Commentary: Simulators for vitreoretinal surgical training

The coronavirus pandemic had a devastating effect on human life and brought radical changes in all its aspects. It disrupted the working of all the sectors, with medical education taking the maximum brunt. Health care systems were reorganized to manage the exponentially rising number of coronavirus patients. The number of patients seeking health care in the ophthalmology department reduced drastically.[1] This gravely affected the surgical training of the budding ophthalmologists. We congratulate the authors for describing a three-pronged approach to ensure that vitreoretinal surgical training continued even in those challenging times.[2]

Vitreoretinal surgery is technically challenging and is associated with a steep learning curve. The surgical simulators have been shown to significantly enhance the surgical training during the early stages by improving the surgeon's hand-eye coordination, stereoscopy, and dexterity, thereby reducing the intraoperative errors. There are two approaches to training. First is the fixed schedule program, while the second is the mastery learning approach (i.e., training until a plateau stage is reached). It has been demonstrated that the mastery learning approach is a better as each trainee has his/her own individual learning curve.[3] The surgical competency of the trainees can be evaluated with the help of the Global Rating Assessment of Skills in Intraocular Surgery (GRASIS) scoring system.[4]

Surgical simulators can be classified into wet lab, that is, those using live or cadaveric animal models and human cadaveric models; dry lab, that is, those using synthetic models; and virtual reality, that is, those using computer-based systems.[5]

Currently, wet-lab models are used to practice steps of scleral buckling. Pujari *et al.*[6] described a model by using mannequin-mounted goat eyes to practice suture placement for scleral buckling. Earlier, Abrams *et al.*[7] suggested practicing and performing vitrectomy on anesthetized rabbits. Similarly, the authors in this manuscript have described performing various steps of vitrectomy on enucleated goat eyes.[2] This seems to be a good idea due to the easy availability of enucleated goat eyes and their anatomical similarities with the human eye. The model can be validated with the help of Messick's framework, which evaluates the content, response process, internal structure, relation to other variables, and consequences of the model.[8]

Two dry-lab models have been validated previously. Hirata *et al*.[9] developed a simulated eye for vitreous surgery by using Japanese quail eggs. The egg was fitted with a simulated silicone sclerocorneal cap, which had a median thickness of 8.0 mm and optical power of +54D. The model can be used to construct sclerotomies in the silicone cap, vitrectomy (considering yolk and albumen as vitreous body), and membrane peeling on the inner eggshell membrane. Yeh *et al*.[10] prepared a model by using the VitRet eye model (Phillips Studio, Bristol, UK) by injecting 3 mL of 10% half-and-half cream/normal saline solution to simulate vitreous. The model can be used to perform sclerotomy construction, core vitrectomy, epiretinal membrane removal, fluid–air exchange, and sclerotomy wound closure.

Computerized virtual models are gaining popularity as they help standardize the training as well as gauge the skill by using quantitative outcome measures. Hikichi *et al*.[11] proposed a virtual technology system for practicing surgical steps. Verma *et al*.[12] developed a vitreoretinal simulator for practicing the initial steps of vitreoretinal surgery. Currently, two validated virtual reality simulators are popular. Eyesi Surgical (VRmagic, Mannheim, Germany) is the most commonly used simulator. Its platform consists of a mannequin head that houses a model eye that can be rotated with the help of surgical instruments during the various intraocular manipulations and an operating microscope that can be moved, zoomed, and focused using a foot pedal. The surgical parameters can also be adjusted while performing different surgical steps. The eye is connected to a computer interface that enables the tracking of the surgical instruments and monitors hand pressure and tremor. The software contains several training modules that simulate different steps of the various vitreoretinal surgeries with increasing difficulty. The system records performance metrics, which are based on five criteria: target achievement, efficiency, instrument handling, microscope handling, and tissue treatment. The trainee needs to remember that mistakes during tissue handling (surgical complications) are very severely sanctioned.[8] Petersen *et al*.[13] showed that practicing the basic skills training modules is of little use and the trainees can directly proceed to simulation-based training modules. The MicroVisTouch (ImmersiveTouch, Inc, Chicago, USA) is another commercially available virtual reality simulator. Kozak *et al*.[14] customized the MicroVisTouch simulator by integrating optical coherence tomography scans of varying vitreoretinal conditions to the simulator. This enabled simulation training for epiretinal and internal limiting membrane peeling.

The cost for setting up such labs is high. Two separate analyses performed in 2013 suggested that the cost-to-benefit ratio of these labs is unfavorable. On the contrary, a recent study by the Royal College of Ophthalmologists argued that the labs prove to be cost-effective if the costs of surgical complication(s) are included.[5]

Simulators are now being regularly used as a part of training in high-risk occupations to minimize human errors. Similarly, simulators for medical training are gaining popularity to familiarize trainees with realistic problems in a controlled setting and help them acquire the necessary manual, cognitive, and technical skills. However, trainees should understand that they should not become overconfident while working on artificial tissues. It is imperative to mention that training on simulation models should be considered only an adjunct during the early phase of training and not as a replacement for the surgical experience on human eyes.

The coronavirus pandemic has provided a unique opportunity to revamp the medical education and make skills lab training a compulsory part of all the resident programs. The proposed three-pronged approach should be made a part of the vitreoretinal surgery training program even after the pandemic ends.[2]

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