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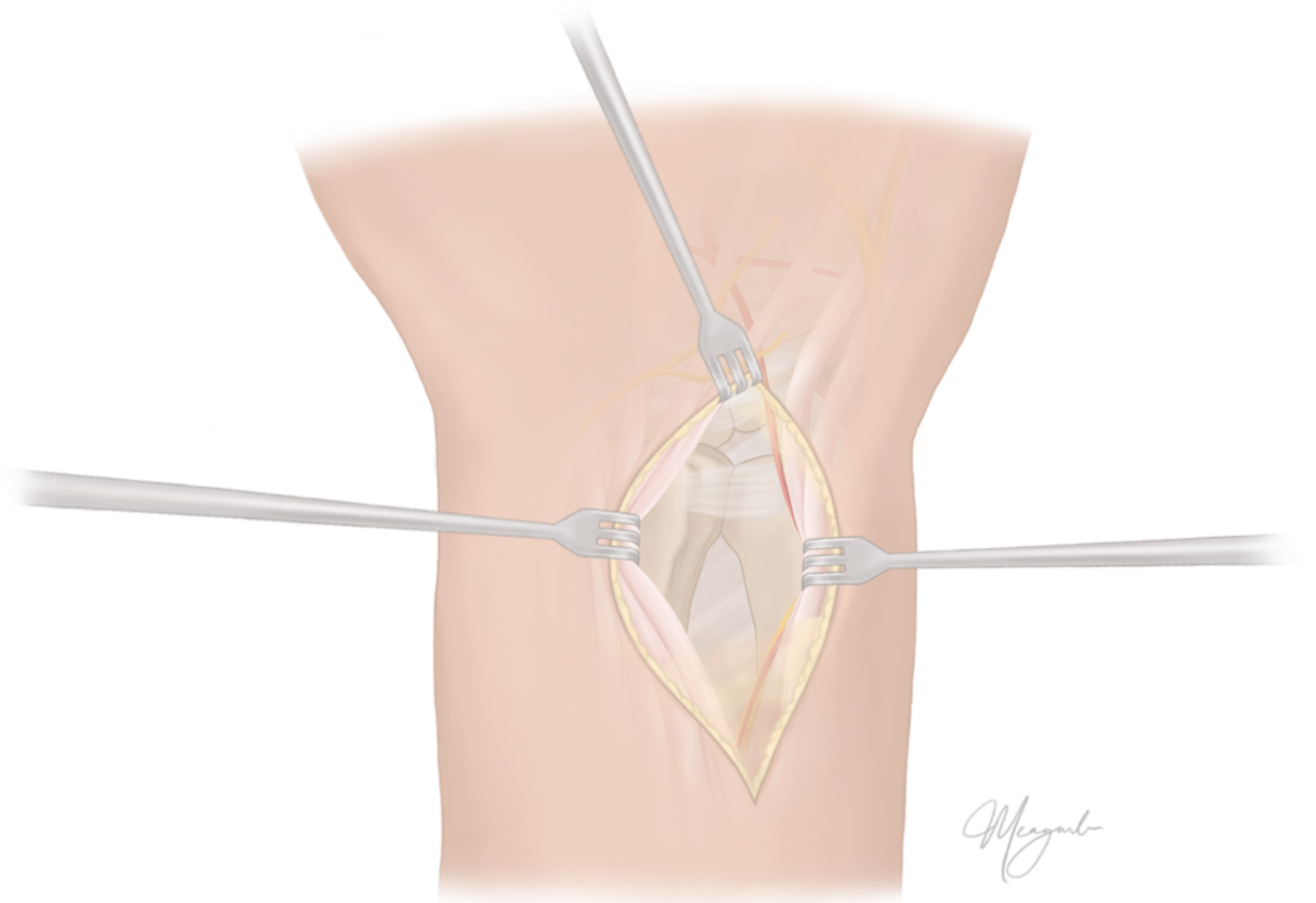
BONE BULLETIN

DePalma Orthopaedic Society

Volume 1 Issue 1 • May 2023

BONE BULLETIN

2023 • Volume 1

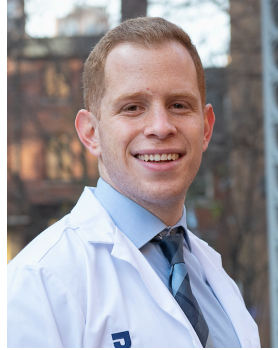


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Editors' Note

We are thrilled to introduce the inaugural issue of the Bone Bulletin, DePalma Orthopaedic Society's student-run, non-peer reviewed journal for Sidney Kimmel Medical College (SKMC) students. The journal's aim is to provide yet another way to be involved with orthopaedics in medical school and to promote student interest in orthopaedics by reporting on diverse aspects of the field through editorial and opinion pieces. Under the close 1-on-1 mentorship of a physician from the Rothman Orthopaedic Institute, students have a hands-on opportunity to write about and directly engage with orthopaedic research and developments.

Within the pages of this journal, you will find research articles, insightful reviews, thought-provoking interviews, and inspiring stories of clinical experiences. We believe that by providing an inclusive platform for students to express their ideas and share their research findings, we can foster a vibrant community of learners and thinkers dedicated to advancing the field of orthopaedic surgery.

We extend our gratitude to the writers and editorial team, who have formed the contributions featured in this issue. We would also like to express our gratitude to the mentors and physicians from the Rothman Orthopaedic Institute, who have supported us throughout this journey. Your guidance, encouragement, and expertise have been invaluable in shaping this endeavor and inspiring us to pursue excellence in the field of orthopaedics.

Thank you for joining us on this exciting venture. We are beyond excited to present the invaluable contributions that everyone has made for the Bone Bulletin.

Sincerely,
Payton Boere & Ari Clements
Editors-in-Chief, The Bone Bulletin

Foreword

As the Director of Undergraduate Medical Education for the Department of Orthopedic Surgery at the Sidney Kimmel Medical College, I am thrilled to have this opportunity to introduce the inaugural issue of the Bone Bulletin. Through the activities of the DePalma Orthopaedic Society, medical students at SKMC have had an excellent venue to learn about orthopaedic surgery, and our surgeons here at Rothman Orthopaedics have enthusiastically mentored younger students interested in the field of orthopedic surgery. The DePalma leadership has worked hard on many initiatives in recent years: providing forums for orthopaedic faculty to speak about their work, assembling lists of orthopaedic programs where former students have trained, developing interview guides and guidance for rising senior students, and trying to encourage women and underrepresented minorities to become part of our orthopaedic family, just to name a few.

Each year I have the pleasure of getting to know all the medical students at SKMC who are interested in a career in orthopedic surgery. I've had the opportunity to follow some of those students through residency training and into academic positions in orthopedic surgery. Some have risen to attending leadership positions in academic medical centers and national orthopaedic societies. They are bright, well-educated physicians who are motivated to accomplish great things in the world of orthopaedic surgery. This new journal is a testament to the energy, enthusiasm, and skills of our outstanding medical students at SKMC. I hope you enjoy reading their work as much as I enjoy being an advisor and mentor to them.

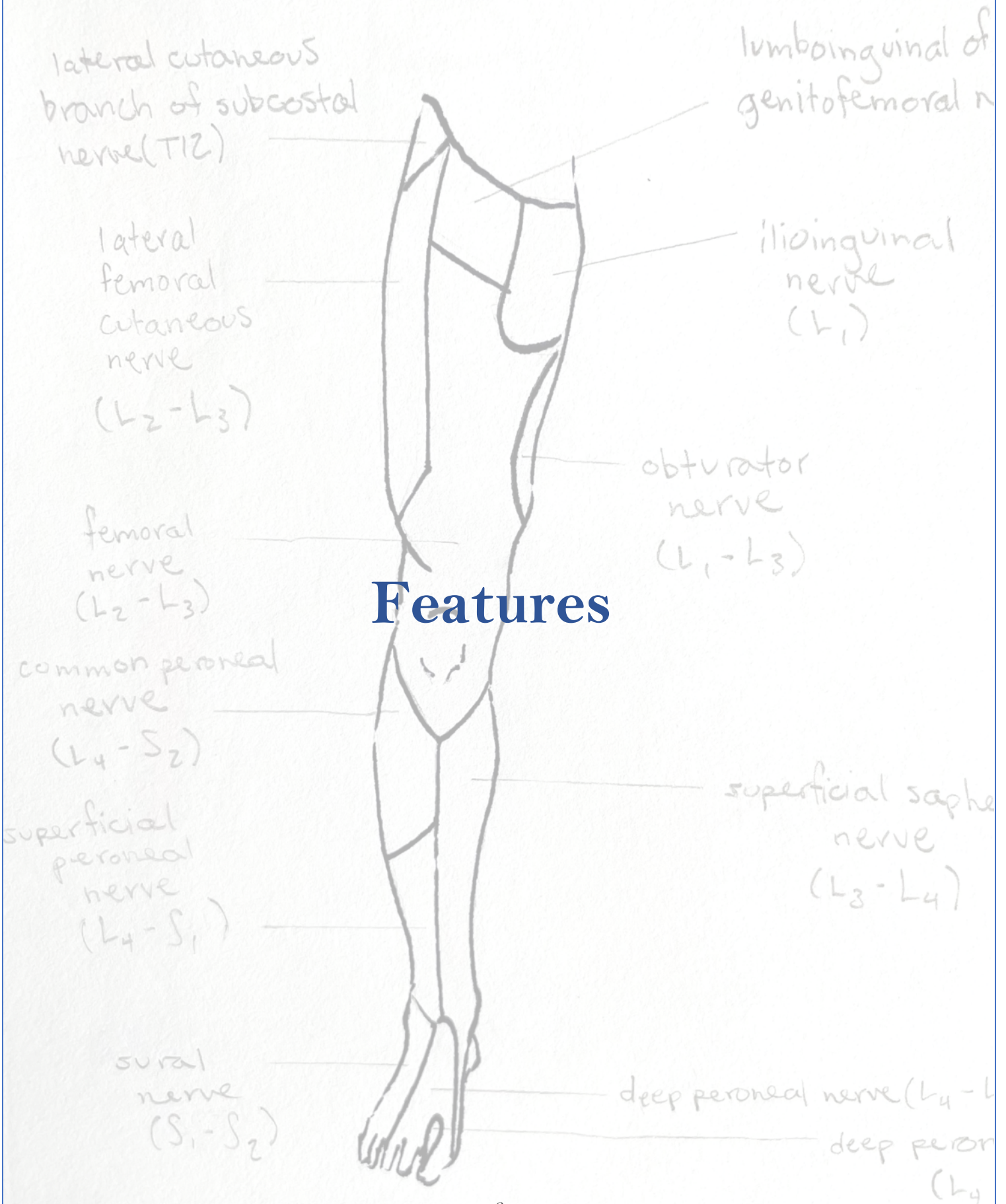
Alan S. Hilibrand, MD, MBA

The Joseph and Marie Field Professor of Spinal Surgery

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Features

Article - Feature

Injuries, Management, and Prevention in the Weekend Warrior

By John Paulik, Class of 2025
Faculty Advisor: Dr. Sarah Weinstein, MD

Introduction

Sports medicine is known for heroically returning competitors back to the big game just in the nick of time for the winning play. This storybook ending is a reality of sports medicine. However, the majority of athletes will not end up on ESPN in the newest *30 for 30*. This begs the question - who is an athlete? To some, it may be defined as someone who participates in an organized sport, culminating in regular competition and requiring systematic training.¹ This definition, however, excludes those who regularly exercise with the goal of improving their health or appearance.² The *weekend warrior* falls under this latter category as someone who largely engages in their sport and activity outside of their busy weekday routine. Luckily, athletes of all varieties with diverse goals are supported equally in their active pursuits.

According to the Journal of the American Medical Association (JAMA), weekend exercise promotes the same reduction in all-cause and case-specific mortality rates as compared to those who exercise regularly throughout the week.³ Nonetheless, all athletes are at risk of injury, regardless of their routine. Often, weekend warriors can face greater risks of injury as they jump into exercise without sufficient training.⁴ At this time the care of a sports medicine physician may be necessary. Dr. Weinstein, a sports medicine physician with the Rothman Orthopaedic Institute, believes that athletes of all levels should receive the same level of care.

According to the Journal of the American Medical Association (JAMA), weekend exercise promotes the same reduction in all-cause and case-specific mortality rates as compared to those who exercise regularly throughout the week.³ Nonetheless, all athletes are at risk of injury, regardless of their routine. Often, weekend warriors can face greater risks of injury as they jump into exercise without sufficient training.⁴ At this time the care of a sports medicine physician may be necessary. Dr. Weinstein, a sports medicine physician with the Rothman Orthopaedic Institute, believes that athletes of all levels should receive the same level of care. Dr. Weinstein's diverse training and practice includes treating athletes at the professional, collegiate, and high school levels in a variety of sports including

football, volleyball, lacrosse, ice hockey, and basketball. In addition to her care of competitive athletes, her practice sees a high volume of those who may not meet the criteria for a "competitive athlete." However, these patients certainly seek to maintain or increase their desired levels of physical activity. Consider a patient who works full time as a business executive but dedicates their winter weekends to high intensity skiing with close friends and family members. Nagging knee pain from an old meniscus tear may progress to early-stage osteoarthritis which could certainly limit their participation in their sport. Dr. Weinstein treats this patient's symptoms as well as many others, while trying to maintain focus on injury prevention and an overall healthy lifestyle.

