



Atrium Health
Musculoskeletal Institute

2021

Highlights Report

OrthoCarolina

CAROLINA
NeuroSurgery & Spine
ASSOCIATES

President's Letter



Claude T. Moorman, III, MD

I couldn't be more proud of how the team at Atrium Health Musculoskeletal Institute has continued adapting to the uncertainties of COVID-19 while maintaining our laser focus on becoming the nation's pre-eminent provider of musculoskeletal care.

This combination of resilience and commitment has enabled us to continue our progress as we build on our innovative integrated care model. We bring together more than 200 renowned physicians across 3 world-class organizations – Atrium Health, Carolina NeuroSurgery & Spine Associates and OrthoCarolina – in a unique collaboration that enables patients to get care that is fast, high-quality, comprehensive and multidisciplinary. I'm pleased to bring you updates in our 3 core areas.

Clinical Care:

We're proud to play a pivotal role in providing care that led U.S. News & World Report to name Atrium Health Carolinas Medical Center a top-performing hospital for orthopaedics. We also continued recording high patient satisfaction scores and registering outcomes that match the nation's other top musculoskeletal centers.

Our other noteworthy 2021 clinical achievements include recruiting national leaders like Peter Waters, MD, and Timothy Sell, PhD. Dr. Waters is a world-renowned hand surgeon who was previously the orthopaedic surgeon-in-chief at Boston Children's Hospital. Dr. Sell is a renowned biomechanist who

comes to us from Duke University. He now directs Atrium Health Musculoskeletal Institute's Performance Center and has helped establish a large and innovative basic science research program.

We have also begun clinical integration with our colleagues at Atrium Health Wake Forest Baptist, Atrium Health Navicent and Atrium Health Floyd. Our collaboration across these entities will enable us to build a musculoskeletal service line that is aligned on best practices and continues our tradition of excellence.

Education:

Our orthopaedic surgery and neurosurgery residency programs remain among the nation's most sought-after training programs. This past year, we graduated 6 chief residents and 20 fellows from Atrium Health and OrthoCarolina. We also graduated the first resident from the Atrium Health Carolinas Medical Center and Carolina NeuroSurgery & Spine Associates neurosurgical residency. Our residents continue to make us proud by earning many regional and national awards.

Research:

Investigators across Atrium Health Musculoskeletal Institute, Carolina NeuroSurgery & Spine Associates and OrthoCarolina published 169 peer-reviewed manuscripts and made more than 90 presentations at international, national and regional conferences.

The OrthoCarolina Research Institute presented Oscar Miller Day, a continuing medical education event. This year's topic was "Can't-Miss Orthopaedic Injuries in Children and Adolescents," and Dr. Waters was an honored guest speaker. At the event, we unveiled a wonderful portrait of Oscar Miller that will be an important contribution to the Atrium Health Musculoskeletal Institute wall of fame.

Our overall progress validates our vision of using a multidisciplinary approach to provide the nation's most comprehensive musculoskeletal care, while using research to set a new standard nationwide. We are eager for you to learn more about this progress in the pages ahead.

Claude T. Moorman, III, MD
President, Atrium Health Musculoskeletal Institute



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2021 by the Numbers

Atrium Health Musculoskeletal Institute, Carolina NeuroSurgery & Spine Associates and OrthoCarolina

