

Original Article

## Complication rates in phacoemulsification surgeries performed by trainee residents

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### ABSTRACT

**Objectives:** Phacoemulsification with a foldable intraocular lens is the gold standard of cataract treatment. Studies have shown that various risk factors affect the visual outcome of cataract surgery. One of these is the availability of well-trained surgeons. Here, we are trying to understand how to achieve good surgical outcomes even if the surgeon has low surgical experience.

**Materials and Methods:** A hospital-based prospective study was done from August 2019 to March 2021. After a detailed examination, each patient was scored based on the risk factors associated and classified into various risk groups. A total of 286 patients were studied, out of which consultants operated on 143 patients and 143 patients were operated on by trainee residents. The intraoperative and postoperative complication rates are compared based on the complexity of cases between trainee residents and consultants.

**Results:** About 82.5% of the patients operated by trainee residents and 78.32% of patients operated by consultants belonged to the no-risk group with complication rates of 2.50% and 1.80%, respectively, which was statistically not significant. In the case of patients with associated preoperative risk factors, 36% of patients operated on by trainee residents had complications, and 9.6% of patients operated on by consultants had statistically significant complications.

**Conclusion:** Preoperative stratification and allocation of cases according to associated risk factors help reduce complications, help trainee residents gain essential surgical skills, and give better surgical outcomes for patients.

**Keywords:** Phacoemulsification, Complications, Resident training, Re-surgery, Cataract

### INTRODUCTION

Cataract is the loss of transparency of the natural lens in the eye<sup>[1]</sup> and is one of the leading causes of blindness. As per 2010 data, globally 33.4% (10.8 million) of all blindness and 18.4% (35.1 million) of all moderate to severe vision impairment are due to cataract.<sup>[2]</sup> In a study conducted in south India, cataract has been reported to cause 50–80% of bilateral blindness.<sup>[3]</sup> Vashist *et al.*, in their study, reported that among people aged >60 years, the prevalence of cataracts was 58% in North India and 53% in South India.<sup>[4]</sup>

The treatment of choice for cataracts is surgery. Phacoemulsification (phaco) with a foldable intraocular lens (IOL) is currently the gold standard of cataract treatment.<sup>[5]</sup> With increasing cataract surgeries in India, many patients now demand better visual outcomes, which makes phaco cataract surgery as the mainstay of cataract treatment. Studies have shown that preoperative, intraoperative, and postoperative factors affect the visual outcome of cataract surgery. These

include the availability of well-trained surgeons, accurate biometry, availability of equipment and consumables, well-trained staff, pre-existing pathologies in the eye, systemic comorbidities like diabetes, previous vitrectomy, complicated cataract surgical steps, and loss of follow-up.<sup>[6-8]</sup>

In this study, we focused on factors of surgeon experience. Various studies have shown that the learning curve of phaco surgeries is in an exponential pattern, and with proper training, the complication rate can be reduced.<sup>[9]</sup> As phaco surgeries are gaining popularity, the resident trainee surgeons must be trained well in handling phaco surgeries. As one of the factors in reducing complications and obtaining better visual outcomes is surgeon experience, it is better to understand how it can be achieved even if the surgeon has low surgical experience.

Here, we have compared the complication rates of phaco surgeries done by resident trainees and consultant surgeons based on case complexity. A study by the Canadian Academic

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Centre in 2018 found that there is no significant difference in complications between the two groups.<sup>[10]</sup> Few studies have been done on this topic in India. Hence, in this study, we intend to test this in an Indian scenario so that we can analyse the resident training program and improve it.

## MATERIALS AND METHODS

Our study is a hospital-based prospective study done in central India from August 2019 to March 2021. Our study aimed to evaluate the ophthalmology training program for trainee residents with respect to phaco training. For this, we compared intraoperative and postoperative complication rates in phaco among surgeries performed by trainee residents and consultants. We assessed the variations in complications rate based on the complexity of cases.

Patients aged above 40 years with senile cataracts who underwent phaco surgery and were willing to participate in the study were included in the study. The resident doctors included in this study had experience in manual small-incision cataract surgery and were able to do phaco surgeries independently. These residents had undergone 30 hours of wet lab training and had done 30 phaco surgeries under the supervision of a consultant. Patients with a history of trauma to the eye and those who were undergoing any other surgeries along with cataract surgery were not included in the study.

We did not intend to compare the results of consultants versus trainee residents in our study. Postoperative outcomes of consultants with five years of surgical experience who had done more than 2000 phaco surgeries were used as a benchmark to grade postoperative outcomes of trainee residents.

