# Commentary: Changing era of modern cataract surgery – The role of virtual reality-based simulators in manual small-incision cataract surgery training modules

Cataract surgery is one of the most commonly performed procedures worldwide. Considering training in cataract surgery, it has undergone a massive revolution because of constant research, innovations, and the availability of better-wet lab facilities.[1] During the earlier days of extra-capsular cataract extraction and manual small-incision cataract surgery (MSICS), the surgeons encountered higher intra-operative and post-operative complications because of a lack of structured training curriculum, limited hands-on training, and a lack of wet lab facilities. Simulation can be defined as an imitative representation of a process or system over time. A systematic simulation requires the use of simulating models. These models represent a step-by-step portrayal of a task enabling a real-time feel without performing the actual procedure.[2] With the introduction of the innovative concept of simulators, the training prospects have undergone a major drift resulting in better surgical outcomes. The use of simulators has resulted in a shorter learning curve, increased confidence during surgery, better tissue handling, lesser complication rates, and a reduced intra-operative time. A simulator also helps a trainee to receive feedback in the form of scores generated by the simulator without putting patients at risk. A number of viable surgical training methods available include Cadaveric eyes, artificial silicone eyes, goat's eyes, pig's eye, and VR-based simulation.[3]

Most of the simulators available in the market are for phaco-emulsification. There are very limited VR-based simulators available for MSICS. VR-based simulators would allow training with a no-contact technique. With the recent challenges such as coronavirus disease 2019, there is an urge to develop similar simulators at low cost that can be made available worldwide to ensure resident training even in situations with low patient load or temporary halt in elective procedures.[4] The addition of VR-based simulation has given a recent kick to simulation-based training in cataract surgery.

Mahr and Hodge,[5] in their analysis of 15 participants (12 residents, three experienced surgeons), demonstrated the use of the EYESi simulator regarding anti-tremor and forceps training. The experienced surgeons had better score, task time, and instrument-in-eye time parameters and showed 76% more precision during anti-tremor task modules. In a study by Banerjee *et al*.[6] among 12 post-graduate residents, a comparison of the steps of capsulorhexis was performed using the MicrovisTouch simulator versus live surgeries. They found a significant validity of the capsulorhexis circularity with a *P* value of <0.05. Laurell *et al*.[7] analyzed the PhacoVision simulator and reported positive feedback from the participants. In an analysis by Selvander and Asman[8] on 24 participants (17 trainees and seven senior surgeons) using an EYESi simulator, the construct validity of surgical steps including the capsulorhexis, hydro-manoeuvers, phaco-emulsification, navigation, forceps, cracking, and chopping training modules was evaluated. They used the video evaluation and found that senior surgeons scored better with the simulator for the steps, including capsulorhexis, navigation, and forceps use. The difference in scores was less evident in phaco-emulsification, cracking, and chopping steps. They noted no difference in hydro-manoeuvers between senior surgeons and trainees. However, with modified Objective Structured Assessment of Surgical Skills (OSATS) and OSA of Cataract Surgical Skill (OSACSS) tools for assessment, a significant difference between the two groups was noted in steps of capsulorhexis, hydro-manoeuvers, and phaco-emulsification. In their multi-centric randomized control trial, Nair *et al*.[9] studied the effectiveness of the HelpMeeSee Eye Surgery simulator in MSICS among resident surgeons (conventional and experimental groups) with no or minimal prior experience. Masked reviewers reviewed the surgical video of the first 20 attempts, and the total number of errors was calculated. The number of total, major, and minor errors was also more in CG groups compared to the EG group. This showed that novice surgeons trained with simulators performed better than the conventional surgeons in the first 20 attempts.

In the current study,[10] the authors have established the face and content validity of the HelpMeSee Eye Surgery Simulator, a virtual reality-based cataract surgery simulator for MSICS, and the authors must be congratulated for this interesting analysis. A total of 35 expert surgeons participated in the study, which is an excellent number to validate the model. Moreover, the study was conducted at the Comprehensive Cataract Conference 2nd World Conference on MSICS and Comprehensive Cataract Conference in Chennai, India, which further enhances the study's validity. The study participants were provided complete information and a training module for virtual reality-based simulation. The study analyzes four critical steps of MSICS: scleral tunnel dissection with a crescent blade, paracentesis incision with a stab entry blade, visco-elastic injection through the paracentesis, and anterior chamber entry with a keratome. The complete session usually lasted 45 minutes, and a short questionnaire was used to evaluate face and content validity. The results are encouraging, with approximately 74% of respondents agreeing that the overall visual performance of the eye and the instruments was realistic in the simulator. The visco-elastic injection was the most realistic task, and 77% believed that errors and complications were near realistic simulations. Approximately 94% believed that simulation would improve hand and eye co-ordination, which can be recommended for future generations. This is a first-of-its-kind virtual reality simulation for MSICS and will enhance the pattern of training in the near future. Similar simulators can be developed to promote research and uplift the standard of training globally. Simulators for MSICS will be a boon in developing countries such as India, Pakistan, Sri Lanka, and Bangladesh, where there is a huge backlog of cataract. This real-time virtual reality-based experience will minimize intra-operative complications during MSICS in inexperienced hands. We recommend more such models to revolutionize MSICS training globally.

