UVA Health

ORTHOPAEDIC JOURNAL

HONORING LEGENDS

DIVISIONAL REPORTS

PHILANTHROPY IN ACTION

RESIDENT RESEARCH

MESSAGE FROM THE CHAIR

Dear UVA Orthopaedic Alumni:

This past summer, I began my 12th year as the Chair of the Department of Orthopaedic Surgery at the University of Virginia. As many of you know, I have spent my entire career here at UVA beginning as a medical student in 1991. It is a tremendous honor to continue to build on the foundation and success of my predecessors who helped create one of the top Orthopaedic programs in the country. UVA Orthopaedics has changed dramatically, and we have experienced unprecedented growth over the last decade. I am excited to share our progress in this third issue of our UVA Department of Orthopaedic Surgery journal.

The biggest news I would like to share is that the new UVA Orthopaedic Center Ivy Road opened in January 2022 for patient care. This 200,000 sq. foot new home for UVA Orthopaedics has been in development for 10 years and is absolutely incredible. It is one of the best Orthopaedic Centers in the country for patient care and for our team members and features an innovative education center for our community, residents and fellows. Our new home is very special and if you have not had a chance to visit, please do so.

UVA Orthopaedics continues to be the busiest surgical service at the UVA Medical Center. We recorded 200,000 patient visits at the UVA Orthopaedic Center and performed 10,500 surgeries in fiscal year 2024 compared to 69,000 patient visits and 6,800 surgeries just 12 years ago. Our faculty size has increased to 33 clinical faculty and 4 research faculty. We have 22 very talented Advanced Practice Providers who help optimize our patient care and access. For the last five years, we have surpassed institutional quality metric and patient satisfaction goals and are one of the top performing clinical departments at UVA Health. For nine years in a row UVA Orthopaedics has been ranked one of the top 100 Orthopaedic programs in the country in *Becker's Hospital Review* and has consistently ranked in the top 10% of Orthopaedic programs in the country in *U.S. News & World Report*. This year, *Newsweek* ranked UVA Health Orthopaedics the number 1 Orthopaedic program in Virginia and the 31st best hospital orthopaedic program in the United States. UVA Pediatric Orthopaedics was ranked the #46 best program in the country in *U.S. News & World Report*.

We are in the midst of a tumultuous time in healthcare with an unclear future. I am fortunate to have a group of faculty and team members who are resilient and determined to provide the best patient care possible despite the pressures we are experiencing. I have challenged our faculty to continue to advance orthopaedic care while responding to increasing competition, declining reimbursement, and increasing focus on the cost, value, and quality measures of patient care. We are well positioned to be one of the leading Orthopaedic programs in the country during this uncertain time.

In addition to the changing clinical care paradigm, our educational model has changed substantially over the last several years. In an effort to improve surgical outcomes and patient safety, we have created innovative methods to educate our residents and fellows. We have successfully implemented a surgical simulation, virtual reality and cadaver dissection curriculum. Our Orthopaedic residency is one of the most competitive programs in the country and was recently ranked in the top 35 by Doximity. Our residency complement is 25 total residents (5 residents/year), and we have 9 fellowship positions in 5 different specialties. All of our residency training is now based in Charlottesville. Under the direction of our very talented residency and fellowships directors, we are constantly modifying and improving our teaching methods and curriculum to ensure that we continue to produce the most skilled Orthopaedic surgeons in the country. The new UVA Orthopaedic Center enhances our ability to provide a world class education. You, our loyal alumni, have allowed us to find ways to support these new educational endeavors with your generous donations.

Coupled with changes in patient care and education, the usual mechanisms of research support are becoming less reliable. Despite this, we have continued to grow in the area of musculoskeletal research. Our Orthopaedic Clinical Trials division has flourished and is one of the most productive in the UVA Health System. We are recognized internationally for our contributions to tissue engineering advances for musculoskeletal disease and have a very busy Human Performance and Motion Analysis laboratory. We have all the facilities and expertise in place to support a robust Orthopaedic translational research program, from bench to bedside.

I am thankful for the great faculty, residents, fellows, advanced practice providers, and staff that I work with every day. I am grateful to our loyal alumni who continue to support our department in so many ways through our educational and research endowments. I look forward to seeing many of you at our UVA Orthopaedic Alumni Reunion April 10-12, 2025. We are expecting a record setting turnout.

Thank you again for your unwavering support of UVA Orthopaedics. Best wishes to you and family for a safe, healthy, and prosperous 2025.

A.C.

Sincerely, Bobby Chhabra

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University of Virginia Orthopaedic Journal | 2025

Editor: Michael Hadeed, MD; Contributor: Carley Bacher, MBA; Publisher: Carden Jennings Publishing Co.

UVA Orthopaedics

UVA Health

The driving missions of our Department of Orthopaedic Surgery are to be national leaders in improving clinical care of orthopaedic conditions, innovators in educating residents who will become future leaders, and to contribute impactful musculoskeletal research which will translate into the future treatments in our field. In pursuit of these goals, we strive always to provide state-of-the-art, comprehensive, but cost-effective care for all, orthopaedic disorders. Our education curriculum is structured to evolve so as to provide updated, competency-based materials and a robust evaluation process. Researchers in Orthopaedics endeavor to make significant and sequential advancements in the science of musculoskeletal medicine using a multi-disciplinary, collaborative research approach which can inform the future practice of Orthopaedic Surgery.

Improving Clinical Care

UVA Orthopaedics is the only healthcare institution in Virginia recognized as Premier Certified by the International Geriatric Fracture Society (IGFS). Over the past year, UVA Orthopaedics has opened a new fragility fracture and bone health clinic. This is the only one of its kind in the area. The clinic's mission is to evaluate and treat at-risk patients before they experience a major fracture. This clinic is run by Lara Myers, NP, a specialist in bone health. This is housed in the state of the art, 200,000-square-foot orthopaedic center where patients can receive comprehensive orthopaedic care. ■

Innovators in Education

Education of the next generation of orthopaedic surgeons is a critical function of UVA Orthopaedics. We strive to not only provide the basics, but to continue to push the boundaries, always working to improve the educational experience. When the new orthopaedic center opened, this priority was clear. The residents each have their own desks which are centered by the UVA Orthopaedics Skills Lab. Both during scheduled didactics as well as in between clinic and OR cases, residents can work here to refine their skills. This convenient access and exceptional resource is advancing UVA orthopaedics educational mission. ■

Translational Musculoskeletal Research

Drs. Li and Jin, in collaboration with Dr. Xu from the School of Engineering, are developing an innovative, electronic-device-controlled smart transdermal microneedle pain patch. Funded through an R21 grant, this project aims to create a wireless, soft-electronics-enabled smart microneedle drug delivery patch specifically designed to manage neck pain. By integrating electronic devices with thermo-responsive therapeutic microneedles, the team seeks to optimize drug delivery. The successful completion of this project has the potential to introduce a multimodal, patient-centered smart patch that minimizes the risk of gastrointestinal upset and first-pass metabolism associated with oral medications, while also helping to prevent opioid addiction. ■

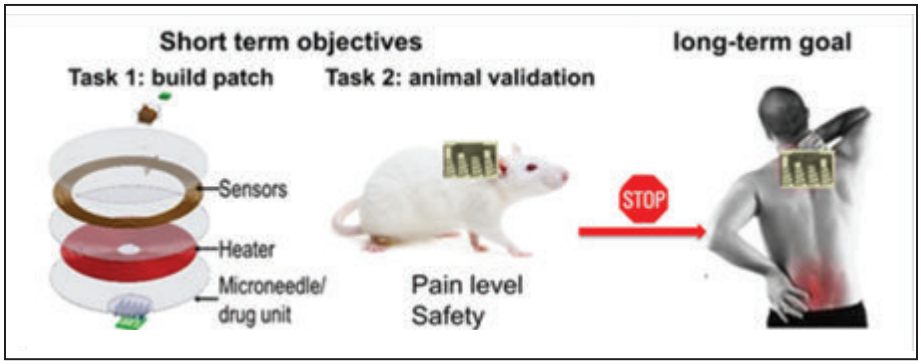

Fig. 1: A smart pain patch for neck pain relief integrating microneedle arrays, sensors, and thermotherapy for a multimodal pain managing strategy.

A Team Effort

By Dave Diduch, MD and alumnist Max Alley, MD

Max Alley, MD '87, Res '93, and David Diduch, MD, Res '94, have known Bobby Chhabra, MD '95, Res '01, since the 1990s.

Alley, an orthopaedic surgeon in upstate New York, was a resident at UVA when he first met Chhabra as a medical student. "He relates the story that we were always having these wonderful dinner parties and whatnot and never invited the lowly medical students who lived next door," Alley laughingly shares.

Diduch, who is the Voshell Professor of Sports Medicine at UVA and head orthopaedic team physician, was on faculty at UVA when he first met and helped train Chhabra, who today chairs the Department of Orthopaedic Surgery. "I saw his incredible leadership potential, as did everybody else," Diduch recalls. "Now he's in the chairman's role, and he provides wonderful leadership and direction for the department."

It was that leadership that led Chhabra and his team to envision a new patient-centered orthopedic facility for UVA, and in 2022, the UVA Health Orthopaedic Center opened. It was a project 10 years in the making. The state-of-the-art, 200,000-square-foot facility offers 90 clinic exam rooms, six operating rooms, imaging, physical therapy, a pharmacy and more.

Earlier this year, colleagues and alumni brainstormed about ways to honor Chhabra for his efforts. In April 2023, the Bobby Chhabra Endowment for Orthopaedic Excellence was officially announced at the UVA Orthopaedic Alumni Conference.

"This is about Bobby Chhabra and his critical role to build the UVA Orthopaedic Center at Ivy Road. We wanted to publicly thank Bobby for his countless hours of personal sacrifice," explains Diduch. "This endowment will have enduring benefit and really make a difference to the educational, research, and clinical missions of the department by equipping him with an endowment which creates perpetual revenue to support the initiatives that he feels are most essential."

"This endowment will have enduring benefit and really make a difference to the educational, research, and clinical missions of the department."

— DAVID DIDUCH, MD, RES '94

The endowment will benefit UVA orthopaedic surgery residents and fellows in a number of ways: funding resident and fellow educational travel for conferences and research presentations at regional and national meetings; purchasing surgical skills lab equipment including surgical simulators; providing seed funds for resident and fellow research projects; and helping with publication costs for research projects initiated by residents and fellows.

Alley says that is fitting that the endowment will support educational initiatives in Chhabra's name. "He is the epitome of a fantastic mentor who does not just teach you things but is there for the long-term. He prides himself on being a mentor for trainees throughout their careers," he says. "We hope that the graduates of the program will get into the habit of giving back to the program that gave them the skills to earn their livelihood."

To date, more than $264,000 has been raised in gifts and pledges for the endowment, with an ultimate goal of $1 million.

Alley is grateful to be associated with UVA's program today and says that patients in New York often tell him they chose to come see him because of UVA's reputation. He says that can be credited in large part to Chhabra, and he hopes the endowment will help him attract more top-notch trainees. "I think it's great to acknowledge him for what he's given to the program while he is the chair and help him continue to build the program."

Diduch, who is now in his 29th year at UVA, agrees. "It's not just a thank you to Bobby but actually a gift that will really do something moving forward," he says. "I know that brings Bobby a lot of satisfaction because his heart is so much behind the Department of Orthopaedic Surgery and the University."

Chhabra says he is humbled and honored by this gift from the faculty and alumni. "I have spent my entire career at UVA, including my medical school and orthopaedic residency training. My career aspiration is to make the UVA Orthopaedic Department the best in the country. This endowment will be instrumental in helping achieve this goal," he says. "The passion, engagement, and support from our faculty and alumni is very special. It is a privilege to be a part of this incredible department." ■

Attendees at the 2023 UVA Orthopaedic Alumni Conference

Thank You for Supporting UVA Orthopaedics

Your philanthropic support of the Department of Orthopaedic Surgery is critical to our success and helps advance innovation in patient care and education. We are grateful to the many alumni who have generously shown their support.

As you consider your year-end and future charitable giving, please consider a gift to the following initiatives:

Hurwitz Endowed Research Fund
Supports both basic science and clinical research initiatives by residents, fellows and faculty in Orthopaedic Surgery, and includes start-up funding for new faculty and on-going research support for travel, supplies, equipment, etc.

Orthopaedic Alumni Fund
Supports departmental initiatives such as alumni events, resident graduation, department resident and faculty awards, etc.

Bobby Chhabra Endowment for Orthopaedic Excellence

- Funds resident and fellow educational travel for conferences and research presentations.
- Purchases surgical skills lab equipment.
- Provides seed funds for resident and fellow research projects.
- Helps with publication costs for research projects initiated by residents and fellows.

There are many ways to show your support, from a one-time gift to a larger multi-year gift or planned gift from your estate. Our development team is available to answer your questions and help you meet your philanthropic goals while supporting the UVA Department of Orthopaedic Surgery.

Thank you for your continued support.

To Make a Gift or Learn More, visit:

https://med.virginia.edu/orthopaedic-surgery/mission-statement/orthopaedic-giving/

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Making Healthcare Education Accessible and Enjoyable for All: 2024 UVA Health Orthopaedics Community Fair

By Sudha Kamath

More than 150 community members from around the Charlottesville area recently attended the 2024 UVA Health Orthopaedics Community Fair at **Orthopaedic Center Ivy Road (OCIR**). They learned about common orthopaedic conditions and injuries, met providers — and had fun with children's activities, free food trucks, and merchandise giveaways!

Seven UVA Health orthopedic providers delivered presentations followed by Q&A sessions about conditions ranging from lower back pain and bone health to carpal tunnel syndrome and concussion management.

More than a dozen booths featured clinics and services with valuable educational materials on conditions such as arthritis, fractures, sports injuries, and more that can significantly impact quality of life, cause pain, limit mobility, and lead to long-term disability if not properly managed. The fair promoted prevention and early detection, informed decision-making, and access to care.

The event also supported our strategic plan initiative of cultivating healthy communities and belonging for all. "My favorite part was the opportunity for attendees to engage directly with our healthcare providers, ask insightful questions, and share their personal experiences," says **Alexis Kouril,** Ambulatory Administrative Coordinator, UVA Health Orthopaedic Center. "I also enjoyed watching families interact, learn together, and enjoy the free merchandise and delicious food — highlighting community spirit and the event's success in making healthcare education accessible and enjoyable for all ages."

She adds that UVA Health Orthopaedics can't wait to grow this event next spring! ■

UVA Orthopaedic Foot & Ankle healthcare providers

Face painting

UVA Orthopaedic nurses pause for a selfie

UVA Orthopaedic Hand & Upper Extremity healthcare providers

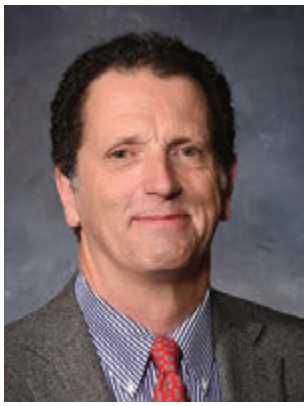
UVA Orthopaedic Foot & Ankle healthcare providers

UVA Orthopaedic Prosthetics & Orthotics table

Over the past year, three legends of UVA Orthopaedics retired. Although their full contributions could never be condensed into a few pages in a journal, many of their highlights will follow over the next several pages.

Mike Boblitz, 47 years

joined 1977, retired 2024



Thom Brown, 27 years

joined 1998, retired 2024

Mark Miller, 25 years

joined 1998, retired 2024

Congratulations To Mike Boblitz, MBA — Retiring After 47 Years With UVA Orthopaedics

Mike Boblitz, retired in 2024 from his post as Chief Operating Officer (COO) of the Department of Orthopaedic Surgery. He was an integral member of UVA Orthopaedics for 47 years. Mike has served under five chairs and has helped build the Department to what it is today. His guidance, knowledge, persistence, and tenacity are some of the main reasons the UVA Orthopaedic Center is in existence.

BACKGROUND AND EARLY CAREER

Mike Boblitz joined the UVA Department of Orthopaedics and Rehabilitation in July 1977 as a Research Assistant and was later promoted to Assistant Professor with his own multiple year Federal grants. In October 1980, the Health Services Foundation (now UPG) was formed, and Mike was chosen to replace the Department's business manager. At the time, he did not have a business background, so he returned to school part-time, and earned his MBA from James Madison University in 1988. After he obtained his MBA, he was promoted to Lecturer in the SOM, a title he holds today.

Mike Boblitz early days

Mike Boblitz — retired!

CAREER HIGHLIGHTS

- More than quadrupled the number of our clinical faculty to 32 FTEs.
- Added advanced practice providers (currently 21 FTEs).
- Increased the number of fellowships from one to eight, while the number of residents has remained unchanged.
- Transitioned from staff (indigent) and private clinics in the private clinic wing (with the only handicapped entrance at Barringer) to a combined clinic on the first floor of 500 Ray C. Hunt Drive, the HSF administrative building at the time. Our volumes went up substantially with increased accessibility.
- Relocated Prosthetics & Orthotics from the Towers Office building (current Battle location) to Townside Shopping Center. This provided better separation of patient care and fabrication areas, and enhanced air handling to minimize dust and fumes for both patients and staff.
- Planned and opened a sports medicine clinic with outpatient therapy at the McCue Center.
- Relocated the other adult ortho clinics from 500 Ray C. Hunt Drive to 545 Ray C. Hunt Dr. which provided more square footage for increased volumes. It was set up with four entrances for specific clinics off the waiting room as our physicians continued to practice as sub-specialists.
- Heavily involved in planning and logistics of the new Orthopaedic Center.
- Relocated the basic science lab from Cobb Hall to new lab space at Aurbach.
- Renovated the fourth floor of McKim for our administrative offices in the mid-90s.
- Relocated the administrative offices to 400 Ray C. Hunt Dr. in April 2000. Renovated the space multiple times to increase offices and facilitate growth.
- Converted from finances being managed using a pencil and paper ledger to the computer age of spreadsheets and ever-evolving advanced software.
- Transitioned finances to Oracle in 2001 and Workday in 2022.
- Served on the Reporting Team for Oracle to improve reporting across the entire University.
- Transitioned to IDX and then to Epic for billing.
- Adjusted administrative operations due to COVID to ensure continued operations and faculty & staff safety.
- Led work group to review clinical trials job profiles to improve compensation and career progression opportunities.
- Managed day to day tasks, along with annual projects such as the budget and incentives, so that the department has always had a positive bottom line.
- Mentored multiple staff within the department, as well as other departmental administrators in the SOM, leaving a lasting legacy. ■

Dr. Brown (center) 1991 MUSC Awards Ceremony

Dr. Thomas E. Brown retires after 27 years of clinical practice

Dr. Thomas E. Brown retired in January 2024 from clinical care in after 27 years of practice. His distinguished career at the University of Virginia has been characterized by exceptional contributions to clinical care, teaching, research and service. Throughout his tenure, he has demonstrated professionalism and integrity at the highest levels and garnered respect from students, leaders and team members within the institutions and nationally. He will leave a legacy including thousands of grateful patients, many student surgeons whose careers he has enhanced, enduring educational literature and improvements in the processes of care at the UVA. He was approved as Emeritus Associate Professor of Orthopaedic Surgery at the University of Virginia.

Following is a brief history of his career through the decades.

TRAINING AND BACKGROUND

Dr. Brown completed a bachelor's degree and a master's degree program at East Carolina University. He graduated Summa Cum Laude while also serving as co-captain on the varsity basketball team. He then went on to medical school at the Medical University of South Carolina where again, he distinguished himself academically and was inducted into the Alpha Omega Alpha (AOA) honorary medical society. He also served as President for the local AOA chapter. He completed an Orthopaedic Surgery Residency at Geisinger Medical Center and entered private practice. Two years into his work in private practice and after completing his Board Certification with the American Board of Orthopaedic Surgeons, he made the decision to cultivate his interest in academic medicine.

Thom started his journey into academic orthopaedic surgery at the University of Virginia in 1998 as a fellow in Adult Reconstruction under the guidance of Dr. Gwo-Jaw Wang who was the Division Head and Department Chair. Thom's gifts as a surgeon and teacher were readily apparent and he was recruited to join the faculty in the Department of Orthopaedic Surgery as a Clinical Instructor in August, 1999 and was promoted to Assistant Professor in July of 2000. Based on his sustained excellence in clinical care and his teaching contributions he was advanced to Associate Professor in 2005 and then received tenure in 2009.

CLINICAL EXPERTISE

Dr. Brown has cultivated a national reputation as an exceptional surgeon. The breadth of his skills includes hip and knee reconstruction including revision surgery. He is a recognized expert in Adult Reconstruction with referrals from across the Commonwealth and beyond. His case load included individuals with massive bone loss and infections, requiring staged revisions with complex solutions such as use of large bone grafts and custom metal implants. He has continually expanded his expertise, learning the minimally invasive anterior approach for total hip replacement and more recently robotic assisted knee replacement. As a consequence of his outstanding surgical results and innovative approaches, he has attracted many patients to UVA, accounting for over 450-500 joint replacement surgeries per year throughout his career. Furthermore, he has leveraged this large clinical practice to attract outstanding Joint Reconstruction Fellows and to teach Orthopaedic residents. In 2017, Dr. Brown was recognized with the SOM Dean's Master Clinician Award for his outstanding surgical care and patient satisfaction outcomes.

Dr. Brown (center) receives 2023 Charles W. Miller Residency Teaching Award

Over his career at UVA, Thom's work has been featured in 47 clinical research presentations at the most prestigious venues including the American Academy of Orthopaedic Surgeons (AAOS), the Canadian Orthopaedic Association and the Orthopaedic Research Society meetings to name a few. He has been a consistent faculty for 'hands-on' surgical skills courses offered by the AAOS and the American Association of Hip and Knee Surgeons including the "Master's Series" and other professional organizations.

MEDICAL EDUCATION CONTRIBUTIONS

Dr. Brown has been one of the most influential teachers and mentors within the Department of Orthopaedic Surgery throughout his tenure. He has been a model physician, demonstrating not only compassionate care and impeccable surgical technique but also effective team dynamics. In the operating room, his equanimity in the most challenging situations is legendary. Consequently, he engenders loyalty from his team of residents, fellows, nurses and anesthesiologists. For the residents and the Joint Reconstruction fellows, his ability to teach surgical skills in a safe and responsible manner is unparalleled. He has been a popular speaker, delivering literally hundreds of didactic sessions for residents, fellows and medical students in his 2 decade plus career. These attributes earned him the Residency Excellence in Teaching Award on four separate occasions. The Resident Excellence in Teaching Award is presented by the Chief Residents to the faculty member felt to be the most influential in their career development during their 5-year training program. To receive this Award on four occasions is unprecedented throughout the long history of the Department of Orthopaedic Surgery. Dr. Brown was also honored in 2022 as the invited Graduation Speaker for the Resident Class. This is the first time in this program's 50+ year history that a UVA faculty member has been bestowed this honor to serve as the "Visiting Professor" and graduation speaker.

As previously mentioned, Thom has been an invited speaker and instructor for many national and regional presentations. He was twice the Course Director for the Arthroplasty Course in 2005 and 2007. He served as the Co-Director of the Orthopaedic Residency Program for 4 years and served as the Fellowship Director for more than 20 years. He was indispensable in developing the initial didactic joint reconstruction curriculum for both the residency program and the adult reconstruction fellowship and has continued to work on its evolution over the last 20 years. He has leveraged his clinical and research experience as the senior editor of a 6 volume textbook series, "Arthritis and Arthroplasty." In addition, he has authored 11 textbook chapters and 36 peer-reviewed publications.

SERVICE AND LEADERSHIP

Dr. Brown served as the Division Head of Adult Reconstruction for 11 years. In this capacity, he recruited 2 outstanding surgeons in building a division of expert surgeons renowned across the Commonwealth. Thom served as the Musculoskeletal Clinic Director from 2006-2008, overseeing 6 adult orthopaedic specialty clinics. He has served on multiple committees for UVA including the Operating Room Committee which adjudicates room allocation and develops operational policies; the OR Supply, Implant and Instrument Governance Committee which seeks to balance cost and innovation in supply purchasing and utilization. During the OR expansion and moves to the Battle Building and the new Orthopaedic Center at Ivy Road, his leadership has been invaluable. His service to the SOM Graduate Medical Education Committee and the Department of Orthopaedic Surgery Curriculum Committee (which he chaired) were complementary to his work as an educator. ■

The Story of Mark D. Miller, MD

Mark Miller high school photo

by F. Winston Gwathmey

"WINGS LEVEL!"

These two words undoubtedly evoke a visceral response for any orthopaedic resident or sports medicine fellow who trained at the University of Virginia during the past two decades. That phrase echoed in the operating room of the incomparable Dr. Mark Miller as the trainee was struggling to arthroscopically navigate the knee while the heads in the room were cocked sideways trying to follow the maneuvering on the monitor. It seems appropriate that we can thank the great United States Air Force for the introduction of that phrase into the orthopaedic lexicon.

Mark Miller grew up in a world of jets and Air Force pilots at Travis Air Force base near Fairfield, California. His father, Dr. Monte B. Miller (who went on to become Surgeon General of the Air Force) was an internal medicine physician and the commander of the base hospital. His mother, Christine Miller, was a former nurse and commanded the household. After graduating as high school valedictorian, he went to the Air Force Academy in Colorado Springs where he studied civil engineering and played linebacker for the Air Force football team. At this point, he had no intention of pursuing a medical career. His closest contact with orthopaedic surgery occurred when a well-meaning surgeon removed his entire medial meniscus after he tore it playing football. He recalls that surgery and his subsequent plaster cast immobilization being more painful than his subsequent simultaneous bilateral knee replacement surgery many years later. Perhaps this is where he developed his lifelong disdain for knee immobilization.

Graduating at the top of his Air Force Academy class, Miller was offered a prestigious position in Albuquerque, New Mexico. However, to the dismay of his academic advisor, he elected to pursue what he calls "a romantic fantasy" and went to Germany to become civil engineering Deputy Program Chair at Ramstein Air Base. Very quickly after relocating to Germany, he realized that his advisor was right. Miller was the only lieutenant on the entire base and was responsible for essentially all the tedious and dirty jobs within the civil engineering squadron, and the entire wing for that matter. On top of that, he was in command of 100 airmen who constantly got into all kinds of trouble. It is possible that here is where he learned to manage troublesome residents and fellows.

Miller spent two years in Germany trying to make a name for himself as a military civil engineer. Much of his appreciation and aptitude for organization and summarization developed during his civil engineering career. As he was envisioning his future as a civil engineer in the Air Force, he observed the constant wave of bureaucratic challenges and budgetary obstacles that frustrated his base civil engineering commander. He realized that his military future would be burdened with similar frustration and disappointment. Not a man who exudes patience, especially when dealing with administrative impediments, Miller called a consult to his internal medicine father for advice. His brush with orthopaedic sports medicine during his meniscus surgery had stuck with him and the thought of becoming a sports medicine surgeon had always been in the back of his mind. After his discussion with his father, he immediately decided to completely change career paths and go to medical school. Patience has always been one of Miller's most fundamental attributes.

