UVA Health

ORTHOPAEDIC JOURNAL

RESIDENT RESEARCH | DIVISIONAL REPORTS | VISITING PROFESSORS | UPDATE: IVY MOUNTAIN | DEPARTMENT SPOTLIGHT

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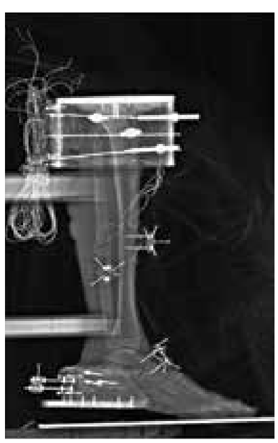

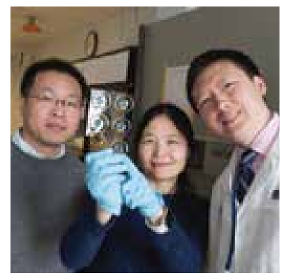

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Dear UVA Orthopaedic Alumni:

This past July, I began my 7th 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 of my predecessors, who helped create one of the top Orthopaedic programs in the country. The *UVA Orthopaedic Journal* was last published in 2000, my chief resident year. Since then, the department has changed dramatically, and we have experienced unprecedented growth. I am excited to share our progress in this second issue of a journal that will be published on a more frequent basis moving forward.

UVA Orthopaedics is now the busiest surgical service at the UVA Medical Center, and we have increased our clinical footprint to include locations east and north of Charlottesville. We recorded 101,000 patient visits and performed 8,300 surgeries in fiscal year 2019 compared to 69,000 patient visits and 6,800 surgeries just seven years ago. Our faculty size has increased to 32 clinical faculty and 6 research faculty. We have 15 very talented Physician Assistants who help optimize our patient care and access. For the last two years, we have surpassed institutional quality metric and patient satisfaction goals and performed better than all other service lines at the UVA Medical Center. For six 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 been ranked in the top 10% of programs in the country in *US News and World Report*.

We are in the midst of dramatic changes in how healthcare will be provided nationally, and this topic is a political hot button in upcoming elections. I am fortunate to have a group of faculty members who are resilient and determined to provide the best patient care possible despite the pressures of healthcare reform. 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 tumultuous and uncertain time.

In addition to the changing clinical care paradigm, our educational model has changed substantially over the last several years. With duty hour restrictions and the need 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 and cadaver dissection curriculum. Our Orthopaedic residency is one of the most competitive programs in the country and was recently ranked in the top 25 by Doximity. This year we received over 750 applications for our 5 intern positions. Our residency complement is still 25 total residents (5 residents/year), but we have expanded to 9 fellowship positions in 5 different specialties (Foot & Ankle, Hand, Adult Reconstruction, Spine, and Sports). Under the direction of our very talented residency and fellowship directors, we are continually modifying and improving our teaching methods and curriculum to ensure that we produce the most skilled Orthopaedic surgeons in the country. 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. We opened a new state-of-the-art Human Performance and Motion Analysis laboratory last year.

In the following pages, you will be introduced to our department by division and get a glimpse into our exciting future. You will learn about our clinical, educational, and research initiatives and get to know a few of us personally. There is also an update on the future home of UVA Orthopaedics: the Ivy Mountain Musculoskeletal Center that is under construction and will be completed in 2022.

I am thankful for the great faculty, residents, fellows, physician assistants, 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, including our educational and research endowments.

I look forward to seeing many of you at our UVA Orthopaedic Alumni reception at the upcoming AAOS Annual meeting in Orlando, Florida in March.

Thank you again for your unwavering support of our department, and I hope our paths cross soon.

Sincerely, Bobby Chhabra

A New Gold Standard

UVA ORTHOPAEDICS FACILITY AIMS TO BE ‘BEST IN THE COUNTRY’

By Whitelaw Reid, University News Associate
Office of University Communications

With exam rooms, operating rooms, surgery support and imaging services, a retail pharmacy, and food service, the Ivy Mountain Musculoskeletal Center will be a one-stop shop for orthopaedic and musculoskeletal care.

When the University of Virginia opened John Paul Jones Arena with a men's basketball game in 2006, legendary boxing announcer Michael Buffer (of "Let's get ready to rumble!" fame) announced the starting lineup as fireworks exploded and the Cav Man mascot dramatically rappelled from the roof.

'Hoos in attendance beamed with pride over the new state-of-the-art building, which quickly was anointed by the college hoops world as one of the best facilities in the country.

Four years from now, Dr. Bobby Chhabra believes the orthopaedic world will have a similar reaction when the UVA Ivy Mountain Musculoskeletal Center opens.

In September, 2018, a beaming Chhabra—along with Dr. Rick Shannon, UVA Health System's executive vice president for health affairs—wielded a shovel in a groundbreaking ceremony for the $160 million project on Ivy Road near the U.S. 29/U.S. 250 interchange.

"This facility," Chhabra, chair of the UVA Department of Orthopaedic Surgery, declared, "will be the best for musculoskeletal and orthopaedic care in the country."

Scheduled to open in 2022, Ivy Mountain will be one of only four similar facilities of its kind on the East Coast, joining the Hospital for Special Surgery in New York City, the Emory University Orthopaedics & Spine Hospital in Georgia, and the University of Florida Orthopaedic and Sports Medicine Institute in Florida.

With 90 exam rooms, six operating rooms, surgery support and imaging services, a retail pharmacy, and food service, the massive 195,000 square-foot facility will be the ultimate one-stop-shop for orthopaedic and musculoskeletal care.

The center will unite all of UVA Orthopaedics' outpatient clinics, meaning patients who have sustained multiple injuries will no longer have to schlep around Charlottesville to various specialists—a foot and ankle clinic here, a hand clinic there—for their treatment.

View East

Renderings courtesy ZGF Architects

Chhabra said other benefits would be better communication between the physicians and providers, as well as improved synergy for patient care and clinical orthopaedic research.

"No matter how many musculoskeletal problems you have, you will be able to get all of your care in one location," Chhabra said. "There will now be seamless care through the whole spectrum—from diagnosis, treatment, to therapy.

"We'll be able to provide the most innovative care and treatment technologies for our patients at a more competitive price."

Shannon has called musculoskeletal and joint problems "the disease of the next century." With many Baby Boomers needing joint replacement, Chhabra said the prediction is already proving true. "If you look at the trends, hip and knee replacement will be one of the most com-

The project has been a true labor of love for Dr. Bobby Chhabra, a "triple-'Hoo."

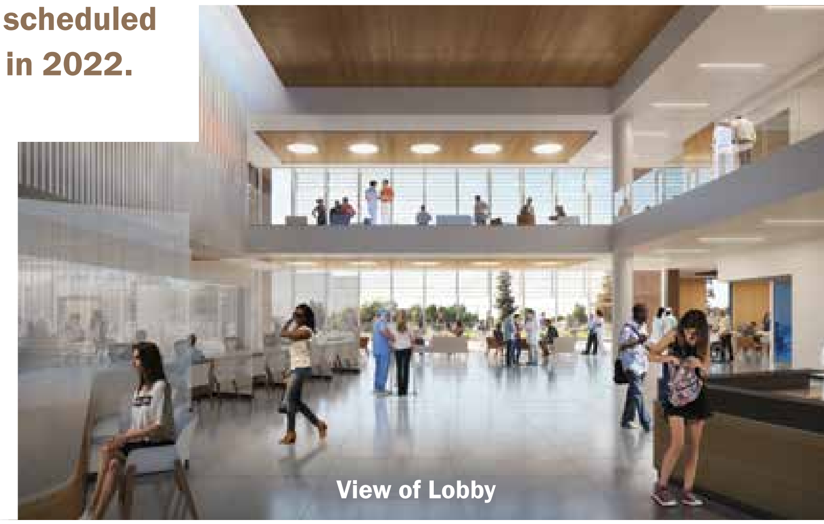
Photo by Kay Taylor, UVA Health System


View Southeast


View West

UVA's Ivy Mountain Musculoskeletal Center is scheduled to open in 2022.

Site Plan


View of Lobby

mon surgeries in the world within the next decade," he said.

And with a dedicated post-operative joint replacement unit where patients can receive therapy right in their rooms while family members are present, Chhabra said they'll now have the perfect place to do it.

The project has been a true labor of love for Chhabra, a "triple-'Hoo" who learned under the legendary Dr. Frank McCue (the former doctor for UVA sports teams). He and his partners at UVA Orthopaedics first dreamed up the idea 10 years ago and Chhabra has spent the last two years navigating the project through the design and approval phase.

UVA men's basketball coach Tony Bennett, whose players have relied on Chhabra and his team for years, said Chhabra's determination to see the project through has been inspiring.

"It's been such a vision for him, and really, the whole orthopaedic department, to have a world-class facility," Bennett said. "To see it starting to come to fruition is really special."

Chhabra, who helped start the UVA Hand Center in 2010, said it's definitely been a team effort.

Chhabra believes Ivy Mountain will give the University a leg up in recruiting the best students and student-athletes.

"It's taken a village," he said. "We've had input from hundreds of people during the planning process, with the sole focus being, 'How do we provide the best care for our patients and at the same time educate the next generation of physicians and providers?'"

Located less than a mile from the UVA sports complex, the facility will be of obvious benefit to Cavalier sports teams.

"The new medical center will provide our student-athletes, and the community, an entirely new level of health care and convenience," UVA Director of Athletics Carla Williams said. "It is a great model of care where so many resources that had previously been spread out around Grounds will be in one central site. The concept and design enhances multidisciplinary care and will greatly benefit patients and their wellness needs."

UVA Head Athletic Trainer, Ethan Saliba, who has cared for Wahoo athletes for 36 years, said Ivy Mountain would be the new "gold standard."

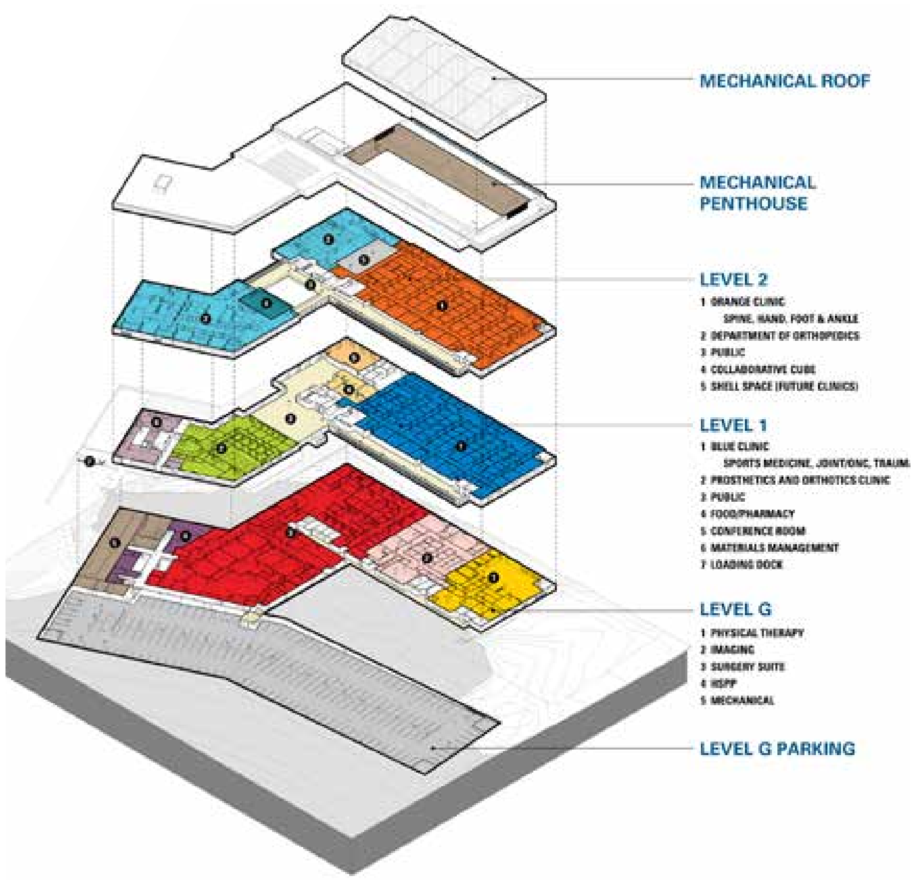
"It will provide resources for the total care of athletes—from the professional to collegiate or high school level—along with those who are just interested in being physically active," Saliba said. "We are very fortunate to have this."

Chhabra believes Ivy Mountain will give the University a leg up in recruiting the best students and student-athletes.

"There's nothing more important for a parent to know that their kid is getting the best health care possible, and this facility will not only be incredibly beautiful, incredibly advanced and innovative, but it will provide the parents of all our students real comfort in knowing their kids are getting the highest level of orthopaedic and musculoskeletal care in the country," he said.

For some UVA athletes, the one-stop nature of Ivy Mountain may feel similar to their current experience at JPJ, where they can practice, study, and eat all in the same place.

"The state-of-the-art facilities all under one roof will just be incredible," Bennett said. "When you combine that with what I believe are some of the best doctors and technicians—that's when you start talking about world-class. I think that's what we have here." ■



UVA Orthopaedics
BY DIVISION

The driving missions of our Department of Orthopaedic Surgery are to be national leaders in improving clinical care of orthopaedic conditions, in being 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 musculoskeletal, 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.

*Division heads denoted with an **

Thomas E. Brown, MD

Associate Professor

Dr. Thomas E. Brown is an Associate Professor in the Adult Reconstruction Division at UVA. He also serves as the Program Director for the Adult Reconstruction (Joint Replacement) Fellowship Program. Dr. Brown's training began at East Carolina, where he received both a Bachelor's and Master's degree in Exercise Physiology. Medical School training was completed at The Medical University of South Carolina, where he received the Thomas M. Savage Award for academic excellence. Residency training was completed at Geisinger Medical Center, followed by a short stint in private practice, before completing a Joint Replacement Fellowship at UVA. He was then asked to stay on as faculty here at UVA upon completion of this Fellowship in 1999.

Dr. Brown's clinical and research interests have focused on complex hip and knee replacement, and he has been awarded the UVA School of Medicine Master Clinician Award. Dr. Brown is an avid cyclist and enjoys spending time on the water with his wife, Janice, either in Maine or locally at Smith Mountain Lake.

James A. Browne, MD*

Vice Chair for Clinical Operations
Alfred R. Shands Professor

Dr. James A. Browne is the Alfred R. Shands Associate Professor of Orthopaedic Surgery, Vice-Chair of Clinical Operations, and Division Head of Adult Reconstruction at the University of Virginia. He also serves as the physician co-lead of the Musculoskeletal Service Line. He was born and raised in Canada and moved to Virginia to pursue his education at Washington and Lee University, where he captained the Men's Swim Team before graduating summa cum laude. He completed medical school at Johns Hopkins, residency 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.

His clinical interests and expertise include complex primary and revision hip and knee, and he received the UVA Dean's Clinical Excellence Award in 2014. Along with his clinical interests, he is actively involved with research encompassing all aspects of hip and knee replacement, has published numerous peer-reviewed journal articles and book chapters, and 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. He is currently an Associate Editor of the Journal of Arthroplasty, serves on the Steering Committee of the American Joint Replacement Registry (AJRR), is a Board Member of the American Association of Hip and Knee Surgeons (AAHKS), is the Program Chair for the AAHKS Annual Meeting in 2019, and was recently inducted into the Knee Society. He and his wife, Amy, have two school-age children.

Quanjun Cui, MD

Gwo-Jaw Wang Professor and
Vice Chair for Research

Dr. Quanjun Cui is the G.J. Wang, MD, Professor of Orthopaedic Surgery, and Vice-Chair for Research. He is a board-certified orthopaedic surgeon and specializes in total hip and knee replacement, osteonecrosis, surgical hip dislocations to treat femoro-acetabular impingement, and computer-aided and minimally invasive surgery for total hip and knee arthroplasty. His research, focusing on stem cell and arthritis, is funded by the National Institute of Health (NIH).

Dr. Cui received his medical degree with honors from Henan Medical University in China and then completed residency and fellowship training in Adult Reconstruction at the University of Virginia School of Medicine. He also completed an AO fellowship at the University of Bern in Switzerland. Dr. Cui has written over 130 papers and book chapters and has edited 9 textbooks. He has served as a faculty member for several national/international instruction courses, including AAOS instruction courses, Advances in Arthritis, Arthroplasty, and Trauma, and Advances in Surgical Technology. Dr. Cui also served as program chair or faculty member at state and national/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 has received numerous academic and professional accolades, including the Hip Society Otto Aufranc Award. He has been recognized as "America's Top Orthopaedist" since 2009 and as one of "the Best Doctors in America" since 2015. He is a Fellow of the American Academy of Orthopaedic Surgeons, a member of the Orthopaedic Research Society, and a Fellow of the American Orthopaedic Association (AOA). He was the President of the Virginia Orthopaedic Society in 2017 and Vice President for North America of ARCO from 2015-2017. He is married to his medical school classmate, Ling, and has two grown children.

Fighting the Good Fight: Searching the Cure for Osteonecrosis

Quanjun Cui, MD, and Nicholas Calabrese, PA

University of Virginia,
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Osteonecrosis of the femoral head (ONFH) is a devastating disease affecting young patients at their most productive age (average 38 years old), whereby the femoral head is necrotic (dead), resulting in significant pain, eventual collapsed femoral head, and arthritis. Unfortunately, there is no effective treatment for the disease. Patients with ONFH that is caught in the very early stages (before the femoral head collapses, ARCO Stages I-II) Figure 1A and B, are potential candidates for hip-preserving procedures, but the results of these treatments are mixed. In patients whose femoral heads have already collapsed (ARCO Stages III-IV), total hip arthroplasty remains the most reliable treatment, but the prostheses may not last for patients' lifespan. Therefore, seeking effective joint-preserving therapy for early-stage disease is of paramount importance.

The most promising interventions to date for pre-collapse ONFH is core decompression (CD) with the use of concentrated bone marrow aspirate to improve the healing potential of the disease. Dr. Quanjun Cui at the University of Virginia Medical Center is one of only a few experts in the nation who perform such a procedure, using bone-forming stem cells from bone marrow (Figure 2) to treat this rare but devastating condition. He is working with investigators at other institutions to organize randomized multi-center clinical trials to assess the effectiveness of this therapy, the best possible source of cells, and the best method of implantation to further improve results in those with pre-collapse ONFH.

Core decompression works by drilling one or multiple tracts from the greater trochanter, through the femoral neck, and into the subchondral lesion of the femoral head (Figure 1C). These tracts relieve the increased pressure and can potentially help to restore adequate blood flow to the femoral head, thereby allowing for healing and preservation of the joint. The injection of concentrated bone marrow aspirates (Figure 1D), containing autologous bone marrow stem cells, through the CD tracts can increase the population of active stem cells present for osteogenesis. Once injected into the femoral head defect, these cells

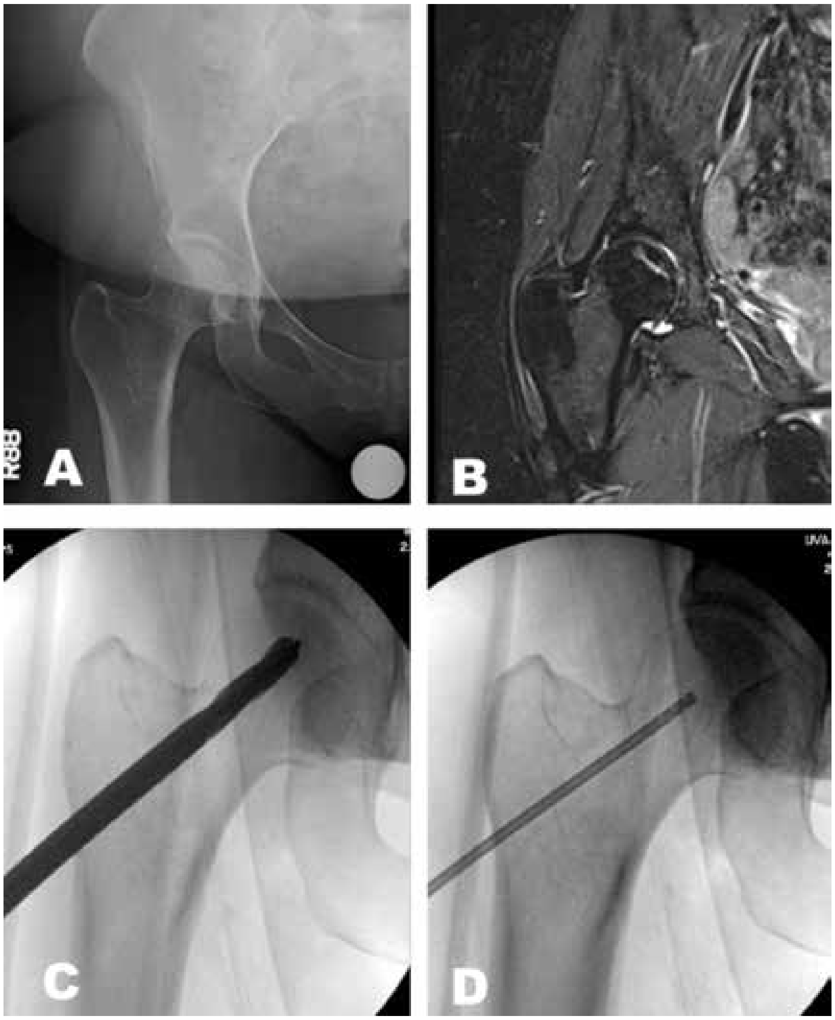

Figure 1. ARCO stage I osteonecrosis of the femoral head. (A) Radiograph shows no significant changes of bone structure, but (B) MRI shows subchondral lesion. Core decompression was performed using 9 mm trephine under the fluoroscopy (C) and the bone marrow aspirate concentrates were delivered to the subchondral area through the core decompression tract (D).

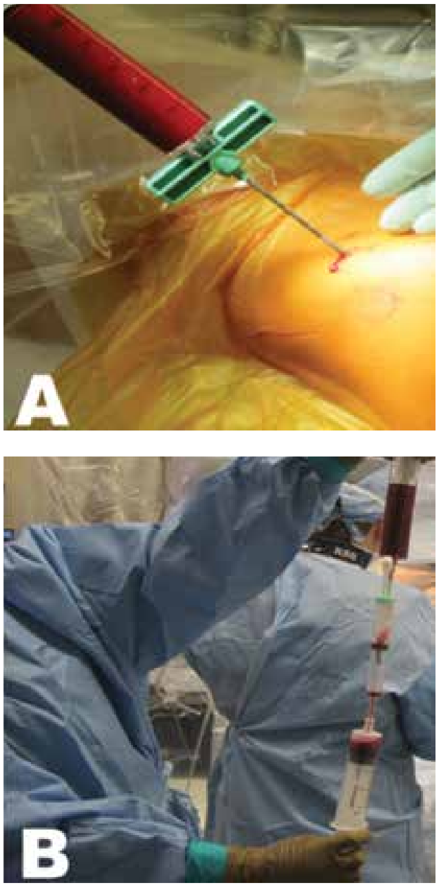

Figure 2. Bone marrow was aspirated from iliac crest (A) and then processed (B) to isolate/concentrate bone marrow stem cells for injection into the femoral head.

have been found to survive and proliferate for up to 12 weeks. Although a controversial topic, it has shown overall positive outcomes.

Though molecular and cellular mechanisms for bone formation by bone marrow stem cells remain unclear, recent discoveries suggest that the regulation of bone formation by the cells of the immune system is the leading mechanism. Supported by funds from National Institute of Health (NIH), Dr. Cui's research team is working to determine which subsets of bone marrow stem cells, immune cells and their cytokines, as well as natural human antibodies correlate with optimal bone healing. ■

Radiographic Evaluation of Acetabular Cup Position in THA: How Good is the Current Literature?

James A. Browne, MD, and
Ian Cook Armstrong

University of Virginia,
Department of Orthopaedic Surgery
Charlottesville, VA

ABSTRACT

Background: Acetabular component orientation affects the stability of the hip joint and plays a role in determining the risk of dislocation after THA. A "safe zone" for cup orientation with anteversion of 15 + 10 degrees and inclination of 40 + 10 degrees has long served as the standard goal for cup placement. Recent studies have called into question the validity of said "safe zone" due to persistence of dislocation within the range, and significant variability in cup orientation measurements. It is known that different radiographic conditions, such as standing versus supine patient position, can affect pelvic tilt and alter measurements of cup position. Standardized methods for quality control of the images can impact the accuracy of cup orientation measurements, as well. The objective of this literature review was to assess the quality and consistency of published studies that attempt to define desirable acetabular component orientation in total hip arthroplasty (THA).

Methods: Relevant studies were systematically reviewed in Medline's PubMed database. Studies were included if they discussed outcomes after THA and assessed acetabular component orientation using the analysis of plain radiographs.

Results: Thirty-three unique studies that met the inclusion criteria were identified. Of the thirty-three studies, one study obtained standing radiographs, four studies obtained supine radiographs, one study obtained both standing and supine radiographs, and twenty-seven studies did not clearly state whether the patient was standing or supine in the radiographs. Within the entire group of studies, twenty-two studies measured anteversion using AP radiographs, nine studies measured anteversion using lateral radiographs, and two studies did not definitively state what position was used to measure anteversion. Upon examination of the studies for the use of standardized quality control methods in radiograph acquisition, it was found that fourteen studies used standardized quality control methods, whereas nineteen studies did not mention that any assessment of the radiographic quality was performed.

Conclusion: The existing body of literature has inconsistencies in the methodology used in radiographic measurement of acetabular component orientation in THA, and there appears to be no consensus as to how to assess cup position. Measurements may not be comparable across studies as the variations in radiograph acquisition reduce confidence in the accuracy and validity of said measurements.

MATERIAL AND METHODS

Literature searches were conducted using the National Library of Medicine's PubMed database to identify relevant publications studying adverse outcomes after THA and the role of acetabular component orientation in said outcomes. The search terms used include total hip arthroplasty, total hip areplacement, total hip prosthesis, dislocation, instability, cup orientation, acetabular component, anteversion, inclination, cup placement, cup positioning, and safe zone (note that an asterisk was used at the end of the term dislocation to include all possible variations of the word). The search terms were searched for in all fields. Before search, a list of known relevant publications was created in to ensure that the search results were focused, yet sufficiently broad and inclusive of the relevant studies. Initial search results were reviewed by title, and studies were selected for abstract review if the title contained any mention of outcomes after THA or acetabular component orientation in THA. Abstracts were reviewed, and studies were chosen for full-text review if they discussed the relationship between acetabular component orientation and outcomes after THA. Following full-text review, studies were reviewed if they discussed outcomes after THA and assessed acetabular component orientation using the analysis of plain radiographs.

The initial search yielded one-thousand one-hundred and sixty unique titles. Title review narrowed the pool of studies to ninety-two abstracts, and abstract review resulted in thirty-six full-texts. Three studies were excluded during full-text review due to the lack of analysis of plain radiographs.

The studies were reviewed for clear, explicit mention of radiographic conditions used when obtaining postoperative radiographs. These include supine vs. standing patient position, and radiograph projection used for calculating anteversion (AP vs. lateral). The studies were reviewed for the use of a quality control method in radiograph acquisition as well.

RESULTS

Thirty-three unique studies that met the inclusion criteria were included in this review. Upon review of the patient position used in post-operative radiographs, it was found that one study obtained standing radiographs, four studies obtained supine radiographs, one study obtained both standing and supine radiographs, and twenty-seven studies did not clearly state whether the patient was standing or supine in the radiographs. For the study by McCollum et al.,[6], where both standing and supine radiographs were obtained, the standing radiograph was a lateral projection, while the supine radiograph was an AP projection.

Further review of the thirty-three studies for type of projection used to measure anteversion revealed that twenty-one studies measured anteversion using AP radiographs, nine studies measured anteversion using lateral radiographs, and three studies did not clearly state what projection was used to measure anteversion. It was found that fourteen studies used standardized quality control methods, whereas nineteen studies did not mention that any assessment of radiographic quality was performed. The most common method for radiograph quality control was centering the beam over the symphysis pubis.

DISCUSSION

The Lewinnek "safe zone" is intended to provide a standard range for acetabular component placement that surgeons can trust to consistently provide a low risk of dislocation. However, it has been shown repeatedly that many THAs with successful cup placement within the "safe zone" result in dislocation. In a study of a cohort of 9,784 primary THAs, Abdel et al. found that sixty-five percent of dislocated, posterior approach THAs were properly placed within the combined "safe zone."[3] Such findings have led some to claim that there is no true "safe zone." Timperley et al. found no significant difference in the variability of dislocating and non-dislocating hips for inclination or anteversion in a series of 1,578 posterior approach THAs.[7] They rejected the existence of a "safe zone" for dislocation, and instead emphasized the multifactorial nature of dislocation. Others have pointed out that it is difficult to assess what angular ranges of acetabular component orientation are recommended by the literature due to inconsistencies in experimental variables used in determining said "safe zones." Yoon et al. found that choice of reference frame and the definitions for acetabular cup orientation angles varied across the existing literature, leading to highly variable and incomparable target orientation values.[8] More uncertainty in the literature is likely if the radiographic methods used to assess acetabular component orientation vary significantly.

This literature review is the first of its nature to assess the quality and consistency of radiographic methods used in the existing literature that attempt to define target acetabular component orientation ranges. The existing body of literature has inconsistencies in the measurement of acetabular component orientation in THA and there appears to be no consensus as to how to assess cup position.

A limitation of this literature review is that there is the possibility that relevant studies could have been wrongfully excluded from the review due to the exclusion criteria that was utilized. Though it is not possible to entirely eliminate this risk from the methodology, we reviewed the titles of 1,160 publications, a fairly large sample size, and included any ambiguously titled studies in the abstract review process. This gives us confidence that our method included the entirety of the relevant literature available to us.

In conclusion, this literature review is the first of its nature to assess the quality and consistency of radiographic methods to define a target range for acetabular component orientation. The existing body of literature has inconsistencies in the measurement of acetabular component orientation in THA and there appears to be no consensus as to how to assess cup position. Measurements may not be comparable across studies as the variations in radiograph acquisition methodology reduce confidence in the accuracy and validity of said measurements. ■

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Revision of a Failed Metal-on-Metal Total Hip Arthroplasty with Incarcerated Components and Acetabular Defect

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ABSTRACT

Managing acetabular defects is one of the most challenging aspects of revision cases in total hip arthroplasty. Trabecular metal technology and surgical ingenuity have provided solutions for these difficult problems. This case presents one such acetabular defect successfully treated with a double cup construct.

INTRODUCTION

The incidence of total hip arthroplasty (THA) revision procedures continues to increase and is expected to double by 2026 (Kurtz 2007). Despite many new implant advancements, the frequency with which primary hip arthroplasty is performed, particularly on younger patients, has yielded many new types of revision challenges.

