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CLINICAL STUDY

Model Orthopaedic Surgical Skills Curriculum for Fourth Year Medical Students

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ABSTRACT

Musculoskeletal education in medical schools throughout the United States is inconsistent. Furthermore, formal surgical skill training in medical school is often lacking. Consequently, orthopaedic surgery residents in the United States are faced with a unique challenge as they transition from medical student to house officer in comparison to their peers pursuing more generalized specialties. In response, we designed and successfully implemented an innovative month long elective at Wake Forest University School of Medicine for fourth year medical students who were in the process of applying to orthopaedic surgery residency programs. This course provides medical students with an introduction to the basic skills and common surgical approaches that are commonly utilized early in orthopaedic surgery residency and beyond. While longitudinal data are needed, we believe this novel month long elective will allow the transition from medical student to house officer to be a smoother and more seamless process.

Keywords: Orthopaedic surgery, Curriculum development, Surgical skills.

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INTRODUCTION

Despite the nationwide movement to system-based curriculum models, many institutions still do not have a required preclinical musculoskeletal course or clerkship rotations.[1-6] This has resulted in a tangible knowledge deficit that has been well documented.[4,7] As a result, medical students pursuing careers in orthopaedic surgery are placed at a particular disadvantage in comparison to their peers when they begin clinical rotations with the Department of Orthopaedic Surgery during their third and fourth years of medical school and, ultimately, residency. In addition, few institutions throughout the nation provide dedicated courses that provide instruction on the fundamental surgical skills that will be required in residency.[7,8] Consequently, students are often forced to initially learn these skills informally on the wards in high pressure patient scenarios or through impromptu after hours workshops hosted by various specialty interest groups. As a result, students are at risk for misunderstanding and poor techniques are perpetuated in residency training to the detriment of patient care.[8]

Similar deficits in formal curriculum models are also evident in Orthopaedic Surgery Residency Programs.[9] Over the past few years, the American Board of Orthopaedic Surgery (ABOS) and the Accreditation Council for Graduate Medical Education (ACGME) Residency Review Committee for Orthopaedic Surgery introduced three new constructs in an attempt to better standardize resident education in the United States. Specifically, the competency-based Milestones Project, a new accreditation system, and a formal technical skill curriculum for residents.[10,11] The technical skill curriculum involves seventeen modules that attempt to address the gaps in technical skill education during medical school and provides a method for uniformity in residency education across the nation. It includes numerous technical tasks of varying difficulty, from basic suturing and knot tying skills to complex microsurgical procedures.[10] While these new systems provide an excellent foundation for the future of Orthopaedic Surgery Residency Programs, the need for formal curriculum models involving both knowledge and technical skills in medical schools still exists.

COURSE DESCRIPTION

This 4 weeks elective is offered as one of the 12 required courses students complete for credit during their fourth year of medical school. The curriculum conforms to Kern's approach to development and utilizes a practical stepwise method that involves many different modalities that are uniquely pertinent to orthopaedic surgery (Fig. 1).[12] The course is designed for senior medical students who have a rudimentary understanding of the musculoskeletal system gained through exposure to musculoskeletal pathology in clinical clerkships.[2] Based on our experience, the optimal faculty to student ratio for the cadaver lab is one to four and the optimal student to cadaver ratio is four to one or two students per surgical approach. Specific course objectives are listed in Table 1.

Self-directed learning is imperative for this course and expected from all students. Numerous excellent resources are readily available online for students to use to prepare for the course. The paradigm of these instructional tools is the Academy of Orthopaedics (AO) Surgery Reference.[13] This resource is available to medical students free of charge and provides detailed information regarding the surgical fixation of common traumatic fractures. It includes step-by-step guidance for various surgical procedures from patient preparation to aftercare. We also encourage students to utilize a common orthopaedic surgical approach textbook as well as a basic human anatomy atlas to prepare for the labs and to help them work through the course.

