

Reworking protocols of ophthalmic resident surgical training in the COVID-19 era – Experiences of a tertiary care institute in northern India

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Purpose: Coronavirus Disease 2019 (COVID-19) pandemic has negatively impacted medical professionals in all fields of medicine and surgery in their academic, clinical and surgical training. The impact of surgical training has been described as 'severe' by most ophthalmology residents worldwide due to their duties in COVID-19 wards, disruption of outpatient and camp services. **Methods:** Ophthalmic surgery demands utmost accuracy and meticulousness. Fine motor proficiencies, stereoscopic skills and hand-eye coordination required can only be achieved by practice. So, a multileveled structured wet-lab teaching schedule was prepared for the residents and implemented to bridge this gap between theory and practice at our tertiary care institute. A semester-wise training schedule was made with the proper distribution of wet-lab and simulator training. Surgeries like phacoemulsification, scleral buckling, pars plana lensectomy and vitrectomy, trabeculectomy and intravitreal injections were practised by the residents on the goat eyes. Simulator training was provided for phacoemulsification and vitrectomy to increase the hand-eye coordination of the residents. **Results:** Residents noticed improvement in their surgical skills and ambidexterity post wet-lab and simulator training. It also increased their confidence and provided essential surgical skills required to be used in the operation theater later. **Conclusion:** It is imperative that wet-lab training be included in the residency training programme in this COVID-19 era.

Key words: Goat eyes, simulator, wet lab

Coronavirus disease 2019 (COVID-19) pandemic has negatively impacted medical professionals in all fields of medicine and surgery in their academic, clinical and surgical training. Institutes had to discontinue offline academics, grand rounds and surgical training rosters. It resulted in tremendous unprecedented disruption of core surgical speciality training due to stoppage/cancellation of elective surgeries and decreased inflow of patients with open-globe injuries mandating repairs.^[1-3] Moreover, the resident trainees were redeployed to COVID-19 designated wards, intensive care units and screening duties, after which they were quarantined/self-isolated. Camps and free services which attract significant patient load were shut down, leading to an inherent decrease in surgeries.^[4]

The impact of surgical training has been described as 'severe' by most ophthalmology residents worldwide.^[5] In an online survey conducted pan-India, 80.7% of ophthalmology trainees felt that the COVID-19-related lockdown had negatively affected their surgical training.^[6] Even though academic theoretical training continued online throughout this phase, hands-on training suffered a significant setback.

Ophthalmic surgery demands utmost accuracy and meticulousness. Fine motor proficiencies, stereoscopic skills and hand-eye coordination required can be achieved only by practice. The delicate character of the ocular structures, and the

miniature anatomy of the eye, leads to a lower margin of error.^[7] It has been seen in literature that insufficient surgical training is associated with higher complication rates in inexperienced ophthalmic surgeons.^[8] To expedite surgical proficiency and decrease the complication rates, wet laboratories and surgical simulators are used worldwide in various surgical branches.^[9] Kirby *et al.*^[10] first proposed an eye surgical wet-lab model for ophthalmic surgical training in 1966. Though wet-lab training has always been a part of ophthalmology resident teaching,^[11,12] its importance accentuated during this long-drawn-out pandemic time.

As the outpatient services were shut in cognizance with government guidelines, in our tertiary care referral centre, with a significant decrease in elective surgeries, it became impossible for a resident to get hands-on surgical training during this time. This 'new' era compelled the administration of our tertiary institute to take notice and reformulate the surgical training curriculums to make up for the time lost.

For the younger trainees/junior residents, basic steps of suturing and cataract surgeries are essential. For the older residents/fellows, hands-on simulator training and wet-lab

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Wet Lab and Simulator Training