Among the failure mechanisms for THA, acetabular defects can be particularly difficult to treat. The goals of such revision procedures are to provide stable initial fixation, to promote bone ingrowth, and to restore the native hip center of rotation. Depending upon the location and amount of pelvic bone stock available, a number of reconstructive options are available, including: bulk allograft, jumbo cup constructs, custom triflange implants, cup-cage constructs, and, more recently, porous metal sockets. Porous metal sockets, also known as trabecular metal cups, have become increasingly popular as they have demonstrated improved rates of bone ingrowth and survivorship over other techniques (Grappiolo 2015). In order to treat a wider variety of irregular bone defects, modular augments are available to be used with porous metal sockets. These trabecular cups and modular augments allow for "off the shelf" customization for almost any acetabular defect.

For large, irregular acetabular defects, treatment with augments can be quite difficult. For such select cases, the use of a double-cup has recently been described (Webb 2017, Loppini 2018). Such a technique allows the bone defect to be filled with a porous metal cup, providing an interference fit for a second cup which appropriately restores the hip center of rotation and biomechanics. The case presented below details one such acetabular defect.

CASE REPORT

A 66 year old gentleman underwent an attempted right hip resurfacing at an outside hospital in 2006. The case was complicated and required intraoperative conversion from a hip resurfacing procedure to a large head metal-on-metal total hip arthroplasty. In 2016, he presented to UVA Orthopaedics complaining of bilateral hip pain. Imaging at presentation demonstrated left hip arthritis and a failed metal-on-metal THA with a modular stem, a loose cup, and a large acetabular defect (Figure 1). After undergoing a workup for infection, he first underwent an uncomplicated left

Figure 1. AP pelvis radiograph from July 2016.

Figure 2. AP pelvis radiograph from December 2016

total hip arthroplasty in November 2016 (Figure 2). After an uneventful recovery from his left hip arthroplasty, the right hip was addressed.

The patient underwent right hip revision in March 2017. Due to the capacious acetabular defect, the proximal migration of the femoral component, and the spin out of the loose cup, the hip was noted to be incarcerated and unable to be explanted from the acetabular cavity during the routine posterior hip approach. Therefore, an extended trochanteric osteotomy was performed in situ in order to gain access to the implants. Despite mobilizing the abductors and trochanter and freeing up the bone-prostheses interface with burrs and osteotomes, the components were still

Figure 3. Intraoperative radiograph demonstrating extended trochanteric osteotomy, cut femoral stem, and trial acetabular cup placement with a high hip center.

Figure 4. AP pelvis radiograph of final construct.

unable to be mobilized. The stem was cut and the proximal portion of the stem then became mobile. However, even with this mobilization the head was still incarcerated within the acetabular cavity. Using a bone tamp, the proximal Morse taper of the femoral component was able to be disengaged from the incarcerated femoral head.

With the proximal stem removed, burs and acetabular reamers were used to expand the acetabular introitus allowing removal of the metal on metal femoral head and cup. The bone stock and continuity of the pelvis were assessed and prep for acetabular reconstruction was performed. Initial reaming of available acetabular bone stock yielded a high hip center and an expansile cavitary defect (Figure 3), therefore a double cup reconstruction was trialed using available acetabular bone stock for the first cup, positioning it in such a way that it provided an interference fit for the second cup with the appropriate hip center of rotation.

The remaining portion of the femoral stem was freed up utilizing flexible osteotomes. A metal cutting bur was used to create a notch into the stem so that it

Due to the capacious acetabular defect, the proximal migration of the femoral component, and the spin out of the loose cup, the hip was noted to be incarcerated and unable to be explanted from the acetabular cavity during the routine posterior hip approach.

could be disimpacted with a bone tamp. Once this was removed, the femoral shaft was reamed up in preparation for a modular taper-fluted stem (Stryker, Mahwah, NJ). The trial components were reduced and intraoperative x-ray confirmed component position.

The trial components were removed and cancellous allograft was packed in part of the acetabular defect followed by the impaction of the first trabecular metal cup. Multiple 6.5 mm screws were placed through the trabecular metal shell. The screw heads were covered with bone wax from the internal cup and then polymethylmethacrylate was placed into the first cup, and the articulating shell was cemented centrally into the first shell, while achieving good host bone contact anteriorly and posteriorly. The polyethylene liner was then cemented into the articulating cup of the united double cup construct, followed by final seating of the taper-fluted stem. The trochanteric osteotomy was repaired, and the wound closed. Patient was allowed toe-touch weight-bearing with abduction orthosis x 6 weeks. Postoperatively the patient was noted to have a complete femoral nerve palsy, which recovered over the next 6-9 months (Figure 4).

In contrast to the majority of hip revisions where the joint is able to be dislocated allowing the femoral stem and acetabular cup to be addressed separately, this particular case required a creative approach where in situ extended trochanteric osteotomy, cutting of the stem, disengagement of the head within the acetabulum, and reaming of the acetabular introitus were required to facilitate component removal.

DISCUSSION

The use of a porous trabecular metal hemispheric shell as an augment allows for an interference fit, with a large surface area for bone ingrowth, while providing stability for an articular shell with the appropriate center of rotation. The utility and benefits of such double-cup constructs have recently been described.

Webb retrospectively reviewed 20 double-cup cases performed by a single surgeon with a mean 2.4 year follow up (Webb 2017). The authors noted that there were no revisions for acetabular loosening and no cases of aseptic loosening. The most common complication was dislocation (25%), however the hip average Harris Hip Score improved from 28.2 to 68.7 postoperatively (P < .001).

Loppini retrospectively reviewed 16 double cup constructs performed at their institution for Paprosky III defects without discontinuity. The authors noted a 100% survivorship of their implants at a mean of 34 months with an average improvement in Harris Hip Score from 19.4 to 77.2 postoperatively (P < .001).

A number of metal-on-metal hips require revision for metallosis and pseudotumor. These were not of concern in this scenario where acetabular failure and joint dissociation were the primary reasons for hip revision.

Removal of incarcerated components can be a major challenge in revision hip arthroplasty. Such cases require alternative and creative strategies to permit component removal. In contrast to the majority of hip revisions where the joint is able to be dislocated allowing the femoral stem and acetabular cup to be addressed separately, this particular case required a creative approach where in situ extended trochanteric osteotomy, cutting of the stem, disengagement of the head within the acetabulum, and reaming of the acetabular introitus were required to facilitate component removal.

Though the stability of the patient's hip construct was able to be restored, his case was complicated by a femoral nerve palsy. This complication is relatively uncommon after hip arthroplasty with a reported incidence in 0.17%-1.3% of cases (Fleischman 2018). Fleischman reviewed the femoral nerve palsy cases at a single institution and found that motor strength recovery did not commence for a majority of patients until 6 months postoperatively, however motor weakness had resolved in 75% of patients by 33 months. Fortunately, our patient is on a similar timeline for nerve symptom resolution.

CONCLUSION

Total hip revisions performed for acetabular defects are challenging procedures. The acetabular defect case presented here was particularly difficult due to component incarceration. Surgical creativity and new technology have provided innovative solutions to these problems and fortunately yielded a stable construct for this patient. ■

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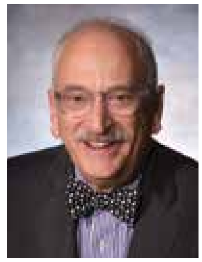
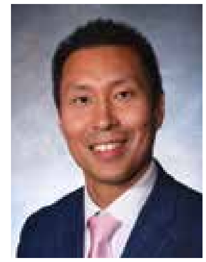
M. Truitt Cooper, MD

Associate Professor



Shepard Hurwitz, MD

Professor Emeritus



Joseph S. Park, MD*

Associate Professor

Dr. M. Truitt Cooper grew up on the east coast of Florida and attended college at Washington and Lee University, followed by medical school at the University of Virginia. He completed his Orthopaedic Surgery Residency at Ohio State University.

Following his residency, Dr. Cooper completed a Fellowship in Foot and Ankle Reconstruction under Michael Coughlin, MD, in Boise, Idaho. Initially, he joined a private practice group in Richmond, VA. However, in 2014, he decided to return to the University of Virginia to pursue a career in academics. Currently, Dr. Cooper serves as the Fellowship Director for the Foot and Ankle Fellowship at the University of Virginia, as well as the Medical Director for the Ambulatory Orthopaedic Clinics.

Dr. Cooper is an active member of the American Orthopaedic Foot and Ankle Society. He currently serves as Vice-Chair of the Physician Resource Committee and has served on the Post-Graduate Education Committee. He serves on the editorial board for Foot and Ankle Specialist and as a reviewer for Foot and Ankle International.

In addition to maintaining an active clinical practice focusing specifically on foot and ankle reconstruction, he has numerous research interests. These include total ankle arthroplasty, midfoot injuries, and arthrodesis healing. He is currently involved in multi-center clinical trials involving total ankle replacement and bone graft substitutes for foot and ankle fusion procedures.

Dr. Cooper is married with three children that keep him and his wife very busy. He enjoys most outdoor activities, including mountain biking and trail running.

Dr. Shepard Hurwitz grew up in New Rochelle, NY, and went to Columbia College, followed by Columbia University College of Physicians & Surgeons for his BA and MD, respectively. He was a college fencer on a team that won two NCAA championships.

Dr. Hurwitz spent two years in Charlottesville after medical school as a General Surgery Resident (1976-1978) and then completed an Orthopaedic Residency in New York City, at the New York Orthopaedic Hospital. He completed one year of adult and pediatric foot/ankle training at the Hospital for Special Surgery in New York City then another year of biomechanics and fracture surgery at New York Hospital/Hospital for Special Surgery. He joined the UVA faculty in 1994 and was the Chief of the Foot/Ankle Division of the department.

Dr. Hurwitz has been on numerous AAOS and AOA committees as well as committees for the ORS, OTA, and AOFAS. He was a member-at-large of the AOFAS Board of Directors (2005-2007), President of the Eastern Orthopaedic Association (2002-2003), and President of the Southeastern Fracture Symposium (2006-2008). He was on the ABOS Board of Directors (2005-2007) and was the Executive Director of the ABOS (2007-2016). He was on the UVA Faculty Senate (2003-2006) and several SOM committees.

Dr. Hurwitz is married to Margretta, and they have two daughters, Zoe and Leah. Zoe played varsity volleyball on an NC High School championship team, and Leah is an outstanding field hockey athlete who recently was named to a national travel team. Dr. Hurwitz volunteers in North Carolina as a physician to the athletic teams in Carrboro and Chapel Hill, and he is the Administrator of the Surgical Skills Laboratory in the Department of Orthopaedic Surgery. His hobby is shooting clay pigeons and competing in skeet and sporting clays events. He plays tennis occasionally and enjoys fishing when he gets the chance to go out on someone else's boat.

Dr. Joseph S. Park was born in Brooklyn, NY, and grew up in the suburbs of Baltimore, MD. He earned his undergraduate degree from the University of Pennsylvania in Philadelphia, where he graduated magna cum laude. He then graduated Alpha Omega Alpha from the University of Virginia School of Medicine. Dr. Park then spent 5 years in New York City, where he completed his Residency in Orthopaedic Surgery at New York University Langone Orthopedic Hospital. He then completed his Fellowship in Orthopaedic Foot and Ankle Surgery at Union Memorial Hospital in Baltimore, MD. He returned to the University of Virginia in 2010 to join our Orthopaedic Surgery Faculty.

Dr. Park, an Associate Professor in Orthopaedic Surgery, has been the Foot and Ankle Division Head at UVA since 2010 and serves as the Foot and Ankle Consultant to the UVA Athletic Department. Through his research collaborations with the Biomedical and Mechanical Engineering Departments at UVA, he has helped establish UVA and the Center for Applied Biomechanics as nationally recognized leaders in biomechanical testing of orthopaedic implants. His peers voted him as one of the Best Doctors in America for 2015-2016 and 2017-2018. He also received the UVA Dean's Award for Clinical Excellence in 2015.

Dr. Park is a reviewer for the *Journal of Bone and Joint Surgery* as well as *Foot and Ankle Orthopaedics*. He is the Associate Foot and Ankle Fellowship Director at UVA and is currently Chairman of the Physician Resource Center Committee for the American Orthopaedic Foot and Ankle Society (AOFAS). In November of 2018, he traveled to Xiamen, China, where he was selected to represent the AOFAS at the 13th Annual Congress of the Chinese Orthopedic Association.

Dr. Park has helped establish and coordinate the Boar's Head UVA Physician Speaker Series and is an avid UVA Athletics fan. He and his wife, Ann Marie, have 3 school-aged children (and 2 puppies). He is a member of the Boar's Head USTA tennis team and enjoys playing sports and spending time with his family.

Venkat Perumal, MBBS

Assistant Professor

Dr. Venkat Perumal was born and grew up in India. He attended medical school and did his Residency in Orthopaedic Surgery in India.

Dr. Perumal's specialty is Foot and Ankle. He completed multiple fellowships, including one in Pediatric Orthopaedic Surgery at Cincinnati Children's Hospital, one in Orthopaedic Trauma at the University of Louisville, and one in Adult Reconstruction and Foot and Ankle at UVA. Dr. Perumal joined the UVA Department of Orthopaedic Surgery's faculty in April 2013.

He has a wife, Vanitha, and has two children. He spends his free time with family and enjoys playing chess, camping, biking, hiking, attending spiritual meetings, and volunteering in free medical camps and homeless shelters.

UVA Foot and Ankle Division

Joseph S. Park, MD[1], M. Truitt Cooper, MD[1], Venkat Perumal, MBBS, MS[1], Victor Shen[2], PhD, Jason R. Kerrigan, PhD[2], E. Meade Spratley, PhD[3]

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[2]University of Virginia, Department of Mechanical and Aerospace Engineering, Charlottesville, VA
[3]University of Virginia, Center for Applied Biomechanics, Charlottesville, VA

The Orthopaedic Foot and Ankle Division at the University of Virginia has become a regional referral center for the comprehensive treatment of complex deformities and athletic injuries to the foot and ankle. Our division is comprised of three Foot and Ankle Fellowship-trained attending surgeons, as well as two experienced physician's assistants. Joseph Park, MD, serves as the Division Head and is a team physician for the University of Virginia. Truitt Cooper, MD, is the Foot and Ankle Fellowship Director, as well as the Medical Director for our outpatient clinics, and is a team physician for James Madison University. Venkat Perumal, MD, serves as the Medical Student and Resident Clerkship Director for the Foot and Ankle Division. Our PAs, Jim Shorten and Andrea White provide exceptional patient care and continuity of follow-up for our busy clinical practice.

Our division is involved in multiple clinical trials and biomechanical studies focusing on ankle replacement, hindfoot arthrodesis, tendon reconstruction, orthopaedic implant performance and optimization, as well as gait analysis for ankle replacement patients. Many of our biomechanical studies have resulted in cross-Grounds collaborations with members of our Engineering Department, including Jason Kerrigan, PhD, and Meade Spratley, PhD, from the Center of Applied Biomechanics and Chris Li, PhD, from Mechanical Aerospace Engineering. Since 2017, when the University of Virginia awarded our group an Engineering in Medicine grant to develop a robotic gait simulator, we have secured approximately $600,000 in external/industry funding for lower extremity research projects. We will continue to cultivate these collaborative endeavors, and hope to establish UVA as a leader in biomechanical testing for orthopaedic implants and procedures.

With Dr. Chris Li, we examined the performance of 1st tarso-metatarsal fusion constructs in a sawbones foot model. In or-

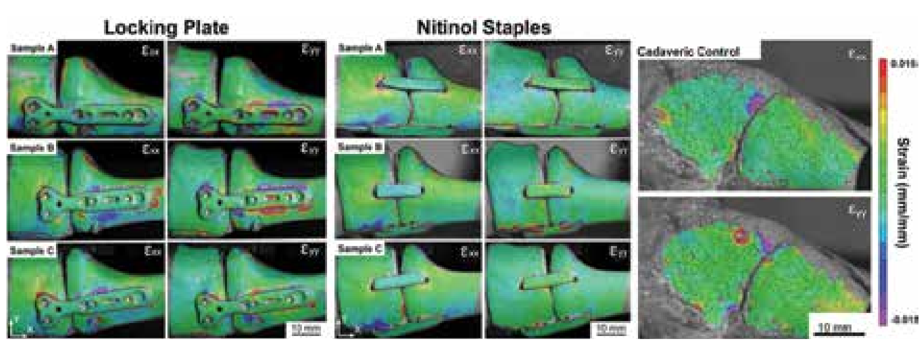


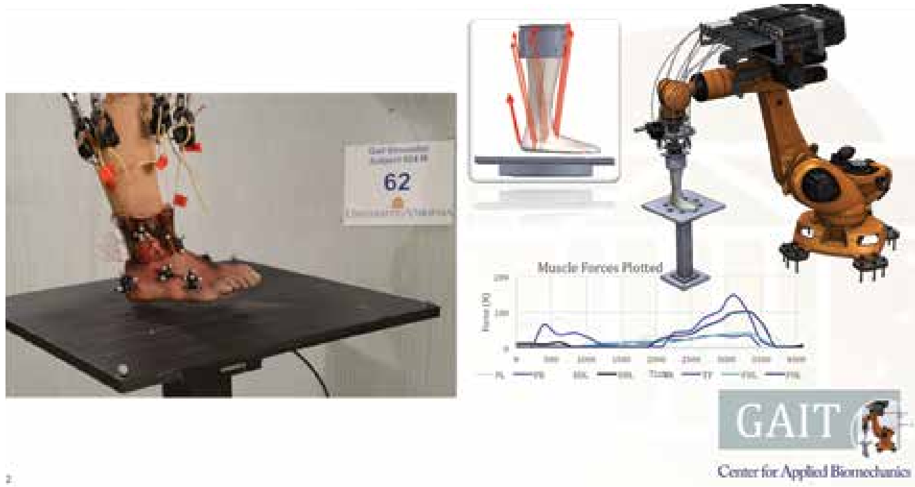
Figure 1. DIC strain maps in the x and y direction are shown at the peak of the last load cycle.

der to better understand the dynamic properties of nitinol continuous compression implants and more traditional lag screw/plate fixation, we utilized 3D digital image correlation to characterize the stress/strain of the arthrodesis construct under 3 point bending. We hypothesized that while stiffness of the joint would play a role in successful arthrodesis, residual displacement after loading might better indicate long-term stability of the implant construct. Paint was applied in a unique speckling pattern, and high resolution multi-planar video was utilized to illustrate the changing relationship between these individual reference points under 50 Newtons of load. This loading was repeated 100 times for each specimen, and we compared two arthrodesis constructs; three samples with a 4.0 mm lag screw and 4 hole locking T plate, and three samples with two nitinol compression staples implanted in an offset 90 degree configuration (dorsal and medial).

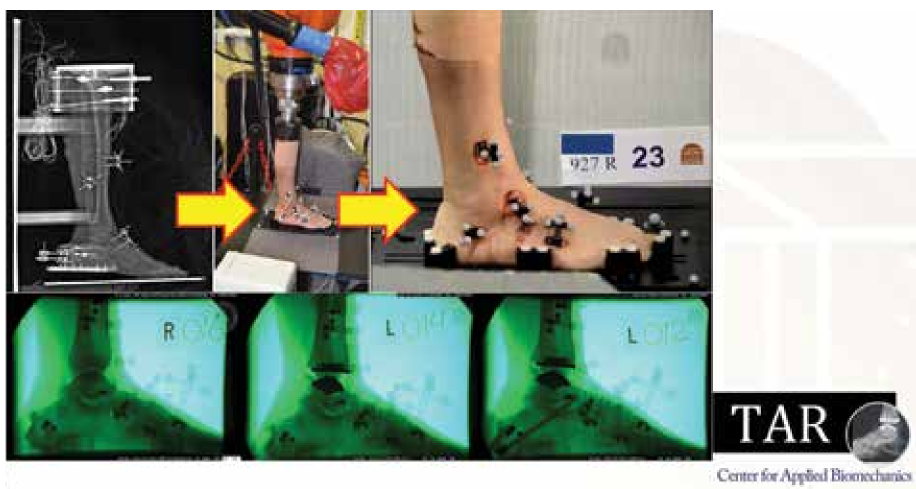
The conclusions of our study showed that although the lag screw and locking plate construct resulted in less initial displacement compared to the compression staples (2.2 mm versus 3.2 mm respectively), after the conclusion of 100 cycles of loading, the lag screw/locking plate construct had more residual plantar gapping of 0.8 mm versus 0.3 mm for the dual staple construct. Although both implant constructs performed well under this simulated weight bearing cycling, the improved recovery of compression after load for nitinol compression staples may facilitate an increase arthrodesis rate for these challenging orthopaedic procedures. Currently, cadaveric testing is underway to better characterize the performance of these implants for simulated weight bearing in a fixed ankle walker.

With internal funding from UVA, we have developed a robotic gait simulator at the Center of Applied Biomechanics. Using a Kuka robot with the ability to move with 6 degrees of freedom, our group has incorporated tendon actuators to more closely replicate human gait by activating tendons during the appropriate time point during the gait cycle. This provides our lower extremity research group with a unique research tool that differentiates us from every other biomechanical testing facility in the world.

In a preliminary mobile bearing ankle arthroplasty study, we demonstrated 3 dimensional motion analysis of the cadaveric ankle in the native condition, after ankle arthroplasty, and after ankle arthroplasty and subtalar arthrodesis. Given the unique characteristics of the mobile bearing implant, we subjected the cadaveric ankle to loading in dorsiflexion, plantarflexion, as well as inversion and eversion to enable us to better understand the response of the arthroplasty construct and mobile bearing polyethylene to complex ambulation tasks such as navigating hills and uneven surfaces. We hypothesized that the mobile bearing may decrease stress on the tibial and talar implant/bone interface due to its ability to rotate and translate within the ankle joint. Data analysis is currently underway, and additional studies to better understand ankle arthroplasty biomechanics are in preparation. ■



Gait Simulator Overview



Robotic Joint Characterization for TAR

A. Bobby Chhabra, MD

Lillian T. Pratt Distinguished Professor and Chair
David Harrison Distinguished Educator

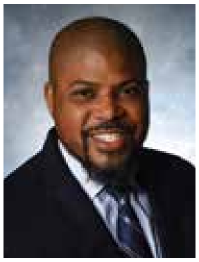
Dr. A. Bobby Chhabra is the Lillian T. Pratt Distinguished Professor and Chair of Orthopaedic Surgery and the David A. Harrison Distinguished Educator, as well as Professor of Plastic Surgery and Professor of Pediatrics at the University of Virginia. He is also a team physician and the Hand and Upper Extremity Consultant for the UVA Department of Athletics. He is currently the President of the University of Virginia Physician's Group and the School of Medicine Faculty Representative to the UVA Health System Board and Board of Visitors.

Dr. Chhabra's areas of expertise include hand, wrist, and elbow trauma and arthritis, with a particular interest in sports injuries and congenital hand surgery.

Dr. Chhabra is a nationally recognized educator. He has received the University of Virginia School of Medicine Dean's Award for Excellence in Teaching, the University of Virginia Master Educator Award, and the David A. Harrison Distinguished Educator Award, the highest teaching honor at the University of Virginia School of Medicine. In 2014, Dr. Chhabra was inducted into the Raven Society, the most prestigious honorary society at the University of Virginia.

Dr. Chhabra graduated from the Johns Hopkins University with a degree in biology before completing his medical education at the University of Virginia School of Medicine. He completed his residency training in Orthopaedic Surgery at the University of Virginia Health System. He received his fellowship training in Hand and Upper Extremity, Microvascular, and Congenital Hand Surgery at the Hand Center of San Antonio and the Texas Scottish Rite Hospital.

Dr. Chhabra has published over 60 peer-reviewed articles and 40 book chapters, has been the editor for 5 textbooks, given 150 national/international presentations, and has been invited as a Visiting Professor at 20 prestigious institutions.



A. Rashard Dacus, MD

Associate Professor and Vice Chair for
Diversity & Wellness

Dr. Dacus joined the department in August of 2007 after completing a Fellowship in Hand and Upper Extremity at the University of California, San Diego. His practice encompasses hand trauma, nerve dysfunction in the upper extremity, joint replacement in the hand and elbow, and reverse total shoulder arthroplasty, as well as microvascular surgery of the hand and upper extremity.

He served as Residency Program Director from July 1, 2011, until June 30, 2019. Since 2008, Dr. Dacus has been Assistant Team Physician for James Madison University Athletics and continues in that capacity. On July 1, 2019, he assumed the role of Vice-Chair for Diversity and Clinician Wellness for the Department of Orthopaedics. It is a newly-created position, so that he will serve as the pioneer for possibilities for this role.

Dr. Dacus serves on the Education Committee for the American Association for Surgery of the Hand and serves as a reviewer for the *Journal of Hand Surgery*. He 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 enjoys spending time with his wife and baby daughter and traveling to new places.

D. Nicole Deal, MD*

Associate Professor

Dr. D. Nicole Deal is an Associate Professor with tenure and the Division Head of Hand Surgery at the University of Virginia. She is also the Co-Director or the UVA Hand Center and the Hand Fellowship Director for the Plastic Surgery Department, where she also has an appointment. Dr. Deal completed her undergraduate degree at the University of Virginia, medical school at the Medical University of South Carolina, and Residency and Hand Fellowship at Wake Forest University. In 2009, Dr. Deal was excited to join the Orthopaedic Hand Faculty at the University of Virginia.

Since joining the faculty, Dr. Deal has received many faculty achievement awards, including the Dean's Award for Clinical Excellence in 2013 and the Dean's Award for Teaching Excellence in 2015, and was inducted into the Academy of Distinguished Educators in 2016. Dr. Deal currently serves as the Secretary/Treasurer for the Virginia Orthopaedic Society and looks forward to serving as the President for the 2020- 2021 term.

Dr. Deal has authored 28 peer-reviewed journal articles and 27 book chapters. Her research interests include nerve regeneration techniques, and she has received 2 prestigious Coulter Foundation grants for her collaboration with faculty from the Department of Biology to develop novel techniques to stimulate nerve growth. In addition, she is the PI for a clinical study investigating the use of allografts for sensory deficits.

Aaron M. Freilich, MD

Associate Professor

Dr. Aaron M. Freilich is an Associate Professor of Orthopaedics in the Hand and Upper Extremity Division with a joint appointment in the Department of Plastic Surgery. Dr. Freilich is the Orthopaedic Hand Fellowship Director and serves as the 3rd Year Medical School Orthopaedic Clerkship Director as well.

He began his education at the University of Michigan, studying Economics and Cell and Molecular Biology, and graduating with honors. He received his MD in 2004 from the University of Virginia. Dr. Freilich continued his training with a Residency in Orthopaedic Surgery at UVA and then completed a Fellowship in Hand and Upper Extremity Surgery at Wake Forest Baptist Medical Center. He is a member of the AAOS and ASSH, serving on several committees both locally and nationally. He continues to serve as a member of the UVA Medical School Curriculum Committee as well.

Dr. Freilich treats hand, wrist, and elbow problems, with a particular interest in trauma and microvascular reconstruction. He works closely with his plastics hand surgery colleagues in training plastic surgery residents and fellows and further developing a joint hand reconstructive service. His research interests are in education and simulation training and collaboration with the Center for Applied Biomechanics. He is married with two children. He enjoys skiing, hiking, and spending time outdoors with his wife, kids, and their 2 Labradoodles.

UVA Hand Highlights

The Hand Division is one of several academic medical centers contributing to a Nationwide Database on outcomes related to hand and digital replants following traumatic amputations.

The UVA hand division has 2 nationally recognized positions for hand fellows in collaboration with the Department of Plastic Surgery. We receive more than 100 applications for these 2 positions and routinely match in the top 5 people on our rank list.

Recent publications from the hand center:

Radial Head Fracture Fixation Using Tripod Technique With Headless Compression Screws

Marc D. Lipman, MD[1], Trent M. Gause, MD[1], Victor A. Teran, MD[1], A. Bobby Chhabra, MD[1], D. Nicole Deal, MD[2]

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[2]Department of Orthopaedic Surgery, University of Virginia Health System, Charlottesville, VA

ABSTRACT

Radial head and neck fractures are one of the most common elbow fractures, comprising 2% to 5% of all fractures, and 30% of elbow fractures. Although uncomplicated Mason type I fractures can be managed nonsurgically, Mason type II-IV fractures require additional intervention. Mason type II-III fractures with 3 or fewer fragments are typically treated with open reduction and internal fixation using 2 to 3 lag screws. Transverse radial neck involvement or axial instability with screw-only fixation has historically required the additional use of a mini fragment T-plate or locking proximal radius plate. More recently, less invasive techniques such as the cross-screw and tripod techniques have been proposed. The purpose of this paper is to detail and demonstrate the proper implementation of the tripod technique using headless compression screws.

J Hand Surg Am. 2018 Jun;43(6):575.e1-575.e6. doi: 10.1016/j.jhsa.2018.03.009. Epub 2018 Apr 27.

Patient-Related Risk Factors for Infection Following Open Carpal Tunnel Release: An Analysis of Over 450,000 Medicare Patients

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ABSTRACT

Purpose: To establish the rate of postoperative infection after open carpal tunnel release (CTR) on a national level using an administrative database and define relevant patient-related risk factors associated with its occurrence.

Methods: The PearlDiver patient records database was used to query the 100%

Medicare Standard Analytic Files retrospectively from 2005 to 2012 for patients undergoing open CTR using Current Procedural Terminology code 64721. Postoperative infection within 90 days of surgery was assessed using both International Classification of Diseases, Ninth Revision codes for diagnoses of postoperative infection or pyogenic arthritis of the wrist, and Current Procedural Terminology codes for procedures for these indications, including either open or arthroscopic irrigation and debridement. We used a multivariable binomial logistic regression model that allows for assessment of the independent effect of a variable while controlling for remaining variables to evaluate which patient demographics and medical comorbidities were associated with an increased risk for postoperative infection. Adjusted odds ratios and 95% confidence intervals were calculated for each risk factor, with P < .05 considered statistically significant.

Results: A total of 454,987 patients met all inclusion and exclusion criteria. Of these patients, 1,466 developed a postoperative infection, corresponding to an infection rate of 0.32%. Independent positive risk factors for infection included younger age, male sex, obesity (body mass index of 30 to 40), morbid obesity (body mass index greater than 40), tobacco use, alcohol use, and numerous medical comorbidities including diabetes, inflammatory arthritis, peripheral vascular disease, chronic liver disease, chronic kidney disease, chronic lung disease, and depression.

Conclusions: The current study reinforced conventional wisdom regarding the the overall low infection rate after CTR and revealed numerous patient-related risk factors that are independently associated with an increased risk of infection after open CTR in patients enrolled in Medicare.

J Hand Surg Am. 2018 Mar;43(3): 214-219. doi: 10.1016/j.jhsa.2017.09.017. Epub 2017 Oct 18.

Bone Graft Substitutes: Current Concepts and Future Expectations

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ABSTRACT

Owing to its osteoinductive and osteoconductive properties and the presence of osteogenic cells, freshly harvested autologous bone graft is the gold standard for skeletal reconstruction where there is inadequate native bone. Whereas these characteristics are difficult to replicate, engineered, commercially available bone graft substitutes aim to achieve a comparable osseoregenerative profile. This work furnishes the reader with an understanding of the predominant classes of bone graft substitutes available for reconstruction of upper extremity bone defects following trauma or oncological surgery. We review bone graft substitutes with respect to their mechanisms of action, their advantages and disadvantages, and their indications and contraindications. We provide examples of bone graft substitutes in clinical use and outline comparative costs. We also describe the future directions for this specific aspect of reconstructive surgery with a focus on the role of bioactive glass.

