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SHORT COMMUNICATION

Simulation training in hand surgery — where are we now and where should we be?

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Traditionally, surgical training has been formed by patient-based exposure in the operating theatre, clinic or emergency room, starting from a role as an observer working towards the role as main operator. There is an ever growing complexity of surgical interventions and there is an ever heightened focus on theatre efficiency [1]. While nothing can compare to the haptic and visual experience of managing real tissue, many simulation tools have today shown to be realistic and useful adjuncts for surgical trainees.

A big part of the hand surgery curriculum is based on fracture management; as a result, the development of synthetic bone substitutes for fracture fixation skills is under constant advancement. However, the limitations that have been recurring despite multiple modifications to the material throughout the years have been that the "true feel" of a real bone is lacking and that there is little consideration of the soft tissue anatomy surrounding the bone [2]. The onset of this decade saw significant improvement in simulation models as progress in 3D printing technologies allows the use of materials that are better suited as biomimetics [3, 4]. Today, there are a variety of options where simulation has given surgical trainees an option to practice technical skills outside the operating theatre. This proved to be of particular importance during times of limited theatre exposure time for trainees, such as the COVID-19 pandemic, which has severely limited operating opportunities. For instance, in our centres, the limited surgical cases that did go ahead were predominately single-led, commonly, by a senior surgeon [5].

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Haptic simulation is a relatively new introduction to the simulation field and while we still have a long way to go when it comes to creating realistic imitations of human tissue, many new 3D printed options are becoming available on the market. Just in the last year, Maier et al. printed a phantom hand with considerations to both hard and soft tissues — allowing for bony protrusions to be palpable — an important factor in fracture fixation operations [6]. Though, when testing it, the models generated had a mixed reception amongst participants.

Another facet of simulation training in hand surgery is the use of software to simulate the steps and the environment of a surgical procedure. In 2019, a study by Tulipan et al. was undertaken to assess how useful a free smartphone app (Touch Surgery) was for medical students and surgical trainees in view of performing a routine hand procedure — a carpal tunnel release [7]. It was revealed that all three cohorts (junior, intermediate and expert) performed better on average after practicing with the app. Furthermore, the more junior trainees were found to be more keen towards simulated training compared to the more senior surgeons scoring the app with higher score in usefulness as a training tool.

Finally, another aspect of surgical training exemplified by the pandemic was the need for training under reduced physical, human contact. While human contact cannot be eliminated completely, recent advancement in AI augmented reality and robotic technology can be used to meet this challenge [8], to allow the continuation of surgical training during pandemics without increasing the risk to the patient or surgeon.

We believe that the future of hand surgery training requires a combination of simulation and patient exposure. While simulation poses a great way of safely practicing a procedure, further work is still needed on improving the haptical experience with better material mimics and also on improving the visual environment. The latter could potentially benefit from the emergence of virtual reality environments which when combined with a realistic haptic component could generate further validity to the overall training framework.

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Declarations

Ethical Approval This article does not contain any studies involving human participants or animals performed by any of the authors. For this kind of study no ethical approval is required.

Conflict of interests Rebecca Harsten, Theodora Papavasiliou and Lauren Uppal declare no conflict of interest.

Consent to participate Not applicable, no patients were used for this study.

References

1. Thorburn H, Khanna S, Boyle J, Good N, Steyn M (2014) Analysis of operating theatre utilisation to drive efficiency and productivity improvements. Stud Health Technol Inform 204:163–168
2. Stirling ER, Lewis TL, Ferran NA (2014) Surgical skills simulation in trauma and orthopaedic training. J Orthop Surg Re 9:126
3. Farrell DA, Miller TJ, Chambers JR, Joseph VA, McClellan WT (2020) Three-dimensionally-printed hand surgical simulator for resident training. Plast Reconstr Surg 146(5):1100–1102
4. Papavasiliou T, Chatzimichail S, Chan CYJ, Bain JC, Uppal L (2021) A standardized hand fracture fixation training framework using novel 3D printed ex vivo hand models: our experience as a unit. Plast Reconstr Surg Glob Open 9:e3406
5. Papavasiliou T, Uppal L (2021) Our hand surgery unit's technological advances in 2020. J Hand Surg Eur 46(6):687–688
6. Tulipan J, Miller A, Park AG, Labrum JT, Ilyas AM (2019) Touch Surgery: analysis and assessment of validity of a hand surgery simulation "app." Hand (N Y) 14(3):311–316
7. Maier J, Weiherer M, Huber M, Palm C (2020) Optically tracked and 3D printed haptic phantom hand for surgical training system. Quant Imaging Med Surg 10(2):340–355
8. Zemmar A, Lozano AM, Nelson BJ (2020) The rise of robots in surgical environments during COVID-19. Nat Mach Intell 2:566–572