Miller quickly learned that deciding to go to medical school and actually getting into medical school were not the same. He had taken zero prerequisite courses and had no scientific background. He checked out a biology book from the base library in Germany and started reading. He eventually passed the college equivalency program test for biology. He tried to take an organic chemistry course by mail correspondence, but this proved difficult. His first MCAT try resulted in near perfect English and Math scores, but his low science scores undermined his medical school applica-

Mark Miller at the Air Force Academy

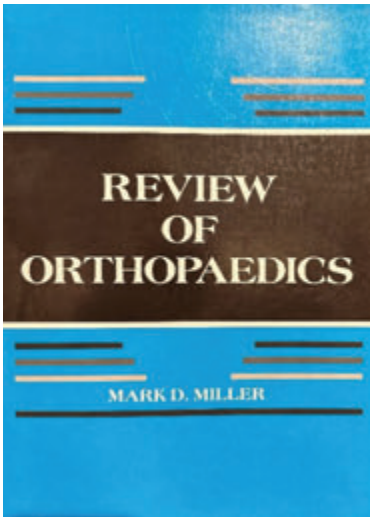
Air Force civil engineer Mark Miller

Medical School graduation from USUHS

tion, and he did not get in his first attempt. Refocusing his efforts, he wrangled a reassignment at Los Angeles Air Force Station to be closer to a night school opportunity where he could take organic chemistry. Achieving one two "A's" in the class, Miller scored much better on the MCAT and re-applied to medical school. This time he got into Uniformed Services University of the Health Sciences in Bethesda, MD, where he was forced to turn in his captain bars and replace them with a second lieutenant bar. Humility came early in his medical career.

Starting medical school at 26, Miller recognized that he would be at a disadvantage against those conventional students who had been on the medical path from the start. He found himself struggling with some of the test questions, in particular the "K-type" multiple choice questions. He realized that the tests were easier if the answers were known ahead of time. Drawing from the organizational skills he developed as a civil engineer, he started making comprehensive charts with his study groups ahead of the tests. His charts were so effective that his entire study group, including Miller, started getting the highest scores in the class. He had an uncanny ability to summarize the complex information from his classes into memorizable outlines. Thus "the Miller approach" was born.

Miller's *Review of Orthopaedics* as we currently know it started on Miller's third year orthopaedic rotation as he started compiling notes on everything orthopaedic. He matched into orthopaedic residency at Wilford Hall in San Antonio, Texas, and his assembling of notes continued. He attended every orthopaedic lecture and course available and added his notes and charts to a three-ringer binder



Review of Orthopaedics (1st edition)

that he entitled, "Basic Orthopaedic Notes Edited" or "BONE." It seems his love for acronyms started at an early age. Using a word processor to polish his handwritten notes, he added photocopied charts that he literally cut out and pasted onto the pages. Cut-and-paste was a little more tedious in those days. He shared his "BONE" book with his peers in his program to aid in their studying and received considerable positive feedback.

By his fourth year, Miller recognized that his notes were comprehensive enough (and peer-reviewed by his classmates, attendings, mentors, and anyone who would listen) that he could publish them as a review book. He presented his "BONE" review book to the AAOS Chair of Publication, Dr. Jim Heckman, who scoffed at the idea that a resident could produce a book worth publishing. Undeterred, Miller sent copies of his book to WB Saunders and JB Lippincott (two publishers that he identified by perusing the front matter of books at the library) but heard nothing for months. Finally, early in his chief year while in cast clinic, he received a call from Richard Lampert at Saunders. "I like your book," Lampert told Miller, and he offered

him a contract to publish it. He recommended changing the name from "BONE" lightheartedly calling the book "Scrapbook of Orthopaedics." He also instructed him to get permission for every illustration that would be included. This is where Miller learned to only use illustrations from the same publisher to obviate the need to painstakingly obtain dozens of different permissions often at a significant cost.

The first edition of *Review of Orthopaedics* was published in May of Miller's chief year. At the time, the Maine Orthopaedic Review Course was the largest review course in the country attended by the majority of orthopaedic residents and other surgeons studying for the board examination. Miller obtained fifty copies of the book in advance of the course and sold them all within the first day. His book was an immediate success and made him into a minor celebrity as his ability to compress five years of orthopaedic training into a concise book was applauded. When he started his fellowship at Pittsburgh later that summer, his fellowship director, Dr. Freddie Fu demanded copies of the book for every resident at the author discount. It quickly became the essential review book for orthopaedic residents (and the world for that matter - later, when Miller was an AOSSM traveling fellow in Asia, one resident asked him to sign a photocopied version of the text).

During the Maine review course, Miller found the Prosthetics and Orthotics (P&O) review lecture to be particularly weak. He had made his own slides from a prior P&O lecture, and he offered to deliver them at the Maine Course the following year. His version of the P&O lecture was immediately recognized as one of the stronger lectures of the course and he was invited back. In his second year at the Maine Review course, the knee ligament lecture that preceded his P&O lecture was a mess and left the audience dazed and confused. Recognizing the audience's bewilderment, Miller started his lecture with a clarification of the knee ligaments. His explanation of knee stability received a standing ovation and the course director promptly requested that he give the knee instability lecture going forward. By year three at the Maine Review course, it was clear that Miller needed his own course. The following year, the first Miller Review Course took place in Colorado Springs in 1995.

Fellowship at Pittsburgh with Drs. Fu, Harner, and Warner

Dr. Miller and fellow Brian Etier perform surgical demo

Miller's books

Some of Miller's favorite clip art

After spending a year at what he describes as "a decade spent in Pittsburgh" for his sports medicine fellowship with Drs. Freddie Fu, Chris Harner and J.P. Warner, Miller returned to the orthopaedic staff at the Air Force Academy in Colorado Springs. At the Air Force Academy, he practiced general orthopaedics and was the junior team physician for the various sports. He remembers that he was assigned to the teams that traveled by bus while his senior partner took care of the teams that traveled by plane. After four years at what he reminisces as "the best job in the world," he received orders to go to San Antonio to develop the sports medicine program at Wilford Hall with the verbal promise that he would later return to the Air Force Academy. When the time came for him to return to Colorado Springs, his commanding officer informed him that he had "pissed off" someone at the Air Force Academy and that he could not return as he had planned. As a concession for going back on his promise, he released him from his military commitment three years early and he took a private practice job with Dr. Dan Cooper at the WB Carroll Memorial Clinic in Dallas, Texas.

Private practice and Mark Miller were not a match. He loved academics, research, and teaching, and these were not part of private practice. He started exploring the idea of pursuing academic positions. He reached out to one of his mentors, Dr. Jesse DeLee, who advised him to check out the program in Charlottesville at the University of Virginia. Dr. Miller joined the Sports Medicine Division at the University of Virginia in 2000 and proceeded to flourish as a true quadruple threat academic orthopaedic sports medicine surgeon demonstrating unparalleled excellence in clinical care, education, research and team coverage. His commitment to teaching and mentoring his fellows and residents, taking care of the athletes at James Madison University, performing world class sports medicine research, and service to the American Orthopaedic Society for Sports Medicine for more than two decades cemented his legendary status. Alongside his long-time colleague and orthopaedic partner, Dr. David Diduch, he built one of the strongest sports medicine programs in the country at UVA.

To enumerate his many awards and achievements over the course his academic career would require me to write a "Gwathmey's Review of Dr. Mark Miller's Achievements." He published 241 peer-review articles, 40 textbooks, 146 chapters, 76 invited articles, and hundreds of published abstracts. The "Miller" name became synonymous with excellence in orthopaedic publishing. The *Miller's Review of Orthopaedics* textbook has sold over 100,000 copies and is in its 9th edition. *DeLee, Drez and Miller's Textbook of Sports Medicine* is the most popular surgical sports medical text in the world. He wrote or contributed to dozens of other textbooks including *Essential Orthopaedics*, *Orthopaedic Surgical Approaches*, and *Textbook of Arthroscopy*. He even wrote *Miller's Review of the Bible*.

Dr. Miller's reputation as a captivating lecturer and presenter is also well-deserved. He diligently prepares every lecture possessing an unmatched talent to infuse humor while retaining the educational impact. He taught us that every slide requires some type of picture or figure to stimulate the audience's interest. The collection of clip art that he incorporated into his powerpoint presentations belongs in the Louvre. He has visited dozens of orthopaedic programs as a visiting professor,

Faculty with UVA Ortho alumnus and Wisconsin head team physician Geof Baer

has participated in over 100 Instructional Course Lectures, and lectured around the world for essentially every major orthopaedic conference. The Miller Review Course that he founded in 1995 continues to be the most well-attended course for surgeons studying for the orthopaedic boards.

Although his research, books, lectures, and review course helped to teach orthopaedics to the entire world, Miller's greatest educational legacy undoubtedly is represented by the fellows, residents, and medical students that he taught and mentored at the University of Virginia. Over the course of his 24-year career at UVA, he trained more than 150 residents and 40 sports medicine fellows and educated countless medical students. His relentless energy and passion for everything orthopaedics was remarkable and inspirational. He demonstrated a true love for his trainees setting high expectations and always pushing for excellence. Many of his trainees and mentees have gone onto prominent academic careers in their own rights including the current chair of UVA, Dr. Bobby Chhabra and several of his junior partners. He received multiple teaching awards and lifetime achievement awards for his dedication to education. The number of orthopaedic surgeons (including me) who have benefited from his mentorship, guidance, and the opportunities he created are incalculable.

UVA Orthopaedics resident and sports medicine fellow alumni at 2022 AOSSM Annual Meeting in Nashville, Tennessee

Dr. Miller's exceptional skillset, boundless energy, unbridled enthusiasm, and unique philosophy left an indelible mark on those of us lucky enough to train with him. Every time we scope a knee, Miller's voice is inside our heads telling us to keep our wings level. We understand that if we operate fast enough, we cannot possibly make a mistake. Every time something goes wrong during surgery, we instinctively blame anesthesia. The UVA Sports Medicine faculty recently hosted a dinner at the AOSSM annual meeting for over 30 resident and fellow alumni to get together and to celebrate Dr. Miller's AOSSM presidency. After dinner, everyone told a "Miller story," many of which are not appropriate to publish. Containing a mixture of humor, disbelief, and reverence, the stories demonstrated the immeasurable influence that he had upon his trainees. The tales went on for more than an hour, and I suspect they could have gone on for much longer. Listening to the laughter of all these leading orthopaedic surgeons brought together over the shared experience of training with him, it became clear to me that **Dr. Miller's greatest accomplishment was all of us.** He built a remarkable sports medicine program and family at the University of Virginia and inspired an entire generation of orthopaedic surgeons to be great. ■

Thoughts on Mark Miller

by Josh Nelson, MD *(2009 Sports Medicine Fellow)*

When asked to give my favorite Mark Miller story at the UVA alumni dinner in 2022, a wave of gratitude came over me. Upon further thought later that night, I realized what I was thankful for was not any one day spent with Dr. Miller, but in the opportunity to simply experience Mark Miller.

When I first arrived at UVA as an incoming fellow in the summer of 2009, there was a JBJS review in sports medicine writing project handed to me by Dr. Miller's secretary, although I had yet to meet him. After I got started on his rotation, he soon invited me over to his house for dinner. By the end of the evening he had given me another gift — his self-published work on disc of The Holy Bible in summary. He had read each book of the Bible and condensed each book into a "Cliff notes" summary so someone could more easily navigate the daunting task of getting through the entire Bible. I soon realized that this was Mark Miller. An idea in the OR one day would equal a write up by the end of the week and a publication submission by the end of the month.

Miller's Review was written by him during his residency to do the same, to organize large amounts of information so others could better grasp and get through large amounts of data. Many other writers have tried, but Miller's Review is easier to read and of better quality and higher yield. In addition, Dr. Miller has published hundreds of articles, authored or edited more than 40 textbooks, taught residents, fellows, and all with a successful clinical practice.

Beyond the energetic loving personality, beyond the jokes and Chinese lunches, there is something of his own genius in Dr. Miller that I could not completely put my finger on. How can one person publish or write so many quality works? Well, ponder these quotes from other composers of vast amounts of written works:

- **Wolfgang Amadeus Mozart**, who composed more than 800 musical works in 35 years of life, his first on the clavier at age 5.

  "When I am, as it were, completely myself, entirely alone, and of good cheer — say traveling in a carriage, or walking after a good meal, or during the night when I cannot sleep — it is on such occasions that my ideas flow best, and most abundantly. Whence and how they come, I know not, nor can I force them."

  "I am never happier than when I have something to compose, for that, after all, is my sole delight and passion."

- **Ludwig van Beethoven**, who composed 722 works in 57 years of life even though he began to lose his hearing at age 28 and was completely deaf by age 44.

  "What you are, you are by accident of birth: what I am, I am by myself. There are and will be a thousand Princes; there is only one Beethoven."

  "Music comes to me more readily than words."

- **Johann Sebastian Bach**, who composed 1128 pieces of music in 65 years of life.

  "There's nothing remarkable about it. All one has to do is hit the right keys at the right time and the instrument plays itself."

  "Anyone who works as hard as I do will succeed as I do."

  "The aim and final end of all music should be none other than the glory of God and the refreshment of the soul."

When you realize what he is by accident of birth and hard work, Mark D. Miller is one of the most renowned organizers of readable knowledge. Just as music is judged by how many listen to it, written works are judged by how many read it. Is there another author of orthopaedic literature more widely read than Dr. Miller? I suspect if you tried to hold him back from writing, summarizing and teaching, it would be nearly impossible to accomplish. It simply is who he is, and I am forever thankful to have experienced time with him in his practice, enjoy his quality, and to be refreshed with his written works. ■

The following are a collection of "Millerisms" submitted by his residents and fellows:

"Wings level!"

"No problem...no problem..."

"At this point, I don't care what you're going to do. Just do something!"

"Med students get a 50/50 question wrong 100% of the time!"

"Be a rock—rocks don't move!"

"No balls, no babies."

"Freddie Fu always told me—if you go fast, you never make a mistake."

"I never operate on bones small enough to swallow."

"It's not a trocar—it's a blunt introducer."

"That patient is a Charlie Bravo."

"Still burring..."

"God I hate August."

"Please make my problem your problem, and solve it."

"Have you ever heard of whipping something slowly?"

"There's a reason why OATS work. Just like a Roman cobblestone road—it lasts forever."

"Perfect!"

James A. Browne, MD

Alfred R. Shands Professor
Adult Reconstruction Division Head
Vice Chair of Clinical Operations

Dr. Browne is the Alfred R. Shands Professor, Adult Reconstruction Division Head and the Vice Chair of Clinical Operations.

He pursued his education at Washington and Lee University where he captained the Men's Swim Team before graduating Summa Cum Laude. Dr. Browne completed medical school at Johns Hopkins University, residency in Orthopaedic surgery at Duke University, and fellowship in Hip and Knee Arthroplasty at the Mayo Clinic where he was honored with the Mark B. Coventry Adult Reconstructive Surgery Fellowship Award.

Dr. Browne's clinical expertise includes complex primary and revision hip and knee. He has been the recipient of the UVA Dean's Master Clinician and Clinical Excellence Awards. He is actively involved with research encompassing all aspects of hip and knee replacement, and has published numerous peer-reviewed journal articles and book chapters. Dr. Browne has been invited to speak nationally and internationally on topics related to joint replacement. He was awarded the Knee Society John Insall Award in 2014 for his research examining obesity and outcomes following total knee arthroplasty. Dr. Browne holds several national leadership roles including Associate Editor of the Journal of Arthroplasty, AAHKS Treasurer, and Member of the Steering Committee of AJRR. He has served as the Editor of the AJRR Annual Report for the past five years. Dr. Browne also chairs the Miller Review Course. He is a member of both the Knee Society and Hip Society.

Tracy Borsinger, MD

Assistant Professor

Dr. Borsinger was born in New Jersey and grew up there. She went to undergrad at Middlebury College where she studied biochemistry and played basketball. She then went to medical school at Georgetown University School of Medicine.

Dr. Borsinger's specialty is hip and knee replacement. She completed fellowship training in Adult Reconstruction and Joint Replacement at the Hospital for Special Surgery in New York City. Her clinical interests are primary, complex primary, and revision total hip and knee replacement, partial knee replacement, robotic total hip and knee arthroplasty, periprosthetic fractures, and prosthetic joint infection.

Quanjun Cui, MD

Gwo-Jaw Wang Professor

Dr. Cui is the G.J. Wang Professor of Orthopaedic Surgery and served as Vice Chair for Research from 2014-2024. Dr. Cui received his medical degree from Henan Medical University with Honors then completed residency and fellowship training in Adult Reconstruction at UVA. He also completed an AO fellowship at the University of Bern in Switzerland. He specializes in total hip and knee replacement, osteonecrosis, surgical hip dislocation to treat femoro-acetabular impingement, and computer-aided and minimally invasive surgery for total hip and knee arthroplasty.

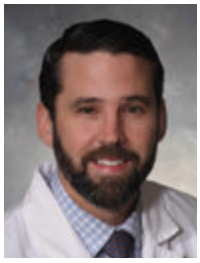
Dr Cui's NIH-funded research focuses on stem cell and arthritis. He has received numerous academic and professional accolades, including the Hip Society Otto Aufranc Award.

Dr. Cui has written over 150 papers and book chapters and has edited 10 text books. He has served as faculty for several national and international instruction courses including AAOS Instruction Courses, Advances in Arthritis, Arthroplasty and Trauma, and Advances in Surgical Technology. Dr. Cui has also served as Program Chair and Faculty Member at state, national and international meetings. He is a board member and reviewer for several prestigious journals including the *Journal of Arthroplasty,* the *Journal of Bone and Joint Surgery*, and the *Journal of Orthopaedic Research*. Dr. Cui is a fellow of the AAOS, a member of the ORS, and a fellow of the AOA. He served as President of VOS in 2017 and President of ARCO in 2020.

ADVANCED PRACTICE PROVIDERS 2024-2025

NICK CALABRESE
MS, PA-C

ALEX LEUZE
PA-C



CHAD WILSON
MS, PA-C, MHS

KYLE WILSON
PA-C

Ian J. Duensing, MD

Assistant Professor

Dr. Ian Duensing graduated magna cum laude from Texas A&M University in College Station, Texas. He continued his medical education at Texas A&M University Health Science Center and Baylor Scott & White Hospital. During medical school, he was inducted into the Alpha Omega Alpha Honor Medical Society and graduated with honors. He then completed his Orthopaedic residency training at the University of Utah in Salt Lake City. He completed his fellowship in Hip and Knee Arthroplasty at Duke University. Dr. Duensing's clinical interests and expertise include primary hip and knee replacement as well as complex primary joint replacement, revision hip and knee replacement, and periprosthetic joint infection. Along with his clinical interests, he is actively involved in multiple regional and national associations aimed at furthering the field of joint replacement. He is passionate about providing good clinical care, trainee education, and research. His specific research interests lie in periprosthetic joint infection, patient reported outcomes, and genetic and familial influences of total joint outcomes.

Understanding the Potential for a Native Knee 'Microbiome'

BACKGROUND

Prosthetic joint infections (PJIs) remain a source of significant patient morbidity and healthcare cost, and are projected to increase with the increasing frequency of total joint arthroplasty. Classically, culture-based methods have been used within the field of orthopaedic surgery in the setting of diagnosing both native and prosthetic joint infection. However, culture-based methods are limited and not always able to detect the presence of all pathogenic organisms in a joint.[1,2] Next generation sequencing (NGS) permits simultaneous, rapid and accurate identification of all DNA present in a particular sample.[3,4]

Although NGS has proven ability to identify many organisms beyond those identified through traditional culture-based techniques in cases of suspected PJI, there is concern that additional organisms identified may represent the natural microbiome of the joint rather than pathogenic agents. Research over the past several decades has elucidated an increasing role for the human body's microbiome in overall health,[5] including the intestinal microbiome which has been implicated in atherosclerotic cardiac disease[6] and cancer.[7] However, prior research with respect to native knee joints is limited and has not addressed whether the microbiome may be joint-specific or patient-specific. Prior work has demonstrated a proportion of patients (up to 30%) with osteoarthritis undergoing primary total knee arthroplasty have organisms identified in their joint by NGS at the time of surgery.[1,8–11]

Abstract

Characterizing the Native Microbiome Using Next Generation Sequencing of Bilateral 'Aseptic' Knees

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INTRODUCTION

Next generation sequencing (NGS) has proven ability to identify organisms beyond those identified through traditional culture-based techniques in cases of suspected prosthetic joint infection (PJI). However, there is concern that some microorganisms identified may represent the natural joint microbiome rather than pathogenic agents. This work sought to evaluate the presence of microorganisms identified with NGS in bilateral native, presumed 'aseptic' knees with osteoarthritis.

METHODS

There were forty patients undergoing primary unilateral (30) or bilateral (10) total knee arthroplasty (TKA) who were enrolled prospectively (Figure 1). During surgery, samples of both fluid and tissue were obtained on operative knees, and joint fluid was obtained from non-operative knees. Samples were sent for NGS analysis and processed according to manufacturer protocols. Patient age, body mass index, comorbidities, prior history of injections, and grade of arthritis were evaluated for association with positive NGS results.

RESULTS

There were three of 80 samples (3.8%) that demonstrated positive NGS. There were two of these that had multiple microorganisms identified (one knee with four microorganisms; one knee with two microorganisms). An additional two samples had positive NGS results below the manufacturer's threshold for reporting. The most common organism identified was *Cutibacterium acnes*, present in two of the three positive samples. No patient baseline characteristics were associated with positive NGS results.

CONCLUSIONS

Some native knee joints with osteoarthritis have positive microorganisms identified with NGS. The presence of microorganisms in the native knee has important implications for better understanding the native joint microbiome as well as utilization of NGS in cases of suspected PJI. ■

"Characterizing the Native Microbiome Using Next-Generation Sequencing of Bilateral 'Aseptic' Knees." The Journal of Arthroplasty (2023). https://doi.org/10.1016/j.arth.2023.11.002

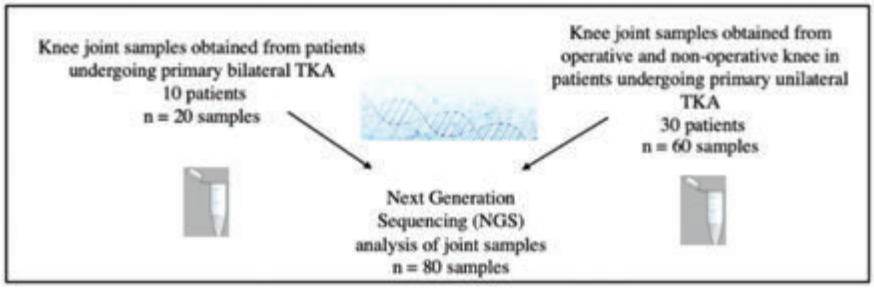

Figure 1. Patients prospectively enrolled for next generation sequencing analysis.

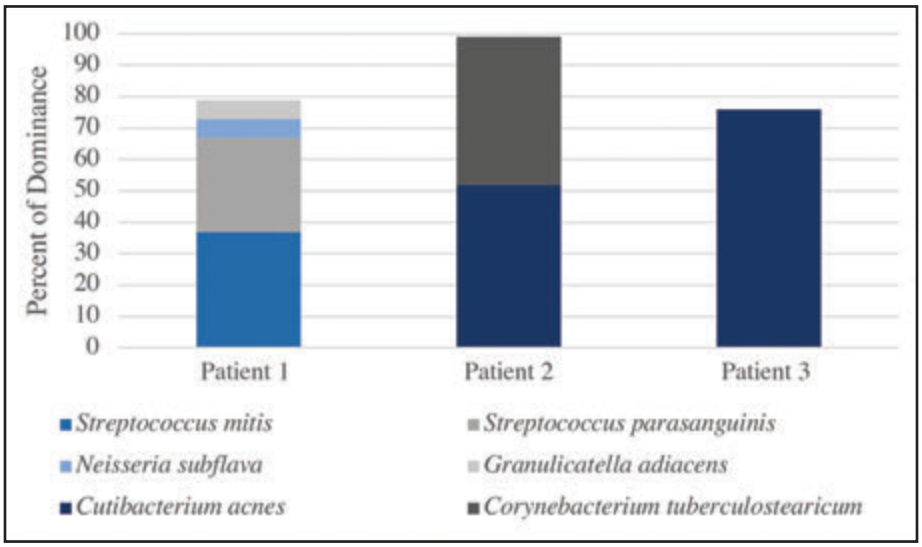

Figure 2. Microbial strains identified with next generation sequencing and percent dominance in three of the 80 native knee samples.

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Joseph S. Park, MD

Professor

Dr. Park is Professor, Division Head and Associate Fellowship Director for Foot and Ankle. He serves as a Team Physician and Foot and Ankle Surgeon for UVA Athletics. Dr. Park graduated Magna Cum Laude as an undergraduate from the University of Pennsylvania, graduated Alpha Omega Alpha from UVA's School of Medicine and completed an Orthopaedic Surgery residency at New York University Langone Orthopaedic Hospital and a Fellowship in Foot and Ankle Surgery at Union Memorial Hospital. In 2010, he returned to UVA as Orthopaedic Surgery Faculty.

Through his research collaborations with UVA Biomedical and Mechanical Engineering, Dr. Park has helped establish UVA and the Center for Applied Biomechanics as nationally recognized leaders in biomechanical testing of orthopaedic implants. In recognition of his contributions, he was awarded an honorary appointment in Mechanical and Aerospace Engineering. He is a recipient of the UVA Dean's Award for Clinical Excellence.

Dr. Park is a reviewer for the *Journal of Bone and Joint Surgery*, *Foot and Ankle International*, as well as *Foot and Ankle Orthopaedics*. He has served as Chairman of the AOFAS Physician Resource Center Committee and was a founding member and Chairman of the AOFAS Orthopodcast Committee (2020–2024). In 2021, he was elected to the AOFAS Foundation Board of Directors as a Member at Large and is presently the President-Elect for the Foundation.

M. Truitt Cooper, MD

Associate Professor

Dr. Cooper is Associate Professor, Director for the Foot and Ankle Surgery Fellowship program and the Medical Director for the ambulatory orthopaedic clinics. Dr. Cooper attended college at Washington and Lee University. He completed his MD at the University of Virginia, and his Orthopaedic Surgery residency at The Ohio State University. Following residency, Dr. Cooper took subspecialty training in Foot and Ankle Surgery with Dr. Michael J. Coughlin in Boise, Idaho. After several years in Private Practice in Richmond, Virginia, Dr. Cooper made the decision to return to UVA to pursue a career in academics. He joined the faculty in 2014.

Dr. Cooper is an active member of the American Orthopaedic Foot and Ankle Society (AOFAS). He previously served as the Chair of the On-Demand Education Committee (previously the Physician Resource Committee), and currently serves on the Annual Meeting Planning Committee. He has served as a section editor for Foot and Ankle Specialist and is currently a reviewer for Foot and Ankle International and Foot and Ankle Specialist.

In addition to maintaining an active clinical practice focusing specifically on foot and ankle reconstruction, Dr. Cooper has numerous research interests. These include total ankle arthroplasty, midfoot injuries, and arthrodesis healing.

Venkat Perumal, MD

Assistant Professor

Dr. Perumal is an Assistant Professor of Orthopaedic Surgery at the University of Virginia, specializing in Foot and Ankle Surgery. Born and raised in India, Dr. Perumal completed his medical education and Orthopaedic Surgery residency there before moving to the United States. He then pursued multiple advanced fellowships, including Pediatric Orthopaedic Surgery at Cincinnati Children's Hospital, Orthopaedic Trauma at the University of Louisville, and Adult Reconstruction and Foot & Ankle Surgery at UVA. He joined the UVA faculty in 2013.

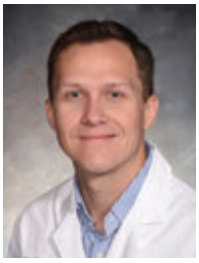
Dr. Perumal's clinical expertise is in minimally invasive foot and ankle surgery, as well as complex foot and ankle reconstruction. His practice includes sports medicine, foot and ankle trauma, total ankle joint replacement, Charcot foot deformities, foot arthritis, and tendon disorders. His research interests focus on the clinical outcomes of foot and ankle pathology, aiming to improve treatment strategies and patient care.

In addition to his clinical and research work, Dr. Perumal is an active member of the International Outreach Committee of the AOFAS, contributing to global efforts in advancing foot and ankle care. He is also a member of AAOS, VOS and AOFAS.