In addition to self-directed learning, eight targeted didactic lectures are distributed throughout the month long course. Didactic lessons are scheduled at the beginning of each week and are delivered by orthopaedic surgery faculty members. Topics include both specific instruction on the surgical approach and fracture fixation technique students will complete during the week as well as basic fundamental surgical skills. Specifically, faculty members provide instruction regarding common surgical fixation techniques of femoral neck fractures, distal tibia fractures, and distal radius fractures. Additionally, faculty members provide instruction on various fundamental skills including operating room setup, surgical dissection techniques, principles of fracture fixation, fundamentals of suturing, and casting/splinting techniques. Each didactic session lasts approximately 2 hours. The lesson typically begins with a formal presentation and is often followed by an informal skills laboratory session where students are able to practice the skills taught during the lesson in a controlled environment under faculty guidance.

Following the completion of the didactic lessons at the beginning of the week, students are given the opportunity to refine their skills in the anatomy laboratory by completing three common orthopaedic surgical procedures in synthetic bone and cadaveric models. Specifically, students complete the following

Table 1: The specific course objectives for the month long orthopaedic surgical skills rotation at Wake Forest University School of Medicine

Course objectives
By the end of the rotation, students should be able to:
1. Achieve and maintain sterile technique in the operating room
2. Properly position the upper and lower extremities for surgery
3. Properly apply drapes to the upper and lower extremity
4. Identify and properly use common surgical instruments (scalpels, scissors, forceps, clamps)
5. Properly handle various types of soft tissue (skin, muscle, nerves, vessels)
6. Demonstrate familiarity with various suture types and the indication for their use
7. Properly tie one-handed, two-handed and instrument square knots
8. Perform common suturing techniques (simple interrupted, simple running, vertical mattress, horizontal mattress)
9. Become familiar with common methods of fracture fixation (absolute stability *vs* relative stability)
10. Become familiar with the basic structure and function of orthopaedic hardware (screws, plates)
11. Plan a surgical approach to the hip, distal tibia and distal radius
12. Demonstrate knowledge of the surgical planes in the hip, leg and forearm
13. Demonstrate knowledge of the pertinent anatomy of the hip, leg and forearm
14. Apply common splints to the upper and lower extremity (sugar tong, dorsal slab, stirrup)
15. Successfully construct a detailed scientific presentation

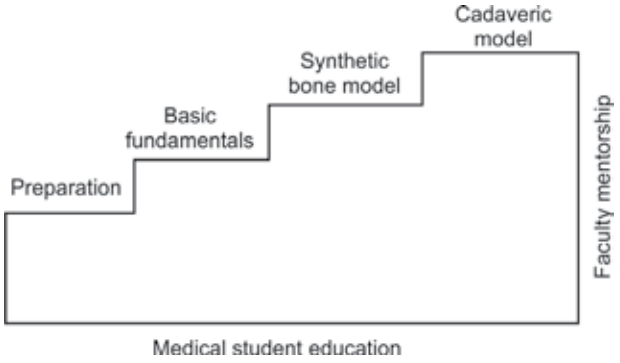


Fig. 1: The five core components of our curriculum model. Medical students' progress through the rotation in a stepwise fashion so that skills and knowledge learned early in the course can be applied and refined in subsequent modules. Throughout the elective, faculty mentorship is intimately linked to medical student education in each step of the curriculum

standardized orthopaedic procedures: (1) cancellous screw fixation of a femoral neck fracture via the direct lateral approach to the hip, (2) compression plating of a distal tibial shaft fracture via the anteromedial approach to the leg, and (3) palmar plating of a distal radius fracture via the modified volar Henry approach to the wrist. Each surgical procedure is completed in a practical stepwise method, beginning with fracture fixation in synthetic bone models and culminating with completion of the entire surgical approach in a fresh frozen cadaveric specimen. While working with the cadaveric specimens, students are expected to conduct all portions of the procedure, from patient preparation and positioning, to incision closure, by themselves. Upon successful completion of each surgical approach, students then conduct a full dissection of the region in order to gain a better appreciation of the relevant surrounding anatomy.

