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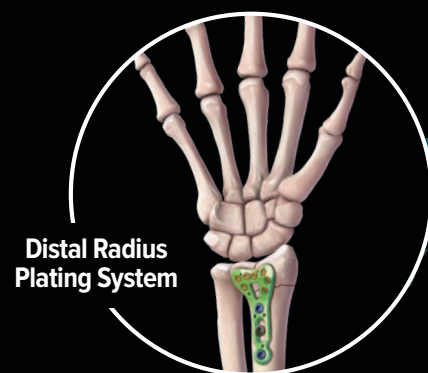
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# CAMPBELL ORTHOPAEDIC JOURNAL

**Volume 9**

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# CAMPBELL ORTHOPAEDIC JOURNAL

Volume 9, May 2023



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## Letter from the Editor-in-Chief



### Frederick M. Azar, MD

Chief of Staff, Campbell Clinic Orthopaedics  
Professor and Sports Medicine Fellowship Director

#### ***Campbell Clinic Foundation Family and Friends,***

In celebration of its 75th anniversary, the Campbell Clinic Foundation hosted a combined Triennial and Alvin J. Ingram Lectureship meeting in April of 2022. It was a great success and enjoyed by all who attended.

Last year, the Campbell Clinic Foundation saw tremendous growth. We launched the James W. Harkess, MD Total Joint Visiting Professorship, with Dr. Robert Barrack as the inaugural speaker and plan to host Dr. Robert Trousdale as our Distinguished Professor in 2023. We have expanded our clinical trials initiative and continue to produce more than 150 presentations, publications, and posters annually to share the results of our research at numerous scientific conferences nationally and internationally. Work on the second edition of *Campbell's Core Orthopaedic Procedures* has been completed just in time for work to begin on the 15th edition of *Campbell's Operative Orthopaedics*. Milestones like these give us a great sense of appreciation and a chance to reflect on our achievements as we set new goals for the coming years.

It is because of you - our patients, alumni, industry partners, staff, and donors around the world - that we have flourished as leaders in orthopaedics. We have benefited greatly by your passion and generosity. Because of your ongoing support and interest, we have been able to continue excelling in patient care, resident and fellow education, and clinical research. We are indebted to all of you.

The Campbell Clinic and Campbell Clinic Foundation have made great strides in advancing our missions. Each year we see more patients in our clinics and perform more procedures in our surgery centers than the year before. To keep up with demand and improve patient access, we have added three local satellite clinics and expanded our affiliate model with Tier One Orthopaedics and Neurosurgical Institute in Cookeville, Tennessee. This spring, a new satellite office will open in Oxford, Mississippi. We are excited to announce that five new orthopaedic surgeons and one new Family Practice Sports Medicine physician will be joining our practice in 2023. They are tremendous physicians, with a shared passion for patient care, teaching, and research. We continue our efforts to attract the best and brightest residents, fellows, and faculty.

Every year the Campbell Orthopaedic Journal shines a spotlight on our graduating class of residents and fellows. These individuals are exceptional surgeons who will continue to provide excellent care to their patients and contribute to our profession in many ways. We are pleased to introduce the 2023 Graduating Class and present abstracts of their research completed during residency. Also included in this edition are the top research and review articles by our staff. Campbell Orthopaedic Journal is distributed to the more than 500 distinguished alumni of our educational programs, every orthopaedic chair and program director in the country, medical schools nationwide, and donors and friends of the Campbell Clinic Foundation.

The physicians at Campbell Clinic remain dedicated to the standards of excellence in patient care established by our founder, Willis C. Campbell, MD, more than a century ago. While the healthcare environment has changed significantly since the early years of the 20th century, our culture has not. We continue to be guided by our Core Values of Excellence, Integrity, Compassion, Innovation, Commitment, Legacy, and Unity. And we remain committed to our priorities of faith, family, and patient care.

We look forward to being together in 2024 for our next Triennial meeting.

Thank you for all that you do for our patients and our profession.

***Together, we are Moving Lives.***

Best regards and God Bless,

**Frederick M. Azar, MD**  
Campbell Clinic Chief of Staff



## CAMPBELL CLINIC MISSION

The mission of the Campbell Clinic is to provide unsurpassed patient care while being recognized as a leader in teaching and research in the profession of orthopaedic surgery.

## CAMPBELL CLINIC VISION STATEMENT

Another century of world-class orthopaedic care restoring function and quality of life.

## CAMPBELL CLINIC CORE VALUES

### EXCELLENCE

We aim to exceed expectations by providing an exceptional patient experience through accessible & efficient quality care, a comfortable and safe environment, and effective communication.

### INTEGRITY

We embrace, expect, and exhibit honesty, accountability and professionalism toward patients, each other, and outside partners.

### COMPASSION

We commit to cultivating an environment of compassion for each patient and family member through sensitivity, sincerity, and empathy.

### INNOVATION

We commit to delivering innovative technologies, products, and services through our rich orthopaedic heritage and a strong research foundation.

### COMMITMENT

We commit to each other, to excellent patient care, to education, to innovation and research, to community service, and to orthopaedic leadership.

### LEGACY

We will do what is right for the Campbell Clinic, our patients, and our employees.

### UNITY

Everything we do, we do together.

# When you're hurt, we're there.

The region's top orthopaedic specialists are available near you when you need them most.

- Break, sprain, and injury care
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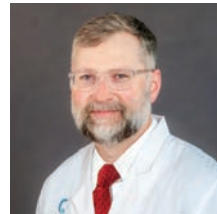


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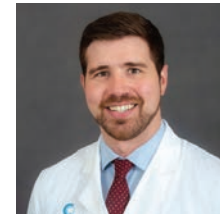
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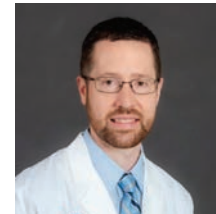
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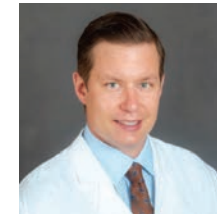
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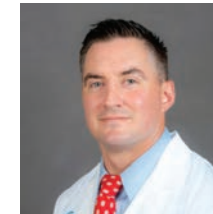
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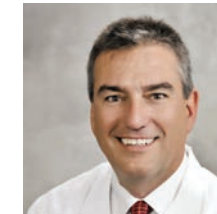
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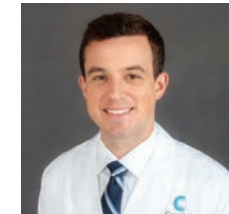
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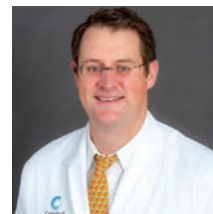
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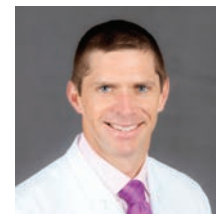
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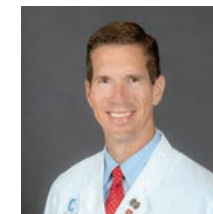
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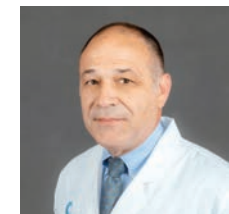
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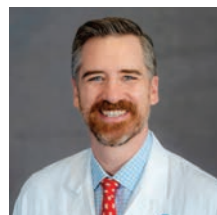
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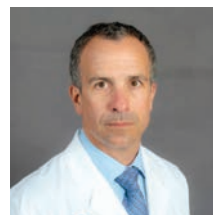
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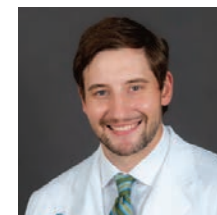
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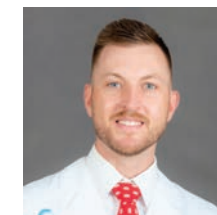
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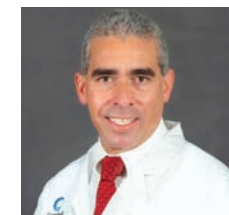
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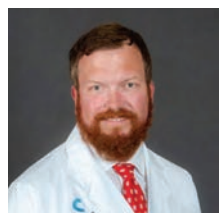
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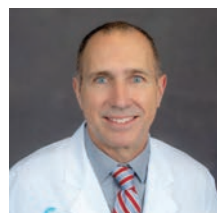
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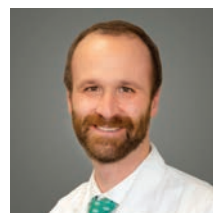
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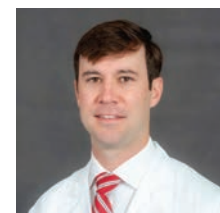
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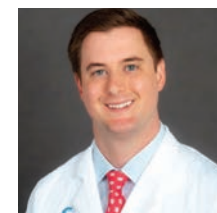
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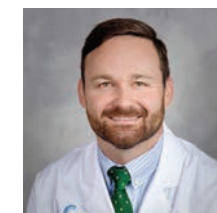
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*We believe that mobility is the foundation of health.*

*Since 1946, the Campbell Clinic Foundation has trained the physicians and facilitated the research that has helped people in our community – and around the world – keep moving toward their best lives.*

*We work every day to take that legendary orthopaedic leadership to the next level, to make life better for those of us who have bone and joint injuries and conditions. To make life better for all of us.*

*We believe the Campbell Clinic Foundation develops the transformational leadership and innovation an active world needs.*

**WE BELIEVE IN MOVING LIVES.**

## OUR THREE PILLARS

### Advancing Surgeon Education

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### Excellence in Orthopaedic Research

We conduct pioneering research into the causes, cures, and treatments of musculoskeletal diseases and disorders and educate the healthcare community as a leading provider of scholarly publications.

### Community Outreach and Impact

Through diverse programs and physician involvement, we provide orthopaedic resources and education programs to children and adults across the Mid-South and around the world.



### Get to know us.

Our website has up-to-date information, event listings, newsroom and more to familiarize you with our mission, impact and opportunities for involvement.

*We are grateful to our generous donors, partners and colleagues who make this work possible.*

Help us build a bright future of  
**MOVING LIVES.**

140

Active research studies (including 15 clinical trials) driving new knowledge and patient outcomes



31

Medical students participated in our orthopaedic research studies



405

Students, residents and clinicians learned new techniques and treatments through our Visiting Professor Series



Celebrating  
75 Years

420

Patients served in our Cerebral Palsy Center in 2022



159

Memphis Union Mission clients served through our annual Our Hearts to Your Soles foot care clinic



151

Presentations, publications and posters demonstrated innovation in surgical technique, pain reduction and patient care



Campbell-Foundation.org



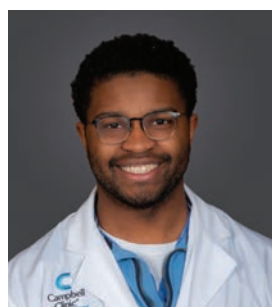


Campbell Clinic  
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MOVING LIVES

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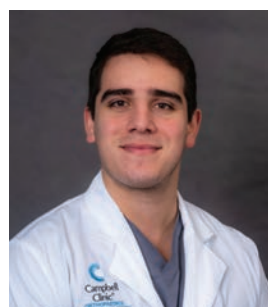
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Campbell Clinic Foundation  
MOVING LIVES

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# ORTHOTIC & PROSTHETIC SOLUTIONS

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For over 155 years, Hanger® Clinic has been at the forefront of orthotic and prosthetic products and services. With hundreds of locations across the country, Hanger Clinic offers an expansive network that provides access to care, whether patients are at home or traveling. No matter which of the over 800 Hanger Clinic locations that you choose, you can rest assured that you will be met with the same dedication to superior care and service.

### SERVICES OFFERED

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- Partial Foot Prostheses
- Symes Prostheses
- Transtibial Prostheses
- Knee Disarticulation Prostheses
- Hip Disarticulation Prostheses
- Hemipelvectomy Prostheses
- Hemicorpectomy Prostheses

#### Lower Limb Orthotics

- Foot Orthoses
- Ankle Foot Orthoses (AFO)
- Knee Ankle Foot Orthoses (KAFO)
- Hip Knee Ankle Foot Orthoses (HKAFO)
- Hip Abduction Orthoses
- Fracture Orthoses
- Neuropathic Walker (Charcot Foot)
- WalkAide (Foot Drop)

### AMPOWER PROGRAM

Beyond clinical care, Hanger Clinic also created and supports the **AMPOWER™** Program, a three tiered program designed to empower and strengthen those affected by amputation or limb difference through peer mentorship, education, and community. **AMPOWER** hosts an online community, [EmpoweringAmputees.org](https://EmpoweringAmputees.org), which was established to provide guidance and encouragement for those with limb deficiency and limb loss. **AMPOWER** also provides in-person and over-the-phone support, education, and the opportunity for community connection. Learn more at [HangerClinic.com/AMPOWER](https://HangerClinic.com/AMPOWER) or call 1-844-AMPOWER.



To learn more about Hanger Clinic’s prosthetic services, please visit [HangerClinic.com](https://HangerClinic.com) or contact us at 1-877-4HANGER option 1.



## RESIDENCY PROGRAM

University of Tennessee Health Science Center-Campbell Clinic  
Department of Orthopaedic Surgery and Biomedical Engineering

The legacy of excellence that Dr. Willis C. Campbell instilled at Campbell Clinic over a century ago pervades the residency program at the University of Tennessee Health Science Center—Campbell Clinic Department of Orthopaedic Surgery and Biomedical Engineering.

“This residency is one of the most well-rounded programs in the country, offering learning opportunities in all subspecialties in addition to training in the business of orthopaedics, making physicians better prepared to enter the workforce,” said Residency Assistant Director, Clayton C. Bettin, MD.

The world has changed, though, since Campbell founded the residency program in 1924. Today, candidates expect residencies to have strong policies, programs, and training that emphasize diversity and inclusion. “The Campbell Clinic Foundation now has a Diversity, Equity, and Inclusion Committee to set policies and procedures to promote these goals. Recent initiatives include partnerships with Nth Dimensions and the J. Robert Gladden Orthopaedic Society and the formulation of our DEI Statement,” says Residency Director, Derek M. Kelly, MD.

Forty residents are enrolled in the accredited 5-year program, which combines rigorous academic learning with a heavy operative load and extensive clinical exposure. Residents train in all subspecialties: trauma, sports medicine, total joint, general, pediatric orthopaedics, adult reconstructive surgery, foot and ankle surgery, hand and spine surgery, orthopaedic oncology, and anatomy and pathology. They are gradually exposed to surgical techniques through a series of rotations in those areas.

Simulations supplement the clinical training. Many industry-sponsored cadaver labs and Sawbone® labs are offered, typically with a subspecialty focus. “We

usually are exposed to that industry sponsor’s implants or instruments for the first portion of the evening, then allowed to continue to dissect the cadavers to practice surgical technique and learn anatomy,” Dr. Hayden Holbrook, Chief Resident, explained. “I have done hand labs with Skeletal Dynamics, arthroplasty labs with Smith & Nephew, trauma labs with Stryker, Exactec for shoulder arthroplasty, and peds labs with Wishbone Orthopedic. These are great experiences for residents.”

Arthroscopy training also takes place at the UTHSC simulation lab, a 45,000-square-foot, state-of-the-art facility that is one of only a few such sites in the country. Simulated patients (trained actors), manikins (high-fidelity patient simulators), and virtual-reality settings help residents hone their clinical skills there.

Casting/splinting labs are held annually so that new residents and medical students can practice applying casts and splints on each other, then removing them with a casting saw.

Technology links students to teachers, with hybrid learning available for Monday Night Meetings and all subspecialty morning conferences.

The residency website, [CampbellResidency.com](https://CampbellResidency.com), and a strong Instagram presence (@ccorthoresidency) have enhanced communication and engagement with prospective residents and alumni alike.

All of these factors have helped produce strong leaders as well as physicians. Dr. Campbell co-founded the American Academy of Orthopaedic Surgeons in 1933 and was its first president, with seven more Campbell Clinic doctors following his lead over the years. In addition, four alumni have been president of the American Orthopaedic Association, nine have headed the American Board of Orthopaedic Surgery, and four alumni have been president of the Pediatric Orthopaedic Society of North America.

“This residency is one of the most well-rounded programs in the country.”



