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EDITORIAL

When it goes wrong, a chance to try again: ophthalmic surgical simulation training borrowed from flight-crash re-runs

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Abstract

Surgical simulation is now a requirement in many training bodies. Ophthalmology is privileged with the existence of a high-fidelity simulation system to aid in cataract surgery training. A new model for surgical simulation in ophthalmology is proposed, borrowing from flight-crash simulations used in the aviation industry, to improve outcomes. Trainees and experienced surgeons would have the opportunity to practice increasingly challenging pre-built scenarios on a simulator to better prepare them for facing complex and unusual situations which they may not have otherwise encountered during training and clinical practice.

Keywords: *cataract surgery; surgical simulation; ophthalmology; flight simulation*

Introduction

In surgical training, the “see one, do one, teach one” Halstedian model in teaching surgical procedural skills has been challenged recently.[1] Surgical coaching can be better comprehended when applying the four stages of learning to surgical training skills.[2] Stage 1 is where a trainee is “unconsciously unskilled” on how to perform the surgery. After joining the training programme, the trainee then progresses to stage 2 where teaching about the surgery takes place, both theoretically and using dry and wet labs. The trainer starts by showing the trainee the surgery in theatre using cameras fixed to the operating microscope. The trainee conducts some self-directed reading as well from external resources and then starts taking steps in performing the surgery and becomes “consciously unskilled”. Personal coaching and positively directed criticism are invaluable at this stage. Progression is then to being “consciously skilled”, which is stage 3. Finally, automated muscular commands enable the trainee to perform the skills without effort, hence becoming “unconsciously skilled”.

Our aim is to propose a new model based on how pilot training academies teach people to fly planes, and to apply this to cataract surgery.

Gap in current surgical training

One problem facing current surgical training is that complex surgical cases are not usually accessible to trainees and hence they do not become accustomed to properly dealing with them. A trainee may never encounter rare clinical events or rare complications of surgery during his years of training and, therefore, may not develop the skills and experience to manage those situations.

Sawyer et al.[3] more recently proposed a new framework for procedural skills training in medicine. They suggested starting with a theoretical “learning” phase in which the trainee reads and watches videos about the procedure, followed by “seeing” the trainer performing it live and explaining the steps to the trainee. Those two steps comprise the cognitive phase of learning. Then comes the psychomotor phase in which the trainee “practices” using a simulator for training, to be followed by the “prove” phase in which the progress is assessed to be of a satisfactory level to proceed to “doing” the procedure on human patients. A final stage of “maintenance” then concludes, during which performance is continually audited and reassessed.

This caters to all four learning styles described by Kolb,[4] and puts the full circle of Honey and Mumford’s learning cycle[5] into effect. Theorists will enjoy the learning part exploring the different literature discussing the subject matter; activists will look forward to practicing on simulators and then later with live patients; reflectors can look back on the theory and different techniques observed during teaching to decide the best way to execute the skills; and pragmatists can then plan on the quickest and most efficient way after auditing their outcomes.

Cataract surgery is the most common procedure in the United Kingdom.[6] Despite that, and perhaps because of it, the need for training new doctors to perform it is extremely important. It is towards this goal that the Royal College of Ophthalmologists has recommended the use of automated computer-based simulators in cataract surgery training.[7] Cataract surgery training using wet labs and animal eyes has had its role in surgical education. Many drawbacks of such systems have been described, such as being unrealistic as a representation of the actual eyes and difficulty in obtaining and disposing of specimens. Also, the difficulty in formulating viable training objectives and recording training progression has reportedly stigmatized those systems.[8] The Eyesi (VR Magic AG, Mannheim, Germany) is the most widely researched virtual reality simulator (VRS) available for cataract surgery and has been adopted by teaching faculties and colleges across Europe and the United States. Various studies have tried to assess the simulator and its potential benefits for ophthalmic trainees. One study aimed to explore the level of experience of a group of surgeons on real-life patients with the level of accomplishment of various modules on the VRS and found it to be highly correlated.[9]

Borrowing from flight simulation models in training

It has been suggested that the use of VRS is better augmented by incorporating it into a proper training curriculum.[10] Clear and well-defined objectives are needed and must be embedded into the curriculum in a stepwise manner.

Our proposed model is based on the current system used by pilot training academies to teach flying of planes.[11] Flight simulation has been shown to be safer, more effective and better for the environment than in-flight training.

