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## Editorial

## Changes to Training Practices during a Pandemic - The Experience of the Irish National Trauma & Orthopaedic Training Scheme

### Introduction

Training orthopaedic surgeons has traditionally utilised the 'Halstedian model', whereby skills and knowledge were attained from hours spent under direct tutelage both in and outside operating theatres [1]. Challenges such as the reduction in permitted in working hours have led to dramatic change in training programmes. In response, trainers have embraced new methods, such as virtual training and simulation [2]. These changes to surgical training pathways required careful planning, not only to maintain standards when producing surgeons, but also to safeguard high standards of clinical care [3].

Unlike previous challenges, the COVID-19 pandemic has mandated unprecedented change, without prior warning [4]. Overnight, training programmes were forced to abandon group, and the majority of face-to-face training. It is not yet known how long these restrictions will last. Trainers have turned to distance learning to facilitate continued teaching. There has been a paradigm shift towards video-based teaching and simulation [5]. What were (only months ago) considered peripheral adjuncts now comprise a central role in current surgical training [6]. The potential opportunities and drawbacks of this "new normal" will merit close scrutiny. What do we know of video-based teaching for surgeons? Is it effective? Specifically, is it effective in orthopaedic training? We know that simulation is gaining momentum in surgical training, but what are the limits to its potential?[7]

Simulation generates an environment to practice basic skills and decision-making, but ultimately the participants know they are working within fabricated scenarios. Furthermore, the myriad of additional challenges posed when operating on a real patient in a real operating theatre is almost impossible to simulate. This begs the question: does simulation offer a genuine reflection of the environment that is the operating theatre? Furthermore, what are the possible implications of decreased patient contact on surgical training? In this editorial we will attempt to summarize not only what is known, but perhaps more importantly what is not known about the implications of the COVID-19 pandemic on orthopaedic training. Furthermore, it will share the experience of a National Trauma & Orthopaedic Surgery Training Scheme with specific focus on our continued training throughout the COVID-19 pandemic.

### Traditional Learning versus Competency Based Learning – An Ongoing Evolution

Orthopaedics training is a competitive and demanding task for surgical training programmes globally. As noted above, the 'Halstedian model' has been the template of surgical training across the globe [8]. Often referred to as the 'apprenticeship model', in Halstedian training, surgical skills are obtained from hours spent under supervision of a skilled trainer [9]. This apprenticeship-style was focused on the 'see one, do one, teach one' mantra [10], however, a poverty of experience was a common and recurring issue, leading to concerns for patient safety [11]. In the UK (and elsewhere), apprenticeship-styled training has since been updated to competency-based learning [12]. Restrictions to working hours have resulted in significant reduction in time spent in clinical practice for trainees, with some reports claiming training hours have been reduced to one fifth [13,14]. Rather than relying solely on hours spent in training, surgical trainees must now demonstrate competency in all core surgical procedures prior to being recognized as independent specialists [15].

### Principles of Distance Learning and the Advent of Simulation

Distance learning involves teaching of a pre-determined curriculum using traditional and virtual learning styles, which are applicable to trainees who may engage with it remotely. The routine use of remote teaching, including virtual classrooms and videoconferencing, offer training bodies an opportunity to deliver standardized teaching to trainees, whilst allowing for 'what if' questioning as an acceptable element of learning, without potentially compromising patient safety [16]. 'Telementoring' has stemmed from a similar concept; whereby an expert surgical trainer can offer real-time supervision with trainees to teach, practice and assess a range of techniques, as well as offer feedback [17]. However, despite these methods of training being available for several decades, they failed to win widespread uptake in surgical training.

With popularization of simulation by Kneebone and associates, the role of distance learning in surgical training was dramatically changed [18]. Surgical simulation supplements both clinical and intra-operative learning, by developing theoretically transferrable skills from the simulation suite into patient care. Furthermore, simulation enables surgical trainees to develop muscle memory by practicing more challenging cases and maneuvers, without the additional stress which is inevitable when operating on a real life pa-

tient. However, despite simulation being augmentative to 'on-the-job' hospital learning, it is not without its drawbacks. For instance, simulation often requires significant investment in new technology as well as construction of simulation theatres. This is viewed as not only costly, but also time and resource consuming. Others have countered these claims by suggesting that simulation does not always mandate a drain on resources [19]. Isn't practicing knot tying a variation of simulation? Is practicing your casting method on peers or a mannequin not simulation?

The COVID-19 pandemic has further limited trainee access to clinical training. Therefore, all the potential of all alternative training methods must be maximized, as an opportunity for incorporation of distance learning into surgical training and simulation, with the potential of establishing its role as routine core curriculum for future trainees.

### **Adult Learning**

Almost a century ago, Lindeman et al. proposed that adults learn more efficiently in a situational environment rather than the traditional classroom [20]. Adults thrive on empowerment of their own learning [21]. For example, adults have been shown to learn most effectively when they control their own targets, work environment and timeline, thus maximising their productivity. Distance learning could allow orthopaedic trainees to personalize many aspects of their learning, such as targets and deadlines, maximizing the potential of the increased time spent away from clinical practice (due to the current pandemic).