94

Presentations
at scientific
meetings

169

Peer-
reviewed
publications

Orthopaedic Surgery Residency Program

26

Residents
in the
program

31

Peer-
reviewed
publications
authored by
residents

25

Conference
presentations
by residents

1

Grants
received by
residents

Neurological Surgery Residency Program

7

Residents
in the
program

14

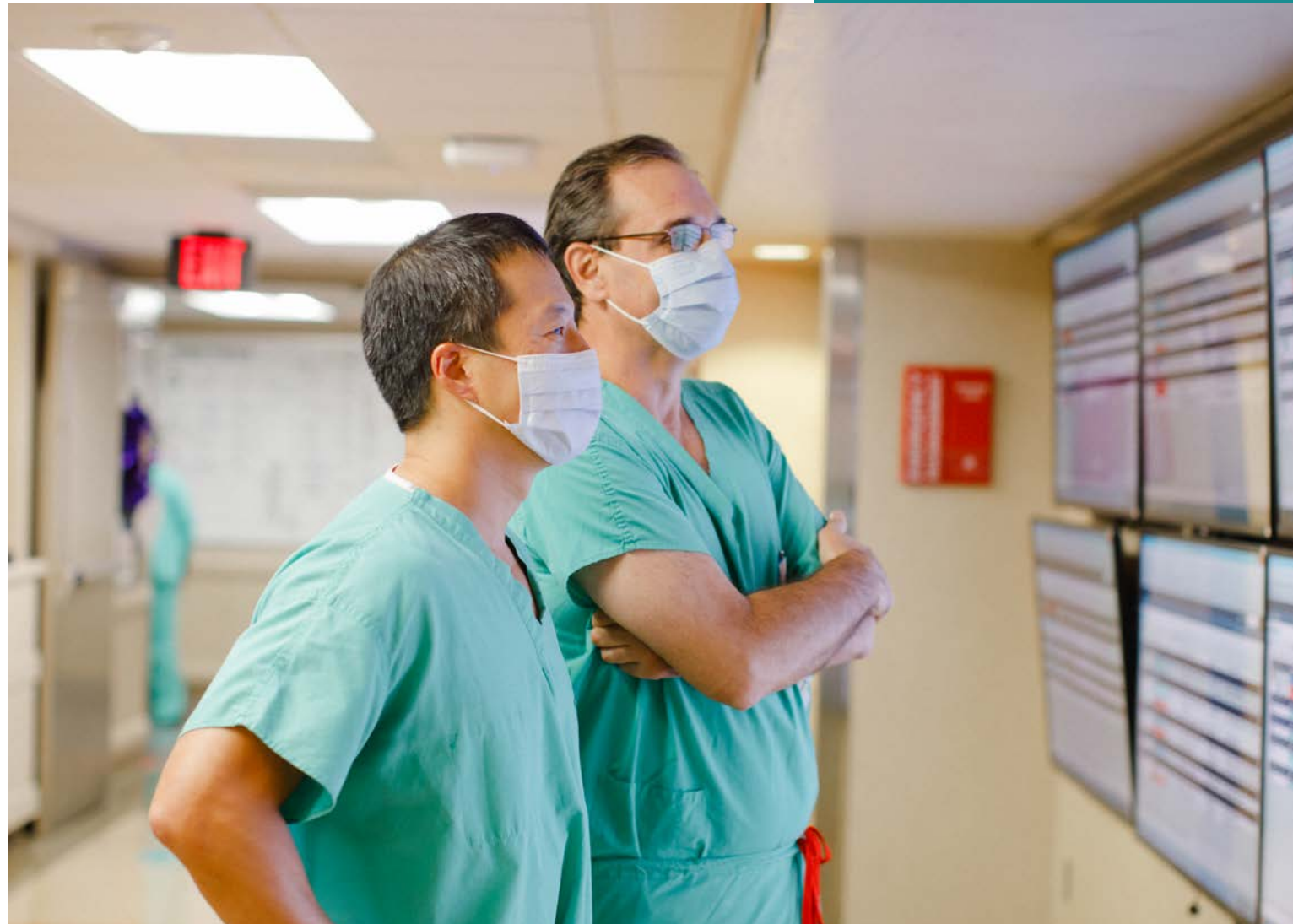
Peer-
reviewed
publications
authored by
residents

3

Book
chapters
authored by
residents

12

Conference
presentations
by residents



New Hires

Atrium Health Musculoskeletal Institute



Matthew Duffin, MD

Total joint physician at Atrium Health Musculoskeletal Institute Orthopedics & Sports Medicine locations in Rock Hill, Pineville and Fort Mill



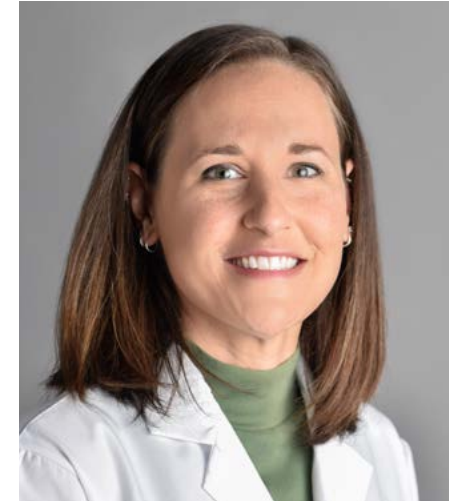
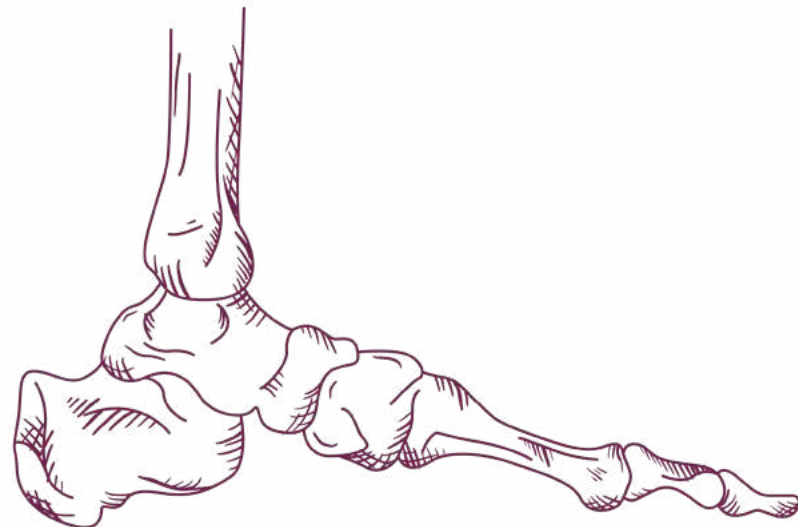
Eric Kropf, MD

Sports medicine surgeon at Atrium Health Musculoskeletal Institute Orthopedics & Sports Medicine locations in Indian Trail and Rea Village



Peter Waters, MD

Faculty addition working throughout teaching programs, Atrium Health Levine Children's Hospital, Atrium Health Wake Forest Baptist and OrthoCarolina