Most Common Injuries in Adult Athletes

Weekend warriors share many of the same injuries as those seen in competitive athletes and this article will discuss just a few of the musculoskeletal injuries that these athletes incur. Upper and lower extremity injuries dominate office visits.⁴ In some non-competitive athletes however, many injuries result from a combination of insufficient training, stretching, and strengthening attributed to doing "too much too soon". In the case of the weekend warrior, this often manifests with specific injuries. Common upper extremity injuries include tennis elbow and rotator cuff tears. Tennis elbow, or lateral epicondylitis, results from excessive extension movements of the athlete, hence its association with the tennis player's backhand shot. The extensor carpi radialis brevis muscle and its tendinous attachment to the lateral epicondyle of the humerus is the most common tendon involved in these injuries. These injuries may occur acutely, but are more commonly a manifestation of overuse, whereby a process of acute inflammation leads to tendon thickening and microtears of the implicated structures.⁵

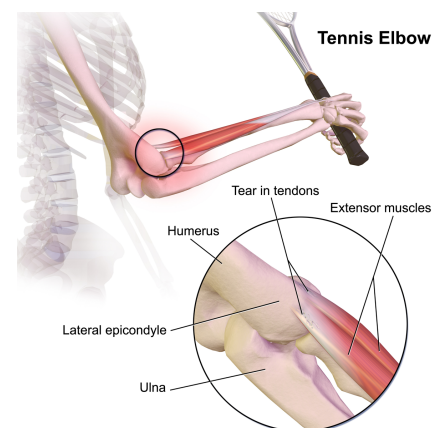


Figure 1. Extensor insertions at the lateral epicondyle.

Likewise, rotator cuff injuries can also be acute or chronic in nature and involve one of the four rotator cuff muscles — supraspinatus, infraspinatus, teres minor, and subscapularis. Adults commonly experience tears due to chronic impingement of the supraspinatus tendon as it passes under the acromion process before inserting on the greater tubercle of the humerus as seen in Figure 2.⁶ One quick move with a chronically inflamed and poorly stretched shoulder can create the dreaded full thickness tear. These injuries are seen in people completing overhead movements as well as those participating in overhead sports and weightlifting. One of the most widespread ailments affecting older athletes is knee pain. Frequent knee injuries in weekend warriors include runner's knee, meniscus tears and exacerbation of underlying degenerative changes. Weekend warriors may also experience more acute ligamentous injuries such as an ACL or MCL tear, though not as common as the overuse type injuries.⁴ Knee injuries can happen while participating in a wide range of activities. In general, previous knee injuries, failure to properly strengthen or stretch the legs before activity, improper footwear, and sudden increases in physical activity are frequent causes of injury. While injuries can present acutely with pain and immobility, they also increase the patient's risk of osteoarthritis and continued soft tissue damages within the affected joint. Globally, osteoarthritis of the knee has an estimated 22.9% prevalence in people over 40.⁷ This occurs when the cartilage surrounding the knee is gradually damaged and presents with pain, swelling, and decreased mobility. Figure 3 demonstrates the typical radiographic findings for a patient with an arthritic knee.⁸ These findings may include narrowing of the joint space, osteophyte (“bone spur”) development, subchondral cystic changes and sclerosis or hardening of the bone just below its cartilage surface. Early and effective treatment can play a huge role in preventing or alleviating these symptoms.

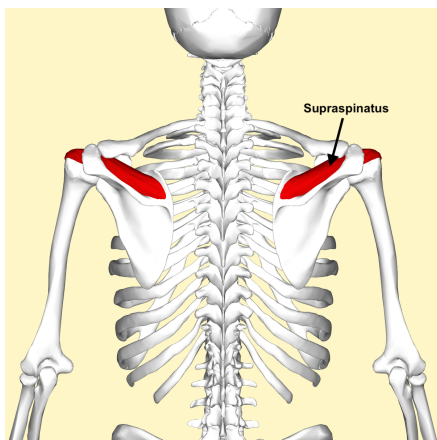


Figure 2. Posterior View of the Supraspinatus

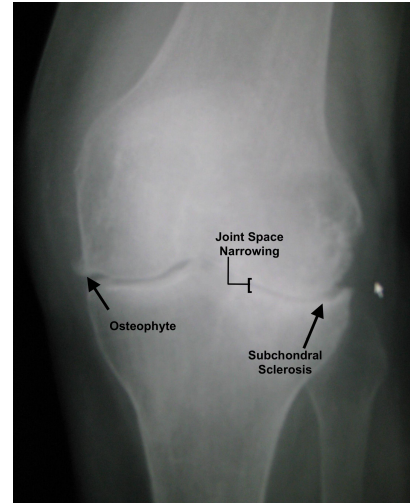


Figure 3. Knee Osteoarthritis on X-Ray

Treatment and Prevention

According to Dr. Weinstein, treating patients with chronic wear and tear injuries as discussed above presents unique challenges. Unlike a competitive athlete, a busy weekend warrior may delay seeing a physician until significant damage has already occurred or until pain is unbearable. Furthermore, it is often difficult to accurately assess injuries as patients may not be able to reproduce their symptoms while removed from a provoking activity. In either case, Dr. Weinstein most often finds herself seeing patients beyond the point of primary prevention. Management at this stage is complicated by pain and immobility.

Patient education is a critical component to treatment and prevention of chronic musculoskeletal injuries. Dr. Weinstein works with patients to explain diagnoses using exam and imaging findings, present the range of treatment strategies, and determine how that patient can be most successful in their outcome. This approach must be individualized to each patient, and each patient's aspirations and goals must be carefully considered when planning treatment. Following this process, Dr. Weinstein can discuss how patients like the weekend warrior can return to and subsequently increase their desired level of activity in the face of their injury. Her main philosophy involves a holistic approach to achieve the best quality of life for her patients. There is a large focus on stretching and strengthening so the body can handle the stress of exercise and reduce risk of injury. Core and gluteal weakness are significant risk factors for the development of chronic knee or hip pain, which plagues many patients within this population. Strengthening exercises are used to prevent injury and maintain a patient's quality of life. It is important to note that these strategies are not reserved for injury prevention — they are also

treatment strategies. A patient's pain and limitations must be balanced with appropriate rehabilitation exercises to maximize their functional outcome.

The weekend warrior should focus on several strategies to prevent injury. First, activity should be gradually increased in a typical "start low, go slow" fashion. Many former athletes try to jump into playing their former sports without proper training, which can increase risk for injury. The key to safe participation is to slowly and gradually intensify activity levels while listening to one's body. Next is strengthening. Patients are advised to incorporate balanced and technically-sound strength training into their routines to engage less frequently used muscle such that the body is prepared for the rigors of athletic participation. Lastly, healthy diet and sleep habits can go a long way towards setting up the weekend warrior for successful participation in any activity. These are a few of the pillars of lifestyle medicine that will further enhance one's quality of life.

Regardless of the level of the athlete or the type of activity, all athletes desire safe and injury free participation in their activities. Sports medicine professionals have developed strategies to keep patients active and healthy. After all, physical activity and exercise is a proven strategy to optimize many aspects of an individual's health. Helping all types of athletes to stay active and prevent injury can be accomplished through simple, yet critically important, preventative measures. As more people engage in physical activity into later years of life, it is important to incorporate these techniques into the standard of sports medicine care.

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Article - Feature**A Practical Guide to Etiquette in the Orthopaedic OR for the Rotating Medical Student**

By Tyler Radack, Class of 2026

Faculty Advisor: Dr. Chad Krueger, MD

The Operating Room, the operating theatre, the lair of the Orthopaedic surgeon, it goes by many names. It is a place most try to avoid, but this daunting windowless room is a classroom and training ground for many. And for the medical student interested in an orthopaedic surgery career, making an impression in the operating room is vital to matching into their desired orthopaedic residency.¹

Unfortunately, making an impression in the operating room is difficult, or more precisely, making a good impression in the operating room is difficult. Furthermore, every operating room dynamic can be different, and the personalities of the surgeon, fellow, resident, and surgical team can vary widely. Stone et al, found that 72% of medical students felt unsure about the expectations in the surgical OR.² Thus, with the approach of orthopaedic rotations, students should undertake some training or at least consider how to act in such an environment.

The Totem Pole

It should go without saying, but medical students are the lowest on the metaphorical totem pole in the orthopaedic OR, and thus entitled to no special benefits or exceptions. While typically easy to understand in terms of the surgeon or the resident, the staff are included as well. Although medical students provide some help to the surgeon/fellow/resident, to the operating room staff, medical students are at best a neutral presence and, at worst, an extra level of stress and liability. That being said, Ji et al, has established that 49% of OR staff enjoy working with medical students but agree that students' OR etiquette needs improvement.³ Recognizing this is important, not only for understanding the proper respect to pay everyone in the OR, but also in terms of establishing expectations for the medical student in the operating room. This will be different depending on the staff, case, and location, but some basic principles apply in all settings.

The student is in the OR to learn. However, the best medical students also work to make everyone else's lives easier, including the attending, fellow, resident, and most importantly, the staff. The most successful medical students look beyond learning and recognize becoming a vital member of the team

improves their day in the OR or on a rotation. Tailoring one's questions, actions, and OR etiquette to match this goal goes a long way to setting one apart from other students.

Before the Operating Room

To begin with, well-timed communication is key to success and starts before arriving in the operating room. Upon starting rotations, ask for the schedule and come ready before the rest of the team. If the attending/resident is arriving in the OR by 5:45 am, be there at 5:30 am, in professional attire. While scrubs will eventually be worn, professional attire is essential and makes a good impression. Just make sure to bring a more practical change of shoes for the OR. More importantly, make sure to review all the day's cases before arriving, taking especially good notes on the relevant anatomy of each procedure. Dr. Krueger, a hip/knee orthopaedic surgeon at Rothman Orthopaedics, recommends students place the bulk of their review in understanding fundamental anatomy and less on the procedure, instruments, and other related topics.

Delving deeper into these more complex topics offers a great opportunity to have a conversation with a fellow or resident about tips or pertinent information to review. Everyone reviews for cases differently and incorporating specific recommendations shows you are taking initiative. Some residents bring a small index card with pertinent information while others carry a notepad. A small notepad is essential for jotting down notes. A student should never have their phone out in the OR, even if only using it for note taking, as the medical student comes across as disinterested in the case. Also, a relevant side benefit to case review is the ability to observe how busy the operating day is going to be; and might provide some preemptive indication of the stress levels of the OR. The average day of cases may vary widely depending on the surgeon and the subspecialty; five cases in a day may be roughly normal for a shoulder and elbow surgeon, but this same case number may be quite small for a hand surgeon.

In the Orthopaedic Operating Room

All ORs are different and vary widely in how they run. This fact is also compounded when considering a surgery center versus main hospital and laxity with certain rules. That being said, OR etiquette should not change depending on location. Upon arriving to the OR, immediately locate these five things: the fellow/resident, the attending, the bathroom/locker room, the procedure board, and the white boards. The first three are self-explanatory, but the procedure board is typically a TV/white board where all the cases are written for the day. The board displays both the order and

location of cases. It can be helpful for you personally as well as your attending/fellow/resident if you make note of and remember the rooms for each case.

In each of the numbered ORs there will also be a whiteboard. Write down your full name, medical school year, and glove sizes. This enables the OR nurse to easily document and enter your information into the system without asking. This is also a great time to introduce yourself, showing respect for a surgeon's entourage and acknowledging every surgery "takes a village." Likewise, do not ignore the reps from implant companies as they are often a good resource with advanced knowledge of procedures, instruments and technology as well as an extensive understanding of OR etiquette.

OR staff and reps are not only vital resources but helping them locate materials needed to scrub-in and demonstrating you know the best place to stand goes a long way. More importantly, avoid irritating or angering them, as they often communicate with your attending about your performance. When it comes to interacting with the non-surgeon staff in the OR, remember you are not an attending/fellow/resident and should not act as such. In general, following 'the three As' is an easy way to make a good impression with the staff members: Be affable with everyone who you interact with, be available to assist, and demonstrate the ability to assist when called upon.

Now let's fast forward to the procedure. Scrubbing-in should not change the student's goal to make the doctors' and staffs' lives easier. First, recognize scrubbing-in is a privilege. To earn this honor, make sure to be well-acquainted with the patient and the procedure. At minimum, you must demonstrate to surgeons and staff your ability to avoid contaminating the sterile field. Dr. Joseph Daniel, a Foot and Ankle surgeon at Rothman Orthopaedics, requires medical students show familiarity with every case before scrubbing in. It may also be worthwhile to ask the attending which cases they prefer you scrub into. If allowed to scrub, it is your responsibility to gather all resources needed, such as surgical gown, correctly sized gloves, and headgear. Additionally, Dr. Daniel also recommends when scrubbing next to your attending, always let them finish scrubbing first. While it is a bit "old school," it is also a sign of respect for both the surgeon and the sterile environment.