ADVANCED PRACTICE PROVIDERS 2024-2025

ANDREA WHITE
PA-C

JIM SHORTEN
MS, PA-C



DANIEL WOLFE, PA-C

Vasc Surg/Limb Preservation

Caroline Tippett, DPM

Assistant Professor

Dr. Caroline Tippett, DPM started in UVA Orthopaedics in August 2022 as Assistant Professor of Podiatry. Her clinical and research focus is limb preservation and establishing an interdisciplinary team approach to diabetic foot complications. Dr. Tippett was born and raised in Wilson, North Carolina, a rural town outside of Raleigh. She attended University of North Carolina Wilmington for her undergraduate degree in Biology with a minor in Psychology. Dr. Tippett attended New York College of Podiatric Medicine and completed her Foot and Ankle surgical residency at Carilion Clinic.

UVA Foot and Ankle Division

TRUITT COOPER, MD

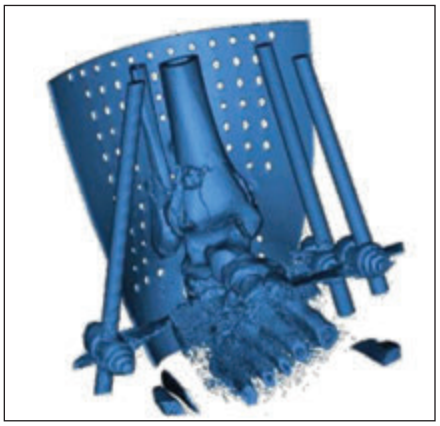
Dr. Cooper continues to serve as the director of the University of Virginia Foot and Ankle Fellowship, as well as the Medical Director for the UVA Orthopaedic Clinics. He recently published a narrative review in the *Journal of the American Medical Association (JAMA)*, discussing common foot conditions. This article primarily focuses on the evaluation and management of Morton's neuroma, plantar fasciitis and mid-portion Achilles tendinopathy. Additionally, Dr. Cooper has been studying variations in midfoot injuries, in particular the proximal extension of these injuries beyond the tarsometatarsal joints/Lisfranc interval into the inter-cuneiform interval. This work has led to acceptance for a podium presentation at the triennial meeting of the International Federation of Foot and Ankle Surgeons this spring in Seoul, South Korea.

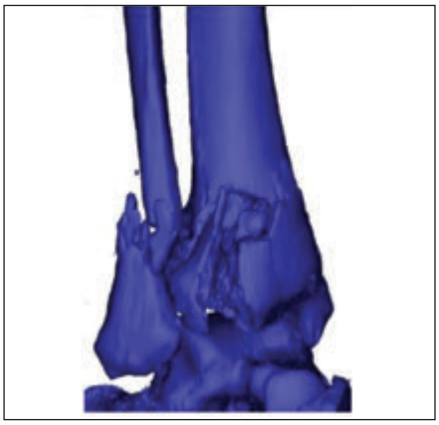
JOSEPH PARK, MD

Dr. Park continues to build upon his unique collaborations with the UVA Center for Applied Biomechanics (CAB) in Mechanical and Aerospace Engineering. In 2023, Dr. Park and the CAB team, under the leadership of Jason Forman, PhD, received a $500,000 grant from Hyundai Motor Company. Their groundbreaking study will investigate the reasons for the nearly 4-fold increase in the rate of ankle/lower extremity injuries during motor vehicle collisions in female occupants compared to their male counterparts. Early analysis suggests that gender differences in skeletal structure and body mass distribution may lead to less effective injury prevention with current seatbelt/airbag designs. Our group will analyze these differences and propose next generation countermeasures to better protect female drivers and passengers. At the 2023 Annual Meeting for the American Orthopaedic Foot and Ankle Society, Dr. Park served as the Symposium Moderator for The Science of Injury Mitigation, Prevention, and Treatment. The symposium highlighted the ongoing collaborative work with Hyundai, as well as with the National Football League (Meade Spratley, PhD). In August 2023, Dr. Park was re-appointed to his second term on the Board of Directors for the Orthopaedic Foot and Ankle Foundation.

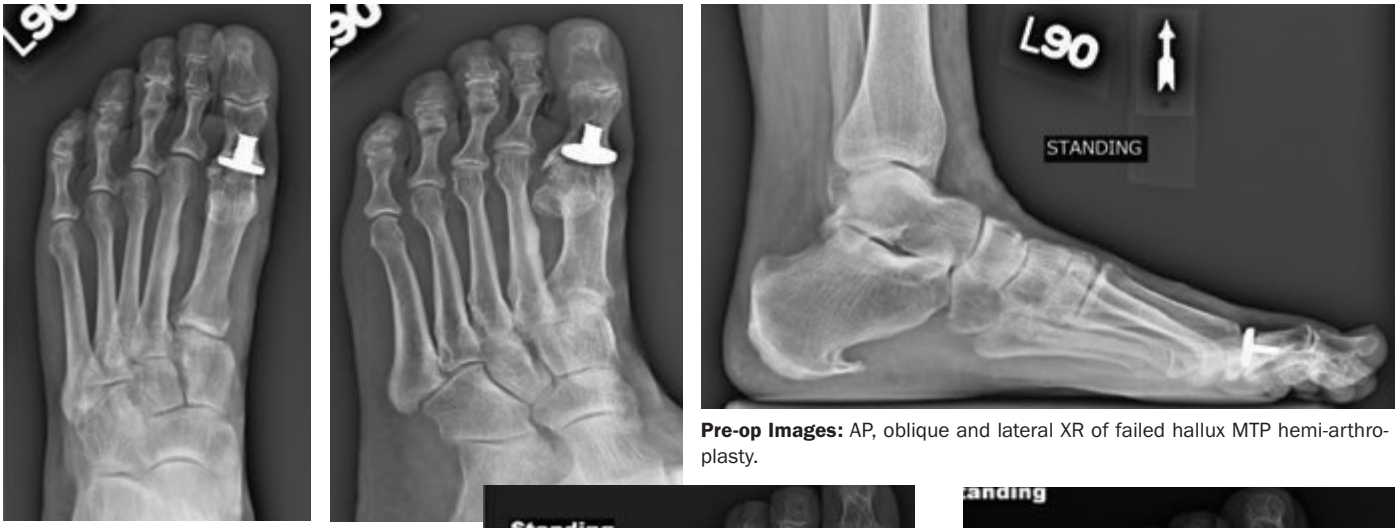
VENKAT PERUMAL, MD

Dr. Perumal served as senior author for our retrospective study (average follow-up time 34.2 months) demonstrating the utility of porous titanium wedges for interposition arthrodesis in 9 hallux MTP joints with substantial bone loss after prior failed ar-





Lower Extremity Injuries Sustained from Car Accident



Pre-op Images: AP, oblique and lateral XR of failed hallux MTP hemi-arthroplasty.

Post-Op Images: 1 year after Interposition Arthrodesis with Porous Titanium Wedge and Dorsal Plating Showing Restoration of length and alignment of the First Ray.

throplasty or arthrodesis (Noble et al, Foot and Ankle Specialist 2023). For these 9 salvage procedures, the average Foot and Ankle Activity Measure (FAAM) score was 91.1 (75.1 FAAM ADL, 17.9 FAAM Sports) out of a possible 116 (84 ADL and 32 Sports). At final follow up, the average VAS score was 1.9 out of a possible 10. Four patients required an additional procedure: one required revision of dorsal plate fixation, two required revision of prominent dorsal plate to a compression staple, and the last required revision fixation with subsequent failure followed by structural iliac crest autograft and eventual union. The use of porous titanium wedges for salvage reconstruction of failed hallux MTP arthroplasty is a viable option to structural allograft or iliac crest autograft.

CAROLINE TIPPETT, DPM

Under Dr. Tippett's leadership, our UVA Foot and Ankle Division has worked diligently to develop a multidisciplinary limb preservation service to improve outcomes in patients with diabetic foot ulcers. Caring for this patient population is particularly challenging due to their multiple medical comorbidities and social factors that increase their complexities of care. These foot ulcers are often superimposed with peripheral arterial disease requiring vascular intervention which even further complicates wound healing. We have standardized the management of patients with foot ulcers through an algorithmic approach, which was created with the input of our emergency medicine, internal medicine, vascular surgery, and infectious disease colleagues. Our goal of minimizing unnecessary resource utilization and consultations, time to the OR, and length of stay has streamlined the care delivered to our limb preservation patients. We are currently building a comprehensive limb preservation database to trend these measures. We have expanded our team by adding an APP, Daniel Wolfe, PA-C, who specializes in inpatient management and facilitates communication amongst the multiple teams involved to efficiently expedite care. With the expertise of our UVA Prosthetics and Orthotics team, we can decrease the risk of re-ulceration through utilization of custom molded shoes and prosthetic devices. Our team approach continues to improve patient outcomes and we will expand our efforts to focus on patient education and prevention of foot ulcers, create a centralized wound care center, and provide formal education curriculum for trainees of all levels. In recognition of her work in limb preservation, Dr. Tippett was invited to speak at the 2024 meeting for the Southern Association for Vascular Surgery on techniques and indications for Transmetatarsal Amputation and Achilles Tendon Lengthening. ■

Cutting Edge Total Ankle Replacement at UVA Health Restores Function & Corrects Deformity

Compared to total hip and knee replacement, total ankle replacement is a relatively newer procedure designed to maintain ankle motion and improve quality of life in patients with end-stage ankle arthritis. UVA Health is one of the few healthcare centers in our region with three fellowship-trained surgeons who perform total ankle replacement. In many cases, total ankle replacement is a good option for improving gait and mitigating pain associated with arthritis or complex deformity.

Unlike ankle fusion surgery, total ankle replacement does not eliminate the motion of the affected joint. Additionally, there is decreased stress placed on adjacent joints when compared to a fusion procedure. Replacement of the ankle joint may be a better option for patients who have maintained ankle motion, even in the setting of advanced arthritis in other joints of the foot.

Surgeons at UVA Health perform an average of 50 total ankle replacements each year, a number which continues to increase as patients are referred to the UVA Foot and Ankle Division from throughout Virginia and beyond. Many of these patients arrive at UVA Health after having exhausted all other nonoperative options for treatment.

PATIENTS REAP THE BENEFITS OF NEW TECHNIQUES & TECHNOLOGIES

Joseph Park, MD, who serves on the board of directors for the American Orthopaedic Foot & Ankle Foundation, describes a case involving a woman in her late 60s with severe bilateral ankle arthritis and valgus (pronation) deformity. "This patient was an otherwise very healthy woman with a history of severe arthritis in both ankles. The condition was so extreme that the bones in her ankles had collapsed leading to severe tilt of the talus within the ankle joint. She'd tried other treatments, including bracing, injections, and physical therapy, but she was now unable to walk for even short distances without severe pain."

After arriving at UVA Health, total ankle replacement was suggested as the best treatment option to restore function and minimize pain. According to Park, even severe deformities can be addressed through ankle replacement and realignment due to improved implant technology and innovations in surgical techniques.

CT SCAN-BASED CUTTING GUIDES ENSURE MORE ACCURACY

A major advancement in total ankle replacement involves the use of CT scan-based cutting guides. These guides, which are customized to each patient, ensure that surgeons make more accurate bone cuts. This, in turn, provides an additional method to improve intraoperative alignment.

Traditionally, CT-based cutting guides have not been widely used, even in hip and knee replacement surgeries. However, by using this technology, surgeons may reference the bony anatomy as precisely as possible. Park says, "The custom cutting guides allow for optimization of the alignment for both the tibial and talar bone cuts. The process is incredibly accurate and helps us provide the best outcomes possible."

While total ankle replacements may be susceptible to the same risks as other joint replacement procedures, such as infection, malalignment, fractures, and wound complications, this patient recovered well from both total ankle replacements. She showed significant improvement in both gait and activity level following the bilateral joint surgery. Park agrees that her outcome was

exceptional, saying, "This is one of the most rewarding surgeries performed in orthopaedics for pain relief and quality of life. Full recovery can take up to a year, but in properly selected patients, this procedure can be life-changing."

FURTHER RESEARCH MAY IMPROVE BONE FIXATION TO IMPLANTS

Park also participates in research to better understand what factors affect the bony incorporation of ankle implants. Part of that research is related to quantifying how much motion there is between the metal implant and the bone it is resurfacing. He explains that micro-motion can eventually lead to loosening or failure of an implant; however, 3D printing and porous metal technology are helping to mitigate this problem.

"With 3D printing technology, we can utilize metal implants that are porous, much like a honeycomb. That way, the bone can grow into the metal, not simply onto it. This may lead to permanent biological fixation and, hopefully, lifelong retention of the ankle replacement. I am hopeful that these innovations may even lead to improvements in outcomes for replacement of other joints, including the hip and knee," says Park. ■

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A. Bobby Chhabra, MD

Lillian T. Pratt Distinguished Professor and
Department Chairman
David A. Harrison Distinguished Educator

Dr. Chhabra is the Lillian T. Pratt Distinguished Professor, the Department Chair, the David A. Harrison Distinguished Educator, Director of the UVA Health Orthopaedic Center and team physician for UVA Athletics. He is the President-Elect of the ASSH, and will serve as President in 2025-2026. He has served as Chair of UVA Orthopaedics since 2013.

Dr. Chhabra's expertise includes hand, wrist, and elbow trauma and arthritis with a particular interest in sports injuries and congenital hand surgery. He was the driving force in the development of UVA's Hand Center and the 200,000 square foot comprehensive UVA Orthopaedic Center.

Dr. Chhabra has received UVA Dean's Awards for Excellence in Teaching, Master Educator, Master Clinician and the David A. Harrison Distinguished Educator Award, the highest teaching honor at the UVA School of Medicine. In 2014, he was inducted into the Raven Society, UVA's most prestigious honorary society. He received the VOS Distinguished Career Achievement Award and the ASSH David P. Green Mentorship Award.

Dr. Chhabra has published over 70 peer-reviewed articles, 40 book chapters, has been editor for five textbooks, given 170 national and international presentations and has been invited as a Visiting Professor at 35 prestigious institutions.

Dr. Chhabra has a weekly show on local ESPN/WINA radio, "Best Seat in the House Injury Report" and "Real Athletic Conversations." He won the Associated Press of Virginia Best Sports Show Award in 2017-2018 and in 2020-2021.

A. Rashard Dacus, MD

Charles J. Frankel Professor and
Vice Chair of Community & Wellness

Dr. Dacus is the Charles J. Frankel Professor and the Vice Chair of Community & Wellness in UVA Orthopaedic Surgery. He joined the department in August of 2007 after completing a fellowship in hand and upper extremity at the University of California, San Diego. He served as Residency Program Director from 2011 to 2019 after serving as the Assistant Residency Program Director from 2009 to 2011. He served as the Co-Fellowship Director for the Hand and Upper Extremity Division from 2009-2014. Dr. Dacus has also served as Assistant Team Physician for James Madison University Athletics since 2008.

Dr Dacus' practice continues to encompass joint replacement in the hand and elbow and reverse total shoulder arthroplasty as well as microvascular surgery of the hand and upper extremity. He is currently researching the effect of EMG results on treatment plans/outcomes in patients with carpal and cubital tunnel syndrome.

Dr. Dacus is dedicated to the Charlottesville community and serves on the Board of Advisors for Big Brothers/Big Sisters of Central Virginia and the New Hill Board. He has participated in the Health Fair at Washington Park by providing physicals since 2009. He has served as a mentor and guest speaker for the AVID program at Albemarle High School.

D. Nicole Deal, MD

Professor and
Vice Chair of Faculty Development

Dr. Deal is a Professor in the Department of Orthopaedic Surgery at the University of Virginia and holds a dual appointment with the Department of Plastic Surgery. She completed her undergraduate degree at the University of Virginia, attended medical school at the Medical University of South Carolina, and completed Orthopaedic Surgery Residency and a Hand Fellowship at Wake Forest University. In 2009, Dr. Deal joined the Orthopaedic Hand faculty at the University of Virginia.

Dr. Deal has received many faculty achievement awards including the Dean's Award for Clinical Excellence in 2013, the Dean's Award for Teaching Excellence in 2015, was inducted into the Academy of Distinguished Educators in 2016, and received the Resident Teaching Award for Orthopaedics in 2018. Dr. Deal served as the President for VOS in 2020-2021.

Dr. Deal has authored 35 peer-reviewed journal articles and 28 book chapters. Her research interests include peripheral nerve repair and regeneration, denervation injury, and nerve regeneration and muscular re-innervation. She has received two prestigious Coulter Foundation grants for her collaboration with faculty from the Department of Biology to develop novel techniques to stimulate nerve growth.

ADVANCED PRACTICE PROVIDERS 2024-2025

AMY RADIGAN
MPAS, PA-C

KELSEY PARENTE
MS, PA-C

Aaron M. Freilich, MD

Associate Professor

Kacy Peek, MD

Assistant Professor

Aaron M. Freilich is an Associate Professor of Orthopaedic Surgery and Plastic Surgery at the University of Virginia who specializes in Hand and Upper Extremity Surgery. He is the Director of the UVA Hand Center, Orthopaedic Hand and Upper Extremity Fellowship Director, and the 3rd Year Clerkship Director for UVA's School of Medicine. He began his secondary education at the University of Michigan, studying Economics and Cell and Molecular Biology, where he graduated with honors. He received his M.D. from the University of Virginia and continued on to complete his Orthopaedic Surgery residency, before training in a Hand and Upper Extremity Fellowship at Wake Forest Baptist Medical Center.

Dr. Freilich is a member of the AAOS and the ASSH, and serves on several committees both locally and nationally. He also continues to serve as a member of the UVA medical school curriculum committee.

Dr. Freilich's practice focuses on treating hand, wrist and elbow problems, with a particular interest in trauma and microvascular reconstruction. He works closely with his Plastics and Orthopaedic Hand colleagues in training residents and fellows and in further developing a joint hand reconstructive service. His research interests are in education and simulation training and collaboration with the Center for Applied Biomechanics.

Dr. Kacy Peek is an Assistant Professor of Orthopaedic Surgery at the University of Virginia. Her specialty is Hand and Upper Extremity Surgery, where she focuses on upper extremity trauma, with a particular interest in complex elbow trauma and replantation. She joined the faculty in 2022.

Dr. Peek graduated from the University of Texas at Austin before pursuing her master's in Health and Medical Sciences at the University of California at Berkeley in 2014. She attended medical school at the University of California, San Francisco and completed her Orthopaedic Surgery residency in 2021 at the University of Washington. She completed fellowship training in Hand and Upper Extremity at the University of Colorado in 2022 before joining the faculty at the University of Virginia.

Three Doctors — Three Viewpoints

DR. NICOLE DEAL

WHAT IS YOUR FAVORITE CASE AND WHY?

Any upper extremity trauma case — from complex distal radius fractures and carpal fractures, to forearm and elbow fractures. I enjoy putting the puzzle back together and returning people to as close to pre-injury level of function as possible. Working with the patient and our Hand therapy team to achieve the patient's post-op goals is extremely gratifying.

NAME SOMETHING YOU DID IN SURGERY WHEN YOU STARTED THAT YOU NO LONGER DO.

I worried a lot! I can recall lying in bed on call worrying about what catastrophes may be headed my way, my upcoming surgeries and my post-op patients. Over the years I have let go of a lot of worry and stress and I now focus on the enjoyment of caring for my patients and the fun of doing surgery-life is much better this way!

WHERE DO YOU SEE THE FUTURE OF HAND SURGERY GOING?

Hand surgery is such a rapidly evolving field. I think we are becoming more adept at handling nerve injuries and can imagine a time when nerve injury is no longer so devastating with increased functional recovery and more rapid re-innervation

times. I also see robotic micro surgery becoming more common allowing shorter surgical times and more robust recovery after injuries requiring microsurgery.

WHAT DO YOU DO NOW THAT YOU DIDN'T DO WHEN YOU STARTED PRACTICE?

I take amyloid biopsies on my patients with carpal tunnel syndrome who are at high risk for amyloidosis. I've been working with a heart failure specialist here at UVA since 2017 to capture those patients who present with carpal tunnel and cardiac amyloidosis so his team can prevent further amyloid deposition in the heart using innovative new therapies. My patients are immensely grateful for this early intervention, potentially adding years to their lives.

DR. BOBBY CHHABRA

WHAT IS YOUR FAVORITE CASE AND WHY?

My favorite case is a pollicization. Although my practice is majority adult hand, wrist, and elbow surgery with a major focus on sports related upper extremity injuries, the case that inspired me to pursue a career in hand surgery was "making a thumb" for a child who was born without a thumb. I chose to pursue a congenital hand fellowship after my adult hand fellowship because I am fascinated by the technical challenges of performing this complex surgery which requires skills in every aspect of hand and microsurgery. Creating a thumb from an index finger that looks and functions normally and allows a child to keep up with their peers in activities is incredibly gratifying. And giving parents confidence that their child has the potential to achieve all their dreams and goals despite being born with a congenital hand difference is an amazing feeling you cannot express in words.

NAME SOMETHING YOU DID IN SURGERY WHEN YOU STARTED THAT YOU NO LONGER DO?

Now that nerve allograft and nerve conduits are proven options for treatment of digital or sensory nerve injuries, I no longer use autograft nerve for digital nor sensory nerve repairs or reconstruction.

WHERE DO YOU SEE THE FUTURE OF HAND SURGERY GOING?

Hand surgery like orthopaedics has a very exciting future. More and more cases will transition to outpatient. Virtual reality will be used in the OR to optimize implant placement and surgical outcomes. Minimally invasive approaches and arthroscopy will be used to treat common hand and wrist pathology such as scaphoid nonunions and scapholunate ligament injuries. Microsurgery will be facilitated with the use of a robot. And Biologics will help improve outcomes in tendon, ligament, and nerve repair.

There will also be an explosion in the use of virtual reality and computer simulation for training our residents and fellows in hand surgery and all Orthopaedic specialties.

WHAT DO YOU DO NOW THAT YOU DIDN'T DO WHEN YOU STARTED PRACTICE?

I always did open carpal tunnel releases when I started practice over twenty years ago. This is what I was trained to do because the technique of endoscopic carpal tunnel release was not available at that time. I would not have started doing endoscopic carpal tunnel releases unless I was pushed to do so by my residents and fellows. I now routinely do endoscopic carpal tunnel releases for most of my elective carpal tunnel syndrome cases. I also have a low threshold to do a wrist arthroscopy for unclear wrist pain or failure of conservative management. This was another treatment option that I did not learn in my training but had to develop the skills for so I could take care of the large number of athletes in my practice with wrist injuries.

DR. DACUS

WHAT IS YOUR FAVORITE CASE AND WHY?

Distal radius fractures. I enjoy putting them back together and the functional improvement is very rewarding. I have a system which makes them very efficient, even with trainees assisting.

NAME SOMETHING YOU DID IN SURGERY WHEN YOU STARTED THAT YOU NO LONGER DO.

I used to use the FCR for my thumb CMC surgeries as an interposition but I transitioned over to suture suspension two years ago. The patients are happy, the results are good and the surgery times are significantly less. There is also less pain.

WHERE DO YOU SEE THE FUTURE OF HAND SURGERY GOING?

The future is intra-office procedures with point of care access. With steady rising costs and limited shares going to the physicians, moving away from the hospital is making more sense. It is better for patients, can become very efficient, has proven to be safe and puts control back in the surgeon's hands.

WHAT DO YOU DO NOW THAT YOU DIDN'T DO WHEN YOU STARTED PRACTICE

I get to know my patients better. I was so busy at the start of my practice that people were better known by their diagnosis. As I have gotten older, I have valued the trust that patients put in their surgeons and have tried to cultivate a real working relationship that has improved patient care. ■

Unparalleled Expertise in Treating UCL Injury at UVA Health

UVA Health orthopaedic surgeons Bobby Chhabra, MD, and Rashard Dacus, MD, are experts in treating an injury that's becoming more common in even young athletes — so common some consider it an epidemic.

Chhabra and Dacus specialize in hand and upper extremity injuries, and have close to 40 years of experience between them in treating elbow ulnar collateral ligament (UCL) injuries in overhead-throwing athletes, including UCL reconstruction surgery. UCL injuries most commonly affect pitchers and other baseball players — from Little League all the way up to MLB — and surgery is increasingly indicated for athletes at younger ages.

"These injuries are becoming more and more common because of the culture of baseball in this country where pitchers basically pitch year-round," Chhabra says. "There also aren't many surgeons who perform these operations because there's a lot of expectations from parents, coaches, and the players themselves. But we've been taking care of these athletes for years and have the highest level of expertise in the state and region."

WHY UCL INJURIES OCCUR

When a thrower fatigues and drops their shoulder during a pitch — subjecting the medial elbow to repeated high-speed valgus torque — the UCL is at risk for injury or tear. UCL injury is a particular risk for baseball pitchers, who are increasingly challenged to throw harder, faster, and more frequently at increasingly younger ages.

"Unfortunately, it's become somewhat of a rite of passage for throwing athletes now," Dacus says. "Some of this is related to pitchers throwing more and more at earlier ages, as well as a lack of diversifying sports and year-round throwing."

Chhabra and Dacus see UCL injuries most often at the end of the fall and spring seasons. "The pitchers are fatigued and their mechanics suffer," says Chhabra, who serves as the University of Virginia Athletics team physician for hand and upper extremity injuries.

MLB and USA Baseball started a program to reduce UCL injuries called Pitch Smart, which sets age-appropriate guidelines for players, coaches, and parents, including recommendations for rest periods between games and limits on the number of pitches players can throw. Yet injuries remain on the rise across youth, collegiate, and professional athletes.

THE IMPACT OF UCL INJURIES ON HIGH-LEVEL THROWERS

Elbow injuries account for 16% of all injuries sustained by college and professional baseball players, according to the Arthroscopy Association of North America (AANA). Each injury in a professional player costs MLB close to $2 million. Each player who undergoes UCL reconstruction surgery, or "Tommy John surgery," is out for an average of 17 months.

Not every UCL injury needs to be treated with surgery, but it's currently the first-line treatment for promising athletes who want to get back to the same level of performance they were at before their injury. That's the expectation from the parents, player, coaches, and trainers, Chhabra says — that they'll return better and stronger. While that's not always the case with UCL reconstruction surgery, it is true most of the time.

"That's why we do this operation," Chhabra says. "It was designed to allow a high-level baseball pitcher with high-level aspirations to keep pitching."

Chhabra adds: "For a non-thrower, like a football player or wrestler, if they have a UCL injury — and they get them frequently — they don't need surgery and will heal with conservative treatment."

Still, a very small percentage of players go on to the next level of baseball, says Dacus, who serves as the James Madison University Athletics team physician for hand and upper extremity injuries. "It's important to have that conversation with parents and set realistic expectations," he says. Sometimes it's protecting the player from themselves. "Everyone wants to play, and they won't tell you they're having pain if it means they can keep playing, so we have to try our best to protect the athletes," he adds.

A LONG REHABILITATION PROCESS

Throwing athletes who present with any medial elbow pain need to be evaluated for UCL injury, Chhabra says. Some of the time, they describe hearing a pop when the injury occurred, but they frequently don't. They also may have some swelling and ecchymosis, but that's fairly rare. Most of the time, they feel some pain and continue to pitch, but nearly all notice a loss of velocity and control.

If diagnostics indicate a partial UCL tear, it's considered a sprain. If it's a first-time injury and it's a partial or low-grade tear, it can often be treated nonsurgically, with no throwing for three months and a brace to protect against valgus stress. Still, rehabilitation needs to include a graduated return to throwing.

In patients with complete, acute ruptures, high-grade tears, or failure to progress with pitching after three months of conservative management, surgery is typically indicated, which generally involves recreating the ligament using a tendon graft. Often, Chhabra says, surgery is the easiest part of the process.