Victoria Burfeind, PA

Providing care at Atrium Health Cabarrus



Daniel Jacobs, PA

Providing care at Atrium Health Myers Park Orthopedics



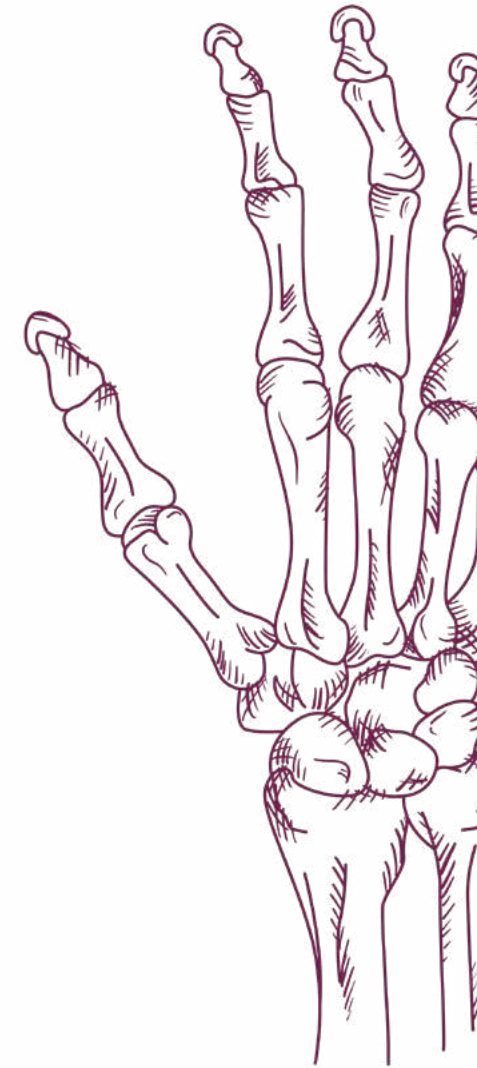
Sammy Mitchell, PA

Providing care at Atrium Health Musculoskeletal Institute Orthopedics & Sports Medicine in Pineville



Robert Ramsey, PA

Providing foot and ankle care at Atrium Health Piedmont Orthopedic Specialists locations in Concord and Poplar Tent



OrthoCarolina



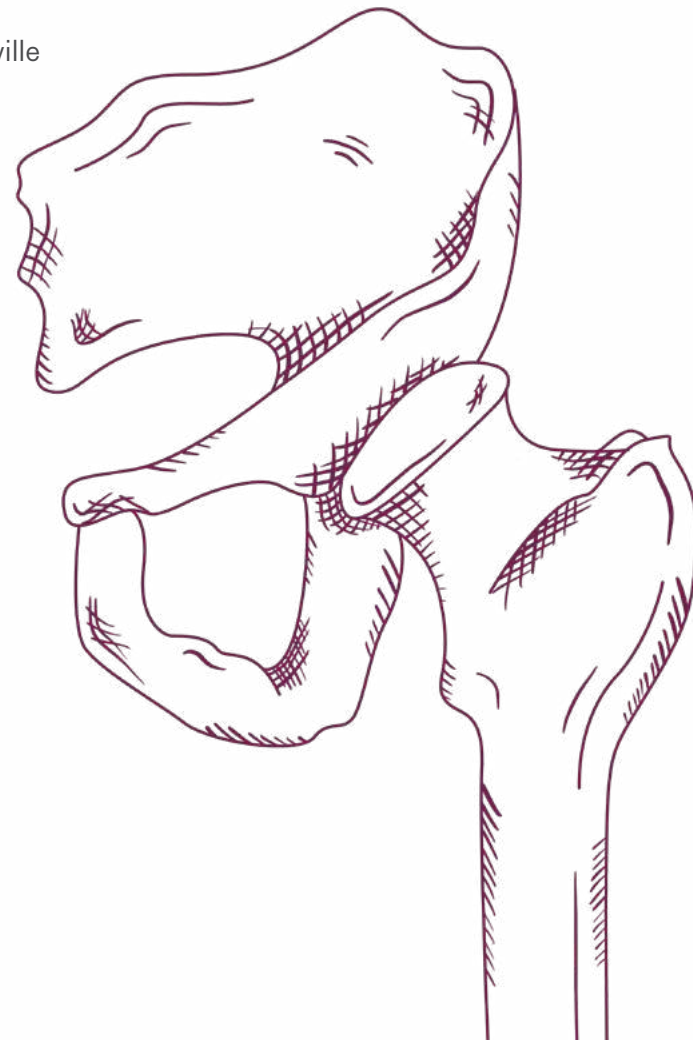
Edward Walker Gallego, MD
Sports Medicine in Lincolnton



Gregory Kurkis, MD
Hip and Knee in Huntersville



Matthew Robinson, MD
Hip and Knee in Monroe



Carolina NeuroSurgery & Spine Associates



Benjamin Boudreaux, MD
Neurosurgery in Gastonia



Troy Dawley, DO
Neurosurgery in Greensboro



Dave Eichman, MD
Anesthesiology in Greensboro



Jonathan Thomas, MD
Neurosurgical Oncology in
Greensboro



Joseph Zuhosky, MD
Physiatry in Lake Norman



Stephanie Plummer, DO
Physiatry in Gastonia

FEATURE ARTICLE:

How New Partnerships Expand Atrium Health Musculoskeletal Institute's Impact



Atrium Health has joined together with 3 regional health systems in the past 3 years: Floyd (now Atrium Health Floyd), Navicent Health (now Atrium Health Navicent) and Wake Forest Baptist Health (now Atrium Health Wake Forest Baptist), including Wake Forest School of Medicine. These strategic combinations expand the Atrium Health umbrella across the Carolinas, Georgia and Alabama, and enable every entity – including Atrium Health Musculoskeletal Institute – to bring state-of-the-art care to larger populations, enhance access and equity, expand training and education, and accelerate research.