We review bone graft substitutes with respect to their mechanisms of action, their advantages and disadvantages, and their indications and contraindications.

J Hand Surg Am. 2019 Jan 28. pii: S0363-5023(18)30766-4. doi: 10.1016/j.jhsa.2018.10.032. [Epub ahead of print]

Perioperative Narcotic Use and Carpal Tunnel Release: Trends, Risk Factors, and Complications

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ABSTRACT

Background: The goals of the study were to: (1) evaluate trends in preoperative and prolonged postoperative narcotic use in carpal tunnel release (CTR); (2) characterize risks for prolonged narcotic use; and (3) evaluate narcotic use as an independent risk factor for complications following CTR.

Methods: A query of a large insurance database from 2007-2016 was conducted. Patients undergoing open or endoscopic CTR were included. Revision surgeries or patients undergoing median nerve repair at the forearm, upper extremity fasciotomies, or with distal radius fractures were excluded. Preoperative use was defined as narcotic use between 1 to 4 months prior to CTR. A narcotic prescription between 1 and 4 months after surgery was considered prolonged postoperative use. Demographics, comorbidities, and other risk factors for prolonged postoperative use were assessed using a regression analysis. Subgroup analysis was performed according to the number of preoperative narcotic prescriptions. Narcotic use as a risk factor for complications, including chronic regional pain syndrome (CRPS) and revision CTR, was assessed.

Results: In total, 66,077 patients were included. A decrease in prescribing of perioperative narcotics was noted. Risk factors for prolonged narcotic use included preoperative narcotic use, drug and substance use, lumbago, and depression. Preoperative narcotics were associated with increased emergency room visits, readmissions, CRPS, and infection. Prolonged postoperative narcotic use was linked to CRPS and revision surgery.

Conclusions: Preoperative narcotic use is strongly associated with prolonged postoperative use. Both preoperative and prolonged postoperative prescriptions narcotic use correlated with increased risk of complications. Preoperative narcotic use is associated with a higher risk of postoperative CRPS.

Hand (N Y). 2018 Aug 1:1558944718792276. doi: 10.1177/1558944718792276. [Epub ahead of print]

Failed Thumb Carpometacarpal Arthroplasty: Common Etiologies and Surgical Options for Revision

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ABSTRACT

Carpometacarpal (CMC) arthroplasty surgery, although modifications have occurred over time, continues to be commonly performed and has provided patients with their desired pain relief and return of function. The complications of primary surgery, although relatively rare, can present in various clinical ways. An understanding of the underlying anatomy, pathology of coexisting conditions, and specific techniques used in the primary surgery is required to make the best recommendation for a patient with residual pain following primary CMC arthroplasty. The purpose of this review is to provide insights into the history of CMC arthroplasty and reasons for failure and to offer an algorithmic treatment approach for the clinical problem of persistent postoperative symptoms.

J Hand Surg Am. 2018 Sep;43(9): 844-852. doi: 10.1016/j.jhsa.2018.03.052. Epub 2018 Jun 20.

MRI and Arthroscopic Correlation of the Wrist

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ABSTRACT

Since its introduction in 1979, the practice of and indications for wrist arthroscopy in the diagnosis and treatment of pathologic conditions in the wrist continues to grow. Magnetic resonance imaging (MRI) is another commonly used tool to noninvasively examine the anatomy and pathology of the wrist joint. Here, we review the normal wrist anatomy as seen arthroscopically and through MRI. We then examine the various common pathologic entities and define both the arthroscopic findings and correlated MRI findings in each of these states.

Sports Med Arthrosc Rev. 2017 Dec;25(4):e18-e30. doi: 10.1097/ JSA.0000000000000172.

Smoking Increases Postoperative Complications After Distal Radius Fracture Fixation: A Review of 417 Patients From a Level I Trauma Center

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Department of Orthopaedic Surgery, University of Virginia, Charlottesville

ABSTRACT

Background: Unstable distal radius fractures that undergo surgical stabilization have varying complication rates in the literature. Smoking is known to affect bone healing and implant fixation rates but has never been definitively shown to affect postoperative outcomes of surgically managed distal radius fractures.

Methods: A retrospective review was performed of patients with surgically treat-

Smoking is known to affect bone healing and implant fixation rates but has never been definitively shown to affect postoperative outcomes of surgically managed distal radius fractures.

ed distal radius fractures at a Level 1 Trauma Center who had at least 6 weeks of follow-up over a 5-year period. Charts were reviewed for basic demographic information, comorbidities, details about the oper-

ative procedure, and early complications. Notable physical examination findings were noted, such as wrist stiffness and distal radius tenderness to palpation. Statistical analysis was performed to compare the smoking and nonsmoking groups. To control for confounding differences, a hierarchical multivariable regression analysis was performed.

Results: Four hundred seventeen patients were included in the study, and 24.6% were current smokers at the time of surgery. The overall complication rate for smokers was 9.8% compared with 5.6% in nonsmokers. The smoking cohort showed significantly higher rates of hardware removal, nonunion, revision procedures, wrist stiffness, and distal radius tenderness. When controlling for the confounding variables of diabetes and obesity, smokers still had significantly higher rates of the same complications.

Conclusion: Patients who smoke have a statistically significant higher rate of postoperative distal radius tenderness, wrist stiffness, nonunion, hardware removal, and revision procedures compared with those who do not smoke in a review of 417 total patients undergoing surgical fixation for distal radius fractures.

Hand (N Y). 2018 Nov 22:1558944718810882. doi: 10.1177/1558944718810882. [Epub ahead of print]

A Cadaveric Study of the Mean Distance of the Radial Artery During the Approach to the First Carpometacarpal Joint

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Department of Orthopaedic Surgery, University of Virginia, Charlottesville, VA

ABSTRACT

Multiple surgical procedures have been described to treat first carpometacarpal (CMC) arthritis. Although the superiority of one procedure over the others continues to be a controversial topic, they all approach the trapezium and require careful attention to the surrounding structures. One potential complication is injury to the radial artery, which lies in close proximity to the trapezium and is often encountered during surgical approach. Using cadaveric specimens, the authors dissected to identify and isolate the radial artery as it travels in the forearm, wrist, and hand while being careful not to disturb its native course. The authors then measured the shortest distance interval from the radial artery to the first CMC joint and from the radial artery to the scaphotrapeziotrapezoidal joint. Descriptive statistics were calculated from these measurements and averaged over the various specimens. The mean distance of the radial artery to the closest segment of the volar CMC joint was 11.6±2.5 mm. The mean distance of the radial artery to the closest segment of the volar scaphotrapeziotrapezoidal joint was 1.6±1.8 mm. A precise understanding of nearby anatomy is paramount to a successful surgical treatment for first CMC arthritis and to avoid iatrogenic complications. The authors describe the mean distance from the radial artery to 2 major landmarks used during surgical treatment and provide insight to surgeons who perform these CMC reconstruction procedures to decrease the risk of intraoperative radial artery injury.

The authors describe the mean distance from the radial artery to 2 major landmarks used during surgical treatment and provide insight to surgeons who perform these CMC reconstruction procedures to decrease the risk of intraoperative radial artery injury.

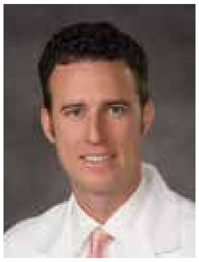
Orthopedics. 2018 Jul 1;41(4):e541-e544. doi: 10.3928/01477447-20180511-05. Epub 2018 May 18.

Figure 1. Wrist fracture simulator

RESIDENT EDUCATION

Distal Radius Fracture Reduction Simulator as a Teaching Adjuvant for Junior Orthopaedic Residents

The educational mission included both didactics and a physical reduction simulator for incoming residents in managing distal radius fracture consults. The 3-D printed wrist fracture simulator led to improved resident comfort with reduction techniques prior to attempts in the emergency department (Figure 1). ■



Gregory Domson, MD

Associate Professor

Dr. Domson specializes in orthopedic 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 orthopedic residency program.

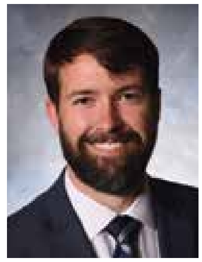
Dr. Domson was an Echols Scholar at UVa, graduating in 1996, before moving on to Eastern Virginia medical school, where he graduated in 2000. He finished his orthopedic residency at VCU in 2005 and completed a musculoskeletal tumor fellowship at the University of Florida in 2006. He received a master's 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 Orthopedics, a fellow of the American Orthopedic Association, and a member of the Musculoskeletal Tumor Society.

Orthopaedic Oncology

The Orthopaedic Oncology Division serves patients in the treatment of both benign and malignant tumors of the extremities, pelvis, and shoulders. This area includes tumors that originate in the soft tissues and bone and tumors that have traveled from other organs to bone. Dr. Domson has years of experience in treating these rare and complicated conditions in children and adults and divides his time between UVA and MCV in Richmond.

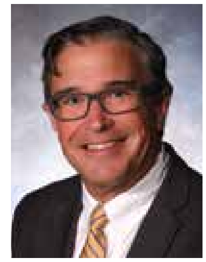
Mark F. Abel, MD*

Charles J. Frankel Professor and
Vice Chair for Faculty Development



Keith R. Bachmann, MD

Assistant Professor and
Associate Residency Director



Mark J. Romness, MD

Associate Professor

Dr. Mark F. Abel, Charles Frankel Professor of Orthopaedic Surgery and Professor of Pediatrics, is the Division Head of Pediatric Orthopaedics. He has a diverse practice covering fractures, limb deformities, and spinal deformities. He has a national reputation for the management of spinal deformities in children, including scoliosis. Through his research and involvement in national study groups, he has been instrumental in improving the non-operative treatment of scoliosis through bracing and casting. In addition, he has worked collaboratively with surgeons from multiple major children's centers to improve the care pathways and surgical techniques for children with spinal deformities, including those with cerebral palsy and other neuromuscular conditions. Dr. Abel has also done extensive research on movement patterns in children with cerebral palsy and studied the effects of orthopaedic surgical procedures to address these disorders.

Dr. Abel attended Tulane University Medical School, then completed an internship in General Surgery at Washington University, St. Louis, followed by Orthopaedic Surgical training at the University of California, San Diego, including a Fellowship in Pediatric Orthopaedic Surgery at the San Diego Rady Children's Hospital.

Dr. Abel served in the Navy at the Portsmouth Naval Hospital for 4 years and then came to the UVA Health System in 1993, where he has practiced for over 25 years. He has served in numerous leadership roles, including Chair of the Department of Orthopaedic Surgery between 2002 and 2003 and from August of 2008 through August 2013. He has been involved in committees overseeing quality and strategy. Currently, he serves as the Vice-Chair for Faculty Development in the Department of Orthopaedics. He has published over 87 peer-reviewed articles and numerous book chapters on pediatric orthopaedic topics. He has been listed among *Connolly's* Best Doctors in America for 13 consecutive years. Dr. Abel enjoys reading, music, and outdoor activities. He has 2 grown sons with his spouse, Jean, of 35 years.

Dr. Keith R. Bachmann 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 Orthopaedics 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.

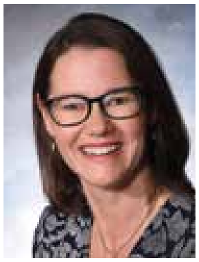
Locally, Dr. Bachmann serves on the UVA Children's Surgical Performance Improvement Committee. He is active in the Virginia Orthopedic Society, and moderates panels and serves on committees through the Pediatric Orthopedic Society of North America (POSNA) and the Scoliosis Research Society (SRS). Dr. Bachmann is a member of the Harms Study Group, which is 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 the need for surgical treatment for spinal disorders.

Outside of work, Dr. Bachmann and his wife like to travel, preferably to destinations with scuba diving. They have two sons, a couple of dogs, and a cat. Dr. Bachmann tries to stay involved with mountain biking, golf, and scuba diving. He is a fan of the University of Virginia collegiate sports, and Cleveland-based professional sports teams.

Dr. Mark J. Romness is an Associate Professor of the Department of Orthopaedic Surgery with a secondary appointment in the Department of Pediatrics. The dual appointment highlights his commitment to Pediatric Orthopaedics and the unique care that children encompass compared to adults. His clinical and academic expertise includes children with special needs such as cerebral palsy and spina bifida, which incorporates his other interests of extremity problems such as 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 interest and expertise.

Dr. Romness has served on the Board of Directors for the American Academy for Cerebral Palsy and Developmental Medicine, been President of the Virginia Orthopaedic Society, and is a long-standing member of the Pediatric Orthopaedic Society of North America. Within the Orthopaedic Department, Dr. Romness serves as the Medical Director for Prosthetics and Orthotics, a member of the Resident Advocacy Committee, and Medical Student Clinical Supervisor. He is also an Associate Medical Director of the Motion Analysis and Motor Performance Lab, which is internationally recognized for clinical evaluations of patients with cerebral palsy.

Dr. Romness grew up in Arlington, Virginia, and has been in practice for more than 25 years, joining the University of Virginia in 2004 after practicing at children's hospitals in Connecticut and Fairfax, Virginia. He received his undergraduate education from the College of William and Mary and then completed medical school and his orthopaedic residency at Northwestern University. He spent one year at the Royal Children's Hospital in Melbourne, Australia for his Fellowship in Pediatric Orthopaedics. He is married to Christine Romness and they have three grown children.



Leigh Ann Lather, MD

Associate Professor

Dr. Leigh Ann Lather was born in Minneapolis, MN, and grew up in Iowa, New Jersey, and England. She majored in Psychology at Duke University and graduated with Honors from UNC Chapel Hill School of Medicine.

Dr. Lather specializes in general orthopaedic care for children ages newborn through 18 years. She originally trained as a pediatrician and completed her residency and served as Chief Resident at UVA before entering private practice pediatrics in rural NC for 13 years. She returned to UVA in 2012 to complete Fellowship in Non-Operative Pediatric Orthopaedics/Musculoskeletal Medicine and then joined the orthopaedic faculty. Dr. Lather sees patients three days per week at UVA Children's Hospital Clinics and one day each week at UVA Zion Crossroads. She teaches medical students and residents from the Departments of Orthopaedics, Pediatrics, Family Medicine, and PM&R, as well as her colleagues in practice who care for children in this region and nationwide.

Dr. Lather serves as the Medical Leader of the 4th floor Women's and Children's Hospital Clinics. She is also involved nationally with a network of other non-operative pediatric orthopedists at large pediatric teaching hospitals across the US. She is proud to be actively engaged in the evolution of this new specialty that fills a growing need in pediatric medical care.

When she is not working, she wants to be with her children, family, and friends. She loves hiking in the Blue Ridge, reading books that are entirely fictional, and practicing Nia and yoga. She also needlepoints, happily carrying on a tradition among the women of her mother's family.

What's New in Pediatric Orthopaedics

Mark F. Abel, MD, Keith R. Bachmann, MD, Leigh Ann Lather, MD, Mark J. Romness, MD

University of Virginia, Department of Orthopaedic Surgery, Charlottesville, VA

CARE OF CHILDREN WITH SPINAL DEFORMITIES

Introduction: Major advances in the management of children with spinal deformities have occurred over the last several decades. Our involvement with multi-center data collection efforts and research has provided collective input leading to evidence-based changes in care pathways and surgical treatments.

ADOLESCENT IDIOPATHIC SCOLIOSIS:

- BRAIST study - a prospective cohort study looking at efficacy of bracing. Finding (NEJM 2013): Bracing reduced the risk of reaching surgical threshold; TLSO - 28% versus 52% of observation group reached surgical threshold (>50 degree).
- Further research shows highest risk: open triradiate, thoracic curves. Minimum brace time to improve outcome is 18 hours/day for patients with a curve >25 degrees and these characteristics.

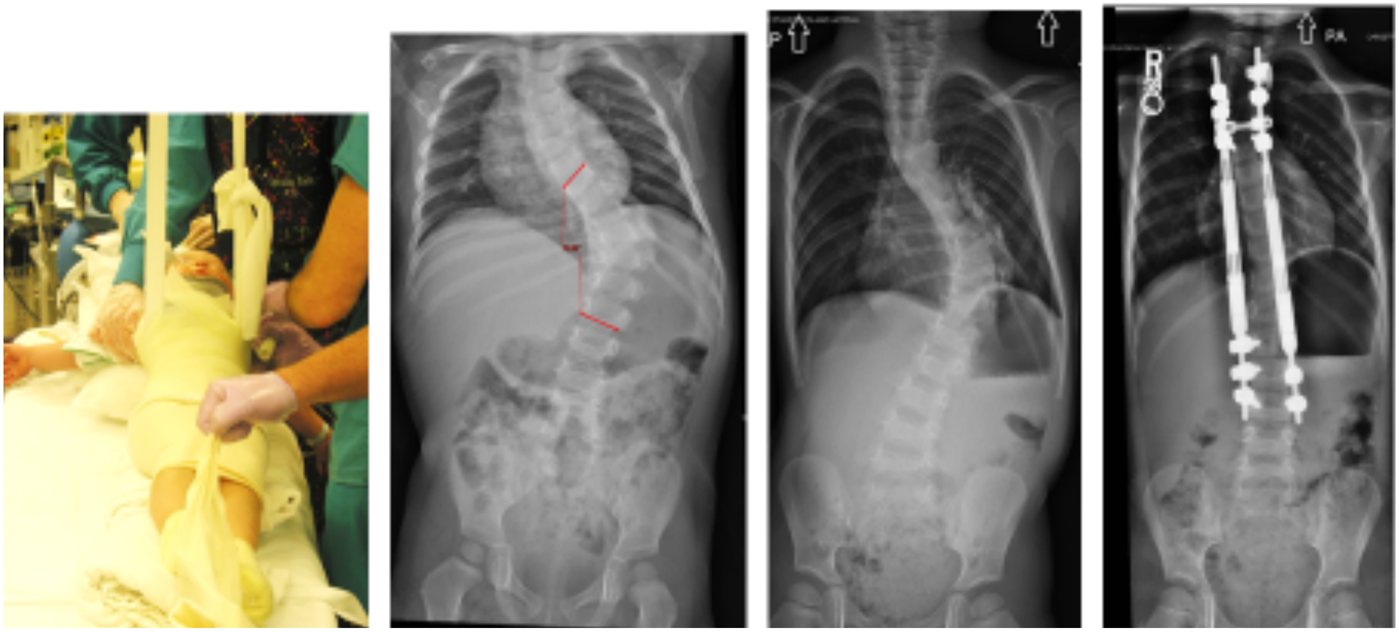
EARLY ONSET SCOLIOSIS: AGE-BASED TREATMENT APPROACHES

- Casting children between 1-3 years of age can slow progression and even improve curve size.
- Improved outcomes associated with earlier age of first cast and greater in-cast correction (>50% correction).
- Growth rod constructs have been replaced by MAGEC, which allows up to 5 cm of lengthening without the need for general anesthetic. The law of diminishing returns still applies with MAGEC. After 7-9 lengthening tensile resistance of the tissues restricts the ability of the rod to lengthen.
- Vertebral Body Tethering: Early trials suggest that tethering the anterior spinal column using vertebral body screws in the apical vertebra and interconnected with a polyethylene cable across the convexity of the curve can lead to slowing of curve enlargement and even correction in some cases. Current indications are for children with a skeletal age of 8 to 10 years and curves of greater than 50 degrees.

The validation of the CP:CHILD, a health-related QOL survey, has greatly facilitated our understanding of the impact the spinal surgery has on this population.

NEUROMUSCULAR SCOLIOSIS: LEARNING FROM THE PROSPECTIVE CEREBRAL PALSY SPINAL DEFORMITY STUDY

- Scoliosis is common in severely impaired patients with cerebral palsy. Up to 70% of patients in the most severe groups (GMFCS IV & V) will develop significant scoliosis which can detrimentally affect sitting, pulmonary function, and GI function, and can cause pain.
- The validation of the CP:CHILD, a health-related QOL survey, has greatly facilitated our understanding of the impact the spinal surgery has on this population.



Sequential treatment of infantile Scoliosis: Casting from 14 months until 30 months of age, then insertion of MAGEC rods to allow serial distraction

CP: Child Questionaire – Prospectsive CP Spine Study

Pre-Post Comparison at 24 Months

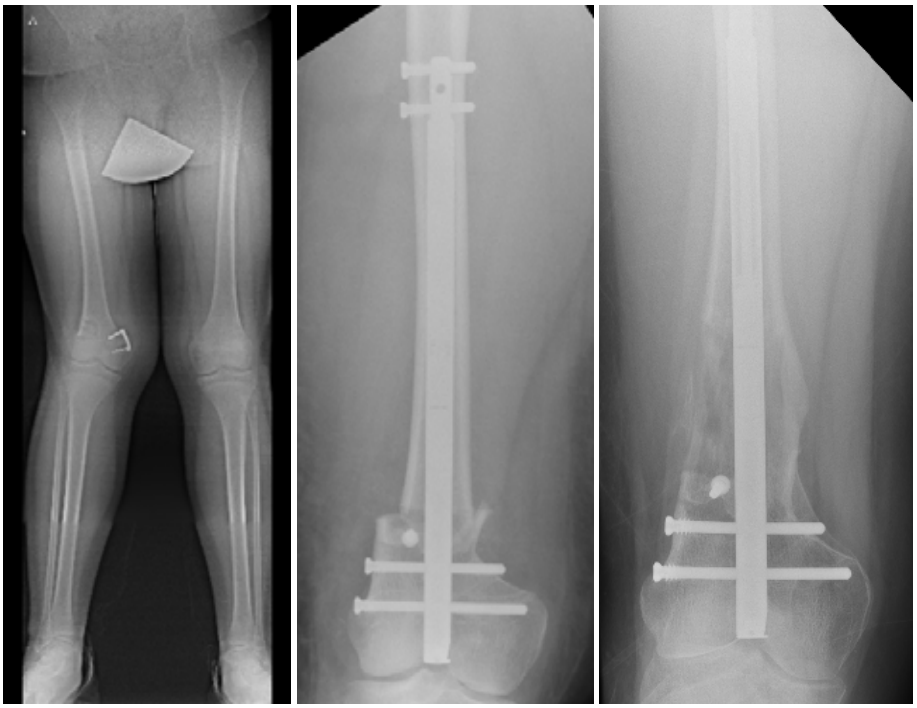
	Pre-op Mean (SD)	Post-op Mean (SD)	Mean of Diff. (95% CI)	P Value
Personal Care & ADLs *(n = 89)*	39.5 (15.8)	44.5 (17.6)	5.1 (1.1, 9.0)	0.013
Positioning, Transfers & Mobillity *(n = 86)*	35.5 (17.3)	44.1 (17.9)	8.6 (4.8, 12.4)	<0.001
Comfort, Emotions Behaviour *(n = 74)*	72.9 (21.9)	80.4 (19.7)	7.5 (2.6, 12.5)	0.003
Communication & Social Interaction *(n = 93)*	53.2 (29.5)	55.1 (28.6)	1.9 (-2.2, 5.9)	0.365
Health *(n = 94)*	55.1 (20.0)	60.6 (19.7)	5.5 (1.4, 9.4)	0.008
Overal QoL *(n = 93)*	63.0 (26.2)	69.2 (24.6)	6.2 (0.5, 12.0)	0.033
Total Score *(N = 90)*	50.7 (14.8)	56.8 (15.9)	6.1 (3.1, 9.0)	<0.001

Patient related outcome of 22 patients with cerebral palsy undergoing spinal surgery.

- Spinal deformity surgery is a major intervention and historically major complications requiring hospitalizations and additional surgery occur in up to 20% of patients.
- Therefore, since 2008 we have participated in research to assess the impact of spinal surgery in this population with the goals of understanding the change in QOL and improving care pathways.
- What we have learned:
  - Intra-op use of tranexamic acid reduces blood loss;
  - Consistent surgical teams reduce complications;
  - The vast majority of patients with CP can have multi-modal spinal cord monitoring intraoperatively;
  - Antibiotic powder may reduce infection rates;
  - Early, day-of-surgery extubation is the most important factor in reducing length of stay.

LIMB LENGTHENING UPDATE: USE OF THE PRECISE NAIL

- Externally controlled intramedullary device to change the length of a bone.
- Similar mechanism to MAGEC rod used in spine.
- Nail can be controlled for lengthening and shortening so it is more adjustable and there are fewer problems with too rapid lengthening or overlengthening compared to prior lengthening nails such as the ISKD.
- Requires correction of angular or rotational deformity before use so osteotomy needs to include that correction.



15 year old male with angular and length deformity. Had unsuccessful attempt at medial growth tether, so had acute fixator-assisted angular correction and then lengthening with the PRECICE nail.

Nail cannot be used across an open physis so it is not useful in younger children, but that may be a reason to postpone lengthening until older.

- Can be used for bone transport to close a defect.
- Nail cannot be used across an open physis so it is not useful in younger children, but that may be a reason to postpone lengthening until older.
- Less pain, easier to do physical therapy, and better cosmetic appearance after treatment than external fixators.
- The nail has FDA clearance for magnetic resonance imaging (MRI) under certain conditions, but removal once healed is usually recommended. ■

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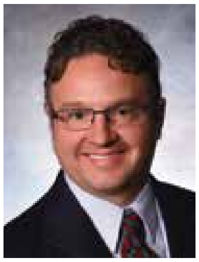
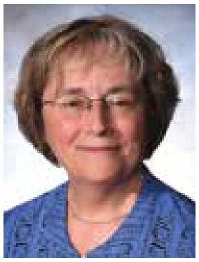


Kevin King, CPO*

Technical Director

Michele E. Bryant, MS, ATC, CO

Assistant Technical Director



Mary Grant, CP

Certified Prosthetist

Kevin is a graduate of Mount Union College in Alliance, Ohio, with a Bachelor of Science in Biology in 1996. He has been employed full time in the field of Prosthetics and Orthotics since 1996. He attended Northwestern University in 1999 for his Orthotic and Prosthetic Certification. He spent the first 7 years of his professional career at the Cleveland Clinic Foundation, working first as a Prosthetic/Orthotic technician, then as a Certified Orthotist, and finally as a Certified Prosthetist/Orthotist. Kevin joined the faculty of the University of Virginia in 2003 in the UVA Orthopedics Division of Prosthetics and Orthotics. In 2008 he was appointed as Assistant Technical Director for the Division of Prosthetics and Orthotics at UVA, and in March of 2017, Kevin was appointed as the Technical Director for the Division of Prosthetics and Orthotics.

Kevin has a keen interest in Computer-Aided Design and Manufacturing for the prosthetics and orthotics field and has used this technology at UVA to help improve orthotic management of scoliosis and plagiocephaly for the Division of P&O. He has most recently used this technology to develop techniques for improved prosthetic fittings and repeatable outcomes.

He is a long-standing member of both the Association of Children's Prosthetic and Orthotic Clinics ACPOC and the American Academy of Prosthetist/Orthotists AAOP. He has served in the Spinal, Cranial, and CAD societies of AAOP over the years (currently active in the CAD society).

Kevin volunteers extensively in the community and has served as both a soccer coach and an adaptive ski instructor. He has spent the past 16 seasons volunteering at Wintergreen Adaptive Sports teaching skiing to people with disabilities and holds a Level 2 Adaptive and Telemark Instructor credential through the Professional Ski Instructors of America. Every day he embraces the WAS slogan "from the top of the mountain, all we see is possibility."

Kevin enjoys spending time with his wife of 24 years and their 3 children. They all enjoy camping, hiking, skiing, and attending sporting events.

Michele grew up in Maryland and started her college career at High Point University, where she graduated with a B.S. 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 Exercise Science/Biomechanics. Michele enjoyed working with the team specialists on lower extremity biomechanics and bracing, and she went on to earn a degree in Orthotics from Northwestern University. After completing her Orthotics Residency at the Cleveland Clinic, Michele went on to work at the University of North Carolina Hospital as a Certified Orthotist.

Michele joined UVA Prosthetics & Orthotics in 2014 and became the Assistant Technical Director in 2017. Michele is a resident mentor for the profession and enjoys educating students and patients.

In her free time, Michele enjoys exercising, crafting, reading, creating Halloween costumes, spending time outside at the beach, in the mountains, and at the local parks with her husband and their dog.

Mary was born and raised in Abingdon, a small town in Southwest Virginia. After graduation, in 1976, she attended Madison College, where she earned a B.S. degree in Biology. She then worked at UVA in Physical and Occupational therapy for a few years before leaving to go to Northwestern University in Chicago to earn her certificate in Prosthetics. She worked in Charlottesville at a P&O facility while she did her apprenticeship and completed all the exams required for Certification. She received her Certification in Prosthetics in 1980 and has been working in the field since that time. She has been a practitioner and supervisor at the University of Virginia Prosthetics and Orthotics Division since 1995.

Mary is certified through the American Board for Certification in Prosthetics and Orthotics. She is also a member of AOPA and ACPOC, two of her field's national organizations. Locally, Mary helped to organize and start "Limbs on the Go," a support group for amputees in Central Virginia that has been helping amputees and their families for over 23 years. She has also been active with Adventure Camp (a camp for kids with limb loss) for almost 22 years, serving as president of the board for much of that time.

Mary lives in Charlottesville and enjoys gardening, traveling, hiking, and spending time with friends and family.

Current Trends in Prosthetics and Orthotics at UVA

The University of Virginia Orthopedics Department has a state-of-the-art Prosthetics and Orthotics Division that has made significant advancements in patient care. Below are services that set us apart from our competition:

Scoliosis management via TLSO using digital imaging and Computer Aided Design (CAD) technology

1. We were a national pioneer in scoliosis management using CAD and digital imaging which is accurate to within .5 mm
2. We developed CAD scanning and modifying protocols that are unique to the field and differentiate us from our competition

We specialize in multiple styles and programming options for microprocessor knees for above knee amputees including C-Leg, Rheo Knee, Plie Knee, Genium, and X3 and Microproccesor ankles including the redesigned Proprio ankle.

Cranial remolding via using CAD technology

1. We were the first facility in our area to start using digital imaging and CAD technology for helmet management of plagiocephaly, brachycephaly, and scaphocephaly
2. We designed our own scanning methods accurate to within .5 mm which provides very accurate digital imaging for devices that require precision fit for proper function

Comprehensive custom upper extremity, lower extremity, and spinal orthotic care with state of the are in-house fabrication

1. ABC certified technicians on staff ensure high level of control and precision over our custom fabricated devices
2. State of the art computer aided design and computer aided manufacture machinery ensure precision and repeatability in the fabrication process

Custom upper and lower extremity prosthetic devices utilizing CAD technology accurate to within .5 mm.

1. Digital scans offer significant precision and accuracy and modification options that are not possible with plaster molds
2. This technology offers the possibility of high level prosthetic care at our remote sites and real-time transfer of work files to our central fabrication site expediting the fabrication process

Custom elevated vacuum above knee and below knee prosthetic sockets

1. Considered to be one of the most effective solutions, we offer elevate vacuum, suspension options to our prosthetic patients
2. We are trained to fabricate and fit elevated vacuum suspensions for our prosthesis. Over the years we have refine our options for prosthetic fitting and suspension in order to offer unparalleled care for amputees in our region

Microprocessor controlled Prosthetic Knees and ankles for above knee amputees

1. We specialize in multiple styles and programming options for microprocessor knees for above knee amputees including C-Leg, Rheo Knee, Plie Knee, Genium, and X3 and Microproccesor ankles including the redesigned Proprio ankle.

