Try Before You Buy: Simulate, Then Operate

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Residency training in the field of orthopedic surgery is evolving. Given the ever increasing restrictions on work hours, combined with a demand for efficiency in the operating room, residents across the country may find their surgical skillset less developed than they would like. Basic orthopedic surgical skills, including arthroscopy and fracture fixation, are essential for all practicing orthopedic surgeons. The hand-eye coordination and dexterity skills required to perform safe, effective, and efficient operations are demanding, typically requiring hours of practice outside of the operating room. With continual advances in imaging modalities, surgical instrument design, and minimally invasive surgical techniques, these skills are of utmost importance.

Alternative methods for obtaining these vital skills are necessary. A variety of modalities, including cadaveric training, sawbones, and virtual simulator trainers, have proven effective. Such simulators not only enable residents to further develop these skills in a safe environment, but also improve overall operative ability and confidence critical for producing excellent clinical outcomes as orthopedic surgeons. During residency training, simulators permit junior residents ample opportunity to establish good operative habits early on, thereby improving the quality of operative abilities every year. This type of training will allow junior residents to develop into technically proficient senior residents, which will in turn enable them to teach with competence and confidence.

A New Requirement for Orthopedic Simulator Training

Over the last 5 years, there has been an exponential increase in the number of publications and presentations describing orthopedic simulator training, both with arthroscopy and fracture fixation.[1,2] Models exist for nearly every joint, including hip, knee, ankle, shoulder, elbow, and wrist. Models for distal radius and hip fractures are also available outside arthroscopy. Other models, such as virtual human limbs, sawbones, and suture-skin models are already in use during various workshops and industry-sponsored training courses. Further, in July, the Accreditation Council for Graduate Medical Education (ACGME) is implementing a drastic change in requirements for post-graduate year 1 (PGY-1) orthopedic surgery residents.[3]

In addition to a total of 6 months of orthopedic surgery rotations, all interns will have a formal surgical skills educational requirement. The exact structure of this new requirement will likely vary amongst residency programs, but according to the ACGME, the curriculum must include the following:

- Goals, objectives, and assessment metrics
- Skills used in initial management of injured patients (splinting, casting, application of traction devices, other types of immobilization)
- Basic operative skills (soft-tissue management, suturing, bone management, arthroscopy, fluoroscopy, use of basic orthopedic equipment)

This new curriculum, and specifically the requirement for surgical skills training, is certainly a reflection on the change in educational focus within orthopedic surgery residency programs. As residents spend less time in the hospital due to work-hour restrictions (specifically intern work-hour restrictions), skills training outside of the trauma bay, emergency department, and operating room are likely going to be essential.

The connection between training on a simulator and

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improved performance in the operating room has been established in the general surgery literature.[4-7] The American Board of Surgery recently implemented the requirement for surgeons seeking board certification to successfully complete the Fundamentals of Laparoscopic Surgery (FLS) training program.[8] The FLS is an education model that was designed for surgical trainees and practicing physicians "to learn and practice laparoscopic skills to have the opportunity to definitely measure and document those skills" and has been shown to directly translate to improved operative performance.[8] In 2013, Gallagher and colleagues[6] performed a randomized clinical trial comparing performance of both novices and experienced laparoscopic surgeons with or without virtual reality laparoscopic simulation. In both groups, despite experience level, subjects in the simulation group performed significantly better than the controls. Similarly, in 2012, Stefanidis and colleagues[5] demonstrated significantly improved operative performance in subjects having undergone participation in the FLS suturing task module compared to controls.

Does Simulator Training Actually Improve Clinical Skills?

This same connection, however, between orthopedic simulator skills and actual clinical skills, has yet to be established in the literature. While the majority of studies have shown improved simulator performance following simulator training, it is unclear whether such training translates to the actual operating environment. Furthermore, other variables including the experience level of the trainee (student, resident, fellow, or attending) as well as the actual number of procedures performed prior to simulator training, have been shown to be correlated with simulator performance. For example, a recent systematic review performed by our own institution found 19 studies analyzing arthroscopic simulators in residency (R.M. Frank, MD, et al, unpublished data, 2013). Nine studies (47%) investigated shoulder models, 9 (47%) evaluated knee models, and 1 (5%) evaluated a hip model. A total of 465 participants with an average age of 30 years (range, 21-55 years) were evaluated, with various degrees of experience including students, orthopaedic residents, fellows, and attendings. Twelve studies (63%) compared task performance between participants of different experience levels with 100% reporting a positive correlation between experience level and simulator performance. Eight studies (42%) evaluated task performance before and after simulator training, with 6 (75%) of these studies showing improvement after training; 1 study of the 8 described (12.5%) noted no difference in performance after 1 hour of training. A single study (5%) commented on improved operating room performance after simulator training. No studies commented on the number of training sessions needed to translate technical skills learned on the models to the operating room. Thus, while overall simulator training appears to improve simulator task performance, we still do not know if orthopedic simulator task performance truly correlates with actual operating room performance.

An analysis of survey data collected by Karam and colleagues[9] at the University of Iowa, makes it clear that both orthopedic surgery faculty and residents believe that surgical skills laboratories and simulation technology *should* become a requirement of orthopedic training programs. With the implementation of the new ACGME PGY-1 curriculum in July, it is clear that such successful completion of such training programs *will* become a requirement of orthopedic surgery residents. JLM, one of the directors of the American Board of Orthopaedic Surgery (ABOS) and chair for the Residency Review Committee (RRC) in Orthopaedic Surgery, has played a major role in the development of the new ACGME PGY-1 curriculum, and further, is a pioneer in research on orthopedic simulation.

In June, I had the distinct pleasure of meeting JLM, and when asked his thoughts about simulation training, he stated that "dedicated practice with an intent to improve, the opportunity to make errors in a safe environment, and the opportunity to improve performance on actual operative cases are but a few of the reasons that the RRC in Orthopaedic Surgery and the ABOS are confident that the new requirements for surgical skills and simulation training will improve how orthopedic residents acquire surgical skills." Clearly, orthopedic simulation training during residency is a significant priority for the American Academy of Orthopaedic Surgeons (AAOS), ABOS, and RRC, and will likely affect all resident levels in the very near future, in addition to the intern requirements for this upcoming year.

Overall, while it seems intuitive that simulators are likely to play a substantial role in enabling the successful development of technical skills, the operative translatability remains undetermined. Furthermore, the learning curve of such training, in terms of the number of repetitions required to achieve proficiency, or more importantly, maintain proficiency, has not yet been analyzed. The goal of simulator training is, of course, to enable the trainee to develop a surgical motor skillset that will promote the delivery of safe, effective, and efficient patient care. Certainly, orthopedic simulators have the potential to enable residents to further develop their skills in a safe environment. At this time, however, it is unknown if simulator training correlates to an improved technical skillset in the operating room. Moreover, we need further research to determine the type and number of training sessions required to translate technical skills learned on the models to the operating room. As residents, we are currently in the midst of drastic paradigm shift in the delivery of our surgical education. While the literature supports the belief that practice on simulators improves performance on simulators, the question remains, should orthopaedic surgery residents *simulate, then operate*? Starting this academic year, we may soon know the answer.

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