When scrubbed-in, make sure to do everything the surgeon asks. This can range widely, but the classic example is holding the retractor and suction. Try to avoid getting "suction crazy" and pay attention to other surgeons, moving out of the way quickly if they continue to operate. You may be asked

to hold a limb in a certain position or at an unnatural angle to improve a surgeon's visual field. Make sure to communicate if you are moving or losing grip and always listen to your team. Finally, maintain the sterile field. While everyone makes mistakes, remember never to catch a falling instrument, and make sure to communicate any loss of sterility.

When not scrubbed-in, your primary role is to be a student and engage with the attending. However, also take note of the OR layout and common patterns to help orient you in the case. "Is the surgeon performing arthroscopic surgery or using fluoroscopy? Does the surgical set-up require a mat under the surgeon's feet? Does the surgeon wear a helmet? How should the patient be positioned? These questions highlight small jobs that can be filled, such as keeping an eye on the saline for arthroscopy, moving the fluoroscopy cart for a fracture case, or helping the resident position the patient. For example, a good medical student will be quick to tie-up the surgeon's, resident's, or PA's sterile gowns. That being said, if a job requires cutting in front of others or is not easily completed, it's best to let someone else do the job or wait until it's more convenient. Most importantly, recognize where people move in the room and ensure you are not in the way or taking up space. Stay light on your feet and always ask how you can help.

One should also consider the rate that you enter and exit the OR. The more times the doors open, the less sterile the operating environment. Try to minimize the number of times you enter and exit, open the OR door as little as possible and/or utilize a sub-sterile connecting room if available. Following the procedure, a medical student can participate in a great number of tasks to help the fellow/resident including wound closure, removing drapes, and transferring the patient.

As a final note, the OR can be stressful for the surgeon and staff no matter their skill, and they can become frustrated from any number of situations. Remember, everyone's tone of voice may not always be polite but as long as it is not inappropriate or abusive, having thick skin goes a long way.^{4*}

This concept is nicely summarized in a review article by Falk et al, who comments that in the orthopaedic OR there are two types of communication: routine and critical. Routine communication is a more conversational form of communication where courtesy, active listening, and emotion are major features. In contrast, critical communication stresses brevity, clarity, and frankness, with an assertive tone. Most junior residents and medical students are used to routine communication such as in the low stakes environment

*I should mention a new JAAOS article by Samir Mehta and others at Penn that talks about how the teaching tone of residents is different than that most students are used to. It is very direct - don't take it personally.

of their classrooms, but often require time to adjust to critical communication that permeates the OR. It is important to recognize critical communication is not meant to be demeaning or reflect negative attitudes but ensures a successful procedure by quickly and efficiently conveying and avoiding errors.

Pimping

Pimping is one of the most dreaded parts of the medical rotation and orthopaedic surgeons are known to pimp medical students vigorously. A number of studies have shown pimping to be one of the most anxiety inducing parts of rotations.^{2,6} All medical students will inevitably look stupid at some point during their time in the OR. It is more important not to look stupid the same way twice. According to Dr. Krueger, remember you will continue to be asked questions until you get one wrong. The goal of pimping is not make students feel inadequate, but to determine the limits of their knowledge, with questions becoming progressively more challenging.

Dr. Krueger recommends students ensure they answer anatomy questions correctly by taking appropriate steps to prepare. Likewise, even if the answer to a question remains elusive, rather than saying “I don’t know”, show that you understand the concept and will research the answer. Getting the same question incorrectly twice shows you are not listening or engaging in the case. While pimping is generally perceived as a way to encourage recall of information, Dr. Luke Austin, a shoulder and elbow surgeon at Rothman Orthopaedics, shares a different perspective. He does not remember the student’s response, but rather if they answered in a logical and cohesive manner. Medical students often rely on “verbal vomit” when they get nervous, which is annoying for the attending and makes a medical student look incompetent and underprepared. Medical students should recognize that pimping questions are not random and having short, professional responses, even if wrong, shows you are following along with the procedure and trying to think critically in a high stress environment.

Asking questions

Of all the skills to develop before entering the OR, learning when to ask questions is probably one of the most subjective and often highly situational. The major rule governing when to ask questions boils down to successfully “reading the room”. This takes time and experience to learn. If there is a stressful case, wait until after the procedure to ask questions. Scrubbing in is often a good moment for a surgeon to answer questions. It is also helpful to save your thoughts until prompted by an attending. Every situation and surgeon are different. In general,

err on the side of caution until you have a good grasp of the OR dynamics.

Additionally, consider the type of question you are asking. Too many or too simple questions may be interpreted as annoying. Certain questions might be better suited for the fellow/resident or even the nurses and reps. Developing the ability to internally analyze questions and target them at a particular question takes time. A good rule of thumb is that all questions for the attending should be based on a technique or surgical decision. For example, asking how long cement takes to dry in hip arthroplasty is a better question for the resident or surgical rep while asking at what point did the surgeon know they were going to have to cement the patient in the prior operation is more appropriate for the attending. Generating questions is a good technique to add when preparing for cases as literature often offers thought provoking conversation starters. Students should also be prepared to answer follow-up questions posed by the attending.

Conclusion

While this is not an all-encompassing review, a main takeaway is to “read the room.” Not only is this an important skill for any future surgeon to possess, but becoming a successful orthopaedic surgeon means learning to balance strong personalities in a high-pressure environment. Dr. Krueger points out it is ok to be stressed in the OR as even attendings share this feeling. But if you are nervous, it is important to persevere. Overall, the orthopaedic OR can be an incredibly fruitful learning environment. Taking the time to develop your OR etiquette can help set you apart from other residency prospects.

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Article - Feature**New Trends in Orthopaedic Surgery Residency Applications: The Role of Preference Signaling**

By J. Liam Gibbons, Class of 2026
Faculty Advisor: Dr. Joseph Abboud, MD

Introduction

Orthopaedic surgery is known to be one of the most competitive specialties for medical students to pursue. It is important for applicants to have a strong portfolio of achievements, including research, presentations, and volunteering to increase chances of matching. USMLE scores and AOA membership tend to be higher among residency applicants that match into orthopaedic surgery. Moreover, the match rate for orthopaedics is lower at 74% compared to the overall match rate of 93.8%.¹ To increase chances of matching into an orthopaedic program, it is recommended to start preparing early and stay informed about trends and strategies in orthopaedic surgery residency matching. This paper aims to provide insight on the new preference signaling program for medical students considering orthopaedic surgery. We also hope this article can serve as a guide for students in other specialties with similar programs in place.

Application Process

The orthopaedic surgery residency application process is selective and demanding. To be eligible for consideration, applicants must have graduated from an accredited medical school and passed the USMLE and/or COMLEX medical board exams. The application process typically begins in the spring of the year prior to the start of the residency, with most programs participating in the National Resident Matching Program (NRMP) and using the Electronic Residency Application Service (ERAS). After applying in the fall, qualified candidates will be invited for interviews in the winter to visit the program's facilities and meet with the faculty and current residents. After interviews, applicants will submit a rank order list of their preferred programs to the NRMP, which will then match them to programs based on both parties' preferences.

In 2022, a new step called preference signaling was integrated into the orthopaedic surgery residency application as an additional tool for applicants to show interest to specific programs; and likewise,

allowing programs to identify applicants most interested in joining their residency class.²

The resident selection process is based on various factors, including academic performance, clinical experience, research, and letters of recommendation. In the most recent match cycle, 35.7% of US MD seniors who matched into orthopaedics were AOA members and had an average of 16.5 combined abstracts, publications, and presentations. Residency programs have also shifted from using USMLE Step 1 scores (which have now become pass-fail) to using 3-digit USMLE Step 2 scores as a way of evaluating applicants. US MD seniors who matched in orthopaedics had an average USMLE Step 2 score of 256 (90th percentile), while the average among all specialties to match was 248 (75th percentile).¹ In light of these factors, it is often recommended that students start preparing as early as possible for the orthopaedic match.³

Trends in the Residency Application Process

The COVID-19 pandemic brought about significant changes to the residency application process. In March 2020, the global economy shut down leading medical institutions to pause all clinical rotations and shift to virtual education. This presented a major challenge for residency programs, which lost two crucial elements of the application process: away rotations and in-person interviews.⁴ In response, programs were forced to adapt and embrace a virtual environment.

While in-person away rotations have mostly been resumed, virtual interviews have emerged as a lasting impact of the pandemic. It is uncertain if virtual interviews will become a permanent feature of the application process, but there is support for their continued use. Surveys indicate that 84% of applicants and 91% of interviewers believe that virtual interviews are effective and convenient and should be continued in the future application process.^{5,6} Given this support, it is likely that virtual interviews will be a common aspect of the residency application process for all applicants.

Shotgun Approach and Interview Hoarding

As popular as virtual interviews have become, there are other concerning issues among application strategies that have been on the rise for some time. One of the most noticeable trends is the sharp increase in the number of applications submitted by an applicant, rising from 46.5 to 74.9 between the years of 2008 and 2018.⁷ This is likely due to the increasingly competitive nature of applying to

orthopaedic surgery, fear of not being matched, and the convenience of the application process. This strategy, known as the “shotgun approach” involves applying to as many programs as possible with hopes of increasing one’s chance at obtaining interviews and matching.⁸

From the program's perspective, the increase in the number of applicants has created logistical challenges for properly reviewing applications. The average number of applications received per program has risen from 323.3 to 576.8 between these same years.⁷ With so many applicants, it becomes more difficult to provide a thorough review of each applicant, raising concerns that programs and applicants are not matching as effectively as possible. The effects of the “shotgun approach” were exacerbated by the reduced time and costs of travel for virtual interviews, leading to a phenomenon known as “interview hoarding” where highly ranked applicants participate in multiple interviews in a single day or weekend.⁸ This “hoarding” leaves fewer interview spots for other applicants who may have more interest in a specific residency program.

Preference Signaling

With the hope to mitigate the “shotgun approach” and “interview hoarding”, the American Orthopaedic Association has introduced a formal preference-signaling process for the 2022-2023 residency application cycle. This process, available through the Electronic Residency Application Service (ERAS) supplemental application page, allows applicants to indicate their preference for up to 30 programs.² While not mandatory, this feature allows programs to see an applicant's “signal” of interest. Similar preference-signaling programs have been implemented and well received in other specialties such as otolaryngology, dermatology, and general surgery. However, the other specialties allow a much lower number of “signals”; only 3 to 5 programs per applicant.⁸ These other specialties use preference signaling as a means for applicants to communicate to programs that they are among their top few choices. But in orthopaedics, it can be suspected that program directors may use signaling as an additional screening tool – though its effectiveness in this regard is yet to be determined.

As a result, fewer top-level candidates “hoarding” interviews is expected to create more opportunities for strong, “mid-tier” applicants at highly competitive programs.⁸ One approach that students can consider when applying to orthopaedic programs is to utilize various resources to identify a range of options that cater to their level of qualifications. Then, one could strategically assign

the 30 signals relative to their portfolio using geographic location, program’s values, or program size as means of determining the best fit.

Additionally, coordination among applicants from the same institution could be beneficial in reducing competition and increasing match rates, especially at institutions that typically only interview a small number of students from the same school.⁸

In the first year of preference-signaling for Orthopaedic applicants, the Jefferson Orthopaedic Surgery Residency Program received approximately 850 applications for 6 spots. Of those 850 applications, 375 indicated a preference for Jefferson. Approximately 100 applicants were offered interviews. All applicants that were offered interviews had signaled a preference for Jefferson during the process. James T. Purtill MD, Jefferson Orthopaedic Residency Program Director, felt that preference-signaling was useful to the department in evaluating the applicants. He felt that preference-signaling had an overall positive effect on the process and will likely continue in future matching cycles.⁹

Conclusion

Orthopaedic surgery is a highly competitive specialty among medical students and requires a strong portfolio of achievements to increase chances of matching. The match rate for orthopaedic surgery is lower compared to the overall match rate, and the selection process is based on various factors such as academic performance, clinical experience, research, and letters of recommendation. The COVID-19 pandemic brought about significant changes to the residency application process, including the use of virtual interviews, which have emerged as a lasting impact of the pandemic. However, there are concerning trends among application strategies, such as the “shotgun approach,” which involves applying to as many programs as possible. The American Orthopaedic Association has introduced a formal preference-signaling program for the 2022-2023 residency application cycle to address the issue of “interview hoarding” and provide more interviews to competitive candidates at strong programs. The program aims to provide more effective matching between programs and applicants and reduce the number of applications received by each program. By utilizing the preference signaling program and other resources, applicants can strategically choose programs that best cater to their qualifications, increasing their chances of matching.