Custom designed 3D printed prosthetic covers for above and below knee amputees

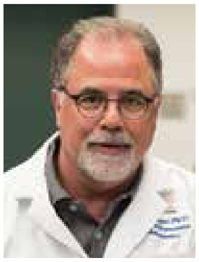
1. Designed through advanced 3D imaging and 3D printing
2. Ability to add personal touch to the design, shape, and covering

Custom myoelectric and body powered upper limb, partial hand, and finger prosthetic options

1. We offer high end myoelectric partial hand options including iDigits and Naked Prosthetics
2. iLimb Ultra, BeBionic, Michelangelo hand, etc offerings
3. High definition custom functionally aesthetic prosthetic options

Team approach to patient care in real-time which is not possible in a private practice

1. We directly communicate with our physician and therapist partners to assure the ideal orthotic and prosthetic designs to fit the patient's conditions.
2. Our collaboration with the medical team is a unique advantage to our patients, especially those with challenging conditions requiring innovative prosthetic and orthotic solutions. ■



George J. Christ, PhD

Mary Muilenburg Stamp Professor

Quanjun Cui, MD

Gwo-Jaw Wang Professor and
Vice Chair for Research

Joe Hart, PhD

Associate Professor

Dr. Christ is a Professor of Biomedical Engineering and Orthopaedic Surgery and holds the Mary Muilenburg Stamp Chair in Orthopaedic Research, where he is Director of Basic and Translational Research in Orthopaedics. He is Co-Director of the Center for Advanced Biomanufacturing. He is the Past Chairman of the Division of Systems and Integrative Pharmacology of the American Society of Pharmacology and Experimental Therapeutics (ASPET), and Past President of the North Carolina Tissue Engineering and Regenerative Medicine (NCTERM) group. He was inducted into AIMBE in 2017. He serves on the Executive Committee of the Division for Integrative Systems, Translational and Clinical Pharmacology of ASPET. He is a member of the Regenerative Rehabilitation Consortium Leadership Council and serves on the Leadership Advisory Council for ARMI/BioFabUSA. He received the Ray Fuller Award and Lecture (ASPET, 2018). He serves on the Editorial Board of five journals and is an ad-hoc reviewer for 2 dozen others. Dr. Christ has authored more than 225 scientific publications and is co-editor of a book on integrative smooth muscle physiology and another on regenerative pharmacology.

Dr. Christ has served on both national and international committees related to his expertise in muscle physiology, and on NIH study sections in the NIDDK, NICHD, NCRR, NAIAD, NIAMS, and NHLBI. He has chaired working groups for both the NIH and the WHO and is co-inventor on more than 26 patents (national and international) either issued or pending. Dr. Christ is also spearheading several MSK-applicable translational research programs to develop novel regenerative medicine treatments for orthopaedic patients, in particular, volumetric muscle loss injuries. He leads a DOD-funded multi-institutional program for the development of a tissue-engineered muscle repair (TEMR) technology platform for the treatment of Wounded Warriors and collaborates in another NIH and DOD funded translational multi-institutional effort as part of the C-DOCTOR consortium. Funding from the DOD and Keratin Biosciences also supports the evaluation of a proprietary hydrogel for the treatment of lower extremity traumatic injuries.

Dr. Quanjun Cui is the G.J. Wang MD Professor of Orthopaedic Surgery, Vice Chair for Research. He is a board-certified orthopaedic surgeon and specializes in adult reconstruction performing primary and revision total hip and total knee replacement surgery. Dr. Cui has written over 130 papers and book chapters on orthopedic surgery and related researches. He edited 9 textbooks. His research is funded by the National Institute of Health (NIH), focusing on stem cell therapy and arthritis.

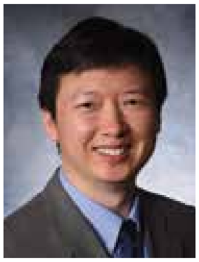
Dr. Cui and his research team have been working on stem cell-based therapy and tissue engineering for the treatment of fractures and osteonecrosis for years. His cutting-edge research has been published in prestigious journals and widely cited by other investigators. One of his current projects entitled "Inhibition of MSC1 stem cells and T cells to endorse bone healing" is supported by NIH, the goal of this study is to improve bone-forming potential of mesenchymal stem cells (MSCs) via inhibition of the TLR4 signaling in MSCs and the activity of T cells to achieve consistent and reliable outcomes. Dr. Cui and his collaborators will use natural antibodies to inhibit MSC1 stem cells and T cells from enhancing the bone-forming ability of MSCs.

The other project entitled "A novel inflammation is targeting Tc-99m probe for osteoarthritis imaging" is also supported by NIH. The goal of this study was to develop a novel approach for the diagnosis of early osteoarthritis using an inflammation specific peptide cFLFLF labeled with Tc-99m. Dr. Cui's research team has established an anterior cruciate ligament transection (ACLT) model of osteoarthritis (OA) in rat and mouse knee joints and examined the activity of inflammatory cells during OA development. The study has demonstrated that the peptide cFLFLF could serve as an inflammation targeting molecule, which has great potential to be used for developing optical and radioactive probes to improve diagnosis and therapeutic evaluation of inflammation-related joint diseases such as OA.

Joe Hart, PhD, was born and raised in Stamford, CT, and studied Athletic Training and Sports Medicine at Marietta College (BS as a Pioneer), West Virginia University (MS as a Mountaineer), and the University of Virginia (PhD as a Cavalier). He has been with UVA Orthopaedics since 2005 as a post-doctoral research associate and research faculty, primarily serving the Sports Medicine Division's clinical research programs. In 2014, he was appointed as the Clinical Research Director for the department and had been serving all divisions' clinical research programs ever since. In that time, he developed a Clinical Trials Division to support the growing clinical research program in UVA Orthopaedics. The Clinical Trials Division now has 5 full-time clinical research coordinators, 3 part-time research assistants, and 2 faculty members to support almost 100 active clinical research protocols.

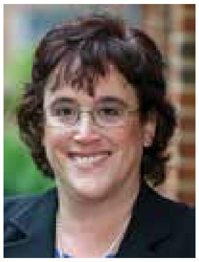
Dr. Hart specializes in movement biomechanics, neuromuscular function, physical activity, and long-term outcomes in patients with ACL reconstructed knees. He is one of 4 faculty directors of the Exercise and Sport Injury Laboratory housed in the Kinesiology Department at UVA, which regularly collaborates with UVA Orthopaedics. Together they have developed a performance testing program for ACL reconstructed patients to help inform post-operative rehabilitation and return to physical activity decision making. They have over 500 patients in their database and regularly perform analyses to understand better factors related to patient outcomes. Dr. Hart serves the *Journal of Athletic Training* as Associate Editor and the NATA Foundation Board of Directors as Vice President of External Affairs. He is a NATA and ACSM Fellow and member of the ORS and AOSSM.

He enjoys spending time with his wife, Jennifer (who is a Physician Assistant with UVA Orthopaedics), his 3 children, and other family and friends. He truly enjoys being a part of the local Charlottesville community and the wonderful local sights, food, and culture. He also loves traveling and sports,...especially beating Mark Miller at golf.



Joshua Li, MD, PhD

Associate Professor



Wendy Novicoff, Ph.D.

Professor

Shawn D. Russell, PhD

Assistant Professor

Dr. Joshua Li was born and grew up in China. He attended Xi'an Medical University for his MD and PhD training. He came to the United States in 1999.

Dr. Li has held dual appointments as an Associate Professor in the Department of Orthopaedic Surgery and the Department of Biomedical Engineering at the University of Virginia since 2017. He completed an Orthopaedic Surgery Residency at the University of Virginia. He followed his internship and residency with a comprehensive Spine Surgery Fellowship at the world-renowned Columbia Spine Hospital. Dr. Li has advanced expertise in a wide range of spinal procedures, from microscope-assisted cervical artificial disc replacement 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 focusing on intervertebral disc degeneration pathology and treatment with stem cells, nanotechnology, and gene therapy. He has been the recipient of over 20 grants as the Principal Investigator, including four NIH (National Institute of Health R03, R21, and R01) grants. He serves as a committee member for the Orthopaedic Research Society and the North American Spine Society. He has been on various grant review panels, including NIH, NASA, MTF, and AO-International.

He is married to Dr. Li Jin. He likes traveling with his wife and plays badminton. He has also led an exercise group practicing Falun Dafa in Charlottesville for a decade.

Wendy Novicoff, PhD, is a Professor of Orthopaedic Surgery and Public Health Sciences at the University of Virginia School of Medicine. 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 Data Science Institute (soon to be the School of Data Science), as the Education Director for the Be Safe Program (the patient safety program at UVA), as the Lead Evaluator for UVA's Clinical and Translational Science Award Program, and as Program Director for a new master's program in interdisciplinary healthcare leadership. She is also a faculty member for the American College of Healthcare Executives (ACHE), where she teaches performance improvement techniques.

Her research interests include health services research and outcomes evaluation, with concentrations in patient decision-making, outcomes after major surgery, comparative effectiveness, and the use of evidence-based medicine. She has also done extensive work in the areas of health system quality and performance improvement, including work on the refinement of measurement systems and reporting mechanisms and standardization of clinical practices. She is a certified Lean Sensei, a certified Change Agent, and a certified Six Sigma Master Black Belt. She has published more than 100 peer-reviewed articles.

She is very involved in local theater, serving on the Boards of the Four County Players and the Virginia Theatre Association, and performing in several shows each year. Wendy lives in Charlottesville with her husband, Bob Davis, and their very fluffy cat, Katrina.

Shawn D. Russell, PhD, is the Director of the Motion Analysis and Motor Performance Laboratory at the University of Virginia, and 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, measurement, 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.

Researchers Developing Drug Delivery Patches to Manage Pain Without Addiction Risk

by Fariss Samarrai,
University News Associate,
Office of University Communications

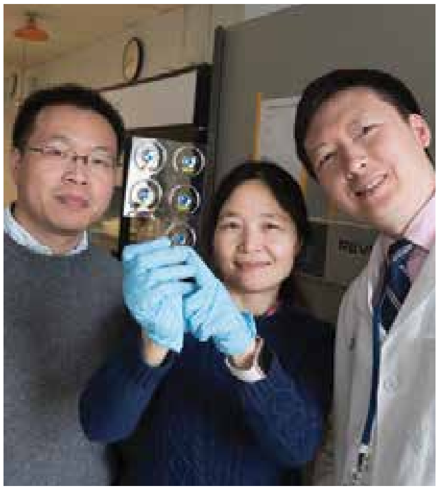


Photo by Dan Addison, University Communications

Mechanical engineer Baoxing Xu, left, Jin Li, a researcher in orthopaedic surgery, and Dr. Joshua Li, an orthopaedic surgeon, are developing an innovative patch that will bypass the bloodstream by delivering medication directly to the site of pain.

Everybody occasionally experiences pain. Generally, pain is manageable with over-the-counter medications, or no medication at all. But when pain is acute and severe, such as after an injury or surgery, stronger pain medication may be required. And for chronic pain, such as from neck and back disorders, the long-term use of opioids to subdue pain can become addictive.

Most narcotics are administered orally or by injection, which means these drugs travel through the bloodstream, affecting the entire body, not only the pain site. This can cause side effects such as gastrointestinal problems, sleeplessness, low blood pressure, and even liver damage. It also can lead to physical dependency.

About 39.5 million adults complain of daily pain, and at least 2 million people in the United States are addicted to prescription pain medications. In 2015, more than 33,000 people died by opioid overdose, many as illicit users who were first exposed to opioid drugs for the treatment of acute or chronic pain. There must be a better way.

Three University of Virginia researchers are working toward an innovative solution for treating lower back pain after surgery and for chronic back pain. They are developing drug delivery patches that would be worn on the skin, like a bandage, to deliver non-addictive pain medicine directly to the site of pain, rather than systemically via pills or injections. The work builds on the UVA Health System's expertise in orthopaedics and pain management—and the engineering of very thin and flexible sensors and circuits.

"We want to relieve pain for patients while also reducing the use of potentially addictive opioids," orthopaedic surgeon Dr. Joshua Li said. "Our goal is to help patients effectively participate in managing their pain without fear of becoming dependent on medications."

Li is a spine surgeon who also conducts pain research. He works daily to alleviate his patients' lower back pain before, during, and after surgery, and is well aware of the opioid addiction problem in the U.S. and the need to keep patients comfortable without creating dependency.

Li is working with mechanical engineer Baoxing Xu, an expert at developing skin sensors and devices that precisely control the flow of microfluids, including medications, and with Jin Li, a researcher in orthopaedic surgery. Together they are taking the concept of a commercially available product—lidocaine pain relief patches—to a new level.

Lidocaine is a non-addictive pain killer that works topically by blocking pain sensors below the skin. Current lidocaine patches release medication to a pain site through skin absorption. But there is no control over when or how much medicine is released, and the skin does not effectively absorb some of it.

The UVA researchers believe they have found a way to improve on these patches in a big way by incorporating dissolvable and minimally invasive microneedles below the surface of the patch to painlessly release controllable flows of medicine, combined with temperature sensors and micro-heaters that would create a warm, soothing effect that also alleviates pain. Relief would come within about 15 minutes.

"We already have experience developing very thin, skin-like sensors and micro-heaters," Xu said. "This new device would bring together several technologies working as one to manage the flow of medication."

The team proposes to add a button or other control mechanism to their patch that would allow patients to manipulate the release of medication based on pain level, while never having to worry about overdosing or developing an addiction.

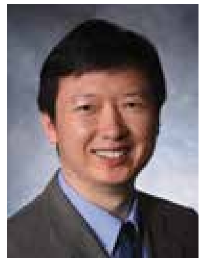
"This device would allow us to treat back pain directly at the site of the pain in a controlled manner while bypassing the bloodstream and the liver," Li said. "We think this could be the solution patients need to manage their pain safely."

The researchers currently are planning fundamental efficacy studies and believe their technology could be ready for use in clinical trials within about five years. ■

This project is funded by a seed grant from UVA Center for Engineering in Medicine.

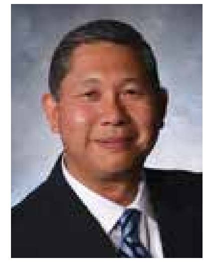
Hamid Hassanzadeh, MD

Associate Professor



Joshua Li, MD, PhD

Associate Professor



Francis H. Shen, MD*

Warren G. Stamp Professor

Dr. Hamid Hassanzadeh joined the UVA Spine Center in 2014 after an Orthopaedic Surgery Residency at Johns Hopkins Hospital and fellowship training in Spine Surgery at Rush University Medical Center. His clinical interests and expertise include complex spinal deformity and the use of minimally invasive surgery. He is an Associate Professor and Director of the Spine Fellowship Program and Co-Director of the UVA Spine Center.

Dr. Hassanzadeh is an award-winning researcher published in more than 100 peer-reviewed journals and has written over 40 textbook chapters. He also leads the Spine Division's Clinical Trial Program with several active phase II/III trials. Dr. Hassanzadeh is actively involved in researching the potential for decreasing complications during large reconstructive spine surgeries by taking appropriate preventive measures and by combining open and minimally invasive techniques. He regularly shares his expertise with fellow providers through continuing medical education courses and presentations at national and international conferences.

In his free time, he enjoys playing guitar and spending time with his wife, Julia, and his two daughters, Stella and Emma.

Dr. Joshua Li was born and grew up in China. He attended Xi'an Medical University for his MD and PhD training. He came to the United States in 1999.

Dr. Li has held dual appointments as an Associate Professor in the Department of Orthopaedic Surgery and the Department of Biomedical Engineering at the University of Virginia since 2017. He completed an Orthopaedic Surgery Residency at the University of Virginia. He followed his internship and residency with a comprehensive Spine Surgery Fellowship at the world-renowned Columbia Spine Hospital. Dr. Li has advanced expertise in a wide range of spinal procedures, from microscope-assisted cervical artificial disc replacement 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).

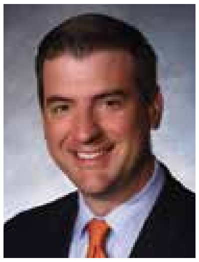
Dr. Li has developed a renowned laboratory focusing on intervertebral disc degeneration pathology and treatment with stem cells, nanotechnology, and gene therapy. He has been the recipient of over 20 grants as the Principal Investigator, including four NIH (National Institute of Health R03, R21, and R01) grants. He serves as a committee member for the Orthopaedic Research Society and the North American Spine Society. He has been on various grant review panels, including NIH, NASA, MTF, and AO-International.

He is married to Dr. Li Jin. He likes traveling with his wife and plays badminton. He has also led an exercise group practicing Falun Dafa in Charlottesville for a decade.

Dr. Francis H. Shen is the Warren G. Stamp Endowed Professor of Orthopaedic Surgery, Professor of Pediatrics, Head of the Division of Spine, and Co-Director of the Spine Center. He earned his biomedical engineering degree from the University of Michigan and completed his orthopaedic residency training at the University of Virginia. He completed fellowship training in Spine at Rush University, Pediatric Spinal Deformity training at Shriners Hospitals for Children in Chicago and an Orthopaedic Research Fellowship at the University of Virginia. He was selected as a Scoliosis Research Society Traveling Fellow and as a North American Spine Society Traveling Fellow.

His clinical practice includes the management of degenerative conditions, spinal deformity, trauma, tumors, and spine infections. He utilizes open surgical techniques but specializes in cutting-edge minimally invasive surgery, image-guided spine surgery, and microsurgery. He performed the first robotic-assisted spine surgery and the first robotic-assisted computer image-guided surgery at UVA. He has been recognized as a Top Doctor by *US News and World Report* and *Castle Connolly Top Physicians* and has been profiled by *Becker's Spine Review*. He has developed several novel surgical techniques.

His research is focused on improving the future of patient care by applying tissue engineering principles to solve clinically relevant problems. He is the Director of the American Academy of Orthopaedic Surgeon Board Review Course, Board Examiner for the American Board of Orthopaedic Surgeons, and Editorial Board Member for the *Spine Journal*, *SPINE*, *European Spine Journal*, and *SpineLine*. He has served on the AOSpine Foundation Board and the Cervical Spine Society Executive Board and is an International Meeting on Advanced Spine Techniques Program members. He is a multiple-time award recipient for Outstanding Basic Science Paper and Outstanding Clinical Paper in the *Spine Journal*. He has received over 20 Young Investigator Awards, Career Development Grants, and Foundation Awards.



Adam L. Shimer, MD

Associate Professor

Anuj Singla, MD

Assistant Professor

Dr. Adam L. Shimer is an Associate Professor of Orthopaedic Spine Surgery at the University of Virginia. Dr. Shimer is the Spine Doctor for the 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 Residency at the 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 faculty in 2009. His practice is focused on complete care of neoplastic, infectious, traumatic, degenerative, and deformity conditions of the spine.

He has extensive experience with and particular interest in treating complex cervical spine pathology. His other research interests include value base spine care, and patient reported outcome measurements and complications of spinal surgery. Dr. Shimer is also the Orthopaedic Inpatient Unit Medical Director. He is a member of the Cervical Spine Research Society, the American Academy of Orthopaedic Surgeons, the North American Spine Society, and the Virginia Orthopaedics Society.

Dr. Anuj Singla was born and grew up in India. He attended medical school and completed his Residency in Orthopaedics in India. He completed fellowships in Pediatric Spine and Orthopaedics/Neurosurgical Spine at LSU, Shriner'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 a 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 committees with the Scoliosis Research Society.

Dr. Singla's clinical and research interests include early-onset scoliosis, fusion-less deformity correction, and patient outcome after spinal surgeries. He has been married to his wife, Priya, for about ten years, and they have two kids.

UPDATE: What's New at UVA Orthopaedic Spine

Francis H. Shen, MD

University of Virginia,
Department of Orthopaedic Surgery,
Charlottesville, VA

SPINE DIVISION

The Division of Spine Surgery has grown steadily over the last 5 years. We now have 5 board-certified spine surgeons and 2 physician assistants covering the whole range of both operative and nonoperative pathologies. As a result of our faculty growth, we have expanded the number of outreach sites, and now see patients not only at the Spine Center at UVA, but also at Zion's Crossroads and Culpeper. This expansion has resulted in a substantial increase in both availability for patient access and office visits, and surgical case volumes over the last 5 years. Perhaps most importantly, this growth has allowed us to expand the care that we can provide for our patients and has given us the ability to see not only routine but also complex pathologies from our referring physicians. What follows is just a small peek into some of the surgical procedures that are now being routinely performed by our surgeons.

Altered spinal anatomy combined with the complex reconstructions required makes these some of the most difficult surgical cases to address, but also some of the most rewarding.

Figure 1A, B. JH is a 39-y.o. right-hand dominant male, who had right arm and right-sided neck pain for over one year with biceps and wrist extension weakness. MRI confirmed a C5-6 herniated disc. He had failed conservative measures, and with associated weakness in a young patient surgery was discussed. In the attempt to reduce the risk of adjacent segment disease, he underwent a C5/6 total cervical disc replacement (Figure 1A, B). He has regained full strength and normal sensation after the surgery.

CERVICAL SPINE

Anterior cervical discectomy and fusion and posterior cervical laminectomy and fusion remain very reliable and durable procedures for the treatment of cervical radiculopathy and myelopathy. However, adjacent segment arthritis and stenosis remain a real clinical concern, especially in our young patients. As a result, total cervical disc replacement (Figure 1) and posterior laminoplasties have gained interest as motion-preserving, non-fusion procedures, and we are now one of the few institutions in the region performing them routinely with excellent results.

DEFORMITY

Spinal deformity can be one of the most technically challenging surgeries that our team manages. Altered spinal anatomy combined with the complex reconstructions required makes these some of the most challenging surgical cases to address, but also some of the most rewarding. For over a decade, we have been developing and using the most cutting-edge technology to address these challenging cases. We developed the technique of Dual Construct (Figure 2) to help address implant failure. More recently, our surgeons performed several "firsts," including the first computer-navigated pedicle screw in the region, the first robotic-assisted pedicle screw in the region, and the first fully navigated robotic case in the region (Figure 3). The ability to apply these techniques to selective cases has dramatically improved patient care and can shorten patient recovery.

TUMOR

Primary or metastatic tumors of the spine and vertebral column can be some of the most difficult conditions for patients, their families, and our surgical team to experience. Many cases are managed medically with systemic or radiation therapies. How-

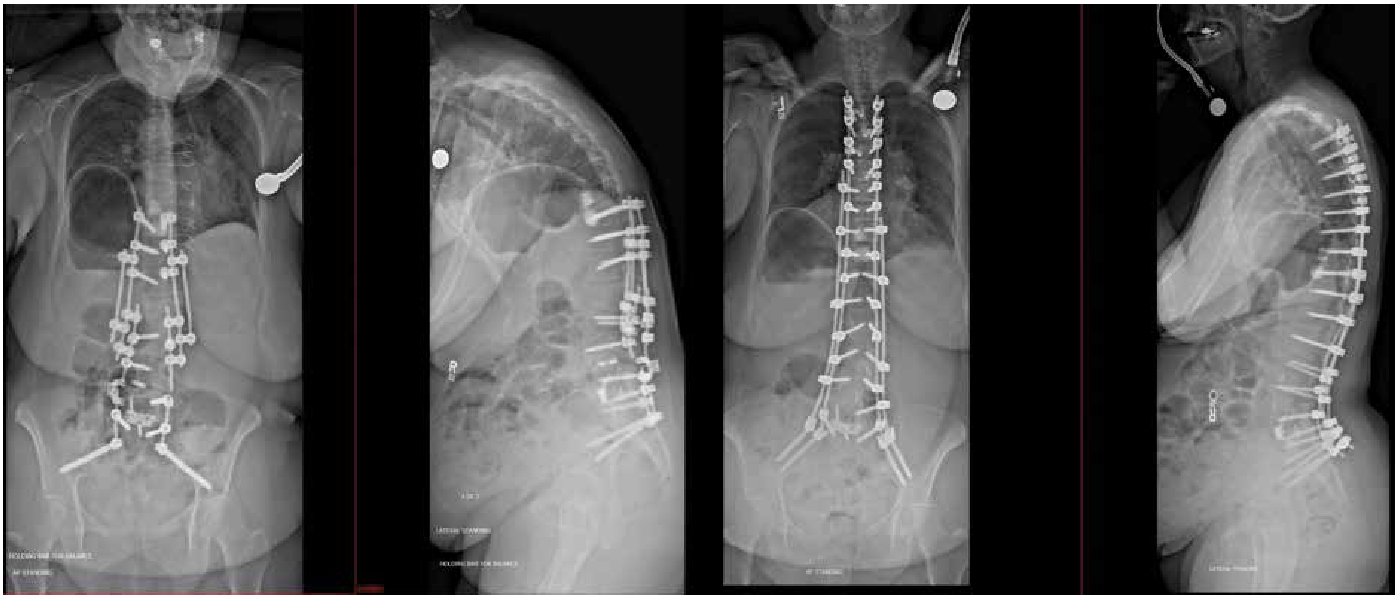


Figure 2A-D. J.R. is a 62-y.o female with progressive adult deformity who underwent multiple surgeries with good initial results at an outside institution, but developed pseudarthrosis and implant fracture (Figure 2A, B). She was referred to our institution for definitive care. She underwent multilevel osteotomy with multi-point fixation and reconstruction utilizing the Dual Construct technique developed at our institution (Figure 2C, D) with a good long-term result.

Figure 3A-D. M.M. is a 22-y.o. male with idiopathic scoliosis that presented to our institution with increasing curve (Figure 3A, B) and progressive back pain. He failed extensive conservative measures. He underwent wide releases and posterior spinal fusion with excellent correction. The ability to utilize computer-navigated, robot-assisted screw fixation allowed for improved accuracy and reduced radiation exposure (Figure 3C, D). Our group was the first to perform robotic-assisted and computer-navigated surgery at UVA and in the region.

ever, frequently, our team is involved in helping resect tumors to restore or maintain neurologic stability or to re-establish spinal biomechanics. In some cases, we are now utilizing navigated instruments to perform precise intra-operative bony resections to reduce morbidity (Figure 4). In other cases, large tumor resections will leave significant bony voids that require complex spinal reconstructions that are frequently unique to the surgical resection performed (Figure 5).

TRAUMA

As a Level I spine trauma center in the area, the University of Virginia receives a wide range of complex fractures. One area that is traditionally challenging to gain stability to allow for more rapid mobilization is com-

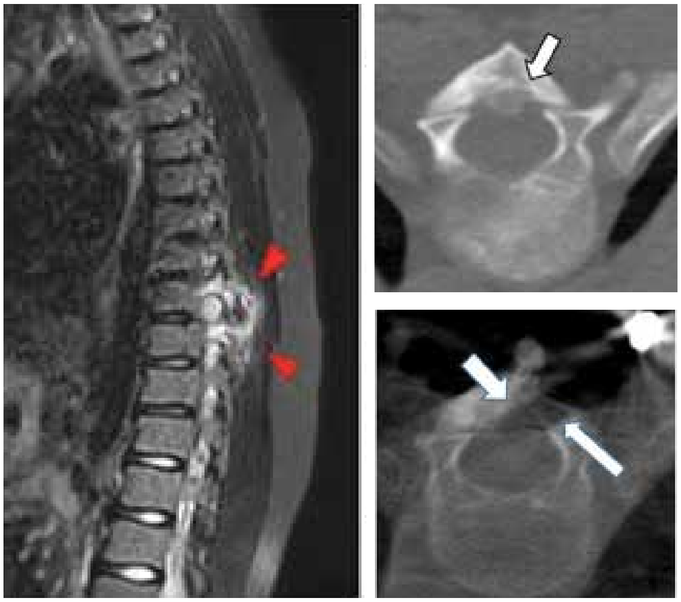


Figure 4A-C. C.C. is a 12-y.o. male with increasing mid-thoracic pain present at rest and waking him from sleep. CT scan confirmed an osteoid osteoma, with a large reactive rim on MRI with gadolinium (Figure 4A, arrowheads). Due to the location adjacent to the thoracic spinal cord (Figure 4B, single arrow), the interventional and musculoskeletal radiologist did not feel that a percutaneous radiofrequency ablation would be a safe option for him. Utilizing intraoperative CT scan and live real-time computer-navigated burr, the osteoid osteoma was localized and resected without extensive removal of the bony and ligamentous elements (Figure 4C, arrow). Therefore, a resection was performed without instrumentation. He had complete relief of pain immediately post op and has returned to school and all sporting activities without restrictions.

Figure 5A-D. T.O. is a 60-y.o female diagnosed with primary liposarcoma of the rigth psoas and pelvis (Figure 5A, B). The patient had progression of tumor burden despite medical oncological therapy. There were no metastases identified on staging, and no further nonoperative options available for the treatment of the lesion. After extensive discussion with patient and family, surgical resection was decided upon. Patient underwent a single stage posterior and anterior en bloc resection with hemipelvectomy and right lower limb amputation. Surgical resection with margins was achieved, and patient underwent complex spinopelvic reconstruction (Figure 5 C,D). Surgical pathology confirmed good margins. As a result, patient did not need to undergo chemotherapy. At recent follow-up, patient is now ambulating unassisted with a walker and independent with ADLs.

Traditionally performed by an interventional radiologist and/or pain management specialist, our team's ability to now provide these procedures allows us to deliver a more streamlined process, comprehensive care, and improved continuity of care for our patients.

plex sacropelvic fractures with lumbopelvic dissociation. In these cases, we have developed and utilized a multi-pelvic fixation (Figure 6) to allow for complex reduction techniques to achieve better anatomic reduction and a more immediate rigid fixation to allow for more immediate mobilization.