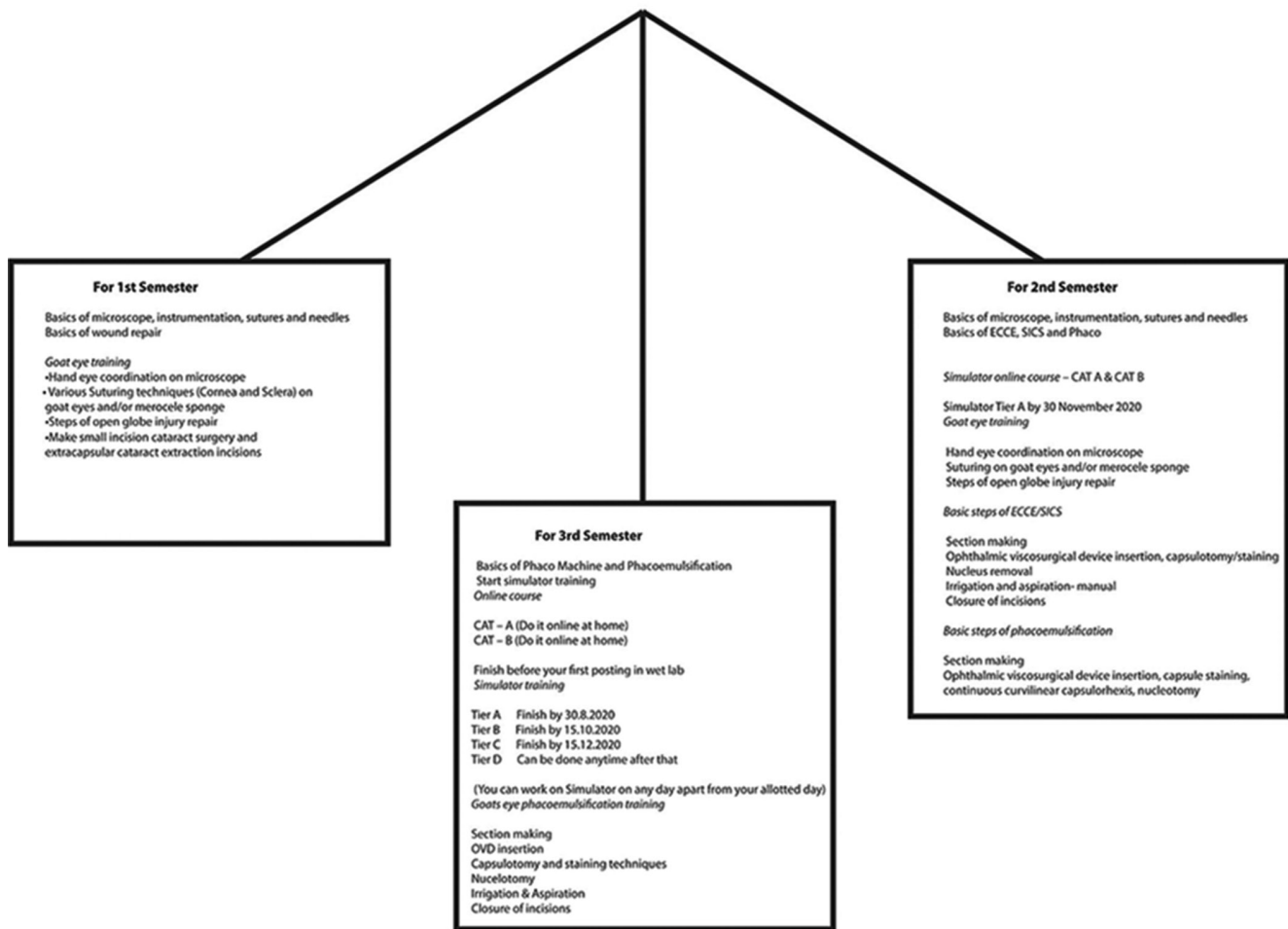


Figure 1: Schedule of the wet lab with the semester-wise distribution

training for phacoemulsification, trabeculectomy and vitrectomy are vital. So, a multileveled structured wet-lab teaching schedule was prepared and implemented to bridge this gap between theory and practice [Fig. 1].

Wet Lab Training

Schedule and station distribution

For the junior resident training, residents of the first three semesters were included in the rotation. Residents belonging to the last three semesters were instructed to join in whenever they got free from clinical duties. The wet-lab and simulator room encompassed four stations. The first station composed of a combined phacoemulsification/vitrectomy machine and one ophthalmic microscope along with a full set of operation theatre instruments. The second and third stations consisted of goat eyeball stands/eyeball stands with fixation heads and microscopes for practising suturing, glaucoma and retinal detachment surgeries, that is, scleral buckling. The fourth station had the Eyesi ophthalmic surgical simulator (VRMagic, Mannheim, Germany).