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Article - Feature**First Job Considerations as an Orthopaedic Surgery Attending: Picking a Practice Setting**

By Purab Kothari, Class of 2026
Faculty Advisor: Dr. Jose Canseco, MD

A career in medicine is a journey with many forks in the road as medical students choose specialties, then subspecialties, and finally a practice setting. Particularly with the latter, becoming familiar with the various practice options early on can lead to an easier decision when the time to join the workforce arrives. Additionally, the ability to work in a setting that aligns with one's career goals may ultimately lead to increased job satisfaction and reduced burnout risk. The following article aims to define various practice settings, including academic, private, community, "privademics" and locum tenens, and explore key considerations orthopaedic surgery trainees should keep in mind when making their final decision.

Academic

In an academic setting, orthopaedic surgeons will typically work within a hospital system that is associated with a medical school. Accordingly, these institutions focus largely on research, so physicians are typically expected to contribute to scientific literature in addition to their clinical practice. These centers are tertiary or quaternary care centers, and generally offer equipment and procedures at the cutting edge. Surgeons will be exposed to more complex cases as many patients seek care amongst superspecialists with access to more resources.¹ Therefore, academic jobs have long been sought after by those with interests piqued by difficult and rare pathologies. Academic attendings also have the opportunity to teach fellows, residents, and medical students as an additional nonclinical role.

Compensation within academics is typically salary based with RVU incentives. In other words, orthopaedic surgeons will be paid a guaranteed base salary, with larger sums paid to surgeons who perform more procedures. Academic surgeons usually receive various benefits, such as health insurance, retirement plans, and paid time off, but are typically paid less than their private practice counterparts (\$364,000/year vs. \$480,000/year).²

As academic jobs tend to exist within tertiary and quaternary care systems, these jobs are harder to

find in more rural areas, as such hospitals require plenty of infrastructure and serve best to provide in large metropolitan areas. This is of special concern to those considering practicing in underserved areas.

Private

In private practice settings, an orthopaedic surgeon will own and operate their own medical practice. Within the realm of private practice exists solo practice, single specialty groups, and multispecialty group practices. Solo practice physicians own their practice and see all patients but also incur the most financial risk as they cover all the overhead themselves (e.g., staff salaries, office building rent, surgical center rights). Single specialty groups consist of partners of the same specialty all owning the practice and splitting overhead costs. Lastly, multi-specialty groups consist of partners in varying specialties working in conjunction under one larger practice umbrella.

The advantages of private practice include autonomy and flexibility in terms of scheduling and the types of cases they take on, as well as the potential to earn more money than in other settings.^{2,3,4} This is due to the elimination of administrator fees, as well as the ability to "eat what you kill;" performing more procedures to generate more revenue.

"Privademics"

With the emersion of private practice groups affiliating themselves with academic centers and residency programs, the term "Privademics" has become increasingly popular.⁵ Privademics falls along some continuum between academics and private practice, in which surgeons are affiliated with an academic medical center, but also can participate in the business side of private practice. This allows practicing orthopaedic surgeons to participate in education, research, and academic activities and utilize the resources of the university. In conjunction, surgeons have autonomy and financial potential to grow their business.

Community

Community hospitals are typically smaller hospital systems with a predominate focus on clinical care and less emphasis on research and education when compared to academic hospitals. Here, orthopaedic surgeons typically receive fewer complex cases, but can perform a wider variety of procedures. One might find themselves performing a total hip arthroplasty, then a shoulder arthroscopy, and then an emergent femur reduction, for example. As a

result, one will find less super-subspecialized orthopaedic surgeons working in these settings. Community hospital surgeons also take call but are often compensated less than their private practice counterparts (\$396,000/year vs. \$480,000/year).³ Such a practice is more conducive to rural living and treating underserved communities than an academic hospital. These hospitals require less resources to establish and are therefore more feasible in such areas. Surgeons who desire a sense of community may find a rewarding career in this practice setting.

Locums Tenens

Locums tenens physicians are commonly known as “traveling doctors,” contracted for short periods of time (2 weeks to several months) wherever their services are needed. This is typically due to a regional physician supply/demand imbalance or temporary absences, and frequently presents in more rural areas. Locums tenens physicians have the power to choose which contracts they accept, and by extension, where they work and how many weeks of the year they work. However, these jobs are typically scattered across the country, which can be burdensome to physicians with families. On the contrary, locum tenens positions allow for travel and experiencing life in a diverse array of geographical locations.

Orthopaedic surgeons willing to work locums are in high demand and can garner a competitive hourly wage, but many positions require their applicants to have some post-training experience (usually a Board Certification). While the flexibility of locums seems appealing, many believe joining an established practice after residency/fellowship is necessary to achieve the level of operating comfort required before one can participate in locums safely.⁶ As such, this practice model may be more suitable later in one’s career. Locums tenens surgeons can find job opportunities through traditional job bulletins, but locums tenens agencies are becoming a more common resource for job selection as they offer benefits like malpractice insurance while also providing a more comprehensive job search.

Key Considerations

- Academic centers have a complex management layout, requiring the presence of executive administrators who many believe to be a source of financial leakage away from both patients and providers.⁷ This structure also sacrifices physician autonomy as surgeons working in these systems are considered employees within a hierarchy and have limited freedom to modulate their work schedule.
- Alternatively, large academic institutions have shifted to vertically integrated delivery systems with provider sponsored health plans. In simple terms, these healthcare companies act as both the insurer and the hospital, while also owning the other care centers (physical therapy, ambulatory surgery centers, etc.). Financially, these companies are incentivized to reward positive patient outcomes as opposed to surgeon productivity (volume and billing value of procedures performed).⁸ If this shift continues, incentivization within academic careers may change, having lifestyle and compensation effects on surgeons of the future.
- The delineation between academic medicine and private practice has faded over the years, so there are many job opportunities that lay everywhere along the spectrum. The exact structure of any practice setting will have a large impact on all the considerations discussed prior, including lifestyle and compensation.
- Some academic institutions grant protected time away from clinical responsibilities to pursue research and other nonclinical endeavors.
- While an appealing option, privademic settings may present the same disadvantages as an academic setting in terms of pressure to publish research and participate in educational activities. Additionally, they may have the same financial responsibilities/risks as private practice.
- It is important to note that opening one’s own practice is becoming less and less feasible these days as there is growing competition from surrounding larger private groups.
- Private practice group positions typically pay a guaranteed salary for the first few years of a surgeon’s contract to allow them to establish a patient population, but most practices compensate based on productivity later. This is important to keep in mind when considering offers to avoid hyper-fixation on starting salary.
- Particularly within orthopaedic surgery, surgeons can expand their utility as consultants for device development. While this isn’t usually a career option for a new attending just completing training, choosing a practice setting heavily involved in the industry may facilitate such a career later.

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Interviews



Article – Interview**A Day in the Life of an Orthopaedic Surgeon with Dr. Rachel Shakked**

By Anne Cohen, Class of 2024
Faculty Advisor: Dr. Rachel Shakked, MD

From a young age, Dr. Shakked knew she wanted to be a doctor and started medical school with an interest in pursuing medical oncology. As a third year, she did her surgery rotation with low expectations but ended up loving it and discovering the field of orthopaedics. After completing her fellowship in 2016, she is now a foot and ankle specialist at the Rothman Institute where she experiences a mix of both private and academic practice. This conversation was born from her desire to show students what life is like beyond medical school and residency, and the importance of living a balanced life. Dr. Shakked prioritizes spending time with her family that includes her husband, also an orthopaedic surgeon, and her two sons ages 5 and 2. We sat down to discuss what her life as an attending surgeon looks like now, how to cultivate mentorship, and the importance of time management and a healthy, balanced lifestyle.

Hometown: Marlboro, NJ

College: Cornell University (B.S. Biology, Genetics), Ithaca, NY

Medical School: Albert Einstein College of Medicine, Bronx, NY

Residency: NYU Hospital for Joint Diseases, New York, NY

Fellowship: Foot and Ankle Surgery, Hospital for Special Surgery, New York, NY

Walk me through your weekly schedule.

Mondays and Tuesdays, I typically have office hours from 8 a.m. to 5 p.m. Monday morning we have 6:30 a.m. to 7 a.m. academic meeting with our entire foot and ankle department. It rotates between lectures given by residents or fellows, journal club, and case presentations. Once a month on Tuesday nights, we have a foot and ankle division meeting that alternates between research or business focused meetings. Wednesdays, I operate at our surgery center from 6 a.m. to 4 p.m. Thursdays, I have office hours again from 8 a.m. to 5 p.m. On Fridays, I do bigger cases in the main OR, starting my day around 6:45 a.m. with a variable end time ranging from 3 p.m. to 7 p.m. Sometimes operating days can be shorter and you get more administrative time. I take call some weekends which means I go in to round, see consults,

or operate. For example, this past weekend, I was on call and had to go in on Saturday for two hours to see four consultations. On Sunday, I was there for three hours to see more patients and did a surgery for a broken hip. I was fielding calls from home throughout the weekend.

On the office hour days, it's busy. Some patients are post-op and need stitches out and we have a conversation about the next set of instructions. One patient had a bad ankle arthritis, so we talked about surgical vs. nonsurgical options, and ended up scheduling her for surgery. Another patient came in and had an ankle fracture, but we decided not do surgery, so I placed her in a cast with our orthotics tech. Then I got a call from another surgeon about an ankle fracture in the emergency room that needed to be added on to my surgery case list tomorrow. I did take ten minutes during my lunch break to read my book for my book club. It's busy! The day passes fast.

Why orthopaedic surgery?

I picked it by accident. I went into medical school knowing I was going to be a medical oncologist. When I arranged my third-year rotations, I put general surgery first to get it done and out of the way. I was working more hours than I'd ever worked in my entire life, but I was so happy. It was gratifying to be able to fix a problem right in front of you. After that, I explored some surgical subspecialties and found orthopaedics was a great fit. I liked the mechanical and engineering aspect, the spatial relations, and realigning fractures. I take people who want to live an active lifestyle but have pain and get them back to doing the things they love.

What is your favorite surgery to perform?

Ankle fractures, always. It's so fun, it's like putting a puzzle together. No two ankle fractures are the same. Even though the principles of fracture fixation remain the same, you get to be creative and use your mind on each individual case. It's extremely fun and satisfying.

What is your favorite part of your job?

Seeing post-op patients in the office and how far they've come. With the ankle fracture patients, when you first meet them, they are injured and can't walk. And then a few months later, you see them in the office walking around without pain. They've come such a long way.

What is the most challenging part of your job?

The hardest part is that it's really not a job. I've dedicated my life to the practice of medicine.

You're never *not* thinking about your patients or work. You can't just turn it off. The good thing is that I love what I do, and I love my patients. It's harder now that I have two little kids and I have to make sure I share my time with them.

What do you like to do outside of work?

I like to be with my two boys, ages 5 and 2. Every morning, evening, and most weekends are for them. I love watching movies and reading books. I am in my neighborhood book club. I used to love to travel but that's on hold with two little kids because they'll be monsters on the plane.

Current book club book: The Paris Apartment (too scary though!)

Next book club book: Lessons in Chemistry

Favorite book: The Cider House Rules by John Irving. I love all his books.

Favorite movie: Avatar

What does work/life balance mean to you?

I am still learning how to balance it all. My husband is also a physician, and our two schedules are really complicated. We delegate as many tasks as possible. We have a wonderful nanny and house cleaning service. Planning far in advance is helpful so that call schedules, office hours, and surgery block time schedules can all be modified accordingly. We make our schedules a year in advance to figure out when we are going to see our family, when our kids are out of school, when we can get our parents to babysit to go on our own vacation. I have a weekend planned every month to see my sister and her family. I still get together regularly with friends from medical school and when we're together we look two months ahead and plan our next get together. There are so many pieces up in the air if you wind up having a family, especially with two partners who are both working full time as physicians. It's like a big logic puzzle.

What is one thing you wish you knew when you were in medical school?

When I was in medical school, the focus was trying to get to the most competitive residency. Then in residency, I was trying to learn as much orthopaedics as I could to match into the best fellowship. You're in this tunnel of just getting to the next step. I wish I had looked beyond training. I don't

think I would have changed anything, but now that I'm on the other side of it, it seems like such a short time. I might have asked different questions on the subject matter, practice management, balancing everything. It's important to protect time for yourself and time for your family. This is your life. You're only in your 20s and 30s once. You can do a good job at work and have a life outside. You can't take good care of patients if you're not taking care of yourself.

What advice do you have for students interested in orthopaedic surgery?

My roommate in medical school gave me the best advice. I told her how much I wanted to be an orthopaedic surgeon, but I didn't think I could to it. She told me to rise to the challenge and just apply, not to shy away from it just because I thought it was going to be hard. It seemed almost impossible to match and then complete such a difficult residency, so I almost let the challenge scare me away. But because I liked the subject material and that's what I wanted to do, I went for it, and I succeeded. It was also incredibly helpful for me to have my family nearby during school and training. My parents would sometimes even stock my kitchen with groceries on weeks that were especially busy in residency. Don't underestimate the power of having people who care about you nearby during training!