NEUROMODULATION AND INTERVENTIONAL SPINE PROCEDURES

As the needs of our patients have expanded, our division has also expanded to match those needs. Fortunately, not all pathologies require a large surgical intervention, and as a result, in selected cases, the Orthopaedic Spine Division is now able to offer our patients more limited alternatives to larger spine procedures, such as cement augmentation for spinal fractures, neuromodulation therapy/spinal cord stimulators, and spinal injections. Traditionally performed by an interventional radiologist and pain management specialist, our team's ability to now provide these procedures

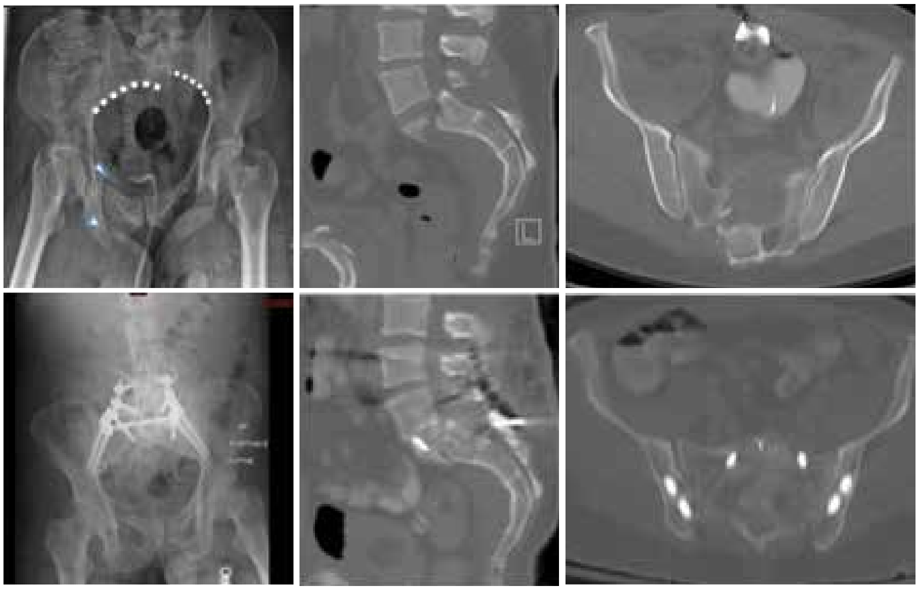


Figure 6. M.K. is a 37-y.o. male in high energy motor vehicle accident with prolonged extrication, transferred to UVA for definitive polytrauma care of polytrauma patient. Code initiated with chest compressions upon arrival and taken to OR for emergent ex-lap and abdominal packing (Figure 6A) due to extensive intraabdominal vascular extravasation. CT scan confirmed vertical and rotationally unstable pelvis (Figure 6B, C). Patient underwent multidirectional pelvic stabilization to allow for multi-planar reduction of the pelvis fracture (Figure D-F).

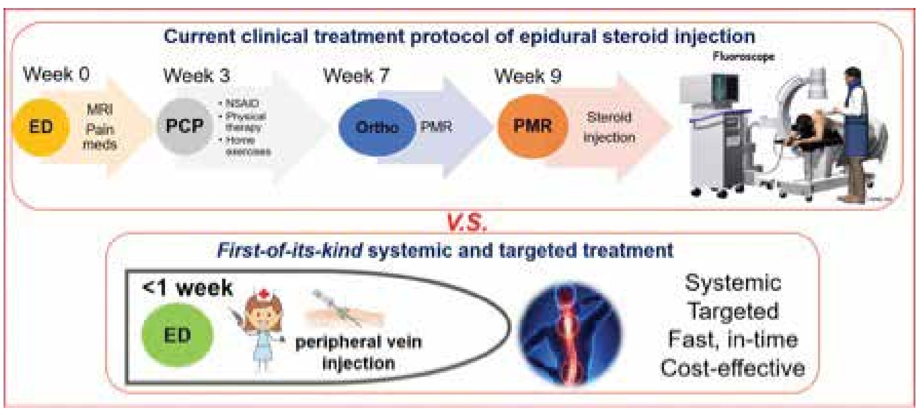
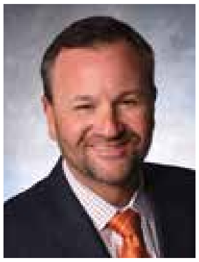


Figure 7. Current treatment for herniated disc with acute radiculopathy can involve multiple providers and a prolonged treatment algorithm that can culminate in an invasive injection within the spinal canal (top pathway). In the current investigation, a peripheral intravenous injection with a site-specific targeted therapy could be delivered at the time of symptomatic flare (bottom pathway).

allows us to deliver a more streamlined process, comprehensive care, and improved continuity of care for our patients.

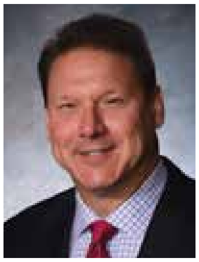
CLINICAL AND BASIC SCIENCE RESEARCH

In the last 5 years, our clinical and basic science research has exploded. There are now over a dozen active clinical trials in place, ranging from an investigation of the role of external spinal fusion devices to analyzing gait patterns of patients who have undergone cervical spine decompressions. Most recently, UVA completed the largest enrollment in an international study of over 50 hospital sites across the globe, investigating the potential for vaccine therapy in the prophylaxis against Methicillin-resistant Staphylococcus aureus (MRSA) related surgical infections. Our basic science research remains in the top tiers in the nation with several million dollars in federal funding from the National Institute of Health (NIH) to support our division's basic science projects. One novel project focuses on treating lumbar radiculopathy by delivering a systemic, injectable, anti-inflammatory nanoparticle via a peptide specifically targeted at active neutrophils and macrophages localizing at the site of disc herniations. This translational study is the first of its kind and would dramatically alter the current paradigm of patient care for the management of lumbar radiculopathy (Figure 7). ■



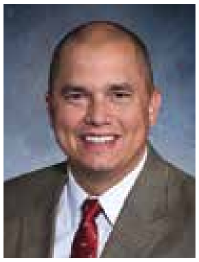
Stephen F. Brockmeier, MD

Associate Professor



David R. Diduch, MD*

Allen F. Voshell Professor of Sports Medicine



F. Winston Gwathmey, MD

Associate Professor and Residency Director

Dr. Stephen F. Brockmeier is an Associate Professor of Orthopaedic Surgery in the Division of Sports Medicine at the University of Virginia. He is Director of the UVA Sports Medicine Fellowship and Team Physician for UVA Athletics, with primary coverage for the UVA Football, Men's Soccer, and Men's Lacrosse teams.

A long-time Hoo, Dr. Brockmeier completed his undergraduate degree here at UVA in 1997. This was followed by medical school and Orthopaedic Residency at Georgetown University. After residency, Dr. Brockmeier spent a year at the renowned Hospital for Special Surgery in New York, where he completed a Fellowship in Sports Medicine and Shoulder Reconstructive Surgery. Prior to coming back to UVA as a faculty member in 2010, Dr. Brockmeier spent three years in practice in Charlotte, NC, where he was the team physician for the NBA Charlotte Bobcats.

His current practice at UVA focuses on sports medicine, knee and shoulder arthroscopy and reconstructive surgery, and the care of athletes and active individuals. He subspecializes in knee ligament, meniscus, and cartilage repair surgery, as well as ACL reconstruction, and has become a regional expert in complex shoulder reconstruction, management of shoulder instability, rotator cuff surgery, as well as total shoulder arthroplasty and reverse shoulder arthroplasty.

His current research focuses on management of 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 Dean's Award for Clinical Excellence at UVA, was selected for the prestigious AOSSM Traveling Fellowship to Europe in 2014, and is the current chair of the Education Committee for AOSSM. He is an active member of ASES, is the Vice President of the ACESS group, and was recently inducted into the Herodicus Society. He lives in Charlottesville with his wife, Kristin, and their three children, Ben, Jack, and Paige.

Dr. David R. Diduch is the Allen F. Voshell Professor and Division Head of Sports Medicine at the University of Virginia. He is also the former Vice-Chair of the department. Dr. Diduch is the Head Orthopaedic Team Physician for UVA Athletics and has primary coverage for men's basketball, football, and women's soccer teams.

Dr. Diduch's training started with college at UNC, followed by medical school at Harvard and Orthopaedic Residency at UVA. After his Sports Fellowship in New York at the Insall-Scott-Kelly Institute, he joined the faculty in 1995. His practice is split between knee and shoulder surgery and the care of injured athletes.

A major area of clinical and research focus for him involves taking care of patients with patella instability. He has extensive experience with treating complex patella instability problems with cutting edge techniques, including tibial tubercle osteotomy, MPFL reconstruction, and limb realignment. He is one of very few surgeons in the U.S. 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.

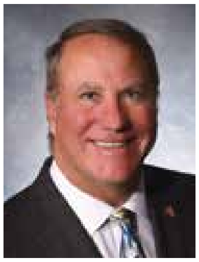
He has received the UVA School of Medicine Master Clinician Award, served as chair of numerous committees for AOSSM as well as the Council of Delegates, served as President of the Virginia Orthopaedic Society, and has been inducted into the Herodicus Society. He has been married to his wife, Lynn, for over 30 years and has 3 grown boys, all of whom graduated from UVA.

Dr. F. Winston Gwathmey is the son of an orthopaedic hand surgeon, Dr. Gwathmey grew up in Norfolk, VA and received his undergraduate degree from the University of Virginia. He received his medical degree from Eastern Virginia Medical School and returned to UVA for residency. He then completed a Sports Medicine and Shoulder Fellowship in Boston at Massachusetts General Hospital and pursued additional hip arthroscopy training with Dr. Thomas Byrd in Nashville, TN.

Dr. Gwathmey returned to UVA as a faculty member 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 Residency Program Director and active in the medical student curriculum as well. 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 of the Sports Medicine Clinic. He is also one of the team physicians for both UVA and JMU Athletics. He is active in the American Orthopaedic Society for Sports Medicine and the Arthroscopy Association of North America, serving as faculty at annual meetings and in surgical skills courses throughout the year.

Outside of work, Dr. Gwathmey enjoys time with his wife, Kelly (a neurologist at VCU), and two kids, Cate and Robert. He enjoys cheering on the UVA and JMU athletic programs.



Mark D. Miller, MD

S. Ward Casscells Professor

Brian C. Werner, MD

Assistant Professor

Dr. Mark D. Miller is the S. Ward Casscells Professor of Orthopaedic Surgery and former Division Head of Sports Medicine at the University of Virginia. He is a retired Colonel in the US Air Force. He is a Distinguished Graduate (top 3%) of the US Air Force Academy and the Uniformed Services University of the Health Sciences (USUHS). Dr. Miller completed his Residency in Orthopaedic Surgery at Wilford Hall USAF Medical Center in San Antonio, Texas, and a Fellowship in Sports Medicine and Shoulder Surgery at the prestigious University of Pittsburgh. He served as a surgeon and team physician at the Air Force Academy and as Chief of Sports Medicine and Deputy Chairman at Wilford Hall before coming to the University of Virginia. He served as Head Team Physician for James Madison University for 15 years.

Dr. Miller has authored over 200 articles and has authored and edited almost 40 textbooks. He has served in numerous leadership positions for the American Orthopaedic Society for Sports Medicine (AOSSM) and currently serves as Secretary on the Board of Directors. He has received the AOSSM George Rovere Award for Education, the USUHS Distinguished Service Award, and the Virginia Orthopaedic Society Lifetime Achievement Award.

Mark Miller is a highly sought after speaker and has organized numerous Instructional Course Lectures, served as a Visiting Professor at multiple prestigious programs, and founded and directed the most successful review course in orthopaedics, the Miller Review Course, established almost 25 years ago.

Dr. Miller's research interests include complex knee to include multiple ligament injuries, revision ACL, articular cartilage injuries, and meniscal repair and transplantation. He is married to Ann Etchison and has four grown children.

Dr. Brian C. Werner is an Assistant Professor in the UVA Department of Orthopaedic Surgery. 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, 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 180 peer-reviewed papers on a wide variety of orthopaedic topics, and has presented his research both regionally and nationally over 300 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 Research Committee for the American Orthopaedic Society for Sports Medicine, Education Committee for the American Academy of Orthopaedic Surgeons, and the Abstract Review 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 and has run numerous marathons and continues to train for both marathon and half marathon distances. He also enjoys golf.

Revision Anterior Cruciate Ligament (ACL) Reconstruction Research

Mark D. Miller, MD

University of Virginia,
Department of Orthopaedic Surgery,
Charlottesville, VA

Revision ACL reconstruction presents a series of challenges for even the most experienced sports medicine knee surgeon. Factors that may lead to ACL reconstruction failure can be grouped into three broad categories: technical errors, repeat trauma, and biologic failure.[1] Technical errors include aberrant tunnel placement, hardware failure, missed concurrent injuries, failure to address excessive tibial slope, and a variety of other factors. Repeat trauma to include overly aggressive physical therapy is often over-diagnosed, but does occur. Biologic failure is perhaps the most poorly understood cause of unsuccessful ACL reconstruction. We are all aware that graft selection is an important factor in ACL success, and allograft use, especially in young patients, is associated with alarmingly higher ACL failure rates.[2] Biologic failure also includes infection and tunnel osteolysis.

Although tunnel Osteolysis can be appreciated on plain radiographs and magnetic resonance imaging (MRI), we have found that computed tomography (CT) is the best way to characterize tunnel Osteolysis.

The problem of tunnel osteolysis in the setting of revision ACL reconstruction is being increasingly recognized, and this is the focus of our current research. Two etiologies of osteolysis have been proposed: the windshield wiper effect and the bungee cord effect.[3] Both are more common with suspensory (cortical) fixation. We have noted increased osteolysis with allograft use (maybe related to processing) and on the tibial side (likely an effect of gravity). The real challenge with osteolysis is determining the optimum way to address it during revision ACL reconstruction. Although tunnel osteolysis can be appreciated on plain radiographs and magnetic resonance imaging (MRI), we have found that computed tomography (CT) is the best way to characterize tunnel osteolysis. The extent and location of osteolysis helps determine whether it can be addressed in a one- versus a two-stage ACL revision.[4]

ONE-STAGE REVISION

Obviously, most patients and, for that matter, surgeons prefer a one-stage approach. Our experience[5] and that of others[6] suggests that a one-stage revision can be successful if the tunnel is less than 14 mm in diameter, and the planned revision tunnel does not substantially overlap the previous tunnels. We have described a technique for one-stage revision ACL using bone dowel allografts[7] that allows successful revision provided the criteria noted above is met and provided that the new tunnels compromise less than 50% of the dowel (Figure 1). Others have described a similar technique using calcium-phosphate to fill the previous tunnels.[8]

TWO-STAGE REVISION

For larger and/or converging tunnels, a two-stage approach is required. The previous tunnel is serially reamed until all fibrous tissue is removed. Dowels, which are cannulated and available up to size 18 x 34 mm, can then be inserted with a cannulated tamp using a press-fit technique. A CT scan is repeated at approximately four months after the first stage procedure to assess healing (Figure 2). Our research has demonstrated that integration

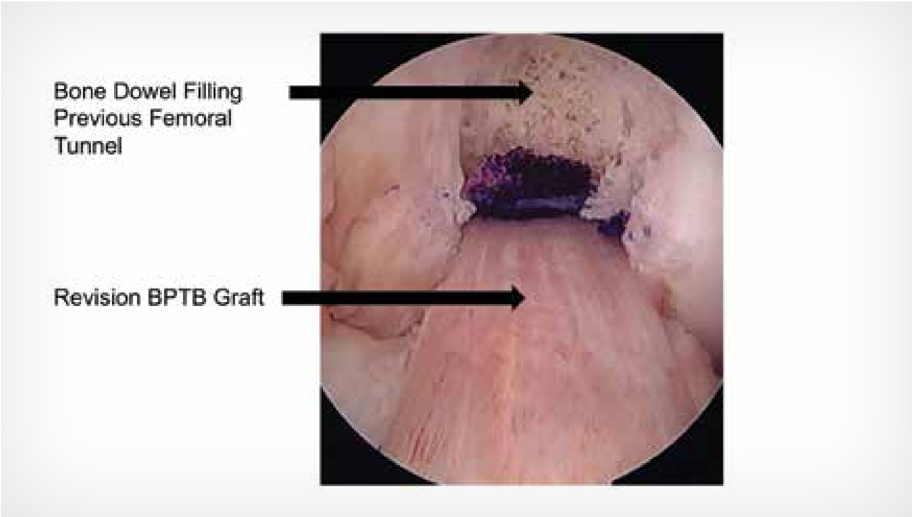


Figure 1. One Stage Revision ACL

of these bone dowels equals the results of filling with autogenous iliac crest grafting.[9] Biopsy of these dowels has shown good integration at four months and creeping substitution at one year (Figure 3). More recently, we have studied tunnel osteolysis and filling using 3-dimensional CT scanning. The preliminary results (Figure 4) are encouraging.

Figure 2. CT Scan demonstrating bone dowel healing at 4 months post op

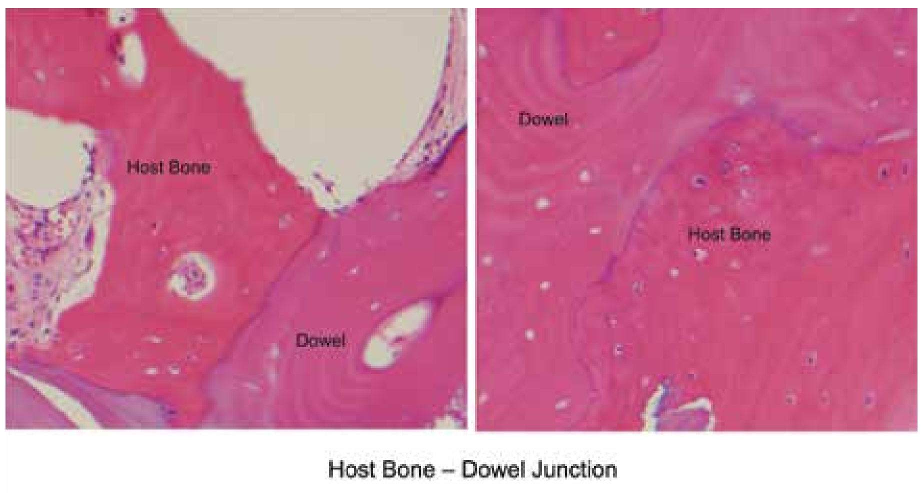


Figure 3. Histology demonstrating healing of bone dowels. A. Four month biopsy shows cement lines between the host bone and allograft bone dowel. B. One year biopsy demonstrating repopulation of the graft with host cells (creeping substitution).

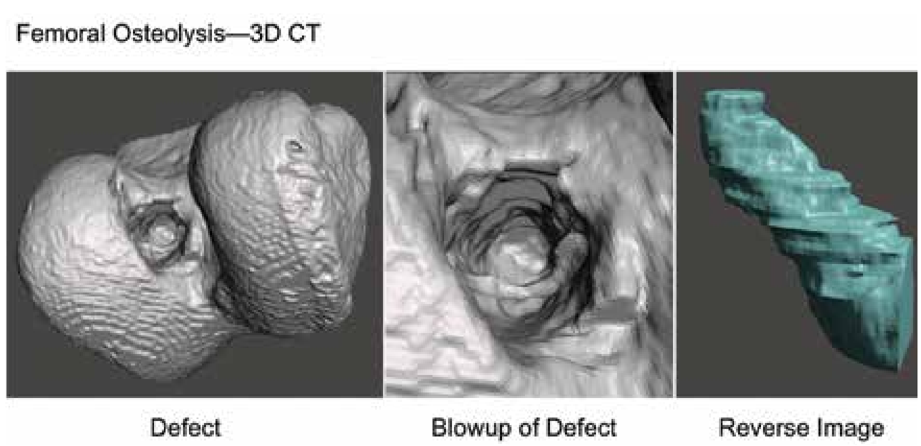


Figure 4. 3-Dimensional CT Scan of bone void and filling.

FUTURE STUDIES

We are continuing our studies of both one- and two-stage revision ACL reconstructions with a clinical study and a randomized controlled study comparing bone dowels with calcium phosphate cement. We hope to report the results of these studies soon. ■

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Engineering Approach to Rotator Cuff Atrophy

Brian C. Werner, MD[1], George Christ, PhD[2], Thomas Barker, PhD[2], Juliana Amaral Passipieri, PhD[2], Sarah Dyer, Graduate student[2], Zoe Roecker, BSE[3]

[1]University of Virginia, Department of Orthopaedic Surgery Charlottesville, VA; [2]University of Virginia, School of Engineering, Charlottesville, VA; [3]University of Virginia Medical Student, Biomedical Engineering, Charlottesville, VA

Rotator cuff tears are the most common musculoskeletal injury in the shoulder, making rotator cuff repair a common procedure. Even with recent advances in repair techniques, there remains a high incidence of healing failure. Numerous factors have been correlated with failure to heal after rotator cuff repair, including patient- and surgeon-related variables.

As rotator cuff repair techniques have improved, failure of the tendon to heal is less likely to occur from weak fixation. More likely causes of failure include biologic factors such as lack of vascularity to the repaired tendon, fatty infiltration or atrophy of the muscle, intrinsic degeneration of the tendon, fibrosis or decreased bone quality at the repair site.

Substantial research has been devoted to improving healing rates and clinical outcomes after rotator cuff repair. The majority of these investigations focus on improving bone-tendon healing through a variety of approaches, including an assortment of methods of footprint preparation, the use of platelet rich plasma, mesenchymal stem cells or growth factors, improving the biomechanical qualities of the repaired tissue through the use of biologic scaffolds or augmentation techniques and improvement of bone quality at the repaired enthesis.

Despite the known association between muscle fibrosis, fatty infiltration and rotator cuff atrophy with poor clinical outcomes and failure after rotator cuff repair, much less research has been devoted to improving muscle quality and function and reducing atrophy following repair of chronic tears. Even with successful surgical repair, defined by a healed tendon-bone interface on imaging, the degenerative changes in the muscle are generally considered irreversible and correlate directly with clinical outcomes.

Dr. Brian Werner has teamed up with Dr. George Christ and Dr. Thomas Barker to develop a tissue-engineering approach to address rotator cuff atrophy. The goals of their in-vivo study are to develop a tissue-engineering muscle repair (TEMR) implant that can reverse rotator cuff atrophy in a rat rotator cuff repair model. To date, Drs. Werner and Christ have made promising progress. The TEMR constructs have been developed and optimized (Figure 1 A-B). A rat rotator cuff model which demonstrates profound supraspinatus atrophy has been developed and optimized as well (Figure 2 A-D). ■

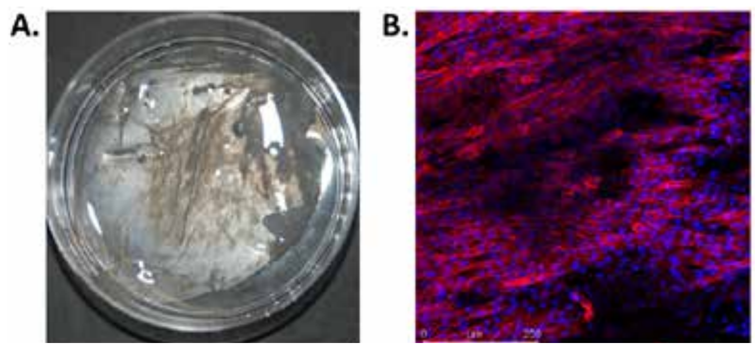


Figure 1. TEMR technology has been optimized in vitro and is ready for implantation in vivo (A). Actin staining shows cell alignment on the BAM after preconditioning in the bioreactor

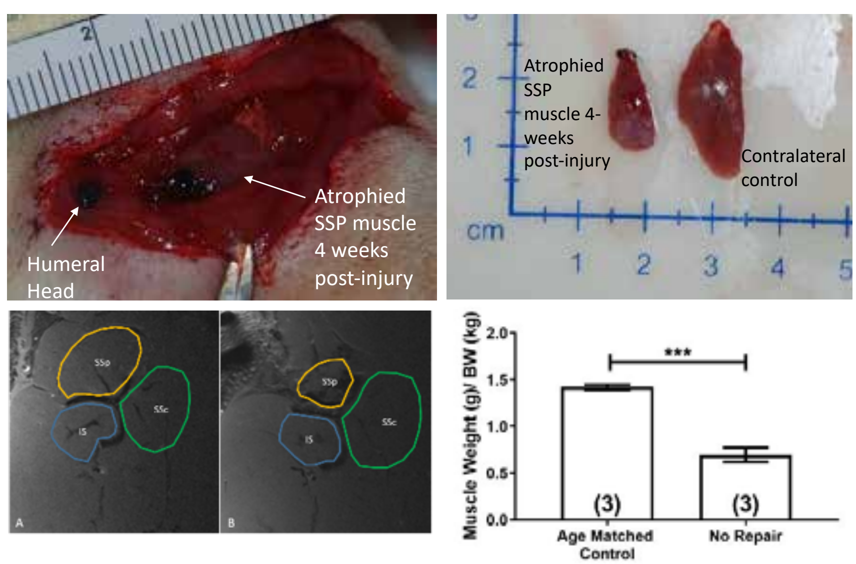
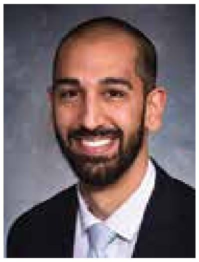


Figure 2. Rotator cuff atrophy rat model. Atrophy of the supraspinatus develops 4 weeks after detachment and can be demonstrated in gross specimens, MRI and in weight testing.

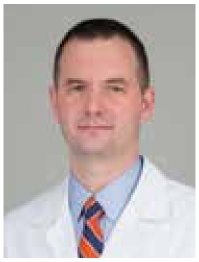


Ahmad Fashandi, MD

Instructor

David B. Weiss, MD*

Associate Professor



Seth R. Yarboro, MD

Associate Professor and Quality Director

Dr. Ahmad Fashandi is a Clinical Instructor in the Orthopaedic Trauma Division. He is a born and raised Virginian, having grown up in the Washington, D.C., suburbs before moving to Charlottesville for higher education. He attended college as well as medical school and completed an Orthopaedic Residency at UVA. Following training, he continued with the faculty in the Orthopaedic Trauma Division at UVA.

His practice focuses on trauma of both the upper and lower extremity as well as the pelvis. He treats a wide range of patients, from adolescents to geriatric populations. His research interests include lower extremity imaging techniques, complex trauma to the foot/tibia/femur, and post-traumatic gait analysis. Dr. Fashandi is married to Dr. Anna Fashandi and is the father of two young girls.

Dr. David B. Weiss attended Johns Hopkins University in Baltimore, MD, for his undergraduate studies majoring in Biomedical Engineering 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 then 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 an 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 the 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 serves on education and patient safety committees for these organizations and has been honored with several education and teaching awards in addition to being selected as a Best Doctor for the last seven years and selected as one of the top 19 Traumatologists in North America in 2015.

Dr. Weiss enjoys trail running, biking, flying (general aviation), and military history. He is married with three boys currently ages 10, 12, and 13 years old. Keeping up with their activities is a second full-time job.

Dr. Seth Yarboro is a North Carolina native who has been an orthopaedic surgeon at UVA since 2012. He 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 at the University of North Carolina at Chapel Hill, where he also completed his Orthopaedic Residency training. Dr. Yarboro then went on to complete Orthopaedic Trauma Fellowships at UNC Hospital, an AOTrauma Fellowship in Hannover, Germany, and a Fellowship in Orthopaedic Trauma and Computer-Assisted Surgery in Ulm, Germany.

At UVA, Dr. Yarboro is an active researcher with a variety of interests, including infection treatment and prevention, ankle syndesmosis injuries, advanced intraoperative imaging, and quality outcomes after surgery. He has contributed to multiple publications and book chapters. 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 currently serves as the Patient Safety and Quality Officer for the Department of Orthopaedics. This work involves organizing regular conferences within the department for case review and education, optimizing quality measures and reporting, and representing the department within the institution regarding quality-related policy.

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

Dr. Yarboro performs surgeries at the UVA Main Hospital and sees patients at the UVA Orthopaedic Clinic in Fontaine Research Park, Office Building 545. He regularly sees new patients through physician referrals and direct patient requests.

Improving Quality of Care for Geriatric Hip Fractures at UVA

Seth R. Yarboro, MD, David Weiss, MD

University of Virginia,
Department of Orthopaedic Surgery
Charlottesville, VA

Hip (or proximal femur) fractures are commonly treated at many hospitals, and the incidence of this type of fracture is increasing as our population, on average, gets older. Specifically, fragility hip fractures, or broken bones that occur in elderly patients, can be challenging, especially when there are other medical issues present. The impact the fractures have on mobility and quality of life can complicate decisions for treatment. These fractures have a substantial impact in terms of cost and lifestyle for patients and their families, and they represent one of the major challenges in caring for an aging population. Therefore, it is very important we optimize and standardize our approach for geriatric fractures.

The University of Virginia is proud of their accomplishment and recent recertification as the only institution in the state of Virginia whose hip fracture program is certified by the International Geriatric Fracture Society (IGFS).

The University of Virginia is proud of their accomplishment, and recent recertification as the only institution in the state of Virginia, whose hip fracture program is certified by the International Geriatric Fracture Society (IGFS). This certification recognizes programs that undertake an interdisciplinary approach to the management of fractures in our elderly population. An interdisciplinary clinical pathway was created to standardize care and move the patient through the system as effectively and efficiently as possible. By measuring and optimizing performance in several different clinical areas, we can ensure the highest level of quality of care is delivered. Adherence to the IGFS guidelines assists in ensuring patients receive the same high standard of care with minimal variability from case-to-case. The ultimate goal is to improve outcomes and to best help patients and their families navigate the difficult situation caused by geriatric fractures.

To be recognized as a premier certified program from IGFS, a program must exceed national quality and outcome benchmarks established for geriatric fracture care. These goals are achieved through co-management of patients—meaning that surgeons and medical doctors work side-by-side in providing specialty care. In other situations, one of the two parties might work as a consultant or secondary physician instead of sharing caregiving duties equally. Other members of the interdisciplinary team include physical and occupational therapists, nurses, care coordinators, case managers, and social workers, among others.

Some of the criteria evaluated when deciding IGFS certification include time from admission until surgery, mortality rates, readmission rates, and general bone health care and education.

Examples of typical patient care are shown below, where this patient is mobilizing with therapy shortly after surgery, as well as working on independence with hygiene, such as brushing teeth. By minimizing downtime after the fracture and having the patient work intensively with therapy, we can determine the patient's rehabilitation and discharge needs and allow families to know what to expect after the hospital stay.

With a clear pathway for patients who have hip fractures, we can give them the best chance of a successful outcome and help them regain as much mobility and independence as possible. ■

Anteroposterior (AP) View of the Knee Does Not Reliably Replace the Lateral View During Evaluation of Femoral Torsion

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ABSTRACT

Background: Femoral shaft fractures in the adult patient are a common injury that almost always require operative fixation. Restoration of anatomic torsion at the fracture site is a critical step. Several accepted methods use the morphology of the femur, such as the lesser trochanter profile technique, to determine anatomic torsion. Recently, the anteroposterior (AP) view of the knee has been used to simplify the procedure, yet this method has not been validated. This potentially introduces variability as the anteroposterior view uses landmarks outside of the femur. The purpose of this study was to[1] assess the reproducibility of anteroposterior view of the knee,[2] compare the side-to-side variability of a patella-centered view compared to the perfect lateral view of the distal femur, and[3] to determine whether the anteroposterior view is adequate for evaluating femoral torsion in femoral shaft fractures.

Hypothesis: It is hypothesized that using a reference point outside of the femur may lead to inaccurate assessment of femoral torsion.

Patients and Methods: Fifteen patients without a history of lower extremity fracture participated in the study. Each participant had their bilateral lower extremities imaged utilizing anteroposterior imaging compared to the gold standard lateral views for establishing rotational alignment of the femur with conventional fluoroscopy. Data were compared between repetitions of a single limb, a single patient's two legs, and between patients. Intra- and inter-rater reliability were measured.

Results: Overall, strong intraclass reliability and reproducibility of the measurements was achieved. Side-to-side and intra-patient variability in the relative position of the patella to the femur was identified, with up to a 14-degree difference between limbs noted.