“When I was recruited here in 2018, it was an opportunity to lead a significant program in an established health system and help it grow into national prominence, so it could deliver innovative care to more people and influence treatment on a large scale,” says Atrium Health Musculoskeletal Institute President Claude T. Moorman, III, MD. “These agreements bring us closer to achieving that vision and we’re becoming increasingly linked across Atrium Health.”

Here are the latest examples of how the combined organizations are becoming integrated and elevating musculoskeletal research, education and care:

Accelerating translational research: Timothy Sell, PhD, research professor and director of Atrium Health Musculoskeletal Institute’s Performance Center, and his Atrium Health colleagues have built one of the nation’s largest and most innovative basic science programs. Combining that with the research program at Wake Forest School of Medicine led by Greg Burke, MD, MSc, allows our teams to collaborate and accelerate bench-to-bedside translation. “We’re even more able to take new findings and put them in play right away,” Dr. Moorman says.



Expanding academic training and education: Atrium Health Musculoskeletal Institute is home to some of the nation’s most sought-after residency and fellowship programs. By joining our efforts with Wake Forest School of Medicine, the new academic core of Atrium Health, we can collectively offer even more robust training and education programs. These will have a multiplier effect that improves musculoskeletal care nationwide, and our work will take another leap forward when the new Wake Forest School of Medicine campus in Charlotte opens in 2024.

Improving and expanding Level 1 trauma care: The Level 1 trauma center at Atrium Health Carolinas Medical Center is a national leader, and Atrium Health Wake Forest Baptist and Atrium Health Navicent both also have strong Level 1 trauma centers and expertise in Level 1 musculoskeletal trauma care. We are steadily integrating our trauma teams and hold a weekly conference that brings together physicians from Atrium Health Navicent, Atrium Health Wake Forest Baptist and Atrium Health Musculoskeletal Institute. This enables us to trade ideas on individual cases and identify opportunities to improve care.

Building a world-leading congenital hand program: Atrium Health Musculoskeletal Institute, Atrium Health Wake Forest Baptist and OrthoCarolina worked together to recruit Peter Waters, MD, a world-renowned surgeon who was previously the orthopaedic surgeon-in-chief at Boston Children’s Hospital. His arrival will enable us to elevate our brachial plexus and congenital hand care, making Atrium Health Musculoskeletal Institute a destination for more patients worldwide.

Expanding the nation’s largest school partnership program: Atrium Health partners with 64 secondary schools to offer comprehensive care to more than 32,000 student-athletes each year. By merging this with similar programs at Atrium Health Navicent and Atrium Health Wake Forest Baptist, we now have a team of more than 150 athletic trainers who are helping student-athletes. Many of our partner schools are home to underserved populations, and trainers are often the only healthcare provider that their student-athletes see. This care opens the door to helping those patients connect with providers who can assist with their broader medical and mental health needs.

Our progress has been facilitated by the close relationships our teams have built over many years of working and collaborating in the same region. Our physicians and leaders regularly travel between sites and host each other for lectures, discussions and grand rounds presentations.

“[Atrium Health Wake Forest Baptist Chair of Orthopaedics] Andy Koman and I have known each other for more than 30 years and have built a relationship based on mutual admiration and respect,” Dr. Moorman says. “Relationships like that make it much easier to align our collective care.”

These relationships will continue to be pivotal as we work to increase integration in 2022.

“This year, our priorities are to continue forging stellar relationships with the independent physician groups that we partner with,” Dr. Moorman says, “and implementing best practices across groups such as ambulatory surgery, outpatient and physical therapy, so we can be sure patients throughout our region access a full continuum of care that’s aligned across institutions.”

Research Report

A Letter From Our Vice Chair



Rachel Seymour,
PhD

Key Research Advances Over the Past Year

Atrium Health Musculoskeletal Institute, Carolina NeuroSurgery & Spine Associates and OrthoCarolina continued a strong partnership this past year. As Atrium Health expanded in 2021 throughout the Southeast by integrating with Navicent Health (now Atrium Health Navicent), Wake Forest Baptist Health (now Atrium Health Wake Forest Baptist) and Floyd (now Atrium Health Floyd), so has our research infrastructure and initiatives.

This year, we made significant progress by continuing to leverage the tremendous opportunity of having leaders and learners collaborate across our organizations. Investigators across Atrium Health Musculoskeletal

Institute, Carolina NeuroSurgery & Spine Associates and OrthoCarolina were excited to publish 169 peer-reviewed manuscripts this year, and approximately 42% included at least one learner. Although many of this past year's scientific meetings continued to be conducted virtually, our teams were able to have 94 presentations at international, national and regional conferences.

