

Prevalence and effectiveness of innovative techniques in ophthalmic surgical training during COVID-19 pandemic in India

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Purpose: This study aimed to determine the various innovative surgical training techniques prevalent among ophthalmology residents in India during the COVID-19 pandemic. **Methods:** This was a prospective cross-sectional study. An online survey questionnaire was completed by ophthalmology residents from different parts of the country. The survey consisted of questions related to the impact of the pandemic on training, innovative training techniques adapted during the pandemic and their effectiveness, and COVID-19 duty-related information. **Results:** A total of 147 responses were obtained. The mean age was 29.3 years (range: 24–40 years, SD: ± 3.82). Of which, 87 (59.2%) respondents were females. A total of 61 (41.5%) respondents reported practicing steps of ocular surgeries on goat eye, 69 (46.9%) on model eye/vegetables/fruits, 30 (20.4%) on surgical simulators, and 26 (17.7%) utilized 3-D virtual images and videos. In addition, 22 (15%) respondents reported never using any such techniques. Furthermore, 130 (88.4%) respondents reported practicing steps of cataract surgery, 52 (35.4%) practiced steps of open globe repair, and steps of trabeculectomy were reported by 24 (16.3%). The steps that were reported to be practiced most are incision or tunnel construction by 108 (73.5%), suturing by 92 (62.6%), capsulorrhexis by 91 (61.9%), primary wound repair by 82 (55.8%), and conjunctival peritomy by 75 (51%). **Conclusion:** The present study demonstrates that residents across the country are adapting to the present scenario by utilizing several innovative methods to sharpen their surgical acumen. The current pandemic situation can serve as an impetus to emphasize upon the institutes and medical regulatory bodies to appropriately remodel the residency curriculum.

Key words: COVID-19 pandemic, innovative training techniques, surgical training

Humankind has been contending with a global pandemic since January 2020, which resulted from the outbreak of a novel virus called severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2).^[1] Being a respiratory virus, SARS-CoV-2 is known to be transmitted largely through droplets. Recent investigations have highlighted the likelihood of airborne transmission, especially in poorly ventilated, enclosed spaces.^[2] Considering the aforementioned predominant modes of transmission, the key strategies recommended by the health and administrative authorities have been directed toward curtailing direct contact by practicing social distancing, sanitization of surfaces, using masks, and other kinds of physical barriers.

Ever since the World Health Organization (WHO) declared that the outbreak constitutes a public health emergency of international concern, India has been through a series of lockdowns with highly stringent restrictions imposed in the initial phase with the gradual relaxation of activities also occurring in a phased manner, the so-called unlocks. The pandemic has adversely affected countless aspects of medical care, the practice of ophthalmology is no exception.

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The government issued directives mandated for all routine outpatient department (OPD) services to be ceased and all elective procedures and surgeries to be deferred and only emergency healthcare services were allowed to function. As a result, as many as 72.5% of practicing ophthalmologists in India had to completely shut down their OPD services and cease all elective surgeries.^[3] The impact of the pandemic and the related restrictions on the ophthalmic fraternity has been persisting long after the easing of government-imposed lockdowns. There is a multitude of reasons responsible for this—prolonged contact at a short working distance for almost all procedures in the eye OPD, continued utilization of residents and faculty from all specialties in COVID-19 wards, and persistence of travel restrictions preventing the rise in footfall of patients.^[4]

In addition to its sizeable influence on the general eye care activities all around the world, the above-outlined situation has remarkably weakened the effectiveness of ophthalmology training for an unforeseeable duration. Ferrara and coworkers

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reported that 74.6% of trainees experienced >75% decline in their surgical practice and about half of the trainees had completely ceased all surgical practice.^[5] A United Kingdom (UK)-based study highlighted that surgical training, especially cataract surgery was the prime concern of the ophthalmology trainees.^[6]

In times like these, telementoring, simulation-based models, demonstration of edited video recordings, and other innovative surgical adaptation techniques would play a greater role than ever to help bridge the gap created in the surgical training programs all over the world. Although a wealth of literature has been published about the impact of the pandemic on ophthalmic training, there is still a dearth of knowledge regarding how the residents across the country are adapting to the drastically changing times with respect to acquisition of surgical skills. In an effort to overcome this, we designed an online survey specifically directed toward ophthalmology residents with the aim to assess the prevalence of various innovative surgical adaptation measures in their training programs and their effectiveness.