A total of 286 patients (143 from each study group-trainee residents and consultants) who had senile cataracts and underwent phaco were included in this study. Detailed history regarding any pre-existing ocular and systemic conditions was taken. On the first preoperative visit, the patients were informed about the objective of the study, and consent was taken. Measurement of uncorrected visual acuity, with pinhole visual acuity and best-corrected visual acuity for distance and near using log minimum angle of resolution (MAR) chart, was done. Intraocular pressure was noted, and sac syringing was done. Detailed ophthalmological examination was done using a slit lamp, and dilated fundus examination was done using +90D and +20D Indirect Ophthalmoscopy to rule out any posterior segment pathology. Preoperative anaesthetist fitness was done in all cases. Anticoagulants, if any, were stopped three days before surgery.

### Preoperative stratification of patients

A score was given to each patient based on the preoperative risk factors associated with them based on Table 1. Then, each

patient was categorised into a risk group according to the number of points that they received, as shown in Table 2.<sup>[11]</sup> The patients were then allotted randomly to trainee residents and consultants. Trainee residents and consultants did cases independently. The surgeries followed the standard protocols in our institute. All surgeries were performed under a Zeiss operating microscope with Oertli CataRhex easy phaco machine (no financial disclosures).

### Post-op follow-up

All the patients were followed up with a scheduled visit on postoperative day 1 and 1 week postoperatively. In case of any complication or poor postoperative vision, patients were followed up for one month, and necessary intervention was done. On each postoperative visit, visual acuity was checked on Log MAR. A complete ophthalmic examination, including slit-lamp evaluation and fundus evaluation, was done.

### Statistical analysis

Statistical analysis was performed using STATA statistical software (Version 10.1, 2011) and Microsoft Excel 2013. Visual acuity was calculated using the Logarithm of the MAR (converted from Snellen's equivalent) for statistical evaluation.

Descriptive data are presented as percentages, means, and standard deviations. Data were checked for the assumption of normality using Shapiro Wilk test. Quantitative outcomes were analysed with two-independent sample *t*-tests and paired *t*-tests. Qualitative outcomes were compared for complications of cataract surgery done by trainee residents versus that of consultants using Pearson's Chi-square test and Z-test for differences in proportions. *P* values were considered statistically significant at <0.05 level.

## RESULTS

A total of 286 cases were analysed, out of which 143 cases were operated by trainee residents and 143 by consultants.

### Complications

Trainee residents had a total of 12 complications. The most common complication was posterior capsular rent (PCR) (58.33%), followed by severe corneal oedema (25%) and aphakia (16.7%).

A total of five complications were reported by consultants – PCR (80%) followed by nucleus drop (20%).

The risk group-wise analysis of complications shows that there is no significant difference in the occurrence of complications in patients operated by consultants and trainee residents who belonged to no-risk and low-risk groups. However, there is a significant difference in rates of

**Table 1:** A scoring system based on preoperative risk factors.<sup>[11]</sup>

| Category A (no points)                            | Category B (1 point each)                                                                                                                                                                                                                                                                                                                                                                                                                             | Category C (3 points each)                                                                                                               |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| No additional risk factors carried by the patient | <ul style="list-style-type: none"> <li>• Previous vitrectomy</li> <li>• Corneal scarring</li> <li>• Small pupil (&lt;3 mm)</li> <li>• Shallow anterior chamber (depth&lt;2.5 mm)</li> <li>• Age&gt;88 years</li> <li>• High ametropia (&gt;6 D of myopia or hyperopia)</li> <li>• Posterior capsule plaque</li> <li>• Posterior polar cataract</li> <li>• Miscellaneous risks assessed by the surgeon (e.g., poor position of eye/patient)</li> </ul> | <ul style="list-style-type: none"> <li>• Dense/total/white or brunescent</li> <li>• Pseudoexfoliation</li> <li>• Phacodonesis</li> </ul> |

**Table 2:** Preoperative risk groups.<sup>[11]</sup>

| Group   | Risk          | Score received   |
|---------|---------------|------------------|
| Group 1 | No added risk | 0 points         |
| Group 2 | Low risk      | 1–2 points       |
| Group 3 | Moderate risk | 3–5 points       |
| Group 4 | High risk     | 6 points or more |

complications between consultants and trainee residents in patients belonging to moderate-risk groups, as shown in Table 3.

### Re-surgery

Our analysis of data shows that a total of four patients (2.8%) operated by trainee residents underwent resurgery. The most common re-surgery was scleral fixation IOL (SFIOL) (50%), followed by anterior chamber (AC) wash and penetrating keratoplasty (PK) (25% each). In patients operated by consultants, only one patient (0.70%) underwent SFIOL.