Throughout the year, our team:

- **Expanded our “tiered-team research” collaborative model:** This model involves investigators, research staff and trainees to maximize academic productivity. Our teams focused on nonunion, infection, pelvic fractures, calcaneus fractures, falls prevention and COVID-19 response. In 2021, the COVID-19 response tiered team published

2 manuscripts. Also of note, the tiered-team work resulted in 2 podium presentations at the American Academy of Orthopaedic Surgeons meeting, 3 posters at the Orthopaedic Trauma Association meeting and 5 podium presentations at the North Carolina Orthopaedic Association meeting.

- **Made great strides in scaling high-impact clinical research topic areas of limb lengthening and deformity—and periprosthetic joint infection—throughout our system:** Notably, we made significant progress on a registry of 20 years of periprosthetic joint infection care.
- **Launched collaborative translational research programs in spine, infection and sports medicine:** These programs unite investigators from Atrium Health Musculoskeletal Institute, OrthoCarolina, the Wake Forest Institute for Regenerative Medicine and the Wake Forest School of Medicine Department of Orthopaedic Surgery. Our teams have developed novel animal models to study the impact of interventions on patients following osseointegration and periprosthetic joint infection. These models allow for rapid translation of research into practice.

Looking forward, we see that our expanding research infrastructure provides the foundation and leadership to answer the critical questions that will transform care for patients in our region and beyond.

Rachel Seymour, PhD

Vice Chair of Research and Professor,
Department of Orthopaedic Surgery, Atrium Health
Musculoskeletal Institute

Associate Dean For Research,
Wake Forest School of Medicine





Rachel Seymour, PhD, and Joseph Hsu, MD, Named Associate Deans For Research

In 2021, Atrium Health Musculoskeletal Institute’s Dr. Hsu and Dr. Seymour were announced as associate deans of research for the Wake Forest School of Medicine. In these positions, they will work closely with the team of research leaders to provide strategic and operational leadership for ongoing efforts to grow research now that Atrium Health and Atrium Health Wake Forest Baptist are unified as part of the same organization.

With an increasingly large footprint across the Southeast region, Atrium Health has the ability to scale research studies beyond the traditional academic hospital and offer clinical trials to highly diverse populations. To harness this research opportunity, the

Wake Forest School of Medicine research department aims to double external funding over the next 10 years. A key focus area will be health equity and reducing health disparities across settings of care and patient demographics.

Department of Defense Grant: Preventing Deep Surgical Site Infection

Atrium Health Musculoskeletal Institute received a \$2.25 million grant from the Department of Defense to research an innovative technique to prevent deep surgical site infection in orthopaedic trauma patients. Atrium Health will be the lead clinical research site, and Atrium Health Wake Forest Baptist, Atrium Health Cabarrus and Atrium Health Navicent will also be participating. This strategic combination enables enrollment of participants across the Southeast.

Nationwide, deep surgical site infection rates are about 20%, and this research will address the critical need to prevent infections not only for civilian trauma patients, but also for military patients. In these studies, patients with severe long bone fractures will receive an antibiotic-coated nail during initial hospitalization to research the effectiveness of this technique in preventing infection before it starts.



Orthopaedic Investigators Receive Grant Awards

Other noteworthy grants include:

Reducing opioids in pain management:

OrthoCarolina Research Institute was awarded a \$1 million, 3-year grant from the Duke Endowment for a study titled “CORE 2.0,” which will expand upon the results of the initial Carolinas Opioid Reduction Effort (CORE) study. The initial study demonstrated that opioid-reducing pain management following orthopaedic surgery is feasible, safe and effective, while dramatically reducing the use of opioids both in the hospital and upon discharge.

CORE 2.0 aims to build and disseminate a clinical decision support platform in the electronic health record to facilitate widespread implementation of this novel clinical pathway. The project will also include a marketing and educational campaign to inform patients, clinicians and the community about opioids and alternatives to opioids for pain management. The principal investigators include Nady Hamid, MD (OrthoCarolina), Meghan Wally, PhD (Atrium Health Musculoskeletal Institute), and Daniel Leas, MD (Carolina NeuroSurgery & Spine Associates).