PGY-4



**Tyler E. Calkins, MD**  
Undergraduate: West Virginia University  
Medical School: West Virginia University School of Medicine



**David W. Cooper, MD**  
Undergraduate: Tusculum College  
Medical School: East Tennessee State University James H. Quillen College of Medicine



**Zachary R. Diltz, MD**  
Undergraduate: The University of Alabama  
Medical School: Ohio State University College of Medicine



**Ilya M. Gutman, MD**  
Undergraduate: The University of Alabama  
Medical School: University of Alabama School of Medicine



**Claire E. Hays, MD**  
Undergraduate: Louisiana State University  
Medical School: Louisiana State University School of Medicine



**W. Colby Skinner, MD**  
Undergraduate: University of Georgia  
Medical School: Medical College of Georgia at Augusta University



**Carson J. Smith, MD**  
Undergraduate: University of Miami  
Medical School: University of South Florida Health Morsani College of Medicine



**Clayton W. Wing, MD**  
Undergraduate: University of Georgia  
Medical School: Medical College of Georgia at Augusta University

PGY-4

PGY-3



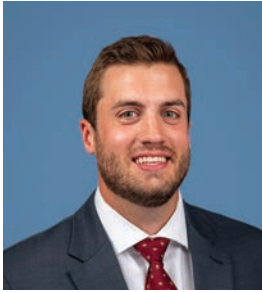
**Andrew J. Couture, MD**  
Undergraduate: University of Central Arkansas  
Medical School: University of Arkansas for Medical Sciences College of Medicine



**Nolan D. Farrell, MD**  
Undergraduate: The Ohio State University  
Medical School: Ohio State University College of Medicine



**Andrew D. Gailey, MD**  
Undergraduate: Tulane University  
Medical School: University of North Carolina at Chapel Hill School of Medicine



**Brenton R. Jennewine, MD**  
Undergraduate: Case Western Reserve University  
Medical School: University of Virginia School of Medicine



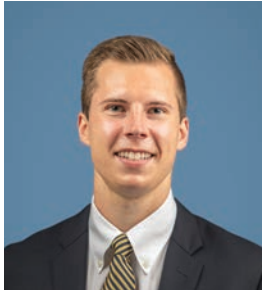
**Andrew D. Nahr, MD**  
Undergraduate: Newman University  
Medical School: University of Kansas School of Medicine



**Evan R. Porter, MD**  
Undergraduate: Drury University  
Medical School: Geisinger Commonwealth School of Medicine



**Eric J. West, MD**  
Undergraduate: Lafayette College  
Medical School: The Brody School of Medicine at East Carolina University



**Jacob T. Zalewski, MD**  
Undergraduate: Sewanee: The University of the South  
Medical School: East Tennessee State University James H. Quillen College of Medicine

PGY-3

PGY-2



**Matthew R. Colatruglio, MD**  
Undergraduate: The Ohio State University  
Medical School: Ohio State University College of Medicine



**Lauren A. Foropoulos, MD**  
Undergraduate: University of Mississippi  
Medical School: University of Tennessee Health Science Center College of Medicine



**Paul T. Greenfield, MD**  
Undergraduate: Rice University  
Medical School: Emory University School of Medicine



**Evan P. Johnson, MD**  
Undergraduate: University of South Florida  
Medical School: University of Central Florida College of Medicine



**Mateo J. Kirwan, MD**  
Undergraduate: University of Kansas  
Medical School: University of Kansas School of Medicine



**Elliot N. Konrade, MD**  
Undergraduate: Washburn University  
Medical School: University of Kansas School of Medicine



**Tanner R. Poppe, MD**  
Undergraduate: University of Kansas  
Medical School: University of Kansas School of Medicine – Wichita



**Ryan G. Rogero, MD**  
Undergraduate: University of California  
Medical School: Lewis Katz School of Medicine at Temple

PGY-2

PGY-1



**Stanley C. Eboh, MD**  
Undergraduate: Texas Tech University  
Medical School: Texas Tech University Health Sciences Center



**Thomas J. Iorio, MD**  
Undergraduate: University of Tennessee  
Medical School: University of Tennessee Health Science Center



**Dylan S. Koolmees, MD**  
Undergraduate: University of California  
Medical School: Wayne State University School of Medicine



**Kailey L. Mansour, MD**  
Undergraduate: University of Florida  
Medical School: University of Miami Leonard M. Miller School of Medicine



**William G. Murphy, MD**  
Undergraduate: Rhodes College  
Medical School: University of Tennessee Health Science Center



**Robert T. Neel, MD**  
Undergraduate: University of Tennessee  
Medical School: University of Tennessee Health Science Center



**Kristin Sheaffer, MD**  
Undergraduate: University of Georgia  
Medical School: Mercer University School of Medicine



**Matthew D. Wideman, MD**  
Undergraduate: University of Alabama  
Medical School: University of Tennessee Health Science Center

PGY-1



# FELLOWSHIP PROGRAM

The Campbell Clinic Foundation offers exceptional training and experience in five 12-month fully accredited orthopaedic surgical subspecialty fellowships each year: Foot and Ankle (2 Fellows); Hand; Trauma; Pediatric Orthopaedics; and Shoulder and Sports Medicine. The Foundation also partners with the University of Tennessee Health Science Center to offer a Primary Care Sports Medicine Fellowship program.

Fellows have specific clinical, hospital, and surgical duties and are introduced to the latest techniques and innovations within their subspecialty. Time is spent with all subspecialty faculty members throughout the year.

Fellows are encouraged to pursue research during their training year with support from the Campbell

Clinic Foundation, including several research fellows, clinical research coordinators, a full-time librarian, along with statistical and editorial support. This allows fellows to concentrate on the most important aspects of orthopaedic research as well as significant collaboration both locally and nationally to expose the fellows to musculoskeletal clinical, biomechanical, and basic science research.

The Fellowship programs receive funding from local anonymous philanthropy, the OMeGA Medical Grants Association, Arthrex, Smith and Nephew, Arthroscopy Association of North America, and American Orthopaedic Foot & Ankle Society to assist in salary and benefit coverage each year. We are very grateful for this support.

## Foot and Ankle Surgery Fellowship

**Clayton C. Bettin, MD**, Assistant Professor, Director of Foot and Ankle Fellowship

Two fellows spend 5 days each week with the Foot and Ankle staff, gaining exposure to acute and reconstructive surgery of the foot and ankle and advanced knowledge about clinical nonsurgical problems. There is no mandatory night call. The fellowship is focused on education (as opposed to routine clinical tasks), with ample time for reading and research. Fellows perform all procedures, and the training locations include Baptist Memorial Health Care, Methodist Le Bonheur Healthcare, Regional One Health, and Campbell Clinic Surgery Centers.

## 2022-2023 Foot and Ankle Fellows



### JOHN ZHIHAO ZHAO, MD

**Hometown:** Houston, TX  
**Undergraduate Institution:** Harvard College  
**Medical School:** Harvard Medical School  
**Orthopaedic Residency:** Harvard Combined Orthopedic Residency Program.

**Personal:** Dr. Zhao's mother has an MD degree from China and currently works as a biostatistician at MD Anderson. He met his wife, Yiling Zhang, through a dating website (Coffee Meets Bagel). She is a technology consultant.

**Hobbies:** Technology tinkering and hiking.

**Asked why he chose medicine as a career:** The feeling of directly helping others on a day-to-day basis.

**Asked why he chose orthopaedics as a specialty:** I enjoy the mechanical nature of the specialty.

**Favorite memory of fellowship:** The amazing faculty within the Foot and Ankle subspecialty.

**Research activities:** Charcot research with Dr. Bettin.

**Plans after Campbell:** Dr. Zhao is hoping to practice in Houston.

**Dr. Zhao adds:** To my amazing Foot and Ankle faculty, my stellar co-fellow, and the incredibly hard-working Campbell Clinic residents, thank you all for making this an amazing year of learning and growth.



### STEPHANIE GARDNER, MD

**Hometown:** Friendswood, TX  
**Undergraduate Institution:** Texas A & M University  
**Medical School:** Texas A & M Health Science Center  
**Orthopaedic Residency:** Houston Methodist  
**Personal:** Dr. Gardner is the first doctor in her family. She met her

husband in College Station during undergraduate studies. He is a sales professional in the wholesale distribution industry. They have two children: Mason, age 2 and Travis, a newborn.

**Hobbies:** Traveling, hunting, watching college football.

**Asked why she chose medicine as a career:** I always liked science and anatomy in school and wanted to help my community.

**Asked why she chose orthopaedics as a specialty:** I enjoy the puzzle-like nature of fractures and the tangible

improvements to patients' mobility and overall function. For foot and ankle, I enjoy the wide variety of cases.

**Favorite memory of fellowship:** When Drs. Clayton and Kristen Bettin threw us a baby shower, I enjoyed watching our children play together. The support from the fellowship has been amazing.

**Research activities:** Dr. Gardner is researching the different clinical presentations and treatment of plantar fasciitis versus calcaneal bursitis. She also helped write a chapter for *Master Techniques in Orthopaedic Surgery: The Foot and Ankle* on Achilles tendon reconstruction for chronic ruptures.

**Plans after Campbell:** Returning to the Houston area to work at the new Methodist Hospital in Cypress, Texas.

**Dr. Gardner adds:** Thank you to the attendings for everything you have taught me this year and for welcoming us into the Campbell Clinic family! It has truly been a fantastic year. I am very grateful for the support the faculty has shown me. Thank you to all the residents and support staff for the hard work and making the days enjoyable!

## Hand Surgery Fellowship

**Benjamin M. Mauck, MD**, Assistant Professor, Hand Program Director

This fellowship focuses on hand surgery and hand conditions, with extensive exposure to surgical management of acute and reconstructive upper-extremity procedures as well as education about clinical nonsurgical problems. Procedures include removal of pins, administration of injections, removal of sutures, debridement of wounds, and removal of casts. Hospital and surgical experiences span various facilities, including Baptist Memorial Health Care, Methodist Le Bonheur Healthcare, Regional One Health, and Campbell Clinic Surgery Centers.

## 2022-2023 Hand Fellow



### PAUL T. RUTKOWSKI, MD

**Hometown:** Honolulu, HI  
**Undergraduate Institution:** St. Louis University  
**Medical School:** Wright State University  
**Orthopaedic Residency:** Mount Carmel Health System, Columbus, OH  
**Personal:** Dr. Rutkowski is the first doctor in his family. He met

his wife, Megan Chan, on an airplane on the way to his undergraduate school. She is a gastroenterologist, and they have one son: PJ, age 2.

**Hobbies:** Spending time with family, golf, and bourbon.

**Asked why he chose medicine as a career:** Now that my training is over, I feel like I can finally answer this question honestly. A girl I was pursuing in college (now my wife) was a pre-med student.

**Asked why he chose orthopaedics as a specialty:** Orthopaedic surgeons have the ability to fix problems and restore function for patients.

**Favorite memory of fellowship:** Fridays at Regional One.

**Research activities:** Novel MCP arthroplasty surgical technique. Review of perioperative pain management for distal radial fractures.

**Plans after Campbell:** Moving back to Columbus, OH to work as a hand and wrist surgeon in a multispecialty orthopaedic group.

**Dr. Rutkowski adds:** Thank you to all the hand staff for the opportunity to train at Campbell Clinic. Your time, patience, and willingness to teach throughout the year has been invaluable to my growth as a hand surgeon. I am also very grateful to the residents for the things they have taught me and their hard work making sure patients are taken care of before and after surgery.

## Pediatric Fellowship

**Derek M. Kelly, MD**, Professor, Director of Pediatric Orthopaedic Fellowship

This ACGME- and POSNA-accredited fellowship program combines clinical training and research, preparing surgeons for a career in both private practice and academic settings. The fellowship offers extensive exposure to trauma, scoliosis, clubfoot, hip diseases, limb deformities, tumors, hand and upper-extremity conditions, sports orthopaedics, metabolic and genetic conditions, neuromuscular disorders, cerebral palsy, myelomeningocele, degenerative diseases, congenital conditions, and other conditions that affect the spine, hip, foot and ankle, and hand. Training locations include Le Bonheur Children’s Hospital and Campbell Clinic Orthopaedics.

## 2022-2023 Pediatrics Fellow



### STERLING KRAMER, DO

**Hometown:** Raleigh, NC  
**Undergraduate Institution:** Temple University

**Medical School:** Inspira Health Network

**Personal:** Dr. Kramer is the first doctor in his family. His wife, Jillian Kramer, is a health coach and mother to Braylen (10 yrs), Avery

(8 yrs), Hayven (4 yrs), and Mycah (7 months). They met when they were both gymnasts at Temple University.

**Hobbies:** Former gymnast, sports, and music. Dr. Kramer plays the piano for his church.

**Asked why he chose medicine as a career:** I always wanted to be a doctor from as early as I can remember.

**Asked why he chose orthopaedics as a specialty:** As a medical student, I was put into an orthopaedic room and felt at home. I have always enjoyed building and fixing things, and now I get to do both while treating patients.

**Favorite memory of fellowship:** Working with the Campbell Clinic attendings.

**Research activities:** Currently working on two projects: one on proximal femoral physeal closure and one on pedicle sizing in scoliosis utilizing a flash referencing system.

**Plans after Campbell:** Dr. Kramer has accepted a position as a general pediatric orthopaedic surgeon with an emphasis on spine, sports, and trauma in Greenville, NC.

**Dr. Kramer adds:** I am grateful to be part of the greatest orthopaedic education and training in the country.

## Sports Medicine and Shoulder Surgery Fellowship

**Frederick M. Azar, MD**, Professor, Director of Sports Medicine Fellowship

**Tyler J. Brolin, MD**, Assistant Professor, Associate Program Director

The Sports Medicine and Shoulder Surgery Fellowship combines 6 months of Sports Medicine education with 6 months of Shoulder and Elbow training. This hybrid program exposes each fellow to a breadth of pathology of the knee, shoulder, and elbow and focuses on all aspects of arthroscopic shoulder, knee, and elbow surgery with special emphasis on shoulder arthroplasty, open shoulder instability, multi-ligamentous knee reconstruction, as well as complex patellofemoral reconstruction. Fellows also gain training in hip arthroscopy, hip preservation, pediatric sports medicine and are exposed to all aspects of practice management including formal training in billing and coding. A major part of the fellowship is the opportunity to participate in clinics, team, and event coverage for the Memphis Grizzlies (NBA), Memphis Hustle (NBA’s G League), Memphis 901 FC (US Soccer League), United States Football League (USFL), Memphis Redbirds (AAA baseball), Division I, II, and III collegiate teams as well as high school teams.

## 2022-2023 Sports Medicine Fellow



### JEFFREY KLOTT, MD

**Hometown:** Washington, MO  
**Undergraduate Institution:** Truman State University

**Medical School:** University of Missouri, Kansas City

**Orthopaedic Residency:** Indiana University

**Personal:** Dr. Klott is the first doctor in his family. He is married to Erin

Klott, who was a high school science teacher and is now a full-time mother to Jane, age 5, and Mark, age 3.

**Hobbies:** Spending time with family, walking the dog, hunting, fitness, and spending time outside.

**Asked why he chose medicine as a career:** I chose medicine to make people better.

**Asked why he chose orthopaedics as a specialty:** I chose orthopaedics to be able to make an acute impact in peoples’ lives and restore function and mobility.

**Favorite memory of fellowship:** Getting to participate in various team sports coverage.

**Research activities:** Sports and shoulder research projects.

**Plans after Campbell:** Dr. Klott plans to practice orthopaedic surgery with an emphasis on sports medicine.

**Dr. Klott adds:** Thank you for welcoming me and my family to the Campbell Clinic family.

## Trauma Fellowship

**John C. Weinlein, MD**, Assistant Professor, Director of Trauma Fellowship

The trauma fellow receives comprehensive experience at Regional One, a high-volume Level 1 trauma center that serves as a referral facility for Tennessee, Arkansas, Mississippi, Missouri, and Kentucky, with four orthopaedic traumatologists on staff. This program is primarily focused on the operative and nonoperative management of complex polytrauma, including pelvic, acetabular, and periarticular fractures; reconstructive fracture management, including nonunions, malunions, and deformity correction; and clinical investigation and research, which provides extensive operative exposure of complex fractures with an emphasis on pelvic and acetabular injuries. Interaction with two orthopaedic trauma teams includes daily morning report/fracture conferences, after which the fellow has first choice of operative cases in a minimum of three orthopaedic trauma rooms. The fellow has opportunities to pursue additional areas of interest, including total joint replacement for acetabular fracture, peri-acetabular osteotomies, and deformity correction.

## 2022-2023 Trauma Fellow



### GAURAV MOOKERJEE, MD

**Hometown:** Pittsburgh, PA  
**Undergraduate Institution:** Temple University

**Medical School:** Temple University  
**Orthopaedic Residency:** SUNY Upstate Medical Center

**Personal:** Dr. Mookerjee is the first doctor in his family and is single.

**Hobbies:** Working out, sports, travel,

trying new cuisines

**Asked why he chose medicine as a career:** I chose medicine for the ability to parlay my interest in biology and science to treat and impact the lives of members of my community.

**Asked why he chose orthopaedics as a specialty:** I chose orthopaedics for the gratification of seeing immediate results from my work.

**Favorite memory of fellowship:** The camaraderie of the resident teams.

**Research activities:** A book chapter on arthroplasty for treatment of fractures above the knee in geriatric patients.

**Plans after Campbell:** Practice orthopaedic surgery.

**Dr. Mookerjee adds:** Special thanks to the trauma staff and all the residents who made my experience exceptional.



Campbell Clinic UTHSC Primary Care Sports Medicine Fellowship

John C. Hyden, MD, Assistant Professor of Family Medicine, Director, Primary Sports Medicine Fellowship

The Campbell Clinic/UTHSC Primary Care Sports Medicine Fellowship’s mission is to train physicians from primary specialties in the art and science of musculoskeletal and sports medicine, encompassing the science and clinical application of exercise physiology, kinesiology, nonoperative orthopaedics, cardiology, and general medicine applied to the care of the active person. It also trains physician specialists who understand, advance, and apply evidence-based medicine in the psychosocial, environmental, and physiologic milieu of athletic training and competition from the pediatric to the elite.

2022-2023 Primary Care Sports Medicine Fellow



WILLIAM ROSS, MD

Hometown: Hattiesburg, MS

Undergraduate Institution: Mississippi State University  
Medical School: University of Mississippi Medical Center School of Medicine

Orthopaedic Residency: University of Alabama Tuscaloosa Family Medicine Residency

Personal: Dr. Ross’s father is a urologist, and his brother is in his last year of a Pulmonology/Critical Care Fellowship.  
Hobbies: Playing golf, reading, organized medicine.  
Asked why he chose medicine as a career: I almost died as a kid and was ultimately saved by a physician. A combination of my personal experiences as a patient

as well as growing up in a medical household led me to pursue a career in medicine.  
Asked why he chose orthopaedics as a specialty: Sports have always played a large part in my life, so I knew I wanted to work in a field that dealt with athletes and musculoskeletal conditions.  
Favorite memory of fellowship: My favorite memory was traveling down to Starkville to help cover the University of Memphis football game against Mississippi State.  
Research activities: Case report on an athlete who contracted malaria.  
Plans after Campbell: I plan to find a job seeing primarily sports medicine patients where I would also have team coverage at the collegiate level.  
Dr. Ross adds: Thank you all for being so welcoming and supportive.

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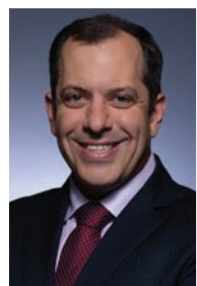
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## 2022-2023

# VISITING PROFESSOR LECTURE SERIES

The Campbell Clinic Foundation is honored to host leading experts as visiting faculty each year to both strengthen our educational offerings and foster the next generation of orthopaedic leaders. Each Visiting Professor event features renowned orthopaedic experts who challenge, train, and inspire participants and prepare them for the complex world of 21st-century healthcare.



### Michael G. Vitale, MD, MPH

Ana Lucia Professor of Pediatric Orthopaedic Surgery, Columbia University, College of Physicians and Surgeons

Vice Chair of the Department of Orthopaedic Surgery

Chief, Pediatric Spine and Scoliosis Surgery and Co-Director, Division of Pediatric Orthopaedics, Morgan Stanley Children's Hospital of New York Presbyterian

Medical Director, MSCH Initiative to Make Care Better

Advanced Pediatric Spinal Deformity Fellowship Director

On January 12, **Dr. Michael Vitale** was featured as the James H. Beaty, MD Pediatric Orthopaedics Visiting Professor. Dr. Vitale received his Medical Degree and a Master's Degree in Public Health from Columbia University College of Physicians and Surgeons in New York. He remained in New York to complete his Medical Internship and Orthopaedic Surgery Residency at Columbia.