Table 4 shows that all four re-surgeries by trainee residents occurred in patients of the moderate-risk group. The only re-surgery SFIOL by consultants occurred in a high-risk patient for cataract surgery. The analysis of data suggests that there is a statistically significant occurrence of re-surgery in trainee residents while doing complicated cases as compared to consultants in a moderate-risk group.

### Risk group comparison of postoperative complications and re-surgery between two study groups

Table 5 shows the distribution of patients with preoperative risk factors between trainee residents and consultants. Trainee residents operated on twenty-five patients (17.5% of a total of 143), and 31 patients (21.7% of a total of 143) were operated on by consultants. In risk group patients, 36% (9 out of 25) patients operated by trainee residents and 9.70% (3 out of 31) patients operated by consultants had complications, and some even needed re-surgery.

The analysis of data shows that trainee residents had more statistically significant ( $P < 0.05$ ) complications than consultants (9 and 3, respectively) while operating patients with some preoperative risk factors.

In the no-risk group, 97.5% (115 out of 118) patients operated on by trainee residents, and 98.20% (110 out of 112) patients operated on by consultants had normal surgical outcomes. However, 2.50% (3 out of 118) patients operated on by trainee residents and 1.80% (2 out of 112) patients operated on by consultants had complications, and some even needed re-surgery. The statistical analysis of data shows that there is no significant difference in complication rates between trainee residents and consultants ( $P > 0.05$ ), indicating that trainee residents and consultants had similar surgical outcomes in no-risk group patients.

The results suggest that in patients with no preoperative risk factors, trainee residents had similar surgical outcomes as compared to consultants, but as the preoperative risk factors increased, surgical complications by residents also increased.

## DISCUSSION

In our study, we compared intra-operative and postoperative complication rates based on the preoperative complexity of cases in phaco surgeries performed by trainee residents and consultants. The results obtained help us to plan preoperatively and provide better surgical results to our patients.

### Preoperative stratification of patients

In a research paper published by Muhtaseb *et al.*, a scoring system for grading patients into different risk groups based on preoperative risk scoring of cataracts was proposed [Tables 1 and 2].<sup>[11]</sup> Based on this scoring system, patients who are undergoing phaco surgery in our institute were also stratified into various risk groups. In our study, it was found that trainee residents operated on 118 patients (82.5%) belonging to the no-risk group, three patients (2.09%) belonging to a low-risk group, and 22 patients (15.38%)

**Table 3:** Risk group-wise stratification and comparison of complications.

| Risk groups   | Complications by trainee residents |        | Complications by consultants |        | P value |                 |
|---------------|------------------------------------|--------|------------------------------|--------|---------|-----------------|
|               | n                                  | %      | n                            | %      |         |                 |
| No risk       | 3                                  | 25.00% | 2                            | 40.00% | 0.6519  | Not significant |
| Low risk      | 1                                  | 8.33%  | 0                            | 0.00   | 0.3165  | Not significant |
| Moderate risk | 8                                  | 66.67% | 1                            | 20.00% | 0.0177  | Significant     |
| High risk     | 0                                  | 0.00   | 2                            | 40.00% | 0.1558  | Not significant |
| Total         | 12                                 | 100.0% | 5                            | 100.0% |         |                 |

**Table 4:** Risk group-wise stratification and comparison of re-surgery between two study groups.

| Risk-groups   | Re-surgery by trainee residents |         | Re-surgery by consultants |       |                          |
|---------------|---------------------------------|---------|---------------------------|-------|--------------------------|
|               | n                               | %       | n                         | %     |                          |
| No Risk       | 0                               | 0.0     | 0                         | 0.00  |                          |
| Low Risk      | 0                               | 0.00    | 0                         | 0.00  |                          |
| Moderate risk | 4                               | 100.00% | 0                         | 0.00  | P-0.044, Significant     |
| High Risk     | 0                               | 0.00    | 1                         | 100.0 | P-0.316, Not significant |
| Total         | 4                               | 100.0%  | 1                         | 100.0 |                          |

**Table 5:** Risk group comparison of postoperative complications and re-surgery between two study groups.

| Number of patients operated by trainee residents | Risk group (mild, moderate, and severe)                                   |                                            |                                                                     |
|--------------------------------------------------|---------------------------------------------------------------------------|--------------------------------------------|---------------------------------------------------------------------|
|                                                  | Number of patients with complications and re-surgery by trainee residents | Number of patients operated by consultants | Number of patients with complications and re-surgery by consultants |
| 25 (17.5% of 143)                                | 9 [36% of risk group]                                                     | 31 (21.7% of 143)                          | 3 [9.70% of risk group]                                             |
| P=0.017, significant                             |                                                                           |                                            |                                                                     |

belonging to a moderate-risk group. Consultants operated on 112 patients (76.92%) belonging to a no-risk group, six patients (4.90%) in the low-risk group, 22 patients (15.38%) in the moderate-risk group, and three patients (2.80%) in the high-risk group. Both study groups had a comparable distribution of patients among the preoperative risk groups, and there is no statistically significant difference ( $P > 0.05$ ) between them.