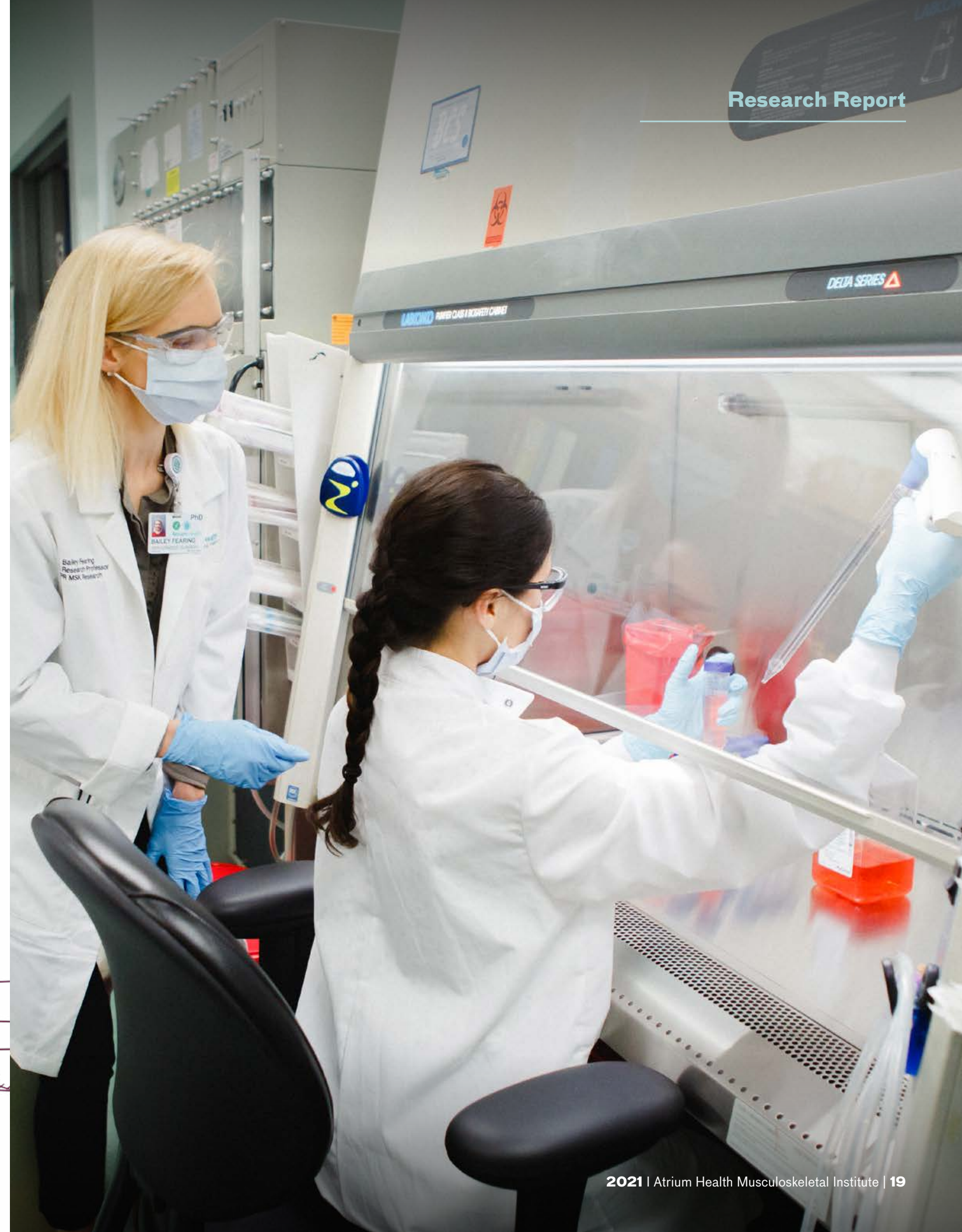
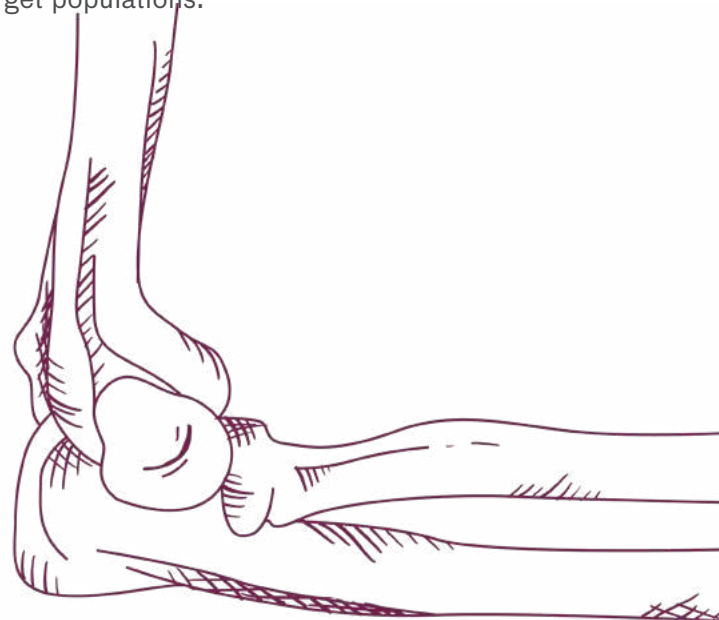
Pursuing a deeper understanding of anterior cruciate ligament reconstruction:

Jonathan Riboh, MD, an associate professor of orthopaedic surgery at Atrium Health Musculoskeletal Institute and sports medicine surgeon at OrthoCarolina, was awarded a \$25,000 Playmaker Grant from the American Orthopaedic Society for Sports Medicine (AOSSM). The study aims to utilize synovial tissue from patients undergoing ACL reconstruction to better understand the role of the inflammatory and immune systems in joint health after knee ligament injury and surgery.

Using cutting-edge molecular techniques, such as single-cell RNA sequencing and time-of-flight cytometry, Dr. Riboh and his colleagues, Atrium Health Musculoskeletal Institute’s Bailey Fearing, PhD, and Dr. Seymour, will lead the way in translational sports medicine research.

Building the nation’s largest spine registry:

Carolina NeuroSurgery & Spine Associates is a leading partner in the American Spine Registry (ASR), the largest spine surgery registry in the U.S. The goal of participating in the registry is to collect quality data to improve outcomes for our patients, but Carolina NeuroSurgery & Spine Associates is also using registry data to power research that will transform patient care beyond our doors. By leveraging ASR data, our spine team is answering critical questions that will shape the future of care in regards to surgeon decision making, avoiding complications, improving the quality of care, and comparing the effectiveness of different treatments for target populations.