Four residents were posted in the wet lab in a single day, out of which one was trained on the simulator and

other three were trained on freshly procured goat eyes or on phacoemulsification practice dummy eyes (Phaco-i Practice Eyes, Madhu Instruments Pvt Ltd, New Delhi, India) which could be used with a practice fixation head for better simulation lab [Fig. 2]. The advantages of these artificial eyes over goat eyes included being able to be stored at room temperature and being made up of non-biological materials. In our experience, we found that goat eyes were more suited for soft cataract phacoemulsification and the phacoemulsification practice dummy eyes were ideal for hard cataract phacoemulsification.

One senior resident and one faculty were posted to assist the junior residents in their training. The mentor primed the phaco machine before starting the wet lab. The number of residents was purposely kept less as compared to the pre-COVID-19 times in order to maintain adequate social distancing. Gloves and face masks were compulsory during wet-lab postings. Cornea, cataract, refractive surgery, vitreo-retina and glaucoma fellows were directed to attend the wet labs in rotation as well.

Wet-lab training

The wet lab provided a safe haven in the form of non-stressful laboratory conditions for the training of the residents without

the risks and issues of ethics involved in operating on real eyes. The junior residents were taught incisions like side ports/main ports/sclerocorneal tunnels and partial-thickness scleral flaps. They were taught corneoscleral tear/open-globe injury repairs^[13] and techniques like phacoemulsification with

anterior and posterior capsulorhexis. Continuous curvilinear capsulorhexis is difficult in goat eyes due to the presence of a shallow anterior chamber. Goat eyes usually have a soft lens, so it helps in practising trench formation. The nucleus can be hardened by heating the eyeball in a microwave for 10 s.^[4,14] The mentor set the parameters on the phacoemulsification machine, and the residents carried out phacoemulsification with intraocular lens implantation. Steps of trabeculectomy were also done in goat eyes [Fig. 3]. Full-thickness keratoplasty was practised by the senior residents and fellows on goat eyes in the wet lab [Fig. 4]. Retinal surgeries like scleral buckling^[15] and pars plana lensectomy and vitrectomy were performed by senior residents [Fig. 5]. The trainers watched and guided the resident trainees through the observer side-viewing tube of the operating microscope stationed in the wet lab. The wet-lab area was purposely designated away from the patient care areas to minimise any contact with the animal tissue.

Simulator training

Published reports in literature stress the importance of simulator-based training to facilitate the rapid acquisition of surgical skills and improve patient safety profiles.^[16,17] The simulator consists of a model eye mounted on a mannequin head, which is connected to a microscope with a camera and a computer interface. Internal sensors are present to track the movements and positions of the surgical instruments, which produces a virtual image that is seen on both the microscope and the touch screen. Both the residents and fellows were also trained on the ophthalmic surgical simulator which has the cataract and vitreoretinal training platforms. The residents were provided online access to cataract surgery training courses (CAT A and CAT B) which were to be completed by the resident before starting the different levels on the simulator. The simulator had various courses incorporated in it with ascending levels of difficulty (Tier A, Tier B, Tier C, Tier D). It helped in breaking complex surgical procedures into smaller doable learning steps for novice surgeons. The simulations were



Figure 2: Setting of the wet lab with the mentors helping the junior residents (a and b), resident practicing on the simulator (c)