Rehabilitation is lengthy and includes immobilization of the elbow for roughly two weeks, followed by easing into elbow and shoulder range of motion, often with a brace. Strengthening can be introduced at 4 to 6 weeks, but there can't be any valgus stress until 4 months. At 7 months, the patient can start a graduated program of range of motion, total body conditioning, and 50% throwing effort. At 9 months, they can throw at 70% maximum velocity. If they have no pain and a full range of motion, they can begin throwing competitively again after one year. 18 months is when they can return to their previous level of play, but they should be carefully supervised by trainers who understand the protocols for UCL rehabilitation.

"When pitchers tell me they feel great 4 or 5 months after surgery and are ready to start throwing again, I tell them you can't rush biology," Chhabra says. "It takes time for the tendon graft to strengthen to that of a ligament and give you the support you need to throw again."

He adds: "The worst thing that can happen is for someone to return to throwing early and re-rupture the reconstruction, because the likelihood of returning to throwing at the same level with a recurrent UCL injury is very low."

Today, after a first time injury and reconstruction return to previous level of performance after 18 months is, on average, up to 97% — a stark increase from the 1970s, when the percentage was 63%.

Still, reaching an optimal return to performance requires specialized expertise.

At UVA Health, "there are 2 of us who take care of these injuries," Dacus says, "so you're able to get differences of opinion, which I think is helpful because every athlete is different. We take care of all age groups, from young kids to collegiate athletes to post-college, so we see the spectrum, which also gives us a different perspective on treatment options. And we have therapy in-house, so we're able to establish the proper therapeutic regimen. We also have athletic trainers in our clinic, so they're able to help facilitate the training portion pre- and post-operatively."

TAPPING NEW TREATMENT OPTIONS

Although the gold standard for treating UCL injuries has been reconstruction, thanks to improved outcomes and new technologies, some surgeons, including Chhabra and Dacus, have been incorporating UCL repair with ligament augmentation in recent years.

"We're doing internal bracing and repairing the ligaments with the goal that this approach result in a shorter recovery," Chhabra says. "It's been an advance in terms of thinking we can repair and augment a native ligament instead of using a graft to reconstruct because grafting has a longer recovery. Currently there are studies investigating repair over reconstruction in high level throwers and this may give us more information."

In addition to different techniques, Chhabra and Dacus are also looking at different biologics that could be used to improve healing, such as collagen tape for acute repairs and platelet-rich plasma (PRP) injections in partial ligament injuries to try to avoid surgery.

"We offer a lot of different treatment options for patients, depending on their needs," Dacus says. "Sometimes it's a nerve problem, sometimes it's a repair and bracing, sometimes it's a full reconstruction. We tailor the treatment to the patient in each and every case." ■

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Mark J. Romness, MD

Professor

Dr. Romness is Professor of Orthopaedic Surgery with a secondary appointment in Pediatrics. The dual appointment highlights his commitment to Pediatric Orthopaedics and the unique care that children encompass compared to adults. Dr. Romness serves as Division Head of Pediatrics, a member of the Resident Advocacy Committee and Medical Student Clinical Supervisor. He is also Medical Director of the Motion Analysis and Motor Performance Lab which is internationally recognized for clinical evaluations of patients with cerebral palsy.

His expertise includes children with special needs such as cerebral palsy and spina bifida which incorporates his other interests of hip, knee and foot disorders. Rare disorders of childhood such as osteogenesis imperfecta, congenital pseudarthrosis of the tibia and genetics syndromes are additional areas of expertise.

Dr. Romness has been in practice for more than 25 years, joining UVA in 2004 after practicing at children's hospitals in Connecticut and Fairfax Virginia. His undergraduate education was at the College of William and Mary and then Northwestern University for medical school and orthopaedic residency. He spent one year for fellowship in pediatric orthopaedics at the Royal Children's Hospital in Melbourne, Australia. He is married to Christine Romness and they have three grown children.

Dr. Romness has served on the Board of Directors for the American Academy for Cerebral Palsy and Developmental Medicine, has been President of VOS and is a long-standing member of POSNA.

Keith R. Bachmann, MD

Associate Professor and
Associate Residency Director

Keith Bachmann, MD was born in Newark, Ohio but moved to Richmond, Virginia with his family before elementary school. He then attended the University of Virginia as an undergrad where he met his wife Anne. Dr. Bachmann went back to Richmond for medical school at MCV and then moved to Cleveland for his residency at the Cleveland Clinic. He completed his fellowship in pediatric orthopedics and scoliosis surgery at Rady Children's hospital in San Diego. Dr. Bachmann began working at the University of Virginia upon completion of his fellowship in August 2016. His practice includes musculoskeletal surgery for children especially those with spinal deformity.

Locally Dr. Bachmann serves on the UVA children's surgical performance improvement committee. He is active in the Virginia Orthopedic Society as member of the board and serves on committees through the Pediatric Orthopedic Society of North America (POSNA) and the Scoliosis Research Society (SRS). Dr. Bachmann is a member of the Harms Study Group working to further scoliosis care through longitudinal outcomes collection. His research focuses on patient outcomes and working to improve the metrics used to measure these outcomes. He is also interested in the long-term effect and need for surgical treatment for spinal disorders.

Outside of work Dr. Bachmann and his wife like to travel. They have three sons, three dogs and two cats. Dr. Bachmann tries to stay involved with wildlife photography, golf, and scuba diving. He is a fan of University of Virginia collegiate sports, and Cleveland based professional sports teams.

Leigh Ann Lather, MD

Associate Professor

Dr. Lather is currently Attending/Consulting in Pediatric Orthopaedic Clinic located at the University of Virginia Children's Hospital Clinics and at the UVA Orthopaedic Center on Ivy Road. She is involved in Clinic-based teaching, conferences, and didactic lectures for Orthopaedics, Pediatrics, Family Medicine, and Physical Medicine and Rehabilitation Residents, Fellows, and rotating medical students. She is a founding member of the national Pediatric Orthopedic Medicine group (POM), a Member of the Pediatric Orthopaedic Society of North America (POSNA) and a fellow of the American Academy of Pediatrics (AAP) and member of the Section on Orthopaedics (AAP SOOr), active in several subcommittees. In an effort to ameliorate medical trauma in children with injuries and disabilities, she is also the caretaker/handler of a full-time service dog, awarded to her by Canine Companions (Home - Canine Companions). Her dog, Benicia, works alongside her in clinic to facilitate exams and procedures.

ADVANCED PRACTICE PROVIDER 2024-2025

EMILY FEINER
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Clubfoot Treatment: From casting to surgery

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Congenital club feet continue to be a common condition seen in our pediatric orthopaedic clinics. The incidence has not seemed to have changed over the last decade or more. There continues to be a spectrum of deformity from mild to severe with many of the more severe now labeled atypical clubfeet. Boys have twice the incidence of girls and 50% of patients have bilateral involvement. If the family has a baby boy with a clubfoot, there is a 1:40 chance that a subsequent brother would have clubfeet and minimal for a baby sister. If the family has a baby girl with a clubfoot, there is a 1:16 risk for a baby brother and 1:40 for a baby sister. Clubfeet are rarely associated with other anomalies but are seen with neuromuscular conditions including myelomeningocele, arthrogryposis, muscular dystrophy and spinal muscular atrophy. While many feet with a deformity at birth are referred to our clinics as a "clubfoot", some are simple positioning deformities that will correct spontaneously such as calcaneal valgus foot. Other conditions include metatarsus adductus and skew foot deformity which have forefoot adduction but do not have equinovarus position of the heel. It is the lack of heel dorsiflexion the distinguishes a clubfoot from these other conditions. Another condition that lacks dorsiflexion of the heel is vertical talus but this can be distinguished from clubfeet by the convexity of the arch from talar head prominence and heel valgus in the vertical talus foot.

Condition	Forefoot	Midfoot	Hindfoot
Calcaneovalgus	Neutral	Neutral or lateral	Hyperdorsiflexed
Metatarsus adductus	Adduction	Normal	Normal
Skewfoot	Adduction	Lateral	Valgus
Vertical talus	Neutral/abduction	Lateral	Valgus/equinus
Clubfoot	Adduction	Medial	Varus/equinus

Figure 1. Foot Positions at Birth

Figure 2. Persistent supination of forefoot.

Ponseti casting protocol remains the standard initial treatment for clubfeet. Casting does not need to be initiated immediately after birth but is preferred within the first few weeks. Most patients require 5-6 weekly casts and then 80-90% of patients will have a percutaneous Achilles tenotomy performed in clinic. Tenotomy is followed by final three-week cast and then bracing. Bracing consists of a variation on the Dennis-Browne bar full-time for 3 months and then nighttime for up to 4 years. The goal of bracing is to maintain ankle dorsiflexion but also to counteract the tibialis anterior causing foot supination. If the patient and family are not adherent to bracing there is an increased need to do a tibialis anterior transfer at 3-5 years of age. Even some children who are adherent to bracing still need the transfer for persistent supination and heel varus.

The feet with more severe deformity do not tolerate nor respond to casting as well which makes the initial casting process much more difficult. We have developed specialty casting techniques which help with these more stubborn feet, but there are still some feet where reconstructive surgery is a better option then repeated casting. Reconstruction has been described by using the Cincinnati incision and the Carroll two incision approaches. There was also a long, single posterior medial incision described by Vincent Turco in 1971, but this incision contributed to recurrence of the equinovarus. The approach used is not as important as what is done inside

the foot. All structures that need to be addressed can be reached through either of the first two approaches except for the calcaneocuboid joint, which sometimes needs a separate lateral incision to get extensive release. The Cincinnati approach puts the blood supply to the heel at risk and necrosis of the heel has been reported. The Cincinnati approach is also difficult to close posteriorly, as maintaining the foot in a neutral position opens the posterior aspect of the incision. The Carroll approach does not put the heel at risk, and with dorsiflexion of the foot, the posterior incision comes together without tension, making closure less problematic. For these reasons, the Carroll approach is preferred. and video of the technique from UVA Orthopedics can be seen at the AAOS Orthopaedic Video Theater: https://www.aaos.org/videos/video-detail-page/27137__Videos. Whether treated with casting alone or extensive reconstruction, the goal is for children to walk, run and play sports at age-appropriate stages with minimal if any symptoms. ■

Figure 3. Two-incision approach of Carroll

Surgical technique video for clubfoot reconstruction was recorded at UVA Orthopaedics by Josh Schwartz, MD, read by Elizabeth Driskill, MS and is available on the AAOS Orthopaedic Video Theater (OVT) as Posterior Medial Release of a Clubfoot.

Early Onset Scoliosis: Casting vs. Bracing

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Early onset scoliosis, defined as onset earlier than age 8, presents problems shared by all scoliosis — potential for pulmonary dysfunction at large magnitudes, trunk shape changes, and potential for further progression. Unique to early onset scoliosis are the limitations created from our most common treatment methods[1]. Namely, a fusion surgery at a young age creates restriction of pulmonary function independent of the pulmonary impact from scoliosis. This creates a challenge because the best correction of the scoliosis occurs with the first surgery and the largest corrections are with fusion surgery due to instrumenting the curve apex. There are many strategies that have evolved to treat the spinal deformity and allow for continued growth: growing construct with or without magnetically actuated growing rods, Shilla technique, casting, and bracing.

Figure 1. 5 year old with early onset scoliosis.

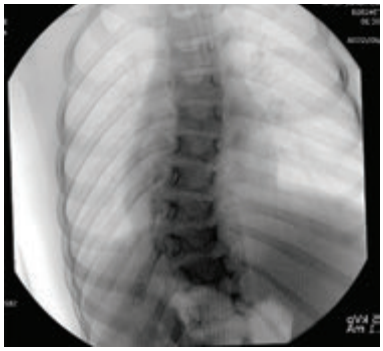

Figure 2. 5 year old with early onset scoliosis with in cast correction.

Figure 3. Another patient who started casting at age 18 months

Figure 4. Interval imaging in final cast.

In order to evaluate the effectiveness of casting compared to bracing for early onset scoliosis the same group that spearheaded the BRAiST trial that was published in the New England Journal of Medicine has organized a casting vs bracing in early onset scoliosis trial[2]. Much like with the prior bracing study we are a site at the University of Virginia and excited to contribute patients as well as bracing and casting expertise. Patients with idiopathic early onset scoliosis are offered the choice of randomization between bracing and casting. There is a preference arm if the patient has a method they would prefer to pursue. The braces are made in conjunction with our orthotics team to include a heat sensor to accurately monitor time in brace. The casts are applied in the operating room with maximal correction obtainable.

With the enrollment numbers and generalizability that can be obtained by utilizing multiple sites we will be able to effectively compare casting and bracing for these individuals with early onset scoliosis. Currently there are some patients that can be treated definitively with casting, but there are other patients where the treatment buys time and growth until instrumented surgical intervention when the child is older. Determining if casting and bracing are capable of achieving correction or maintenance might help younger patients avoid repeat anesthetic events. We continue to leverage our clinical expertise and research framework to participate in studies that will help shape the practice of pediatric spine surgery. ■

Figure 5. Most recent follow up – patient is now 9 years of age and has been maintained in a brace after casting until age 5.

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Aceline Alusca Green, CP, MSOP
P & O Residency Director

Aceline grew up in Florida and graduated from Oakwood University in 2011 with a Bachelor's degree in Health Science and a concentration in Physical Therapy. After graduation, she got accepted into the elMSOP Orthotics and Prosthetics program at Loma Linda University (LLU) School of Allied Health Professions in California. During her time at LLU, she worked as a Teacher's Assistant and patient model manager. She went on to graduate from LLU with a Master's degree in Orthotics and Prosthetics in 2015 and started her Residency there. She became a Certified Orthotist in 2017, and began working at the University of Virginia (UVA) Prosthetics and Orthotics in 2018. In 2021, She became a Certified Prosthetist-Orthotist. Because of her passion for teaching, she developed the Residency program at UVA where she is now the Residency Director.

Alex Ashoff, CP, MSOP
Senior Prosthetist

Alex grew up in Maryland and completed his Bachelor's in Rehabilitation Science and Master's in Prosthetics and Orthotics at the University of Pittsburgh. While studying as an undergraduate, he worked on multiple research studies including studying stem cell treatment for muscle injuries at the McGowan Institute for Regenerative Medicine and balance control strategies in amputees at the Human Engineering Research Laboratory. After completing his Prosthetic Residency at the Oklahoma City VA Medical Center, Alex worked as a Certified Prosthetist at Martin Bionics where he contributed to the early implementation of new adjustable socket technology for amputees. Alex joined UVA Prosthetics and Orthotics in 2020 and became the Senior Prosthetist in July of 2023. Alex is a content contributor for the AAOP exam preparation seminar and has served on the evidence-based practice committee to facilitate reviews of critically appraised topics in the field.

Michele E. Bryant, MS, ATC, CO
Senior Orthotist

Michele started her college career at High Point University where she graduated with a BS in Sports Medicine and became a Certified Athletic Trainer. She worked for the University of Tennessee Athletic Training Department while earning her Master's Degree in Sports Medicine/Biomechanics. At Tennessee, Michele enjoyed working with the team physicians on biomechanics and bracing. She earned a degree in Orthotics from Northwestern University. After completing her Orthotics Residency at the Cleveland Clinic, Michele worked at UNC Hospital as a Certified Orthotist.

Michele joined UVA Prosthetics & Orthotics in 2014 and acted as Assistant Technical Director from 2017-2022. She has served on the Cranial and Gait Societies of AAOP and on the AOPA Coding and Reimbursement Committee. Michele is involved in yearly AOPA Policy Legislative Forums to advocate for the needs of the profession and the patients it serves. Michele is a resident mentor and enjoys educating students and patients.

Gary Malnowski, CPed, CFo
Operations Manager

Gary earned his Bachelor's degree from UVA and began his career in the orthotics field in 2007 at Richey Shoe Stores, where he worked closely with senior-level Certified Pedorthists, specializing in diabetic foot care, therapeutic shoes, and custom orthotics. In 2012, Gary achieved board certification as a Pedorthist and subsequently managed a foot orthotic manufacturing lab, overseeing the production and distribution of hundreds of orthotics weekly across the Mid-Atlantic region.Later, Gary joined Foot and Ankle Specialists of the Mid-Atlantic, working with a team of podiatrists to provide comprehensive patient care. He transitioned to UVA, in 2022, where he now serves as Operations Manager, focusing on enhancing patient care and streamlining operational efficiency.

Meagan Salehin, BS, CPed, CFo
Project Manager

Meagan is an ABC certified Pedorthist and Orthotic Fitter who has been with UVA Prosthetics and Orthotics since 2017. Meagan spearheads several department initiatives to include supply chain management, referral source engagement, insurance compliance, and documentation enhancement. Meagan enjoys motherhood, hiking, gardening, live music and crafting. She also serves on the committee for the American Orthotic and Prosthetic Association (AOPA).

Team Approach to Prosthetic and Orthotic Care

UVA Prosthetics and Orthotics has the privilege of being located in the Orthopaedic Center. Having all providers under one roof is advantageous for both the patient and the P&O providers. Proximity of the clinics reduces errors in communication, speeds up treatment timelines, and promotes collaboration between providers to solve unique patient problems.

The weekly Amputee Clinic is a great example of collaboration between providers to effectively serve our patients. The amputee clinic consists of a Physical Medicine Rehabilitation physician, Prosthetist/Orthotist, Social Worker, and the patient. If necessary, the Orthopaedic surgeon or Plastic Surgeon can be included or contacted to address relevant problems to the amputation site.

COMBINATION OF COMPUTER AIDED DESIGN (CAD) AND HAND CASTING TECHNIQUES

UVA Prosthetic and Orthotics clinicians are trained to be able to use all available tools at their disposal to successfully treat patients. Our clinicians are able to use the latest CAD software and scanning techniques as well as tried-and-true hand casting and plaster modification techniques.

Our team takes a patient centered approach to providing P&O care. We believe there is no one solution that works for every patient. Therefore, we have continued to stay relevant with the development of new technologies in the field as well as maintain our hand skills and traditional techniques.

For example, in prosthetics our clinicians are trained on vacuum casting techniques, which utilizes a vacuum pump to help define the plaster mold more accurately. In situations where this technique does not apply due to the presentation of the limb, a standard hand cast can be taken, or a 3-dimensional scan can be captured and modified using CAD software.

MYOELECTRIC UPPER EXTREMITY PROSTHETIC SOLUTIONS

Working with the Orthopaedic Hand Clinic and Plastic Surgery, we are able to provide myoelectric prosthetic devices in combination with Targeted Muscle Reinnervation surgical techniques. This approach allows us to specifically target muscle sites for optimal activation and function of the prosthetic for the patient.

CNC AND CAD FOOT ORTHOTIC MANUFACTURING

With the addition of a 3-axis CNC router machine and integrated CAD/CAM software, we have the ability to evaluate and manufacture foot orthotics for delivery in 1-5 business days with same-day delivery possible if needed. It typically takes about 4 weeks to receive items that are sent out for third party fabrication. By moving more fabrication in house we are able to better control the quality of the devices we deliver and reduce the need for revisions to these devices.

ORTHOTIC RESIDENCY PROGRAM

Beginning July 2024 University of Virginia's Prosthetic and Orthotic department will welcome its first Orthotic Resident to our newly established Residency Program. We are excited for the opportunity to educate the next generation of P&O practitioners.

AOPA CAPITOL HILL VISIT, APRIL 2024

Michele Bryant, MS, ATC, CO attended the Academy of Orthotists and Prosthetists Association's meeting on Capitol Hill to advocate for P&O legislation. She met directly with members of Congress to ask for support of the Medicare Orthotics and Prosthetics Patient-Centered Care Act. This act would ensure patients living with limb loss, limb difference and mobility impairments can access timely, quality O&P care while reducing fraud and saving the Medicare program money. ■

New Technique Improves Prosthetic Functionality

Amputation of any part of the upper extremities typically represents a substantial threat to a patient's functional abilities and quality of life. Traditional prosthetics, while helpful, are static, or fixed: a patient may be able to manipulate the prosthesis to perform some activities of daily living, but its performance pales in comparison to the patient's natural limb.

Myoelectric prostheses are a significant improvement over conventional hand and arm prosthetics. Targeted muscle reinnervation (TMR) allows the patient greater control of an upper extremity prosthetic. Past procedures often sacrificed one or several nerves, leading to complications like phantom limb pain as a result of neuroma formation.

Now, orthopaedic and plastic hand surgery specialists at UVA Health offer a new TMR technique that preserves nerve endings to help drive upper extremity prosthetics, giving patients more intuitive functional control over a myoelectric prosthetic.

Together with other experts from UVA Health orthopaedics and plastic hand surgery and UVA Health prosthetics, Department of Orthopaedics chair Bobby Chhabra, MD, and associate professor of plastic surgery Brent DeGeorge, MD, PhD, detail how this new technique helped one patient regain functionality by pushing the boundaries of nerve regeneration and recovery.

CASE STUDY: TABLE SAW TRAUMATIC INJURY BENEFITS FROM TMR

In most cases, upper extremity amputations result from traumatic injuries. That was the case with a former UVA Health physician, who sustained substantial injuries to his hand while using a table saw.

Chhabra explains, "This patient was experienced with using tools like a table saw, but unfortunately, something in the saw got stuck, and he ended up having a pretty severe amputation of his entire hand. The saw came through his hand and forearm in multiple locations — the injury included his bones, soft tissues, nerves, and blood vessels. While we attempted to save his hand so he could retain function, it wasn't possible given the severity of the injury."

Ultimately, the surgical team performed a transradial amputation, removing both the wrist and hand and providing stable, soft tissue coverage for the resulting amputation stump. While healing, the patient expressed a desire for a prosthetic that would offer greater finger dexterity and more natural hand movements. Such a prosthetic would also provide better management of residual, or phantom, limb pain.

After the initial surgery and subsequent recovery period, both DeGeorge and senior prosthetist Alex Ashoff, CP, MSPO, were consulted to help the patient manage the new amputation. After orthopaedic hand surgery management, plastic hand surgery specialist DeGeorge got involved to help manage soft tissue and nerve-related pain. DeGeorge says, "I work extremely closely with the orthopaedic surgeons. We want to give challenging patients like this the best chance for functional recovery."

TMR TECHNIQUE BETTER MANAGES NERVES

In the past, the median, radial, and ulnar nerves were typically sacrificed when a hand or upper extremity was amputated. These nerves would be cut and their endings placed under the skin, with the hope that neuromas wouldn't form and become painful and symptomatic.

From left, Bobby Chhabra, MD, Brent DeGeorge, MD, PhD, and Alexander Ashoff, CP, MSPO

DeGeorge explains, "Now, we reroute the nerves to new muscle targets. This results in new nerve signals that can be used to help drive prosthetics, giving patients more intuitive functional control over a myoelectric prosthesis. We also found that this approach helps minimize phantom limb pain. This is a truly innovative procedure at UVA Health that helps manage many nerve-related problems."

Following the procedure, Ashoff was brought on to fit the new prosthetic and teach the patient how to use it. He says,

"This patient was highly motivated to use this type of [myoelectric] device. They can be cumbersome, and the patient rejection rate can be high. However, this type of prosthesis picks up the muscle signal topically on the arm when the patient thinks about flexing or opening his wrist. That sends a signal to the prosthetic to either open or close the hand."

PROSTHETIC PROVIDES GREATER GRIP CONTROL

The patient can push a button on the prosthetic to switch between different grips; different-sized and shaped objects require different grips. The patient now has the ability to change grips to complete any task, from gripping a fork to holding onto bicycle handlebars. See the prosthetic in action.

Ashoff says, "It's really important that the patient is compliant with their therapy — PT and OT — so that they can master using the device every day. Patients also come back to see me so that we can optimize their prosthetic and make any necessary adjustments."

Thanks to the specialists' collaborative efforts, the patient is learning to use his prothesis for daily tasks. "This particular patient had a lot of goals related to really precise grip patterns — think of a pinch grip and being able to handle small objects for different household activities of daily living. Already, the prosthetic makes frequent travel possible, and the patient can interact with family and grandchildren normally," says Ashoff.

ADVANCING NERVE REPAIR WITH ELECTRICAL STIMULATION

UVA Health continues to push the boundaries of nerve regeneration and recovery by incorporating electrical stimulation as a component of nerve repair.

DeGeorge notes, "There's new evidence that low-grade electrical stimulation of peripheral nerves can enhance repair and the muscle regeneration process."

"While we didn't use these techniques with this patient, we are trialing them with others. It's another example of how UVA Health is on the cutting edge of medicine that helps patients recover better."

Chhabra agrees, "TMR surgery, it's not just for traumatic injuries. We hope to develop the program for people with amputations related to vascular problems or diabetes. We also want to better serve patients with significant pain issues so we can help improve their quality of life."

REFERRAL CENTER FOR DIFFICULT NERVE-RELATED PROBLEMS

Results like these wouldn't be possible without the team approach UVA Health experts take toward managing injuries of this type. The collaborative effort between specialty teams in a single location allows physicians to provide truly advanced care for this specific patient population. Patients see multiple providers during the same visit at the **UVA Health Orthopaedic Center Ivy Road,** which helps the entire team develop a treatment plan for the best outcomes possible.

Chhabra says, "I want other physicians to know that we're a center that wants to see these patients; in many cases, they're not given many options, or they mistakenly believe they have to live with a decreased quality of life. That simply isn't true. We're one of a very few facilities in Virginia offering these new TMR techniques. The program is ideal in that it shows the collaborative effort across disciplinary teams. It also shows how innovative UVA Health is in terms of caring for difficult, complex medical problems."

"This is for a lot of people. If patients have difficult-to-treat nerve-related problems, we're here. We're available and willing and excited to see these patients. We offer additional options that are not just narcotics," agrees DeGeorge.

UVA Health is focused on providing the most advanced care for amputees. Many patients and providers are unaware of new surgical techniques and innovations that can help this patient population thrive. These new tools, coupled with the UVA Health interdisciplinary approach to patient care, mean patients with devastating injuries have hope for recovery.

Chhabra says, "Other facilities in the state aren't doing this, particularly for upper limb prosthetics. Having prosthetics that are this functional — as close to the human hand as possible — is a huge advance. It wouldn't be possible without TMR and the work of all our specialists." ■

George J. Christ, PhD

Commonwealth Professor

Dr. Christ is Professor of Biomedical Engineering and Orthopaedic Surgery, Co-Director of the Center for Advanced Biomanufacturing and Past Chairman of the Division of Systems and Integrative Pharmacology of the ASPET, and Past President of the NCTERM group. He serves on the Executive Committee of the Division for Integrative Systems, Translational and Clinical Pharmacology of ASPET, is a member of the Regenerative Rehabilitation Consortium Leadership Council, and serves on the Leadership Advisory Council for ARMI/BioFabUSA. He received the ASPET Ray Fuller Award and Lecture, serves on the Editorial Board of five journals, is an ad-hoc reviewer for two dozen others, has authored over 225 scientific publications and is co-editor of a books on integrative smooth muscle physiology and regenerative pharmacology. He has served on committees related to his expertise in muscle physiology, and on NIH study sections in NIDDK, NICHD, NCRR, NAIAD, NIAMS and NHLBI. He has chaired working groups for NIH and WHO and is co-inventor on more than 26 patents . Dr. Christ is spearheading several programs to develop novel regenerative medicine treatments for orthopaedic patients(volumetric muscle loss injuries). He leads a DOD-funded multi-institutional program for development of a TEMR technology platform for the treatment of Wounded Warriors, and collaborates in NIH and DOD funded translational effort as part of the C-DOCTOR consortium. Funding from the DOD and Keratin Biosciences supports evaluation of proprietary hydrogel for the treatment of lower extremity traumatic injuries.