A Letter From Our Vice Chair

Fueling New Quality Improvements and Operational Excellence



Joseph Hsu, MD

Atrium Health Musculoskeletal Institute, Carolina NeuroSurgery & Spine Associates and OrthoCarolina understand that every patient deserves care that helps them get back to normal life as quickly as possible and minimizes complications and readmissions. That's why we built one of the nation's most robust quality improvement programs.

We've also continued our strong commitment to operational excellence as Atrium Health has expanded in 2021 by integrating Floyd (now Atrium Health Floyd), Navicent Health (now Atrium Health Navicent) and Wake Forest Baptist Health (now Atrium Health Wake Forest Baptist). These strategic combinations leverage the expertise of our partners and enable us to provide accessible, state-of-the-art care to more of our patients at their medical home.

In 2021, our quality and operations improvement efforts included:

- **An interactive, detailed readmission registry:** This captures nuanced, detailed data that helps us understand what causes readmissions. In 2021, we improved this registry by making data interactive and available in real time to surgeons and our registry team. This improves the quality of the data, informs surgeons of potential innovation opportunities and has contributed to a year-over-year decline in our readmission rates, which were already well below the national average.
- **Diligent dashboard reporting:** By regularly providing specific, actionable dashboards to providers, we're leveraging data to impact patient outcomes more



than ever. For example, our dashboard that tracks opioid prescriptions and compliance with appropriate guidelines has been particularly successful in reducing variance in care and ensuring appropriate dosage and duration.

- **A dedicated pathway for musculoskeletal infection:** This new pathway optimizes collaboration between our infectious disease specialists to decrease variance in care, shorten length of stay, and help patients quickly transition to either outpatient IV therapy or oral antimicrobial therapy to ensure the best possible outcomes.
- **Expanded concierge pathways:** These pathways support patients who want to travel to Atrium Health Musculoskeletal Institute facilities with Global Health Care services at Atrium Health. We provide concierge services to regional, national and international patients, including NFL retirees. We also partner with commercial insurance groups to bring patients here for optimized surgeries.

- **Integrated outpatient physical therapy with Atrium Health Musculoskeletal Institute:** Outpatient physical therapy is now integrated with surgical and nonsurgical musculoskeletal care across Atrium Health to provide a more seamless transition for patients to access highly specialized care.

We are extraordinarily excited about our quality improvement and operational excellence initiatives that continued to enhance patient care in 2021. Looking forward, we see that this successful foundation and our strategic partnerships will enable Atrium Health Musculoskeletal Institute to make an even greater impact across the Southeast.

Joseph Hsu, MD

Vice Chair of Quality
Atrium Health Musculoskeletal Institute

Associate Dean For Research,
Wake Forest School of Medicine

Bone Fracture Care Is Becoming More Proactive Across the Southeast

When it comes to proactive bone health care and fracture prevention, Atrium Health Wake Forest Baptist's fracture liaison service is one of the model programs in the US. Years ago, leaders at Atrium Health Wake Forest Baptist (then Wake Forest Baptist Health) mentored Atrium Health Musculoskeletal Institute on fracture prevention care for elderly patients. In 2021, the Atrium Health Musculoskeletal Institute team and Atrium Health Wake Forest Baptist began working side-by-side again through our new strategic combination.

Now, the fracture liaison service offered at Atrium Health Wake Forest Baptist is expanding throughout Atrium Health, with this service currently available at many Atrium Health facilities, including Atrium Health Cabarrus. This service will also expand to Atrium Health Navicent.

The service provides comprehensive care for primary and secondary fracture prevention, including appropriate diagnostic workup, medical management, exercise management and nutrition. The program has received recognition from the National Osteoporosis Foundation as leading the nation in fall and fracture prevention.

"In traditional musculoskeletal care, treatment has really been reactionary," Dr. Hsu says. "This is an innovative model that helps proactively reduce the frequency and severity of injurious falls. Our goal is to remove any barriers for patients to receive this preventive care. That's why we aim to scale our model to all of our major centers, as well as traditionally underserved rural areas, so elderly patients across the Southeast can access this care at their medical home."



Awarded for Improving Bone Health Following Fractures

Atrium Health is proud to be home to 2 institutions/facilities that recently received an Own the Bone designation by the American Orthopaedic Association for their commitment to improving patient bone health after a fracture. These Atrium Health programs, including Atrium Health Carolinas Medical Center Orthopaedics and Atrium Health Wake Forest Baptist Medical Center Orthopaedics, are among a select group of just 75 national programs to receive this designation.

"This recognition honors the work that teammates have been doing to keep elderly patients safe and demonstrates Atrium Health Musculoskeletal Institute's commitment to caring for those who are at high risk for fractures before they need the care of a surgeon," says Luke Harmer, MD, an Atrium Health Musculoskeletal Institute orthopaedic surgeon.

Leading the US in Advanced Certification for Spine Surgery

Atrium Health Carolinas Medical Center, in partnership with Carolina NeuroSurgery & Spine Associates, became the first in North Carolina to receive the new Joint Commission Advanced Certification for Spine Surgery. The advanced certification program evaluates healthcare organizations on communication and collaboration through the entire patient continuum – from pre-surgical consultation with their spine surgeon all the way to discharge planning and post-hospitalization.