Thereafter, he moved to Los Angeles to do a Fellowship in Pediatric Orthopaedics under the tutelage of Dr. Vernon Tolo at the Children's Hospital of Los Angeles. Dr. Vitale returned to New York to begin his practice at Morgan Stanley Children's Hospital of New York Presbyterian, where he now serves as Chief of

Pediatric Spine and Scoliosis Surgery and Co-Director of the Division of Pediatric Orthopaedics. He also is the Director of Pediatric Orthopaedics for the NYP Enterprise, the Medical Director of MSCH Initiative to Make Care Better, and the Director of Advanced Fellowship in Pediatric Spinal Deformity.

As a pioneer of numerous surgical techniques and spinal instrumentations, Dr. Vitale remains staunchly committed to safety in spine surgery, which first motivated him to establish the Safety in Spine Surgery Project (S3P), an organization that works with stakeholders to enhance safety and prevent potential injuries. He is currently launching a Spine Safety Summit to focus on optimizing care in spine surgery.

He has received numerous awards over his career, the latest being recognized by Orthopedics This Week as one of the top 17 North American Pediatric Orthopaedic Surgeons, the USNWR Top Doctors list, Becker's Spine Review List, and Samburg Scholars in Children's Health Award.

Dr. Vitale served as Vice President and 37th President of the Pediatric Orthopaedic Surgeons of North America (POSNA) and currently is the Senior Advisor for the Quality, Safety, Experience, and Value Initiative Steering Committee and the Liaison for International Pediatric Orthopaedic Society (IPOS). He is on the Board of Directors of the AAP Orthopaedic Subgroup, and, as a member of the AAOS, serves on the Surgi-

cal Quality Alliance Committee. He is Chairman of the ADHOC Committee on Pediatric Medical Devices of the SRS and the current President of the Children's Spine Foundation. He also is the Past President of the Children's Spine Study Group and remains on the Executive Committee.

In addition to his many lectures, course presentations, and visiting professorships locally, nationally, and internationally, he has published over 260 journal articles as well as book chapters and has served on editorial review boards for JBJS, Journal of Children's Orthopaedics, Pediatrics, American Family Physician, Lancet, and JPO.



### Joaquin Sanchez-Sotelo, MD, PhD

Consultant, Division of Adult Reconstruction, Department of Orthopedic Surgery, Mayo Clinic

Master's Faculty Privileges in Orthopedics, Mayo Clinic College of Medicine

Professor of Orthopedics, Mayo Clinic College of Medicine

Division Chair, Shoulder and Elbow Surgery, Mayo Clinic

Medical Editor for Shoulder and Elbow Surgery, Mayo Foundation Medical Education and Research

**Dr. Joaquin Sanchez-Sotelo**, MD, PhD will be the featured Visiting Professor on April 20. In addition to the positions listed above, he serves as Chairman of the Orthopedic Research Review Committee at Mayo Clinic and Liaison for the Department of Orthopedic Surgery with Mayo Clinic Media Relationships. His awards include two Mayo Clinic Teacher of the Year Awards, the Mark B. Coventry, Melvin Post, MidAmerica Orthopedic Association, Knee Society, ISOLS 2019, ICSES 2019, AAOS Achievement's Awards, Course Director for Best Mayo Clinic Course (2017 and 2021), and Digital Educator of the Year at Mayo Clinic 2021.

Born in Madrid, Spain, Dr. Sanchez-Sotelo graduated as Medical Doctor from Universidad Autonoma de Madrid and obtained the #1 position in the Spanish National Exam for Medical Graduates. He completed his residency in Orthopedic Surgery at Hospital Universitario La Paz and his PhD Program at Universidad Autonoma de Madrid and was selected for a fellowship position at Mayo Clinic, completing a 2-year program in adult reconstruction.

Dr. Sanchez-Sotelo has published more than 300 articles in peer-reviewed literature in addition to more than 50 book chapters. He is co-editor of the most widely read textbook on elbow surgery, "The Elbow and its Disorders." He is actively involved in the design of implants for joint replacement, shoulder sports medicine, and fracture fixation. Dr. Sanchez-Sotelo serves as course co-director for the Mayo Clinic Annual Elbow Course "Teach the Teachers," the Combined Harvard-Mayo Clinic Course on Shoulder Tendon Transfers and Complex Rotator Cuff Tears, the International Advanced Course on Elbow Surgery (IACES), and the FORE Critical Concepts in Shoulder and Elbow Surgery Course. He has presented his research on numerous occasions at national and international meetings.

Dr. Sanchez-Sotelo is a member of multiple professional societies, has served as Board Member at large for the American Shoulder and Elbow Surgeons (ASES), and was recently selected as ASES Vice-President. Dr. Sanchez-Sotelo serves as associate editor for the Journal of Shoulder and Elbow Surgery (JSES) and has served as associate editor



for the Journal of Orthopedic Trauma (JOT). He was recently selected as Presidential Guest Speaker for the European Society of Shoulder and Elbow Surgery (SECEC).

Dr. Sanchez-Sotelo has developed a special interest in complex reconstructive surgery of the shoulder and elbow joints, as well as in basic science research

related to the genetic and molecular basis of orthopedic conditions, particularly joint stiffness, as well as the biomechanics of shoulder and elbow injuries and implants and the application of artificial intelligence to shoulder and elbow surgery. Other interests outside orthopedic surgery include cooking, ballroom dancing, traveling and reading.

James W. Harkess, MD Total Joint Fund

In 2022, with support from staff, alumni, and friends, the Campbell Clinic Foundation established a fund to expand education in the subspecialty of adult reconstruction. This fund honors the lifetime contributions made by Campbell Clinic physician, Dr. James W. Harkess. The Harkess Fund will benefit generations of orthopaedic surgeons in training and research.

The inaugural James W. Harkess, MD Total Joint Fund Lectureship was held on February 17, 2022. We were honored to host **Robert L. Barrack, MD**, Charles F. and Joanne Knight Distinguished Professor of Orthopaedic Surgery at Washington University School of Medicine, St. Louis as our inaugural Visiting Professor.



Dr. Barrack discussed “TKA 2022: Problems and Solutions,” which was an excellent overview of the problems encountered in total knee arthroplasty and evidence-based solutions. Dr. Barrack is the recipient of innumerable awards and has authored over 350 journal articles and book chapters. He is also the current editor for the *Bone and Joint Journal*.

The 2023 Harkess Fund Lecture will take place June 15, 2023, featuring **Robert T. Trousdale, MD**, Consultant and Professor at Mayo Clinic College of Medicine.

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## ALVIN J. INGRAM MEMORIAL LECTURE



The annual Alvin J. Ingram, MD Memorial Lecture was established to honor the memory of a former Campbell Clinic Chief of Staff and department chairman who had a larger-than-life presence among his colleagues.

“Alvin Ingram was a thoughtful and very well-respected man,” said Dr. James H. Beaty, who worked under the Jackson, TN native as an orthopaedic resident and during Ingram’s last two years at Campbell Clinic. “He was my mentor, role model and the reason I went into pediatric orthopaedics.”

Dr. Ingram was the kind of person who, when he spoke, people listened.

Beaty described Ingram as a great leader who was President of everything from the Memphis and Shelby County Medical Society to the American Orthopaedic Association, Pediatric Orthopaedic Society of North America, American Academy for Cerebral Palsy, American Orthopaedic Association, and American Board of Orthopaedic Surgery.

“Dr. Ingram was the kind of person who, when he spoke, people listened,” Beaty said. “He was a consensus builder, but he could make a decision when it needed to be made. He was a wonderful leader in every way.”

Dr. Ingram attended Union University before receiving a bachelor of science degree from the University of Tennessee-Knoxville, then proceeding to UT-Memphis for his medical degree. A graduate of the University of Tennessee-Campbell Clinic’s residency program, Ingram was medical director of the Crippled Children’s Hospital and a world authority on polio treatment. He died in 1999 at age 85.

The lecture in Ingram’s honor highlights achievements in surgeon education and features a distinguished visiting professor and presentations from the Campbell Clinic Foundation graduating residents. Since 2014, under the guidance of Course Director Derek M. Kelly, MD, the lecture has expanded to include talks by a distinguished professor, faculty, and an expert panel.

## 2023 INGRAM MEMORIAL LECTURE

APRIL 14

Our keynote speaker for the Ingram Memorial Lecture will be **Dr. Annunziato (Ned) Amendola**, the Virginia Baker-Flowers Distinguished Professor and Vice Chair of the Department of Orthopaedic Surgery at Duke University in Durham, North Carolina. He serves as Division Chief of Sports Medicine, Director of the Urbaniak Sports Sciences Institute, and Chief Medical Officer of Duke Athletics. Prior to Duke University, Dr. Amendola served as Professor of Orthopaedic Surgery and Rehabilitation, Professor of Physical Therapy and Rehabilitation Science, the John and Kim Callaghan Endowed Chair in Sports Medicine, and the Director of Sports Medicine at the University of Iowa. In addition, he has served as the chief orthopaedic consultant at the NBA combine for which he received the Orthopedic Consultant in Charge award in 2022.



**Annunziato (Ned)  
Amendola,  
MD, FRCS(C), DABOS**

Over his long career in orthopaedic surgery, Dr. Amendola’s main interest has been in sports rehabilitation of the foot, ankle, and knee. After his orthopaedic residency at the University of Western Ontario, he completed several fellowships, which included a Sports Medicine Fellowship at the University Hospital in London, Ontario, an Upper Extremity Trauma Fellowship at the University of Verona, Italy, and a Foot and Ankle Sports Medicine Fellowship at the Crystal Clinic in Akron, Ohio. Since that time, he has shared his knowledge, mentoring and training medical students and residents alike and has supervised over 100 fellows in sports medicine and foot and ankle surgery.

Dr. Amendola has been extensively involved in the research of biologic resurfacing techniques for articular disorders of the knee and ankle. He is an original member of Multicenter Orthopaedic Outcomes Net-

work (MOON) and Multicenter ACL Revision Study (MARS) and has been the primary investigator on many research projects that have culminated in a vast number of high-impact publications and have led to technological advances and device development. His most recent professional awards and recognitions have included the AOSSM AJSM Systematic Review Award, the AAOS Kappa Delta Ann Doner Vaughn Award, the O’Donohue Award, and Godfather of the ESSKAAOSSM Traveling Fellowship to Europe.

As a leading expert in his field, Dr. Amendola has edited or co-edited nine books and has written over 70 book chapters. In addition to an extensive publication list, which includes over 300 articles, he has served and continues to serve on multiple editorial boards and professional organizations. Currently, he serves on the Board of Directors, Finance Committee, Subspecialty Committee, and Written Exam Committee of the ABOS. He is on the OREF Board of Trustees, the AAOSM Treasurer of Medical Publishing Board, and the Herodicus Orthopedic Society Executive Committee.

Dr. Amendola has presented hundreds of lectures and symposia at local, national, and international meetings and has been visiting professor at numerous academic institutions. We are honored to welcome Dr. Amendola as our distinguished keynote speaker.



We are proud that the Ingram legacy includes the following list of esteemed leaders in the orthopaedic community who have served as Distinguished Professor:

**2014**  
**TERRANCE PEABODY, MD**  
Edwin W. Ryerson Professor & Chairman  
Northwestern University Feinberg School of Medicine

**2015**  
**J. LAWRENCE MARSH, MD**  
Chairman, Professor  
Residency Director, Carroll B. Larson Chair  
Department of Orthopaedic Surgery  
University of Iowa Hospitals & Clinics

**2016**  
**WILLIAM J. MALONEY, MD**  
Elsbach-Richards Professor in Surgery  
Chair, Stanford University School of Medicine -  
Orthopaedic Surgery

**2017**  
**DAVID A. HALSEY, MD**  
Medical Director, Adult Reconstructive Surgery  
Professor, University of Vermont College of Medicine

**2018**  
**KRISTY L. WEBER, MD**  
Chief, Orthopaedic Oncology  
Department of Orthopaedic Surgery  
Perelman School of Medicine  
University of Pennsylvania

**2019**  
**JOSEPH A. BOSCO, III, MD**  
Professor & Vice Chair  
Department of Orthopaedic Surgery  
NYU Langone Health

**2020**  
**DANIEL K. GUY, MD, FAAOS**  
Emory Southern Orthopedics  
Medical Director, Emory Surgery Center at LaGrange

**2021**  
**FELIX "BUDDY" SAVOIE, MD**  
Ray J. Haddad Professor of Clinical Orthopaedics  
Chief of the Division of Sports Medicine  
Tulane School of Medicine  
Director, Tulane Institute of Sports Medicine

**2022**  
**AMY L. LADD, MD, FAOA, FAAOS**  
Elsbach-Richards Professor of Surgery, Stanford  
University School of Medicine; Vice-Chair of Academic  
Affairs, Department of Orthopaedics; Chief, Chase  
Hand & Upper Limb Center; Assistant Dean for Medical  
Student Advising

**MICHAEL L. PARKS, MD**  
Associate Professor of Clinical Orthopaedic Surgery at  
Weill Cornell College of Medicine; Associate Attending  
at the Hospital for Special Surgery



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To the partners who support the Alvin J. Ingram Memorial Lecture in its commitment to provide continuing education to physicians and health professionals dedicated to excellence in orthopaedics.

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## RESEARCH

Excellence in orthopaedic research is one of the three pillars on which the Campbell Clinic Foundation was built. Clinical research helps pinpoint best practices so that our physicians can deliver superior, evidence-based orthopaedic care to patients while educating the next generation of doctors.

“All of our residents are required to complete at least one research project during their residency,” said Margaret Knack, Research Manager for the Campbell Clinic Foundation. “After graduation, many alumni incorporate clinical research into their own practices, building upon their research experiences at Campbell Clinic.”

Three Campbell Clinic Foundation research scholars as well as 32 medical students from the University of Tennessee Health Science Center (UTHSC) assist staff physicians as they delve into their research studies. More than 150 academic papers, presentations and posters are published each year. Extensive research support includes four clinical research coordinators, a full-time librarian, and an editorial team to help hone the written studies before they are submitted for journal publication.

Research productivity has grown 200% over the last seven years. This is due to the expansion of physician-led prospective studies, multicenter studies and industry trials. In addition, there are active studies in all sub-specialties.

“Industry-funded clinical trials help pay for our infrastructure and research personnel so that we can answer our physicians' questions,” Knack said. “These clinical trials also give us exposure to rigorous study design. This translates into making us better researchers internally by modeling how external partners execute their studies.”

In 2022, Campbell Clinic researchers:

- Launched a randomized controlled trial (RCT) of people having their distal radial fracture repaired through an open incision with internal fixation, comparing the use of opiates for pain relief versus non-opiate medications.
- Completed enrollment for an industry-funded clinical trial comparing the use of a VELYS robot versus manual instrumentation for completion of a total knee replacement.
- Started enrollment into an investigator-initiated study comparing use of oral tranexamic acid (TXA) versus placebo among total knee arthroplasty (TKA) patients in the early postoperative period. Researchers have to discern a difference between hemoglobin levels, pain and function scores, range of motion, and knee circumference.
- Implemented DocuSign for obtaining patient consent for study participation. The eSignature allows a patient seen at a remote clinic site or after-hours clinic, for example, to enroll in a study without having to drive to Memphis and sign the legal documents.
- Initiated and completed a clinical trial with AxoGen, which compared using the RANGER allograft versus autograft for nerve repair in upper extremities and evaluated differences in patient outcomes.

- Neared completion on a Salvation Stryker industry study that compared bone healing and patients' ability to walk after receiving a foot implant.

“In 2023, the studies we have on the table have a more complex study design, which translates to an increase in the number of study personnel required to support execution of the study procedures,” Knack said:

- Dr. William Mihalko is leading an FDA-funded study to examine the occurrence of metal hypersensitivity in patients who have had a TKA. Implants and tissue specimens are being retrieved from patients who are having a revision TKA to determine if their persistent pain is related to an autoimmune response to the metal in the implant. The goal is to predict which patients are likely to react to cobalt-chromium implants before their TKA procedure is completed. A titanium implant would be the best fit for those patients.
- An investigator-initiated kinematic assessment, funded by a Medacta grant, is comparing four post-TKA implants by analyzing how the patients walk, stand, sit, climb stairs, and how their gait varies during these activities. “We hope to discover differences between implant types in everyday activities,” Knack explained.
- Campbell Clinic is conducting its first industry-funded spine clinical trial to examine the performance of an allograft, Virtuos, which can be maintained at shelf temperature. The study will examine radiographic fusion rates at 6, 12, and 24 months as well as patient-reported outcomes.
- Campbell Clinic is the lead research site, under Dr. Tyler Brolin's direction, for an industry-funded study comparing home-based physical therapy (using the mymobility® digital app) with standard in-office physical therapy. Differences in clinical and patient-reported outcomes at 6 months are being evaluated.
- A RCT is comparing repair of the subscapularis tendon during reverse total shoulder arthroplasty (RTSA) with non-repair, aiming to determine whether repair produces results that are clinically superior or inferior to non-repair.

- An American Shoulder and Elbow Society grant is being sought to fund an evaluation of internal rotation muscle activation after RTSA that allows a person reach behind his or her back. Study findings are expected to aid in patient rehabilitation by pinpointing different exercises that would improve the motion.

Since 2019, research scholars have helped conduct some of this research. The research scholar program has been offered as a “gap year” for young professionals interested in medical careers who want to engage in immersive clinical research. During the paid, year-long experience, they work with the Sports, Total Joint, Shoulder and Elbow, Pediatric, Hand, and Foot and Ankle subspecialty teams, depending on where the need for support is greatest.

The scholars gain experience in study design, data collection and analysis, literature review, institutional reviews and approvals, patient enrollment, regulatory compliance, safety reporting, and abstract/manuscript preparation.

“The research scholar position has opened my eyes to the fascinating worlds of clinical research and orthopaedics in general.”

“The research scholar position has opened my eyes to the fascinating worlds of clinical research and orthopaedics in general,” said Andrew Pierce, 24. “I have thoroughly enjoyed learning the subtleties of the clinical research process, especially through face-to-face interactions with patients. The physicians and staff I interact with have been welcoming and inviting, often taking the extra time to explain to me the particulars of an interesting injury or procedure.

“My time in the program will pay dividends in years to come since few students enter medical school with such high-quality, hands-on clinical research experience,” added Pierce, who will begin medical school



this fall. “I have no clue where I will end up within the field of health care, but orthopaedics is definitely on my radar!”

Research scholar Derek Dixon also lauded the experience. “You get to shadow MDs in the operating room and clinic, have patient interaction depending on the study, and have the possibility of becoming a published author,” said Dixon, 25. “You get to network with doctors and medical device reps and learn the whole research process.”

Campbell Clinic research scholars are set up to have success because the physicians teach from a holistic rather than symptomatic perspective, he said. “You have to completely change your style of learning and processing information,” added Dixon, who also plans to attend medical school.