### Complications and re-surgery

In our study, the complication rate for trainee residents was 8.40% (12 complications), and the re-surgery rate was 2.80% (4 re-surgery). The most common complication was PCR (58.33%), with an incidence of 4.9%, followed by severe corneal oedema (25%) and aphakia (16.7%) [Table 3]. The majority of complications by trainee residents occurred in the moderate-risk group (66.67%), followed by the no-risk group (25%) and low-risk group (8.33%) [Table 4]. The most common re-surgery in patients operated by trainee residents is SFIOL (50%), followed by AC wash and PK (01

each). All the re-surgeries occurred in the moderate-risk group. Various other studies were done analyzing phaco surgery complications and factors associated with it. In a 2013 study by Hashemi *et al.*<sup>[12]</sup> In surgeries performed by trainee residents, it was found that the incidence of PCR was 9.6% and risk factors for it include lack of supervision by attending surgeons, anterior capsule tear and longer effective phaco.

In a similar study by Rutar *et al.*<sup>[13]</sup> in 2009, it was found that the overall intraoperative complication rate was 4.7%, and the presence of preoperative risk factors such as mature cataract and zonular pathology increased the odds of complication by 18.9 times and 26.2 times, respectively. In our study, it was also found that in risk group patients, 36% (9 out of 25) patients operated on by trainee residents, and 9.70% (3 out of 31) patients operated on by consultants had complications. Some even needed re-surgery [Table 5], suggesting that an increase in preoperative risk factors affects the surgical outcome in trainee residents. In a similar study done by Low *et al.* in 2018 at a Canadian academic centre about intraoperative complication rates of phaco surgeries,<sup>[10]</sup> it was found that for simple cases,

there was no significant difference in the overall complication rates (1.7% and 2.0%;  $P = 0.52$ ) between staff surgeons and residents, respectively. Another study was done by Woodfield *et al.*<sup>[14]</sup> comparing complication rates between the 2<sup>nd</sup> and 3<sup>rd</sup>-year residents, it came to a similar conclusion that for simple cases, 2<sup>nd</sup>-year residents had similar intraoperative complications as of 3<sup>rd</sup>-year resident surgeries (odds ratio, 1.15; 95% confidence interval, 0.6–2.19).

Our study also reached a similar conclusion that, in no-risk group patients, 97.5% (115 out of 118) patients operated by trainee residents and 98.20% (110 out of 112) patients operated by consultants had normal surgical outcomes. Only 2.50% (3 out of 118) patients operated by trainee residents and 1.80% (2 out of 112) patients operated by consultants had complications, and some even needed re-surgery, which was statistically not significant indicating that trainee residents and consultants had a similar surgical outcome in no-risk group patients.

By comparing our study with other international studies, it can be safely concluded that trainee residents perform better in cases with no preoperative risk factors associated with them. However, in cases with risk factors, trainee residents have more complications. As shown in a study by Lee *et al.*<sup>[9]</sup>, the learning curve of phaco surgery is of an exponential pattern. Hence, to gain experience, trainee residents need to preferably do surgery with no preoperative risk factors, thereby providing better surgical outcomes to patients. This will provide the upcoming trainee resident with the necessary skills and confidence. With proper experience in phaco surgery, trainee residents can reduce their complication rates.

## CONCLUSION

The study concludes that the trainee resident needs to start doing phaco surgery initially in cases with no risk factors. Doing phaco in patients with preoperative risk factors will result in complications and poor surgical outcomes for trainee residents. Complicated cases need to be allotted to senior surgeons. Preoperative stratification and allocation of cases according to associated risk factors help to reduce complications and help gain essential surgical skills for trainee residents and give better surgical outcomes for patients. This strategy will help to improve the resident training program and develop good surgeons for the future.

## Ethical approval

The author(s) declare that they have taken the ethical approval from IRB/Ref no- NBEMS/THESIS/2021/A-213001, DATE-17/01/2022.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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## Conflicts of interest

There are no conflicts of interest.

## Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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