Methods

An online survey in the form of a questionnaire was designed on Google forms and circulated to ophthalmology residents undergoing training at tertiary eye care centers of national importance from various regions of the country on April 27, 2021. The survey consisted of 25 questions related to sociodemographic data, the impact of COVID-19 pandemic on resident training during the lockdown, surgical innovative techniques adapted during the pandemic, level of effectiveness of innovative techniques, and COVID-19 duty-related information. The residents were also asked to state the postgraduate course that they were pursuing and the year of residency.

The participants were invited primarily via Whatsapp messenger and had the option of providing their email addresses. The study protocol was conducted in accordance with the tenets of the Declaration of Helsinki for clinical research. Consent was obtained from the participants for the use of the survey data for scientific and statistical purposes. The different categorical variables were summarized as percentages.

Results

An aggregate of 147 valid responses was obtained. All responses were tabulated and analyzed.

Demographics

The average age of the participants was 29.3 years (range: 24–40 years, SD: ± 3.82). A total of 87 (59.2%) respondents were females. The geographical (state-wise) distribution of the responses is indicated in Fig. 1.

A total of 117 (79.6%) respondents were enrolled in MD/MS course, 22 (15%) trainees were pursuing Diplomate in National Board (DNB) residency programs, and eight (5.4%) were undergoing Diploma in Ophthalmology (DO). Out of all the participating trainees, 43 (29.3%) were in the first year of residency, 41 (27.9%) were in the second year, and 63 (42.8%) were in the third year.

Impact of COVID-19 pandemic on resident training during lockdown

To obtain a perspective into the perceived impact of the pandemic on various aspects of resident training, the respondents were

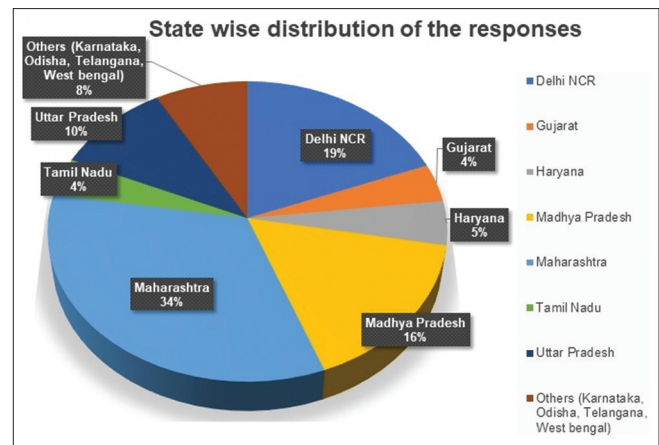


Figure 1: The geographic distribution of the responses obtained

asked to what extent they thought their academic training, thesis work, clinical exposure, and surgical training were affected. Fig. 2 summarizes the responses that were obtained.

On being asked about the types of surgeries being performed at their center during the pandemic, 80 (54.4%) participants' response was only emergency surgeries, 39 (26.5%) answered urgent elective and emergencies, 17 (11.6%) indicated both elective and emergencies, whereas 11 (7.5%) replied that their centers had suspended the entire surgical practice.

Innovative surgical training techniques practiced

The residents were asked about their frequency of use of innovative surgical training techniques prior to the pandemic, to which 47 (32%) answered "never," 36 (24.5%) responded "rarely," 48 (32.7%) replied "sometimes," whereas only 16 (10.9%) indicated that they "often" employed such techniques.

A total of 61 (41.5%) respondents indicated that they practiced surgical steps of various ocular surgeries on goat eye, 69 (46.9%) residents reported training on model eye/vegetables/fruits, 30 (20.4%) practiced on surgical simulators, and 26 (17.7%) utilized 3-D virtual images and videos. Furthermore, 22 (15%) of the participants responded that they never used any such innovative training techniques. The different types of surgical training methods that were utilized by the respondents are summarized in Fig. 3.

Of the 61 residents who practiced on goat eye, 28 (45.9%) were in the third year, 18 (29.5%) in the second year, and 15 (24.5%) in the first year. Of the 69 residents who practiced on model eye/vegetables/fruits, 31 (44.9%) were in the third year, 21 (30.4%) in the second year, and 17 (24.6%) in the first year. The proportion of first, second, and third-year trainees among those who stated that they have trained on surgical simulators were 36.7%, 26.7%, and 36.7%, respectively. Out of those who employed 3-D virtual images and videos, 38.5% were in the third year, 26.9% in the second year, and 34.6% in the first year. A total of 52 (35.4%) residents selected more than one modality of surgical training technique, of whom 21 (40.4%) were in the third year, 16 (30.8%) in the second year, and 15 (28.8%) in the first year.

The survey enquired the participants about the frequency of practicing these training techniques, the responses to which are shown in Fig. 4.