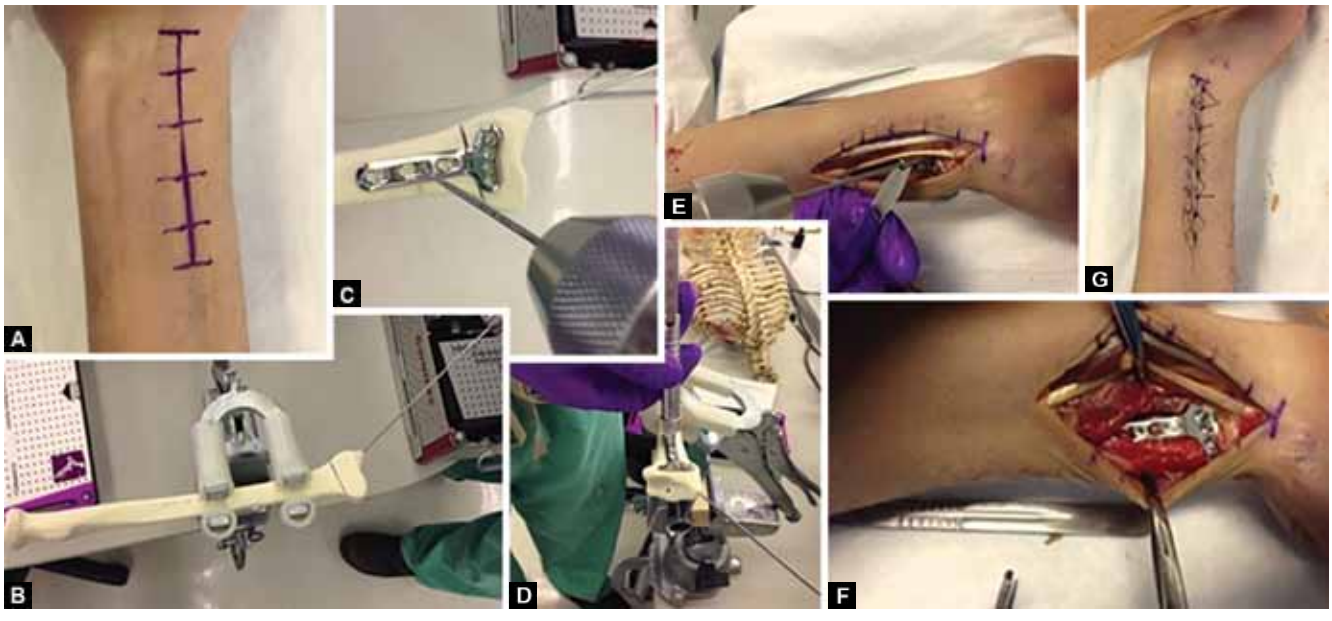
STUDENT ASSESSMENT

During the final week of the course, each student is required to give a detailed formal presentation of one of the surgical procedures they completed during the rotation to faculty members. Throughout the rotation, students are expected to use digital media to document each self-directed surgical procedure they complete on both the synthetic bone models and cadaveric specimens. Students are then required to compile the images and/or videos they collected throughout the rotation into a comprehensive multimedia presentation given to faculty members. This presentation is expected to include all components of the surgical approach, from patient preparation and positioning to final skin closure (Figs 2A to G). Pictures and videos from their full dissection of the cadaver with all important vessels, nerves, muscles, and skeletal anatomy labeled appropriately are also expected to be incorporated into their presentation (Fig. 3).

This presentation encourages faculty mentorship and student independence during the week. It also gives students the opportunity to demonstrate what they have learned throughout the rotation. The final presentation is structured in a similar fashion to the weekly conferences hosted by the Department of Orthopaedics and is expected to last approximately 1 hour. This capstone event provides students with the opportunity to refine their scientific presentation skills, reflect on surgical indications and techniques, and interact with faculty—all substantial to their future success as house officers.

COMMENT

Similar surgical skill curriculum models have been previously described in the literature. However, these models have only been implemented in Orthopaedic Residency Programs and not in medical schools.[14,15] While our curriculum model does not resolve the issues with musculoskeletal education in preclinical years of medical school, we believe that it provides senior students with the opportunity to begin developing fundamental skills that will accelerate surgical skill acquisition and facilitate a smoother transition from medical student to house officer.