### **Distance Learning in Surgical Training**

Similar to the fundamentals of aviation and military based learning, surgical training mandates an experience-based format [22]. In response to working time restrictions, distance learning in the form of video-based remote learning, telementoring and simulation have become increasingly common in many training programmes. Distance learning empowers surgical trainees to learn theoretical surgical knowledge outside the working environment, reserving the limited time in the operating theatre with an expert-trainer for the development of manual, specialist surgical skills. Distance learning has also been utilized as a supplemental resource to augment traditional teaching methods [23]. The role of distance learning in the form of both virtual classrooms and simulation in surgical training is gaining recognition within the literature [24,25]. Kingsnorth et al. previously reported that the videoled virtual classroom environment is not only an effective method of teaching doctors from distance, but also results in high rates of student satisfaction [26]. It has also been suggested that telementoring of trainees may yield similar clinical outcomes, comparative operative times and complication rates when compared to those with an on-site hospital mentor [27,28].

While the use of virtual classrooms and telementoring may be increasing, there is very limited evidence at present to support their adoption. However, this is not the case for surgical simulation, which offers surgical trainees an opportunity to hone their skills remotely, prior to operating [29–34]. The major disadvantage with simulation in the literature is the expense associated and the required technology being tied permanently to a single location (a centrally located simulation suite). As many surgical trainees are often rotating through peripheral hospitals with no access to the simulation suite, utilizing the available simulation resources was beyond the grasp of the majority of trainees. In an effort to remedy this, Kneebone et al. proposed the use of easily transportable simulation suites, or 'distributed simulation'. This solution offered a suitable alternative at a fraction of the cost of traditional surgical simulation suites [18,19].

However, surgical simulation does not always require a suite. Kneebone et al. have had success using unorthodox and cost effective methods such as textile anatomic learning tools. This allowed trainees practice the step-by-step tensile approach to procedures; therefore satisfying the definition of surgical simulation [35]. The work of Kneebone challenges assertion that simulation mandates heavy financial investment. Nevertheless, while there is a substantive evidence for simulation as an effective training tool for specified skills, robust evidence does not support transferability of these skills into the operating theatre [36]. This is perhaps unsurprising. As noted above, simulation cannot account for the numerous, unpredictable external factors that occur in the operating theatre must be taken into account [37].

### **Distance Learning with Specific Respect to Orthopaedic Surgical Training**

Although video-based teaching enables effective supplementary, as well as core curricular teaching [38], few institutions have reported their experience with distance learning in training orthopaedic surgeons in the form of video-based remote teaching or telementoring. However in 2014, the American Association of Orthopaedic Surgeons (AAOS) published their exhibit in relation to the promising outlook of using telementoring in training orthopaedic surgeons, reporting that it enhances training opportunities without increasing operative times [17]. Despite these optimistic findings, little has been published in relation to telementoring in orthopaedic training since then, with the majority of the literature focusing on simulation in this field specifically.

With respect to the acquisition of orthopaedic skills, many studies have demonstrated that simulation results in improved clinical outcomes with proportional reduction in operating times, however not without substantial cost [39]. Previous literature has demonstrated that non-suite simulation offers an ideal platform in order to teach new orthopaedic interns the basic skills of splinting, casting, suturing and knot tying [40]. Furthermore, Seeley et al. proposed that mobile life-sized prosthetic limbs are a suitable teaching adjuncts for practicing and mastering the skills of fracture reduction and immobilization [41], whilst further studies have demonstrated standard-driven cast removal simulation training to aid trainee learning and ensure patient safety [42,43].

Although applicable for many orthopaedic procedures, simulation suites are predominantly being used for joint arthroscopy practice in orthopaedic training. The basics of arthroscopy are now considered a core skill in training; with numerous studies having demonstrated improved trainee performance following the use of simulators [7,44–48]. However, as with other forms of simulation, the transferability of these skills to clinical practice has not yet been assessed [49]. Additionally, inconsistencies in reporting and the lack of a competency-based assessment of simulation confound a major portion of the academic reporting, which further highlights the need for standardized simulation to ensure it acts as an augmentative teaching tool in orthopaedic training [50].

The Association of Surgeons in Training (ASIT) proposed that a standardized, competency-based simulation curriculum must be accepted amongst collaborating training bodies prior to implementing simulation into training programmes [51]. Additionally, this curriculum must facilitate simulation as an element of core training for trainees, with potential out-of-hours accessibility available to all trainees [49]. As the trainees of many collaborating training schemes use common exit examinations, this standardization of simulation training is paramount to maximize training potential of future orthopaedic surgeons. However, as the body of evidence supporting simulation continues to grow without agreed standardized competency-based standards, one must realize that the list of inconsistencies in reporting will also do so proportion-

ally. This poses a potential question whether the implementation of, and also the transferability of, unstandardized surgical simulation into clinical practice may set an uneven playing field for trainees between the various intercollegiate training bodies.

