then IOL was placed in the sulcus. If the rent was large, the patient was kept aphakic and was posted for secondary ACIOL after 4-6 weeks. Scleral fixation IOL or Iris claw lens were not available in our setup.(Table 2)

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The association between the group and the rate of surgical complications was confirmed by multiple logistic regression. Surgeries performed by residents in group 1 were 1.9 times more bound to include complications than those done by group 3 residents (OR = 1.9 [95% CI: 1.2-5.34]). Similarly, complications were 1.65 times more likely in surgeries performed by residents in Group 2 than in surgeries performed by residents in Group 3 (OR = 1.65; 95% CI: 1.4-6.78].

The connection between the group and PCR was also confirmed by multiple logistic regression: This complication occurred 1.87 times more frequently in surgeries performed by Group 2 residents than in surgeries performed by Group 3 residents (OR = 1.87; 95 percent CI: 1.76-3.45]) and 3 times more frequently in surgeries performed by Group 1 residents than in surgeries performed by Group 3 residents (OR = 3.1; 95 percent CI: 1.54-4.18]). The overall incidence of postoperative complications was 14.8% (n=73/492).(Table 4)

The Table 5 shows that Corneal edema was the most common postoperative complication seen in all 3 groups. It was seen in 14.7% (n=15/102) of surgeries in group 1, 7.8% (n=8/189) of surgeries in group 2, and 4.5% (n=9/201) of surgeries in group 3. Among all the three groups, most cases of post-operative uveitis were seen in group 2, 5.3% (n=7/189) which may be due to excessive iris manipulation and retained lens matter postoperatively. Only 1 case had a post-operative retinal detachment in group 2 which probably may be due to sudden post-operative shallowing of the anterior chamber. It was successfully drained and repaired on the next day. There were no cases of any Toxic anterior segment syndrome and postoperative endophthalmitis in our study.

4. Discussion

One important surgical technique that ophthalmology residents learn as part of their training is manual SICS. Teaching methods and training procedures vary between residency programs. Individual skill development is inevitable among residents; However, in order to ensure that residents acquire the necessary competence in SICS, ophthalmology residency training programs ought to have specific training guidelines and provide a minimum number of surgeries. A review of teaching methods revealed that

Table 2: Shows the distribution of intraoperative complications in each group during SICS

Intraoperative complications	1^{st} Year Resident (Group 1) (n=102)	2^{nd} Year Resident (Group 2) (n=189)	3rd Year Resident (Group 3) (n=201)
Posterior Capsular Rent with Vitreous loss (n=51)	4	20	27
Iris prolapse (n=21)	5	11	5
Descemet Membrane detachment (n=11)	6	4	1
Iridodialysis (n=3)	0	2	1
Tunnel site burn (n=4)	4	0	0
Lens Drop (n=1)	0	1	0

Table 3: Shows multiple regression analysis of all intraoperative complications adjusted for age and groups

Group	N	All Intraoperative complications Odds Ratio (95% CI)	Posterior Capsular Rent with vitreous loss Odds Ratio (95% CI)
Group 1	102	1.9 (1.2-5.34) p= 0.005	3.1 (1.54-4.18) p=0.007
Group 2	189	1.65(1.4-6.78) p= 0.001	1.87 (1.76-3.45) p=0.004
Group 3	201		

Table 4: Shows the distribution and rates of various postoperative complications

Postoperative Complications	Rate of the complications (n=73/492)
Hyphema	1% (n=5)
Shallow anterior Chamber	1% (n=5)
Wound leak	1% (n=5)
Subluxation/Decentration of Intraocular lens	3% (n=12)
Cystoid Macular Edema	0.2%(n=1)
Retinal Detachment	0.2% (n=1)
Choroidal Detachment	0% (n=0)
Uveitis	3% (n=12)
Corneal Edema	6.5%(n=32)

Table 5: Shows the frequency of postoperative complications seen in each group during follow-up

Postoperative complications	1^{st} Year Resident (Group 1) (n=102)	2^{nd} Year Resident (Group 2) (n=189)	3rd Year Resident (Group 3) (n=201)
Hyphema (n=5)	2	1	1
Shallow anterior Chamber (n=5)	1	3	1
Wound leak (n=5)	2	2	1
Subluxation/Decentration of Intraocular lens (n=12)	2	4	6
Cystoid Macular Edema (n=1)	1	0	0
Retinal Detachment(n=1)	0	1	0
Choroidal Detachment (n=0)	0	0	0
Uveitis (n=12)	3	7	2
Corneal Edema (n=32)	15	8	9

complication rates decrease after a resident performs an average of 70 surgeries.[13] The surgical training begins with extracapsular cataract surgery and continues with SICS instruction in stages. All surgeries are performed under the direction of a senior surgeon.