The research scholars work alongside clinical research coordinators to help oversee clinicaltrials.gov registration, secure statistical support and provide comprehensive research support. That, in turn, allows Campbell Clinic physicians to conduct industry, collaborative, multicenter study groups, and investigator-initiated studies.

Research teams also include UTHSC medical students who partner with Campbell Clinic principal investigators on subspecialty research projects. This opportunity affords students an in-depth exposure to orthopaedic clinical research that they might not otherwise experience. Students actively engage in literature reviews, data analysis, and manuscript preparation. This one-of-a-kind, hands-on experience supports the next generation of physicians, researchers, and healthcare leaders.

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## 2023 RESIDENT RESEARCH



Seth R. Cope, MD  
Austin T. Hardaway, MD  
Zachary A. Mosher, MD  
Tyler J. Brolin, MD  
David L. Bernholt, MD  
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Institutional Review Board approval was  
received from the University of Tennessee  
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Accuracy of the International  
Consensus Scoring System for  
Diagnosis of Periprosthetic Joint  
Infection in Revision Shoulder  
Arthroplasty

ABSTRACT

Background

Total shoulder arthroplasty (TSA) continues to undergo dramatic growth with expanding indications and improvements in implants and surgical techniques. A major complication following TSA is periprosthetic joint infection (PJI), which remains difficult to diagnose, often relying on clinical judgment. A contemporary definition of PJI was established at the 2018 International Consensus Meeting (ICM) on Musculoskeletal Infection. We sought to retrospectively examine the accuracy of this scoring system in previously performed revision TSA and hypothesized that the ICM scoring system would be reliable in determining the presence of TSA PJI.

Methods

Our institutional database was reviewed to identify patients undergoing revision TSA before the advent of the ICM PJI scoring system. Clinical notes and operative reports were reviewed for data regarding the preoperative clinical examination, laboratory values, and intraoperative findings. The findings were assigned scores based on the definition of probable PJI by the ICM scoring system. Scores were compared to treatment plans of infected vs. noninfected patients. The diagnosis of PJI was made using a combination of clinical examination, laboratory values, and intraoperative findings. Sensitivity, specificity, positive and negative predictive values, and accuracy of the ICM scoring system were calculated compared to actual treatment decision, the gold standard.

Results

Of 81 revision arthroplasties, 52 were revision reverse TSA (rTSA), and 29 were revision anatomic TSA (aTSA). Seven rTSA patients were treated as infected (7/52, 13.5%), and the scoring system identified 4 of those as being probable infections (4/7, 57.1%). One additional rTSA patient scored as probable infection, underwent a revision for instability, and was found to have no infection. Three aTSA patients were treated as infected (3/29, 10.3%), with one of those identified as probable infection by the scoring system (1/3, 33.3%). Four patients in the rTSA group and no patients in the aTSA group met the criteria for definite infection. Using the threshold of probable infection to identify PJI, the sensitivity of the scoring system was 0.6, and specificity was 0.99. The positive predictive

value was 0.86, and the negative predictive value was 0.95. With the same threshold, the ICM scoring system was 93.8% accurate.

Conclusions

Identifying PJI in TSA remains difficult in the absence of definite signs of joint sepsis. This study found the scoring system to be highly accurate, although with modest sensitivity, and a reliable tool for the diagnosis of PJI following TSA.

SETH R. COPE, MD



**Hometown:** Bountiful, UT  
**Undergraduate Institution:** Brigham Young University  
**Medical School:** University of Texas Health Science Center at San Antonio  
**Personal:** His father David is a family medicine physician, and his brother Zachary is an emergency medicine resident. Dr. Cope and his wife of 10 years, Brooke, met through friends during college. She is a stay-at-home mother to Liam, 8; Ryan, 5; and Halle, 2.  
**Hobbies:** Dr. Cope likes to spend time with his family, reading, cooking, baking, smoking meats, and playing soccer, bass, and violin.  
**Asked why he chose medicine as a career:** *It's a field in which you can very positively impact the lives of patients, and also can be a community leader.*  
**And why he chose orthopaedics as a specialty:** *We can make a real difference in patients' lives and help them be their most active.*  
**Favorite memory of residency:** *Annual Friendsgiving tradition, having a class dinner every month during fifth year.*  
**Plans after Campbell:** Dr. Cope will complete a Sports Fellowship at UCLA.  
**Dr. Cope adds:** *I'm very grateful to all of the staff for the dedication they have to our education, for their patience with us as we learn, and their willingness to help us.*

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Institutional Review Board approval was received from the University of Tennessee Health Science Center (19-06815-XP).

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# A Comparative Analysis of Anatomic Total Shoulder Arthroplasty Versus Reverse Shoulder Arthroplasty for Posterior Glenoid Wear Patterns

**Background**  
Reverse shoulder arthroplasty (RSA) and anatomic total shoulder arthroplasty (TSA) are well known methods to treat various forms of glenohumeral arthritis. As glenohumeral osteoarthritis progresses, posterior wear of the glenoid often develops. The Walch classification of glenohumeral arthritis defines the B glenoid as posterior humeral head subluxation with resultant progressive posterior glenoid wear. Both TSA and RSA treat glenohumeral osteoarthritis with an intact rotator cuff and posterior glenoid wear, but it remains unclear which is preferable. This study compared minimum 2-year outcome measures in patients treated with RSA and TSA for Walch B2 and B3 glenoids.

**Methods**  
An institutional database query was performed for all patients undergoing RSA or TSA for primary glenohumeral osteoarthritis with an intact rotator cuff and posterior glenoid wear (B2 or B3 glenoid). Patients with less than 2 years follow-up, revision arthroplasties, rotator cuff pathology, and traumatic and post-traumatic operative indications were excluded. A total of 38 shoulders underwent TSA, and 40 shoulders underwent RSA. All arthroplasties were performed by two fellowship-trained shoulder surgeons at a tertiary referral center. Patients were clinically evaluated using American Shoulder and Elbow Society (ASES) scores, Visual Analog pain scores (VAS), Single Assessment Numeric Evaluation (SANE) scores, active shoulder range of motion (ROM), and strength testing. Demographic and clinical data were compiled, and postoperative complications were analyzed. A minimum 2-year radiographic analysis was also performed to assess implant failure, loosening, and radiolucent line formation. Wilcoxon rank sum analysis compared means between continuous variables. Fisher exact testing compared categorical variables, such as comorbidities, and overall complication rates between groups. *P* values less than 0.05 were considered statistically significant.

**Results**  
The mean follow-up was 25.9 months and 25.5 months for RSA and TSA groups, respectively (*P* = 0.47). The RSA group consisted of 27 men and 13 women; the TSA group consisted of 37 men and 1 woman (*P* < 0.001). The mean age at surgery for RSA was 71 years and 61 years for TSA (*P* < 0.001). No significant differences were found between the groups regarding preoperative body mass index (BMI) (*P* > 0.99) or other

medical comorbidities. Compared with RSA patients, TSA patients demonstrated superior average active external rotation (47 degrees vs 40 degrees; *P* = 0.003) and internal rotation (60 degrees vs 52 degrees; *P* = 0.002). Active forward elevation did not significantly differ between the groups (160 degrees for TSA vs 155 degrees for RSA; *P* = 0.19). There were no differences in forward elevation, internal rotation, and external rotation strength testing. No significant difference was detected between the mean ASES (89 [TSA] and 85 [RSA]; *P* = 0.24), SANE (89 [TSA] and 82 [RSA]; *P* = 0.086), and VAS scores (1.18 [TSA] and 0.88 [RSA]; *P* = 0.51). Seven (18.4%) postoperative complications occurred in the TSA group and three (7.5%) in the RSA group (*P* = 0.27). The most common complication was cephalic vein thrombosis. No complications required revision in either group. Neither group demonstrated any cases of implant failure or loosening on radiographic analysis.

**Conclusions**  
TSA had similar outcomes as RSA in patients with shoulder osteoarthritis and posterior glenoid wear patterns with an intact rotator cuff. Although the TSA group had superior active external rotation and internal rotation 2 years postoperatively compared with RSA, 2-year active forward elevation was equivalent between groups. Furthermore, both groups had similar 2-year outcomes for strength in all planes and in all three clinical outcome scoring systems analyzed. The TSA group demonstrated higher incidence of postoperative complications, which, although not statistically significant, was likely of clinical significance. Additionally, neither group required any reoperations or demonstrated implant failure or loosening on radiographic analysis. These results must be interpreted cautiously given the demographic differences between cohorts and the lack of randomized allocation of groups. Nevertheless, they indicate both TSA and RSA can be safely utilized in posterior glenoid wear patterns with good clinical outcomes.

## AUSTIN T. HARDAWAY, MD



**Hometown:** Memphis, TN  
**Undergraduate Institution:** University of Alabama  
**Medical School:** The University of Tennessee Health Science Center  
**Personal:** Dr. Hardaway is the first doctor in his family. He met his fiancée, Ashley Banks, through mutual friends. She teaches second grade at Forrest Hill Elementary School in Germantown.  
**Hobbies:** He enjoys working out, watching college football, trying new restaurants, traveling, and taking care of their yellow Lab, Sugar.  
**Asked why he chose medicine as a career:** *Medicine was a perfect career that combined my desire to interact with people while applying my enthusiasm for the sciences to make a direct impact.*  
**And why he chose orthopaedics as a specialty:** *In medical school, I was drawn to the excitement of the operating room and knew that I wanted to invest in developing hands-on skills to help patients. Orthopaedic surgery offers such tangible results that oftentimes get people back to being mobile and doing what they love. As an active person myself, I look forward to the opportunity to take care of people pursuing active lifestyles.*  
**Favorite memory of residency:** *My favorite part of residency has been all of the great friends I have made among the co-residents. Going through residency alongside this exceptional group of people has made this such a memorable phase of life.*  
**Plans after Campbell:** Dr. Hardaway will complete the Andrews Sports Medicine Fellowship in Birmingham, AL.  
**Dr. Hardaway adds:** *I want to thank every staff member who invested time and patience into helping me develop both as a person and a future surgeon.*



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Determining the “Gold Standard”  
for Shoulder Arthroplasty Follow-Up:  
A Multicenter Study

ABSTRACT

Introduction

Routine postoperative follow-up after shoulder arthroplasty is advocated to assess patient outcomes, educate patients on rehabilitation and restrictions through the postoperative course, set patient expectations, and prevent or intervene upon complications. With the increasing number of arthroplasties being performed, combined with increasing life expectancy, long-term follow-up for shoulder arthroplasty has the potential to overload outpatient clinics. Obtaining long-, mid-, or even short-term follow-up necessitates dedicated commitment from the patient, surgeon, and research team and can be expensive to manage. Maintaining high follow-up rates within studies minimizes the potential introduction of bias due to loss of a particular patient population. The primary aim of this study was to report the true follow-up rates after total shoulder arthroplasty among a multicenter cohort at 1, 2, 5, and 10 years. We hypothesized that fewer than half of all shoulder arthroplasty patients complete more than 2 years of postoperative follow-up care.

Methods

Medical records of consecutive anatomic and reverse total shoulder arthroplasties performed between January 1, 2000, and March 31, 2020, at five high-volume shoulder arthroplasty centers across the United States were retrospectively reviewed. All patients ages 18 and over who underwent either a primary or revision anatomic or reverse total shoulder arthroplasty were included. Demographic data included age at time of surgery, gender, race, work status, insurance, psychiatric diagnosis, tobacco use, alcohol use, preoperative opioid use, and diagnosis. The presence or absence of clinical evaluation, patient-recorded outcome measures (PROMs), and radiographic interpretation at 1-, 2-, 5-, and 10-year follow-up intervals was recorded. Patients were excluded from time points for which they were not eligible for follow-up when insufficient time had elapsed since their surgery. Univariate logistic regression model was performed to determine the odds ratio (OR) in reference to the most populous group within each category.

Results

During the study period, 4700 shoulder arthroplasties were identified across five centers for review. Eligible follow-up rates for any of the three parameters was 66% at 1 year, 47% at 2 years, 26% at 5 years, and 9% at 10 years. When compared with the baseline groups at 2 years, the OR

of follow-up was significantly less for patients who were unemployed (OR=0.64), Hispanic (OR = 0.38), had a history of psychiatric diagnosis (OR = 0.81), or were current smokers (OR = 0.68).

Conclusions

Maintaining high follow-up rates over short-, mid-, and long-term intervals limits the introduction of bias against those lost to follow-up and ensures the achieved outcomes are generalizable to the entire population. Two-year follow-up rates were 47%, well below the recommended 80% required by many orthopaedic journals. Loss of follow-up may be due to a variety of factors including financial limitations, travel restraints, language barriers, social constraints, loss of contact information, being exceptionally pleased or displeased with the outcome, among others. Prior studies have indicated most complications that require intervention occur within the first 2 postoperative years after shoulder arthroplasty. This study presents the true follow-up rate after shoulder arthroplasty and the independent factors that may affect follow-up rates. This will guide future researchers when designing research studies and enrolling patients.

HAYDEN S. HOLBROOK, MD



Hometown: Johnson City, TN

Undergraduate Institution: Wake Forest University

Medical School: Wake Forest School of Medicine

Personal: Dr. Holbrook comes from a long line of doctors – his father, grandfather, great-grandfather, great-great-grandfather, and three uncles have been physicians, and three also were orthopaedic surgeons. He met his wife, Bridgitt, through friends while attending Wake Forest in 2011. She is a commercial real estate underwriting manager.

Hobbies: Tennis, snowboarding, traveling, and eating.

Asked why he chose medicine as a career: *Medicine is the best way I felt I could contribute to my community and make it a better place. It is incredibly rewarding to be entrusted to better a person’s health.*

And why he chose orthopaedics as a specialty: *Orthopaedic surgery gives me the opportunity to improve a patient’s ability to interact and contribute to the world. You also get to perform awesome surgeries and solve many musculoskeletal issues in the clinic.*

Favorite memory of residency: *There are too many to count. I loved sitting around the couches after a long week at Regional One (The Med), telling stories with my co-residents. I also loved all of our residency get-togethers for birthdays, holidays, and any type of celebration.*

Plans after Campbell: Dr. Holbrook will complete a Hand Surgery Fellowship at the Indiana Hand to Shoulder Center.

Dr. Holbrook adds: *I am incredibly thankful to every staff physician, especially the trauma and hand staff, who took time to teach me the foundation of orthopaedics and the intricacies of taking care of patients in the clinic. I am also grateful to the countless senior residents who taught me so many tips and tricks to be a successful resident and surgeon. Thank you, residency leadership, for always working to improve the residency.*

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# Opioid-Sparing Pain Management Protocol After Shoulder Arthroplasty Results in Less Opioid Consumption and Higher Satisfaction: A Prospective, Randomized Controlled Trial

## ABSTRACT

### Background

The opioid epidemic has become a central focus in health care. In an effort to reduce opioid use, orthopaedic surgeons use multimodal strategies to control postoperative pain. However, no clear consensus exists on ideal pain management strategies after shoulder arthroplasty, and most protocols are opioid-driven. This study sought to determine if patients undergoing shoulder arthroplasty using a postoperative opioid-sparing pain-control regimen would have equivalent pain scores and satisfaction compared with patients using a traditional opioid-based regimen.

### Methods

Patients undergoing primary anatomic or reverse total shoulder arthroplasty were prospectively enrolled and randomized into an opioid-sparing (OS) or a traditional opioid-based (OB) postoperative pain protocol. Both groups received opioid education, periarticular injection with liposomal bupivacaine, and preoperative and postoperative multimodal management (acetaminophen, celecoxib, and gabapentin). The OB group was discharged with 40 oxycodone tablets and standard icing, whereas the OS group received ketorolac during admission, continuous cryotherapy, and was discharged with 10 oxycodone tablets for rescue. Patients were queried regarding levels of pain and opioid consumption at days 1-7 and at 2, 6, and 12 weeks postoperatively. Patient satisfaction was recorded at 1, 2, 6, and 12 weeks. Range of motion (ROM), American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), and Single Assessment Numerical Evaluation (SANE) scores were assessed preoperatively and at 12 weeks postoperatively. Complications, readmissions, and reoperations were recorded.

### Results

In 78 patients, no differences in VAS pain scores were seen at any time between groups. The OS group consumed less oral morphine equivalents (OME) from inpatient hospitalization to 12 weeks postoperatively ( $P < 0.05$ ). Total OME consumption was reduced by 213% for the OS vs. the OB group (112 vs. 239;  $P < 0.0001$ ). The OS group consumed fewer

opioid pills at all time points ( $P < 0.05$ ). A 395% reduction in number of opioid pills consumed in the first 12 weeks postoperatively was seen in the OS vs. the OB group (4.3 vs. 17.0;  $P < 0.0001$ ). Significantly more patients in the OS group discontinued opioids by 2 weeks postoperatively (86.1% vs. 58.5%;  $P = 0.011$ ), and 94.4% in the OS group discontinued opioids by 6 weeks postoperatively. The OS group was more satisfied with pain management at 1 and 6 weeks ( $P = 0.05$ ). No differences in ROM, ASES or SANE scores, complications, readmissions, or reoperations were seen between groups.

### Conclusions

This study demonstrated a nearly 4-fold reduction in opioid pill consumption and earlier cessation of opioids with an OS pain management protocol. Patients also reported higher satisfaction with this pain management strategy.

## CALEB A. JONES, MD



**Hometown:** Tyler, TX

**Undergraduate Institution:** The University of Texas at Austin

**Medical School:** The University of Texas Health Science Center at San Antonio

**Personal:** His father is an orthopaedic surgeon, his older brother is a pediatric ophthalmologist, and his younger brother is doing an internal medicine internship. Dr. Jones met his wife, Lacy, while he was attending medical school and she was working as a dietitian. Lacy is a neonatal and pediatric dietitian at LeBonheur Children's Hospital. They have two children, Hannah Grace, 2; and 5-month-old Luke.

**Hobbies:** Hiking, fishing, hunting, and swimming.

**Asked why he chose medicine as a career:** *I went into medicine to have the opportunity to make a meaningful impact on patients' lives by helping them get back to the activities they love.*

**And why he chose orthopaedics as a specialty:** *I grew up shadowing my dad and really enjoyed the variety of procedures and the immediate feedback.*

**Favorite memory of residency:** *The Wilderness Hand Journal Club at Dr. Cal's farm – always great camaraderie and excellent food.*

**Plans after Campbell:** Dr. Jones will complete a Shoulder and Elbow Fellowship at the Florida Orthopaedic Institute in Tampa, FL.