A 2018 editorial proposed that we ask ourselves as to whether continued virtual reality simulation and distance learning in orthopaedic surgical training, as we know it, is “realistically helpful, or virtually useless?” [50]. The subsequent arrival of a pandemic and further pressurization of clinical training time makes this question timely. The standardization of video-based remote teaching, as well as simulation, offers potential platforms of orthopaedic training, which were previously deemed supplementary, but overnight have become essential in response to the unprecedented COVID-19 pandemic [52].

### **The Experience of the Irish National Trauma & Orthopaedic Surgery Training Scheme**

Alongside the provision of medical care during the pandemic, the continued delivery of surgical training has been deemed essential by training bodies worldwide. In 2018 Kneebone et al. previously proposed that improvisation will become a necessary skill to further clinical practice, which physicians and surgeons should not only embrace, but practice [53]. The National Trauma & Orthopaedic Surgery Training scheme in the Royal College of Surgeons in Ireland (RCSI), Dublin, Ireland has subsequently adapted.

Prior to the COVID-19 pandemic, orthopaedic trainees were required to attend mandatory core curriculum study days in association with the Irish Orthopaedic Trainees Association (IOTA). These involved trainees convening on a monthly basis at one of the specialist orthopaedic units in Ireland as hosted by an expert trainer. This involved instructional, didactic teaching on one of several pre-determined topics; these included basic science, paediatrics, spinal trauma, upper limb, lower limb and soft tissue injuries, amongst many others. Core curriculum is viewed as an essential theory-based training modality which aims to augment the more traditional, practice-based learning in which trainees get access to in their unit on a daily basis.

These methods had to be as advised by government bodies who outlined strict public health measures to minimize spread of the virus. The pandemic diminished not only the ability of training bodies to offer scheduled teaching, but also the number of daily cases in the operating theatres nationally, significantly affecting trainee exposure. The Irish training body has responded by actioning major changes in the style and delivery of trainee teaching, resulting in an instantaneous shift towards distance learning with respect to the aforementioned principles of adult learning. Forthwith, topics previously covered at monthly core curriculum training days are now being delivered by specialist trainers using video-based remote teaching on a weekly basis. Furthermore, these problem-based virtual classroom sessions are being recorded, allowing orthopaedic trainees the opportunity to access the material at a time and place of their own convenience, therefore satisfying the theories proposed by Lindeman and Knowles in relation to adult learning [20,54]. This learning modality possesses the potential to be integrated into future orthopaedic learning platforms as an easily accessible adjunctive resource of our training scheme.

In a survey offered to all higher specialist trainees (HST) orthopaedic trainees in Ireland, all participating HST trainees confirmed that the distance learning being offered in response to COVID-19 is easily accessible and beneficial, with approximately two-thirds of trainees suggesting that it should be routinely offered alongside previously offered core curriculum training in the future post-COVID-19 era. Furthermore, over 90% of trainees agreed that the video-based distance learning is of the same quality or an improvement of previous utilized teaching styles. Irrespective

of the long-term outcome of the COVID-19 pandemic, further development of the concept of distance learning is warranted in the years to come. Despite our training body boasting a centralized state-of-the-art simulation suite, until now distance simulation had remained an untapped style of learning for our orthopaedic trainees. However in response to COVID-19, RCSI have rolled out planned distance learning for the annual ‘surgical boot camp’, a week-long course focusing on fundamental surgical skills for all surgical trainees commencing CST, which is now being offered in the format of distributed simulation. Although this surgical boot camp was traditionally offered by didactic methods in the simulation suite, it will be offered to CST trainees in the format of video-based teaching, as trainees will utilize pre-delivered suturing and knot tying kits in the comfort of their own homes this coming July. Furthermore, the implementation of telementoring proposes another further potential teaching avenue for our trainees, particularly in relation to the supportive literature previously published on the topic with comparable operative times and clinical outcomes reported when compared to previously used face-to-face mentor models. Therefore, although the training of orthopaedic trainees has been demanding with COVID-19, this period has offered us an ideal opportunity to explore distance learning methods, which would traditionally have been seen as unconventional. The potential successes of these methods can be implemented hereafter to augment our traditional and still valued training methods, particularly for the trainee rotating in more remote regions.

### **Conclusion**

As orthopaedic training schemes globally have had to adapt to the unprecedented COVID-19 pandemic, the shift away from traditional teaching methods offers opportunity to both the training bodies, as well as the trainees themselves. Distance learning, be it video-based virtual classrooms, telementoring or distance simulation, offers orthopaedic trainees the autonomy to personalize their learning at a time and place of their favour with respect to the principles of adult learning. Our experience at the National Trauma & Orthopaedic Surgery Training Scheme in Ireland with adaptation towards distance learning in response to the pandemic has been an extremely positive one, with the potential to integrate such previously deemed unconventional teaching methods into our training pathway as part of routine orthopaedic training in future.

### **Declaration of Competing Interest**

None

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