***Kirandeep Kaur, Bharat Gurnani[1], Dharavath Venkatesh[2], Aprajita Sinha[4], Antarvedi Tejaswini[2], Jella Niharika[2], Arvind K Morya[3]***

Pediatric Ophthalmology and Strabismus, [1]Consultant Cornea, External Disease, Trauma, Ocular Surface and Refractive Surgery, Dr. Om Parkash Eye Institute, Amritsar, Punjab, India, [2]Department of Ophthalmology, [3]Cataract, Glaucoma, Refractive, Squint, Pediatric Ophthalmology and Medical Retina Services, All India Institute of Medical Sciences, Bibinagar, Telangana, India, [4]Specialty Doctor Ophthalmology, Worcestershire Acute Hospitals NHS Trust, Worcester WR5 1DD, United Kingdom

Correspondence to: Dr. Arvind K Morya, Cataract, Glaucoma, Refractive, Squint, Pediatric Ophthalmology and Medical Retina Services, All India Institute of Medical Sciences, Bibinagar, Hyderabad - 508 126, Telangana, India.
E-mail: bulbul.morya@gmail.com

## References

1. Allen D, Vasavada A. Cataract and surgery for cataract. BMJ 2006;333:128-32.
2. Berges AJ, Baam ZR, Zhu A, Sikder S, Yiu S, Ravindran RD, *et al*. Addressing the MSICS learning curve: Identification of instrument-holding techniques used by experienced surgeons. Int J Ophthalmol 2021;14:693-9.
3. Samia H, Khan S, Lawrence J. Simulation and its role in training. Clin Colon Rectal Surg 2013;26:47-55.
4. Buyego P, Katwesigye E, Kebirungi G, Nsubuga M, Nakyejwe S, Cruz P, *et al*. Feasibility of virtual reality based training for optimising COVID-19 case handling in Uganda. BMC Med Educ 2022;22:274. doi: 10.1186/s12909-022-03294-x.
5. Mahr MA, Hodge DO. Construct validity of anterior segment anti-tremor and forceps surgical simulator training modules. J Cataract Refractive Surg 2008;34:980-5.
6. Banerjee PP, Edward DP, Liang S, Bouchard CS, Bryar PJ, Ahuja R, *et al*. Concurrent and face validity of a capsulorhexis simulation with respect to human patients. Stud Health Technol Inform 2012;173:35-41.
7. Laurell CG, Söderberg P, Nordh L, Skarman E, Nordqvist P. Computer-simulated phacoemulsification. Ophthalmology 2004;111:693-8.
8. Selvander M, Asman P. Cataract surgeons outperform medical students in EYESi virtual reality cataract surgery: Evidence for construct validity. Acta Ophthalmologica 2012;91:1-6.
9. Nair AG, Ahiwalay C, Bacchav AE, Sheth T, Lansingh VC, Vedula SS, *et al*. Effectiveness of simulation-based training for manual small incision cataract surgery among novice surgeons: a randomized controlled trial. Sci Rep 2021;11:10945. doi: 10.1038/s41598-021-90410-4.
10. Nair AG, Ahiwalay C, Bacchav AE, Sheth T, Lansingh VC. Assessment of a high-fidelity, virtual reality-based, manual small-incision cataract surgery simulator: A face and content validity study. Indian J Ophthalmol 2022;70:4010-5.



**Access this article online**

**Quick Response Code:**

**Website:** www.ijo.in

**DOI:** 10.4103/ijo.IJO_2233_22

**Cite this article as:** Kaur K, Gurnani B, Venkatesh D, Sinha A, Tejaswini A, Niharika J, *et al*. Commentary: Changing era of modern cataract surgery – The role of virtual reality-based simulators in manual small-incision cataract surgery training modules. Indian J Ophthalmol 2022;70:4016-7.