Residents are expected to be able to perform incisions, capsulorhexis, hydrodissection, hydro delineation, and intraocular lens implantation by the end of the second year of the residency. The resident's quality and time taken for completing surgery are also expected to improve over the third year of the residency.

In this study, rates of intraoperative and postoperative complications were taken for evaluation of the surgical outcomes of the residents as well as their learning curve. The rate of posterior capsular rent with vitreous loss was 10.4%. In a study by Thevi Thanigasalam (14), PCR with vitreous loss occurred in 1.5–3.1%. In the study of Stephanie A.W. Low,[14] posterior capsule rupture rates with vitreous loss were 0.9% among residents. In the study by Bhagat et al,[5] the rate of Posterior capsular rent with vitreous loss was 5.4%. In our study, higher rate of PCR and other complications were seen.

In our study, the incidence of tunnel site burn was 0.8% and lens drop was 0.2%. It was comparable to the study of C.S. Fong, [15] where the incidence of tunnel site burn was 2% and dropped nucleus/lens fragment in 0.18-1%.

The overall rate of complications in our study was 32.3%. These rates of complications as shown in the literature range from 1.8% to 27.4% (4,5,8,17,18). As residents progressed through their residency, the overall rate of complications increased which can be attributed to the fact that most residents neglect several important rules once they feel confident enough to reduce operating times after their first 30 cases The rate of complications among second-year residents was relatively high compared to both third-year residents and first-year residents, which possibly may be due to fact that after residents completed their first semester of initial training without many intraoperative events, possible overconfidence develops in them similar to learning how to ride a bike and falling when the training wheels come off, it could be an attempt to perform the procedures on one's own. Additionally, it is likewise conceivable that senior surgeons' carelessness in the students' abilities right now in the growing experience lessens the attending surgeon's frequency of interventions, whether they be verbal or specialized. This finding has likewise been accounted for in past studies. [16,17]

Third-year residents experienced rates that were more comparable to those of other programs. [4,5,8,18,19] The reason for fewer complications among first-year resident trainees was due to appropriate case selection by the attending surgeon and meticulous supervision, including appropriate and timely intervention by the supervising surgeon when it was determined that further surgery by the resident would likely lead to a complication.

A comparison of the types of complications among the resident trainees that occurred throughout the program revealed a significant decrease in more serious complications such as iridodialysis, Descemet membrane detachment, lens drop, etc as there was an increase in the experience of operating residents.

The current study helps us comprehend that senior surgeons' increased attention and intervention at a specific point in the learning process may improve this trend. Since understudies will quite often encounter an expansion in entanglements at a particular point, this period might expect changes to the cataract training program to decrease careful difficulties.

A few constraints of this study may likewise be noted. The absence of data on emotional patient fulfillment, resident criticism, and a depiction of the residents' degree of contribution in every medical procedure, are restrictions of the review. The study would have been enhanced if it had been recorded whether the resident performed the surgery entirely or only in part, but sadly, this particular piece of information was not recorded. At the time of this study, neither simulator training nor wet lab training was offered in our residency program. We believe that beginning surgeons would benefit from taking this crucial training step in order to gain confidence and surgical skills. A few examinations in the writing have revealed the utilization of wet labs to start residents' careful training, [8] while others have detailed the utilization of test systems and computer-generated reality simulation. [20–24] Writers have revealed proof of higher achievement rates and lower paces of complexities while these learning procedures are added. Such strategies might further develop the expectation to absorb information experienced by inhabitants, and may diminish careful complexities; notwithstanding, they can't completely supplant genuinely careful experience, which is an inborn and necessary piece of residency preparation. Therefore, the baseline evidence provided by this study will enable comparisons and a better comprehension of their impact on SICS training when we can incorporate wet lab training in animals, simulators, and virtual reality simulation into our residency program. We also think about using competency grading tools for cataract surgery in subsequent studies.

5. Conclusion

This study demonstrated that residents, particularly those in their second year of training have a relatively high rate of complications in cataract surgery. For residents and patients alike, a safe training process necessitates close, careful, and intense supervision. Senior surgeons might have to pull together their considerations while, in the wake of prevailing in the underlying strides of the preparation cycle, residents might show a measure of certainty that isn't yet corresponding to their capacities to perceive chances, defeat challenges, and keep away from extreme difficulties. Additionally, senior surgeons may provide fewer interventions as they gain confidence in a trainee's performance. As previously mentioned, this is typically the time when the most serious issues arise.

A steady rise in the number of cataract surgeries and the number of surgeons qualified to perform them is anticipated as life expectancy rises. Therefore, proper consideration of the training process for cataract surgery is necessary to guarantee skilled surgeons, successful surgeries, improved outcomes, and visual rehabilitation.

Educators may be able to develop better teaching strategies for cataract surgery with the assistance of a deeper comprehension of the learning processes, the rates of complications, and the most essential steps to achieving surgical skills.

6. Source of Funding

None.

7. Conflict of Interest

None.

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