Is there anything else we didn't discuss yet that you think is important for students to know?

When I was a student, I didn't have a good mentor. I didn't know how to cultivate a mentorship relationship. And now having been on the other side where I am the mentor, I have had great connections with mentees because my mentees have cultivated it. Mentorship was posed as a "magical spark" to me, and I don't think that's real or common. More often the relationship is built by meetings and regular check-ins that are scheduled by the mentee. If I had realized that when I was a student, I may have tried to make a better connection with someone and that probably would've helped over the years. I had always felt I was a bother, but students shouldn't feel that way. One of my students texts me every month to tell me what she's up to and asks me a short question like 'help me figure out where to do this rotation'. I have all of this knowledge from going through the process, all of us attendings do, and we are happy to share it.



Clinical Medicine

Article - Clinical Medicine

Biologic Augmentation in Osteochondral Lesions of the Talus

By Yashas Reddy, Class of 2025
Faculty Advisor: Dr. David Pedowitz, MD

Introduction

Osteochondral lesions of the talus (OLT) are injuries involving damage to the cartilage and bone associated with the talar dome. They occur in up to 50% of ankle sprains and 73% of ankle fractures, varying in stability and severity.¹ Standard weight-bearing ankle radiographs may allow for visualization of the lesions if substantial bone fragmentation is involved but CT and MRI are more sensitive for subchondral bone damage and purely cartilaginous lesions, respectively (Figure 1). The majority of patients with OLT are active individuals in their 20s and 30s, and often present after sustaining an acute inversion injury.² Trauma to the talar dome creates an ischemic environment in the joint, which ultimately leads to disintegration of the subchondral bone in addition to damage to the overlying cartilage. This may lead to generalized ankle pain, weakness, and swelling. In addition to acute trauma, these lesions may develop as a result of osteochondritis dissecans (OCD). OCD lesions commonly present in patients between 10-20 years of age and have a multifactorial etiology, including genetic predisposition and loss of blood supply to a region of the joint.³ Incidence of these lesions is higher in young athletes, suggesting that microtrauma also plays a role in OCD becoming symptomatic.



Figure 1. MRI of osteochondral lesion. Image obtained from Dr. David Pedowitz (Rothman).

Despite the prevalence of OLT, there is still a great deal of uncertainty regarding the best treatment option. Although non-operative management such as NSAIDs, rest, and immobilization is a viable option for some patients, these methods fail about 45-55% of the time.⁴ Traditionally, bone marrow stimulation (BMS) through microfracture is often the treatment of choice for OLT. Microfracture involves drilling small holes through the subchondral plate (Figure 2), which releases mesenchymal stem cells and growth factors, in hopes of filling the lesion with fibrocartilage and vascular supply over time. This is a relatively simple and inexpensive surgical technique that yields about 85% good-excellent outcome scores for small to medium sized lesions.⁵ However, the fibrocartilage produced as a result of microfracture is inferior to the body's native cartilage and susceptible to greater deterioration over time with compression shear and tension forces.² In addition, the fibrocartilaginous ingrowth does not always completely integrate with surrounding cartilage after microfracture.⁵ Further challenges with this method include intra-lesion osteophytes, subchondral bone resorption, and fissures within the repaired lesion seen on long-term follow-up.^{6,7} Lastly, regarding the unclear pain generator in OLTs, some are concerned that microfracture merely creates a painful lesion rather than a biological substrate for a new bearing surface.

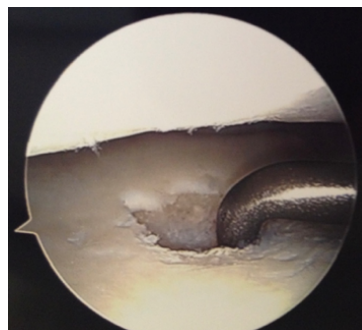


Figure 2. Arthroscopic Image of Lesion Created By Microfracture. Image obtained from Dr. David Pedowitz (Rothman).

Osteochondral autografts and allografts are an alternative treatment method (Figure 3). These grafts allow for the repair of subchondral bone through the transplantation of hyaline cartilage to the site of injury. However, poor incorporation between the graft and host leading to peripheral cell death and the formation of cysts remains a challenge of this technique.⁸

For skeletally immature patients, conservative treatment, BMS, and osteochondral autografts have been shown to be successful in about

44%, 77%, and 67% of children, respectively.⁹ In addition, fixation of the fragment to underlying bone using Kirschner wires, screws, or bioabsorbable pins was clinically successful in about 80% of children.⁹ This fixation method has also had significantly higher radiological success rates compared to other surgical methods due to the preservation of the natural architecture and hyaline cartilage.⁹

In recent years, biologic augmentation in OLT has emerged as an attempt to minimize the challenges posed by established treatments – most notably their limited durability and poor incorporation. Biologics have also been shown to decrease the action of osteoclasts and may minimize cyst formation, allowing them to be an effective adjunct to microfracture and osteochondral graft transfer.¹⁰

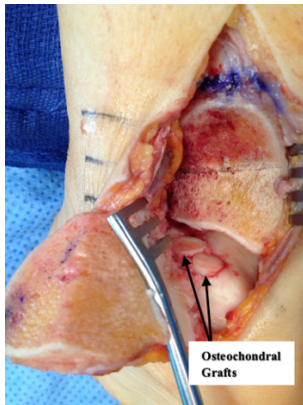


Figure 3. Implantation of osteochondral grafts at lesion site. Image obtained from Dr. David Pedowitz (Rothman).

Platelet-Rich Plasma Therapy

Platelet-rich plasma (PRP) therapy is a growing biologic augmentation method that utilizes a patient's own platelets and growth factors to stimulate the regeneration of injured ligaments and tendons. The injection is prepared by drawing a patient's blood, centrifuging the sample, and isolating the platelets from other components. This releases numerous factors from the broken platelets which can contribute to a healing cascade. Chondrocyte cultures in PRP have demonstrated increased chondrogenesis, type II collagen deposition, and proteoglycan synthesis, all of which are essential components of articular cartilage. These effects help prevent resorption of bone and degradation of cartilage.¹¹

Initial in-vitro studies in sheep and rabbits showed that PRP allowed for improved osteochondral lesion healing when combined with microfracture, in comparison to microfracture alone.^{12,13} PRP-treated lesions in rabbits also demonstrated an increase in type II collagen and proteoglycan content in the repaired tissue, along

with improved histological scores.¹⁴ Recent in-vivo research has shown that PRP, in conjunction with bone marrow stimulation, demonstrated greater improvements in functional outcome scores, joint function and decreased pain¹⁵. Benefits were most pronounced in smaller-sized lesions (<15 mm). However, sample sizes in each of these studies was small and the method/content of PRP preparation varied in each case.

Bone Marrow Aspirate Concentrate

Bone marrow aspirate concentrate (BMAC) has also been of great interest with regard to the management of OLT. Bone marrow aspirate is obtained from the patient's bone marrow, traditionally from the iliac crest, as shown in Figure 4. It contains both platelets and mesenchymal stem cells and possesses similar anti-inflammatory effects to PRP. Moreover, the mesenchymal stem cells within BMAC have the capacity to differentiate into chondrocytes, making it a useful biologic in conjunction with BMS.¹⁶



Figure 4. BMAC in syringe after harvesting from iliac crest. Image obtained from Dr. David Pedowitz (Rothman).

In the equine model, BMAC combined with microfracture was shown to improve histologic scores at the site of the lesion in comparison to microfracture alone.¹⁷ MRI mapping also demonstrated improved healing in the experimental group.¹⁷ In a human study, adding BMAC to BMS has been shown to improve articular cartilage repair, functional outcomes, and MOCART scores, the latter of which are used to grade the quality of repaired cartilage tissue after surgery.^{18,19} The merits of BMAC have not only been demonstrated when implemented with microfracture, but also when used with osteochondral autograft transplantation.²⁰

BioCartilage

Extracellular matrix cartilage allograft – marketed as BioCartilage (Arthrex, Naples FL) – is developed from dehydrated allograft cartilage and is composed of type II collagen, proteoglycans, and cartilage growth factors. BioCartilage enables chondrocyte synthesis and proliferation by acting as a tissue network to allow for greater cell interaction. After stimulation of mesenchymal cell migration by

microfracture, these cells mix with the matrix provided by BioCartilage leading to the formation of hyaline cartilage.²¹ Figure 5 demonstrates insertion of BioCartilage at the lesion after microfracture has been performed.

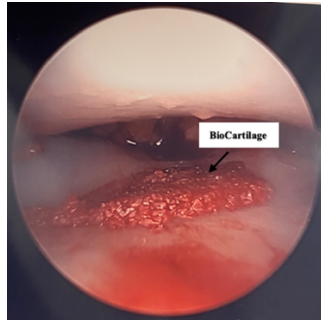


Figure 5. Microfracture site after BioCartilage implantation. Image obtained from Dr. David Pedowitz (Rothman).

When combined with BMS and BMAC, BioCartilage improves pain, functional outcomes, and MOCART scores.²² In radiographic studies, the BMS + BioCartilage groups showed a greater infill, less edema, and fewer fissures compared to the groups receiving only BMS²³. The decrease in fissures is especially noteworthy as this is a commonly encountered problem in long-term MRI follow-up of OLT's treated with microfracture. Support for BioCartilage has grown rapidly in recent years as long-term follow up outcomes have been favorable.²²

DeNovo Natural Tissue Graft

DeNovo (Zimmer Biomet, Warsaw IN) is allograft composed of juvenile hyaline cartilage, which contains immature chondrocytes. Juvenile chondrocytes have much higher proteoglycan and collagen type II content and demonstrate significantly faster growth in monolayer cultures compared to adult cells.²⁴ Early clinical trials in patients with large OLT have also shown substantial improvements in pain, activity, and function.²⁵ Although DeNovo allograft implantation in conjunction with BMAC has demonstrated improved functional outcome scores, postoperative MRI of the tissue still showed similar composition to that of fibrocartilage.²⁶ Therefore, long-term follow up is still needed to determine the durability of this augmentation method.

Conclusion

Overall, PRP, BMAC, BioCartilage, and DeNovo have all had promising results in early in-vivo and in-vitro studies. However, the superiority of

certain methods over others has not been studied in a randomized fashion. The utility of peripheral blood stem cells and adipose-derived stem cells are also being investigated with respect to the management of OLT. Rather than the superiority of certain biologic augments, it is likely that a combination of biologic augments must be utilized for increased durability and tissue incorporation in OLT. Harvesting the body's natural capability of restoring cartilage is a challenging, but potentially very fruitful endeavor in foot-and-ankle orthopaedics.

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Article - Clinical Medicine**Exploring the Use of Robotics in Orthopaedic Surgery**

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Over the last few decades, the use of robotics has dramatically increased across all surgical specialties. While initially only utilized in a few gynecological and urological procedures, robotics are now used in a wide range of surgical procedures ranging from general surgery, cardiovascular surgery, to otolaryngology and orthopaedic surgery. One study noted in the field of general surgery, roughly 15% of all surgeries are utilizing some form of robotics.¹ Surgical robotics assist in a variety of ways ranging from guiding procedures by creating 3D images of the anatomic landscape, to allowing physicians to operate through telemanipulating in a separate room. The use of robotics has aided in increasing the surgical accuracy and precision through smaller incisions, while reducing the risk of complications, radiation exposure, and overall surgical time.¹⁻³

In orthopaedic surgical history, the TiRobot[®] has been noted as the first robot to reduce human errors in the implantation of screws during spine surgery. The system is multifaceted consisting of three main components: a robotic arm, an optical tracking device, and a surgical planning and controlling workstation. It works by first creating a 3D anatomical map of the procedure that the surgeon can view in the optical tracking device. Simultaneously, the robot utilizes its unique algorithm to calculate the precise screw trajectory with only less than 1 mm of inaccuracy.^{4,5} In addition to these advantages, the robotic apparatus provides an arm that can precisely move to any planned position while providing the surgeons a stable trajectory to place the cannulated screws effortlessly.