Li Jin, PhD

Professor

Dr. Jin grew up in China, where she earned her PhD in tumor immunology. After relocating to the United States, she completed her postdoctoral training at the University of Virginia and later embarked on a career in Orthopaedic Surgery. Collaborating with Dr. Joshua Li, her research focuses on understanding the role of immune cells in the progression of disc degeneration and developing effective therapies to alleviate back and leg pain caused by this condition. Additionally, she is passionate about creating targeted therapies for osteoarthritis.

Outside of her professional work, Dr. Jin enjoys spending time with family and friends, hiking, and reading.

Wendy Novicoff, PhD

Professor

Wendy Novicoff, PhD, is a Professor of Orthopaedic Surgery and Public Health Sciences at the University of Virginia School of Medicine and serves as the Director of Clinical Trials for Orthopaedic Surgery. She grew up in Omaha, Nebraska, and came to the East Coast for college, receiving her undergraduate degree at Duke University and her graduate degrees from the University of Virginia. Wendy works with many groups at the University of Virginia, including serving as Faculty for the School of Data Science, as the Education Director for the Be Safe Program (UVA's patient safety program), as the lead Evaluator for UVA's Clinical and Translational Science Award program, and as Program Director for both the Master of Science in Clinical Research and the Graduate Certificate in Public Health Sciences programs.

Wendy is very involved in local theater and serves on the Boards of the Four County Players and the Virginia Theatre Association. She also performs in several shows each year.

Drs. Jin and Li Lab Research

Shawn D. Russell, PhD

Associate Professor

Shawn D. Russell, PhD, graduated from Hampton Roads Academy and attended Virginia Tech, where he graduated with a BS in Mechanical Engineering, and a BS in Engineering Science and Mechanics. After graduation he enrolled in graduate school at the University of Virginia where he earned an MS in Biomedical Engineering, and a PhD in Mechanical Engineering.

He is currently the director of the Motion Analysis and Motor Performance Laboratory at the University of Virginia, oversees the day to day research operations of the laboratory and guides data collection and analysis. He has been conducting research using motion analysis for the last 18 years. This work has included the detection of motion events and the quantification of the kinetics and kinematics associated with tasks including; simple typically developed walking, pathological walking with and without assistive devices, scaling rock climbing walls, and predictive modeling of human movements. In addition his work is developing methods for detection, measure, and recognition of human movement in out of lab environments using state of the art IMU technology. More recently he has begun developing models and methods for the analysis of gait function in Lewis rats used in preclinical trials. These methods have enabled him to begin quantifying the effects of musculoskeletal injury and applied therapeutics on the movement function quality of their gait characteristics.

Back and leg pain are the leading causes of disability in the US, resulting in over 264 million lost workdays annually. Disc herniation and degeneration are primary contributors to back pain, yet there are currently no effective treatments to control acute pain or prevent chronic pain. Our long-term objective is to develop disease-modifying therapies to manage back and leg pain more effectively.

Our laboratory is focused on understanding the inflammatory processes involved in spinal disc disease and herniation, aiming to discover novel therapeutic and regenerative strategies to alleviate this inflammation and the resulting pain. To pursue these goals, we employ a wide range of techniques, including transgenic mouse models, organ-on-chip systems, tissue slicing, multiplex immunostaining, impedance cytometry, and single-cell RNA sequencing. These methods allow us to investigate the underlying mechanisms and develop targeted therapies for both acute and chronic pain.

We and other researchers have observed high numbers of macrophages in herniated disc tissues; however, the origins and roles of these macrophages remain unclear. To address this, we developed a disc herniation animal model that simulates human disc herniation and radiculopathy. This model enables us to examine inflammatory responses, identify biomarkers and cellular targets, and evaluate potential therapies. Using this model, we found that inflammation and oxidative stress contribute to disc herniation pathology, with neutrophils and macrophages infiltrating the disc hernia site in distinct patterns. To target inflammation locally, we developed a non-invasive nanomedicine that binds to the Formyl Peptide Receptor (FPR1) on activated neutrophils and macrophages, directing treatment to injured areas in animals.

In our recent studies with the macrophage Fas-induced apoptosis (MaFIA) transgenic mouse strain, we demonstrated that temporarily depleting macrophages during the early stages of disc herniation reduced local inflammation, decreased both pro- and anti-inflammatory macrophages, and reduced endplate ossification. Additionally, by using a novel fate-mapping mouse model to track the entry of CCR2+ monocytes and monocyte-derived macrophages into the disc hernia site, we explored the effects of CCR2 signaling on pain sensitivity, local inflammation, and

disc degeneration. Our findings suggest that CCR2+ monocytes play a crucial role in initiating and sustaining inflammation at disc hernia sites, impacting both pain sensitivity and disc degeneration. This points to a potential therapy for acute disc herniation-related pain through the inhibition of monocyte infiltration.

Collaboration is central to our work. We engage with experts across multiple disciplines, including surgeons, engineers, immunologists, molecular biologists, chemists, and neuroscientists. Over the past two years, with generous support from our department and school of medicine, we have successfully secured federal funding, earning national recognition. Our recent awards include an NIAMS R01, four R21 grants, the Coulter Award, the North American Spine Society (NASS) Basic Science award, and an OREF resident award. ■

GRANTS

NIH R01 AR078888-01A1 (Li)
02/01/2022 – 01/31/2027
Deciphering Macrophage Function in Disc Herniation

NIH R21 AR078547 (Li)
10/01/2021 – 09/30/2024
An ex vivo system to model the inflammatory microenvironment of human disc herniation

R21 AR082052-01 (Jin/Li/Miller)
05/01/2023 – 4/30/2025
Macrophage Anchoring Nanomedicine to Replace Steroids for Intra-articular Injection

R21 1AG088864-01 (Xu/Jin/Li)
08/01/2024 – 7/31/2026
A soft electronics-enabled smart microneedle patch for neck pain management

OREF resident grant (Wang)
07/01/2022 – 05/31/2023
Modulation of macrophages on pathogenesis of degenerative disc disease

Coulter Foundation Grant (Li)
10/01/2022 – 9/30/2023
Smart pain patch: Wireless sensors controlled pain drug delivery

Researcher Highlight Q&A:

Joshua Li, MD, Targeted Therapy for Spinal Disc Herniation

Xudong Joshua Li, MD, PhD, is a musculoskeletal researcher and the director of UVA Health's orthopaedic spine research, with dual appointments as a professor in orthopaedics and biomedical engineering. He is also the director of UVA Health's orthopaedic spine fellowship program.

Work in Li's lab focuses on a wide range of spinal conditions and procedures, such as complex spine deformities, degenerative disc disorders, tumors and metastatic disease, trauma, minimally invasive and robotic surgery, and artificial disc replacements.

His research interests include intervertebral disc biology, cervical spinal surgery, scoliosis treatment, and clinical outcomes and epidemiology related to spinal surgery.

See Li's selected publications. Below, Li discusses his work and answers our Researcher Highlight questions:

WHAT ARE YOU WORKING ON RIGHT NOW?

I am currently developing a targeted therapy for disc herniation. We're using a short peptide that binds to a cell membrane marker expressed by activated macrophages around the herniation site. This peptide is linked to a nanoparticle with potent anti-inflammatory and antioxidative properties.

The goal is to enable nurses to administer this compound via peripheral vein injection to reduce inflammation around the disc herniation site.

WHAT ARE THE MOST INTRIGUING POTENTIAL CLINICAL APPLICATIONS OF YOUR WORK?

Our work aims to simplify the treatment of disc herniation. Instead of the traditional approach of epidural steroid injections performed by physicians in a procedure room, our targeted therapy (if successful) could allow for pain relief through a straightforward peripheral vein injection.

WHAT RECENT DISCOVERY/PAPER/PRESENTATION HAS IMPACTED THE WAY YOU THINK?

Our recent discovery of the peptide-nanoparticle combination has been instrumental in shaping our research into targeted therapy for disc herniation.

WHAT MADE YOU CHOOSE UVA HEALTH AS THE PLACE TO DO YOUR RESEARCH?

I chose UVA Health for my research because our laboratory has received over 6 million dollars in support from the NIH and UVA Health, allowing us to conduct cutting-edge research in this field.

WHAT DO YOU WISH MORE PEOPLE KNEW ABOUT YOUR AREA OF RESEARCH?

I want people to understand that our translational research has the potential to significantly improve the lives of patients with disc herniation, reducing their suffering and offering a more accessible treatment option.

HOW DID YOU BECOME INTERESTED IN YOUR AREA OF RESEARCH?

My passion for patient care drives my research into spine-related issues. Seeing patients at UVA Health's Orthopaedic Center endure prolonged suffering before receiving epidural steroid injections motivated me to explore innovative solutions for their pain relief. ■

PUBLICATIONS

Xie W, Xing Y, **Xiao L**, Zhang P, Oh R, Zhang Y, Yu X, He, Y, Oh E, Ramasubramanian M, Wang Y, **Jin L**, Oberhozler J, Li X. Intervertebral disc-on-a-Chip^{MF}: a new model for mouse disc culture via integrating mechanical loading and dynamic media flow. *Advanced Materials Technologie*s. https://doi.org/10.1002/admt.202300606. **Selected for front cover.**

Biswas R, Manley B, **Xiao L**, Lee K, **Jin L**, **Li X**, Zhang J. ROS Scavenging Capacity of Functional Fullerenes in Solution and in Macrophage Cells. *ACS Applied Nano Materials*.2024,7(15):18036-18044.

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Francis H. Shen, MD

Warren G. Stamp Endowed Professor

Dr. Francis H. Shen is the Warren G. Stamp Endowed Professor of Orthopaedic Surgery, Professor of Pediatrics, head of the Orthopaedic Division of Spine, and Co-Director of the Spine Center at UVA. He also serves as Vice Chair for Faculty Affairs in the department.

Dr. Shen earned his biomedical engineering degree from the University of Michigan and completed his MD, Orthopaedic Surgery residency, and Orthopaedic Research Fellowship at UVA. He further specialized with a Spine Surgery Fellowship at Rush University and Pediatric Spinal Deformity training at Shriners Hospitals for Children in Chicago. He was also an SRS and NASS Traveling Fellow.

Dr. Shen's expertise includes managing degenerative conditions, spinal deformities, trauma, tumors, and infections. He specializes in minimally invasive, robotic-assisted, and image-guided spine surgeries, performing UVA's first robotic-assisted spine procedures.

Recognized as a Top Doctor by *US News & World Report* and *Castle Connolly*, Dr. Shen's innovative techniques are widely published. His research focuses on using tissue engineering to improve patient care.

Nationally, he directs the AAOS Board Review Course, serves as a Board Examiner for the American Board of Orthopaedic Surgeons, and is on editorial boards for *The Spine Journal*, *SPINE*, *European Spine Journal*, and *SpineLine*. Internationally, he has served on the AOSpine Foundation Board and contributed to the International Meeting on Advanced Spine Techniques, advancing spine care globally.

Adam L. Shimer, MD

Professor

Dr. Adam L. Shimer is a Professor of Orthopaedic Spine Surgery at the University of Virginia. He was also Fellowship Director for the Orthopaedic Surgery of the Spine Fellowship from 2018–2019. Additionally, Dr. Shimer is the Spine doctor for both University of Virginia and James Madison University Athletics. Dr. Shimer's training started with college at UVA, followed by medical school at UVA and Orthopaedic Surgery residency at University of Pittsburgh Medical Center. He completed an Orthopaedic Research fellowship at UPMC focused on cellular- and gene-based therapy for intervertebral disc repair and regeneration. After his Orthopaedic Spine Fellowship at the Rothman Institute at Thomas Jefferson Hospital in Philadelphia, he joined the UVA faculty in 2009.

Dr. Shimer's practice is focused on complete care of neoplastic, infectious, traumatic, degenerative, and deformity conditions of the spine. He has extensive experience and particular interest in treating complex cervical spine pathology. His research interests include value base spine care, patient reported outcome measurements, and complications of spinal surgery.

Dr. Shimer is the Orthopaedic In-Patient Unit Medical Director. He is a member of the Cervical Spine Research Society, American Academy of Orthopaedic Surgeons, North American Spine Society, and the Virginia Orthopaedics Society.

Xudong Joshua Li, MD, PhD

Mary Muilenburg Stamp Professor
Vice Chair for Research

Dr. Li is the Mary Muilenburg Stamp Professor and Spine Fellowship Director. Dr. Li was born and grew up in China. He attended Xi'an Medical University for both his MD and PhD. He came to the United States in 1999.

Dr. Li holds dual appointments as Professor in the departments of Orthopaedic Surgery and Biomedical Engineering at UVA. He completed an Orthopaedic Surgery residency at UVA, and a comprehensive Spine Surgery fellowship at Columbia Spine Hospital with Drs. Lenke, Riew and Lehman. Dr. Li has advanced expertise in a wide range of spinal procedures from microscope-assisted cervical artificial disc replacement, to single position OLIF, to the most complex spinal reconstruction for scoliosis. His clinical interests include degenerative disorders of the cervical, thoracic, and lumbar spine (herniated disc, spinal stenosis, etc.), spinal deformities (scoliosis, kyphosis, flatback syndrome, etc.), spinal tumors, metastatic spine disease, spine trauma, minimally invasive spine surgery, robotic assisted spine surgery, and motion-sparing technology (artificial disc replacement).

Dr. Li has developed a renowned laboratory that focuses on intervertebral disc degeneration pathology and treatment with stem cells, nanotechnology, and gene therapy. He has been the recipient of over 30 grants as the Principle Investigator, including five NIH (National Institute of Health R03, R21s, and R01) grants. He serves as a committee member for the Orthopaedic Research Society (ORS), and the North American Spine Society (NASS). He has been on various grant review panels including those for the NIH, NASA, MTF, and AO-International.

Stephen D. Lockey, MD, MBA

Assistant Professor

Anuj Singla, MD

Associate Professor

Dr. Lockey is an Assistant Professor of Orthopaedic Surgery at the University of Virginia who specializes in adult spinal surgery. He received his medical degree and masters of business administration from Georgetown University, where he was inducted into the Alpha Omega Alpha Medical Honor Society and received the John N. Delahay orthopaedic surgery award, the Jesuit leadership and service award, and the award for outstanding student achievement. He remained at Georgetown University for his residency training in Orthopaedic Surgery and served as academic chief in his final year. Dr. Lockey then completed a fellowship in spine surgery at the University of Maryland/R. Adams Cowley Shock Trauma Center in Baltimore, Maryland.

In 2023, Dr. Lockey received the North American Spine Society traveling fellowship award for advanced training in minimally invasive surgery at the Rothman Institute, the Swedish Medical Center, and the Hospital for Special Surgery. He is thrilled to be at UVA and is committed to personalized patient care, education, and clinical research. Dr. Lockey has authored dozens of scientific articles and textbook chapters and is dedicated to advancing the field of spine surgery. His research interests include minimally invasive deformity correction, patient reported outcomes in spinal trauma, and neuromonitoring during lateral access spine surgery.

Dr. Singla is an Associate Professor of Orthopaedic Spine Surgery at the University of Virginia. Dr. Singla was born and grew up in India. He attended medical school and completed Orthopaedic residency training in India. Dr. Singla completed fellowships in Pediatric Spine and Orthopaedics/Neurosurgical Spine at LSU, Shiner's Hospital and UVA. He is a comprehensive spine surgeon with a current practice including both pediatric and adult spine surgery.

Dr. Singla joined UVA as a fellow in 2013 and has been part of the faculty since 2014. He is a reviewer/editorial board member for top spine journals. He is also an active member of many communities within the Scoliosis Research Society.

Dr. Singla's clinical and research interests include early onset scoliosis, fusion-less deformity correction, and patient outcomes after spinal surgeries.

ADVANCED PRACTICE PROVIDERS 2024-2025

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Lumbar Interbody Fusion-Approaches and Options

INTRODUCTION

Low back pain and lumbar degenerative spinal disorders are one of the most prevalent musculoskeletal conditions. Approximately 75% to 80% of the adult population may experience LBP at least once in their lifetime. Most common causes for back pain include disc degeneration, facet joint disorders/instability, spinal stenosis and deformity. Conservative treatment remains the first line of management including observation, physiotherapy, pain medications and injections. Surgical treatment is usually required for symptoms unresponsive to non-surgical options. Spinal decompression/decompression & fusion is required depending on the symptoms and the underlying pathology. Lumbar interbody fusion is usually combined with spinal instrumentation to stabilize and fuse the painful motion segment, restore lordosis, correct deformity, and provide indirect decompression.

Although the value and utility of interbody fusion remains questionable and controversial, rate of interbody fusion have increased significantly in last few decades. These techniques include transformational interbody fusion (TLIF), posterolateral fusion (PLF), posterolateral interbody fusion (PLIF), oblique lumbar interbody fusion (OLIF) and anterior interbody fusion (ALIF). In addition to being lower cost, techniques that involve a posterior approach (PLF, PLIF, TLIF) offer a familiar strategy to address the pathology and carry fewer surgical risks to the viscera. For these reasons, the posterior approaches are more commonly utilized compared to techniques from the front. Despite these advantages, it is important to recognize that anterior approaches provide clearer view of the vertebral body, create less damage to paraspinal muscles and vertebral ligaments, and are associated with a lower rate of nerve root injury compared to posterior techniques. Additionally, anterior approaches provide an important salvage option for revision in cases of pseudoarthrosis. The purpose of this review is to discuss the advantages and pitfalls of each technique and provide an update on current literature on respective outcomes and complications.

The ALIF is an increasingly common technique for treating symptomatic spinal stenosis, spondylolisthesis and deformity. Compared to the posterior approaches, ALIF allows for complete removal of painful discs, increased interbody column support, higher fusion rates and restoration of disc height.

ANTERIOR LUMBAR INTERBODY FUSION (ALIF)

The ALIF is an increasingly common technique for treating symptomatic spinal stenosis, spondylolisthesis and deformity. Compared to the posterior approaches, ALIF allows for complete removal of painful discs, increased interbody column support, higher fusion rates and restoration of disc height. One of the major advantages of ALIF is that it can be used in conjunction with a posterior approach or percutaneous instrumentation. Studies have demonstrated that a standalone ALIF has similar outcomes to circumferential fusion while allowing for shorter operative times and less morbidity. A prospective study of 20 adult patients who underwent ALIF for low-grade L5-S1 spondylolisthesis was performed with a mean follow up of 26.2 months. The authors found an improvement in mean Oswestry Disability Index (ODI) scores from 57 preoperatively to 30 at 6 weeks ($P < .0001$) and to 21 at final follow up. Visual Analog Scale (VAS) scores also improved from 6.5 to 2.7 after the procedure.

There are several studies that compared clinical and radiographic outcomes of ALIF versus TLIF. One investigation determined that ALIF was superior to TLIF in restoring the local disc angle and lumbar lordosis. Additionally, the patients who underwent ALIF experienced an increase in the local disc angle by 8.3° and lumbar lordosis by 6.2°, while the local disc angle decreased by 0.1° and lumbar lordosis by 2.1° in the TLIF group. Similarly, another study demonstrated that the change in disc height, segmental lordosis, and lumbar lordosis was higher in patients who underwent ALIF compared to TLIF.

TRANSFORAMINAL LUMBAR INTERBODY FUSION (TLIF)

One of the major advantages of the TLIF procedure is that the interbody fusion, nerve root decompression, slip reduction, and posterolateral stabilization can all be achieved through a single posterior incision. A study found the improvement in VAS and ODI scores are roughly the same between ALIF and TLIF. Of note, a systematic review found that estimated blood loss and operative time were less in TLIF compared to ALIF.

Radiographic parameters also improve following TLIF. With regards to reduction of the deformity, a prospective study following 17 patients undergoing TLIF for L5-S1 spondylolisthesis found a mean slip

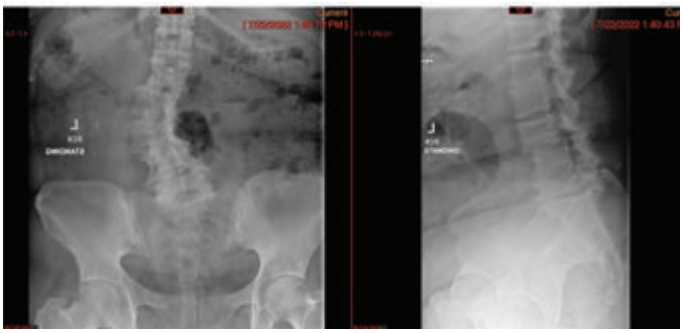

Figure 1. Preoperative radiographs.

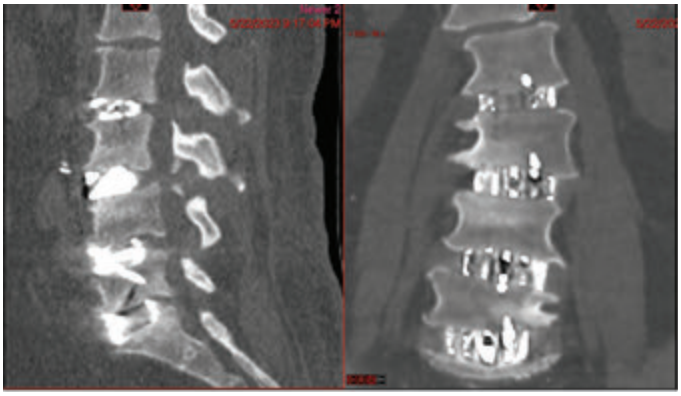

Figure 2. Intrastage CT to confirm conformity of custom cages.

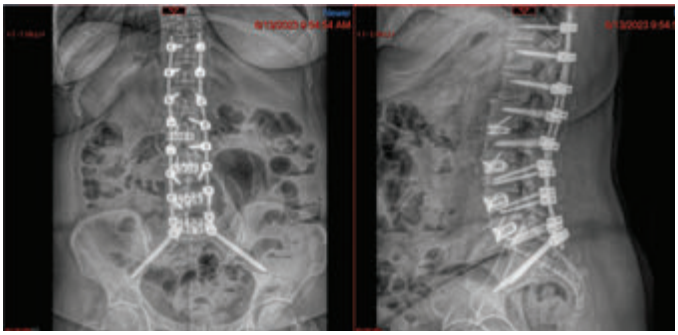

Figure 3. Postoperative radiographs.

CASE EXAMPLE

46-year-old female with history of Ehlers-Danlos Syndrome presented with worsening low back and right lower extremity pain, along with complaints of increasing difficulty with standing upright. Radiographs over previous years demonstrates significant progression of lumbar kyphoscoliosis, spondylolisthesis and sagittal malalignment. Surgical deformity correction and stabilization was achieve via a combined anterior and posterior approach using custom, 3D-printed titanium intervertebral cages.

reduction of 54% following surgery. Additionally, a case series of 24 patients showed a solid fusion in 100% and a significant increase in disc height (P = 0.003) following TLIF.22 When compared to ALIF, the anterior approach was superior in restoring disc height and lumbar lordosis at the L5-S1 level, but there were no differences in fusion rates between the two procedures.

OBLIQUE LUMBAR INTERBODY FUSION (OLIF)

The OLIF was developed with the aim of minimizing paraspinal muscle dissection and retraction. The technique uses a retroperitoneal plane to reach the spine through a corridor anterior to both the iliac crests and psoas muscle. The oblique trajectory provides for direct visualization of the disc space while avoiding psoas muscle and lumbosacral plexus. The OLIF is most commonly performed at L4-L5 and further offers the advantage of avoiding the vessel mobilization required in ALIF. One of the most common indications reported in the literature for OLIF is in the management of spondylolisthesis. Similar to ALIF, the OLIF is less insult to spinal musculature and provides for more rapid postoperative mobilization. The approach also provides for aggressive deformity correction and impressive fusion rates. However, potential risks involved with OLIF include sympathetic dysfunction and vascular injury. Lumbar plexus and psoas injury are uncommon as dissection is performed anterior to the psoas muscle, but complications do occur given the proximity.

POSTERIOR LUMBAR INTERBODY FUSION (PLIF)

One of the original methods for performing lumbar interbody fusion is PLIF. In the PLIF technique, access to the intervertebral disc is achieved posteriorly. One of the main advantages of the PLIF technique is that it is a traditional lumbar approach that the majority of spinal surgeons are comfortable performing. The posterior exposure provides direct visualization of the nerve roots without compromising blood supply to the inserted allograft. Additionally, PLIF allows for interbody height restoration and neural decompression while maintaining posterior support structures. Furthermore, similar to a TLIF, the posterior approach creates the potential for 360-degree fusion through a single incision. One downfall of PLIF is that there may be significant paraspinal iatrogenic injury associated with prolonged muscle retraction. This disadvantage may delay recovery and postoperative mobility. Other potential risks include retraction injury of nerve roots resulting in fibrosis and chronic radiculopathy.


Figure 4. Pre op frontal and lateral images showing disc collapse and deformity.


Figure 5. Post op frontal and lateral images showing disc height restoration and deformity correction.

CASE EXAMPLE

55 years old with multilevel degeneration, scoliosis, bilateral leg radiculopathy and weakness. *(continued on page 50)*

PLIF was reported to have better long-term outcomes than PLF with instrumentation in a randomized control trial (RCT) that included patients with spondylolisthesis and other degenerative lumbar disorders. However, no difference was detected in the subgroup of 43 patients with isthmic spondylolisthesis. A prospective study involving patients who received PLIF versus PLF showed nearly identical results of ODI scores, reported pain scores and postoperative complications. In a systematic review, nine studies showed that PLIF resulted in higher fusion rates when compared to PLF ($P = 0.005$) as well as shorter operation times. However, there was no difference in postoperative VAS back scores, blood loss, complication rates or ODI scores.

EXTREME LATERAL LIF (LLIF/XLIF)

Extreme lateral approach is a safe and effective alternative to the anterior or posterior approaches to lumbar fusion, avoiding the large anterior vessels and posterior structures. The access is through the obliquus externus and internus abdominis as well as the transversus abdominis. It allows for access to the anterior and middle columns of the lumbar spine via a small incision (approximately 3–4 cm) and relatively low blood loss. In the lateral position, gravity clears most of the abdominal content away from the field. The lateral approach allows relatively easy access to multiple levels from T11 to L4. This technique has a limitation of accessing the commonly involved L5-S1 level as iliac crest obstructs the approach. Lumbar plexus injury with resultant thigh weakness/ numbness as well as Genitofemoral nerve injuries are other common risks with this approach.

PRONE LATERAL LUMBAR INTERBODY FUSION

The single-position prone transpsoas approach is a technique that allows surgeons to access both the anterior and posterior aspects of the spine, bypassing the need for intraoperative repositioning and therefore optimizing efficiency. Following the posterior instrumentation, a skin incision for LLIF is made in the cephalocaudal direction, orthogonal to the disc space for decompression and fusion. This relatively newer approach is considered to provide advantages of decreased risks of vascular injury, visceral injury compared to OLIF/ALIF approach and also lesser risk of dural tear, and perioperative infection compared to posterior approaches.

CONCLUSION

Lumbar spinal degeneration is a common source of back and radicular pain and in severe cases can cause canal compromise. Surgery is an effective intervention in refractory pain or if neurologic deficits are present. There are several surgical options that vary widely in their approach, and while the literature has elucidated specific advantages and pitfalls in each case, there appears to be little evidence to support choosing one technique over another. The number of studies that address this question is small, and given the variety of techniques further investigation is needed to demonstrate what, if any, technique is superior. ■

CASE EXAMPLE – *continued from page 49*

Figure 6. OLIF L2-5 pre and postop of 74 year old female who had history of L4/5 grade 1 spondylolisthesis, L2/3 spondylosis and L2-5 stenosis.