**Dr. Jones adds:** *Many thanks to Drs. Throckmorton and Brolin for their guidance and mentorship. Also, thanks to the trauma staff – Drs. Rudloff, Weinlein, Beebe, and Cosgrove – for the excellent operative experience and training.*



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This study was accepted for a podium presentation at the American Shoulder and Elbow Surgeons Specialty Day, March 7, 2023 in Las Vegas, Nevada and at Mid-America Orthopaedic Association, April 19-23, 2023 in Miramar Beach, Florida

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Teres Minor Deficiency Does Not Predict Clinically Inferior External Rotation after Reverse Total Shoulder Arthroplasty: A 2-Year Matched Cohort Study

ABSTRACT

Background

Reverse total shoulder arthroplasty (RTSA) has emerged as a successful option for patients with end-stage shoulder pathology. Current teaching maintains that RTSA is unlikely to restore external rotation (ER) in those without a functional posterior rotator cuff, specifically the teres minor (TM). We hypothesized that patients with TM deficiency (TMD) would have inferior ER outcome parameters to those with an intact TM (TMI).

Methods

A prospectively maintained database was used to identify all patients at a single institution between January 2014 and July 2020 who underwent lateralized RTSA, had 2-year (Y2) follow-up, and did not have an adjunct tendon transfer procedure. Preoperative imaging was reviewed to identify patients with TMD, and propensity score matching was used to construct a control group (CG) of equal size. TMD was defined and divided into three subgroups: 1) atrophy: cuff tear arthropathy (CTA), osteoarthritis (OA), rotator cuff tear (RCT) with grade III or IV TM atrophy on MRI (CG: similar diagnosis with intact TM); 2) fracture: proximal humeral fracture, nonunion treated with RTSA with failed or resorbed greater tuberosity (GT) repair on follow-up radiograph (CG: fracture with healed GT repair); 3) endoprosthesis: any endoprosthesis reconstruction in which all rotator cuff tissue was resected (CG: large three-tendon RCT and intact TM without atrophy). Primary outcome measures were active ER range of motion (ROM) measured at the side, change in ER ( $\Delta$ ER) ROM from baseline, ER strength, and ASES subscore question “can you reach back of head to comb hair.”

Results

Thirty-nine TMD patients (atrophy: n=15; fracture n=14; endoprosthesis: n=10) were successfully matched with 39 TMI patients. All groups were similar with respect to indication, diagnosis and demographics. Although TMD was associated with reduced baseline ER ROM (13.6 vs 28.8; P = 0.004), TMD achieved greater  $\Delta$ ER ROM 2 years after RTSA (24.6 vs 10.3; P = 0.014) and demonstrated comparable Y2 ER ROM (38.6 vs 40.7; P = 0.484). TMD had a higher rate of ER weakness (12% vs 0%; P = 0.044); however, this did not lead to clinically significant differences in ability to

reach back of head (Subscore [Unable]: 24% vs 20%; P = 0.686) or patient-reported functional scores (Y2 ASES: 76.2 vs 74.8; P = 0.793). Subgroup analysis showed significantly improved  $\Delta$ ER ROM for TMD patients in the Atrophy group (28.2 vs 8.3; P = 0.036) and reduced Y2 ER ROM in the endoprosthesis group (34.5 vs 41.7; P = 0.029). There otherwise were no significant differences in Y2 ER ROM,  $\Delta$ ER ROM, ER weakness, or ability to reach back of head.

Conclusions

Restoration of ER after RTSA in the setting of TMD has been a recent topic of interest as surgeons seek evidence to guide patient expectations and/or determine the need for adjunct tendon transfer procedures. Our study, which represents the largest cohort of TMD patients to date, suggests that patients with an insufficient or absent TM can achieve satisfactory ER ROM and ER function after RTSA that is similar to their TMI peers. Future study will seek to identify muscle activation patterns of the shoulder girdle which allow TMD patients to functionally overcome this insufficiency to perform activities requiring ER.

ANTHONY J. MAROIS, MD



**Hometown:** Waterford, NY  
**Undergraduate Institution:** Wake Forest University  
**Medical School:** Wake Forest School of Medicine  
**Personal:** Dr. Marois met his wife, Allison Emrey, while they were attending Wake Forest. She is a professional golfer.  
**Hobbies:** Running, golf, Peloton, watching professional sports  
**Asked why he chose medicine as a career:** *It was the most challenging and rewarding career path that would allow me to blend my passion for science with the opportunity to see patients and improve their quality of life.*  
**And why he chose orthopaedics as a specialty:** *I have always had a love of sports and physical activity. Orthopaedic surgery (sports medicine in particular) allows me to work most often with relatively healthy patients who want to get better, and to perform surgeries that have good outcomes.*  
**Favorite memory of residency:** *Golf tournaments, Wilderness Hand Journal Club*  
**Plans after Campbell:** Dr. Marois will complete a Sports Medicine Fellowship at the Mississippi Sports Medicine & Orthopaedic Center.  
**Dr. Marois adds:** *I would like to thank all of the faculty, staff, and my co-residents for making Memphis feel like home for 5 years. I would choose to come back here again and again.*

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Intraobserver and Interobserver  
Reliability of the Peritubercle  
Lucency Sign in Slipped Capital  
Femoral Epiphysis

ABSTRACT

Background

An area of enlargement of the metaphyseal socket around the epiphyseal tubercle, termed the peritubercle lucency sign, has recently been introduced as a possible predictor of contralateral slipped capital femoral epiphysis in patients with previous unilateral slipped capital femoral epiphysis. This study aimed to assess intraobserver and interobserver reliability for detecting the presence or absence of the peritubercle lucency sign.

Methods

Thirty-five radiographs were presented to six fellowship-trained pediatric orthopaedic surgeons on two separate occasions 30 days apart, ensuring that the images were shown in a different order on the second exposure. Both times the reviewers recorded whether the peritubercle lucency sign was present or absent in each of the radiographs. Statistical analysis was performed to determine the intraobserver and interobserver reliability.

Results

In the intraobserver analysis, percent agreement between the first and second time the radiographs were reviewed varied between 62.9% and 85.7%, for an average intraobserver agreement of 74.8%.  $\kappa$  values for the six reviewers varied between 0.34 and 0.716, with an average intraobserver  $\kappa$  value of 0.508. The interobserver percent agreement was 40.0% for the first time the radiographs were reviewed, 42.9% the second time, and the overall interobserver percent agreement was 29%. The interobserver  $\kappa$  value was 0.44 the first time the radiographs were reviewed, 0.45 the second time, and the overall interobserver  $\kappa$  value was 0.45.

Discussion

On the basis of our findings, the peritubercle lucency has modest intraobserver and interobserver reliability at best and should be used with other currently used factors, such as age, presence of endocrinopathy, status of triradiate cartilage, posterior sloping angle, and modified Oxford score, in determining the need for prophylactic pinning. Further refinement of the definition of the peritubercle lucency sign may be needed to improve agreement and reliability of the sign.

ZACHARY A. MOSHER, MD



Hometown: Elkmont, AL

Undergraduate Institution: Auburn University

Medical School: University of Alabama School of Medicine

Personal: His mother is a veterinarian, his father is a material handler, and his stepfather works in auto body repair. Dr. Mosher met his wife, Erin, during a spring break mission trip to Port St. Joe, FL, while he was at Auburn. She is vice president of product for BoomNation and creative director of Nonfiction LLC. They have two daughters, 2-year-old Holland and Charlotte, who was born in January.

Hobbies: Running, smoking meats, watching college football, reading.

Asked why he chose medicine as a career: To help other people in rural communities who don't have easy access to care that is afforded to those in larger cities.

And why he chose orthopaedics as a specialty: I enjoy everything about orthopaedics. I enjoy working with my hands, the patient population, and the procedures.

Favorite memory of residency: The birth of our daughters.

Plans after Campbell: Dr. Mosher will complete an Adult Reconstruction Fellowship at Anderson Orthopaedic Research Institute in Alexandria, VA.

Dr. Mosher adds: Thank you to my co-residents, the faculty, and clinical staff for the last five years. I am especially grateful for my co-residents who are willing to answer the phone or do a case at any time of night.



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Preoperative Opioid Use is  
Associated with a More Painful  
Postoperative Course After Reverse  
Total Shoulder Arthroplasty

ABSTRACT

Background

Studies investigating preoperative use of opioid medication and early postoperative outcomes are lacking in reverse total shoulder arthroplasty (RTSA), findings that would be relevant in the setting of bundled payment plans. This study compared patients with chronic preoperative opioid use with patients who were opioid naïve in regard to pain, opioid use, length of hospital stay, and complications after RTSA.

Methods

Patients using opioids chronically (>3 months) preoperatively and those not using opioid medications before RTSA were identified through an institutional database. Visual analog scale (VAS) pain scores were recorded at the preoperative visit and 12 weeks after surgery. Oral morphine equivalents (OME) were recorded from in-hospital use, discharge, and subsequent opioid prescriptions, and a search of a statewide controlled substances monitoring database was performed during the 3-month postoperative period. The hospital length of stay and complications also were recorded. Statistical analyses for preoperative and postoperative measurements were performed using Mann-Whitney testing. Differences with  $P < 0.05$  were considered statistically significant.

Results

There were 55 patients with chronic preoperative opioid use and 134 nonusers included in the study. Preoperative VAS scores (6.7 vs. 5.6;  $P = 0.01$ ) were found to be higher for the opioid group. At 3 months postoperatively, VAS (3.5 vs. 1.9;  $P = 0.04$ ) was again found to be higher for the opioid group. However, the degree of improvement in VAS (4.1 vs. 3.6;  $P = 0.65$ ) was similar between groups. The amounts of inpatient OME (66.6 vs. 55;  $P = 0.76$ ) and post-discharge OME (606 vs. 559;  $P = 0.76$ ) consumed were similar between groups. The cumulative 3-month postoperative OME use (1457 vs. 569;  $P = 0.07$ ) was higher in the opioid group and trended toward statistical significance. No differences were noted in the length of stay between the two groups, with each averaging 2.3 days. Complication rates were similar between the two groups in the 90-day episode of care (9.1% vs. 10.4%).

Conclusions

These results indicate that chronic preoperative opioid use is associated with increased postoperative pain after RTSA, although VAS improvement

was similar to narcotic-naïve patients. Furthermore, cumulative OME usage only trended toward statistical significance but, nevertheless, reflected an over 2.5-fold increased requirement in the group of patients using opioids preoperatively. Although opioid users did not require substantially more perioperative resources, these data can be used to further counsel patients regarding opioid use, manage postoperative expectations, and aid in risk stratification during the evolution of bundled payments and the transition to value-based care.

DANIEL J. SMIGIELSKI, MD



Hometown: Jackson, TN

Undergraduate Institution: University of Alabama

Medical School: University of Tennessee Health Science Center

Personal: His father, Mike, is an orthopaedic surgeon, and his grandfather was a family medicine doctor. Dr. Smigielski and his wife, Sara, have been together since high school. They have two children Luke (3) and Eli (1). Sara is a retail pharmacist at Kroger.

Hobbies: He enjoys sports, spending time with his family, fishing, and reading.

Asked why he chose medicine as a career: *Medicine is an excellent opportunity to interact with people and help them. It also is a field that is constantly changing and improving with new science and technologies.*

And why he chose orthopaedics as a specialty: *I followed in my dad's footsteps. Orthopaedics combines biomechanical science with a hands-on approach to treating patients and making their lives better.*

Favorite memory of residency: *Wilderness Hand Journal Club and The Roast.*

Plans after Campbell: Dr. Smigielski will complete a Sports Medicine Fellowship at American Sports Medicine Institute in Birmingham, AL. Afterwards, he plans to return to West Tennessee to practice orthopaedic surgery.

Dr. Smigielski adds: *Thank you to all of the faculty, co-residents, fellows, and staff at Campbell Clinic. These five years have been memorable, and I am grateful to have had the opportunity to train at this program with such wonderful, talented people.*

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# Do Patient-specific or Fracture-specific Factors Predict the Development of Acute Compartment Syndrome After Pediatric Tibial Shaft Fractures?

## ABSTRACT

### Background

Tibial shaft fractures are the most common injuries preceding acute compartment syndrome (ACS), so it is important to understand the incidence of and risk factors for ACS after pediatric tibial shaft fractures. The purposes of this study were to determine the rate at which ACS occurs and if any patient or fracture characteristics are significantly associated with developing ACS.

### Methods

All patients aged 5 to 17 years treated for a tibial shaft fracture at a level 1 pediatric trauma center, a level 1 adult trauma center, and an outpatient orthopaedic practice between 2008 and 2016 were retrospectively identified. Demographics, mechanisms of injury, and fracture characteristics were collected from the medical records. Radiographs were reviewed by study authors. ACS was diagnosed clinically or by intracompartmental pressure measurement. Univariable analysis was performed using the Fisher exact test for nominal variables and simple logistic regression for continuous variables. Multivariable analysis was performed using stepwise logistic regression.

### Results

Among 515 patients with 517 tibial shaft fractures, 9 patients (1.7%) with 10 (1.9%) fractures developed ACS at a mean age of 15.2 years compared with a mean age of 11 years in patients without ACS (P=0.001). One patient with bilateral tibial fractures developed ACS bilaterally. Age greater than 14 years (P=0.006), higher body mass index (P < 0.001), motorcycle or motor vehicle accidents (P = 0.034), comminuted and segmental tibial shaft fractures (P < 0.001), ipsilateral fibular fracture (P = 0.002), and associated orthopaedic injuries (P = 0.032) were all significantly more common in the ACS group.

### Conclusions

ACS developed in 1.7% of the patients with tibial shaft fractures in this retrospective study—a rate significantly lower than previously reported. Age greater than 14 years, higher body mass index, motor vehicle or motorcycle accidents, comminuted or segmental fracture pattern, ipsilateral fibular fracture, and associated orthopaedic injuries are all significantly associated with its development.

## ERIC D. VILLARREAL, MD



**Hometown:** Jackson, TN

**Undergraduate Institution:** University of Mississippi

**Medical School:** University of Tennessee Health Science Center

**Personal:** His father is a general surgeon, and an uncle practices family medicine. Dr. Villarreal met his wife, Tessa, while he was in medical school. She is a former financial adviser and is now a stay-at-home mother to Olivia, 4.

**Hobbies:** He enjoys spending time outdoors with his family, especially visiting the Memphis Zoo, Mud Island, Memphis Botanic Garden, and Shelby Farms. They love to travel. *Olivia has been to more places in her 4 years of life than I ever thought possible.* On fall weekends, he enjoys rooting for Ole Miss football and *our perpetual state of mediocrity.*

**Asked why he chose medicine as a career:** *I wanted to be able to help people through my work. It was important to me that if I was going to wake up and do the same thing every day for 30 years, that I would enjoy it and help others.*

**And why he chose orthopaedics as a specialty:** *I enjoy being able to fix problems immediately, and I enjoy the variety of pathology that you see in orthopaedics.*

**Favorite memory of residency:** *The camaraderie that you form with everyone at the Med and the stories that develop over time as you spend more and more time there.*

**Plans after Campbell:** Dr. Villarreal will complete a Foot and Ankle Fellowship at the University of Colorado in Denver.

**Dr. Villarreal adds:** *Thank you to all of the faculty for their support of resident surgical training and for allowing us to grow as surgeons during the last 5 years.*





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# STAFF RESEARCH



# 2023 NEER AWARD

Congratulations to the 2023 Charles S. Neer Basic Science Award recipients for their work on **Muscle Activation Patterns during Active External Rotation after Reverse Total Shoulder Arthroplasty: An Electrophysiological Study of the Teres Minor and Associated Musculature**. The contributors were Dr. Thomas Throckmorton, Dr. William Polio, Mr. Blake Hajek, Dr. Tyler Brolin, Dr. William Mihalko, Dr. Kunal Singhal, Ms. Shannon Hughes, Ms. Alexis Nelson, Mr. Tristan Hayes, Ms. Margaret Knack, Dr. Chi-Yang Chiu, Dr. David Bernholt, and Dr. Frederick M. Azar. This represents a second Neer win for the UTHSC-Campbell Clinic Department of Orthopaedic Surgery and Biomedical Engineering, Memphis, Tennessee.

The prestigious Neer Award, created in 1985 and named after its benefactor, is presented annually by the American Shoulder and Elbow Surgeons (ASES) to physicians in recognition of superb research in the prevention and treatment of shoulder injuries. Dr. Charles Neer, known as the “father of shoulder surgery” in the United States, was born in 1917 in Oklahoma. He received his medical degree from the University of Pennsylvania and began his orthopaedic residency at Presbyterian Hospital in New York before leaving to serve in World War II in Europe and Asia. He returned to New York City to complete his residency and join the Fracture Service at Presbyterian Hospital, becoming faculty at Columbia University College of Physicians and Surgeons where he remained as a tenured professor until he retired in 1990. Dr. Neer was the founding member of the ASES and served on the American Board of Orthopaedic Surgery, the Board of Trustees of the Journal of Shoulder and Elbow Surgery, and the International Board of Shoulder and Elbow Surgeons. Among his many achievements, Dr. Neer is best known for his classification of proximal humeral fractures,

which is still widely used today, and for developing the first practical shoulder arthroplasty system.

In their award-winning research project, Dr. Throckmorton and colleagues questioned the assumption that preoperative teres minor insufficiency causes poor functional external rotation after reverse total shoulder arthroplasty (RTSA). They sought to determine the timing, sequence, duration, and intensity of activation



Thomas W. Throckmorton, MD



## Muscle Activation Patterns during ER after RTSA: An Electrophysiological Study of the Teres Minor and Associated Musculature

I and my co-authors have nothing to disclose

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### Introduction

- Return of functional external rotation (ER) after RTSA has been inconsistent, with preop teres minor insufficiency identified as risk factor for poor function.
- There has been little investigation of muscle activation patterns generating postop ER.
- This study sought to determine timing and relative activation levels of the shoulder girdle muscles during ER in patients who have a well-functioning RTSA.

### Methods

- Patients  $\geq 1$ -year from RTSA with intact functional ER and ASES score  $> 70$ , superior rotator cuff deficiency and intact teres minor based on MRI were included.
- All RTSAs performed using medial glenoid/lateral humeral design.
- Subjects recruited to perform electrophysiological and kinematic analyses of shoulder during ER in two starting positions: modified neutral (MN) and abduction (AB).
- Dynamometer-recorded torque and position at 100 Hz were mathematically pattern-matched to electromyography (2000 Hz; EMG) during ER.
- Root mean square integrated EMG, and median frequency were calculated from EMG onset to offset to determine muscle fiber recruitment strategies.