Figs 2A to G: Example of a student's digital documentation of palmer plating of a distal radius fracture in synthetic bone and cadaveric model. This figure was used in the student's final presentation to faculty members at the end of the course: (A) Patient positioning and incision preparation, (B) provisional fracture fixation with K-wire, (C) proximal drilling for plate application, (D) measuring for proximal screw length with depth gauge, (E) distal drilling for plate application, (F) insertion of final screws and (G) incision closure

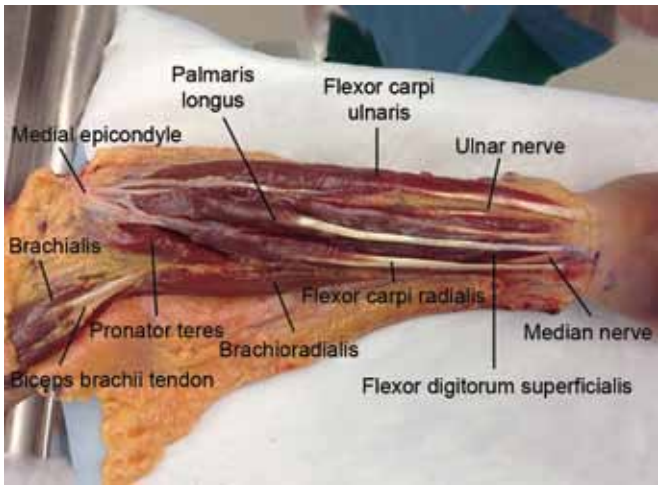


Fig. 3: Example of a student's digital documentation of their complete dissection of the superficial volar forearm in a fresh frozen cadaver with all important structures labeled. This figure was used in the student's final presentation to faculty members at the end of the course

Although students often have the opportunity to witness various surgical procedures on patients in the operating room during their third and fourth years of medical school, their role is often limited.[16] While first year residents are not expected to be able to conduct surgical procedures on their own, they are expected to be proficient with the basic skills utilized in many common surgical approaches. Consequently, students would stand to benefit greatly in residency from being able to learn how to conduct these procedures on their own in a controlled, low stress environment while in medical school.[8]

In Malcolm Gladwell's, 'Outliers: The Story of Success', he posits that it takes 10,000 hours of practice to become a master of any given skill.[17] In light of the new resident work hour restrictions for residents, gaining true expertise in surgical skills has become quite the formidable task. Consequently, it stands to reason that providing students with formal technical skill training during medical school would allow them gain mastery of various surgical skills earlier in their training. In fact, providing a structured curriculum for basic procedural skills has been shown to have a long-term effect on and self-rated confidence and competency in medical students.[18]

While there are numerous surgical approaches that each student physician will learn to master during their residency training, we chose to focus on three common approaches for the month long rotation that the students will likely see early in their training. The overarching goal of this elective is for students to become familiar with the basic skills that will be required during the first year of residency training in a surgical model. Consequently, focus is placed on the fundamental principles of fracture fixation and basic surgical skills rather than conducting numerous individual surgical approaches. That being said, the approaches outlined in this course can easily be tailored to each institution based on faculty preference and availability.

In addition to orthopaedic faculty member involvement, this curriculum model requires effective communication and extensive collaboration with the department of medical education and an orthopaedic surgery vendor. All surgical instruments, implants, and synthetic bone models for the course were provided by Synthes of North America®. The fresh frozen cadavers and suture materials were provided by the Department of Medical Education at our home institution.

LIMITATIONS AND FUTURE WORK

This was a pilot curriculum designed to provide students with a strong foundation as they embark onto the next step of their education. Consequently, longitudinal data are necessary to provide further insight into the benefits that this course provides to students as they transition to resident physician. To refine our conclusions about our curriculum's impact, we plan to follow the students who participated in this inaugural course as they begin the first year of residency and beyond in order to gain more insight into the advantages that this course provides to students.

Due to logistical difficulties with the cadaver laboratory and the department of radiology at our home institution, students were not able to utilize fluoroscopy during the rotation. As fluoroscopy is a common tool of fracture fixation in the operating room, future courses would benefit from being able to use this modality in the cadaver lab. We are currently working on ways to incorporate fluoroscopy into the rotation for future students.

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