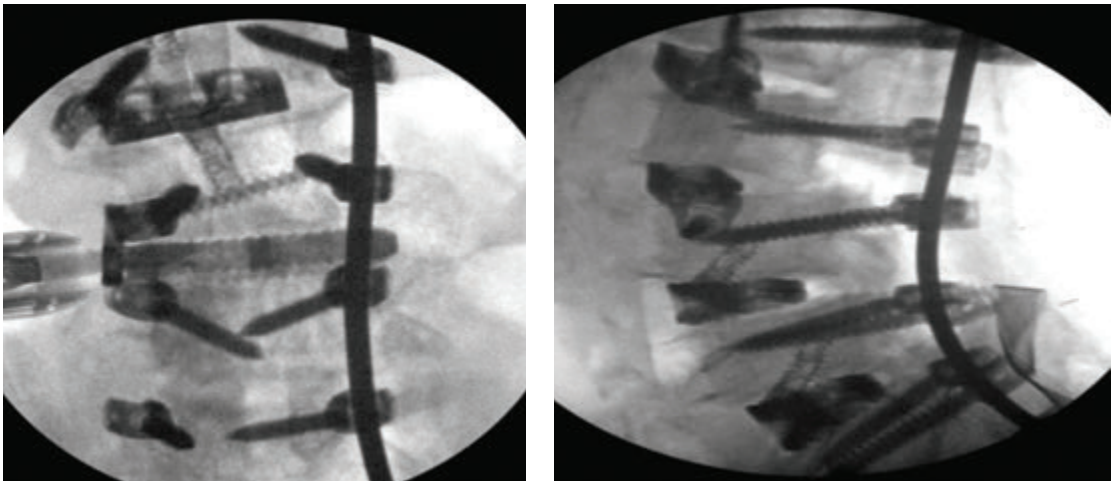

Figure 7. Intra-operative images showing prone lateral interbody spacer palcement at L3-4 and L2-L3.

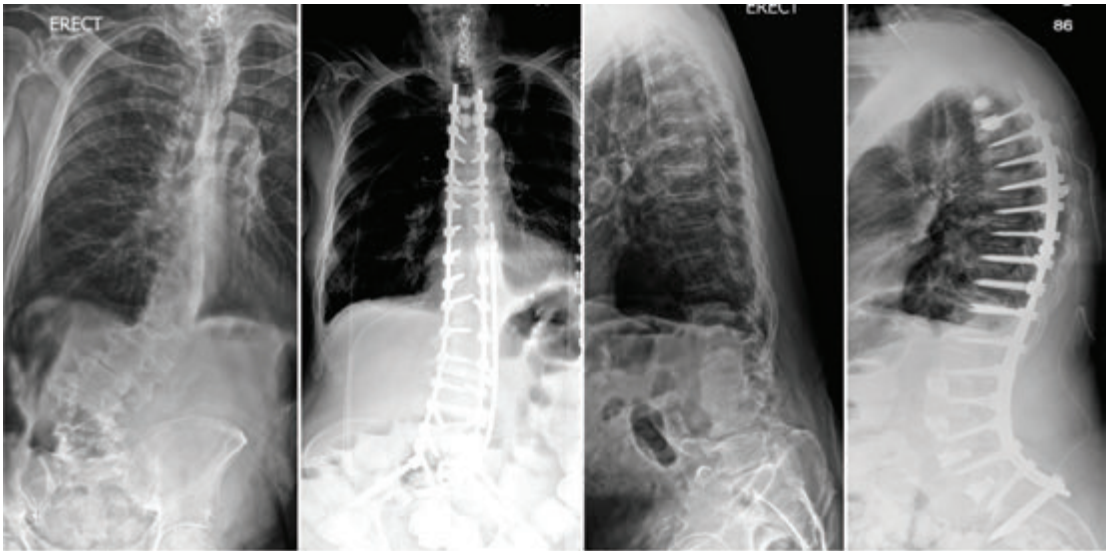

Figure 8. Pre-operative and post-operative images showing deformity correction utilizing posterior screws, ALIF at L4-L5/L5-S1 and prone lateral interbody fusion at L2-L3 and L3-L4.

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David R. Diduch, MD

Allen F. Voshell Professor

Dr. Diduch is the Allen F. Voshell Professor, Sports Medicine Division Head, and former Vice Chair of the Department. Dr. Diduch is the team physician for UVA Athletics and has primary coverage for men's basketball and women's soccer. Dr. Diduch's training started at UNC followed by medical school at Harvard and Orthopaedic residency at UVA. After his Sports fellowship at the Insall-Scott-Kelly Institute, he joined the UVA faculty in 1995. His practice is split between knee and shoulder surgery and the care of injured athletes.

Dr. Diduch has extensive experience with treating complex patella instability problems with cutting edge techniques, including tibial tubercle osteotomy, MPFL reconstruction, and limb realignment. Dr. Diduch is one of very few surgeons in the US performing deepening trochleoplasty procedures for trochlear dysplasia and patella instability. His other research interests include post ACL surgery return to play decision making, articular cartilage and meniscal repair, and novel knee unloading devices for early arthritis.

Dr. Diduch has received the UVA Master Clinician Award, served as Chair of numerous AOSSM committees as well as the Council of Delegates, served as President of VOS, and has been inducted into the Herodicus Society. His recent honors include receiving the 2021 Charles W. Miller Resident Teaching Award, the 2020 UVA Research Collaboration Award, and he has been consistently named in both "America's Top Doctors," and "Best Doctors in America."

Stephen F. Brockmeier, MD

S. Ward Cascells Professor

Dr. Brockmeier is Professor, co-Director of the UVA Sports Medicine Fellowship and Head Team Physician for UVA Athletics, with primary coverage as the Head Team Physician for UVA Football, Men's Soccer, and Men's Lacrosse. Dr. Brockmeier completed his undergraduate degree at UVA, medical school and Orthopaedic Surgery residency at Georgetown University. Dr. Brockmeier spent a year at the renowned Hospital for Special Surgery where he completed a fellowship in Sports Medicine and Shoulder Reconstructive Surgery at the Hospital for Special Surgery.

Dr. Brockmeier spent three years in practice in Charlotte, NC, where he was the team physician for the NBA Charlotte Bobcats. His current practice focuses on sports medicine, knee and shoulder arthroscopy and reconstructive surgery. He subspecializes in knee ligament, meniscus, and cartilage repair surgery, ACL reconstruction, and has become a regional expert in complex shoulder reconstruction, management of shoulder instability, rotator cuff surgery, total shoulder arthroplasty and reverse shoulder arthroplasty.

Dr. Brockmeier researches shoulder instability in the contact athlete, return to play strategies after ACL reconstruction, biologic options for rotator cuff repair, and cutting edge and novel techniques in shoulder replacement surgery. He received the UVA Deans' Award for Clinical Excellence, was selected for the AOSSM Traveling Fellowship to Europe, and is Chair of the Education Committee for AOSSM, and Editor for the Video Journal of Sports Medicine.

Dr. Brockmeier is an active member of ASES, is the current President of ACESS, and was inducted into the Herodicus Society in 2019. He is an active member of AAOS, AOSSM, AANA, and MASES.

Matthew Deasey, MD

Assistant Professor

Dr. Deasey is an Assistant Professor of Orthopaedic Surgery in the Division of Sports Medicine at the University of Virginia. His clinical and academic interests span the breadth of Sports Medicine, from joint preserving osteotomies about the knee to shoulder arthroplasty and complex knee arthroscopy. Dr. Deasey attended UVA, where he fulfilled his dream of playing college basketball as a member of the Men's Varsity Basketball team as an Academic All-ACC performer. His academic and athletic achievement, along with his commitment to the Charlottesville community earned him the privilege of living on the University's historic Lawn in a room endowed for the top pre-medical student. Dr Deasey attended medical school at Temple University, where he was a member of the Gold Humanism Honor Society and the Alpha Omega Honor Society. He returned to Charlottesville for residency at UVA. Dr. Deasey remains the first and only resident to receive the U-Team Award, a health-system wide award given to recognize exemplary patient care. The Emergency Department named him the Consult Resident of the Year. He was named the UVA Orthopaedics Junior Resident of the Year and later: Chief Orthopaedic Resident of the Year.

Prior to coming back to UVA as a faculty member in 2024, Dr. Deasey completed fellowship training at the world renowned Steadman Clinic in Vail, CO. His commitment to education shone through; he received the Outstanding Fellow Educator Award. He then spent a year in practice at the Rothman Institute, but jumped at the opportunity to return to UVA to join the Sports Division.

F. Winston Gwathmey, MD

Associate Professor, Vice Chair for Education & Residency Program Director

Dr. Gwathmey is the son of an Orthopaedic Hand Surgeon and grew up in Norfolk, Virginia. He received his undergraduate degree at the University of Virginia (UVA). His medical degree came from Eastern Virginia Medical School. Dr. Gwathmey matched into Orthopaedic Surgery residency at UVA. Following residency, he completed a Sports Medicine and Shoulder fellowship in Boston at Massachusetts General Hospital. He also pursued additional hip arthroscopy training with Dr. Thomas Byrd in Nashville, Tennessee.

Dr. Gwathmey returned to UVA on faculty in 2013 and currently is an Associate Professor in the Division of Sports Medicine with a special interest in arthroscopic techniques around the hip. He established the hip arthroscopy program at UVA and currently performs upwards of 200 hip arthroscopic surgeries per year. He is the Orthopaedic Surgery Residency Program Director and is active in the medical student curriculum. He has won multiple teaching awards including the Mulholland Teaching award, the Charles W. Miller Resident Teaching award, and the Dean's Award for Excellence in Medical Student Teaching.

Dr. Gwathmey is the Medical Director for the Sports Medicine Clinic. He is also one of the team physicians for both UVA and James Madison University (JMU). He is active in the American Orthopaedic Society for Sports Medicine (AOSSM), and the Arthroscopy Association of North American (AANA), and serves as faculty at annual meetings and in surgical skills courses throughout the year.

Charles A. Su, MD, PhD

Assistant Professor

Dr. Su graduated summa cum laude with honors from Case Western Reserve University with a BS in biology, BA in psychology, and a minor in chemistry. During his undergraduate years, he received a Howard Hughes medical institute research grant for his work in hematology. After college, he was accepted into the combined MD/PhD Medical Scientist Training Program at Case Western. Here, he completed his PhD thesis in transplantation immunology at the Cleveland Clinic. He performed cardiac transplants in a mouse model and evaluated methods to prolong graft survival. He was recognized for this work with a Young Investigator Award from the American Transplant Congress. Following residency, Dr. Su completed his orthopedic sports fellowship training at the world-renowned Steadman Clinic/Steadman Philippon Research Institute in Vail, Colorado. There he was able to provide care for the United States Olympic Ski and Snowboard team and train with some of the top thought leaders in orthopedic sports.

During his fellowship year, he also won the top Clinical Science Fellow Award for outstanding research as well as the Outstanding Fellow Teaching Award. His current research interests include clinical outcomes, biologic therapies, and the natural history of hip impingement and development of osteoarthritis.

Dr. Su specializes in hip, shoulder, and knee surgery and serves as the team physician for James Madison University athletics and Monticello High School.

Brian C. Werner, MD

Associate Professor

Brian Werner, MD is an Associate Professor in the Department of Orthopaedic Surgery, and Director of the Sports Medicine fellowship. He completed a fellowship in Sports Medicine and Shoulder Surgery at the Hospital for Special Surgery, where he was a team physician for the New York Giants and the New York Red Bulls. Dr. Werner currently serves as the Head Orthopaedic Team Physician for James Madison University athletics, where he provides primary coverage for all sports, including the 2016 FCS national championship football team, men's and women's basketball, men's and women's soccer and the 2018 national champion women's lacrosse team among others. Board certified in Orthopaedic Surgery with subspecialty certification in Sports Medicine, he specializes in Sports Medicine and Shoulder Surgery. This includes both arthroscopic and open reconstructive surgery of the shoulder and knee. He focuses on all sports and athletic injuries, and has a particular clinical interest in shoulder replacement and ligament reconstruction of the knee.

Dr. Werner has a significant interest in both clinical and basic science research, has published over 325 peer-reviewed papers on a wide variety of orthopaedic topics and has presented his research both regionally and nationally over 450 times. He has won numerous national awards for his research. His current research interests include clinical outcomes after knee and shoulder surgery, biomechanical studies in the knee and shoulder, shoulder arthroplasty and cartilage injury and repair.

Dr. Werner has numerous national leadership roles, and serves on the fellowship committee for the American Orthopaedic Society for Sports Medicine, education and assessments committee for the American Academy of Orthopaedic Surgeons, and the research committee for the American Shoulder and Elbow Surgeons society.

Outside of Orthopaedics, Dr. Werner enjoys spending time with his wife and two boys, Benjamin and Wyatt. He is an avid runner, having run numerous marathons and continues to train for both marathon and half marathon distances. He also enjoys golf.

ADVANCED PRACTICE PROVIDERS 2024-2025

KIMBERLY HIGGINBOTHAM, PA-C

G.M. PUGH, MS, PA-C, ATC, LRT

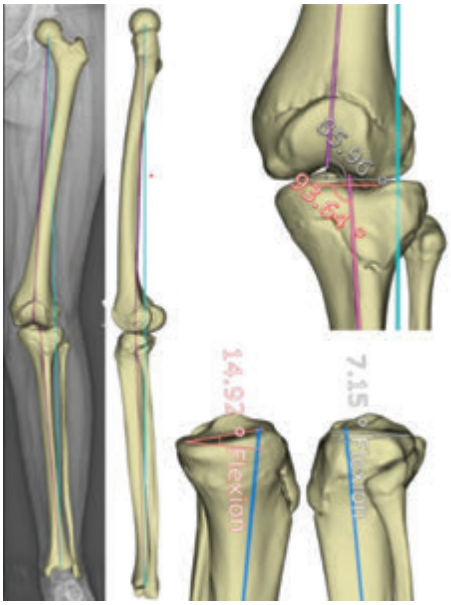
What's Old is New Again

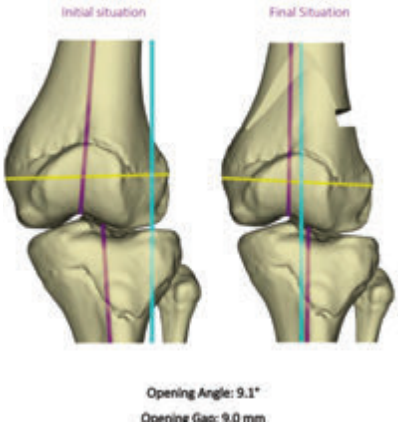
The UVA Sports Medicine Division remains on the forefront of knee joint preservation

by Matt Deasey, MD

The UVA Sports Medicine Division remains on the forefront of knee joint preservation. Our cartilage restoration armamentarium has evolved to include osteochondral autograft (OATs), ostechondral allograft (OCA), and matrix assisted chondrocyte implantation (MACI). In order to optimize the biomechanical enviroment in patients with unicompatemental chondrosis, we modify the weight-bearing axis through the lower extremity to off-load the affected compartment with high tibial (HTO) and distal femoral osteotomies (DFO).

We have embraced the scanogram, which allows us to assess our patients' mechanical axes. Our philosophy is that 'long-standing problems get long standing films.' While HTO and DFO are by no means novel procedures, we have begun to implement patient specific osteotomy protocols to improve the accuracy of our corections with reduce fluoroscopy time. In addition to treating tibiofemoral chondral issues, our DFOs provide adjunctive treatment to our already internationally renowned patellofemoral service, led by Dr. Diduch. This has given our residents and fellows fantastic exposure to the cutting edge of knee joint preservation. ■





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David B. Weiss, MD

Professor, Division Head

Gregory Domson, MD

Professor

Michael M. Hadeed, MD

Assistant Professor

Dr. Weiss is a Professor and Division Head for Trauma and Oncology in the Department of Orthopaedic Surgery. He attended Johns Hopkins University as an undergraduate with a major in Biomedical Engineering in order to facilitate his future career as an Orthopaedic Trauma surgeon involved with re-engineering humans instead of bridges and machines. Dr. Weiss attended Georgetown University for medical school and completed a surgical internship at the University of Michigan. He then spent three years as an active duty Air Force flight surgeon stationed at McConnell AFB in Wichita, KS.

After serving in the Air Force, Dr. Weiss returned to the University of Michigan to finish Orthopaedic Surgery residency and then completed a one year fellowship in Orthopaedic Trauma at Harborview Hospital in Seattle, WA. He spent the next five years as the Director of Orthopaedic Trauma at St Joseph Mercy Hospital in Ann Arbor, MI and joined the University of Virginia in 2010 as the Division Head of Orthopaedic Trauma. His areas of clinical focus include complex fractures of the proximal and distal tibia and malformed or unhealed fractures of the hips, legs and feet.

Dr. Weiss is heavily involved with education of medical students and orthopaedic residents at the local and national level with our specialty organization — the Orthopaedic Trauma Association, the Academy of Orthopaedic Surgeons, and the AOTrauma foundation. He has served on the education and patient safety committees for these organizations, has been honored with several education and teaching awards.

Dr. Domson specializes in orthopaedic oncology, caring for patients from all over the state of Virginia with benign and malignant, bone and soft tissue tumors of the extremities and pelvis. He treats both pediatric and adult patients. While he works one day a week at UVA and has for 10 years, he lives in Richmond and works full time at VCU as a musculoskeletal tumor specialist as well as Program Director for the Orthopaedic Residency Program.

Dr. Domson was an Echols Scholar at UVA, graduating in 1996, before moving on to Eastern Virginia Medical School, where he graduated in 2000. He finished his orthopaedic residency at VCU in 2005 and completed a musculoskeletal tumor fellowship at the University of Florida in 2006. He received a master's in adult education from VCU in 2013, and most of his current research focuses on resident training and education. He is a fellow of the American Academy of Orthopaedics, a fellow of the American Orthopaedic Association, and a member of the Musculoskeletal Tumor Society.

Dr. Hadeed was born and raised in Virginia. He went to UVA for undergrad and fell in love with the people and town of Charlottesville. He stayed at UVA for medical school and orthopaedic surgery residency where he won multiple awards for research and clinical care including the chief resident of the year award.

After residency he moved to Denver for additional training in complex Orthopaedic trauma. In Denver, he trained under experts from across the world expanding his knowledge and refining his techniques.

He then returned to Charlottesville and the University of Virginia with his wife and three daughters. He specializes in complex trauma of the arm, leg and pelvis. Clinically, his focus is to individualize treatment plans to each patient's specific goals. His research is focused on how stress affects fracture healing.

ADVANCED PRACTICE PROVIDERS 2024-2025

LARA MYERS, MSN, RN, ACNP-BC

JACQUELYN WILSON, MHSc, PA-C

CLAIRE McMAHON, FNP-C

Max Hoggard, MD

Assistant Professor

Dr. Hoggard is originally from Florida where he graduated with a bachelor's degree in biology from the University of West Florida. He obtained his medical degree from the University of South Florida in Tampa. His orthopaedic surgery training was completed at the University of Virginia. Additionally, he completed fellowship training in orthopaedic trauma at Prisma Health in Greenville, SC and musculoskeletal oncology at the University of Florida in Gainesville. Dr. Hoggard returned to UVA as Assistant Professor of Orthopaedic Trauma and Oncology in 2023.

Seth R. Yarboro, MD

Associate Professor and Vice Chair for Quality and Performance Improvement

Dr. Yarboro is an orthopedic surgeon who specializes in fracture care of both acute and chronic injuries, as well as pathology involving soft tissue and infection. His approach to surgery utilizes both traditional as well as minimally invasive and computer-assisted surgical techniques.

Dr. Yarboro attended medical school and completed his orthopedic residency training at University of North Carolina at Chapel Hill. He completed orthopedic trauma fellowships at UNC Hospital, an AOTrauma Fellowship in Hannover, Germany, and a fellowship in orthopedic trauma and computer-assisted surgery in Ulm, Germany.

Dr. Yarboro is an active researcher with a variety of interests, including infection treatment and prevention, ankle syndesmosis injuries, intraoperative advanced imaging, and quality outcomes after surgery. He is also involved with the AO Technical Congress (AOTK) in their Computer-assisted and Image-guided Expert Group (CIEG), where technology is used to advance the field of surgery.

Dr. Yarboro is our first Vice Chair for Quality and Performance Improvement. As Director of Quality over the last several years, he has worked tirelessly to improve our clinical documentation and quality reporting. This work involves organizing regular conferences for case review and education, optimizing quality measures and reporting, and representing the department within the institution regarding quality-related policy. He is responsible for yearly department provider practice evaluations and credentialing of our faculty and APPs.

He has specific interest in orthopedic education, working routinely with residents in conferences and surgical training. He also works regularly with OTA, participating in their resident fracture course. Additionally, he has served as program chair for educational meetings ranging from the local to national level.

METRC Update

David Weiss, MD

University of Virginia,
Department of Orthopaedic Surgery
Charlottesville, VA

Research is an important component of medical care at the University of Virginia and the Orthopaedic Trauma Division has been heavily involved in clinical research with a multi-center organization called METRC: Major Extremity Trauma Research (and Rehabilitation) Consortium. METRC was the brainchild of Drs. Michael Bosse and Ellen Mackenzie who foresaw the need to study difficult/complex injuries at a large scale. This came out of the work they had done on the LEAP study which looked at >600 patients who had sustained severe trauma to their lower legs and some of whom underwent limb salvage and some of whom underwent amputation. The study provided great insight into decision making for limb salvage and amputation and was a source of significant publications over many years as the cohort was followed and reevaluated multiple times. Drs. Bosse and Mackenzie thought that a group of civilian and military trauma centers could work together to study difficult injuries that may not happen very frequently but can produce severe disability. Congress provided funding for the original METRC study group which was composed of 15 centers. Since then, the group has been expanded with both core centers which tend to be large urban trauma centers and satellite centers which tend to be smaller or more rural trauma centers which do not have the same vol-

ume but can still participate by recruiting patients and participating in study design and execution.

Currently METRC involves >70 centers throughout the United States which are a mix of civilian and military. UVA has been a METRC satellite center since 2012 and has participated in multiple METRC studies. Examples of previous studies include BIOBURDEN which sampled the bacterial milieu from severe open tibia fractures that were treated with multiple debridements. The samples were sent to a central lab and were evaluated using mRNA technology to identify the bacteria present in the wounds at the time of their final closure. This has provided valuable insight into bacterial growth on wounds, particularly those that occur in the hospital and often the ICU setting. Work continues on this topic with the current SEXTANT study, which looks to direct antibiotics against specific organisms identified by the microbiome at a particular center. The UVA Ortho Trauma Division was a participant in BIOBURDEN and is a participant in the SEXTANT study as well. Other interesting studies of note include the VANCO trial which studied the effects of placing intra wound vancomycin powder into fractures at high risk for infection and was able to show a significant decrease in Gram positive infections by using this powder. The second iteration of the study uses a combination of vancomycin and tobramycin powder in the study group versus vancomycin powder alone in the control group and UVA is also a participant in this (TOBRA) study.

METRC: Major Extremity Trauma Research (and Rehabilitation) Consortium — the brainchild of **Drs. Michael Bosse** and **Ellen Mackenzie** who foresaw the need to study difficult/complex injuries at a large scale.

The concept of personalized medicine is a hot topic these days and in the field of Orthopaedics; one of the ways we are looking to personalize medicine is through the use of biomarkers. These are proteins that the body secretes and can be detected in the bloodstream during different types of response to fractures or injuries. Since humeral shaft fractures can often be treated non-operatively, they provide an opportunity to study biomarker production through the course of healing for those patients who go on to either delayed or non-united fractures, we can evaluate whether the biomarker profile demonstrated this prior to making a radiologic or clinical determination of a non-union. This could lead to significantly faster decision trees on surgical intervention or perhaps lead to other areas when a patient is identified as having poor biomarkers in a certain area, there could potentially be medications, supplements, or other options to improve their biomarker profile and promote healing. The UNION BIOMARKERS study is tracking patients with humeral shaft fractures and blood draws are done at each routine follow-up visit. The biomarker profile of patients who heal as well as the patients who do not heal and are going to have surgical treatment will be studied and hopefully will give us information concerning patterns of proteins which can be identified as being pro-healing or potentially see a lack of healing or certain biomarkers which suggest healing will not occur. This study is ongoing and results are anticipated within the next one to two years. Other previous studies UVA has participated include the OUTLET study which looked at limb salvage either patients who had chosen to have a limb salvage pathway or an amputation pathway and studied functional testing one year to 18 months after their definitive treatments. The results of the study indicated that patients who had severe hind foot injuries often did better with amputations. The PO versus IV (POvIV) study looked at a comparison between IV antibiotics and PO antibiotics for fracture related infections and showed that PO antibiotics were at least as effective as IV antibiotics in the vast majority of cases. This has led to a change in practice for certain types of infections. The WEIGHT BEARING study evaluated early versus delayed weight bearing in operatively treated bimalleolar ankle fractures and Schatzker 1 tibial plateau fractures. The results of the study are still being evaluated. However, early evidence suggest that earlier weight bearing may be safe and most patient populations that have adequate fixation.

The REPAIR study looked at use of Blood Flow Restriction therapy for femur fractures treated with intramedullary nailing. In collaboration with our physical therapy lab in the Department of Kinesiology patients were randomized into standard physical therapy or therapy performed with a blood flow restriction tourniquet in place for a specific set of exercises to use oxygen deprivation as a tool to increase the speed and strength of muscle recovery. Results are still being analyzed but early data are promising.

The ALTER G study examined the use of an Alter-G treadmill which is a unique therapy treadmill that allows for partial weight bearing during walking or running exercising to evaluate the potential benefits of earlier activity on operatively treated, intra-articular fractures of the tibial plateau or pilon so as to avoid some of the disability

associated with a prolonged period of non or touch down weight bearing after these injuries. Initial results are encouraging.

When METRC was first formed the wars in Iraq and Afghanistan were ongoing and producing multiple casualties daily. The studies thus focused on acute injuries and treatments. While the wars have effectively concluded, there are significant number of service members left with debilitating, long-term musculoskeletal injuries and so the more recent focus of METRC has been towards rehabilitation as well as mental health recognizing that it is a significant component of many injuries, either pre-existing or related to the dysfunction and disability that often accompanies major injuries. Current study directions include looking at improved ways to deliver mental health treatments, particularly to a trauma population who is often somewhat mobile as well as far flung and not necessarily close to the center they are treated at. Studies looking at the use of technology, support groups online and online mental health treatment are being formulated as some early pilot studies have showed some success with these techniques. To date, METRC has enrolled >30 thousand patients in their studies and has a tremendous database of patients who have been successfully cared for at a number of METRC centers worldwide. Many studies are now being published using these databases and looking at different aspects of care and so an entire generation of clinician scientists will be helped currently and in the future as well as providing significant benefits to our patient population.

METRC continues to generate funding from Congress and allows centers to work collaboratively for the care of the injured patients. UVA is proud to be a participant in these METRC trials and will continue to do so moving forward. ■

Custom 3D printed implant for tough trauma problems

Custom 3D printed implants have become more common in recent years. As technology improves, cost and turnaround time are decreasing. However, for most trauma cases, there still is not enough time to get a custom implant made, and there is little evidence to guide their optimal use. Yet some difficult nonunions may benefit from this emerging technology.

PROBLEM FRACTURES

Nonunions can impact a significant number of patients–up to 100,000 per year in the United States alone. The cost to the health system and the patients is significant. Despite all of our diagnostic and therapeutic techniques, we continue to have recalcitrant nonunions that are difficult to heal. These are circumstances where basic principles have been correctly applied (sometimes many times) and despite no evidence of infection, malnutrition, metabolic abnormalities or other causative factors, nonunions persist. These problems are likely due to poorly understood mechanical or biological issues.