The TiRobot[®] was first documented in spinal surgical studies placing pedicle screws in scoliosis surgery, as well as placing percutaneous sacroiliac screws in separate surgeries. One study notably found a 98.2% success rate while using the TiRobot[®] to place pedicle screws compared to a 91.6% rate for freehand fluoroscopy-assisted pedicle screw insertion using a traditional open technique.⁶ Additionally, studies have shown significantly lower surgical time, less intraoperative blood loss and less postoperative drainage in robotic-assisted procedures compared to a traditional approach.⁴⁻⁶ Following these studies, the TiRobot[®] was later

trialed in placing screws in distal extremities; again, providing to be as efficacious as current traditional approaches, with increased accuracy, and reduced surgical complications.⁷

In addition to spine surgery, robotics have also been integrated and documented in both trauma and joint replacement surgery. As both specialties require high levels of precision and dexterity, robotics have been able to assist in reducing iatrogenic fractures and screw implant malpositioning. In joint surgery, the use of robotics have been studied particularly in both total knee arthroplasty (TKA) and hip arthroplasty (THA). One retrospective study examined robot-assisted total knee arthroplasties compared to conventional TKAs and found that while the clinical outcomes and survival rates were similar, the robot-assisted group had fewer postoperative leg malalignment, fewer radio-lucent lines, and significantly improved mechanical axes.⁸ A separate prospective study found that although the robot-assisted TKAs had a higher rate of complications, the patients in this cohort noted better quality-of-life measures, including significant improvements in SF-36 vitality and role emotional, and a larger proportion of patient achieving SF-36 vitality minimum clinically important difference.⁹ Lastly, a meta-analysis found similar pain, quality of life, satisfaction and clinical outcomes between robotically-assisted THAs and TKAs compared to conventional approaches.¹⁰

In hand surgery, the use of robotics has been shown to not only improving accuracy and precision, but decrease overall surgical time and complications. A randomized control trial comparing robotic-assistance screw fixation for acute scaphoid fractures to traditional scaphoid screw fixation found that robotic-assisted surgery had a significantly lower guidewire insertion time, increased accuracy in guidewire insertion, and decrease in the number of attempts at inserting the guidewire.¹¹ Additionally, multiple studies have also concluded that the use of robotics in percutaneous scaphoid fixations were comparable to conventional techniques by having similar postoperative outcomes, complications rate, and scarring.¹²⁻¹⁴ Moreover, the robotic assisted cohorts were associated with significantly decreased surgical time and an overall 28% reduction in radiation used in the OR.¹²⁻¹⁴ As a result, robotic-assisted hand surgery has been shown to not only provide comparable clinical outcomes for patients, but also improve the health and safety for the entire surgical team.

In addition to the benefits listed above, robotics can also reduce the physical strain on surgeons. This assistance might seem minimal, however even the

smallest assistance over time helps improve the overall safety and efficiency of the procedure for the patient and surgical team involved. A study published in the Journal of the American Medical Association concluded that the use of a robotic system resulted in significantly less muscle fatigue for surgeons compared to traditional methods.¹⁵ For all the reasons above, robotics has been documented to be comparable to current surgical approaches, while improve overall surgical efficiency.

Despite the potential advantages robotics provide, there are still large barriers to incorporating them into every OR. The largest barriers to instituting robotics are the cost and availability of the technology. Robotically assisted procedures have been noted to cost roughly \$2,000 more expensive than non-robotically assisted procedures due to estimated increases of \$1,866 for robotic specific instruments and accessories, \$1,038 for robot systems, and \$663 for the service contracts.¹⁶ However, with all these incurred costs, robotically assisted procedure have been noted to decrease surgical time, allowing for more procedures to be performed to offset the high overhead. Lastly, as the technology is constantly improving, this increases the availability of robotics in the marketplace and allowing for more hospitals to incorporate them into their practices. This is evident with the increase in rise and use of the new Tuoshou® robot, which has improved on the TiRobot® robotic arm, imaging, and interface within the workstation to increase precision and provide real time intraoperative e feedback.¹⁷ As technology continues to advance and become more widely available, many of the initial barriers limiting use of robotic-assisted surgery in orthopaedics will begin to dissipate.

Regardless of the existing barriers, the current clinical evidence suggests the use of robotics in orthopaedic surgery is a promising trend. With the growth of technology in the OR, it is likely that more surgeons will adopt the new innovative approaches, leading to improved patient outcomes, and more efficient surgical procedures.

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Article - Review**Additional Strategies to Heal a Fracture: The Impact of Lifestyle Modifications to Improve Bone Repair**

By Katie Duquette, Class of 2026

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Suffering from a bone fracture can hinder a patient's ability to work and greatly diminish their quality of life. Depending on fracture characteristics, treatment options consist of non-operative and operative management. Regardless of intervention needed, the process of bone healing is multi-factorial. Therefore, patients who are interested in maximizing their functional recovery can make changes within their control to optimize the healing process. Changes as simple as adding beets and probiotics could have a significant impact on returning function earlier and alleviating pain sooner.

If physicians elevate their current recovery strategy advice, it may be possible to improve a patient's recovery and increase bone healing whilst minimizing adverse effects on quality of life. A clear set of guidelines related to diet, nutritional supplementation, sleep, and activity are essential tactics to minimize the time it takes for the patient to return to work or essential activities of daily living.

Dietary Considerations for Bone Healing

Depending on management, the bony healing process after a fracture consists of primary bone healing without callus formation through the cutting cone pathway or secondary bone healing which occurs through three stages: inflammation, callus formation, and bone remodeling.¹ The diet of our patients can either directly foster these processes or hinder them.

Initially, cells and cytokines are recruited to remove necrotic tissue, promote angiogenesis, and initiate bone repair. Angiogenesis refers to the formation of new blood vessels, which allows growth factors and immune cells access to the area of injury to supply the new bone. The vascular endothelial cells continue to proliferate and divide.² While anti-angiogenic diets have been researched as a method of tumor treatment to inhibit vascular development, pro-angiogenic foods may be beneficial for an individual to incorporate into his or her diet for improved fracture healing. For instance, dietary nitrites were associated with improved revascularization in patients with ischemia and can be found in leafy green vegetables like spinach and beets.⁴

Revascularization is important because bone repair requires oxygen and nutrients, which are provided by blood flow.¹ Oxygen is necessary for both the survival and proliferation of new cells. Mineral nutrients such as calcium, vitamin D, phosphorus, and magnesium are all required for the formation of new bone. Additionally, blood flow helps remove waste such as carbon dioxide and lactic acid from the area of injury, which reduces inflammation and promotes healing. As inflammation subsides, chondrogenesis and osteogenesis begin to heal the broken bone. The cartilage extracellular matrix provides strength and support as the bone heals. As the bone remodels into new bone, the bone marrow space is re-established and the previously increased vasculature regresses to the pre-trauma level.

Vitamins

To support new bone development, patients should prevent developing micronutrient deficiencies.⁵ For example, vitamin D deficiency was found in 40-70% of elderly patients presenting with a fracture and is associated with an increased risk of non-union.⁶ Vitamin D is necessary to support the absorption of calcium for callus formation. Vitamin D can be found in tuna, salmon, some mushrooms, and fortified cereals and plant milks.⁷ Additionally, phosphate-restricted diets negatively impacted fracture healing due to decreased bone morphogenetic protein signaling-2 and a disrupted circadian cycle. Dietary sources of phosphates include yogurt, fish, eggs, nuts, and legumes.⁸

Vitamin C is necessary for chondrogenic and osteogenic differentiation of the mesenchymal stem cells, as well as collagen formation for bone healing.⁵ A deficiency in Vitamin C delays callus and cartilage formation and increases the risk of impaired healing. A case study by Michelson, et al., demonstrated the importance of Vitamin C by describing a 25-year-old female with scurvy and a humerus fracture. After 6 months, radiology showed no evidence of healing. However, callus formation began soon after her vitamin C deficiency was addressed.⁹ An estimated 40-80% of elderly patients with fractures are deficient in Vitamin C, but Vitamin C can easily be found in citrus fruits, green peppers, red peppers, strawberries, tomatoes, broccoli, brussels sprouts, turnip, and other leafy vegetables.¹⁰

Adequate intake of vitamin K and vitamin A facilitates calcium absorption, direction, and utilization for the bone healing process.¹¹ Current research suggests that post-trauma, calcium used for bone callus formation is derived from the skeleton, which is independent of dietary calcium. In contrast, dietary calcium appears to be utilized more frequently during the late stages of post-fracture recovery. Although there is still room for research on how vitamins specifically benefit bone healing after a

fracture, Vitamin K₂, a regulator of bone resorption, may help bone recovery by stabilizing bone metabolism.¹²

Alcohol and Smoking

The current general recommendations for alcohol consumption for women are 1 drink per day and 2 drinks per day for men (due to the differences in alcohol metabolism).¹³ However, when healing from a fracture, alcohol increases the chance of nonunion by significantly inhibiting normal fracture callus formation due to several proposed mechanisms. Alcohol appears to inhibit mesenchymal stem cells (MSCs) at the site of the fracture injury, which give rise to osteoblasts and chondrocytes necessary for callus formation.¹⁴ Alcohol can also reduce blood supply to the fracture site, impeding the delivery of vital nutrients and oxygen to the healing bone tissue. Additionally, it weakens the immune system, making it harder for the body to fight off infection and inflammation, both of which can delay the healing process.

Supporting this, Chakkalakal, et al., demonstrated reduced fracture callus bone strength, stiffness, and rigidity in animals that received 36% of calories from alcohol for 6 weeks before and 6 weeks after a surgically administered fibula fracture in rats.¹⁵ Interestingly, those that became abstinent after the injury have normal fracture callus bio mechanical properties. This suggests that even those who consume alcohol regularly prior to their fracture could experience the healing benefits of removing alcohol from their diet while recovering.

Nicotine smoking is also a well-documented factor that slows bone healing and increases the risk for non-union.¹⁶ Hoogendorn, et al., even found a 40% increased time to union and chance of non-union when compared with non-smokers.¹⁷ Refraining from smoking may be a much more difficult change compared to the other suggestions noted in this article. However, an earlier recovery could be a motivating factor as ex-smokers can experience bone healing benefits upon quitting.

Probiotics

The gut-bone axis refers to the bi-directional relationship of the digestive tract and bone health. The gut's microbiome plays an important role in the absorption and metabolism of nutrients such as calcium and vitamin D19. The gut also produces hormones and other signaling molecules that can affect bone cells and bone remodeling. For example, the hormone leptin, which is produced in the gut and fat cells, can regulate bone mass by affecting the activity of osteoblasts and osteoclasts. Comparatively, osteocalcin, a protein produced by osteoblasts, has been shown to affect the

composition of the gut microbiome and improve glucose metabolism.

Therefore, probiotics may be a beneficial addition to a patient's post-trauma diet. Howard, et al., identified significant change in the microbiome of the gut after only 72 hours of a trauma.²⁰ Studying the impact of probiotic treatment on elderly patients with distal radius fracture, Lei, et al., designed a randomized double-blind, placebo-controlled study.²¹ At the end of month 6, the group consuming probiotic treatment and the placebo group both experienced similar end results in pain improvement and the ability to perform functional activities of daily living. Fascinatingly, however, the group that consumed the probiotics experienced much faster pain improvement and recovery to perform functional activities of daily living when compared to the placebo group during the first 4 months of the study. Therefore, supplementing with probiotics may alleviate pain sooner and return to normal function earlier.

Nutrient	Female RDA	Male RDA
Vitamins		
Vitamin C (mg/day)	75	90
Vitamin D (µg/day)		
19-70 years	15	15
>70 years	20	20
Vitamin E (mg/day)	15	15
Minerals		
Calcium (mg/day)		
19 to 50 years	1,000	1,000
51-70 years	1,200	1,000
>70 years	1,200	1,200
Copper (µg/day)	900	900
Phosphorus	700	700
Zinc (mg/day)	8	11
Iron (mg/day)		
19-50 years	18	8
>50 years	8	8
Macronutrients		
Protein (g/day)	46	56

Table 1. Adult Recommended Dietary Allowances (RDA) for Nutrients Related to Fracture. Reproduced from Roberts, J.L. and Drissi, H. (2020), Advances and Promises of Nutritional Influences on Natural Bone Repair. *J. Orthop. Res.*, 38: 695-707. <https://doi.org/10.1002/jor.2452>

Fact or Myth? Drink Milk

Due to the association of calcium with both milk and bone, a common notion for healing bone is to drink milk. While calcium is a significant part of bone composition, research is ongoing whether dairy is the best source of calcium for health and to what extent increasing intake of dairy post-fracture improves fracture healing. For example, a review by Tai, et al., of dietary calcium intake on bone mineral density (BMD) found it can produce a small increase in BMD but was limited in its progression and not associated with lower fracture risk.²² Further, Michaelsson, et al., found high milk intake (more than

3 glasses per day) was associated with higher fracture and mortality risk for both men and women in Sweden. The study suggested the increased risk of mortality and fracture could be explained by the increased D-galactose content of milk, leading to elevated biomarkers for oxidative stress and inflammation (Interleukin 6).²³ Meanwhile, this same study found that yogurts and cheese, which contain lower D-galactose content, were associated with lower rates of mortality and fracture risk. However, calcium deficiency may not significantly impact bone fracture healing after the injury occurred.⁵

If dairy is consumed for dietary calcium, yogurts or cheeses would be a better choice than milk. Dr. Derek Donegan, M.D., MBA, a Professor of Orthopaedic Surgery at the University of Pennsylvania recognizes nutritional drawbacks in the diet of his patients, stating “dietary sources are important, but the bioavailability of key nutrients are variable. I often recommend supplementation in addition to dietary changes to fully optimize my patients nutrient profile.” Therefore, calcium supplements should also be considered over milk.