Furthermore, our model suggests adding the concept of continuous improvement and revalidation of training efficiency to deal with various scenarios and complications. Under this model, the progress of a trainee from one stage to the next is not solely based on passing exams or documenting and logging workplace-based assessments (WBA) or direct observation of procedural skills (DOPS). The incorporation of the "human" factor can taint these assessments with subjectivity as a result of a lack of measured objective parameters. We suggest that progress in training should be demonstrated, among other parameters, by the ability to safely and effectively deal with increasingly challenging pre-built scenarios on the simulator. Various "test" modules could be implemented with real-life scenarios, such as the lack of certain instruments or patients facing other co-pathologies during surgery, to test the trainees' ability to adapt and respond in these situations. Furthermore, revalidation for fitness to perform these procedures could be governed by re-examining the surgeon on modules more relevant to their level of experience. This could provide measurable and attributable evidence that the surgeon is fit to operate. Much like drivers need to revalidate their driving license regularly to ensure safety on the road, the same concept could be applied to surgeons. Ophthalmology has been privileged in this respect by its use of slit lamps and surgical microscopes. In a sense, most of the ophthalmic procedures are performed from behind a lens piece; which makes it as close to virtual reality as possible. Ophthalmic training therefore lends itself naturally to the uptake of a virtual reality system for training. A similar application of such concepts can be applied to other fields of surgery such as surgical endoscopy or ENT microsurgery, and thus the model can go beyond cataract surgery and ophthalmology. This can be demonstrated by the flowchart in Fig. 1.

The simulator, in addition, can be programmed to mimic various complex situations that could be faced by the surgeon. It can potentially provide an opportunity for the trainee, and even the trainer and any practicing surgeon, to revisit previous "flight crashes", i.e. surgical situations that are

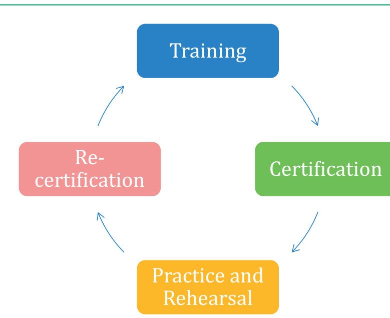

Figure 1. Flow chart demonstrating suggested training modules. Training: "test" modules with measurable and attributable evidence; increasingly challenging pre-built real-life scenarios on the simulator. Rehearsal: rehearsal of previous "flight crashes"; surgical situations that are unique and that the surgeon may never have faced before. This can be simulated in a controlled environment and various methods tried to resolve the complication, and thus, be ready to face it again. Re-certification: revalidation by re-examining the surgeon on modules more relevant to their level of experience for fitness to perform these procedures.

unique, and which the surgeon may have never faced before. This can be simulated in a controlled environment, and various methods tried by the trainee to resolve the complication, and thus, making them ready to face it again. We suggest coining a new term, continuing surgical simulation (CSS). Much like continuing medical education (CME), CSS describes the need to continue developing surgical skill throughout professional life. This model we feel is very similar to how flight crashes are re-run in simulators to provide a tool for revalidation and continuous training to achieve maximum learning outcomes.

Conflict of interest

None declared.

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References

1. Rodriguez-Paz JM, Kennedy M, Salas E, Wu AW, Sexton JB, Hunt EA, et al. Beyond "see one, do one, teach one": toward a different training paradigm. Postgrad Med J 2009; 85: 244–249. https://doi.org/10.1136/qshc.2007.023903.
2. Adams L. Learning a new skill is easier said than done. Available from: http://www.gordontraining.com/free-workplace-articles/learning-a-new-skill-is-easier-said-than-done/. Accessed 15 June 2018.
3. Sawyer T, White M, Zaveri P, Chang T, Ades A, French H, et al. Learn, see, practice, prove, do, maintain: an evidence-based pedagogical framework for procedural skill training in medicine. Acad Med 2015; 90: 1025–1033. https://doi.org/10.1097/ACM.0000000000000734.
4. Kolb DA. Experiential learning: experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall; 1984.
5. Honey P, Mumford A. The manual of learning styles. 3rd revised edition. Peter Honey Publications; 1992.
6. NHS: Cataract surgery - NHS choices. http://www.nhs.uk/Conditions/Cataract-surgery/Pages/Introduction.aspx. Accessed 15 June 2018.
7. Royal College of Ophthalmologists. Simulation in training 2015. https://www.rcophth.ac.uk/training/ost-information/simulation/ Accessed 15 June 2018.
8. Solverson DJ, Mazzoli RA, Raymond WR, Nelson ML, Hansen EA, Torres MF, et al. Virtual reality simulation in acquiring and differentiating basic ophthalmic microsurgical skills. Simul Healthc 2009; 4: 98–103. https://doi.org/10.1097/SIH.0b013e318195419e.
9. Thomsen AS, Kiilgaard JF, Kjaerbo H, la Cour M, Konge L. Simulation-based certification for cataract surgery. Acta Ophthalmol 2015; 93: 416–421. https://doi.org/10.1111/aos.12691.
10. Khalifa YM, Bogorad D, Gibson V, Peifer J, Nussbaum J. Virtual reality in ophthalmology training. Surv Ophthalmol 2006; 51: 259–273. https://doi.org/10.1016/j.survophthal.2006.02.005.
11. Allerton DJ. The impact of flight simulation in aerospace. Aeronaut J 2010; 114: 747–756. https://doi.org/10.1017/S0001924000004231.