DISTAL FEMUR

Certain anatomic regions are known for problematic healing–the distal femur is one of those areas. There have been a significant amount of resources devoted to understanding the optimal treatment strategies for this area, and research remains ongoing. In particular, interprosthetic femur fractures have a particularly high complication rate. There are relatively fewer fixation options, which limit the treating surgeon and often can dictate the ultimate construct chosen. Furthermore, the presence of a stemmed component and cement mantle adds a variable to the overall mechanical forces at a fracture site. ■

CASE REPORT

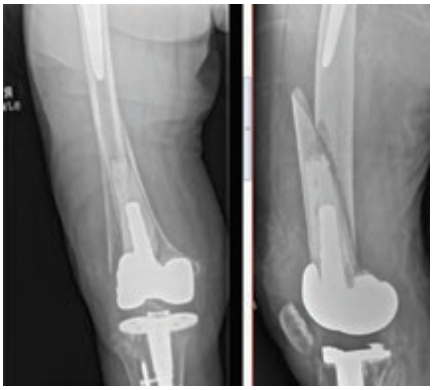

Figure 1. A 60-year-old female presented with acute right leg pain after a GLF. She had several previous orthopaedic surgeries including revision total hip and total knee replacements on the right side. She was diagnosed with an interprosthetic femur fracture.

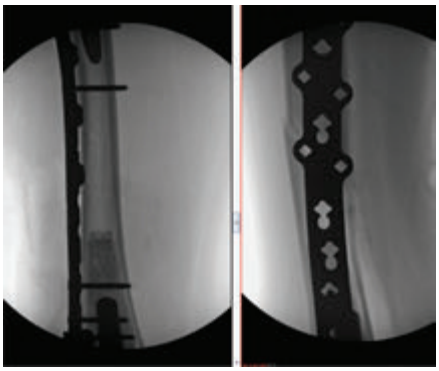

Figure 2. She was taken to the operating room the next day and underwent an ORIF with a bridge plate construct. **NOTE:** ***Case Report continues on page 60.***

CASE REPORT – ***continued from page 59***

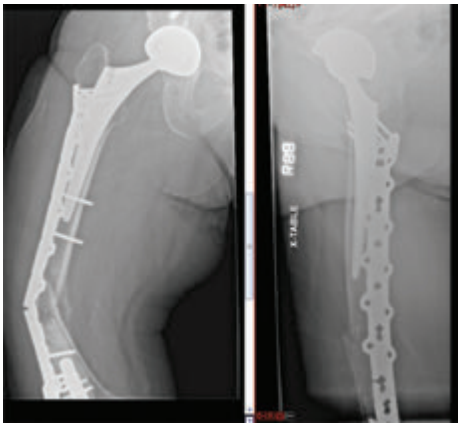

Figure 3. She returned to clinic 2 months postoperatively with a new clinical deformity. XRs showed failure of the bridge construct with varus deformity through the fracture.

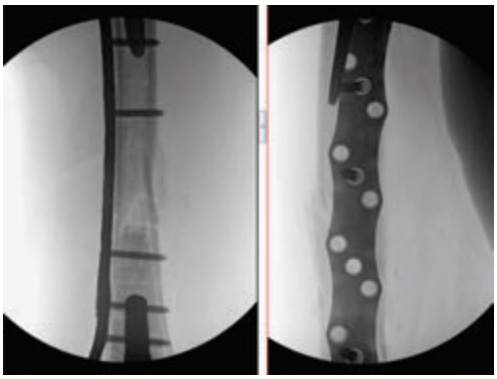

Figure 4. She returned to the operating room and was revised to a different bridge plate construct.

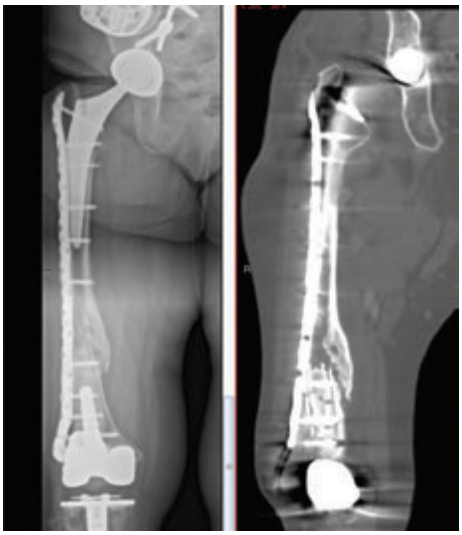

Figure 5. Despite making callus at the fracture site she continued to have significant pain with ambulation. A CT obtained 9 months post revision showed a nonunion.

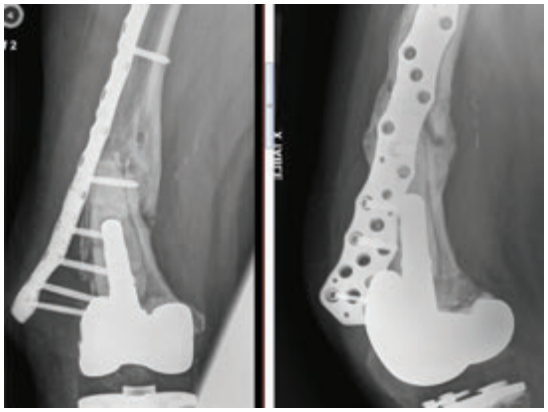

Figure 6. 2 months later (now 11 months post revision ORIF and 13 months post fracture) her implants failed.

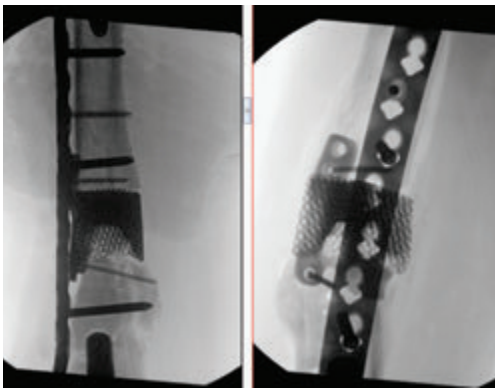

Figure 7. She then underwent a revision surgery with excision of the nonunion and placement of a custom 3D printed implant to bridge the defect.

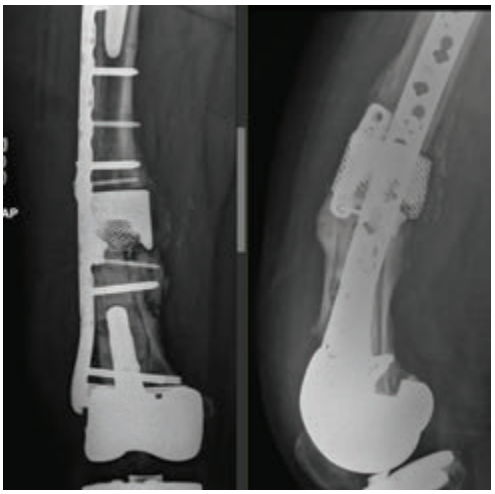

Figure 8. She remains early in the post-operative period but has shown interval callus formation 6 weeks postoperatively at the non-union site. Optimal use of this strategy remains unknown, but this technique may be beneficial in difficult trauma scenarios.

Oncology Update

Max Hoggard, MD

The Orthopaedic Oncology division continues to advance under Dr. Greg Domson. With the recent addition of Dr. Max Hoggard, access to musculoskeletal oncology care is at an all-time high. The division cares for a diverse cohort of patients with a wide variety of bone and soft tissue tumors, including primary sarcomas, various benign conditions and those with metastatic bone disease. Drs. Domson and Hoggard are supported by a strong multidisciplinary team, highlighted by NP Claire McMahon, and collaborate directly with providers at the Emily Couric Cancer center, the state of Virginia's first NCI Comprehensive Cancer Center.

IMPROVING ACCESS/CARE FOR PATIENTS

Given the large referral base surrounding Charlottesville, patients often travel long distances to be seen by UVA providers. The continued growth of the Orthopaedic Center at Ivy Road has enabled expedited care of undiagnosed oncology patients, particularly those from far away, evidenced by the ability to often obtain same day advanced imaging and in-clinic biopsies.

CASE REPORT

A 70-year-old male presented with shoulder pain and swelling. He underwent an uncomplicated total shoulder arthroplasty 12 months prior.

An MRI revealed a heterogenous enhancing soft tissue mass within the trapezius muscle. Measured at 7x4x4 cm with areas of central non-enhancement. This was concerning for a soft tissue sarcoma. (Figure 1)

He underwent a core needle biopsy in clinic the same day. 6 core samples were obtained and the wound was closed with steri-strips. (Figure 2)

The biopsy results showed a high-grade pleomorphic sarcoma. After appropriate staging studies, the mass was resected. (Figure 3)

Once the surgical wound healed, the patient began radiation treatment. ■

Figure 1. An MRI revealed a heterogenous enhancing soft tissue mass within the trapezius muscle. Measured at 7x4x4 cm with areas of central non-enhancement. This was concerning for a soft tissue sarcoma.

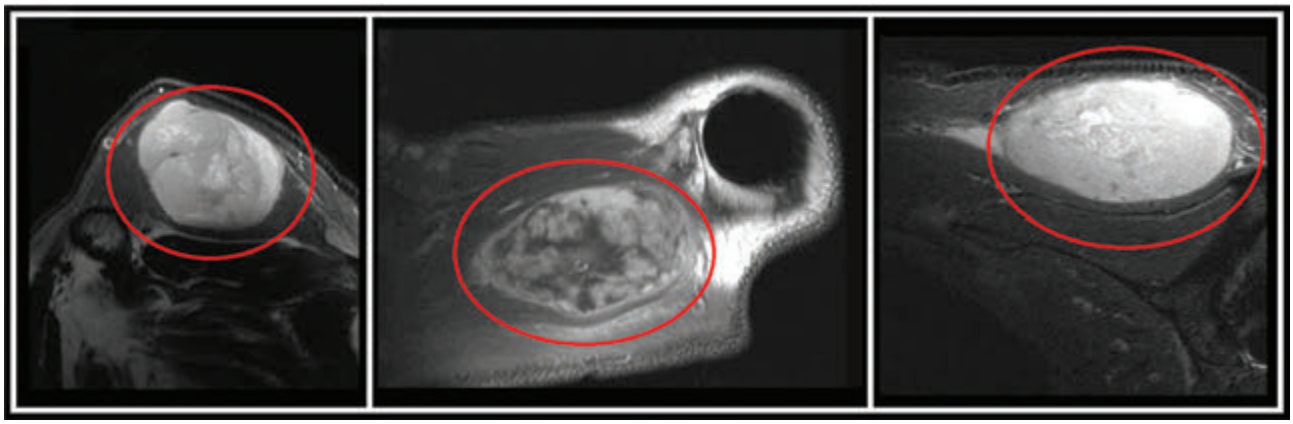

Figure 2. He underwent a core needle biopsy in clinic the same day. Six core samples were obtained and the wound was closed with steri-strips.

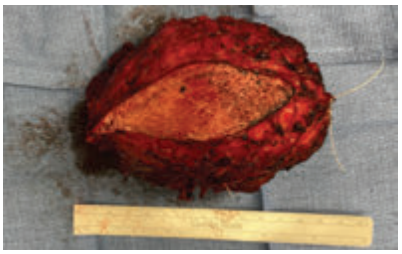

Figure 3. The biopsy results showed a highgrade pleomorphic sarcoma. After appropriate staging studies, the mass was resected.

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RESIDENTS

ORTHOPAEDIC SURGERY RESIDENTS 2024-2025

Monica Arney, MD

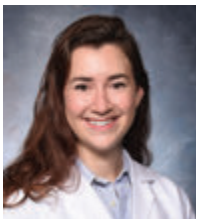
CHIEF

Richard Campbell, MD

CHIEF

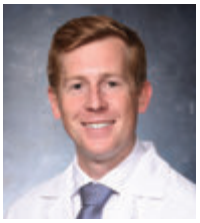
Lawal Labaran, MD

CHIEF



Liza Pelrine, MD

CHIEF



Jeff Ruland, MD

CHIEF

Vidu Nadarajah, MD

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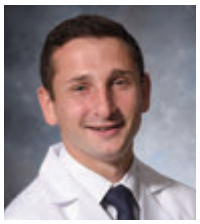
Katie Schultz, MD

Program Year 4

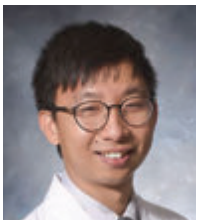


Josh Schwartz, MD

Program Year 4

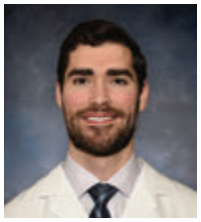
Vaib Tadepalli, MD

Program Year 4



Jesse Wang, MD

Program Year 4



John Burke, MD

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Charlie Engh, MD

Program Year 3

Pradip Ramamurti, MD

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Corinne Vennitti, MD

Program Year 3

Keith Wells, MD

Program Year 3

Anthony Ignozzi, MD

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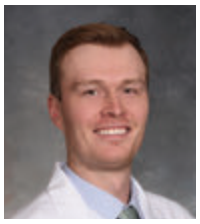
Kara McConaghy, MD

Program Year 2



Philip Nelson, MD

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Brad Reahl, MD

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Elizabeth Driskill, MD

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Tom Fenn

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Clare Green, MD

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Kate Panzer, MD

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Advancing Orthopaedics through our Educational Programs

The Department of Orthopaedic Surgery at the University of Virginia prides itself on contributing to the advancement of orthopaedics through our educational programs. Our goals include providing quality graduate orthopaedic education through a structured innovative teaching and evaluation process as well as training and nurturing the next generation of orthopaedic physicians who will utilize medical care decision making techniques based on outcomes-based evidence when considering diagnostic and therapeutic options of care. We also recognize the many phases of lifelong learning and strive to serve as a foundation for continuing education for practicing orthopaedic surgeons in addition to other healthcare providers who take care of musculoskeletal injuries and conditions.

RECENT FELLOWSHIP MATCHES FOR UVA ORTHOPAEDIC RESIDENT GRADUATES

2024

Alyssa Althoff – Sports at HSS
Neil Blanchard – Sports at Steadman Philippon
Pearson Gean – Sports at American Sports Medicine Institute
Thomas Moran – Sports at Rush

2023

Ian Backlund – Sports at Steadman Philippon
James Burgess – Trauma at Harvard/MGH
Zach Burnett – Sports at Ohio State
Francis Bustos – Sports at SCOI
Tim Lancaster – Hand at UC Irvine
David Noble – Hand at Cleveland Clinic
Cara Thorne – Hand at University of Colorado

2022

Matt Deasey – Sports at Steadman Philippon
Nicole Quinlan – Recon at Rocky Mountain Joint Replacement
Emanuel Haug – Recon at UVA
Baris Yildirim – Hand at Cleveland Clinic

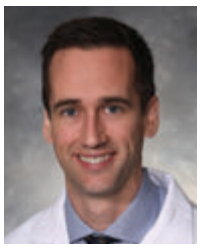
2021

Dennis Chen – Recon at University of Florida
Trent Gause – Hand at University of Pittsburgh
Max Hoggard – Oncology at University of Florida and Trauma at Greenville/Prisma Health
Michelle Kew – Sports at HSS
Eric Larson – Hand at UCSF

FELLOWS

CURRENT FELLOWS 2024-2025

Jacob Brennan, MD
Adult Reconstruction



John Carroll, MD
Adult Reconstruction

Qutaiba Al-Radawneh
Foot & Ankle

Ayah Mohamed, MD (P)
Hand and Upper Extremity

Sneha Rao, MD (O)
Hand and Upper Extremity

Zeeshan Akhtar, MD
Spine

Zachary Braig, MD
Sports Medicine

Abbey DeBruin, MD
Sports Medicine

Andrew Holte, MD
Sports Medicine

FELLOWSHIPS OFFERED AT UVA

ADULT RECONSTRUCTION FELLOWSHIP The University of Virginia Orthopaedic Adult Reconstruction Fellowship offers an exceptional opportunity for surgeons seeking advanced training in total hip and knee arthroplasty. Over the course of the fellowship year, fellows are immersed in a diverse surgical curriculum, encompassing both primary and revision procedures, as well as advanced techniques in robotic and minimally invasive joint replacement. Fellows are directly involved in a high volume of cases, gaining expertise in the management of complex joint conditions, including arthritis, deformities, and periprosthetic fractures, implant failure, and infection. The program also emphasizes comprehensive patient care, with fellows working closely with experienced faculty in preoperative planning, intraoperative decision-making, and postoperative rehabilitation. Fellows engage in regular didactic sessions, multidisciplinary rounds, and opportunities for research in clinical outcomes, surgical innovation, and healthcare optimization. The program's collaborative, high-volume setting provides a well-rounded, high-level training experience for those pursuing a career in adult reconstruction. The ambulatory surgery center environment at the Orthopaedic Center at Ivy Road offers exposure and experience with same day discharge joint replacement.

FOOT AND ANKLE FELLOWSHIP The Foot and Ankle Fellowship at the University of Virginia offers individuals who have completed a 5-year orthopaedic surgery residency the opportunity to enhance their skills in all areas of foot and ankle surgery. The fellow will be exposed to a large volume of cutting-edge foot and ankle procedures, including advanced arthroscopy/foot and ankle sports medicine, deformity correction, ankle arthroplasty, tendon reconstruction, diabetic care and trauma. The fellow will work directly with three attendings in the clinic and operating room to develop the necessary skills to succeed in an academic or private practice setting. Extensive clinical and basic science research opportunities are available, with protected time allotted to explore specific interests.

HAND AND UPPER EXTREMITY FELLOWSHIP The University of Virginia Hand and Upper Extremity Fellowship has grown over the last 14 years. We have maintained a very close relationship with our Plastic Surgery colleagues, training 2 fellows per year in all aspects of hand and upper extremity care. Our fellows have the ability to work with 7 faculty in areas including microsurgery, free tissue transfer, brachial plexus reconstruction, congenital hand and complex trauma (hand and elbow) within a busy academic practice. The fellows have been actively involved in caring for the UVA and JMU athletes as well. Every year the hand fellows are active in pursuing research projects with a result of multiple abstracts, podiums and published manuscripts in addition to securing fast track grant funding from the hand society for these projects. Please visit our website at https://med.virginia.edu/orthopaedic-surgery/orthopaedic-education/fellowship-programs/hand-upper-extremity-fellowship-information

SPINE FELLOWSHIP The Surgery of the Spine Fellowship program at the University of Virginia traces its origins back to 1994 when it was established under the visionary leadership of Dr. Donald Chan. Dr. Chris Shaffrey was our inaugural fellow. Over the course of a comprehensive one-year training within this ACGME-accredited program, our spine fellows are immersed in the art and science of delivering personalized treatments for a wide spectrum of spine pathologies. Proficiency is developed across a spectrum of surgical techniques, ranging from minimally invasive spine surgery to substantial spinal deformity correction. Our fellowship program prides itself on striking a well-balanced approach, encompassing both open procedures and the latest in robot-assisted surgery. Our fellows undergo rigorous training in motion preservation surgery, including advanced procedures such as disc replacement, laminoplasty, and tubular or endoscopic decompression surgeries. Join us at the University of Virginia's Spine Fellowship program to cultivate expertise, refine skills, and contribute to advancing the field of spine surgery.

SPORTS MEDICINE FELLOWSHIP The University of Virginia Orthopaedic Sports Medicine fellowship is one of the top fellowship programs in the country. Fellows have an incredible year-long experience that covers the spectrum of sports medicine problems, emphasizing a high volume of arthroscopic and open knee and shoulder cases, as well as shoulder replacement and hip arthroscopy. Additional experiences with sports foot and ankle and hand/upper extremity surgery are also available. Fellows are an active part of the sports medicine team providing coverage for all University of Virginia and James Madison University athletes, including experience on the sidelines and in the training room. There is a robust conference schedule throughout the year, as well as ample research opportunities. To learn more, visit https://med.virginia.edu/orthopaedic-surgery/orthopaedic-education/fellowship-programs/sports-medicine-fellowship/

Comparison of the Novel Coin Test and the Modified Japanese Orthopaedic Association (mJOA) Score in Assessing Cervical Spondylotic Myelopathy: Preliminary Results

LAWAL LABARAN, MD

2024 Resident Research Day

INTRODUCTION Cervical spondylotic myelopathy (CSM) diagnosis often requires a combination of clinical evaluation such as Hoffman's and Tandem Gait, as well as further imaging modalities such as MRI for accurate diagnosis. The novel Coin Test (CT) introduces a simple yet effective assessment tool for evaluating upper extremity function, aiding in the diagnosis of CSM compared to other traditional assessment tools. This study aims to assess and correlate pre- and postoperative CT times and modified mJOA scores, as well as to explore potential correlations between CT results and severity of cervical cord compression observed on MRI scans in CSM patients.

METHODS A prospective observational study was conducted, comparing 32 patients diagnosed with CSM based on clinical examination findings and MRI scans. The novel CT was administered and recorded both pre- and postoperatively, in conjunction with mJOA scores. In the CT assessments, patients diagnosed with CSM were instructed to transfer five coins (dime) from a randomly arranged starting position on a flat surface to an adjacent stack. Subsequently, the duration required to complete this task was recorded for each patient. Cervical cord compression ratio was quantified for all 32 patients and subsequently compared with preoperative CT results and mJOA scores to evaluate correlation utilizing the Pearson correlation test.

RESULTS The study cohort had a mean age of 66 years old. The mean preoperative mJOA

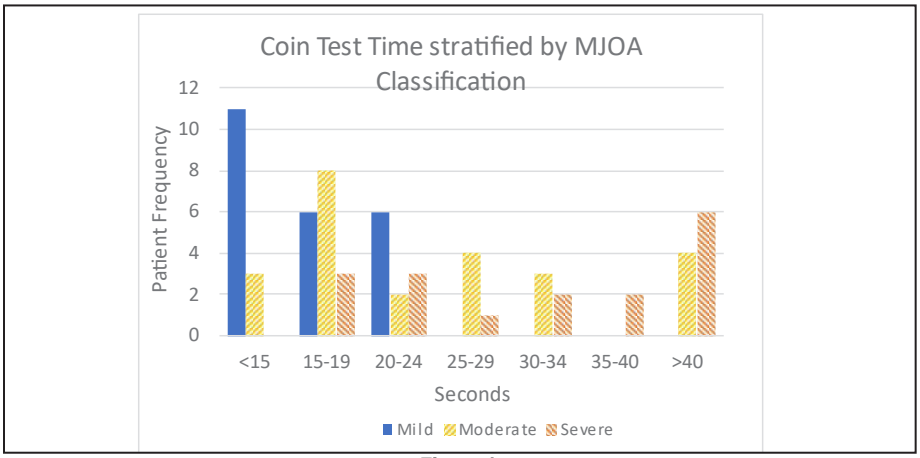


Figure 1

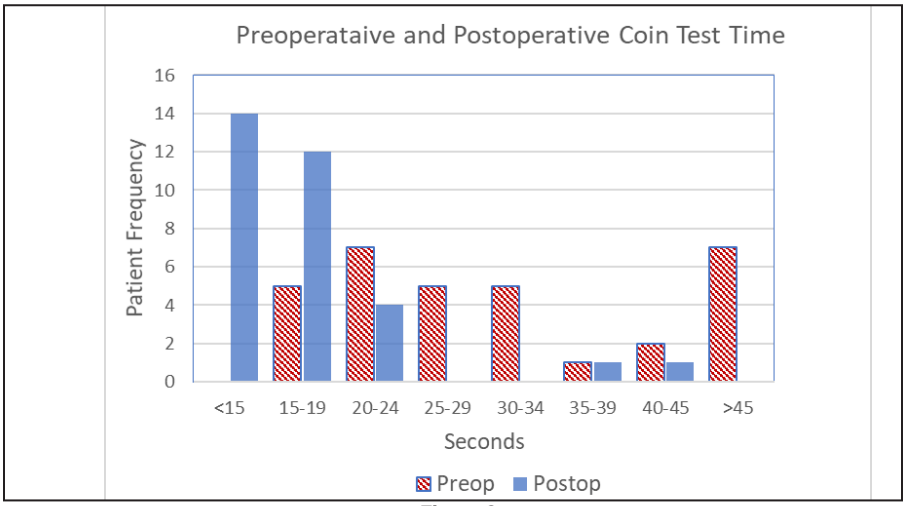


Figure 2

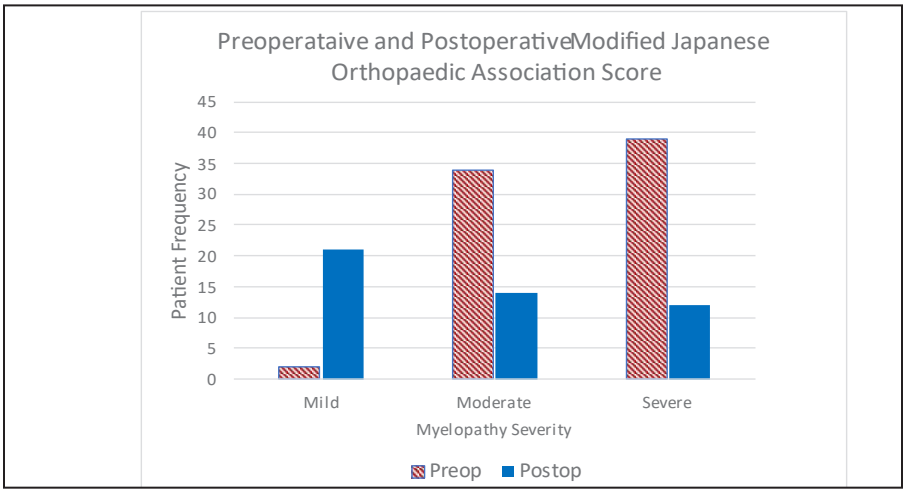


Figure 3

score was 11.9, indicating moderate CSM. Following anterior cervical decompression and fusion surgery, the mean postoperative mJOA score improved to 15.1, reflecting a shift to mild CSM. Preoperatively, the mean CT completion time was 34 seconds, which decreased to 16.8 seconds postoperatively, resulting in a mean improvement in CT completion time of about 17.4 seconds. The mean postoperative follow-up duration was 4.9 months. Statistical analysis using paired T-test revealed a significant decrease in CT time ($p < 0.001$) (fig. 1) and increase in mJOA scores ($p < 0.001$) (fig. 2) postoperatively. Furthermore, preoperatively, longer CT times were significantly associated with poorer mJOA scores, as evidenced by Spearman's Correlation test ($r= -0.646$; $p < 0.001$) (Fig. 3). Additionally, CT time exhibited a significant negative correlation with recorded cervical spine cord compression ratio, indicating that longer CT times correlated with more severe cord compression ($r=-0.498$; $p=0.004$). Interestingly, there was no significant correlation observed between cord compression and the traditional mJOA score ($r=0.305$; $p=0.095$).

CONCLUSION Our preliminary findings underscore the efficacy of the Coin Test (CT) as a simple and effective tool for assessing upper extremity function in CSM patients. CT times exhibited a promising significant correlation with disease severity, as evidenced by their association with both preoperative mJOA scores and cervical spine cord compression. These results highlight the potential of the CT to complement traditional assessments and provide valuable prognostic information for CSM management. ■

Magnetic Resonance Imaging versus Diagnostic Arthroscopy to Identify Intra-articular Pathology Associated with Patellar Instability: A High Rate of Discordant Findings Altering Surgical Treatment

VAIBHAV R. TADEPALLI, MD
2024 Resident Research Day

Vaibhav R. Tadepalli, MD; Adam J. Tagliero, MD; Royce Le, BS; David Diduch, MD

BACKGROUND Acute traumatic patellar dislocations may cause intra-articular derangements of the knee in the setting of acute and chronic instability which may not always be appropriately identified on magnetic resonance imaging (MRI).