### Results

- 16 patients included (10 female; avg. age 71.9 y) with 24.8-month follow-up. Average ASES score 87.7 (range 70.8-100). Average VAS pain score 0.5 (range 0-3). Average ASES sub-score for ER in AB (“comb hair”) 2.75 out of 3 (range 2-3).
- In AB, sequence of muscle activation from IR to ER began with upper trapezius, middle trapezius, and latissimus dorsi then anterior deltoid activating until arm reached neutral.
- With continued ER past neutral, teres major (9.6, SD 9.2) initiated ER against gravity followed by the teres minor (14.1, SD 18.2) and posterior deltoid (11.1, SD 9.3).
- Median frequency analysis indicated that teres major (1.1 Hz, SD 0.5), teres minor (1.2, SD 0.4), and posterior deltoid (1.1, SD 0.4) work as equivalent contributors to ER beyond neutral.
- In MN, upper and middle trapezius were not recruited to same level as in AB.
- As ER beyond neutral was initiated, teres major (9.5, SD 9, MF 1.1, SD 0.5), teres minor (11.4, SD 15.1, MF 1.1, SD 0.5), and posterior deltoid (8.5, SD 8, MF 1.2, SD 0.3) were activated in same sequence and similar intensity as in AB.
- No significant differences were noted in duration or intensity of muscle activation among teres major, teres minor, and posterior deltoid ( $p > 0.05$ ).

### Conclusion

Active external rotation after RTSA is a complex interplay of the shoulder girdle musculature that is not governed by a single muscle-tendon unit. The results of this study establish a sequence, duration, and intensity of muscle activation for ER in a well-functioning RTSA. In both tested positions, the teres major, teres minor, and posterior deltoid function equally and sequentially power ER.

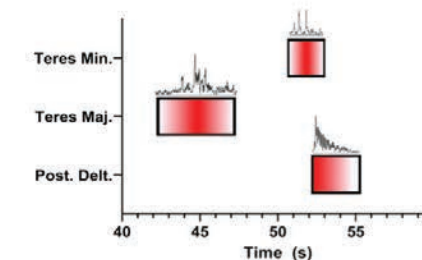


Figure 1: Muscle activation timing (seconds) and a representation of EMG intensity (microVolts\*ms) demonstrates sequence, duration, and intensity of muscle activation to power ER after RTSA.



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Hip Arthroplasty Femoral Stem Designs and Their Association with Early Postoperative Periprosthetic Femoral Fractures

ABSTRACT

Background

Periprosthetic femoral fractures (PFFs) in total hip arthroplasty (THA), especially those in contact with the diaphyseal stem, carry high morbidity. This study evaluated how stem design influences the risk of early Vancouver B PFF or other PFF requiring operative intervention after THA.

Methods

A multicenter, retrospective study of 3,433 primary cementless THAs performed from 2014 to 2021 included 2,302 single-taper (micro M/L [n . 1,169]; M/L [n . 1,133]) and 1,131 double-taper (fit-and fill [n . 420]; compaction-collared [n . 711]) stems. Mean follow-up was 2.2 years (range, 0.3 to 6.5 years). Primary outcomes were Vancouver B and surgically treated postoperative PFFs among differing femoral stems. Secondary outcomes included rates of intraoperative and postoperative Vancouver A and C PFFs.

Results

Forty-five postoperative PFFs (1.3%) occurred within 8.8 weeks (median), 25 of which were Vancouver B (0.7%) and 20 total PFFs that required operative intervention (0.6%). Compaction-collared stems had a decreased risk of Vancouver B (hazard ratio 0.18, 95% confidence interval: 0.03-0.97 P = .044) and any surgically treated PFF (hazard ratio 0.10, 95% confidence interval: 0.01-0.95; P = .037). Intraoperative PFFs were most common with fit-and-fill stems (3.6%, P < .001) and Vancouver A with compaction-collared stems (1.8%, P < .001). The cohort with PFF had a higher Charlson comorbidity index (P = .004), more women (P = .001), more Dorr A or C femora (P = .013), and more posterior or lateral surgical approaches compared to those without PFF (P < .001).

Conclusion

After controlling for confounding variables, compaction-collared stems had a significantly lower risk of postoperative Vancouver B and PFF requiring operative treatment than single-taper and double-taper stems.

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In-Vitro Cell-Induced Corrosion by Macrophages on Cobalt-Chromium-Molybdenum Alloy

ABSTRACT

Background

Patients have received cobalt-chromium-molybdenum (CoCrMo) implants for their joint replacement for decades. There have been reports of inflammatory cell-induced corrosion (ICIC) of these implants from retrieval studies. The goal of this study is to see if we could recreate ICIC in vitro and whether electrocautery damage to alloy surfaces may hasten this process.

Methods

Murine macrophages were cultured on CoCr disks with and without damage from a monopolar electrocautery. Culture medium was replaced every 12 hours and supernatant was collected every 4 days. After 30 days, cells were removed, counted, and digested. The metal concentrations in the supernatant and within cells were assessed using inductively coupled plasma spectrometry for comparison.

Results

The Co supernatant concentration was higher in the undamaged disks with activated macrophages. Higher concentrations of Co and Mo were found in the supernatant of the undamaged disks vs the electrocautery (EC) corrosion damaged disks. There was a significantly higher intracellular Co and Mo concentration with activated cells on CoCrMo disks vs the control group and no difference compared to EC damaged disk group. Scanning electron microscopy displayed microscopic pitting on the surfaces exposed to macrophages without EC damage.

Conclusion

We found that macrophages could reproduce findings of ICIC pits on the surface of CoCrMo alloy and that the addition of EC damage to the surface did not increase the process. The clinical significance of these findings should be further investigated to determine if this could explain a small number of poor total knee arthroplasty reported outcomes.

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# Efficacy of Postoperative Oral Antibiotics in Foot and Ankle Surgery

## ABSTRACT

### Background

Preoperative oral antibiotic use in patients undergoing foot and ankle surgery is standard practice, but no consensus has been reached regarding the efficacy of postoperative oral antibiotics. The purpose of this study was to determine whether postoperative oral antibiotics reduce the rate of surgical site infections (SSIs) in patients, with and without comorbidities, undergoing foot and ankle surgery.

### Methods

A retrospective chart review was conducted identifying patients who underwent foot and ankle surgery by 4 fellowship-trained, foot and ankle orthopaedic surgeons between January 1, 2015, and January 1, 2019. Patients were divided into 2 groups: those who received postoperative oral antibiotics (group 1) and those who did not (group 2). Two surgeons routinely prescribed postoperative oral antibiotics, and 2 did not. Demographics, comorbidities, and procedure complexity based on surgical site and Current Procedural Terminology code were recorded from the charts. The primary outcome was postoperative infection (superficial or deep) within 6 months after surgery. Patients with antibiotic use prior to surgery, preoperative infection, or lack of follow-up >6 weeks were excluded. Multivariate logistic regression modeling was used to analyze differences in infection rate and severity.

### Results

Chart review identified 3631 patients, 1227 of whom did not receive postoperative oral antibiotics whereas 2394 patients did. Routine postoperative oral antibiotic use did not significantly affect postoperative infection rates or severity. However, all covariates studied (diabetes, hypertension, obesity, tobacco use, alcohol use, rheumatoid conditions, and age) influenced postoperative infection rates and severity.

### Conclusion

The results of this study indicate that postoperative oral antibiotics are not associated with differences in infection rates or severity. We do not recommend routine use in foot and ankle surgery.

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# Comparing Rates of Fusion and Time to Fusion in Viable Cellular Allograft and Autograft

## ABSTRACT

### Background

Autograft or allograft frequently are used to enhance bone union in foot and ankle surgery. Viable cellular bone allograft uses viable cells and bone scaffolding in a gel base, but uncertainty remains around allograft’s greater efficacy than autograft regarding rates of fusion (ROF) and time to fusion (TTF).

### Methods

Autograft, viable cellular allograft, and viable cellular allograft with autograft were compared in 199 forefoot, midfoot, and hindfoot arthrodeses performed over a 6-year period. Data collected from electronic medical records and radiographs were analyzed to determine ROF and TTF as well as rates of revision surgery for delayed or nonunion and compared among groups.

### Results

Eighty-seven patients comprised the autograft group; 81, the allograft group; and 31, the combined group. No significant differences were noted in patient demographics among the groups. No statistically significant differences in ROF were noted among the 3 groups, with 86% (75 of 87) fusion in the autograft group, 93% (75 of 81) in the allograft group, and 84% (26 of 31) in the combined group (P = .20). After conducting a multivariate analysis, we found no statistically significant difference for allograft or combined graft on TTF (P = .1379 and .2311, respectively). No significant difference was found in rate of revision surgery for nonunion, which was 1.2% (1 of 81) in the allograft group, 3.4% (3 of 87) in the autograft group, and 6.5% (2 of 31) in the combined group (P = .3).

### Conclusion

No significant difference was found in ROF, TTF, or rate of revision surgery when comparing viable cellular allograft to autograft or combined allograft-autograft. Viable cellular allograft may be a reasonable alternative to the gold standard of autograft and should be considered an option in patients undergoing arthrodesis in foot and ankle surgery.



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# Building a Clinical Skills Program for Orthopaedic Trainees

**ABSTRACT**  
Orthopaedic surgery residency education is evolving from the historic mantra of “see one, do one, teach one” to incorporating more formal skill programs into curricula. Each training environment possesses unique resources and constraints, with no single one-size-fits-all approach. Cost remains the single greatest barrier to the development of orthopaedic surgery skills programs. Time also is a concern, as trainees have a finite amount of time to spend in the training environment. Furthermore, time spent in simulation or a skills workshop has the potential to interfere with time spent on direct patient care. Training programs must therefore utilize all available resources in a thoughtful and efficient manner to maximize the educational potential of such a program. By enlisting the help of enthusiastic educators and partners, program directors can build a team with shared common goals. This includes collaboration between training programs, medical schools, and industry. Experience across all levels of orthopaedic knowledge can be incorporated in a top-down fashion to both facilitate trainee education and create an environment conducive to future growth. As educational technology becomes more accessible and educational research advances, skills programs will be able to adapt and adopt evidence-based strategies to improve orthopaedic trainee education.

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# Sagittal Band Injury and Extensor Tendon Realignment

**ABSTRACT**  
Injury to the sagittal band can cause pain, extensor tendon subluxation, or dislocation. Nonoperative treatment involves splinting the affected metacarpophalangeal (MCP) joint in extension within 3 weeks of injury. Direct surgical repair of the sagittal band can be performed if the tissue quality is adequate; if not, reconstruction needs to be considered. The use of local anesthetic and testing the stability of the tendon intraoperatively are important to obtain proper soft-tissue balancing.

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# Two-Year Functional Outcomes of Operative vs Nonoperative Treatment of Completely Displaced Midshaft Clavicle Fractures in Adolescents: Results From the Prospective Multicenter FACTS Study Group

## ABSTRACT

### Background

The optimal treatment of midshaft clavicle fractures is controversial. Few previous comparative functional outcome studies have investigated these fractures in adolescents, the most commonly affected epidemiologic subpopulation.

### Purpose/Hypothesis

The purpose was to prospectively compare the outcomes of operative versus nonoperative treatment in adolescents with completely displaced midshaft clavicle fractures. The study hypothesis was that surgery would yield superior outcomes.

### Study Design

Cohort study; Level of evidence, 2.

### Methods

Patients aged 10 to 18 years treated for a midshaft clavicle fracture over a 5-year period at 1 of 8 pediatric centers were prospectively screened, with independent treatment decisions determined by individual musculoskeletal professionals. Demographics, radiographic clinical features, complications, and patient-reported outcomes (PROs) were prospectively recorded for 2 years. Regression and matching techniques were utilized to adjust for potential age- and fracture severity–based confounders for creation of comparable subgroups for analysis.

### Results

Of 416 adolescents with completely displaced midshaft clavicle fractures, 282 (68) provided 2-year PRO data. Operative patients (n = 88; 31%) demonstrated no difference in sex (78% male) or athletic participation but were older (mean age, 15.2 vs 13.5 years; P\0.001), had more comminuted fractures (49.4% vs 26.3%; P\0.001), and had greater fracture shortening (25.5 vs 20.7 mm; P\0.001) than nonoperative patients (n = 194; 69%). There was no difference in mean PRO scores or rates of “suboptimal” scores (based on threshold values established a priori) between the operative and nonoperative treatment groups (American Shoulder and

Elbow Surgeons, 96.8 vs 98.4; shortened version of the Disabilities of the Arm, Shoulder and Hand, 3.0 vs 1.6; EuroQol [EQ] visual analog scale, 93.0 vs 93.9; EQ–5 Dimensions index, 0.96 vs 0.98), even after regression and matching techniques adjusted for confounders. Operative patients had more unexpected subsequent surgery (10.4% vs 1.4%; P = .004) and clinically significant complications (20.8% vs 5.2%; P = .001). Overall, nonunion (0.4%), delayed union (1.9%), symptomatic malunion (0.4%), and refracture (2.6%) were exceedingly rare, with no difference between treatment groups.

### Conclusion

Surgery demonstrated no benefit in patient-reported quality of life, satisfaction, shoulder-specific function, or prevention of complications after completely displaced clavicle shaft fractures in adolescents at 2 years after injury.

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# Infections After Open Fractures in Pediatric Patients: A Review of 288 Open Fractures

## ABSTRACT

We reviewed pediatric open fractures treated at a large Level 1 children's trauma center to determine the rate of infection after open fractures, potential risk factors for infection, and the rate of infection caused by antibiotic-resistant organisms. A retrospective review identified 288 open fractures in children 1 to 17 years of age. Post-traumatic infections developed in 24 (8.3%) open fractures. There was no significant association between the development of infection and mechanism of injury ( $p = 0.33$ ), time to surgical debridement ( $p = 0.93$ ), or type of empiric antibiotic given ( $p = 0.66$ ). Infection occurred more frequently in overweight and obese patients (odds ratio = 2.22; 95% confidence interval: 0.93, 5.46,  $p = 0.07$ ). There was one infection (4.2%) caused by methicillin-resistant staphylococcus aureus (MRSA). The most commonly identified organisms on culture were methicillin-sensitive staphylococcus aureus ( $n = 3$ ) and pseudomonas ( $n = 3$ ). Obesity is a significant risk factor for the development of infection after an open fracture in the pediatric population.

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# Safety and Short-term Outcomes of Anatomic vs. Reverse Total Shoulder Arthroplasty in an Ambulatory Surgery Center

## ABSTRACT

### Background

A scarcity of literature exists comparing outcomes of outpatient anatomic (aTSA) and reverse total shoulder arthroplasty (rTSA). This study was performed to compare early outcomes between the 2 procedures in a freestanding ambulatory surgery center (ASC) and to determine if the addition of preoperative interscalene nerve block (ISNB) with periarticular liposomal bupivacaine injection (PAI) in the postanesthesia care unit (PACU) would improve outcomes over PAI alone.

### Methods

Medical charts of all patients undergoing outpatient primary aTSA or rTSA at 2 ASCs from 2012 to 2020 were reviewed. A total of 198 patients were ultimately identified (117 aTSA and 81 rTSA) to make up this retrospective cohort study. Patient demographics, PACU outcomes, complications, readmissions, reoperations, calls to the office, and unplanned clinic visit rates were compared between procedures. PACU outcomes were compared between those receiving ISNB with PAI and those receiving PAI alone.

### Results

Patients undergoing rTSA were older (61.1 vs. 55.7 years,  $P < .001$ ) and more likely to have American Society of Anesthesiologists (ASA) class 3 (51.9% vs. 41.0%,  $P = .050$ ) compared to patients having aTSA. No patient required an overnight stay. Time in the PACU before discharge (89.1 vs. 95.6 minutes,  $P = .231$ ) and pain scores at discharge (3.0 vs. 3.0,  $P = .815$ ) were similar for aTSA and rTSA, respectively. One intraoperative complication occurred in the aTSA group (posterior humeral circumflex artery injury) and 1 in the rTSA group (calcar fracture) ( $P = .793$ ). Ninety-day postoperative total complication (7.7% vs. 7.4%), shoulder-related complication (6.0% vs. 6.2%), medical-related complication (1.7% vs. 1.2%), admission (0.8% vs. 2.5%), reoperation (2.6% vs. 1.2%), and unplanned clinic visit (6.0% vs. 6.1%) rates were similar between aTSA and rTSA, respectively ( $P \geq .361$  for all comparisons). At 1 year, there were 8 reoperations and 15 complications in the aTSA group compared with 1 reoperation and 8 complications in the rTSA group ( $P = .091$  and  $P = .818$ , respectively). Patients who had ISNB spent less time in PACU (75 vs. 97 minutes,  $P < .001$ ), had less pain at discharge (0.2 vs. 3.9,  $P < .001$ ), and consumed less oral morphine equivalents in the PACU (1.2 vs. 16.6 mg,  $P < .001$ ).

### Conclusion

Early postoperative outcomes and complication rates were similar between the 2 groups, and all patients were successfully discharged home the day of surgery. The addition of preoperative ISNB led to more efficient discharge from the ASC with less pain in the PACU.

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Clinical and Radiographic Outcomes  
of Hybrid Glenoid Fixation with a  
Central Porous Titanium Post: Analysis  
of 713 Consecutive Shoulders

ABSTRACT

Background

Hybrid glenoid component fixation represents an emerging technology in total shoulder arthroplasty (TSA) design. However, there is a paucity of larger-scale studies reporting the outcomes following implantation of these components. This study aimed to determine the outcomes following primary TSA using hybrid glenoid component fixation with a central porous titanium post.

Methods

A retrospective review of 2 institutional databases identified patients aged 18 years who underwent primary elective hybrid TSA between 2009 and 2018 with a minimum of 2 years of follow-up. Outcomes evaluated included the visual analog scale pain score, range of motion, American Shoulder and Elbow Surgeons (ASES) score, complications, and implant survivorship free from reoperation or revision. Postoperative imaging was assessed for glenoid radiolucent lines and evidence of aseptic glenoid component loosening (AGL).

Results

A total of 713 shoulders in 666 patients with a mean age of 61.6 years were included in the study at a mean follow-up period of 4.3 years

(range, 2.0-9.1 years); male shoulders comprised 50.9% of shoulders. Notable clinical improvements were observed with respect to the visual analog scale pain score (7.0 to 1.4, P < .001), active forward elevation (91 to 155, P < .001), active external rotation (21 to 50, P < .001), and the ASES score (38.6 to 82.7, P < .001), with all exceeding the substantial clinical benefit threshold for TSA. The active internal rotation score also showed significant improvement (3.1 to 5.7, P < .001). Glenoid radiolucent lines were identified in 57 TSAs (8.2%), with 1 radiographically loose glenoid component (0.1%). There were 54 complications (7.6%), with postoperative rotator cuff tear as the most common complication (n = 15, 2.1%); only 4 cases (0.6%) of glenoid-related complications (AGL) were observed. The Kaplan-Meier rate of survival free from revision surgery was 98.7% at 1 year, 98.5% at 2 years, and 96.7% at 5 years.