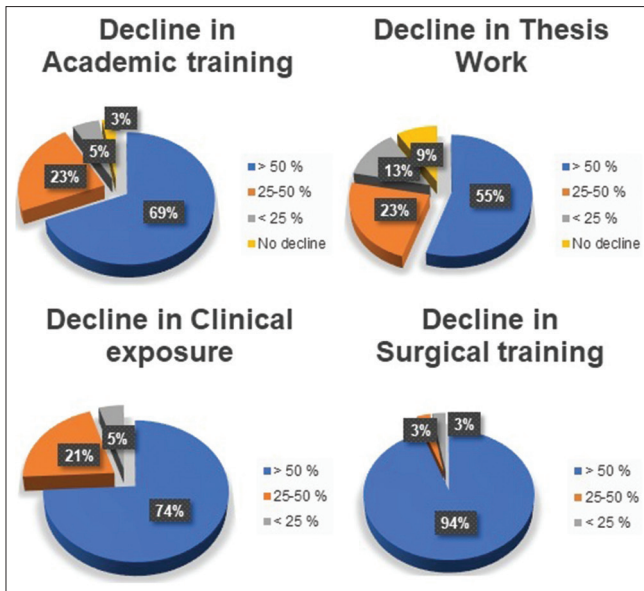


Figure 2: The extent to which the respondents' academic training, thesis work, clinical exposure, and surgical training were affected

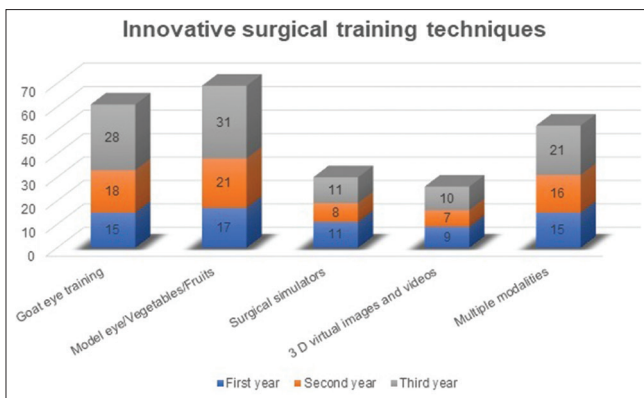


Figure 3: The different types of surgical training methods utilized by the respondents

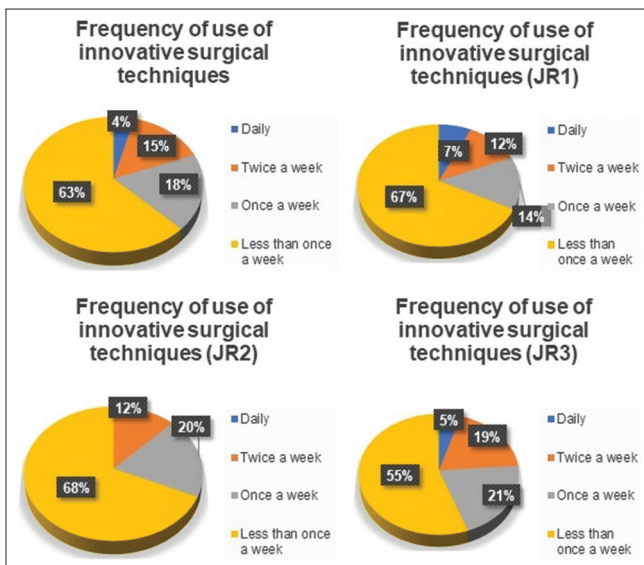


Figure 4: Frequency of practicing innovative surgical training techniques

An overwhelming majority of trainees, i.e., 130/147 (88.4%) reported practicing steps of cataract surgery by means of innovative techniques, whereas 52 (35.4%) practiced steps of open globe repair and steps of trabeculectomy were practiced by 24 (16.3%) only.

The survey also sought insight into the relative regularity with which particular steps of different ocular surgeries were practiced by the respondents. The steps reported to be practiced most by the trainees, in descending order are as follows: Incision or tunnel construction by 108 (73.5%), suturing by 92 (62.6%), capsulorrhexis by 91 (61.9%), primary closure of corneoscleral laceration by 82 (55.8%), and conjunctival peritomy by 75 (51%) trainees. The details of all surgical steps which could be practiced by innovative techniques are summarized in Table 1.

The majority of the participants, i.e., 95 (64.6%) expressed that the absence of tissue sense was an important downside to the innovative training techniques. For 83 (56.5%) respondents, adjustment to the anatomic variation was an issue and 43 (29.3%) indicated that there was a lack of self-motivation.