Fact of Myth? Take NSAIDs for the Pain

Nonsteroidal anti-inflammatory drugs (NSAIDs) are also a common recovery strategy for a bone fracture management. However, NSAIDs have an inhibitory effect on the cyclooxygenase enzyme activity that is needed for bone healing. Research is inconclusive as to whether this translates to clinical medicine and impairs the healing process for bone fractures. Al Farii, et al., found that patients on NSAIDs for over 4 weeks after a fracture were at higher risk for nonunion, while less than 2 weeks of NSAID use was not associated with impaired fracture healing.²⁴ However, the use of indomethacin specifically was significantly associated with an increased risk of nonunion of the bone.

Although research is inconclusive, pain maintenance is an indisputable and essential aspect of patient care that should be considered carefully. Regarding his use of NSAIDs in managing fractures, Dr. Donegan noted that “while animal studies in both spine fusions and femur fractures have demonstrated an increased nonunion rate with the use of NSAIDs, this has not translated into the clinical realm. Most clinical studies demonstrate a benign effect of NSAIDs on fracture healing. Additionally, due to our current concerns about opioid use and the “Opioid Crisis,” the use of non-opioid medications, such as NSAIDs, to help manage patient’s pain after an acute fracture is an important part of the treatment algorithm. Clinical studies have actually demonstrated that the nonunion rate in patients healing from fractures using opioids versus NSAIDs is the same. Therefore, except for very select situations, NSAIDs are a cornerstone to my multi-

modal approach to treating patients after an acute fracture.” As such, pain relievers may be a necessity for many patients and should be balanced with the individual patient’s recovery goals.

Fact or Myth? Limit activity and Rest

Rest should not be mistaken for inactivity. Mechanical stimulation can stimulate the bone repair pathways of inflammation, proliferation, and remodeling.²⁵ While physical therapy is commonly prescribed after a fracture to return strength to the affected area, non-weight-bearing movement and activity of the area may improve the bone repair process as well. Pursuant to Wolff’s law, if a bone is subjected to increased stress, it will respond by increasing its density and strength, making it better able to withstand the loads placed upon it.²⁶ Dr. Donegan’s goals for fracture healing is “to allow return to function as soon as possible.” He states that “this is often a guiding tenet for operative versus non-operative management. In that regard, for non-articular fractures, once the bone is stable, weight bearing is initiated to take advantage of Wolff’s law and enhance fracture healing.”

Beyond weight-bearing exercises for a stable bone, Dr. Donegan also stated “in regard to articular fractures, initiation of range of motion of the joint involved is critical for healing of the articular fracture and ultimate long term outcome of that joint.” Prior research demonstrates that bone repair at a fracture site is stimulated by mechanical movement²⁵. One potential explanation for improved fracture repair is that increased mechanical stimulation during the proliferation and the remodeling phase increases vascularization and chondrogenesis to the fracture site²⁷.

Additionally, sleep has a biochemical impact on bone recovery. While research is limited, current studies suggest that abnormal sleep patterns increase fracture risk.²⁸ One explanation is that bone resorption is regulated by a person’s circadian clock.²⁹ Further, a lack of sleep will increase cortisol levels and inflammation, which impair bone recovery. Specific guidelines for post-fracture sleep are still being researched, but general optimal sleep recommendations for adults include 7-9 hours of sleep per night, regular bedtime and wake-up times, limitation of noise where you sleep, avoidance of nicotine and alcohol, and avoidance of caffeine 6 hours before sleep.^{30,31,32}

Patients trust their physician to care for them, and it is important for physicians to have the ability to provide patients information and a plan that can materially aid in the patient’s recovery. Patients can control a piece of their recovery pathway by ensuring adequate and regular sleep, maintaining movement and activity, and temporarily modifying their diet to include foods that support angiogenesis,

callus formation, and bone remodeling. The standard of care for a bone fracture should incorporate these types of specific diet modifications, as well as specific sleep and activity guidance, to support healing and new bone growth.

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Article - Review**Evaluation and Management-focused Medicare Billing Threatens Orthopaedic Practice Sustainability and Equitable Access**

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The US government established Medicare in 1965 through The Centers for Medicare and Medicaid Services (CMS) with the principal purpose of providing national health coverage and financial security for America's vulnerable population over age 65 not well covered by already established employment-linked plans. In 2022, 58.6 million individuals received medical insurance through Medicare, with 28.4 million of those beneficiaries enrolled in Medicare Advantage plans. As our population continues to age, a substantial portion of the population, will increasingly rely on this coverage to access hospital and healthcare-related services. Unfortunately, financial pressures continue to stack against providers, especially proceduralists who care for larger Medicare populations. In the setting of pre-existing human capital strain after the Covid-19 pandemic, 50-year high inflation rates and increasing administrative costs associated with surgical practice, orthopaedic surgeons are among the most negatively affected by the recent changes announced in the CMS 2023 Final Rule.⁸

While the changes outlined in the CMS 2023 Final Rule are diverse and interconnected, most of the discussion and advocacy has been focused on the proposed decrease in the Physician Fee Schedule (PFS) conversion factor from \$34.61 to \$33.06.¹ Orthopaedic surgeons and other proceduralists would be well-served to understand the context of these changes to better advocate for policies that ensure fair reimbursement for caring for America's older and financially vulnerable population. Many of these policy changes were initially introduced in 2021, when CMS overhauled the office Evaluation and Management (E/M) coding system. Broadly, E/M coding classifies the 1) type and 2) amount of physician work and documentation depending on service location and patient complexity. CMS proposed a significant increase in reimbursement for office/outpatient E/M visits, citing the growing Medicare population as well as the increasing medical complexity of beneficiary health. In a capturing statement, then CMS administrator Seema

Verma commented, "in the past, the system has rewarded interventions and procedures over time spent with patients – time taken preventing disease and managing chronic illnesses."²

In the Calendar Year (CY) 2023 proposed rule, CMS demonstrated its continued agenda to update the E/M coding guidelines. The agency expanded the E/M coding and documentation changes to other locations including hospital inpatient, hospital observation, emergency department, and nursing facility.¹ Moreover, peri-operative E/M services were included in calculating the total value of surgical CPT codes. However, 2023 surgical CPT codes did not reflect the 2023 E/M increases; and as a result, follow-up visits during the global period (within 90 days postoperatively) will be worth less than office visits for new patients or non-surgical follow-ups.³ Moreover, increases in E/M reimbursement are not without consequences in the zero-sum game of government spending. The Social Security Act requires that increases or decreases in reimbursement may not cause the amount of Medicare Part B expenditures for the year to differ by more than \$20 million from what expenditures would have been in the absence of these changes.⁴ If added expenditures exceed the threshold, CMS can adjust to preserve budget neutrality.

To account for the increases in reimbursement as measured by Relative Value Units (RVUs) for E/M services and maintain budget neutrality compliance, CMS proposed a 4.42% decrease in the CY 2023 PFS conversion factor from \$34.61 to \$33.08.¹ Accordingly, CMS projected those specialties performing more E/M services, such as family practice, endocrinology, oncology, and rheumatology, would see increases of 7-16% in total yearly reimbursement.⁵ On the other hand, CMS projected a proportional inverse change in Medicare reimbursement for procedural and surgical specialties. These increases in E/M reimbursement, coupled with a decrease in the broader conversion factor, have gravely disincentivized orthopaedic surgeons from performing necessary and appropriate surgical services for the Medicare population.⁹ Projecting out the current trend in rising reimbursement for E/M visits and decreased reimbursement for surgical care, orthopaedic surgeons are facing a payment fulcrum where clinical office time will equal or surmount operating room time.

As the general population ages and the demand for orthopaedic care increases, CMS may place further negative pressure on orthopaedic reimbursement rates to maintain budget neutrality. Taken together, these future trends in the field of orthopaedic

surgery will require practice groups to adapt. In an effort to contain costs associated with highly utilized orthopaedic procedures such as hip and knee replacements, multiple groups have utilized time-driven activity-based costing (TDABC) approaches to ascertain their true costs and remain net neutral against bundled payments.¹⁰⁻¹² As office and operating reimbursements trend towards reimbursement parity for the Medicare population, some orthopaedic groups may prioritize surgical care and operating room time for commercially insured patients to support the economic demands of running their practice. Moreover, such rationing could manifest as physician groups delaying important surgical care for Medicare patients. Many orthopaedic emergencies, notably pathologic hip fractures, require time sensitive interventions, with patient outcomes linked directly to the “time-to-surgery” metric. As such, delays in care could lead to poorer outcomes and increased mortality in this cohort. To address these impending disparities in orthopaedic patient outcomes, the following options are available:

- **Advocacy:** Surgeons and advocacy groups such as the American Academy of Orthopaedic Surgeons (AAOS) must emphasize the consequences of reimbursement parity for surgical and E/M services to policymakers and regulators in Washington, DC at the RVS Update Committee (RUC).
- **Policy Re-design:** Re-examine Medicare budget neutrality. As Mann et al. discusses in the context of Medicaid, the benefits of challenging narrow part B-focused budget neutrality policies accelerate efforts to address inequities in access for publicly covered populations.⁶ Importantly, this strategy expands the pie of government spending that many specialty groups are lobbying to access, but would potentially increase total public Medicare expenditures, thus hastening Medicare Trust Fund solvency.
- **Implement Incentives:** CMS may consider releasing alternative payment models (APMs) that fall outside the purview of budget neutrality, much like the existing “New Technology Add-On Payments” that incentivizes providers to engage in innovative, high-value care for Medicare beneficiaries without the constraints of RVU-based payment.⁷ While the strength of this approach lies in its incentivization of provider groups to innovate in orthopaedic patient care, it may select for already top practice groups who can “perform to play” in these models.

In sum, addressing the Medicare reimbursement crisis in Orthopaedics will take a creative multi-pronged approach, but Advocacy must lead other actionable policy steps. With focused leadership representing the field at the RUC and other policy roundtables, Policy Re-Design and Implement Incentives can follow suit to ensure orthopaedic practice sustainability and equitable access for the more than 50 million publicly covered Medicare patients.

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Article - Review**Summary of Early Sport Specialization in Baseball**

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Background/ Scope of the Problem

Early sport specialization, defined as playing one sport for over eight months in a year without participation in any other sports, has gained significant popularity in recent years.^{1,2} Increasing numbers of young baseball players are leaving their local leagues for travel programs where they may pay thousands to play for a team year-round.³ Youth baseball players are competing in more games than ever. During the busiest months, summer travel teams routinely schedule around 80 games over the course of just three months.⁴ Putting this in perspective, Division I college programs play about 60 games per year over a five-month span.⁵

While teams, tournament hosts, and other entities profit from youth athletics, the question remains: does early specialization provide any benefit for the athletes? This article will discuss the perceived benefits and risks of early sport specialization in baseball, and how physicians can support athletes pursuing this path.

Perceived Benefits of Early Sport Specialization

Proponents of early sport specialization assert that by focusing on one sport from an early age, athletes can develop and strengthen specialized skills, thereby gaining a competitive edge.¹ Evoking the old adage “iron sharpens iron,” many parents believe that early exposure to competitive environments benefit their children’s athletic development as they learn to succeed against higher levels of competition compared to their local leagues. With this advantage, athletes often hope for increased opportunities to compete at higher levels such as college or professional baseball.

Athletes may elect to specialize out of a strong passion for their sport.⁶ Interviewed MLB players revealed that they chose to specialize early on because of their love for baseball.⁷ Engaging in sports can also have many psychological and physiological benefits, such as lower levels of stress, prevention of depression, and strengthening of the immune system.⁷

Risks and Drawbacks of Early Sport Specialization

Supporters of early specialization maintain that this training approach leads to increased achievement. However, it may not be necessary for achieving elite status as less than half of MLB players specialized in baseball at a young age.^{1,8}

Research correlates early specialization with a greater risk of injury.^{1,2,8,9,10} The most common injuries amongst baseball players are localized to the upper extremity for several reasons.¹¹ Repeated throwing motions place extreme amounts of valgus stress on the elbow joint; the ulnar collateral ligament (UCL) in particular absorbs most of the force.¹ Simple overuse is one mechanism of injury, but this risk is amplified by poor throwing biomechanics and length of play, the latter of which is influenced by early specialization and not adhering to pitch count limits. Biomechanics are impacted by the mobility of certain joints, degrees of maximal rotation, stride length, and more. For example, the timing of trunk rotation and degree of external rotation of the shoulder directly influence the amount of stress put on the UCL during the pitching delivery.¹²

In addition, a player’s position influences the types of injuries they are most at risk for.⁹ Pitchers are frequently afflicted by upper extremity injuries, while position players commonly suffer from rotation injuries. One example is in pars fractures and subsequent spondylolisthesis, which occur at higher rates in position players compared to pitchers.¹³

As for psychological risks, early specialization may increase risk of burnout in young athletes.^{1,14} Players that specialize are more likely to retire or drop out of their sport at an earlier age.¹⁴ However, the reason why athletes choose to play a sport may determine their risk of burnout. Pressure from parents may have a negative impact, a contrast to the MLB players who specialized because of their genuine passion.¹⁴

Discussion of Early Sport Specialization

While the benefits of early sport specialization depend on individual athletes’ abilities and goals, the undeniable fact is that this path increases risk for injury, irrespective of the level of competition. Unfortunately, as with most cases in medicine, the story of early specialization is not a “one size fits all”. It is important for healthcare providers to identify their patients’ goals, and subsequently create a treatment plan that optimizes performance while

minimizing injury. Providers should educate patients and family members about the increased risks of injury correlated with early specialization. These transparent and informative conversations are essential to achieving positive outcomes.