Conclusions

Hybrid glenoid component fixation of anatomic TSA with a central porous titanium post demonstrated statistically significant and clinically meaningful improvements in pain, range of motion, and ASES scores. Although AGL remains a concern, only 0.6% of TSAs sustained glenoid-related complications at a mean follow-up period of 4.3 years and the rate of survivorship free from revision was 96.7% at 5 years. These favorable clinical findings support the theoretical advantages of hybrid glenoid fixation; however, large comparative investigations with long-term follow-up are needed to validate these results.

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High Rate of Revision Surgery After  
Limited Decompression of Lumbar  
Facet Cysts

ABSTRACT

Introduction

The surgical treatment of lumbar facet cysts has long been debated. Some surgeons elect for limited decompression of such cysts while other surgeons elect for primary decompression and fusion over concerns for recurrence and instability. Previous studies have suggested the rate of revision surgery after facet cyst excision to be as low as 1%, whereas others have reported this rate to be markedly higher. In this study, we examined revision surgery rates and patient-reported outcomes and conducted a radiographic analysis to identify predictors of failure after limited decompression of lumbar facet cysts.

Methods

A retrospective review of the electronic medical records of patients treated at our institution using the Current Procedural Terminology code 63267 before January 2018 was conducted. The primary outcome measure was revision surgery at the index level for recurrence or instability or a minimum 2-year follow-up without revision surgery. Secondary outcome measures include radiographic assessments of preoperative and postoperative spondylolisthesis and patient-reported outcome measures. Using preoperative MRI studies, an analysis of facet angles at the surgical level was conducted and the presence, location, and amount of facet fluid were calculated.

Results

A total of 162 patients met inclusion criteria. Of these, 93 patients had a minimum 2-year follow-up. Of these, 19 had undergone a revision surgery at the index level for cyst recurrence or instability. The revision rate for this group was 20.4%. The median time to initial revision surgery was 2.2 years. The median time from index operation to last follow-up was 3.8 years. No differences were observed between the groups regarding the presence of preoperative spondylolisthesis, age, sex, body mass index, blood loss, or patient demographics. 60.2% of all procedures were done at the L4-5 level, but this level accounted for 73.7% of primary failures. A radiographic analysis showed facet angle >.45° at L4-5 to be associated with risk of failure of primary decompression. The presence and absolute amount of fluid in the facets were not associated with risk of failure at the L4-5 level.

Discussion

Our revision rate of 20.4% is higher than what is commonly reported in the literature. The radiographic analysis shows that at the L4-5 level, a facet angle of >.45° is associated with failure of primary decompression.



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# Skeletally Immature Patients With Classic Anterior Cruciate Ligament Bone Bruise Patterns Have a Higher Likelihood of Having an Intact Anterior Cruciate Ligament Compared With Skeletally Mature Patients

## ABSTRACT

### Background

The incidence of anterior cruciate ligament (ACL) tears in skeletally immature patients with an ACL bone contusion pattern has been sparsely investigated. The purpose of this study is to investigate whether physal status has an influence on the likelihood of sustaining an ACL tear when classic bipolar ACL bone bruising pattern is present.

### Methods

Magnetic resonance imaging reports were queried for “contusion” on all patients between 6 and 22 years between 2015 and 2019. Images were reviewed to denote all intra-articular pathology and the physal status of the femur and tibia. The primary outcome was the incidence of ACL tears in patients with the presence of bipolar bone contusions. Fischer exact testing was used to determine associations.

### Results

Of 499 patients included, 269 of those had bipolar bone contusions. Patients with bipolar bone contusions and ACL tears had a shorter duration between injury and imaging date compared with patients with ACL tears without bipolar bone contusions (6.9 vs. 38.6 d, P=0.05). Patients with an open femoral physis had a higher likelihood of having an intact ACL despite the presence of bipolar bone contusions than patients with a closed femoral physis (10.8% vs. 1.0%, P<0.001). Of patients with bipolar bone contusions, those with an intact ACL were younger than patients with an ACL tear (14.6 vs. 16.4, P=0.017).

### Conclusions

Although bipolar bone contusions of the central lateral femoral condyle and posterior lateral tibial plateau are typically found after ACL injury, these bipolar contusions can be found concomitantly with an intact ACL and were more often found in relatively younger patients. Patients who have an open femoral physis have a higher likelihood to have an intact ACL despite the presence of bipolar bone contusions compared with patients who have a closed femoral physis.





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April 2023	October 2023	.5 Hours

**Target Audience:** This activity has been designed to meet the education needs of orthopaedic surgeons, residents, fellows, and allied health providers involved in the care of patients under the age 14 years with anterior shoulder instability.

**Statement of Need/Program Overview:** This article gives learners a better understanding of surgical techniques and outcomes for patients under 14 years of age who have undergone arthroscopic stabilization of traumatic shoulder instability.

## Learning Objectives:

1. Identify adolescent patients under 14 years of age in whom traumatic shoulder instability can achieve satisfactory outcomes with arthroscopic stabilization.
2. Describe suggested reasons for differences in recurrence rates between adolescents under age 14 years and older patient populations.
3. Identify scoring systems for postoperative assessment after repair of traumatic shoulder instability.

**Funding:** None

**Ethical Approval:** This study was approved by the institutional Review Board of the University of Tennessee Health Science Center (approval #20-07209-X), with a waiver of informed consent.

## Accreditation Statement



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# Outcomes of Arthroscopic Stabilization for Anterior Shoulder Instability in Patients Younger than 14 Years of Age

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**ABSTRACT**

**Background**

Adolescents with shoulder instability have an increased risk of recurrence after stabilization procedures compared with adults; however, the literature is limited regarding recurrence in patients <14 years of age. This study evaluates recurrence after arthroscopic anterior shoulder stabilization in patients <14 years of age with traumatic anterior shoulder instability.

**Methods**

A retrospective review was performed of patients <14 years of age treated with arthroscopic anterior stabilization procedure for traumatic anterior shoulder instability. Exclusion criteria were prior shoulder surgery, primary posterior instability, or rotator cuff or humeral head injury requiring repair. Preoperative imaging studies and operative reports were reviewed. Patients were contacted to complete a survey. The Single Assessment Numeric Evaluation (SANE) and Rowe scores were primary outcome measures.

**Results**

Twenty-two patients were confirmed by chart review and imaging to have primary anterior instability. Eleven completed the telephone survey. The mean follow-up was 63 (range 20-116) months. All patients had open proximal humeral physes at the time of surgery. Recurrent instability episodes were reported in two patients (18.2%) after arthroscopic stabilization, both undergoing revision repair. Ten (90.9%) were able to return to sports at the same or higher competitive level. The mean Rowe and SANE scores were 95.45 (SD 7.9; range 80.0-100.0) and 89.55 (SD 7.6; range 75.0-100.0), respectively, with nine (81.8%) having an excellent outcome and two (18.2%) having a good outcome.

**Conclusions**

A recurrent instability rate of 18.2% was noted after anterior arthroscopic stabilization in patients <14 years of age, which is slightly higher than that reported in adults (12%) but lower than that reported in older adolescents >14 (<25%). This suggests that arthroscopic stabilization in this lower age range may be more successful in terms of long-term stability. This study highlights that arthroscopic stabilization in appropriately selected pediatric patients <14 years of age with traumatic anterior shoulder instability can achieve satisfactory outcomes with low recurrence and high return to sports rates.

**Level of Evidence**

Level IV, Therapeutic case series

**Keywords**

Pediatric shoulder dislocation; anterior shoulder instability; arthroscopic stabilization; Bankart lesion; recurrence

**INTRODUCTION**

Traumatic shoulder instability is a common condition in the general population, with an estimated incidence of 1.7%.<sup>1</sup> Nonoperative management of shoulder instability in the active adolescent population has high failure rates with high rates of recurrent instability.<sup>2,3</sup> This has been proposed to lead to increased cartilage damage and higher-grade chondral lesions of the glenohumeral joint<sup>4</sup> as well as increased amounts and prevalence of glenoid bone loss.<sup>5,6</sup> It is thought that this high rate of failure is caused by acquired pathologic changes in the shoulder from the traumatic dislocation or subluxation episode. An associated detachment of the anterior-inferior capsulolabral complex, or Bankart lesion, is present in 85% of patients.<sup>7</sup> This compromises the static restraint maintaining glenohumeral joint stability and predisposes to recurrent instability episodes. Surgical intervention to correct continued instability typically includes anterior labral repair with capsulorrhaphy. Historically, these repairs were performed open, but there has been a trend towards arthroscopic techniques, which now predominate with similar clinical outcomes.<sup>8-10</sup> A lower recurrence rate has been shown with open repair, with male sex and the presence of a Hill-Sachs lesion being associated with recurrent instability after repair.<sup>10</sup>

Studies investigating surgical outcomes in adolescent patients with shoulder instability have demonstrated increased recurrence rates of shoulder dislocation when compared with adult-aged patients, with rates ranging from 21% to 51%.<sup>11-15</sup> This may be the result of a host of factors, including continued participation in competitive or contact sports, continued participation in overhead athletics, and general hyperlaxity that may have predisposed the patient to earlier traumatic instability initially.<sup>16</sup> An increased number of instability episodes is also a well-documented risk factor for recurrent instability because of its direct relation to the degree of glenoid and humeral bone loss, and this may be the most significant risk factor.<sup>5,17,18</sup>

Many young athletes with shoulder instability desire a return to competitive sports. Thus, an important clinical outcome measure is the return to sport (RTS) rate after intervention. Reported RTS rates have ranged from 80% to 90% in the literature, with return to prior levels of competitiveness being slightly lower.<sup>18-20</sup>

Recent literature has shown that children 14 years of age or younger have a substantially lower risk of recurrent instability than those older than 14 years of age after a single traumatic shoulder dislocation.<sup>21</sup> In the referenced meta-analysis, those older than 14 had a 24-times increased risk of recurrent instability when compared with younger adolescents (<14 years). This may be due to several factors including physeal status, a more lateral glenohumeral joint capsule insertion at a younger age, greater joint capsule elasticity, and increased healing potential.

The literature is limited regarding recurrent pediatric instability as most studies investigate older adolescent patients (15-18 years of age) or those who are part of a larger group that includes adults or skeletally mature patients. To our knowledge, no study has evaluated recurrence rates in children 14 years of age or younger after arthroscopic shoulder stabilization.

The purpose of this study was to evaluate a retrospective case series of adolescent patients 14 years of age or younger with traumatic anterior shoulder instability treated with arthroscopic anterior shoulder stabilization. The hypothesis was that recurrence rates would be lower with improved clinical outcomes in this specific population when compared with older cohorts.

**METHODS**

After institutional review board approval was obtained, patients 14 years of age or younger treated for traumatic anterior shoulder instability with arthroscopic stabilization were retrospectively identified by querying medical records for CPT code 29806. Inclusion criteria were a diagnosis of anterior instability, age of 14

years or younger at the time of surgery, arthroscopic anterior labral repair with capsulorrhaphy, and a minimum of 12 months of clinical follow-up. Exclusion criteria were prior shoulder surgery, primary posterior instability, or evidence of concomitant injury to the rotator cuff or humeral head requiring repair.

Chart review for each identified patient confirmed the inclusion and exclusion criteria, and demographic and surgical data for patients was obtained, including age, sex, operative side, primary surgeon, mechanism of injury, and primary sports played. Preoperative imaging studies were reviewed to determine the presence or absence of a Hill-Sachs lesion, glenoid bone loss, and physeal status (closed or open). Operative reports were reviewed to determine surgical technique.

All patients underwent general anesthesia with repair performed in either the beach-chair or lateral-decubitus position. All patients underwent anterior Bankart repair with suture anchors, with other concomitant procedures performed at the discretion of the primary surgeon.

Patients were contacted by telephone to complete a telephone survey. Phone numbers were identified using those on file at our offices. Once contacted, verbal consent was obtained from parents or guardians for patients younger than 18 years of age. Otherwise, consent was obtained from the subject. Then a telephone survey was conducted to determine clinical outcomes. The content of this survey is shown in **Figure 1**.

The Single Assessment Numeric Evaluation (SANE) score was determined by asking the following question: on a scale of 0 to 100, with 100 being normal, how would you currently rate your injured shoulder? The Rowe score also was calculated for each patient.<sup>22</sup>

Once data were collected and recorded, analysis was performed by

the Biostatistics, Epidemiology, and Research Design (BERD) unit at our institution. Baseline demographics and clinical outcomes were described using means and standard deviations for continuous variables, and frequencies and percentages for categorical variables.

RESULTS

A total of 27 patients with arthroscopic shoulder stabilization procedures were identified. Five of the identified patients had primary posterior instability and were excluded. The remaining 22 patients were confirmed by chart review and imaging to have primary anterior instability. All patients were treated with an arthroscopic anterior stabilization procedure. A minimum follow-up was 18 months for all patients. The mean length of follow-up was 63 (range 20-116) months.

Of the remaining 22 subjects, eleven (50%) telephone surveys were completed. These included three

**Figure 1:** Telephone survey depicts questions asked to determine postoperative outcomes of study patients, including Single Assessment Numeric Evaluation (SANE) and Rowe scores.

Telephone Survey Questions:

- 1. Have you sustained an instability episode after your surgery? ☐Yes ☐No
- 2. Have you required a second surgery? ☐Yes ☐No
- 3. Current return to sport status:  
Did you RTS at a competitive level? ☐Yes ☐No  
Did you RTS at the same or better level of performance? ☐Yes ☐No
- 4. On a scale of 0 to 100, with **100 =normal**, how would you currently rate your injured shoulder on a scale of 0 to 100? \_\_\_\_\_
- 5. Function:  
☐ No limitation in work and sports  
☐ No limitation in work, mild limitation in sports  
☐ Mild limitation in work above head and sports  
☐ Marked limitation and pain
- 6. Pain:  
☐ None  
☐ Mild  
☐ Severe
- 7. Stability:  
☐ No recurrence, subluxation or apprehension  
☐ Apprehension when placing arm in certain positions  
☐ Subluxation (not requiring reduction)  
☐ Notion of instability

female and eight male patients, with a mean age at surgery of 14 (range 12-14) years. Injuries occurred in contact sports (football) in nine (81.8%) of the 11 patients, three of whom had recurring episodes while involved in basketball, weightlifting, or competitive cheerleading. The remaining two injuries occurred during softball or running. Six (54.5%) of the patients had experienced recurrent dislocations before stabilization surgery and five had a primary dislocation or subluxation before surgery.

All patients underwent anterior labral repair with suture anchors. Two (18.2%) of 11 patients had a concomitant bony Bankart lesion repaired, and one (9.1%) had a loose body removed at the time of surgery. The two Bankart lesions were repaired using suture anchors passed through the attached labrum. Appropriate reduction was obtained and confirmed after tightening and cutting of the sutures. Hill-Sachs lesions were identified on preoperative imaging and/or intraoperatively in eight (72.7%) of the 11 patients. All 11 patients had an open proximal humeral physis identified on preoperative imaging. One patient was treated with concomitant remplissage procedure at the time of surgery.

Recurrent instability episodes were reported in two (18.2%) patients after arthroscopic repair and both underwent revision repair. Ten (90.9%) were able to RTS at a competitive level and subjectively believed they had returned at the same or better level of performance. The mean Rowe score was 95.45 (SD 7.9; range 80.0-100.0), with nine (81.8%) having an excellent outcome and two (18.2%) having a good outcome. The mean SANE score for the group was 89.55 (SD 7.6; range 75.0-100.0). These results are summarized in **Table 1**.

DISCUSSION

Recurrent instability after arthroscopic stabilization for traumatic shoulder instability has been shown to be higher in younger patients when compared with older

cohorts.<sup>23,24</sup> The current study demonstrated a slightly increased rate of recurrent instability of 18.2% in young adolescents compared with adults, which has been shown to be around 12%.<sup>9,10,25</sup> However, reported rates in postpubertal adolescents or college-aged athletes have ranged from 21% to 51%.<sup>11-15</sup> The studies with higher rates looked specifically at contact athletes, which predisposes to instability due to continued traumatic forces.

The majority of patients (81.8%) included in the current study were involved in contact sports, with nine patients having an instability episode during participation in football. Of the two patients who had a recurrence postoperatively, one was involved in contact sports and the other one was not. The presence of a Hill-Sachs lesion is a documented risk factor for recurrent instability after surgical repair.<sup>16,18</sup> In this study, however, one patient who had recurrence had a Hill-Sachs lesion noted preoperatively (on-track) and the other did not.

To our knowledge, no study has evaluated recurrence specifically in the younger adolescent age group (<14 years of age). Our rate of 18.2% is lower than that reported in older adolescents (<25%11), suggesting that arthroscopic stabilization in this lower age range has similar rates of recurrent instability.<sup>11,14</sup>

It has been documented in the literature that recurrence rates after primary episodes of instability in younger adolescents are lower than older cohorts.<sup>21,26,27</sup> A meta-analysis investigating shoulder instability recurrence rates in adolescents found that older adolescents between the ages of 14 to 18 years had a significantly higher rate of recurrence (93%) when compared with patients younger than 13 (40%).<sup>21</sup> An analysis demonstrated 24 times increased odds of recurrent instability in the older group. This is significant as previous studies investigating recurrence after arthroscopic stabilization included older adolescent patients (15-18 years) or adolescent patients within a larger group that included adults or skeletally mature

**Table 1:** Postoperative outcomes.

Recurrent instability		Required reoperation		Return to sport		Rowe score outcome	
Yes	No	Yes	No	Yes	No	Excellent	Good
2 (18%)	9 (82%)	2 (18%)	9 (82%)	10 (91%)	1 (9%)	9 (82%)	2 (18%)



patients. The current study is unique in that it includes only this group of younger adolescents.

Several reasons have been suggested to explain this difference in recurrence. At a younger age, the glenohumeral joint capsule insertion is more lateral and moves medial with age, leading to a decrease in overall strength, and younger patients tend to have greater joint capsule elasticity, with higher proportions of type III compared with type I collagen.<sup>28</sup> The status of the physis, open or closed, also contributes. Patients with a closed physis are more likely to experience recurrent episodes of instability compared with those with an open physis.<sup>21,27</sup> All patients in our study had an open proximal humeral physis, so both recurrences occurred in patients with an open physis.