Level of the effectiveness of innovative training techniques

Fig. 5 outlines the participants' responses when asked about the ideal way of imparting surgical skill training. In addition, 66.7% of residents felt that there was the benefit of virtual training in actual practice.

In our study, it was seen that 90 (61.2%) respondents assisted in emergency ocular surgeries during the pandemic.

COVID-19 duty-related information

Of all the participants, 118 (80.3%) reported having been detailed to a COVID-19 unit. A total of 45 (36.9%) trainees indicated the duration of their COVID-19 duty to be <30 days, 41 (33.6%) were detailed for 30–60 days, 20 (16.4%) trainees for 60–90 days, and 16 (13.1%) residents for >90 days.

In addition, 47 (32%) respondents reported having contracted COVID-19 infection during the pandemic.

Discussion

The 147 responses obtained from the ophthalmology residents from reputed institutes all across India have given us a plethora of information about how these trainees are adapting to various challenges presented by the COVID-19 pandemic, especially with respect to their surgical training. Postgraduate training in Ophthalmology is unique in several ways, it entails acquisition of comprehensive theoretical knowledge, keeping abreast with the latest advancements in investigative modalities as well as achieving microsurgical skills with proper hand-eye coordination.

In pursuance of these goals, residency programs in the western countries range from 4- to 7-year duration with compulsory minimum surgical exposure that they attain by means of a standardized curriculum including wet-lab training, which has been mandated by the Accreditation Council for Graduate Medical Education in the United States and the Royal College of Ophthalmologists in the United Kingdom.^[7]

The role of wet-lab training in strengthening the surgical competence of the residents and building their confidence has also been demonstrated in several studies conducted in

Table 1: Details of surgical procedures practiced by the innovative techniques

| Surgical procedure | Number of residents <i>n</i> (%) | JR1 <i>n</i> (%) | JR2 <i>n</i> (%) | JR3 <i>n</i> (%) |
|--|----------------------------------|------------------|------------------|------------------|
| Steps of cataract surgery | 130 (88.4%) | 38 (25.9%) | 38 (25.9%) | 54 (36.7%) |
| Incision/Tunnel | 108 (73.5%) | 34 (23.1%) | 33 (22.4%) | 41 (27.9%) |
| Capsulorrhexis | 91 (61.9%) | 22 (14.9%) | 25 (17%) | 44 (29.9%) |
| Lens delivery | 35 (23.8%) | 10 (6.8%) | 8 (5.4%) | 17 (11.6%) |
| Suturing | 92 (62.6%) | 26 (17.7%) | 29 (19.7%) | 37 (25.2%) |
| Loading of IOL | 35 (23.8%) | 8 (5.4%) | 8 (5.4%) | 19 (12.9%) |
| Steps of trabeculectomy | 24 (16.3%) | 5 (3.4%) | 7 (4.8%) | 12 (8.2%) |
| Conjunctival peritomy | 75 (51%) | 24 (16.3%) | 22 (14.9%) | 29 (19.7) |
| Scleral flap preparation | 56 (38.1%) | 11 (7.5%) | 17 (11.6%) | 28 (19%) |
| Surgical PI | 32 (21.8%) | 11 (7.5%) | 10 (6.8%) | 11 (7.5%) |
| Scleral flap suturing | 60 (40.8%) | 19 (12.9%) | 15 (10.2%) | 26 (17.7%) |
| Steps of open globe repair | 52 (35.4%) | 13 (8.8%) | 16 (10.9) | 23 (15.6%) |
| Conjunctival exploration | 58 (39.5%) | 16 (10.9%) | 17 (11.6%) | 25 (17%) |
| Limbal anatomy restoration | 34 (23.1%) | 10 (6.8%) | 8 (5.4%) | 16 (10.9%) |
| Excision of prolapsed iris | 36 (24.5%) | 8 (5.4%) | 10 (6.8%) | 18 (12.2%) |
| Primary closure of corneo-scleral laceration | 82 (55.8%) | 22 (14.9%) | 25 (17%) | 35 (23.8%) |
| AC reformation | 39 (26.5%) | 9 (6.1%) | 14 (9.5%) | 16 (10.9%) |

IOL: Intraocular lens, PI: Peripheral iridectomy, AC: Anterior chamber

**Figure 5: Responses on the ideal way of imparting surgical skill training**

India.^[8] However, most surveys have reported the inadequacy of wet-lab training facilities in the majority of Indian institutes.^[9] This observation corroborates with our study finding that almost one-third of the respondents indicated that they “never” utilized innovative surgical training techniques prior to the pandemic and up to a quarter replied “rarely” to the same question.