Consider how two athletes, one with lesser and one with greater athletic talent, weigh the benefits and risks of early specialization as they strive to reach their goal of playing on their school's varsity team. With additional training and focused instruction, the athlete with less talent may improve enough to make the team. From this player's perspective, the risk of injury may be worth achieving their goal. This is an individual decision influenced by fluctuating priorities and personal aspirations.

In contrast, early specialization and focused training may have diminishing returns for the more talented player. Irrespective of professional aspirations, research suggests that this player would benefit instead from diversifying their athletic abilities by participating in other sports.¹⁴ In doing so, athletes can learn movement patterns and strengthen their bodies in diverse manners, which translates to even better results in their primary sport.¹⁴

Physicians may not always be familiar with their patients' skill level or the amount of training it might take for these players to achieve their goals. Nonetheless, physicians can educate their patients, specifically sharing that early sport specialization not only increases the risk of injury but might not be necessary for those with high athletic ability. Athletes can then individually determine to what degree they believe specialization will help them achieve their goals and if they want to proceed.

For patients that decide to specialize, physicians can emphasize strategies to make this training as safe as possible for the patient. There are many recommendations on how to minimize injury risk for baseball players such as pitch limits and periods of time off from throwing each year.¹⁵ Teaching proper biomechanics to young players has the additional benefit of enhancing athletic performance. Additionally, if players do make it to elite levels of competition such as college or professional, this prevents the need to remap their biomechanics after their incorrect movement patterns have been solidified through years of playing.

No matter what, young players need a break from competition and should take time off each year to recover. While specialization may be beneficial on an individual basis, it is important to analyze how the players who get paid to specialize go about training. MLB organizations invest millions into player

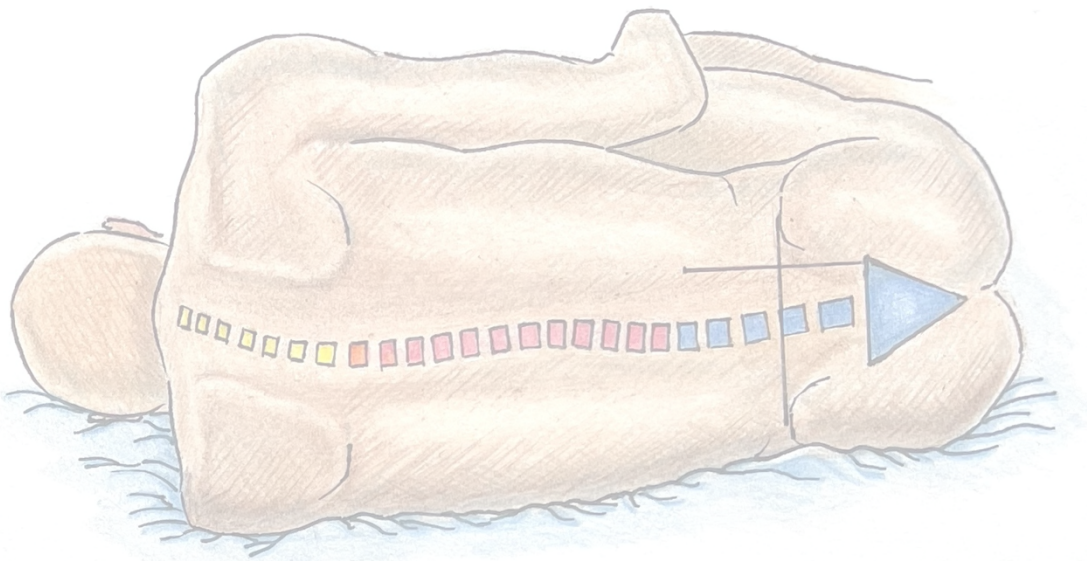
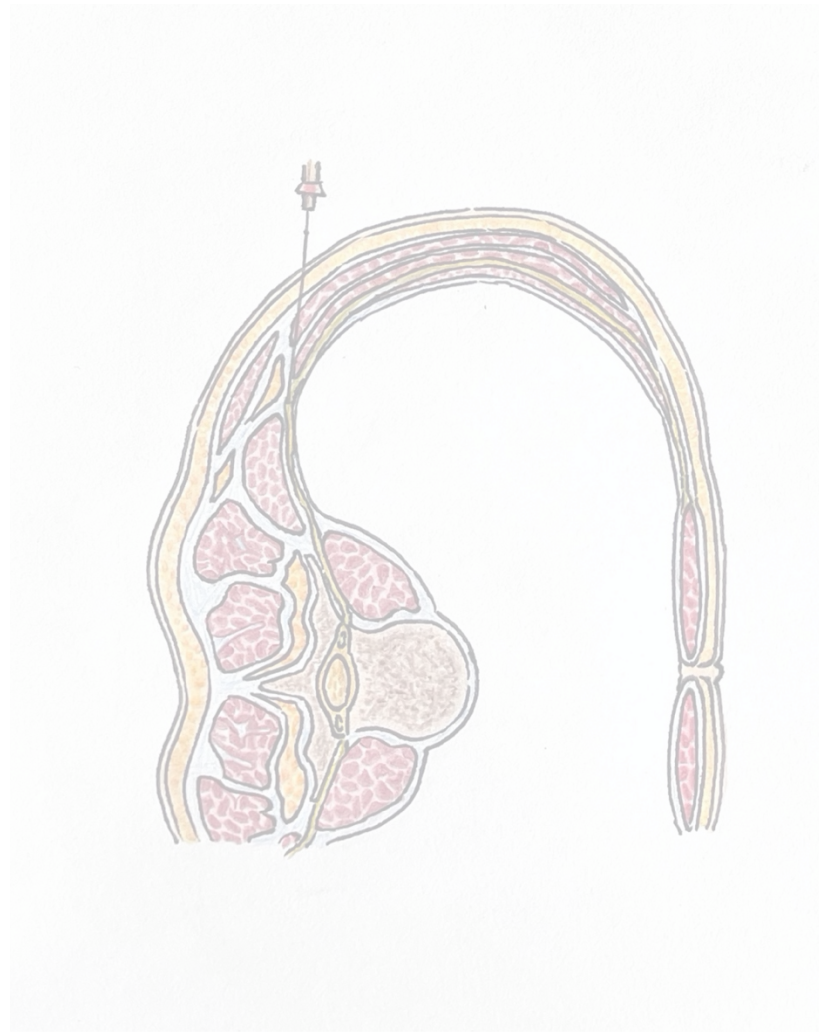
development and training in the off season. Whether the focus is on mechanics, strength, or strategy, professional players take time off from competition each year to let their bodies rest and find other ways to gain a competitive advantage. As early sport specialization grows in popularity, it may be time to rethink how it is implemented. College baseball recruiters often focus their evaluations on the tools players have, such as proper mechanics, speed, strength, and projectable frames, all of which can be developed through focused training instead of competing in games. Future research should assess the efficacy of spending more time off the field improving strength and biomechanics versus competing in more games.

Current statements from the American Orthopaedic Society for Sports Medicine highlight a research gap relative to load management and how to keep youth athletes safe.¹⁶ It is not clear what types of training are safest for young athletes to perform year-round, and sport specific inquiries are necessary to address this question. Research into baseball should consider the effect of training proper biomechanics such as arm mapping, stride force and landing location, and hip rotation. This training can be done without throwing any baseballs or causing excess force or stress to be placed on the body. Often, young pitchers do not receive proper instruction on mechanics, and studies consistently find that certain movement patterns are associated with increased risk of injury.¹⁷ Identification and correction of mechanical flaws could lower injury risk in youth athletes and prevent injury down the road. Furthermore, evaluating the effectiveness of strengthening targeted muscle groups, such as the scapular stabilizers, is yet another strategy and point of research to lower injury rates in youth pitchers and throwing athletes.¹⁸

As more research is published and recommendations continue to change with the rapidly evolving landscape of youth athletics, it is imperative physicians remain up to date on the competition and training regimens of their patients. By having conversations early on about goals and safety, physicians have the ability to prevent injury while ensuring their patients live the lifestyle they choose.

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MS4 Spotlight

Congratulations to our graduating fourth year medical students on matching to residency!

Name:

Zachary Aman

Undergraduate school:

Colorado College

Residency program:

Duke University



Favorite orthopaedic memory from medical school:

Scrubbing into my first orthopaedic case!

Name:

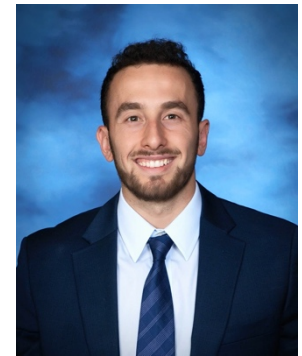
Evan Bloom

Undergraduate school:

University of Wisconsin-Madison

Residency program:

NYU - Long Island



Favorite orthopaedic memory from medical school:

The Stryker workshop was awesome! First time using most of those tools.

Name:

Olivia Blaber

Undergraduate school:

University of Pennsylvania

Residency program:

Duke University



Favorite orthopaedic memory from medical school:

The whole 4 months of Sub-I's were a blast. An absolute grind but you learn so much and meet awesome people from all over. On my last Sub-I, I got to do a lot in the OR and it got me so jazzed about a career as a surgeon!

Name:

Nick D'Antonio

Undergraduate school:

Villanova University

Residency program:

Cooper University Hospital



Favorite orthopaedic memory from medical school:

Placing pedicle screws with navigation in the operating room.

Name:

Nathan Houlihan

Undergraduate school:

Wheaton College

Residency program:

University of Michigan



Favorite orthopaedic memory from medical school:

Doing a research/clinical year in pediatric orthopaedics at CHOP. Great experience!

Name:

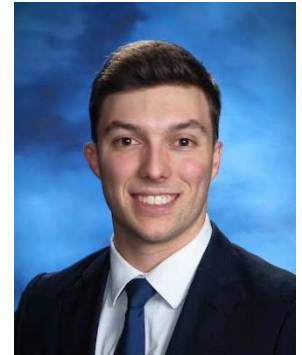
Kyle Plusch

Undergraduate school:

University of Delaware

Residency program:

Prisma Health - University of South Carolina



Favorite orthopaedic memory from medical school:

First Sawbones lab with DePalma/Jefferson Residents.

Name:

Jonathan Ledesma

Undergraduate school:

University of Virginia

Residency program:

University of Illinois Chicago



Favorite orthopaedic memory from medical school:

Giving a podium at The Atlantis resort in the Bahamas. Got to meet future applicants (many now incoming interns!), connect with subspecialty leaders, and learn about emerging technologies all while at a swanky beach resort and sea turtles. Big shoutout to the Rothman Spine team and everyone who's helped out along the way!

Name:

Greg Schneider

Undergraduate school:

University of Pittsburgh

Residency program:

Einstein Medical Center



Favorite orthopaedic memory from medical school:

Getting to place a CMN (cephalomedullary nail) on an away rotation.

Name:
Akash Singh

Undergraduate school: Pennsylvania State University

Residency program:
Thomas Jefferson University



Favorite orthopaedic memory from medical school:
Hanging out in the city with the other Sub-Is after a long day of cases.

Name:
Baylor Wickes

Undergraduate school:
The University of Virginia

Residency program:
Northwell Health LIJ



Favorite orthopaedic memory from medical school:
Placing a C2 pedicle screw!

Name:
Jasmine Wang

Undergraduate school:
University of Pennsylvania

Residency program:
University of Pittsburgh

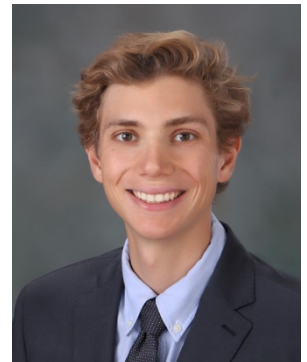


Favorite orthopaedic memory from medical school:
It was just me and a former Jefferson chief resident at the beginning of a case on my home Sub-I. He takes a scalpel from the scrub nurse and turns it around to hand it to me. I was confused and shocked that he was allowing me to make the incision. He said, "Jasmine, you should always be prepared to do anything in the case." And these are always my favorite moments - when I get to be involved in new ways when I least expect it.

Name:
Cole Zingas

Undergraduate school:
University of Michigan

Residency program:
Henry Ford Macomb Hospital



Favorite orthopaedic memory from medical school:
Reducing a distal radius fracture (pretty much) on my own... then getting a high five from the resident.