Adolescent patients who have traumatic shoulder instability during athletic competition, including contact sports, are typically looking to return to competitive sports at a high school or college level. Measuring the ability to do so through not only RTS rates but also RTS at the prior level of competitiveness are important clinical markers of successful intervention. Reported RTS rates in older adolescents have ranged from 81% to 88% after arthroscopic repair.<sup>18-20</sup> Those returning to the prior level of competitiveness in these studies ranged lower (66-75%). In the present study, 91% of patients were able to RTS at a competitive level and also believed they had returned at the same or higher level of performance. The single patient who did not return switched from football to a noncontact sport after the operation. These results in younger adolescents compare favorably to those reported for older adolescents and suggest that arthroscopic stabilization can provide return to a competitive level of play in most adolescent patients.

The Rowe score is a recognized scoring system for the overall postoperative assessment of Bankart repairs. The SANE score is a simplified means of collecting outcomes data in which the patient answers

a single question of overall satisfaction. The SANE score has been shown to correlate well with the Rowe and the American Shoulder Elbow Surgeons score.<sup>29</sup> SANE scores reported after shoulder stabilization procedures have ranged from 71% to 91%.<sup>13-15,19</sup> The Rowe score is less commonly used, but it has ranged from 85% to 87% in a similar cohort.<sup>9,14</sup> The mean scores reported in our study were 95% for the Rowe score and 89% for SANE score. Thus, in this young cohort of patients (<14 years), arthroscopic stabilization resulted in high-functioning shoulders and patient satisfaction the same or better than that reported in older adolescents and young adults.

The homogeneity of the study population is a strength of this study. We used a specific study population, patients 14 years old or younger with traumatic anterior shoulder instability. This allowed for a truer assessment of outcomes in this specific pediatric age group. Previous studies have included this age range along with older adolescents and young adults, which confounded the results.<sup>11-14</sup>

There are several limitations to consider with this study, including the small study sample size as well as the low response rate. Since adolescent instability is less common in this younger age group, the available study population was low.<sup>30,31</sup> Also, the telephone survey response rate was low at 50%, which often is the case as noted in other adolescent studies because many patients are lost to follow-up once they reach adulthood.<sup>32,33</sup> Further studies with larger sample sizes are needed to prospectively evaluate treatments and outcomes in this patient population in order to validate the findings of this study.

This study highlights that arthroscopic stabilization in appropriately selected pediatric patients under the age of 14 years with traumatic anterior shoulder instability can achieve satisfactory outcomes with low recurrence rates and high RTS rates.

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# 2022 YEAR IN REVIEW

## University of Tennessee Health Science Center - Campbell Clinic Department of Orthopaedic Surgery & Biomedical Engineering

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## SHOULDER AND ELBOW

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Campbell Clinic  
Foundation  
MOVING LIVES

## OUTREACH

The physicians and residents at Campbell Clinic make life better for adults and children in need of orthopaedic care, regardless of their ability to pay.

The International Service Elective was established in 2013 so that an upper-level University of Tennessee Health Science Center-Campbell Clinic Department of Orthopaedic Surgery and Biomedical Engineering resident could deliver orthopaedic care to an underserved area. With support from the Molly Shumate Community Service Scholarship, this two-week mission trip lets a Campbell resident share the latest orthopaedic techniques and treatments while working side-by-side with an international village's health-care teams. Residents have served in Dominican Republic, Guatemala, Honduras, Nicaragua, Tanzania, and Uganda.

In Memphis, the Campbell Clinic Foundation, in partnership with Le Bonheur Children's Hospital, has led a comprehensive, multidisciplinary outpatient clinic focused on children with cerebral palsy. A \$1 million

gift from the Children's Foundation of Memphis helped fund the Center of Excellence for Cerebral Palsy Care and Research, which is the first such facility in the Mid-South. Drs. William Warner and David Spence lead the dedicated therapists and physicians who offer a broad range of services and individualized, all-encompassing treatment plans. Over 400 patients were served in 2022.

"I'm so grateful for Campbell Clinic because it's not one-size-fits-all," said Emily Dilley, a long-time Campbell Clinic CP patient who undergoes physical therapy three times a week. "God is the Great Healer, but He uses places like Campbell Clinic."

Our Hearts to Your Soles, led by Dr. David Richardson each November, offers foot care, socks, and shoes to clients of the Memphis Union Mission. "This program was started by the Conti family in Pittsburgh, and it went national in 2007," said Dr. Richardson, an orthopaedic foot and ankle subspecialist. "We were one of the first sites

### The Center of Excellence for Cerebral Palsy Care and Research

Since its creation in 2018, hundreds of children have benefited from the comprehensive one-stop-care and treatment at the Center. This multidisciplinary approach provides patients and their families the convenience of seeing the experts needed to improve their mobility—all in one location. The Center is the only one of its kind within a 200-mile radius of Memphis.



nationally." That year, about 75 homeless people were served in Memphis—a number that was doubled in 2022. Generous sponsors and employee volunteers help make the event possible.

Each participant has his/her feet washed, then toenails and calluses trimmed and any special issues, such as bunions, are addressed. Sometimes, foot problems that could evolve into bigger issues are spotted and treated. After foot treatment, each person receives two new pairs of socks, a pair of shoes, and a goodie bag filled with cookies, shampoo, toothpaste and toothbrush.

"This event is meaningful to me. I have a bit more time to get to know some wonderful people in my community," Dr. Richardson said, which is not possible when he is working in a busy emergency room.

Those emergency rooms, at Regional One and Methodist University Hospital, are where Campbell Clinic physicians and residents provide trauma care to uninsured and underinsured people. The

intensive, high-volume experience ensures that the residents receive solid trauma training while providing unsurpassed patient care. The Campbell Clinic Foundation funds all outreach programs.

Campbell Clinic's community outreach extends to young athletes who attend 13 area high schools. Each spring, more than 750 such athletes receive annual physical exams administered by the clinic's physicians, residents, fellows, and athletic training staff, usually at the Germantown Road location. The thorough evaluation, performed in accordance with Tennessee Secondary Schools Athletic Association rules, includes height, weight, blood pressure, vision, an internal medicine screening, and orthopaedic assessment.

"This takes away one headache from parents who otherwise would have to schedule an appointment, then take the time to visit with their child's pediatrician," explained Thad Avery, manager of Sports Medicine.

God is the Great Healer,  
but He uses places like  
Campbell Clinic.



### Our Hearts to Your Soles

In November, over 150 individuals received free foot and nail care as part of the annual Our Hearts to Your Soles. For the past 15 years, physicians and employees from the Campbell Clinic and the Campbell Clinic Foundation have served the clients at the Memphis Union Mission. They received foot examinations and nail care along with free boots, socks, and homemade cookies.

Campbell Clinic's own Dr. David Richardson, a foot and ankle specialist, has organized this annual event. Dozens of volunteers, orthopaedic residents and fellows, and medical students provided vital support for this important health initiative.



## MOVING LIVES

**Mobility is the foundation of health.** At the Campbell Clinic Foundation, we train the physicians and facilitate the research that keeps Campbell orthopaedic care on the leading edge and keeps you moving forward. We also work to make sure everyone in our community has access to the same excellent orthopaedic care.

Generous donors and strategic partners play a key role in *moving lives* each and every day—in the Mid-South and around the world. With these allies, we have made a profound impact on orthopaedic education, research and outreach throughout our 75-year history. As a nonprofit, we rely on compassionate individuals and organizations to improve health and well-being.

*In celebration of last year's 75<sup>th</sup> anniversary, the Campbell Clinic Foundation expanded several initiatives in the education, clinical research, and outreach programs:*

### The 75th Anniversary Diamond Campaign

In celebration of the Campbell Clinic Foundation's 75th anniversary, the Diamond Anniversary campaign was created to support the long-term growth and expansion of resident training and clinical research efforts.

Graduates of the University of Tennessee Health Science Center-Campbell Clinic Department of Orthopaedic Surgery and Biomedical Engineering Resi-

dency and Fellowship programs were asked to pledge during our 75th anniversary year. More than \$450,000 was raised!

We are deeply grateful to the generous alumni invested in this initiative to advance education, deliver transformational care, and make patients better.

### The Momentum Society

More than 350 Campbell Clinic and Foundation employees participate in the Momentum Society by making regular donations to the Foundation and supporting efforts to raise awareness and funds for education and outreach programs. Momentum T-shirts, Popsicle days, and jeans days are ways the employees celebrate their membership and build camaraderie. And just knowing they are supporting the work of the Foundation gives them a sense of pride. Having contributed to the Momentum Society since her first day at Campbell Clinic, employee Rachel Rucker Few says the Foundation is "near and dear to my heart!" The Momentum newsletter shares patient success stories, groundbreaking research, and shows our Momentum members how their dollars make a difference.



## Campbell Celebrates...Diamonds are Forever!

Campbell Clinic Foundation's annual gala event raised more than \$210,000 to support the Campbell Clinic Foundation-led Center of Excellence for Cerebral Palsy Research and Care and local community outreach. After a three-year hiatus due to the pandemic, it included an online auction and gala, with

live auction, festive food and libations, entertainment by the Stax Alumni Band, and the company of fellow Campbell Clinic Foundation friends. Many thanks to the sponsors, host committee, volunteers, and donors who made this event a huge success.



**SAVE THE DATE: Campbell Celebrates will take place Friday, September 15, 2023!** Corporate partnerships and host committee opportunities are now available.

To learn more about the event, visit [CampbellCelebrates.org](https://CampbellCelebrates.org).



### Patient Giving

We are deeply grateful to the many generous Campbell Clinic patients who support the Foundation. What may have begun as a trusting relationship with a physician or caregiver led to supporting leading-edge patient care, education, and orthopaedic research. For many, the care they received gave them freedom from pain or freedom to move.

The Campbell Clinic Foundation is a nonprofit 501(c)(3) charitable organization, and contributions are tax-deductible to the extent allowed by law. The Foundation's tax ID number is 62-0548038.

Donors will receive a letter confirming receipt of each gift and the gift amount.

There are many ways individuals can support the Campbell Clinic Foundation, and gifts of all sizes make a difference. You may choose to also make a tribute gift in honor or in memory of someone, and the Foundation will send a card to inform the family of your generous remembrance to the individual or individuals memorialized or honored.

Gifts may be made online, by mail or other means. If you would like to discuss a gift, please contact Jenny Koltnow, Executive Director, at the **Campbell Clinic Foundation at 901.759.3233** or [jkoltnow@campbell-foundation.org](mailto:jkoltnow@campbell-foundation.org).

*On behalf of those trainees, patients and partners who will benefit from your generosity in the future, thank you.*



## The Campbell Clinic Foundation Implements Efforts in

# DIVERSITY, EQUITY, AND INCLUSION

Research has shown that diversity improves productivity, research quality, and, perhaps most importantly, healthcare outcomes. In the field of medicine, orthopaedic surgery has been slower than other specialties to recruit women and underrepresented minorities. Acknowledging the importance of diversity is a first step toward reducing this gap.

To address some of these concerns, the Campbell Clinic Foundation (CCF) formed a Diversity, Equity, and Inclusion (DEI) committee. The committee, which meets quarterly, includes CCF associates, former and current residents and fellows, and Campbell Clinic (CC) attending physicians from a wide variety of backgrounds. Increased diversity will allow the Clinic and the Foundation to continue as strong, resilient, and compassionate organizations.

The committee statement outlines its areas of focus:

The Campbell Clinic Foundation strives to foster a vibrant, dynamic community of orthopaedic surgeons, staff, and partners. We recognize diversity as an important step toward the elimination of healthcare disparities, caring for our community and strengthening our education, research, and outreach programs. We are committed to an affirming, inclusive workplace, and culture.

Several steps have been taken to address DEI in the last year. Improvements in outreach and communication continue within the residency program, attracting more matches with women and members of underrepresented minority groups in both the 2022 and 2023 incoming classes. The UTHSC Office of Inclusion, Equity, and Diversity has delivered annual lectures in our education program. During the 2022 Triennial meeting and Alvin J. Ingram Memorial Lecture, an expert panel discussed DEI, featuring Visiting Faculty Drs. Amy Ladd and Michael Parks, and alumni, Dr. Kaku Barkoh (Class of 2016).

The CCF DEI committee is dedicated to increasing access, inclusion, and representation by raising awareness of its importance and actively engaging with groups dedicated to DEI. Partnerships with Nth Dimensions and J. Robert Gladden Orthopaedic Society, and being intentional in the mentoring and recruitment, fosters relationships and trust.

Nth Dimensions is a national organization founded by Dr. Bonnie Mason, MD, an African American female orthopaedic surgeon who experienced a career-ending medical issue and repurposed her knowledge and expertise to create opportunities for students just like her. The core focus of Nth Dimensions is the summer internship program for first-year medical students.

In 2022, the Foundation hosted Nth Dimension scholar Dr. Kathryn Eaton for an 8-week clinical rotation, which was enhanced by mentorship, coaching, and research. Dr. Eaton earned a Bachelor's degree from the University of Georgia, a Master's degree from Philadelphia College of Medicine in Suwanee, GA and a doctoral degree with work from two institutions, University of Nebraska



Medical Center and University of Arkansas for Medical Sciences (UAMS). She is currently a medical student in the class of 2025 at the College of Medicine at UAMS.

Working with Dr. David Richardson as her clinical preceptor and Dr. Derek Kelly as her research preceptor, Dr. Eaton completed clinical experience structured by shadowing Campbell Clinic attendings in various subspecialties during each of the 8 weeks of the program: Drs. Beaty and Sawyer in pediatrics, Drs. Richardson and Bettin in foot and ankle, Drs. Mihalko and Guyton in adult joint reconstruction, and Drs. Azar and Brown in sports medicine. Her research with Dr. Kelly focused on a case series and literature review that researched the presence of accessory musculature that may contribute to the recurrence of congenital clubfoot after initial healing through Ponseti casting.

Although there were “too many positive experiences to choose a favorite,” Dr. Eaton explained, she shared one remarkable clinical experience during her time at with the Foundation and Campbell Clinic.

*I was working with Dr. Beaty with a long-term patient of his with osteogenesis imperfecta cystica. The patient was so inspiring to me; their joy was infectious and positive, even though they were experiencing such difficult circumstances. I was very encouraged by observing Dr. Beaty's phenomenal patient care and interaction with the patient and family members throughout the office visit. Overall, I gained a sense of the true character of*

*Campbell Clinic and a deeper understanding of the expertise and talent that must be integrated with compassion and humility to serve as an orthopaedic surgeon.*

Dr. Eaton is grateful to each of the physicians who taught her various surgical techniques, more about surgical anatomy and approaches, and allowed her to have such an immersive experience. She gained confidence to know that she can be part of the orthopaedic surgery field, and she knows that she has the needed support and guidance to be successful.

Dr. Eaton hopes to be accepted into an orthopaedic surgery residency program that will support her growth and development. While she is undecided about a subspecialty, her overall goal is to work in a diverse community to provide guidance and care to patients in their healing and rehabilitation processes. In the long-term, she and her husband, a physical therapist, aim to open a clinic that will provide orthopaedic and physical therapy services. She also plans to serve as a mentor to students from underrepresented backgrounds who are interested in medical careers.

Exciting new initiatives will be forthcoming from the CCF DEI committee, including a high school BioSkills workshop and local educational outreach programs to generate interest in orthopaedics from a diverse student population. In the words of Clinical Research Coordinator and DEI committee member Larry Baker, “We are on a journey - to create better systems and programs to solve the complex problems in an ever-changing diverse world.”







## Letter from the President of the Alumni Board



**Dear Campbell Alumni,**

Thank you for your continued support of the Campbell Clinic Foundation. I must extend a very special thanks to all who participated in the 75th Anniversary “Diamond Campaign.” Your donations create new opportunities for surgeon training and orthopaedic research. Sustaining the Campbell legacy of excellence—and expanding surgeon education, orthopaedic research, and community healthcare— benefits all of us as alumni.

Likewise, *it takes all of us* to be sustained and successful.

The 25th Campbell Club Triennial and 2022 Alvin J. Ingram Lecture were huge successes by every measure. Combining the two functions increased the value and experience of both. Attendance, feedback, and engagement demonstrated that April is the best time to host an event that offers educational value while catching up with fellow alumni, connecting with current residents and fellows, and reacquainting ourselves with Memphis. Plus, I hear it’s also a good time to recruit our successors! A definite win-win-win in my book.

I am excited to announce that the **26th Triennial will be April 4-6, 2024**. Once again, we will offer CMEs by combining it with the Ingram Lecture, and the Peabody Hotel will serve as our “home.” This upcoming year is significant: This will be the 100th anniversary of the Campbell residency program! Please block your calendar and make plans to be in Memphis for the party of the century.

The Campbell Club Alumni Board is focused on expanding resources for our alumni in return for your generosity and to support your continued development as a surgeon and leader. These ideas came from YOU, the alumni, and we welcome your input on what more could be done and how to improve upon these offerings:

- In this issue of the *COJ*, the article “Outcomes of Arthroscopic Stabilization for Anterior Shoulder Instability in Patients Younger than 14 Years of Age” offers **.5 CME credit**. Please read the article on page 78, fill out the survey, and follow the directions to receive your credit. Stay tuned for additional platforms to deliver CME content.
- The Foundation staff has developed a new online, password-protected **Campbell Alumni Directory** to facilitate networking, mentoring, and camaraderie among alumni. To be useful, we need everyone to complete the form. Please add your information to the directory, then enjoy connecting with those who trained at Campbell before and after you. This is also an easy way to update your contact information, employment status, and more. Be sure to include a current photo.

- When COVID hit, **Monday Night Meetings** went virtual. Meetings are now “hybrid” so participants may attend in-person or via computer. Technology allows us to invite experts and long-distance guest faculty to teach and interface with our residents. We are exploring how best to offer alumni opportunities to virtually “attend” residency-training programs.

We are always looking for new ideas and methods to assist Campbell alumni. If you are in or near the Memphis area, please contact the Foundation team to arrange a tour of the new facilities, meet up with former colleagues and friends, and peruse the Alumni Wall, featuring photos of all alumni since the days of Dr. Campbell.

Throughout the year, the Campbell Clinic Foundation will arrange gatherings at various sub-specialty meetings, including Pediatric Orthopaedic Society of North America, America Orthopaedic Foot & Ankle Society, and Orthopaedic Trauma Association. This is in addition to our annual gathering at the American Academy of Orthopaedic Surgeons Meeting each spring.

On a personal note, the pandemic and my entering the “third trimester” of my life have shown me—and I am sure many of you—the importance of relationships. Our time is limited. Please consider taking time out of your busy schedules to attend the 2024 Triennial, participate in future subspecialty gatherings, and reach out to catch up with your Campbell family.

Thanks again for your time and continued support.

Respectfully,

**Christopher (Chris) Ihle, MD, Class of 1985**  
Campbell Club & Alumni Foundation President



**Campbell Clinic  
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## ALVIN J. INGRAM MEMORIAL LECTURE

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