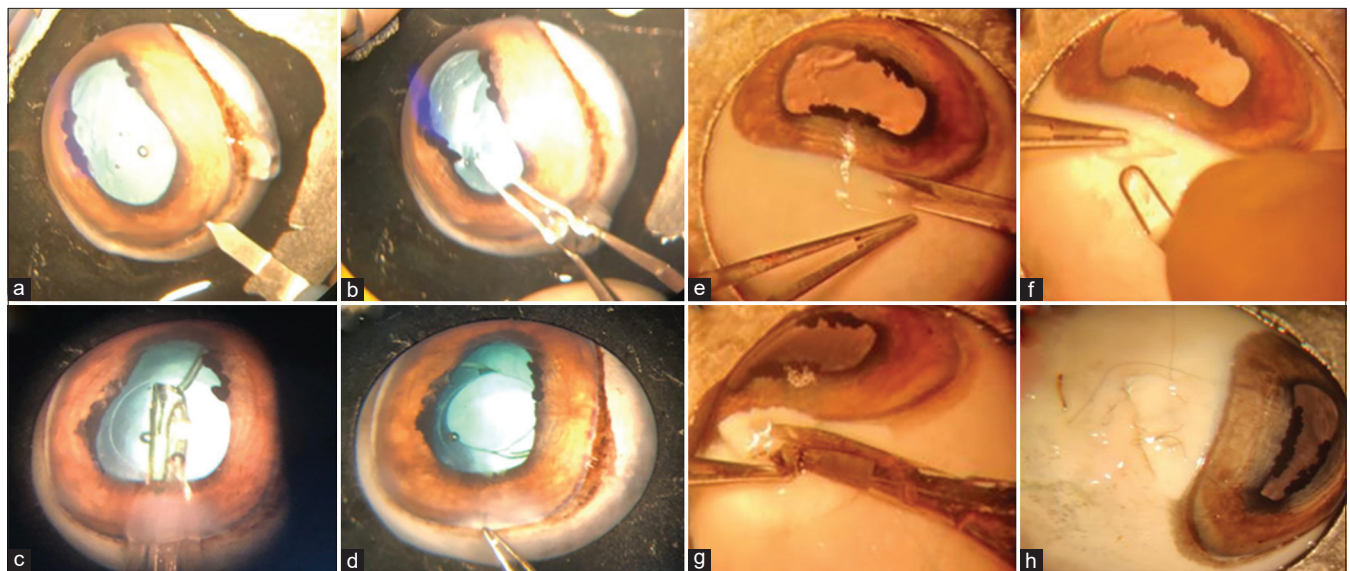


Figure 3: Steps of phacoemulsification, practised on goat's eye-side port and main port formation (a); capsulorhexis formation (b); post phacoemulsification, foldable IOL insertion (c); dialling of IOL and final intraoperative image post phacoemulsification, main port sutured with 10-0 nylon suture (d); steps of trabeculectomy conjunctival peritomy (e); formation of a partial thickness scleral flap (f); iridectomy (g); suturing of the flap (h)

initially abstract to improve the hand–eye–foot coordination of the residents, but eventually, they progressed to actual surgical steps. The residents performed on the simulator either on their own or under the guidance of a mentor.

For training in cataract surgery, the simulator was equipped with a head with an artificial eye interface, instrument sets, foot pedals and corresponding software. It was configured for superior or temporal access. The simulator was used for imparting extensive training in capsulorhexis. It also trained the residents for any simulated complications arising during phacoemulsification. The phaco training modules had different

levels of proficiency, and the higher level was attained after the trainee crossed the initial levels after mastering them. The vitreoretinal platform helped the student perform various tasks like posterior hyaloid detachment, peripheral vitrectomies, internal limiting membrane peeling, removal of epiretinal membranes, treatment of retinal detachments with silicone oil or gas tamponade. An actual posterior segment simulation was possible due to the provision of scleral indentation and retinal lenses. This realistic simulation of different surgical steps increased the residents' surgical experience, ambidexterity, hand–eye coordination and psychomotor skills before performing on patients. The simulator also provided cognitive feedback and helped the resident to retake the surgical steps.

Resident and Attendee Feedback

Residents were allowed to operate on real patients only after successfully completing the entire course. The trainees trained on the simulator and in the wet lab expressed more confidence while doing actual surgeries in the operating room later and decreased the risk of complications. The lifelike surgical training helped residents and fellows develop essential cataract and vitreoretinal surgical skills with dexterity. The frequent practice helped in improving proficiency in complex task assignments. At the finish of each task, the trainee was provided with a detailed performance summary. The students were judged on different parameters concerning instrument/microscope handling, surgical efficiency and tissue treatment [Supplementary Table 1].

