# The Changing Landscape of Surgical Education and Training

Traditionally, surgical handicraft has been taught and learned through a structured training program and proctorship.[1] The orthodox apprenticeship approach of surgical training where trainees would fortuitously learn from their supervisors while essentially delivering service is no longer sustainable. Recently, this landscape of surgical education and training has significantly evolved due to the complexity of procedures, technological developments in bioengineering, and the need for a longer training curve for the trainees.[2] The core purpose of surgical training is to ensure that the trainee surgeons develop the right personality, attitudes, and professional competence that will equip them with the desired surgical as well as nontechnical surgical skills. Technical surgical skills encompass manual dexterity, while situation awareness, leadership, and effective communication are considered as nontechnical surgical skills. Unfortunately, a significant decrease of training hours in North America and Europe and issues about patient safety have challenged the impact of accredited training programs in all surgical subspecialties.[3] Development of validated and structured parallel surgical training programs with the state-of-the-art surgical tools is needed that can bridge educational gaps within the context of cognitive and psychomotor skills. Unfortunately, there is a dearth of evidence that can shed light on such surgical educational programs with the potential to complementing the surgical trainees' skills.

From the perspective of general surgery, the Advanced Trauma Operative Management (ATOM) is an established surgical training program, accredited and run by the American College of Surgeons, which includes six 30-min lectures followed by a 3-h laboratory session about the management of severe trauma.[4] The laboratory sessions used in ATOM are particularly useful in providing hands-on surgical training in a virtual environment. A host of accredited surgical training centers are available across the globe: the l'Institut de Recherche contre les Cancers de l'Appareil Digestif in Strasbourg, France, demonstrates live operations to the participants and uses dry and wet laboratories and then hands-on training in animal laboratories; the Cuscheiri Skills Centre at the University of Dundee, UK, has limited training experience due to restrictions on the use of animals in the UK; the Methodist Institute for Technology, Innovation and Education Houston, USA, utilizes a range of theoretical and practical sessions for the surgical trainees.[5] A newer European surgical training center, Academy for Int'l Minimally Invasive Surgery Milan Italy, has shown great promise in providing versatile training courses in surgical subspecialties.[6] In addition, the center has successfully set up a model of surgical telementoring in remote areas for a laparoscopic colorectal training program that included a theoretical master class, practical modules, telementored sessions in experimental settings, and finally telementoring a surgeon in remote areas of Russia from Italy.[7]

Simulation-based surgical training tools have shown great promise in promoting experiential learning, securing patient safety, and recreating rarely encountered scenarios.[8] At the same time, the next-generation modern simulators have the ability to assess the trainees' skills and competence in diverse situations. Two most popular versions are mechanical and virtual reality simulators that provide training without supervision or time constraints. There is substantial evidence that video games enhance the impact of surgical training by promoting spatial attention, cognitive skills, and hand-to-eye coordination.[9] However, the effectiveness of video gaming in transferring the desired surgical skills that are comparable to the operating room (OR) experience has not been validated yet. The utility of animal laboratories in surgical education, training, and research has been well established.[10] In addition, animal laboratories are valuable platforms for the initial applications of experimental innovative technique.[11] For certain surgical subspecialties such as general, vascular, urology, and cardiothoracic surgery, live animal surgery remains the best training model, offering high fidelity that is unmatched by other kinds of simulation models.[12] Such laboratories are also free from medicolegal concerns. For orthopedic and plastic surgeries, particularly hand and joint replacement, there is growing evidence that cadaveric laboratories augment surgical education and training, particularly if the use of such laboratories is preceded by simulator-based training.[13]

Orthopedic surgery is a versatile surgical discipline that contains sports medicine, arthroplasty, pediatric orthopedics, hand and upper-extremity surgery, foot and ankle surgery, spine surgery, trauma, and musculoskeletal oncology. This array of subspecialties requires every single trainee to complete training in general orthopedics and then in his/her selected subspecialty. In addition to the aforementioned surgical training tools, a touch surgery, simulation-based training tool, has been recently introduced for training in orthopedic surgery. The touch surgery is a clinical smartphone application that fosters surgical acumen of the trainees in operations such as intramedullary femoral nailing and tendon repair. Sugand *et al*. investigated the effectiveness of touch surgery for cognitive simulation in intramedullary nailing.[14] The authors have observed that the graphics, quality of simulation, and procedural steps by touch surgery had high fidelity. In another study, Ramírez León *et al*. investigated the multispecialty

learning processes during the use of biological and mechanical simulators in discectomy for degenerative discopathies in a minimally invasive spine surgery program.[15] The observers reported that the use of simulators significantly enhanced the training experience of residents of spine surgery and have argued that different training models could be effectively used for training all surgical residents. Another fascinating training tool is cigar box arthroscopy trainer (CBAT) that utilizes cigar boxes, drilled and then covered with discarded bicycle tubing. Different objects are placed inside the box and the trainees are instructed to sequentially complete certain tasks.[16] In CBAT, educational material in the form of videos, clips, and reading text with the protocols is placed online into the cloud storage system. Hybrid OR uses a three-dimensional (3D) fluoroscopic imaging and navigation system, which allows the trainee to place implants for patients with orthopedic trauma and even in spine and pelvis surgery by minimally invasive as well as conventional approaches. For establishing an immaculate reduction and implant position, the 3D imaging is used that avoids the need for a postoperative computed tomography confirmation.