Discussion: The use of AP imaging alone does not reliably replace the lateral view for the evaluation of femoral torsion. Circumstances were using the AP view will provide erroneous results were identified. Due to side-to-side differences, the AP technique cannot be recommended to determine anatomic torsion in femoral shaft fractures. The conventional technique using overlapping posterior condyles on the lateral view of the knee remains an important part of determining femoral torsion.

Keywords: Femur fracture; torsion; malunion; fluoroscopy; intraoperative imaging

INTRODUCTION

When fixing a femoral shaft fracture, it is critical to restore the anatomy in all three planes—length, angulation, and rotation. Of these deformities, detecting malrotation with conventional fluoroscopy is the most challenging. Despite attempts to restore the anatomic alignment, rotational malalignment remains a common complication, reported in up to 27% of cases[1-4].

Evaluation of normal anatomy has proven that a wide range of femoral torsion exists in healthy, uninjured populations. Variations in proximal femoral anteversion between individuals of >10° has been found without clinical implication. Side-to-side differences in anteversion have also been noted in healthy individuals with an average of 4 degrees of variation, and 95% of patients within 11 degrees of the contralateral extremity.[9,10] In evaluating postoperative patients, malrotation has been defined as >10° of variation from a patient's native anatomy while >15° has shown clinical and functional significance.[3] While appropriate torsion may be determined based on fracture reduction in spiral or long oblique patterns, this method may not be reliable in transverse, short oblique, segmental, or comminuted fractures. As such, appropriately evaluating and reestablishing native anatomy through secondary methods is required.

The use of AP imaging alone does not reliably replace the lateral view for evaluation of femoral torsion.

Several methods have been described to evaluate intraoperative femoral torsion at the time of fracture fixation. Clinical examination of range of motion and lower extremity alignment, cortical thickness at the fracture site, evaluation of anteversion on lateral imaging, lesser trochanteric profiles, and greater trochanter-head contact methods have all been described as techniques or adjuncts to determining appropriate rotation.[5-8] The latter three methods require the surgeon to obtain a perfect lateral view of the knee on the uninjured side prior to draping, as well as intraoperative lateral imaging of the injured extremity. This task may be challenging or cumbersome if the extremities are at the same level, or the fractured extremity must be manipulated.

This difficulty with positioning the injured limb and maneuvering the fluoroscope has led some surgeons to use an anteroposterior (AP) view of the knee with the patella-centered relative to the distal femur as the basis for determining equal femoral torsion, thus avoiding the need for a lateral fluoroscopic view. However, this method has never been validated for utility and reliability. The purpose of this study was to (1) assess the reproducibility of anteroposterior view of the knee, (2) compare the side-to-side variability of a patella-centered view compared to the perfect lateral view of the distal femur, and (3) to determine whether the anteroposterior view is adequate for evaluating femoral torsion in femoral shaft fractures. The lateral view is used as the gold standard for comparison.

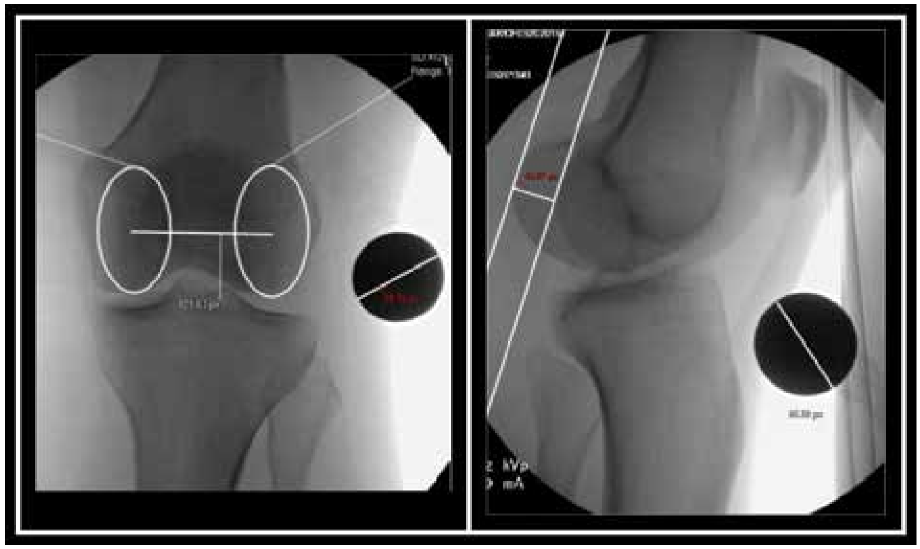

Figure 1. The patella is centered over the tibia spines, then the cross-table lateral view is obtained. PACS software is used to determine distance between condyles on the AP view (left), and the lateral is measured for posterior condyle offset (right).

MATERIALS AND METHODS

After obtaining institutional review board approval, 15 healthy subjects without a history of lower extremity fracture were consented for participation in this study.

Patients were placed supine on a standard operating room table to simulate intraoperative conditions. The extremity being evaluated was imaged at the level of the knee with an AP fluoroscopic image rotated, so the patella was located between the tibial spines (Figure 1). While maintaining the lower extremity in this position, the fluoroscope was rotated 90o, and a cross-table lateral image was obtained. The extremity was then released to neutral rotation, and the process was repeated to obtain 5 sets of such images from each extremity. Imaging was obtained with a marker ball and with consistent positioning of the fluoroscope to maintain magnification and allow for comparison. If indicated due to an inability of the examiner to determine which condyle (medial or lateral femoral condyle) was more posterior on a given lateral image, additional oblique imaging was obtained, and the more posterior condyle was noted on the datasheet.

Images were measured using standard imaging software (PACS) to determine degrees of rotation from perfect lateral of the distal femur based on condylar overlap on a lateral image. The distance was standardized with a marker ball to allow conversion from the pixels measured to the distance in centimeters and finally to degrees of rotation (Figure 1). These data were compared between a given set of five repetitions on a single limb, compared between a given patient's two limbs, and compared between patients to determine the reliability of measurements.

The reliability of data was assessed using Cronbach's alpha and the intraclass correlation coefficient (ICC (2,1)). Cronbach's alpha can be interpreted as a measure of internal consistency of these measurements or as a measure of the generalizability of this group of measurements to measurements in a larger population.[11,12] The intraclass correlation coefficient (the same raters measured each subject, and each rater was considered representative of a larger population of similar raters) was also calculated to provide a composite value for both intra-rater and inter-rater reliability.[13]

RESULTS

Cronbach's alpha and intraclass correlations were considered good (above 0.80) or excellent (above 0.90) for all comparisons (Table 1).[14] Both Cronbach alpha values and ICC values were higher in the left-side measures compared to the right-side measures; the lowest Cronbach alpha and ICC were observed in the side-to-side measurements.

Table 2 shows the actual side-to-side difference for each of the subjects. The average side-to-side difference between legs on individual patients was 6.2 degrees, with a standard deviation of 1.6. The largest value was 14 degrees with a standard deviation of 3.3.

Table 1. Statistical analysis of data from participant imaging

Description of Measurement	Cronbach's Alpha	ICC
Right side – offset pixels	0.970	0.864
Right side – offset centimeters	0.977	0.895
Right side – offset degrees	0.983	0.919
Left side – offset pixels	0.988	0.942
Left side – offset centimeters	0.985	0.930
Left side – offset degrees	0.988	0.941
Side-to-side differences	0.954	0.806

Table 2. Side-to-side difference between legs of individual subjects

Subject Number	Average Side-to-Side Difference (Femoral Version)	Standard Deviation
1	4.7°	±3.1
2	2.6°	±1.6
3	14.0°	±3.3
4	2.0°	±1.5
5	8.6°	±2.3
6	6.4°	±1.6
7	7.5°	±0.9
8	7.9°	±0.9
9	1.4°	±1.2
10	8.3°	±1.1
11	4.4°	±1.9
12	8.9°	±0.7
13	3.4°	±0.7
14	11.0°	±1.9
15	1.2°	±0.9

DISCUSSION

Reestablishing appropriate rotational alignment of a femoral shaft fracture can be both difficult and cumbersome. Current gold standard techniques rely on obtaining orthogonal views of the uninjured extremity while also obtaining orthogonal intraoperative imaging of the injured limb. These orthogonal images allow direct assessment of femoral morphology. Imaging in a single plane would simplify the procedure and increase intraoperative efficiency, which is beneficial to patients. However, imaging in a single plane relies on landmarks outside of the femur, including the patella and tibial spines. Despite use by some surgeons, this method has not been empirically evaluated and compared to the gold standard, and it is unknown how those additional variables might change the reliability and reproducibility of the technique.

This study evaluated the use of intraoperative anteroposterior imaging alone for establishing rotation of a femoral shaft fracture undergoing intramedullary fixation. For this to be used in clinical practice, the measurements must be reproducible, and the femoral torsion must be adequately represented on the AP imaging alone. This study demonstrated that an AP image of the distal femur with the patella centered over the tibial spines is a reproducible intraoperative measure. However, unlike techniques that rely on the perfect lateral radiograph, AP imaging of the distal femur does not provide a reliable side-to-side guide to reestablish femoral torsion for all participants. The maximum side-to-side difference in this cohort was 14 degrees. Given that studies have shown clinical significance when malrotation of >15 degrees occurs, a significant margin of error to this magnitude is unacceptable.

Utilization of the patella as a marker of position implicates soft tissues about the knee that may be impacted by surgical or degenerative changes in addition to variability in anatomy. The subject that had the largest side-to-side difference previously underwent bilateral primary ACL reconstructions, and subsequent revision ACL reconstruction on one extremity. Participants in this series without a surgical history of knee or lower extremity procedures were all noted to have a reproducible side-to-side rotational profile within 5 degrees. However, as noted by outliers in this series of patients, soft tissue procedures about the knee can greatly influence the relative alignment of the patella and distal femur. As such, the key to utilizing a technique of anteroposterior imaging alone intraoperatively is establishing its applicability to each patient scenario prior to its use (Table 3.) When significant variability is noted, the gold standard of intraoperative perfect lateral imaging is recommended.

Table 3. Steps to verify side-to-side similarity when using single plane fluoroscopy

Steps to verify side-to-side similarity when using single plane fluoroscopy
Uninjured Limb
• AP of the knee with the patella centered over the tibial spines (save all images)
• Rotate the fluoroscope 90º and obtain a lateral view
• Move the fluoroscope proximally and obtain an AP image of the proximal femur to use for the lesser trochanteric profile (if side-to-side is equivalent)
Injured Limb
• Move to the injured limb and take an AP of the uninjured knee with the patella centered over the tibial spines
• Rotate the fluoroscope 90º and obtain a lateral view
If the two lateral views (injured versus uninjured) are evaluated and deemed to have a matching condylar overlap, the usage of anteroposterior imaging alone intraoperatively is deemed to be a viable tool.

This study has several limitations. Foremost is the sample size, both of the entire cohort and the subset of patients with previous ligamentous/soft tissue procedures about the knee. Of interest to future study would be the evaluation of patients with no previous history of soft tissue procedures about the knee compared to a cohort of patients having had cruciate, collateral, or patellofemoral ligament procedures. Data from this study imply a significant influence of these interventions on the relative positioning of the patella and distal femur and as such, is a relationship that warrants evaluation.

CONCLUSION

Based on these data, we cannot recommend routine use of AP views with the patella centered over the tibial eminence to reliably match the distal femur position when determining femoral torsion. However, if AP and lateral views of a patient's bilateral lower extremities are compared and found to be consistent between sides, the AP view does appear to be a reproducible measure. In this instance, the AP distal femur may be a more efficient view than the lateral for comparing proximal and distal femur appearance when confirming appropriate femoral torsion intraoperatively. ■

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- There were no sources of funding for this project
- The authors have nothing to disclose
- Author contributions:
  - Michael M Hadeed, data acquisition, manuscript preparation
  - Ahmad H Fashandi, data acquisition, manuscript preparation
  - Wendy Novicoff, statistical analysis, manuscript revisions
  - Seth R Yarboro, conception and design of the study, data acquisition, manuscript revisions

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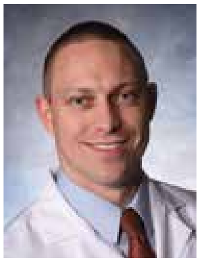
PHYSICIAN ASSISTANTS



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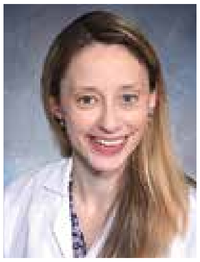

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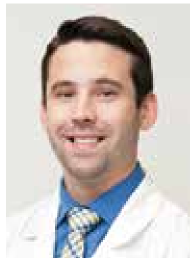

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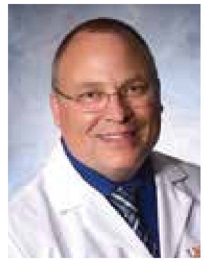

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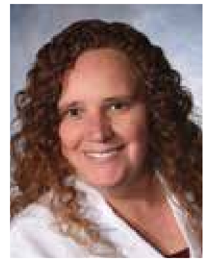

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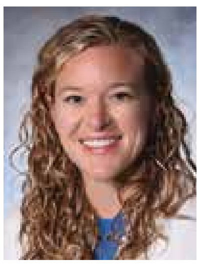

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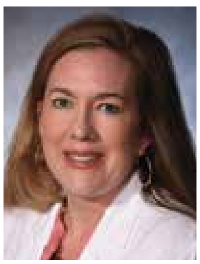

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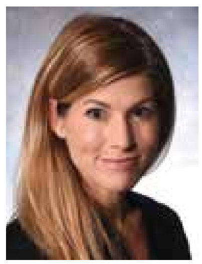

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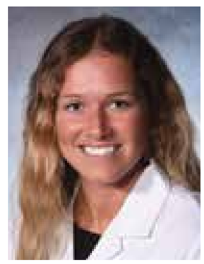

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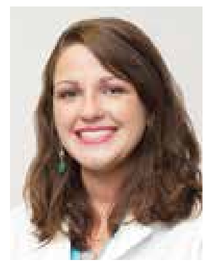

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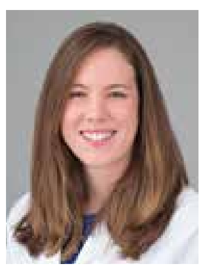

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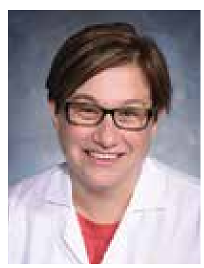

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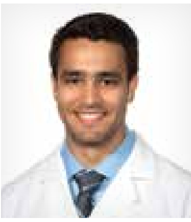
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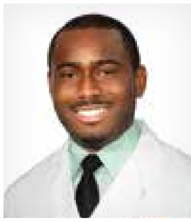
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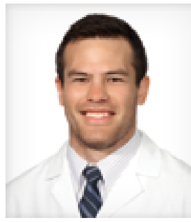
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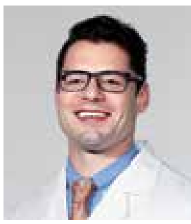
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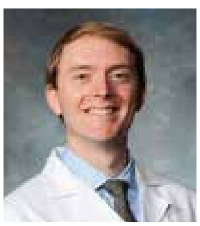
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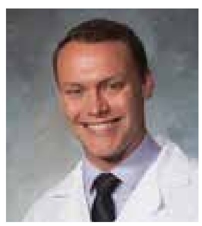
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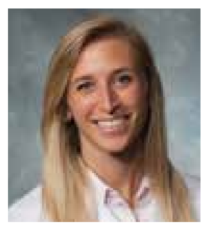
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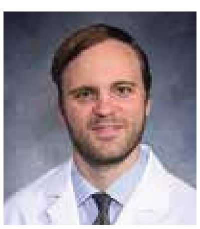
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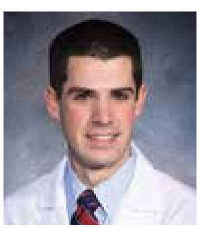
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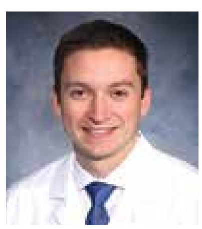
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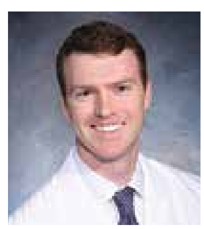
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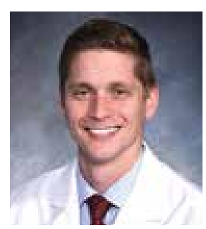
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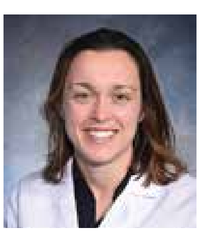
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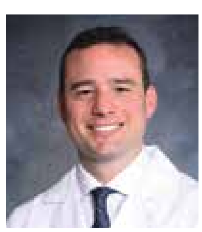
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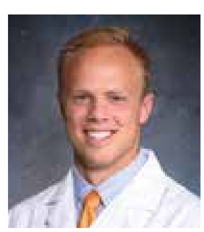
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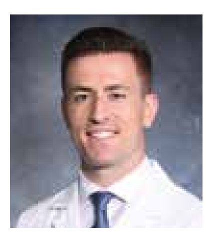
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- January 16, 2019 – Dr. Asheesh Bedi, Sports Medicine, University of Michigan

2018

- November 21, 2018 – Dr. Keith Wapner, Foot & Ankle VP – University of Pennsylvania
- October 31, 2018 – Dr. Hank Chambers – UC San Diego – Mark and Jean Abel Visiting Professor

(from left) Jeremy Rush, MD, UVA Ortho, Stephen Brockmeier, MD, UVA Ortho, Brian Werner, MD, UVA Ortho, Eric Carson, MD, (was at UVA Ortho at time of photo; now at VA St. Louis Health Care System) A. Bobby Chhabra, MD, Asheesh Bedi, MD, University of Michigan, Judd Smith, MD, David Diduch, MD, F. Winston Gwathmey, MD, Mark Miller, MD, John Awowale, MD

- August 29, 2018 – Dr. Rahman Kandil – StoneSprings Orthopaedics
- July 18, 2018 – Dr. Robin Queen, Research VP – Virginia Tech
- June 23, 2018 – Dr. Sig Hansen, Harborview Medical Center
- May 23, 2018 – Dr. Lynne Jones, Research VP, Johns Hopkins University – "Teamwork: From Bench to Bedside. My Experience with Total Joint Replacement"
- May 16, 2018 – Dr. John France, Chan Spine VP, West Virginia University
- April 18, 2018 – Dr. Nicholas Vedder, Morgan-McCue VP, University of Washington
- March 21, 2018 – Dr. Robert Arciero, Sports Medicine, University of Connecticut
- February 21, 2018 – Dr. Bob Zura, Trauma, Louisiana State University (Richard Whitehill Visiting Professor)
- January 17, 2018 – Dr. James Nunley, Foot and Ankle, Duke University

2017

- November 1, 2017 – Brian Shaw, Pediatric Orthopaedics, Children's Hospital of Colorado (Mark and Jean Abel Visiting Professor)
- September 20, 2017 – Dr. Ginger Holt, Oncology, Vanderbilt University
- June 23, 2017 – Dr. Peter Stern, Hand and Upper Extremity, Cincinnati (Chief Resident Graduation Visiting Professor)
- May 17, 2017 – Dr. Frank Phillips, Spine Surgery, Rush University (Donald Chan Spine Visiting Professor)
- April 19, 2017 – Dr. Reid Abrams, Hand and Upper Extremity, UC-San Diego (McCue-Morgan Visiting Professor)
- March 22, 2017 – Dr. James Andrews, Sports Medicine, American Sports Medicine Institute (Richard Whitehill Visiting Professor)
- February 22, 2017 – Dr. Michael Meneghini, Adult Reconstruction, Indiana University

2016

- December 14, 2016 – Dr. Michael Coughlin, Foot and Ankle, Saint Alphonsus, Boise, ID
- November 2, 2016 – Dr. John Blanco, Pediatric Orthopaedics, Hospital for Special Surgery (Mark and Jean Abel Visiting Professor)
- June 23, 2016 – Dr. Darren Johnson, Sports Medicine, University of Kentucky (Chief Resident Graduation Visiting Professor)
- April 20, 2016 – Dr. Jay Lieberman, Adult Reconstruction, University of Southern California
- April 13, 2016 – Dr. Donald LaLonde, Hand Surgery / Plastic Surgery, St. John, Canada (Morgan-McCue Visiting Professor)
- February 17, 2016 – Dr. Marty Boyer, Hand and Upper Extremity Surgery, Washington University, St. Louis
- January 20, 2016 – Dr. Gus Mazzocca, Sports Medicine, University of Connecticut

A. Bobby Chhabra, MD, UVA Ortho, (left) and Dean Taylor, MD, Duke Health (right)

2015

- December 16, 2015 – Dr. Mark Easley, Foot and Ankle, Duke University
- November 4, 2015 – Dr. James Sanders, Pediatric Orthopaedics, University of Rochester (Mark and Jean Abel Visiting Professor)
- August 19, 2015 – Dr. John McCormick, Spine Surgery, Private Practice in Savannah, GA
- June 19, 2015 – Dr. Thomas Byrd, Sports Medicine and Hip Arthroscopy, Nashville Sports Medicine (Chief Resident Graduation Visiting Professor)
- May 13, 2015 – Dr. Geof Baer, Sports Medicine, University of Wisconsin
- February 25, 2015 – Dr. Jeff Dugas, Sports Medicine, American Sports Medicine Institute
- April 15, 2015 – Dr. David Ruch, Hand and Upper Extremity, Duke University (Morgan-McCue Visiting Professor)
- February 18, 2015 – Dr. Robert Trousdale, Adult Reconstruction, Mayo Clinic

The Impact of Meniscus Treatment on Functional Outcomes 6 Months After Anterior Cruciate Ligament Reconstruction

Aaron J. Casp, MD, Marvin K. Smith, MD, Stephan Bodkin, M.Ed., Sterling Tran, MD, Frank Winston Gwathmey, MD, Eric W. Carson, MD, Brian C. Werner, MD, Mark D. Miller, MD, David R. Diduch, MD, Stephen F. Brockmeier, MD, Joseph M. Hart, PhD

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Objectives: Anterior cruciate ligament (ACL) tears are often associated with meniscal injury. Meniscus tears are treated at the time of ACL reconstruction (ACLR) via repair or partial meniscectomy. Persistent muscle weakness, impaired function, and poor patient-reported outcomes are a concern for patients early after reconstruction and impact a timely and successful return to unrestricted physical activity without re-injury. However, little is known about the effect of weight-bearing restrictions and range of motion limitations after meniscus repair on short term ACLR recovery and return-to-play assessment. The purpose of this study was to compare strength, jumping performance, and patient-reported outcomes between isolated ACLR patients and those undergoing meniscus treatment at the time of ACLR surgery. The hypothesis is that weight-bearing restrictions after meniscal repair would hinder functional recovery.

Methods: ACLR patients at the time of point of return to activity (5-7-month post-ACLR) and healthy controls completed patient-reported outcomes (IKDC, KOOS, and Tegner Activity Scale), and underwent bilateral isokinetic (90°/sec) and isometric (90°) strength tests of the knee extensor and flexor groups. Outcomes were recorded in a single session as part of a return-to-sport test battery. Strength was expressed as torque normalized to mass (Nm/kg), and limb-symmetry was expressed as a ratio of involved: uninvolved torque. ACLR patients were stratified into meniscal subgroups dependent on meniscal involvement at the time of ACLR: Isolated ACLR (ACLR), ACLR+Meniscectomy (ACLR-MS), ACLR+Meniscal Repair (ACLR-MR). One-way ANOVAs with post-hoc Tukey's test for equal variances was used to assess differences in subjective knee function as well as quadriceps and hamstring strength between groups.

Results: A total of 306 participants, including 165 ACLR patients and 141 healthy controls, were recruited for participation. The average time post-operatively was 5.96±0.47 months. Meniscal group stratification resulted in: ACLR: n=50, ACLR+MS: n=44, and ACLR+MR: n=71. Heathy controls demonstrated higher subjective knee function than all meniscal subgroups (p<.001); however, there were no differences between any of the meniscal subgroups on the IKDC or any KOOS subscales. Healthy controls demonstrated significantly higher unilateral peak extensor torque (2.08 ±.56 Nm/kg) and limb symmetry (98±.12%) than all meniscal subgroups (p<.001). There were no differences in unilateral or limb symmetry measures of peak knee extensor

Table 1. Patient Demographics Based on Meniscal Treatment Type

	ACLR	ACLR+MS	ACLR+MR	Healthy	P-value
n	**50**	**44**	**71**	**140**	
Age (years)	22.9±10.1	25.0±12.5	20.3±7.0	21.4±3.5	.008[a]
Sex (F:M)	31:19:00	23:21	33:38:00	82:59:00	n.s.
Height (cm)	171.2±10.2	170.4±10.7	173.3±10.2	171.9±18.0	n.s.
Mass (kg)	70.6±15.1	75.7±19.1	77.1±19.3	70.0±12.5	.008[b]
Graft Type					
BTB	33	25	42	–	n.s.
HS	17	19	29	–	n.s.
Time Post Surgery (months)	6.0±.42	6.1±.53	5.9±.47	–	n.s.
Tegner Activity Level (Pre-Injury)	8.1±1.6	8.4±1.6	8.6±1.2	–	–
Tegner Activity Level (Current)	5.7±1.8	6.0±1.6	6.0±2.0	7.8±1.7	<0.001[c]
IKDC (%)	80.2±12.7	83.4±9.1	78.6±14.8	97.0±5.0	<0.001[d]

[a] Healthy participants are significantly younger than ACLR+MS patients
[b] Healthy participants have significantly lower mass than ACLR+MR patients
[c] Healthy participants have a significantly greater current activity level than all ACLR groups
[d] Healthy participants have a significantly greater IKDC score than all ACLR groups

torque between ACLR (1.45±.46 Nm/kg, 68±19%), ACLR+MS (1.48±.48 Nm/kg, 68±19%), and ACLR+MR (1.58±.52 Nm/kg, 71±20%) patients (all p-values>.05). There were no differences in unilateral or limb symmetry measures of peak knee flexor torque between any subgroups (all p-values>.05).

Conclusion: At 6 months following ACLR, patients remain weaker and more symptomatic compared to healthy controls. Meniscus treatment during surgery—whether it was meniscus repair or meniscectomy—did not influence the objective strength and functional test results. These findings suggest that the postoperative weight-bearing and range-of-motion restrictions associated with meniscus repair do not result in early functional differences in strength symmetry between ACLR and ACLR+MR patients at the time of return to sport. Such results may provide further insights for postoperative rehabilitation and inform intraoperative decision-making. ■

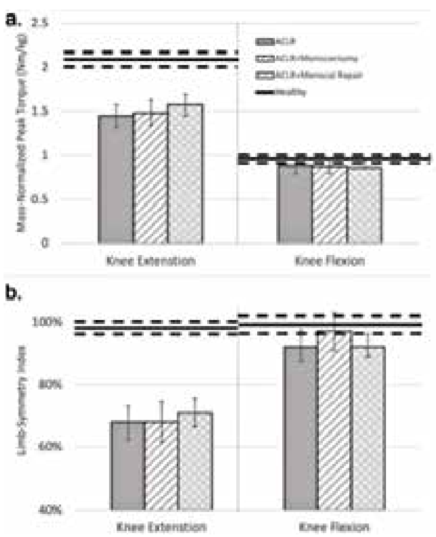

Figure 1. Comparison of knee flexor and extensor strength and symmetry across meniscal treatment groups

Motion and Strength Analysis of Scapholunate Ligament Reconstruction Using a Two-Tine Staple in a Novel Cadaver Model

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Introduction: The scapholunate ligament (SLL) is vital for maintaining normal wrist kinematics. Numerous strategies for repairing or reconstructing the SLL after an acute injury have been described in the literature, but no single technique dominates, as each has significant drawbacks, including mandatory second procedures, pin site infections, and wrist stiffness. Recently, the use of two- and four-tine staples has emerged as a promising method for SLL reconstruction. We, therefore, sought to compare SLL fixation techniques, including traditional Kirshner wire (K-wire) fixation technique and two-tine staple fixation.

Materials and Methods: We used eight fresh cadaver arms with normal SL intervals, the kinematics between the scaphoid and lunate were assessed using motion capture cameras in four distinct states: a) SLL intact, b) SLL divided, c) K-wire fixation across SL interval and scaphocapitate interval, and d) two-tine staple across SL interval. Data were collected using Vicon software (Vicon Motion Systems Inc, Los Angeles, CA) and processed for modeling in MSC.Adams (MSC Software, Newport Beach, CA) with LifeModeler plug-in. Specimens with SL staple in place were then loaded with the higher of 1000N or 200% subject body weight using MTS tensile strength machine the (MTS Systems Corporation, Eden Prairie, MN) and analyzed for moment of structural failure.

Results: The eight sample arms used came from 2 male and 2 female subjects with an average age of 76.3 years (range 62-89 years) and average the weight of 170lbs (range 100-208lbs). Motion capture data demonstrated that, compared with an intact SLL, motion between the scaphoid and lunate is increased with division of the SLL and reduced with K-wire fixation. With the two-tine staple in place, SL motion and kinematics were similar to prior to SLL division. Under axial load with staple fixation in place, 3 specimens demonstrated scaphoid fractures, 2 specimens demonstrated distal radius fractures, and 3 specimens proceeded through testing without failure. There were no hardware failures or deformation of the staple.

Conclusion: This study illustrates a novel technique for assessing carpal kinematics using motion capture technology. It also demonstrates that the two-tine staple system provides adequate fixation strength with motion more similar to the native SLL than K-wire fixation. ■

Do Local Anesthetic Arthroscopic Portal Injections Decrease Pain After Knee Arthroscopy?

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Background: Knee arthroscopy is one of the most common orthopaedic procedures performed in the United States. With a continued trend toward performance-driven outcomes that rely on patient satisfaction, it is of interest to the surgeon and of benefit to the patient to minimize pain after knee arthroscopy. Additionally, in light of the current narcotic crisis in the United States, multimodal analgesia has become an area of focus during routine orthopaedic procedures. This includes local anesthetics like bupivacaine that have become a mainstay for targeted analgesia around surgical incisions. The purpose of this study was to evaluate the effect of local anesthetic during knee arthroscopy in improving postoperative pain.

Methods: A prospective, randomized, controlled, non-blinded study was conducted. 277 consecutive patients undergoing simple knee arthroscopy by two fellowship-trained surgeons were prospectively randomized to one of three groups, which received either 20 cc of 0.5% bupivacaine(group 1), 20 cc of 0.25% bupivacaine (group 2), or 20 cc of normal saline (group 3). Baseline demographics, including Lysholm Knee Scores, were obtained. Pain was assessed using VAS scores preoperatively, 1 hour postoperatively, 4 hours, 24 hours, 48 hours, and at the 2 week follow up. A standardized number of narcotic pills were given in the form of 40 total pills of hydrocodone-acetaminophen 5-325 mg. Daily pill counts were self-reported by patients for the first week, and then the total number of pills consumed was recorded at the two-week follow-up.