In a survey conducted among the first, second and third semester residents, a set of 10 questions were compiled, and their feedback gathered. All the trainees felt satisfied regarding the opportunities they got in the wet lab. Eight out of 12 (67%) trainees found that the simulator helped improve their operative skills for the future. Ten out of 12 trainees (83.3%) completely agreed that suture training on goat eyes had improved their surgical skill in the actual surgical scenario, and

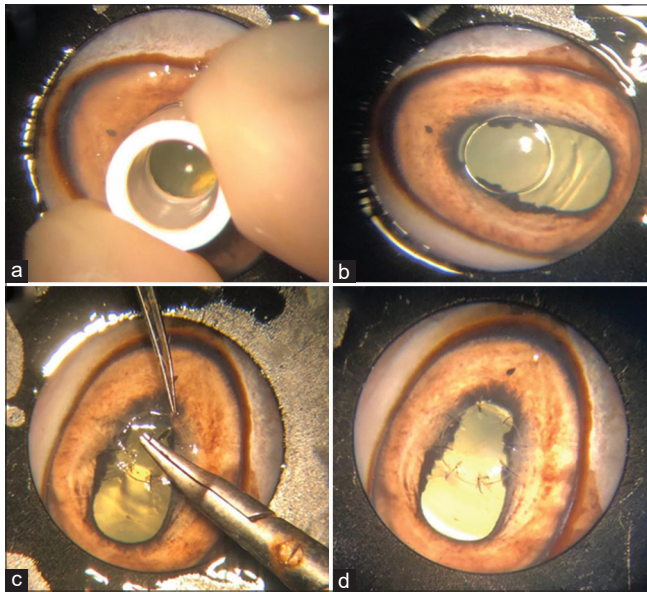


Figure 4: Steps of penetrating keratoplasty, practised on goat's eye – 6 mm trephine used to cut the goat cornea (a and b), cardinal sutures placed (c) and then eight interrupted sutures placed (d)