As surgeons' intraoperative nontechnical skills are significantly correlated with the outcome of the surgical procedure, it is imperative to gauge surgeons' nontechnical surgical skills in the OR. The assessment tool of Surgical Team Assessment Record (STAR) is commonly employed in evaluating the trainees' nontechnical surgical behaviors in the OR.[17] STAR has the ability to assess the organizational, situational, teamwork, and personal traits that might influence a surgeon's conduct in the OR. Modern surgical education strategies delivered by trained instructors, regular faculty development programs for the instructors, and provision of immediate and constructive feedback play crucial roles in enhancing the surgical competence of the trainees.[18]

To wrap up, financial constraints, reduction in training hours, long learning curves needed to master the state-of-the-art cutting-edge surgical technologies, medicolegal claims, and patient safety concerns urge the surgical educators to explore and develop more cost-effective surgical educational platforms that can be employed outside the OR. The striking difference between surgical and nonsurgical training programs is the need for a hands-on structured training agendum that gradually enhances the trainee's surgical competence in the OR. Thus, the orchestra of surgical education is more complex and interwoven that embraces professional training inside and outside the OR. Educators have a wide spectrum of innovative tools for virtual reality training outside the OR such as box trainers, simulation, video gaming, CBAT, hybrid ORs, and telementoring. These gadgets provide a 3D graphical recreation of human anatomy, can re-enact hemorrhage, and can assess performance in the absence of a content expert by a predetermined scoring system. However, as of today, no structured and accredited surgical education program can be offered that can comprehensively supplement the training gaps at workplaces. There is a pressing need to develop globally acceptable validated surgical training programs across all surgical disciplines, and there is a need to develop more training tools in every subspecialty and for every group of similar procedures.

**Salman Y. Guraya**

Department of Clinical Sciences, College of Medicine, University of Sharjah, Sharjah, UAE

**Address for correspondence:** Prof. Salman Y. Guraya, Department of Clinical Sciences, College of Medicine, University of Sharjah, Sharjah, UAE.
E-mail: salmanguraya@gmail.com

## References

1. Kneebone R. Simulation in surgical training: Educational issues and practical implications. Med Educ 2003;37:267-77.
2. Jeon S, Park J, Chien J, Hong J. A hybrid method to improve target registration accuracy in surgical navigation. Minim Invasive Ther Allied Technol 2015;24:356-63.
3. Reznick RK, MacRae H. Teaching surgical skills – Changes in the wind. N Engl J Med 2006;355:2664-9.
4. Jacobs LM, Burns KJ, Luk SS, Marshall WT 3rd. Follow-up survey of participants attending the advanced trauma operative management (ATOM) course. J Trauma 2005;58:1140-3.
5. Malassagne B, Mutter D, Leroy J, Smith M, Soler L, Marescaux J, *et al.* Teleeducation in surgery: European institute for telesurgery experience. World J Surg 2001;25:1490-4.
6. Guraya SY, Forgione A, Sampogna G, Pugliese R. The mapping of preferred resources for surgical education: Perceptions of surgical trainees at the Advanced International Minimally Invasive Surgery Academy (AIMS), Milan, Italy. J Taibah Univ Med Sci 2015;10:396-404.
7. Forgione A, Kislov V, Guraya SY, Kasakevich E, Pugliese R. Safe introduction of laparoscopic colorectal surgery even in remote areas of the world: The value of a comprehensive telementoring training program. J Laparoendosc Adv Surg Tech A 2015;25:37-42.
8. Thomsen AS, Subhi Y, Kiilgaard JF, la Cour M, Konge L. Update on simulation-based surgical training and assessment in ophthalmology: A systematic review. Ophthalmology 2015;122:1111-30.e1.
9. Jalink MB, Goris J, Heineman E, Pierie JP, Ten Cate Hoedemaker HO. Face validity of a Wii U video game for training basic laparoscopic skills. Am J Surg 2015;209:1102-6.
10. Whitehurst SV, Lockrow EG, Lendvay TS, Propst AM, Dunlow SG, Rosemeyer CJ, *et al.* Comparison of two simulation systems to support robotic-assisted surgical training: A pilot study (Swine model). J Minim Invasive Gynecol 2015;22:483-8.
11. Sun YH, Wu Z, Yang B. The Laparoscopic Animal Lab Training Module. The Training Courses of Urological Laparoscopy. Springer; 2012. p. 45-59.
12. Swindle MM, Smith AC, Hepburn BJ. Swine as models in experimental surgery. J Invest Surg 1988;1:65-79.
13. Karam MD, Pedowitz RA, Natividad H, Murray J, Marsh JL. Current and future use of surgical skills training laboratories in orthopaedic resident education: A national survey. J Bone Joint Surg Am 2013;95:e4.
14. Sugand K, Mawkin M, Gupte C. Validating touch surgery™: A cognitive task simulation and rehearsal app for intramedullary femoral nailing. Injury 2015;46:2212-6.
15. Ramírez León JF, Alonso Cuéllar GO, Rugeles Ortiz JG, Ramírez Martínez C. Multispecialty and multilanguage training in spine surgery: A Latin-American experience. Educ Méd 2016;17:61-6.
16. Sandberg RP, Sherman NC, Latt LD, Hardy JC. Cigar box arthroscopy: A Randomized controlled trial validates nonanatomic simulation training of novice arthroscopy skills. Arthroscopy 2017;33:2015-23.e3.

17. de Leval MR, Carthey J, Wright DJ, Farewell VT, Reason JT. Human factors and cardiac surgery: A multicenter study. J Thorac Cardiovasc Surg 2000;119:661-72.
18. AlHaqwi AI, Taha WS. Promoting excellence in teaching and learning in clinical education. J Taibah Univ Med Sci 2015;10:97-101.



**Access this article online**

**Quick Response Code:**

**Website:** www.journalmsr.com

**DOI:** 10.4103/jmsr.jmsr_43_17

**How to cite this article:** Guraya SY. The changing landscape of surgical education and training. J Musculoskelet Surg Res 2018;2:1-3.