Results: There was no difference in preoperative VAS scores amongst the 3 groups (3.0 vs. 3.1 vs. 3.5) (P = 0.56). There was a significant difference in VAS scores at 1 hour postoperatively between groups 1 and 3 (3.1 vs. 4.4) (P = 0.013) with a trend towards significance between groups 2 and 3 (3.5 vs. 4.4) (P = 0.059). There was a significant difference in VAS scores at 4 hours postoperatively between groups 1 and 3 (2.9 vs. 4.3) (P = 0.001) and between groups 2 and 3 (3.0 vs. 4.3) (P = 0.003). There was a trend toward decreased narcotic use in the first 2 postoperative days, but the overall number of narcotic pills consumed was the same by 2 weeks postoperatively.

Conclusions: The Use of local anesthetic at the time of knee arthroscopy was found to result in a significant reduction in patient-reported pain scores at 1 hour and 4 hours postoperatively in this prospective, randomized controlled study. These results suggest routine use of local anesthetic as a multimodal analgesic regimen is reasonable for routine knee arthroscopy. ■

Level of evidence: Level I, randomized controlled trial

Biomechanical Analysis of the Deep Squatting Position in Baseball Catchers With and Without Knee Saver™ Pads

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Objectives: Overuse injuries continue to increase at alarming rates in youth sports. Prevention of overuse injuries is an important focus in managing young athletes. In particular, overuse upper extremity injuries are a major focus in youth baseball and softball. However, little attention has been paid to lower extremity overuse injuries. The position of catcher is a demanding position that requires prolonged time squatting with deep knee flexion. Some catchers wear posterior leg pads, called Knee Saver™ pads (Easton, Van Nuys, CA) with the goal of reducing stress across the knee joint. However, the actual ergonomic benefits of Knee Saver™ pads have never been quantified to our knowledge. This study has two main objectives:

1) To analyze the biomechanics of a catcher's deep squat with and without Knee Saver™ pads; and 2) to quantify the percentage of body weight absorbed by each Knee Saver™ pad during a deep squat.

Methods: Subjects were analyzed at our institution's motion analysis lab using reflective tape marker balls and ten infrared motion sensing cameras. Each catcher performed a series of two squats with and without Knee Savers™. Each squat was performed three times and held for three seconds. The first squat performed was the "sign" stance, which was the normal stance while giving a sign to the pitcher. The second squat was the "receiving" stance, which was the normal deep squat for catching a pitch without a runner on base. Lastly, each catcher performed at least three "receiving" squats while wearing our load cell Knee Saver™ pad model in order to calculate the force transmitted through a Knee Saver™ pad. Data was collected using Vicon software (Vicon Motion Systems Inc, Los Angeles, CA) and then subsequently processed for modeling in MSC.Adams (MSC Software, Newport Beach, CA) with LifeModeler plug-in. For each squat, ankle, knee, and hip flexion angles were calculated. Values for each leg in every stance with and without Knee Savers™ were averaged and compared using a paired student's t-test with a p-value of 0.05 set for significance. The force transmitted through each load cell model was calculated as a percentage of total body weight.

Results: A total of 4 male baseball catchers with an average age of 16.8 years (range 14-19 years) were analyzed. For both stances, Knee Saver™ pads increased the average ankle flexion angle while reducing the average knee and hip flexion angle in each leg, yet these values were not significant except for left hip flexion in the sign stance. The greatest difference in knee flexion was observed in the right knee during the sign stance, which resulted in a 4.3 angle difference (p=0.18). On average, each catcher loaded 22.1% body weight (range 18.4%-25.6%) through the right Knee Saver™ pad and 23.0% body weight (range 18.9%-25.8%) through the left Knee Saver™ pad while squatting with the load cell model. The ankle, knee, and hip flexion values from the load cell trials did not differ significantly from the values obtained from Knee Saver™ trials, suggesting that our load cell model recreated similar squatting mechanics to the Knee Saver™ pads.

Conclusions: Knee Saver™ pads did not significantly reduce the knee flexion angles in the two most commonly performed squats for a catcher. Based on our load cell model, Knee Saver™ pads received a combined 45.1% of a catcher's body weight during a normal receiving squat.

Therefore, any ergonomic value is likely attributable to force redistribution as opposed to alteration of squatting mechanics. It is possible that Knee Saver™ pads may help reduce overuse injuries to the knee by reducing the force across the knee joint without altering squatting mechanics. Further studies are needed to better elucidate possible benefits of Knee Saver™ pads in overuse injury prevention. ■

Is It Safe to Weight Bear Immediately After Intramedullary Nailing of Extra-Articular Distal Tibia Fractures?

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Introduction: Extra-articular distal tibia fractures are often treated with reduction and fixation with either a plate and screw construct or an intramedullary nail with interlocking bolts. In isthmic tibia fractures, one benefit of intramedullary nailing is the safety of immediate weight-bearing post operatively. This can lead to improved healing, a decreased period of convalescence, and potentially lower the risks of venous thromboembolism and muscle atrophy. Outside of the isthmus, there is concern that immediate weight-bearing after fixation with an intramedullary nail may lead to fracture displacement. If shown to be safe, immediate weight-bearing after extra-articular distal tibia fractures may lead to the same benefits described above. The purpose of this study was to determine whether weight-bearing after intramedullary nailing of extra-articular distal tibia fractures is safe. The specific aims include 1) to determine if the construct can withstand simulated weight-bearing, 2) to determine how much the fracture will displace during simulated weight-bearing, 3) to determine whether that displacement occurs early or late in the loading period, and 4) to determine the rate of displacement.

Methods: A biomechanical model of distal metaphyseal tibia fractures was created using fourth generation composite bone models. Three fracture patterns were tested: a spiral fracture (AO/OTA 43A1.1), an oblique fracture (AO/OTA 43A1.2), and a fracture with a zone of comminution (AO/OTA 43A3.2). The models were fixed with intramedullary nails with three distal interlocking bolts and then cyclically loaded.

Loading was done in compression at 3000N at 1 Hz for a total of 70,000 cycles. Displacement (shortening, coronal angulation, sagittal angulation) was measured at regular intervals.

Results: The spiral and oblique fracture patterns were able to withstand simulated weight-bearing. The comminuted model had early implant failure with breaking of the distal interlocking bolts. The spiral fracture model shortened an average of 0.27mm, developed an average coronal angulation of 2 degrees, and developed an average sagittal angulation of 1.22 degrees. Most of the displacement occurred in the first 2,500 cycles, and the rate of displacement declined over time. The oblique fracture model shortened an average of 0.18mm, developed an average coronal angulation of 2.36 degrees, and developed an average sagittal angulation of 2.56 degrees. Similar to the spiral model, most of the displacement occurred in the first 2,500 cycles, and the rate of displacement declined over time.

Conclusions: For spiral and oblique fracture patterns, simulated weight-bearing caused minor displacement. The amount of displacement was well under the typical thresholds which define a malunion. Most of the displacement occurred immediately, and the rate of displacement decreased over time. Based on these data, immediate weight-bearing after reduction and fixation of an extra-articular distal tibia fracture with an intramedullary nail and three distal interlocking bolts is safe, and it can be recommended for patient care in the right clinical scenario. ■

Ioban™ Suction Dressing Showed No Untoward Complications When Used on Kocher-Langenbeck Incisions for Acetabulum Fractures

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Introduction: Incisional negative pressure wound therapy (INPWT) has been shown to be effective in reducing the incidence of postoperative wound infection following surgery to address tibial pilon, tibial plateau, and calcaneus fractures. Every significant study to date has utilized the proprietary products from KCI, such as the V.A.C. Ulta or Prevena. Despite being effective in reducing wound complications, the cost of these products to patients and the healthcare system can be large. We have previously administered NPWT using a less expensive dressing made from gauze bandage, Ioban™, and wall suction tubing. Despite the presumptive effectiveness and safety of this dressing based on anecdotal evaluation, concerns were raised regarding its safety. To address this lack of understanding, we created a randomized trial to compare the short-term postoperative complication rates and safety profiles among three types of dressings in patients with acetabulum fractures being addressed with a Kocher-Langenbeck incision.

Methods: Trauma patients admitted to the University of Virginia Medical Center with posterior column, posterior wall, and/or posterior wall acetabulum fractures amenable to fixation through a Kocher-Langenbeck incision were prospectively identified and queried for participation in this study, after IRB approval was granted. Participants were randomly assigned to one of three surgical dressing types using a random number generator. The three dressing types were: NPWT using a KCI V.A.C. Ultra, NPWT using the aforementioned in-house dressing, or a standard adhesive dressing. The selected dressing was applied at the end of the surgery and remained in place for 48 hours, as is standard practice for NPWT. Both NPWT dressings were applied with 75 mmHg, which is also an accepted pressure. At the end of the 48 hour period, a clinical photograph was taken of the wound, and a second photograph was taken at the first 2 week post-op appointment. All wounds were closed with staples. Data categories that were collected included patient demographics, medical comorbidities, injury comorbidities, length of stay, estimated blood loss from surgery, type of VTE chemoprophylaxis utilized, duration of surgery, time from injury to surgery, and acetabulum fracture pattern. The wounds were monitored for postoperative complications, including seroma formation, cellulitis, suture abscess, or overt surgical site dehiscence and deep infection. The occurrence of any postoperative wound complication was the primary outcome measure. All patients had follow-up to at least the 6 week postoperative mark. Given the low incidence of complications, we sought to compare the dressings with regards to wound appearance. The clinical photographs from each postop point were de-identified and placed into a PowerPoint file. A trauma surgeon, operating room nurse, resident, and medical student at our institution then compared the wounds and ranked the wounds in order of appearance, from most appealing to least. Observers were provided a validated grading system previously used in hernia surgery and encouraged to reference the grading system when ranking the wounds. The final rank orders were analyzed to look for clustering of the dressing types and for inter-observer agreement.

Results: Over the course of twelve months, there were 26 patients who enrolled in the study and were randomized. The number of patients assigned to the Ioban™, adhesive, and KCI groups were 12, 7, and 13, respectively. Twenty of 26 patients (77%) were male. Average age was 40 years. The average EBL was 700 milliliters. Average duration was two hours twenty-four minutes. All patients were treated with enoxaparin for VTE chemoprophylaxis. Average BMI was 28.4. Two patients experienced superficial wound complications treated with a course of oral antibiotic, and both of these patients were in the adhesive gauze treatment group. One of these patients was diabetic and a smoker. The second patient developed post-operative pulmonary embolisms and was treated with therapeutic strength anticoagulation. There were no wound complications in either of the NPWT groups.

Discussion: Overall the rate of wound complication was very low, which is corroborated in other studies evaluating acetabulum fractures. The low number of events makes detecting superiority of any one dressing over another difficult, however the primary goal of the study was to determine whether or not the Ioban™ NPWT dressing was inferior or caused any unforeseen safety problems with regards to wounds. Given that no wound complications were experienced within this group, and that photographs corresponding to the Ioban™ group were competitive in the ranking portion of the study, this dressing is a safe option with which to treat high-risk wounds in the future, such as tibial pilon, plateau, and calcaneus fractures. We feel that a randomized trial comparing dressings among these patients would be valuable in determining if this dressing type is safe and efficacious in those wounds. If that is the case, then the less-expensive Ioban™ dressing may be a more cost-effective dressing to use in the future. ■

Dialysis Dependence and Treatment Modality Impact Complication Rates Following Shoulder Arthroplasty

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Background: While abundant literature has cited dialysis-dependence as an independent risk factor for increased complications following total hip (THA) and total knee arthroplasty (TKA), no studies have distinguished if the modality of treatment has an effect on these complications. Furthermore, no current studies have demonstrated if dialysis carries similar risks for similar complications following shoulder arthroplasty (SA). Therefore, the goal of the present study was fourfold: 1) to compare periprosthetic joint infection rates after THA, TKA, and SA in hemodialysis (HD) and peritoneal dialysis (PD) patients; 2) to compare adverse events after THA, TKA, and SA in HD and PD patients; 3) to compare adverse events after THA, TKA, and SA in HD and PD patients with matched controls without dialysis dependence; and 4) to determine the incidence of dialysis-dependent patients undergoing SA.

Methods: Dialysis-dependent patients undergoing THA, TKA, and SA were identified in a national insurance database and compared to a control cohort without dialysis dependence, matched in a 3:1 ratio by age, sex, year of procedure, obesity, tobacco use, alcohol abuse, and diabetes mellitus. A subgroup analysis was performed comparing patients using PD with a group of patients using HD that were matched in a 1:1 ratio using the same demographic variables. Complications were assessed for all cohorts using ICD-9 and CPT codes including in-hospital death, emergency room visits, hospital readmission, infection, and revision surgery. Statistical comparisons were completed with a logistic regression analysis controlling for additional comorbidities.

Results: The incidence of SA in dialysis-dependent patients significantly increased over the study period ($p < 0.0001$). Compared to matched controls, dialysis dependence at the time of SA was associated with increased rates of in-hospital death (OR 7.60, $p < 0.0001$), emergency room visits (OR 4.16, $p < 0.0001$), hospital admission (OR 1.63, $p < 0.0001$), and infection within one year (OR 1.90, $p = 0.009$) (Table 1). Compared to matched SA patients on HD, PD patients had lower rates of in-hospital death (OR 0.40; $p = 0.008$) and hospital readmission (OR 0.43, $p = 0.047$), as well as a lower incidence of infection (OR 0.30, $p = 0.018$) and revision surgery (OR 0.23, $p = 0.037$). Compared to controls, SA patients on PD had similar rates of in-hospital death ($p = 0.342$), readmission ($p = 0.888$), infection ($p = 0.789$), and revision surgery ($p = 0.701$) (Table 2). When comparing TKA patients on PD to matched HD controls, PD patients experienced significantly lower periprosthetic infection rates (OR 0.67, p = 0.026) and similar rates of other measured complications. When comparing TKA patients on PD to matched non-dialysis controls, there were no differences in periprosthetic infection (p = 0.395) or revision TKA (0.478) (Table 3). Similarly, when comparing THA patients on PD to matched HD controls, there was also significantly lower periprosthetic infection rates (OR 0.30, p = 0.006). When comparing THA patients on PD to matched non-dialysis controls, there were no differences in rates of periprosthetic joint infection (p = 0.382), readmission within 30 days (p = 0.276), and revision THA (p = 0.593) (Table 4).

Conclusions: Although there is a significantly increased risk of postoperative complications in dialysis-dependent patients who undergo SA, THA, and TKA, this risk is highly influenced by the type of dialysis. Whereas patients on HD have a significantly higher risk of infection, patients on PD do not appear to have this same risk when compared to non-dialysis-dependent patients. To our knowledge, this is the only study to date to distinguish patients by the type of dialysis and suggests the type of dialysis should be used to assess risk when considering hip, knee, and shoulder arthroplasty. ■

Table 1. Comparison of Adverse Events and Complications after Shoulder Arthroplasty

Complication	Dialysis		Matched Controls		Comparison (Dialysis v Control)		
	N	%	N	%	OR	95% CI	P
In-Hospital Death (1 yr)	78	6.37%	31	0.84%	7.60	[4.69-12.31]	< 0.0001
ER Visit (30 d)	166	13.55%	98	2.67%	4.16	[3.11-5.56]	< 0.0001
Admission to Hosp (30 d)	121	9.88%	205	5.58%	1.63	[1.25-2.13]	< 0.0001
Infection (1 yr)	37	3.02%	46	1.25%	1.90	[1.40-2.58]	0.009
Revision	52	4.24%	75	2.04%	1.48	[0.97-2.26]	0.067

Table 2. Comparison of Adverse Events and Complications after Shoulder Arthroplasty

Complication	Peritoneal Dial.		Hemodialysis		Controls		Comparison (PD v HD)			Comparison (PD v Control)		
	N	%	N	%	N	%	OR	95% CI	P	OR	95% CI	P
In-Hospital Death (1 yr)	7	5.38%	13	10.00%	5	1.28%	0.40	[0.22-0.74]	0.008	4.87	[1.24-19.16]	0.342
ER Visit (30 d)	23	17.69%	23	17.69%	10	2.56%	0.94	[0.49-1.82]	0.855	6.88	[2.91-16.26]	< 0.0001
Admission to Hosp (30 d)	10	7.69%	20	15.38%	23	5.90%	0.43	[0.19-0.99]	0.047	1.06	[0.46-2.46]	0.888
Infection (1 yr)	2	1.54%	6	4.62%	7	1.79%	0.30	[0.11-0.79]	0.018	0.79	[0.14-4.47]	0.789
Revision (1 yr)	3	2.31%	8	6.15%	6	1.54%	0.23	[0.06-0.81]	0.037	1.36	[0.28-6.63]	0.701

Table 3. Comparison of Adverse Events and Complications after TKA

Complication	Peritoneal Dial.		Hemodialysis		Controls		Comparison (PD v HD)			Comparison (PD v Control)		
	N	%	N	%	N	%	OR	95% CI	P	OR	95% CI	P
In-Hospital Death (1 yr)	30	5.65%	28	5.27%	12	0.75%	1.13	[0.65-1.96]	0.487	6.16	[3.04-12.46]	< 0.0001
ER Visit (30 d)	72	13.56%	75	14.12%	113	7.09%	0.98	[0.69-1.39]	0.910	3.15	[2.18-4.55]	< 0.0001
Admission to Hosp (30 d)	45	8.47%	43	8.10%	70	4.39%	1.03	[0.66-1.60]	0.896	2.01	[1.38-2.93]	< 0.0001
Infection (1 yr)	18	3.39%	32	6.03%	42	2.64%	0.67	[0.49-0.93]	0.026	1.28	[0.73-2.24]	0.395
Stiffness (1 yr)	4	0.75%	7	1.32%	49	3.08%	0.57	[0.16-1.98]	0.379	0.32	[0.11-0.91]	0.012
Revision TKA (1 yr)	16	3.01%	21	3.95%	41	2.57%	0.79	[0.41-1.52]	0.483	1.24	[0.68-2.28]	0.478

Table 4. Comparison of Adverse Events and Complications after THA

Complication	Peritoneal Dial.		Hemodialysis		Matched Controls		Comparison (PD v HD)			Comparison (PD v Control)		
	N	%	N	%	N	%	OR	95% CI	P	OR	95% CI	P
In-Hospital Death (1 yr)	37	6.47%	37	6.47%	15	0.87%	1.11	[0.68-1.80]	0.675	7.22	[3.58-14.55]	< 0.0001
ER Visit (30 d)	96	16.78%	110	19.23%	85	4.95%	0.88	[0.65-1.20]	0.436	3.23	[2.32-4.50]	< 0.0001
Admission to Hosp (30 d)	38	6.64%	38	6.64%	86	5.01%	1.04	[0.65-1.68]	0.857	1.26	[0.83-1.92]	0.276
Infection (1 yr)	9	1.57%	24	4.20%	38	2.21%	0.30	[0.12-0.71]	0.006	0.68	[0.36-1.29]	0.382
Dislocation (1 yr)	23	4.02%	26	4.55%	32	1.86%	0.99	[0.55-1.77]	0.966	2.00	[1.11-3.59]	0.020
Revision THA (1 yr)	18	3.15%	22	3.85%	42	2.45%	0.77	[0.41-1.47]	0.433	1.17	[0.65-2.10]	0.593

Rate of Conversion to Surgery and Risk Factors Analysis Following Fluoroscopically Guided Facet Cyst Rupture

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Introduction: Juxta-articular cysts, which are composed of ganglion and synovial cysts, arise from periarticular tissue and can occur in any joint. Cysts that are lined with synovium and communicate with the joint are characterized as true synovial cysts while cysts without a synovial lining that do not communicate with the facet joint are known as ganglion cysts.[1] While ganglion and facet cysts can look alike externally, there are histologic and pathologic differences. Synovial facet cysts are thought to originate from instability of the facet which leads to herniation of the synovial membrane either due to tissue laxity, as seen in younger women, or degenerative joint disease, as seen in older patients.[2] Additional etiologies of facet cysts could be due to myxoid degeneration or increased production of hyaluronic acid. Regardless of the etiology, herniation of the synovial membrane can lead to spinal cord or nerve root compression.

Facet cysts are a common finding on magnetic resonance imaging (MRI) when evaluating a patient with back pain and radicular symptoms. The reported prevalence of these cysts can vary widely, and studies have shown results ranging from 0.5% to 7.3%.[3,4] These facet cysts have a wide range of clinical and radiographic findings. Studies have examined the level, size, rim characteristics, and contents of cysts in order to better understand possible pathogenesis.[5,6] It is thought that these variables may relate to the differences in efficacy of treatment.

There are several treatment options for symptomatic facet cysts. Non-operative management can include intraarticular steroid injections or fluoroscopically guided percutaneous rupture, whereas operative management includes direct decompression and cyst excision with possible fusion.[7] While studies currently report the efficacy of percutaneous treatment of facet cysts to be between 20 and 39%, further research to identify clinical and radiographic factors associated with failure of percutaneous treatment is needed.[8-12]

The aim of this retrospective review is to evaluate the rate of conversion to surgery following percutaneous cyst rupture and to examine clinical, radiographic, and procedural variables that might be associated with that conversion. Ultimately, if specific clinical and radiographic risk factors can be elucidated, it may be possible to more effectively and efficiently counsel and treat patients.

Materials and Methods: A retrospective review was completed for all patients who underwent fluoroscopically guided facet cyst rupture from 2010-2016 at an academic medical center. All patients who had undergone fluoroscopically guided facet cyst rupture at the authors' institution were included in the study. The procedures were performed in a fluoroscopy suite with a fixed C-arm unit, with the patient in a prone position. After sterile preparation and local analgesia, the inferior recess of the facet joint was targeted using fluoroscopy in the anteroposterior and ipsilateral oblique positions using a 22-gauge needle. A small amount, approximately 1 cc, of Omnipaque™ iodinated contrast was injected to demonstrate placement within the facet joint. A mixture of 0.5 cc (20mg) of Depo-Medrol™ or 0.5 cc (20 mg) of Kenalog™ along with 0.5 cc of preservative free 0.25% Bupivacaine™ was injected into the joint, either before or after cyst rupture depending on operator preference. Additional fluid was injected into the facet joint to pressure the cyst and induce rupture. Fluoroscopy images were obtained to demonstrate location of contrast after attempted cyst rupture.

Several variables were chosen based on either prior literature or theoretical association with failure of percutaneous management (Table 1). The clinical variables examined included sex, age, number of comorbidities, laterality (unilateral or bilateral), type of symptoms (pain, motor deficit, sensory deficit), and whether the pain was predominantly leg, back, or combined. The radiographic variables examined included cyst signal, rim signal, presence of spondylolisthesis, presence of canal stenosis, presence of facet joint fluid, bilateral fluid, facet bone edema, bone erosion, cyst opacification, cyst size, and cyst shape. The procedural variables examined included the pain score change from immediately pre and post procedure, cyst contrast filling, and successful cyst rupture. Finally, post procedure MRIs that were obtained within the first year after attempted cyst rupture were evaluated to determine the decrease in cyst size and the relationship with decrease in cyst size and conversion to surgery.

Table 1. Data Variables Collected

Clinical	Sex Age Number of comorbidities BMI Laterality of symptoms Symptoms Pain location
Radiographic	Cyst signal Rim signal Spondylolisthesis Canal stenosis Facet joint fluid Bilateral fluid Facet bone edema Bone erosion Cyst opacification Cyst size Cyst shape
Procedural	Decrease in pain score ≥50% improvement pain score same or worse cyst contrast filling successful rupture

Table 2. Clinical Variable Results

	Surgery	No Surgery	p-Value
Sex			
Males	17.6%	82.4%	0.310
Females	35.7%	64.3%	
Age	62.6 ± 10.7	57.6 ± 12.4	0.187
Number of Comorbidities	7.23 ± 3.54	4.50 ± 3.70	0.030
BMI (Body Mass Index)	27.54 ± 3.43	28.34 ± 5.16	0.545
Laterality of Symptoms			
Bilateral	28.5%	71.5%	1
Unilateral	28.9%	71.1%	
Symptom Type			
Motor	25.0%	75.0%	0.472
Sensory	38.4%	61.6%	
Pain Location			
Back & Leg	28.9%	71.1%	1
Leg Only	28.5%	71.5%	

The primary outcome was rate of conversion to surgery. For those that converted to surgery, the rate of decompression and fusion compared to decompression alone was recorded. Secondary outcomes included clinical, radiographic, procedural, and follow up MRI variable analysis to determine if there were risk factors associated with conversion to surgery. Categorical variables were analyzed using Fisher's exact test as an alternative to the Chi-square test and continuous variables were analyzed using a T-test.

Results: Forty-nine patients met the inclusion criteria for the study. Four were excluded because they had no clinical notes or because no MRI was available for review. Clinical, radiographic, and procedural variables for 45 patients were recorded and examined (Table 1). The average post procedural follow-up for this cohort of patients was 1.4 years.

Twenty-nine percent (95%CI = 15.7%, 42.2%) (13/45) of patients eventually underwent a surgical procedure to address their facet cyst. The average interval to surgery was 95 days (median = 50 ± 105) after attempted cyst rupture. Of those that had a surgical intervention, 38% (5/13) had a decompression and fusion while 62% had decompression alone.

The variables in Table 1 were analyzed to evaluate for an association with future conversion to surgery after percutaneous management of facet cysts. The results for the clinical variables are listed in Table 2, the results for the radiographic variables are listed in Table 3, and the results for the procedural variables are listed in Table 4.

Of the variables examined in this cohort, the number of comorbidities did have a significant association with later conversion to surgery. Patients that underwent surgery had an average of 7.23 comorbidities and patients that did not have surgery had an average of 4.50 comorbidities (p = 0.030). Failure of cyst rupture did trend towards significance for later conversion to surgery (p = 0.08). No other clinical, radiographic, or procedural variables were associated with conversion to surgery in this cohort.

Thirteen patients had a post procedure MRI within 1 year of the attempted fluoroscopic cyst rupture. These were completed based on various indications from their treating physicians. Nine out of the 13 patients did have a greater than 50% decrease in size of their cyst (Table 5). This was not a direct correlation with successful cyst rupture. Of those nine, only one eventually converted to surgery.

Discussion: Despite these reported outcomes in the literature, it is unknown which patients that undergo fluoroscopic facet cyst rupture end up converting to surgery. If clinical, radiographic, or procedural variables could be determined as predictors of future surgical intervention, then it would be possible to better counsel patients. Furthermore, if it was known who would convert to surgery, it may be possible to skip unnecessary procedures and more definitively treat patients from initial presentation. Although some studies have evaluated certain variables in isolation, a thorough evaluation has not previously been reported.

The meta-analysis done by Shuang et al.[9] showed 38.6% of the 544 patients that had satisfactory results with percutaneous procedures had to eventually undergo surgery to achieve long-lasting relief of symptoms. More recent studies done by Eshraghi et al. in 2016 and Lutz et al. in 2017 reported surgery rates of 20% (6/30) and 31% (11/35) respectively.[11,12] The current study results of 29% fit well within the rates of surgery that have already been reported. With so many studies demonstrating the success of percutaneous management for lumbar facet cysts, it appears to be viable as an initial method of treatment. Percutaneous management carries less risk than surgical management and would be especially useful in higher risk patients that might not be ideal surgical candidates.

Out of the clinical factors from Table 1, only the number of comorbidities was shown to have a significant association with the future need for surgical conversion. None of the other clinical variables had any significant association with need for surgical conversion after percutaneous management of facet cysts. Our results for the association between patient sex and age match up with the study conducted by Allen et al. who also found no significance between a successful outcome and patient age or sex.[13] It would be difficult to use the comorbidity finding to change treatment decisions. Patients with an increased number of comorbidities are, generally, considered more high-risk surgical candidates. While surgery is currently the most effective management method as shown in the prospective study done by Schulz et al.[14] it makes sense that non-surgical and lower risk approaches should be attempted prior to a higher risk surgical approach for treatment of facet cysts in higher risk patients. This association could, however, be useful for patient education and counseling for the future need of a surgery in order to treat facet cysts.

None of the radiographic variables tested correlated with conversion to surgery. Prior to the statistical analysis, we were expecting cysts with a T2 hyperintense signal to have a decreased need for surgery. Cambron et al. looked at the T2 signal intensity and found that a T2 hyperintense cyst was less likely to have need for future surgery.[10] While the reason for the difference between T2 hyperintense versus intermediate to low intensity cysts is unclear, Cambron et al. suggested that hyperintense cysts could contain a larger amount of fluid while also having

Table 3. Radiographic Variable Results

	Surgery	No Surgery	p-Value
Cyst Signal			
Low T1/High T2	30%	70%	0.320
High T1/Low T2	100%	0%	
Low T1/Low T2	100%	0%	
High T1/High T2	0%	100%	
Rim Signal			
Low T1	22%	78%	0.094
Intermediate/High T1	55.5%	45.5%	
Spondylolisthesis			
Present	29.4%	70.6%	1
Absent	28.5%	71.5%	
Canal Stenosis			
Present	30.4%	69.6%	1
Absent	27.2%	72.8%	
Facet Joint Fluid			
Present	16.6%	83.4%	0.459
Absent	33.3%	66.7%	
Laterality of Fluid			
Unilateral	23.1%	76.9%	0.340
Bilateral	36.8%	63.2%	
Facet Bone Edema			
Present	42.8%	57.2%	0.394
Absent	26.3%	73.7%	
Bone Erosion			
Present	0%	100%	1
Absent	30.2%	69.8%	
Cyst Opacification			
Opaque	30%	70%	1
Non-Opaque	20%	80%	
Cyst Size	13.69mm ± 2.98	11.9mm ± 5.43	0.270
Cyst Shape			
Round	20%	80%	0.763
Oval	33.3%	66.7%	
Irregular	25%	75%	

Table 4. Procedural Variable Results

	Surgery	No Surgery	p-Value
Mean Decrease in Pain Score	2.5 ± 2.8	1.4 ± 2.6	0.243
≥50% Improvement in Pain Scores	38.4%	34.3%	1.0
Same or Worse Pain Score	38.4%	37.5%	1.0
Cyst Contrast Filling	92.3%	87.5%	1.0
Successful Cyst Rupture	53.8%	81.2%	0.08

Table 5. Follow-Up MRI Results

	Successful Rupture	No Rupture	p-Value
≥50% Decrease in Cyst Size	75%	60%	1.0
	Surgery	**No Surgery**	
Of those with ≥50% Decrease in Cyst Size	87%	13%	0.22

less calcifications which could account for greater rates of success after percutaneous management. When compared to our study, while the patient demographics (62% female) and location of lumbar cysts (60% L4-L5) are similar in both studies, Cambron et al. has a much larger sample size at 110 patients. The difference in sample size and increased power could account for the results seen in Cambron's study.

Of the procedural variables tested, only failure of cyst rupture trended toward significance for later conversion to surgery. This makes intuitive sense; however, the conversion to surgery rate for those who failed was still only 50%. Ultimately, further data is needed to help discern how important this variable is to further conversion to surgery.

Finally, the follow-up MRI evaluation did have some interesting findings. A decrease in cyst size was seen in 70% of the patients who had a follow-up MRI. Of these patients, only 66% were noted to have had a successful cyst rupture, which shows that there is potential for a decrease in cyst size despite the failure of cyst rupture. Of those that had a decrease in cyst size of at least 50%, only one patient converted to surgery. While this was not statistically significant, it was likely limited due to the small sample size of follow-up MRIs.