HYPOTHESIS/PURPOSE The purpose of this study is to determine the rates of coexisting intra-articular pathology in patients with patellar instability requiring MPFL reconstruction, and to report discordance between preoperative MRI findings and diagnostic arthroscopy findings.

STUDY DESIGN Retrospective Case Series

METHODS All patients undergoing MPFL reconstruction at a single institution between 2010 and 2023 were identified. Operative reports and preoperative MRI reports, defined as the most recent MRI to the date of surgery, were queried. Records without full MRI reports as read by a radiologist or cases in which a diagnostic arthroscopy was not conducted were excluded. All intra-articular pathology that was documented on MRI and confirmed by arthroscopy was documented. MRI findings were considered to be discordant from arthroscopic findings if a lesion was identified on diagnostic arthroscopy that was not present in the full MRI report and that lesion required additional surgical procedures.

RESULTS 508 patients were ultimately included who had 701 arthroscopic procedures conducted which included 331 patellar shaving chondroplasties, 180 loose body removals, and 95 osteochondral lesions treated via ORIF (26 cases), chondral allograft grafting (30 cases), osteochondral allograft transplantation (9 cases), and microfracture (30 cases), and 39 meniscus tears resulting in 33 partial meniscectomies and 6 meniscus repairs. However, among these 508 patients, 173 (34%) demonstrated discordance of preoperative MRI and arthroscopic findings which necessitated additional procedures. These arthroscopic findings resulted in 75 loose body removals, 93 shaving chondroplasties, 3 osteochondral fracture fixation procedures, 3 microfractures for full thickness cartilage loss, 16 partial meniscectomies and 2 meniscal repairs which would have been missed without diagnostic arthroscopy due to discordant MRI findings. Magnetic Resonance Imaging obtained greater than 90 days from the date of surgery had a statistically higher rate of discordant findings (40% 75/187) than those conducted within 90 days of the surgical date (31%, 98/321) ($p =0.029$). However, MRIs obtained within 90 days of the date of surgery still had more than 30% rate of discordance.

CONCLUSION Greater than 1/3 of patients who underwent diagnostic arthroscopy during patellar instability surgery had pathology identified which required surgical intervention that was not reported on a pre-operative MRI. The findings of this study highlight the importance of diagnostic arthroscopy in the treatment of patellar instability. ■

Sarcopenia and Cage Subsidence after Single Level Anterior Cervical Discectomy and Fusion

JESSE WANG, MD
Resident Research Day 2024

Jesse Wang, Jasraj Raghuwanshi, Kamran Arastu, Lawal Labaran, Stephen Lockey, Xudong Li

INTRODUCTION Sarcopenia is an age-related progressive loss of skeletal muscle mass and function and has been associated with increased complication rate, length of stay and mortality after spine surgeries. Anterior Cervical Discectomy and Fusion (ACDF) is a commonly performed procedure for cervical disc degeneration. A major potential complication of ACDF is cage subsidence, which is the loss of intervertebral height. This can potentially result in sagittal malalignment, pseudoarthrosis, and restenosis of the cervical foramina. A number of factors, including bone mineral density, cage material, and cage placement, are known to influence the risk of subsidence, but the role of sarcopenia is unknown. This study aims to investigate the relationship between sarcopenia and incidence of cage subsidence following single level ACDF surgery.

METHODS A retrospective review of patients undergoing single-level ACDF between 2017-2023 was performed. Exclusion criteria include revision surgeries, surgeries with additional procedures, or surgeries with indications involving infection, neoplasm or metabolic bone diseases. Sarcopenia was defined by evaluating fatty infiltration of the axial cuts of T2-weighted MRI images of the multifidus muscle at C5-6 using the modified Goutallier classification. Sarcopenia was graded as mild (Goutallier 0,1), moderate (Goutallier 2), or severe (Goutallier 3,4). Cage subsidence was calculated by first measuring intervertebral body height (IVH) represented as an average of anterior, middle and posterior IVH normalized to vertebral body length (VBL) **Figure 1**. The difference between IVH on postoperative day 0 and most recent follow up was then calculated and represented as a percentage height loss. Three independent reviewers performed blinded assessment of sarcopenia grading and measurement of cage subsidence, and the results were aggregated. Other variables including cage material, patient demographics and comorbidities were also collected from the electronic medical record.

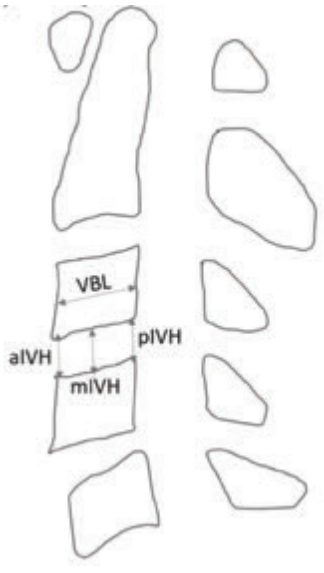


Figure 1. Measurement of intervertebral height (IVH) by averaging aIVH, mIVH, and pIVH normalized to vertebral body length (VBL).

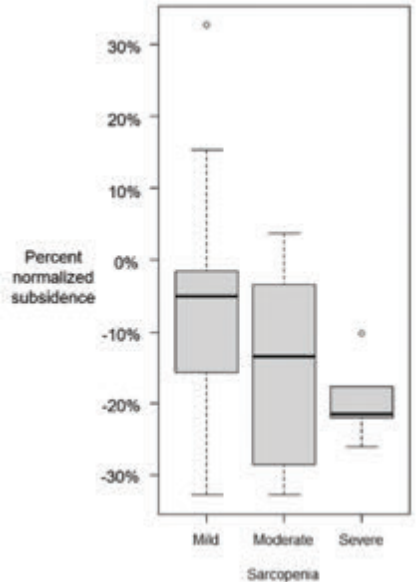


Figure 2. Percent loss of intervertebral height between patients with mild, moderate or severe sarcopenia.

RESULTS 50 patients met inclusion criteria during the study period. The average time for follow-up was 358 days. Sarcopenia was grouped into mild (36 patients), moderate (8 patients), and severe (6 patients). Patients with mild sarcopenia noted 5.9% reduction in IVH, compared to 15% in moderate and 19.8% in severe group **Figure 2**. There was no statistically significant difference in cage subsidence between the mild and moderate sarcopenic group (p = 0.73), however, there was statistically significant increase in subsidence between the mild and severe group (p = 0.004). Regarding cage material, 42% used PEEK cages, 32% used titanium, and 26% used allograft. No difference was noted between the degree of height loss in terms of cage material (PEEK 10.7%, titanium 10.8%, allograft 7.07%; p = 0.69). Smokers had average 13.4% subsidence compared to nonsmokers at 8.9%, though this did not reach statistical significance (p = 0.12). When comparing comorbidities, there was no difference in rate of hypertension, sleep apnea, coronary artery disease or chronic kidney disease between the three sarcopenia groups.

CONCLUSIONS Patients with severe sarcopenia demonstrated higher degree of cage subsidence following single level ACDF. No difference was noted for cage material regarding subsidence. Surgeons should consider screening patients for sarcopenia preoperatively and counsel them regarding their increased risk of postoperative complications following ACDF. ■

Sulcus-Deepening Trochleoplasty and Medial Patellofemoral Ligament Reconstruction Provide Good Clinical Outcomes in Addressing Patellar Instability at Mid-Term Follow-Up

THOMAS E. MORAN, MD
Resident Research Day 2024

Thomas E. Moran, MD, Adam J. Tagliero, MD, Elizabeth K. Driskill BS, David R. Diduch, MD

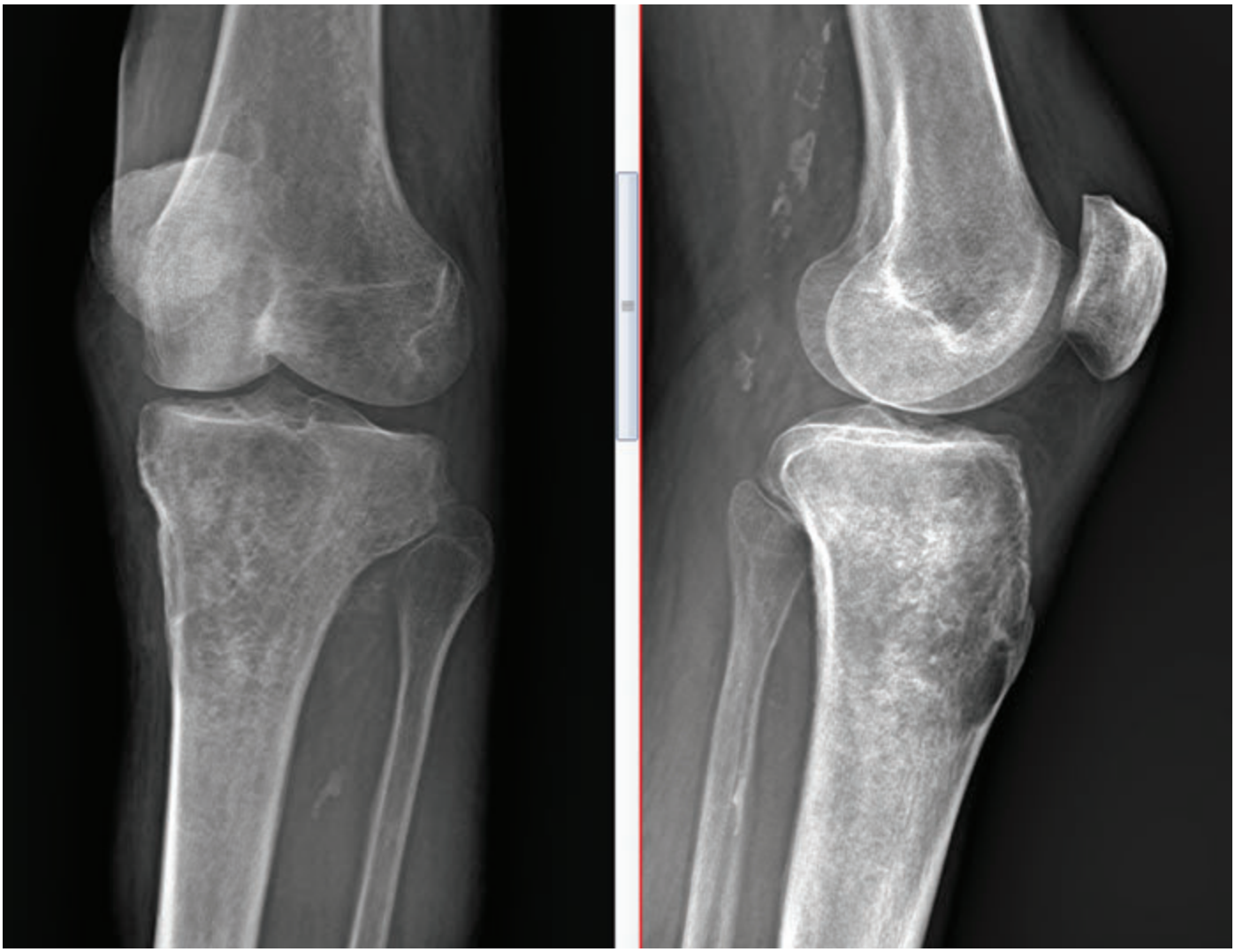
PURPOSE To update previously published clinical and radiographic outcomes of DeJour sulcus-deepening trochleoplasty and medial patellofemoral ligament reconstruction (MPFL-R), at mid-term follow-up, and monitor trends in patient reported outcome scores and satisfaction.

METHODS Interval follow-up was performed on a total of 67 patients (76 knees) with severe trochlear dysplasia and recurrent patellar instability who were prospectively enrolled and underwent DeJour sulcus-deepening trochleoplasty and MPFL-R combined with other patellar-stabilization procedures. Patients with less than 2-year follow-up were excluded. Evaluation of included patients involved radiographic analysis, physical examination, clinical follow-up, and collection of patient-reported outcome scores.

RESULTS 37 patients (45 knees) were included in the current study, with mean final follow-up of 6.1 years postoperatively. Two interval re-operations were performed (arthroscopic lysis of adhesions; hardware removal and arthroscopic shaving chondroplasty). There remained no occurrences of re-operation for recurrent patellar instability. Compared to the prior follow up at minimum 2 years postoperatively (mean 3.6 years), the mean IKDC score improved from 79.1 to 82.0, the mean Kujala score improved from 86.5 to 89.3, and the mean VAS pain score improved from 2.5 to 1.9. Mean patient satisfaction rating changed from 9.1 to 9.3. Mean Kellgren–Lawrence grading of patellofemoral arthritis changed from 0.56 to 0.52 on sunrise radiographs at the most recent follow-up.

CONCLUSIONS At mid-term follow-up, DeJour sulcus-deepening trochleoplasty and MPFL-R, combined with other patellar stabilization procedures, achieves durable resolution of patellar instability with maintained patient-reported outcome scores and satisfaction rates, and is without interval evidence of clinical or radiographic progression of patellofemoral arthritis. ■

2 Minute Consult: Next step?



A healthy 66 year old male presents to clinic with insidious onset of left knee pain. Pain worsens with prolonged weight bearing. He has trialed NSAIDs with incomplete pain relief. He has joint line pain, medial > lateral. He also has tenderness to palpation at the pes anserinus and tibial tubercle. He is stable to A/P and V/V stress. Equivocal mcmurray. He has not tried bracing or cryotherapy.

Radiographs show minimal joint space narrowing, no osteophytes or subchondral sclerosis.

What is the best next step? ***(Answer on page 76)***

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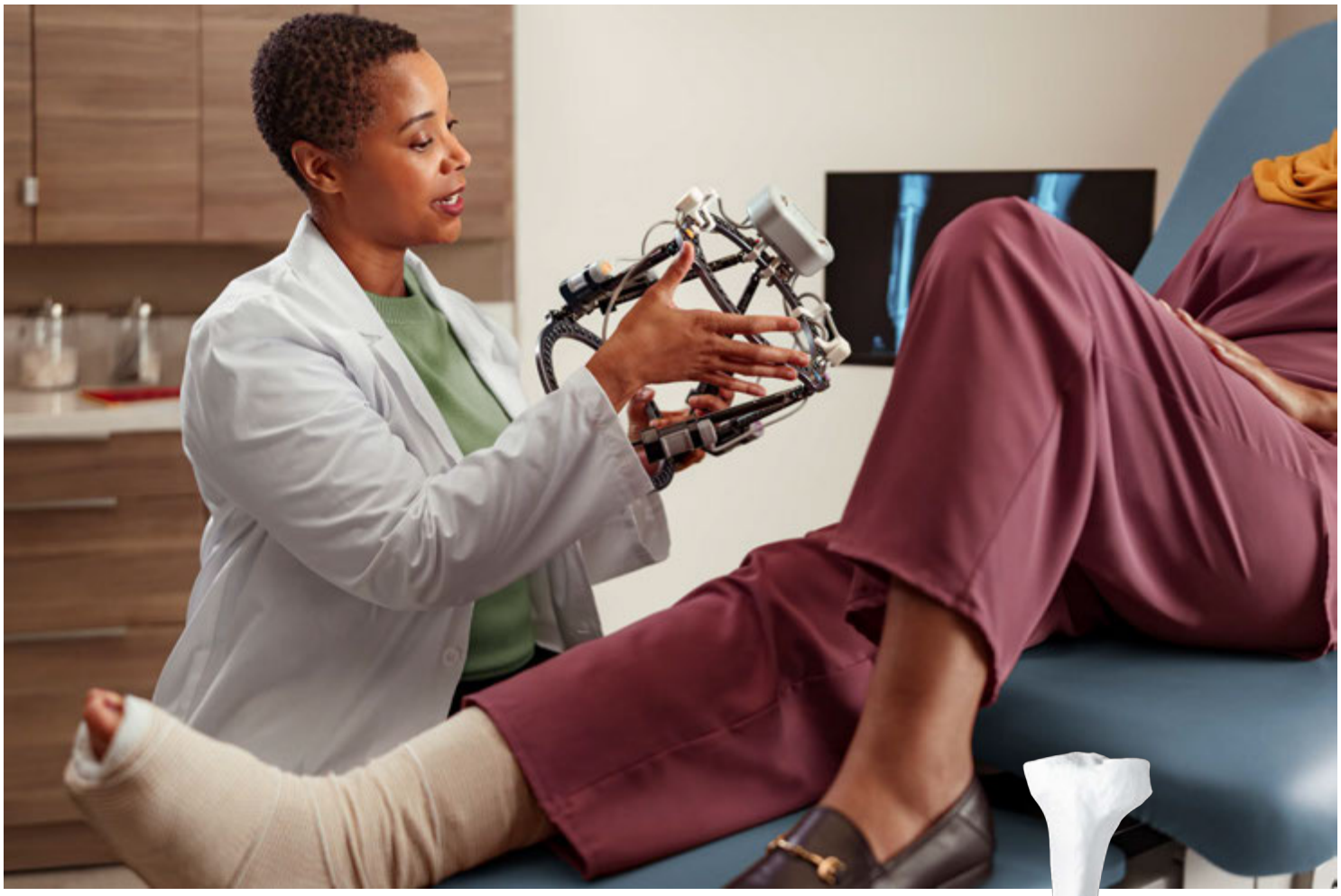

The first-of-its-kind hexapod ring fixation system offering fully automated strut adjustments up to 20 times per day.[2,3,*,†]

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*Geffner et al, 2021 is an n=1 pediatric case study. Clinical outcomes in these cases may not be representative of outcomes in other patients. †Preclinical studies may not be indicative of clinical performance.

1. OrthoSpin. MAXFRAME AUTOSTRUT Surgeon User Manual. 03/2022. OrthoSpin Document #IFU-0140 Rev. B.
2. Geffner AD, Reif TJ, Fragomen AT, Rozbruch SR. Use of OrthoSpin technology in the correction of complex limb deformities. J Ann Robot Automation. 2021;5(1):037-041.*
3. DePuy Synthes. MAXFRAME AUTOSTRUT and Distraction Considerations for Patient Treatment: Pre-Clinical, ClinicalMedical Affairs (PCM) Memo. 02/2022. Windchill #0000315770. †

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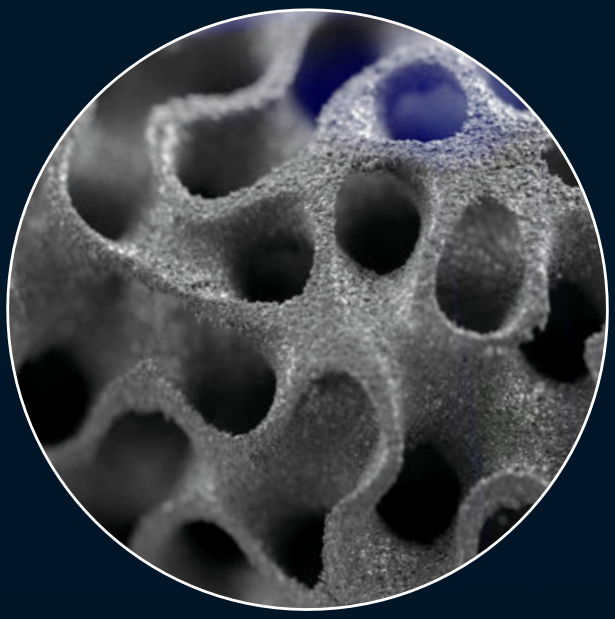

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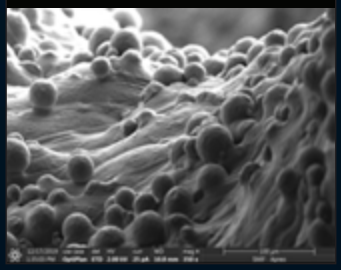
Direct bony apposition driven by surface topography demonstrated in preclinical model[2]:

SEM 150x



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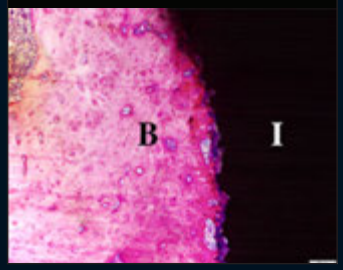
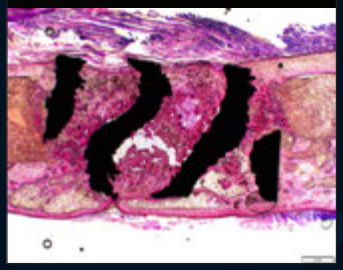
Bone Ongrowth to TIDAL Surface



Scale bar = 100 µm,
B = Bone, I = Implant

Continuous curvature of TIDAL architecture demonstrated to facilitate fusion in preclinical critical-sized bone defect[1]:

Bone Bridging at 12-Weeks



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1. Kelly, et al. Acta Biomaterialia (2019) 94, 601-626.
2. Kelly, et al. Journal of the Mechanical Behavior of Biomedical Materials (2021) 116, 104380.
3. Kelly et al. Biomaterials (2021) 279, 121206.

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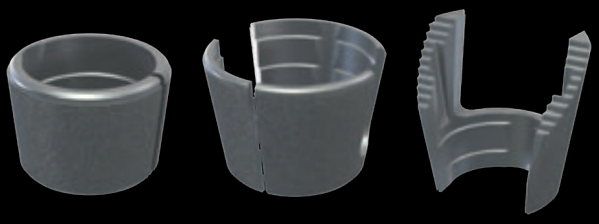

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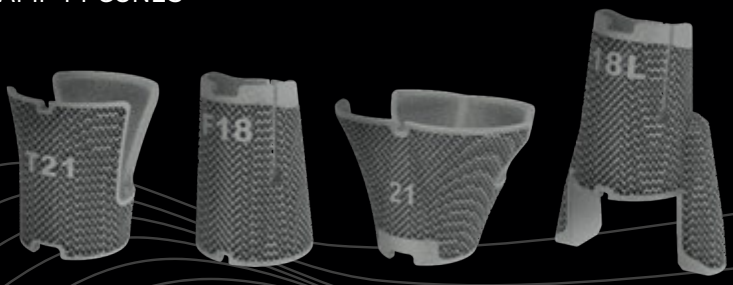
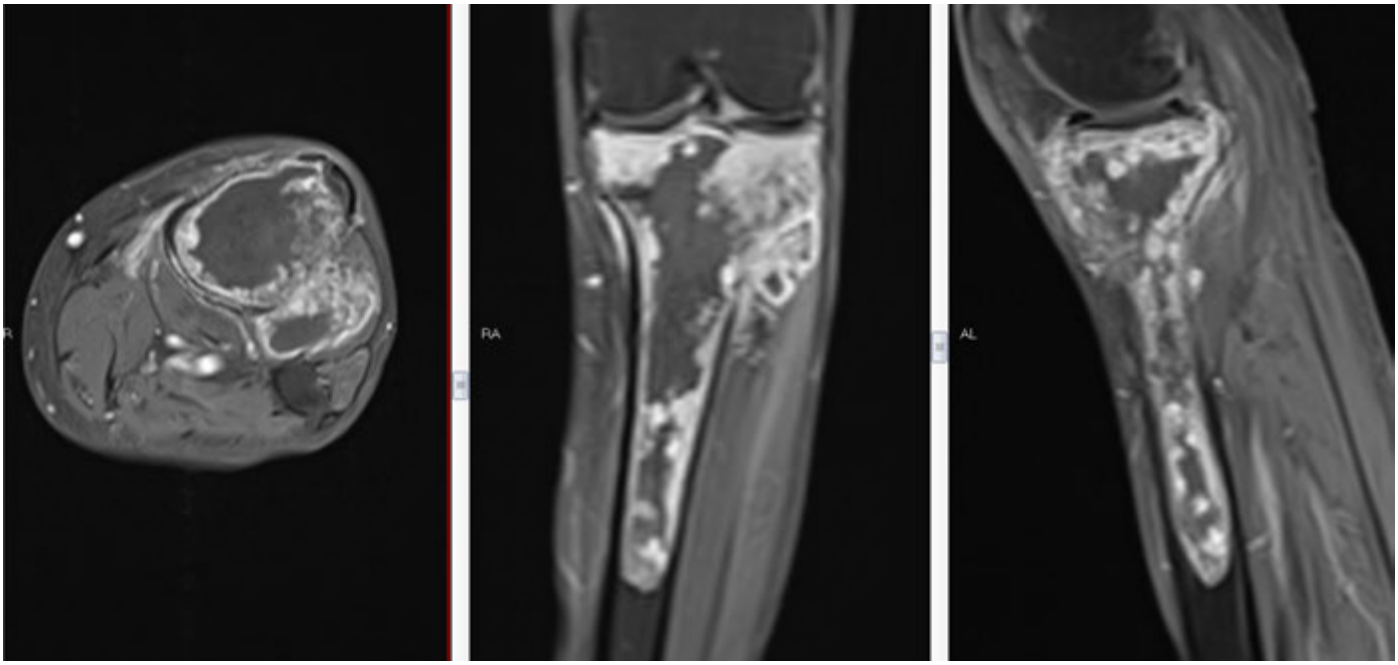
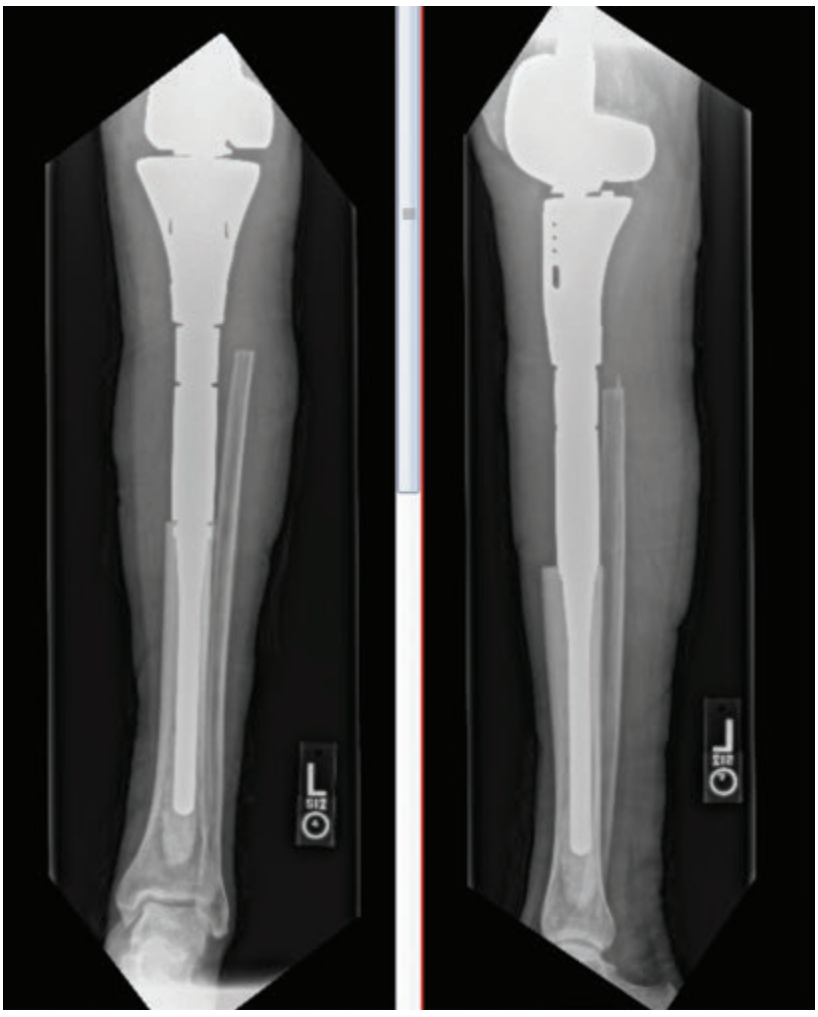


LEARN MORE

Next step? ***Answer:*** MRI to evaluate the proximal tibia lesion





Diagnosis: chondrosarcoma

Treatment: proximal tibia replacement

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