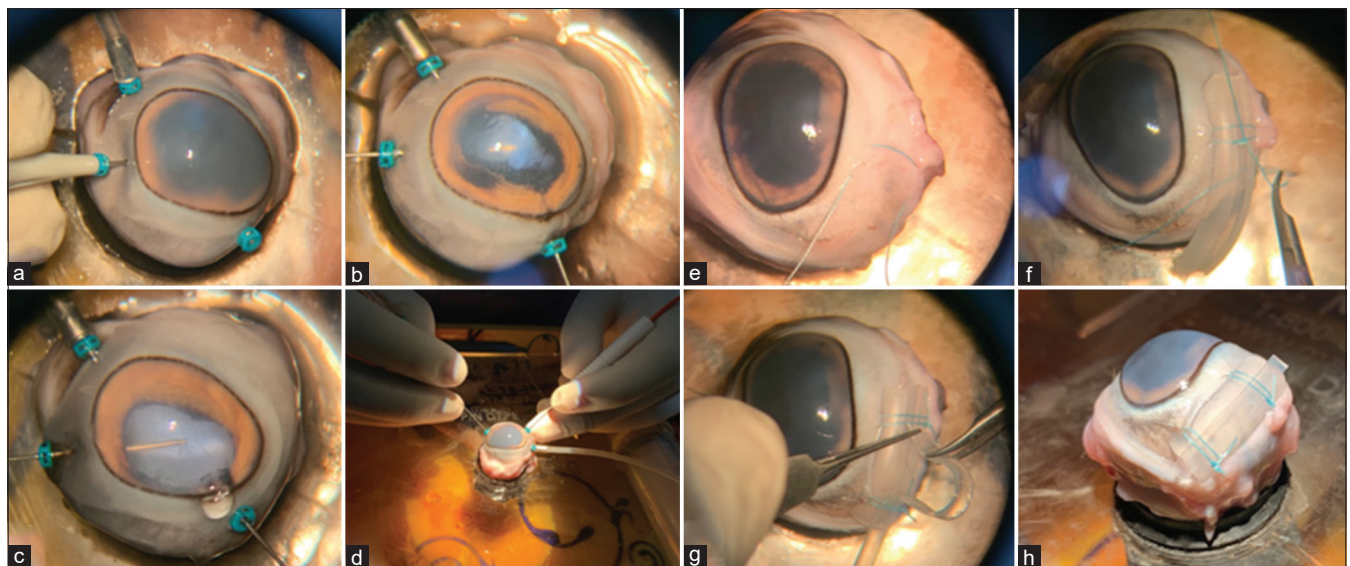


Figure 5: Lensectomy and vitrectomy in a goat eye: Placement of 25-gauge trocar-canula system through a goat eye (a and b); performing 3-port lensectomy (c); Anterior vitrectomy after clearing out the lens (d). Steps of Scleral Buckling: Placement of mattress sutures with 5-0 Dacron (e); securing the 277-type silicon tyre under the mattress sutures (f); passing the 240-type silicon band under the mattress sutures (g); final outcome after placing the buckle (h).

suturing and goat eye training were the most popular training procedures among the residents. All the trainees agreed that phacoemulsification training on artificial phaco eyes and the phaco machine was helpful in their surgical training. All the residents felt that phacoemulsification/extracapsular cataract surgery steps could be practised the most in the wet lab in their future training sessions. The trainees also evaluated the mentors, and 91.6% of trainees felt that their instructors were good. Lastly, all the residents agreed that the wet-lab training had benefitted them in improving their hand-eye coordination and building confidence during surgery. Their overall experience of the wet lab was good.

Positive feedback received from the trainees, and their supervising mentor surgeons accentuated the fact that resident surgical training needs to be addressed immediately.

Conclusion

To conclude, both wet-lab and surgical simulator trainings are imperative, especially during the COVID-19 global pandemic era, to prevent the shortcomings which may arise due to the restriction in the number of surgeries occurring worldwide. They can provide practical training at any time and independent of the patient flow. They should be integrated with the ophthalmology curriculum to benefit the surgical resident community in shortening their learning curve and safely conducting cataract and other surgeries with minimal complication rates. Permanent restructuring of surgical training programmes is mandatory to maintain rigorous education standards in the unfortunate event of another unpredictable crisis within the healthcare system. Moreover, the possibilities of a remote wet lab,^[18] which can be functional in the eventuality of a complete future lockdown, should also be explored.

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Evaluation sheet for first, second and third semester junior residents

Consultant signature

Date

First semester

- Basics of microscope, instrumentation, sutures and needles
- Basics of wound repair
- Goat eye training (first two classes)
- Class 1 - Hand-eye coordination on microscope
 - Various suturing techniques (cornea and sclera) on goat eyes and/or merocele sponge
- Class 2 - Steps of OGI repair
 - Make SICS and ECCE sections

Second semester

- Basics of microscope, instrumentation, sutures and needles
- Basics of ECCE, SICS and phaco
- Goat eye training (first two classes)
- Class 1 - Hand-eye coordination on microscope
 - Suturing on goat eyes and/or merocele sponge
- Class 2 - Steps of OGI repair
- Goat eye training (classes 3-8)
 - Section making
 - OVD insertion, capsulotomy/staining
 - Nucleus removal
 - IA - Manual
 - Closure
 - Classes 6-8 - Complete ECCE/SICS
- Simulator online course - CAT A and CAT B by October 2020
- Simulator Tier A by 30 November 2020
- Basic steps of phaco (classes 9-12)
 - Entry section
 - OVD, staining, CCC
 - Nucleotomy

Third semester

- Basics of phaco machine and phacoemulsification
- Online course
- CAT A
- CAT B
- Finish before your first posting in wet lab
- Simulator training
 - Tier A - Finish by 30.8.2020
 - Tier B - Finish by 15.10.2020
 - Tier C - Finish by 15.12.2020
 - Tier D
- Goat eye training 1st posting
- Section making
- OVD insertion
- Capsulotomy and staining techniques
- Goat eye training 2nd posting
- Nucleotomy
- Irrigation and aspiration
- Closure
 - Goat eye training 3rd posting
 - Complete phaco
 - Goat eye training 4th posting
 - Complete phaco

OGI=Open-globe injury, SICS=Small incision cataract surgery, ECCE=Extracapsular cataract extraction, OVD=Ophthalmic viscosurgical device, IA=Irrigation and aspiration, phaco=phacoemulsification, CCC=Continuous curvilinear capsulorhexis