The main limitation of this study is sample size. Because of the small population studied, we were unable to complete a robust analysis of the various clinical and radiographic outcomes that were obtained. If a thorough clinical and radiologic evaluation of a larger population is completed, it may reveal more insight into which patients eventually convert to surgery. Future areas of research could include a multicenter study which would be able to recruit more patients. Additionally, this was a retrospective review, which carries the limitation of the data available in the medical record.

Facet cysts have been recognized as a cause of spinal stenosis, but their optimal treatment is unknown. Typically, non-operative interventions are attempted prior to surgery, which often includes fluoroscopically guided facet cyst rupture. However, there is a significant percentage of patients in which this treatment fails to provide durable relief, and eventually, patients undergo a surgical intervention. This study shows that there is a large percentage of patients in whom percutaneous management is successful, which is consistent with previously published reports. At this time, we would recommend continuing to attempt fluoroscopic guided facet cyst rupture in all patients with appropriate post procedural clinical monitoring. ■

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2018 Best Bedside Manner Award

Congratulations to our UVA Ortho Faculty who have been recognized with the 2018 Best Bedside Manner Award in *Our Health: Charlottesville and Shenandoah Valley Magazine*.

- SPORTS MEDICINE
  First Place – Eric Carson
- SPORTS MEDICINE
  Honorable Mention – Steve Brockmeier
- ORTHOPAEDIC SURGERY
  First Place – Winston Gwathmey
- ORTHOPAEDIC SURGERY
  Honorable Mention – David Weiss
- HAND SURGERY
  Second Place – Bobby Chhabra
- HAND SURGERY
  Third Place – Nicole Deal

Doctor Hoo – Best Boss – Dr. Chhabra

by Richard Albas
Charlottesville Daily Progress

An individual can achieve success, and a team can achieve miracles.

Dr. Bobby Chhabra, Chair of Orthopaedic Surgery at the University of Virginia, knows what it takes to be successful: listen to your team, be open to ideas, and above all, share the same vision.

Dr. Chhabra was voted best boss in Charlottesville in this year's Readers' Choice, and he's honored with that distinction. "It's fantastic to get this kind of recognition," he said. "That is very special to me." He is also quick to point out that being a successful leader is the result of having a great team.

"In the Department of Orthopaedic Surgery alone, I lead a team of over 300 people. That includes the surgeons, nurses, physician's assistants, and administrative staff. I value them equally, and I listen to all of them," he said. "I got to know them personally, and I learn what they are passionate about. By respecting each other and everyone's contribution, we can provide the best care possible for our patients."

That philosophy works. Dr. Chhabra's orthopaedic program at the University of Virginia was named the best program in the state of Virginia and the 33rd best in the country by *US News & World Report*. "You can only accomplish that if you have a team that works well together," Chhabra said.

Dr. Chhabra came to Charlottesville in 1991 to attend medical school. He co-founded the University of Virginia Hand Center, holds the title of Lillian T. Pratt Distinguished Professor and Chair of Orthopaedic Surgery, is a Professor of Plastic Surgery, and has now been recognized as Best Boss of Charlottesville, among many other accomplishments.

"But," he said, "I don't do this work for the accolades. I do it because I'm passionate about working with a dedicated team of exceptional people that consistently strives to provide the very best care we can for all our patients."

Catching up with Dr. Bobby Chhabra, Chair of the Department of Orthopaedic Surgery at UVA

Pulse, UVA Health System

Dr. Bobby Chhabra is a 'Hoo through-and-through. In addition to being a member of the University of Virginia School of Medicine's Class of 1995, Chhabra serves as the Lillian T. Pratt Distinguished Professor and Chair of Orthopaedic Surgery, and the David A. Harrison Distinguished Educator. He is also a Professor of Plastic Surgery at UVA, the Hand and Upper Extremity Consultant for UVA Athletics, and the President of the UVA Physicians Group. You can hear him every Thursday on ESPN Radio/Newsradio WINA's Best Seat in the House Injury Report, when he discusses everything from UVA player updates to the latest in the NFL and NBA. Most recently, Chhabra has been the champion for the future Ivy

Photo by Jackson Smith

Dr. Bobby Chhabra

Mountain Orthopaedic Outpatient Care Facility, noting at the building's groundbreaking ceremony that "the facility will be the best for musculoskeletal and orthopaedic care in the country."

Q: From caring for patients from our community and beyond to your extensive involvement with the Health System and School of Medicine, your dedication to the University of Virginia is evident. Why UVA? What makes UVA so special?

I came to UVA in 1991, and I am proud to be a triple 'Hoo. The environment here, from both an education and patient care standpoint, is truly exceptional. I'm from Virginia and have raised my family here. My wife, an endocrinologist in the community, did her residency and fellowship at UVA, and she is a Darden School of Business graduate. UVA is just a special place, and Charlottesville a special city.

I've been in department leadership for 11 years now, and I can attest to how a collegial environment drives interactions and collaborations that advance our patient care and academic missions. Simply put, we're a family and we help each other. It's a great environment for faculty, staff, and for our trainees, and UVA and Charlottesville help make that possible. During my time here, I've had the opportunity to participate in almost every committee at the School of Medicine and Medical Center. I've learned a lot about this institution, and I have seen it from so many perspectives. I've had other opportunities offered to me, but what's kept me here at UVA are the people and the collegial relationships, and the ability to do what I am passionate about every day.

Additionally, UVA blessed me with great mentors during my medical school training, orthopaedic residency, and throughout my time as a junior faculty member. These meaningful relationships have really inspired me in my clinical and academic practice. These mentors have challenged me to be a better educator and leader, and without their support, guidance, and encouragement, I do not think I would be where I am today.

Q: What kind of growth have you seen in the Orthopaedics and Musculoskeletal Programs at UVA during your time here? What kind of growth do you see in the next decade?

The musculoskeletal specialty is one of the fastest growing specialties in the country and the world. Similarly, joint replacement is already a common procedure, but it will be one of the most common procedures in the next decade or two.

The growth of the musculoskeletal specialty at UVA has surpassed even that of the national trend. In just the past six to seven years, we've doubled the size of the Orthopaedic Department. When I joined the faculty in 2002, I was the ninth faculty member in the department. Now, we have 30 orthopaedic surgeons.

This tremendous growth has been mirrored by an increasing need for orthopaedic care globally. People are staying active later in life, and they are just generally participating in recreational activities and athletics much more.

The growth has been remarkable in both patient volume and technology. Procedures such as hip and knee replacements used to require long inpatient recovery stays. Now, because of advances in surgical and anesthesia techniques, as well as implant technology, many patients undergoing those procedures go home the very same day without a compromise in their overall outcome. So there has been a dramatic change in post-operative care and rehabilitation, even from the time when I was a resident.

Q: This growth you've seen and experienced firsthand—is orthopaedic research spurring it? And if so, how?

Absolutely. I can certainly speak for the UVA Musculoskeletal Research Division—we're figuring out how to use growth factors and other biologics to improve healing across several musculoskeletal tissues, such as bone, ligament, tendons, and nerves. Our research program is completely focused on clinical translation. Our priority is to translate all research to clinical applications. We have a very robust clinical trials program. We utilize safe new techniques and new technologies—all while evaluating to make sure that patient outcomes are the best that they can be. Our efforts include the whole spectrum of research—we take ideas that require basic science investigation, and we work to translate them into clinical use, evaluate their outcomes, and make sure these advances results in better rehabilitation and the return to everyday activities.

And patients are noticing our efforts and advances. They're traveling from farther away specifically for the care they will receive at UVA. We're the busiest spine trauma center in the state, and our sports medicine program has a very large reach. Also, many of us have unique specialties, or we are experts in certain procedures. Patients from around the country come to UVA Orthopaedics for consultation and care because many of us are designing new techniques and procedures and improving outcomes.

Q: One of the many incredible care opportunities the Ivy Mountain Orthopaedic Outpatient Care Facility will provide is 23-hour joint replacement. Can you walk us through how that will work?

A 23-hour procedure is considered outpatient because there is no admission to the hospital. Our new facility will include a joint replacement center, where a patient can be evaluated and receive non-invasive treatment before surgery becomes an option. The center will be a one-stop shop—therapy if needed, imaging and x-rays, and conservative treatment options like bracing. This is all before we even have the conversation about surgery, as outpatient joint replacement surgery requires a clear understanding of the process and expectations by the patient.

If joint replacement is the course of treatment, the next step is the operating room. The Joint Replacement Center operating rooms will be specifically built for joint replacement, and they will be home to trained staff who specifically do joint replacement every day.

Following surgery, the facility will have a specialized post-operative unit where family can stay in the room with the patient. Therapy can be done in the room and the patient will receive the highest level of nursing care. When they're ready to go home, they'll have appropriate instructions for pain management and their rehabilitation. It'll be a very collaborative and focused service, and will include experts in every aspect of joint replacement. That's the key thing about 23-hour joint replacement—you need a specialized program and a specialized team. From the minute you come in to when you leave, it's a very unique program for our area. The entire spectrum of care will be provided within a very specialized center.

Q: How has philanthropy impacted your work and your patients during your career?

The philanthropic support of grateful patients and loyal alumni has been tremendous during my time at UVA. Alumni have helped create endowed chairs, which allow me to support the work of my researchers and clinicians. I've also had several current faculty members and alumni contribute to research endowments for fellows and residents. The training and education they received here inspires them to set the stage for the next generations with their support. These endowments allow our residents and fellows to travel to meetings, share their research projects, and receive a more comprehensive and forward-thinking medical foundation.

Support for research is incredibly crucial because, as in many fields, if you don't focus on developing new treatments, your care becomes stagnant, which means that you're not doing the best for the patients you care for. Especially in an academic environment like UVA's, that's one of our missions—to provide the best patient care thanks to new discoveries that happen across Grounds through collaboration.

The best doctors are lifelong learners, and the best patient care comes from constant learning. Research plays a huge role in that.

Q: A fun fact, or one thing most people don't know about you?

I'm very passionate about sports. My wife, kids, and I spend a lot of time watching and going to sporting events, and I'm a diehard UVA and Washington, D.C., sports fan. But what really drives me, and what is incredibly rewarding for me, is educating my patients and the community on orthopaedics, and more specifically on injuries related to athletic or recreational activities.

This desire to share this knowledge with others led me to the radio show I host every Thursday alongside Jay James, the Best Seat in the House Injury Report. We talk about what sports injuries mean and when you can expect to see athletes to return to play. We actually won an Associated Press Award last year for the show, and it's our third year broadcasting it together.

So here's what most people don't know—an ultimate goal of mine is to one day be on ESPN TV or Radio. I'd love to be the official injury consultant for ESPN. I joke around about it, but now with the success of my weekly show, it would be a dream come true for me to go national with ESPN someday.

National '100 Great Orthopaedics Programs' List Features UVA

by Eric Swensen, UVA Health System

For the fifth consecutive year, Becker's Hospital Review has named University of Virginia Orthopaedics at UVA Medical Center to its list of 100 hospitals and health systems with great orthopaedics programs.

"The hospitals featured on *Becker's Healthcare*'s 100 hospitals and health systems with great orthopaedic programs list for 2018 have earned recognition for quality of care and patient satisfaction for orthopaedic and spine surgery," wrote the editors of the national healthcare publication in introducing this year's list. "Many of the orthopaedic programs highlighted have rich histories of innovation and have won grants to research musculoskeletal treatments. The centers include robust nonoperative services and provide care to professional and elite athletes in their communities."

Becker's highlighted the role of the UVA Sports Medicine Team in caring for UVA student-athletes, as well as the more than 1,000 joint replacement surgeries—many done using minimally invasive techniques—and 1,500 spine surgeries performed each year at UVA. The publication also highlighted health insurer Blue Cross Blue Shield designating UVA as a Blue Distinction Center for its expertise in knee and hip replacements.

"This honor from *Becker's Hospital Review* highlights both the high quality and the wide range of orthopaedic care we provide here at UVA," said Bobby Chhabra, MD, chair of the UVA Department of Orthopaedic Surgery. "Providing excellent care to our patients is a true team effort, and I want to thank everyone at UVA Health System that works together with our department to serve our patients."

"I am so pleased to see our orthopaedics team recognized for their outstanding care and service to our patients," said Pamela M. Sutton-Wallace, Chief Executive Officer of UVA Medical Center. "Their ability to find innovative ways to care for our patients will only be enhanced following the construction of our new musculoskeletal center on Ivy Road here in Charlottesville."

Q&A with Michael Boblitz

The philosophy that drove 40+ years of success at University of Virginia Health System's Orthopaedic Department & a new Musculoskeletal Center

by Laura Dyrda, *Becker's Spine Review*

Earlier this fall, Charlottesville-based University of Virginia Health System began construction on a new Musculoskeletal Center, which will consolidate multiple outpatient orthopaedic clinics to a single location. The 195,000 square-foot facility will include six outpatient operating rooms, advanced imaging, physical and occupational therapy, and 95 exam rooms.

The center will also include same-day joint replacements and open in February 2022. Although the project has just begun the building phase, COO and Lecturer at UVA Orthopaedic Surgery Michael H. Boblitz, the man helping the Chair of Orthopaedics to drive this new facility, has spent more than four decades shaping and growing the Orthopaedics Program at UVA.

He was previously instrumental in opening the McCue Center at UVA in 1991, a sports medicine and football athletic building named for Frank McCue, MD, a pioneer in sports medicine. One of Dr. McCue's fellows, James Andrews, MD, has become renowned for his treatment of professional athletes and his campaign against youth sports injuries.

Mr. Boblitz also played a big role in negotiating a multiyear contract for UVA to provide sports medicine services to Harrisonburg, VA-based James Madison University, which it has done since 2003. UVA Orthopaedics provides care for both UVA and JMU Athletics, several small colleges, and 10 high schools.

In partnership with Bobby Chhabra, MD, Chair of the Orthopaedics Department, Mr. Boblitz is excited to grow the department and continue the UVA Health System's legacy of attracting diverse orthopaedic surgeon faculty, residents, and fellows who provide world-class care.

Here, Mr. Boblitz discusses his career and the new UVA Musculoskeletal Center and shares his best advice for aspiring leaders.

Q: Since you joined UVA in 1977 as a research assistant, you've been able to work with orthopaedic surgeons as residents and fellows who are now spread across the country. What have you learned from the growing network of surgeons who trained at UVA?

Michael Boblitz: I have been fortunate to work with many fine orthopaedic surgeons during their training who have become leaders across the country, including our current Chair. For instance, the Head of Hospital for Special Surgery in New York City is a former UVA medical student and several former residents are Chairs of academic departments or are successful leaders in private practice or their specialty societies. It is great to see these surgeons grow, but for the future we would love to have more diversity within our department. That is a challenge for us and across the country in Orthopaedics.

We try to recruit women and underrepresented minorities in every orthopaedic residency and fellowship class, as they add tremendous value to our program. But it is a challenge to recruit to a small city. We are not as large as Atlanta, New York City, or D.C., but we do have a wonderful environment and community in Charlottesville. We are a cosmopolitan city and we have people from all over the world who go to school here and teach here.

Q: What makes the department unique?

MB: Our department is unique because we have to compete regionally and nationally. If you don't compete nationally it's harder to recruit quality residents, fellows, and faculty. One of the frustrations of being [in] an academic environment, unlike in private practice, is it takes longer to get projects started, planned, approved, and built. The new Musculoskeletal Center has been a 10-year effort from inception of the vision to beginning construction, but it's something we've wanted to do for quite a while so that we can provide the highest level of innovative care for our patients.

Q: Why did you decide to build a new facility?

MB: Our existing facilities have served us well, but we are growing at a rapid pace and we have exhausted our space capacity. We currently have orthopaedic clinics in different locations including a separate Hand Center, Spine Center, and Pediatric Orthopaedics Clinic. Our different locations in town make it difficult to provide efficient care. This is an opportunity for us to bring everyone together in one location and provide care more efficiently and at a lower cost. We will have six operating rooms and will be able to do outpatient total joint replacements and many sports surgeries and allow patients to stay 23 hours for recovery in our new facility.

Our goal is to provide outstanding care with a seamless process.

Q: You have experience as an occupational therapist as well, focused on hand surgery and upper extremity injuries. Could you talk about your early career and how it has shaped your current philosophy of care?

MB: I graduated from Virginia Commonwealth University as an occupational therapist and two weeks later I went into basic training in San Antonio at Brooke Army Medical Center as a second lieutenant. I was attached to the 1st Infantry and 24th Infantry divisions and spent time at Fort Riley, Kansas. The 1st Infantry Division was rotating in and out of Vietnam and the 24th Infantry Division was rotating in and out of Germany because of the Berlin crisis. Our 300-bed hospital often had 1,000 patients from Vietnam that we were treating, and I worked with other clinicians to take care of gunshot wounds, burns, and other traumatic injuries.

Even when I arrived at UVA to teach and perform research, I kept up my certifications that allowed me to continue to care for hand and upper extremity injuries. I've been able to do a variety of things in my role, which is one of the reasons I stayed here at UVA for so long. We have built an exceptional team here, and we're unique because we have had no turnover of faculty in over 10 years; two surgeons retired, but we have been able to build a collegial, transparent, team-oriented environment. Any faculty member can come and look at the performance of themselves and their colleagues. We make an effort to compensate our staff and faculty appropriately and reward them for what they do in all areas of our mission (clinical care, research, and education). I think that's one of the reasons we are successful. Nobody is perfect, but we have been able to get our group to work together and accomplish a great deal.

Q: How did you recruit and select the right people to build your department?

MB: I hired people who are smarter than me and I take very good care of them. We have a good team of people who look after each other. It's almost like a family. I have a CFO who has worked here for 35 years and many of our staff members have been here for decades. I feel that I've been the glue that holds the department together as leaders and Chairs change. One of my key roles has been managing expectations. You have topflight surgeons who are well-respected around the country and we want to make sure they have the tools to do everything they can to provide quality care. If there are patient complaints, I'm heavily involved in that with my boss.

Q: With the new building, how are you employing your core competencies of team building and managing people to get the job done?

MB: Dr. Chhabra and I have been overseeing the whole project from conception and working with the leaders of the hospital, health system, and University. We have a large group of people who have input in the building concept and overall project. It's been a challenge and we still have a lot of work to do. We want this center to be high-tech but with a feeling of warmth and comfort. We expect the project to be done in the fall of 2021 and opened early 2022.

Q: What has changed since you first joined the department?

MB: For the first few years, I was heavily involved in research. One of the first Chairs of the department, Dr. Warren Stamp, obtained permission to do total joint replacements here and we developed a joint replacement program. Since then, we've had a very active research arm and developed the department with the idea of translational research being a key aspect of the program. Taking a clinical issue people are concerned about, bringing it to the lab to find a solution and then implementing it in the clinical environment is critical in advancing our patient care.

It has been an honor to be a faculty member in the UVA School of Medicine and having a leadership role in Orthopaedic Surgery all these years. I hope to continue to contribute as long as I can.

UVA Helped Matt Deasey Live Two Dreams: Basketball and Medicine

by Amy Hughes, UVA Health System

Matt Deasey, MD, says being an orthopaedic surgeon is a lot like playing basketball. Well, sort of. Now in his second year of his Orthopaedic Surgery Residency at UVA, he's had many lessons along the way, most notably as a Virginia men's basketball player.

Deasey attended Episcopal Academy near his hometown of Wynnewood, Pennsylvania, a suburb of Philadelphia. He was a basketball star, point guard, and team captain. He went to prom with his high-school sweetheart, Lindsay, and he "was in love with her from that point on."

When Deasey graduated from high school, his next goal was to attend college and later to go to medical school. He had several schools on his short list, but after visiting UVA, he never looked back. He started his first year in the fall of 2003.

"I came to UVA thinking I was done with basketball," he says. "I was like, 'I'm just going to go be a student and go to medical school.'"

Deasey filled his schedule with an ambitious course load and balanced homework with friends and his ongoing relationship with Lindsay. She had a car, so she would drive down from Pennsylvania to visit him on the weekends.

A couple years into his college career, Deasey befriended a fellow former high-school athlete. The two had a common intertest in the sports where they used to shine, and the duo started working out together after class. His friend set his sights on making the UVA wrestling team, so Deasey thought, "I'll go play basketball." Although he hadn't played basketball in two years, he felt stronger than ever before.

JOINING THE TEAM

It was 2005, and Pete Gillen had stepped down as head coach for the UVA men's basketball team. Dave Leitao was hired to lead the team's final season in U-Hall, which is currently being demolished to make way for an athletic precinct near the John Paul Jones Arena.

Before the 2005 season began, Leitao hosted a one-night tryout for walk-on players. This was Deasey's shot to join the team. He and 11 other hopefuls came to U-Hall to try to impress the coaches. The trial started with a warmup, free-throw shooting, full-court drills, full- and half-court shooting, and running between each.

"I was exhausted 15 minutes in," Deasey says. "I was in pretty good shape, but I hadn't been playing Division I college basketball."

At the end of practice, Deasey received positive feedback from the coaches. To keep the momentum going, the following week, he and scholarship player Sean Singletary, whose No. 44 jersey is now retired, reconnected for workouts at U-Hall. Deasey and Singletary grew up as basketball rivals at neighboring middle and high schools in Philadelphia.

Soon, Deasey received a phone call from the coaching team. In that moment, he joined the Virginia Cavaliers roster. "My strategy

Photo by Kay Taylor, UVA Health System

Dr. Matt Deasey

of leaving it all on the floor worked," Deasey says.

As a member of the team, he describes the experience as "thrilling. It's something I've been wanting to do since I was seven years old."

He was fulfilling his dreams and pushing his physical limits. Practice was 35-40 hours per week on the court, plus additional time lifting weights in the gym.

"It was awesome just to get to warm up before the games," Deasey says. "That was a time when I knew I would get shots. So, I was always the first person out of the locker room. ...It was amazing to go and play in these arenas where I had been glued to the TV growing up watching my heroes play. To get to go and play in Cameron, to play at the dome at UNC, to go play at Maples Pavilion at Stanford was amazing."

In a video lingering on the internet from Deasey's days on the court, you get a glimpse into Deasey's personality—likeable, humble, hardworking—all things that have led him on the path to becoming an orthopaedic surgeon.

"I had been playing pickup, but now I was playing with guys who were amazing," Deasey says. "That's something I am grateful for now because that was the perfect preparation for being a resident: You are not as good as those who have been doing it for two years or five years or 25 years."

At the end of the 2005-2006 season, Deasey's basketball experience came to an end. He played six games, and Leitao's team relied on him heavily in practice.

"We participated in practice," Deasey says, "and during five-on-five drills, we played."

THE REAL WORLD

Deasey graduated from UVA in 2007 and headed back home to Pennsylvania and to Lindsay. He worked in a cardiothoracic research lab for nine months, then became a high-school science teacher and basketball coach. Coaching helped him stay connected to his past, and teaching helped him prepare for his future.

"I got to study for the MCATs [Medical College Admission Test] by learning how to teach private-school kids chemistry, because I didn't learn it while I was on the basketball team," Deasey laughs. "A parent of one of my students was a surgeon and Dean of the Medical School at Temple. He said, 'It's not too late. If you want to go back and be a doctor, you should go be a doctor.' So, I applied to one place, and that was it."

Deasey left high-school science and enrolled in the Lewis Katz School of Medicine at Temple University. He didn't know until much later, but in the middle of one of his long nights of his first year, Lindsay (then his wife!) wrote a prediction on a piece of paper that Deasey would be an orthopaedic surgeon at UVA.

"Not a joke, not exaggerating—she put it in an envelope," Deasey says.

And here he is.

BACK TO CHARLOTTESVILLE

Deasey is currently in the middle of his second year of Orthopaedic Surgery Residency at UVA. He calls it "grueling" but also "rewarding."

He brings all his experiences into his residency, especially his time as a Virginia Cavalier basketball player. "It's remarkably similar to being on the team," he says. "I improved more in a year of playing here than I did in four years of high school. And I think that's true of every year of residency; you improve more than you did in all of medical school. It's amazing. You can't help but get better because you work at it so much."

Halfway through his five-year residency, Deasey is spending more time in the operating room.

"We get to do a lot of surgery as a second year," he says. "Intern year, first year you do a lot of watching, a lot of learning, which I think is appropriate. It's a lot like being a walk-on—you don't get to do a lot of games, but now you get a bit more game time."

That game time comes at a price—a price of a demanding schedule, little sleep, and scarce family time. Deasey recently worked two-and-a-half months of nights consecutively. On those shifts, "It's you against the world," he starts, then stops with a chuckle. "It's you on behalf of all the orthopaedic patients in the hospital and everyone that gets hurt in Central Virginia."

On those long nights, Deasey had plenty of time to doubt his choices or second guess the path he took. But he never let the negativity creep in. "Moments when I feel frustrated or tired or wonder why I am doing this, I think about the fact that this is something I really wanted, I worked hard to get," he says. "I'm grateful that UVA gave me a chance."

Bobby Chhabra, MD, Chairman of Orthopaedic Surgery, was once a resident at UVA himself. Now as Chair, the culture he has created for his own team is what drew Deasey back to UVA.

"Dr. Chhabra is an inspirational Chairman," Deasey says. "I think he is similar to Coach [Tony] Bennett [men's basketball coach] in that they are both people who care deeply about what kind of person is part of their team."

Deasey appreciates being chosen for the team once again. He feels at home in Charlottesville and would like to stick around this time.

"I'm naturally better at surgery than I was at defending elite athletes," Deasey laughs. "I want to keep doing this, and I'm grateful that I get to do it here."

For now, Deasey can look forward to working alongside his UVA colleagues for at least a few more years. If we want to know where Deasey will end up after that, perhaps we should ask Lindsay to put another prediction for the future in an envelope.

Deasey and Lindsay married in 2010. She is a philanthropic consultant working to eradicate polio. Deasey is thankful for all the sacrifices she's made so he can pursue his dreams of being a doctor and says he "can't do it without her." They have a four-year-old daughter named Maggie who has been cheering "Go Hoos, go!" since she was 14 months old.

GO HOOS!

Deasey has had little contact with the basketball team since he's been back in town. Quite frankly, he hasn't had the time between a workday that goes beyond dusk to dawn and a family at home. However, he is an avid fan and has had a few behind-the-scenes experiences.

This year, he thinks the team can win the NCAA tournament (they did, in fact, win).

"I love the way they play," he says. "I like Ty Jerome. He has amazing poise. I wish that I had a 10th of his poise on the ball. ... The way he and Kyle Guy work off each other and find each other; it shows.

"I love Mamadi Diakite. [Diakite and Deasey share the same number: 25.] So, I hope he does well and starts selling those jerseys. He's the guy who I think will continue to emerge throughout this year and has the potential to become a pro and make millions of dollars just because of his untapped skills on the ball. He shows flashes of it. Same thing with [Jay] Huff. He can shoot from deep, he can stretch the defense, take away the rim protector, and then punish people. His quote before the blue-white scrimmage last year was amazing. His quote was, 'Dunk everything,' which he said with a wry smile, but he's doing it now."

Basketball and orthopaedic surgery have shaped much of Deasey's life up to this point. The common thread between both has been UVA.

"The orthopaedic program here is similar to the basketball program here because it just keeps getting better," he says. "My goal is to be good enough to be here."

Deasey keeps choosing UVA, and UVA keeps choosing him. He hopes to be in Charlottesville for the long term, and he hopes Maggie will get the chance to grow up cheering on the team for which her dad once played. Go Hoos! ■

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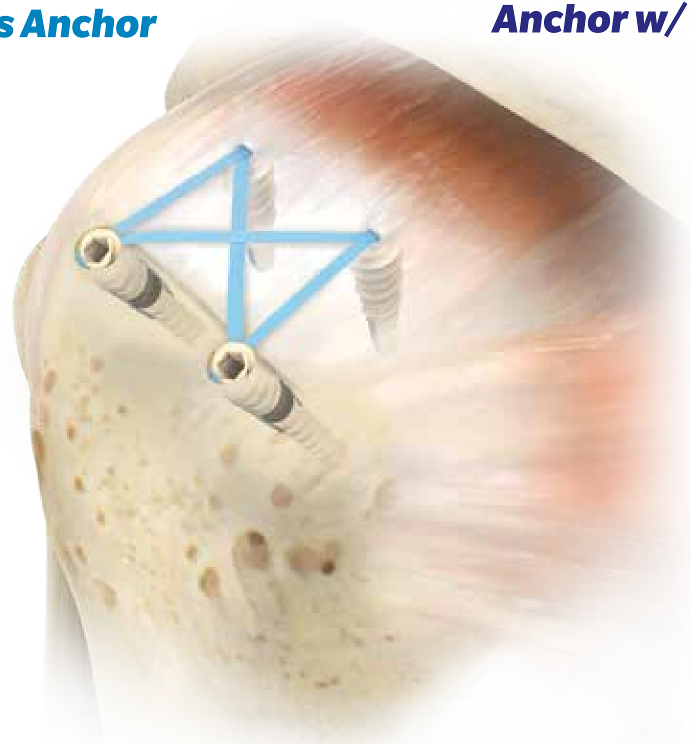

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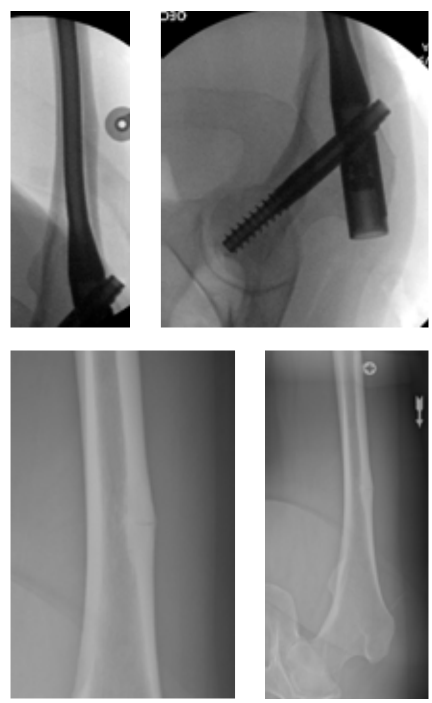
A 50 yo F was seen in the sports and joints clinics for left knee pain. She has a history of rheumatoid arthritis, osteoporosis, and left femoral nail for subtrochanteric fracture. Long length alignment films revealed a valgus deformity of the left knee. Surgical options including HTO and TKA have been discussed. What is the next best step?

ANSWER:

Cephalomedullary nail for prophylactic fixation of right femur.



This patient has cortical thickening in the lateral subtrochanteric region consistent with an impending atypical femur fracture (AFF), which may be associated with prolonged bisphosphonate use. The patient likely had AFF on the left. Upon further questioning, she had no significant trauma leading to the femur fracture, and did not have significant antecedent pain. Imaging of the contralateral side may be considered when treating any AFF, and it is clearly indicated if the patient is having any pain.

Thus, before undergoing either procedure being considered on the left lower extremity, she would benefit from stabilization of the right femur to avoid fracture in the post operative period where she will likely increase load in the RLE while recovering.

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