Ever since the global pandemic was declared in March 2020, many governments across the globe have taken stringent measures to curb transmission and consequently, all medical infrastructures were focused on containing this problem, which meant that even the needy nonemergency procedures including cataract surgeries were indefinitely delayed.^[10]

The initial decline in the academic training was promptly compensated by an upsurge in virtual conferences, online seminars within the department, and continued medical education (CME) programs. However, these do not address the issue of downturn in hands-on surgical training. In response,

certain institutes have revamped their curriculum to include wet-lab training on goat eyes.^[11] Surgical simulators have also emerged recently as a comparable alternative to wet-lab training.^[12] The availability of these tools in India is quite limited as evidenced by our study finding that only 41.5% of the respondents were trained on goat eyes and 20.4% on surgical simulators.

Hussain *et al.*^[6] demonstrated that among various aspects of training impacted by the COVID-19 pandemic, the biggest concern of the residents was cataract surgery. Our survey also demonstrates that almost 90% of the respondents reported practicing steps of cataract surgery using different available innovative methods. In addition, 46.9% of residents reported practicing steps on model or dummy eye, vegetables, and fruits making this the most prevalent method of innovative surgical training among our study participants. Similar ingenious techniques have been reported to be utilized for training in India in a pre-COVID-19 era as well, e.g., capsulorrhexis practice on cigarette carton transparent covers and boiled tomato and potato peels.^[13] Although the resident surgical teaching curriculum is clearly predominated by cataract surgery, it is not limited to it. Our survey findings show that more than one-third of the participants practiced steps of open globe repair and 16.3% of the participants practiced steps of trabeculectomy.

As per our survey, 94% of the respondents perceived a more than 50% decline in surgical training due to the pandemic, whereas the perception of decline in academic training and thesis work was not as profound. Thus, the pandemic has resulted not only in the reduction of hands-on surgical training but also significantly deprived the trainees of the opportunity to learn by means of observing and assisting.^[5] Even our study observed that only 60% have assisted in emergency ocular surgery during the pandemic. This is further compounded by the fact that more than 80% of the study participants have reportedly been detailed for COVID-19 care duties with almost one-third of them deployed for more than 2 months duration.

These figures are remarkably more than what was previously reported by the surveys conducted both in India and abroad.^[14]

The value of virtual training in ophthalmology residency programs has been vehemently underscored by studies leading to its incorporation in the proposed national residency curriculum given by the All India Ophthalmological Society.^[15] COVID-19 pandemic has compelled few institutes to embrace novel training techniques and in most cases, the residents have employed innovative ways in their individual capacity in an attempt to acquire the coveted microsurgical skills. Ajay *et al.*^[16] have shown that a cohort of residents from southern India indicated wet-lab training as one of the most preferred methods of learning. We also noted in our study that 83% of the respondents expressed that the ideal way of imparting surgical teaching should include virtual training.

In our survey, we have also seen that a larger proportion of third-year residents employed innovative virtual training methods and with greater regularity. This could be explained by their possible apprehension owing to fewer days remaining in training.

Our study has certain inherent limitations of being a survey-based study. In view of the unpredictable and ever-changing scenario, the questionnaire could not be validated. The sample size was relatively small but it was obvious as the study was conducted in midst of the second wave of the pandemic in India with increased resident deployment to COVID-19 wards. But the present study has a definite advantage over earlier published literature on the subject in providing a general understanding of the consequences of COVID-19 pandemic on ophthalmic training as well as imparting a distinctive insight into the effectiveness of various adaptations in surgical training undertaken by residents in tertiary care centers all over India.

The following recommendations are being proposed:

- (i) Implementation of a structured mandatory wet-lab curriculum aided by a dedicated system for procurement and storage of goat eye or porcine eye in all institutes with ophthalmology residency programs.
- (ii) Compulsory video recording of resident cases and maintenance of video library to facilitate lecture cum demonstrations in which common pitfalls in surgical steps and suggested improvements may be discussed.
- (iii) Utilization of tools like the International Council of Ophthalmology-Ophthalmology Surgical Competency Assessment Rubric (ICO-OSCAR) to objectively assess and identify trainees requiring additional guidance and accordingly regulate their wet-lab sessions.

Conclusion

In conclusion, ophthalmology training has suffered the serious ramifications of pandemic-related decline in clinical and surgical workload. Much emphasis has already been laid on the benefit of virtual training in boosting the confidence of trainees and yielding better outcomes. The present study demonstrates that residents across the country are adapting to the present scenario by utilizing several innovative methods to sharpen their surgical acumen. The current pandemic situation

can serve as an impetus to emphasize upon the institutes and medical regulatory bodies to remodel the residency curriculum to compulsorily include wet-lab or simulation-based training.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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