To complete the certification and site review, clinical teams across Atrium Health Carolinas Medical Center came together in a continued commitment to multidisciplinary collaboration and standardization. These teams included nursing, perioperative services, therapy and many others. Our collective group highlighted our clinical program to the Joint Commission, reviewing how we offer the most complete spine care throughout the patient journey, and ensure the best possible outcomes and patient experience.

These differentiators include:

- **Pre-operative:** Offering online pre-operative education classes for spine surgery patients and their caregivers. The goal is to better prepare patients for surgery—so they have a better patient experience and are more likely to have better post-surgical outcomes, with a goal of reducing unplanned readmission and infection rates.
- **Perioperative:** Implementing standardized processes to streamline communication and ensure a seamless transition of the patient throughout their stay, from pre-op to operating room to post-op nursing unit.
- **Discharge:** Focusing on our pre-operative discharge planning – including how we can initiate communication between teams before the patient comes to the hospital for surgery, providing an opportunity for continuity of care to improve the patient experience and reduce readmission rates.



Advanced Certification in Spine Surgery

A Letter From Our Vice Chair

Using Virtual Platforms to Enhance Education and Collaboration



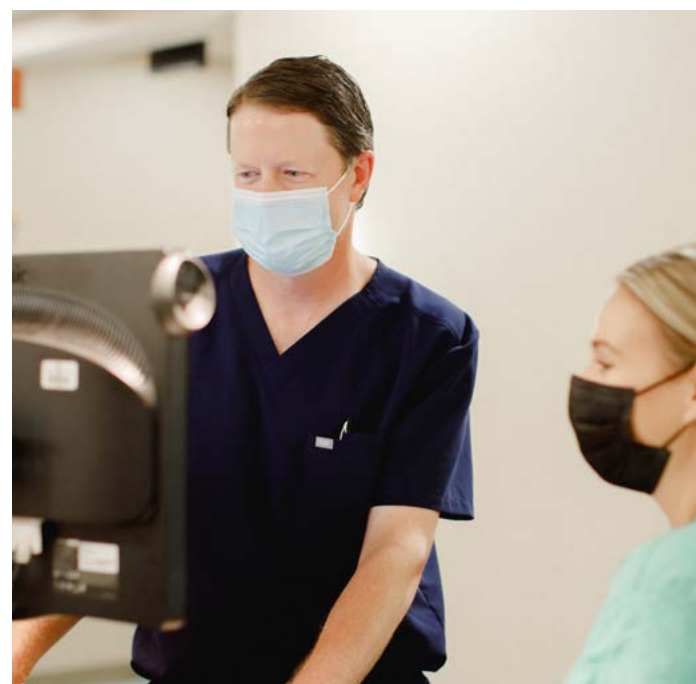
Joshua C. Patt,
MD, MPH, FAOA

The resilience shown by the cohort of residents and fellows trained during the last 2 years has been truly amazing. They will each certainly have a unique collection of memories from this time. In a profession where 75% of what we do can be considered elective, the number of canceled or postponed procedures that this group has experienced during their training due to COVID-19 surges is nothing short of shocking.

Despite these obstacles, the residents, fellows and teaching faculty have continued to amaze us all with their innovation and creativity. We are incredibly proud of the team we have here at Atrium Health Musculoskeletal Institute and can't say enough about the sacrifices and grit they continue to demonstrate to provide the best care for our region while learning their craft.

In June, we graduated 6 incredible chief residents and 20 fellows from Atrium Health and OrthoCarolina. As part of the cycle of education, July and August saw the onboarding of 5 new orthopaedic residents and 20 fellows from Atrium Health and OrthoCarolina. The end of the academic year also saw our Atrium Health Carolinas Medical Center and Carolina NeuroSurgery & Spine Associates neurosurgical residency graduate its first resident.

From an educational perspective, we have been intentional in our desire to create a diverse and inclusive environment. Fully 35% of our current residency cohort are female and 15% are Black, compared to national rates of practicing orthopaedic surgeons of 6% and 3%, respectively.



In 2020 we were forced to rapidly adapt to a virtual world by necessity. While 2021 has seen a modest return to the "old ways," we've applied what we learned to evolve the way we approach education. At graduation each year, we have an essay contest for the residents to allow them to exercise non-medical parts of their brains. We asked them to look back at the lessons learned and changes made in response to the pandemic and identify elements that should be adopted into our daily routines to accelerate the evolution of our educational process.

The most commonly identified positive changes centered around virtual access to our weekly educational programming. Morning didactics have remained entirely virtual, allowing broader audiences from faculty, fellows and residents. Most significantly, enabling residents to tune in virtually from their various sites of care allows a more efficient and seamless transition from didactics to clinical care, and reduces travel and missed operating room time.

Also, the Thursday morning grand rounds meeting, co-hosted by Atrium Health Musculoskeletal Institute, Carolina NeuroSurgery & Spine Associates and OrthoCarolina, has transitioned from fully virtual to a hybrid model. This allows most of the residents and some faculty to be there in person and benefit from the experience of presenting from the podium. Meanwhile, virtual access allows for widespread viewing and participation. Pre-pandemic, in-person audiences averaged 50 to 60 people. We now routinely have over 100 participants.

Digital education platforms have also allowed us to create a rich array of recorded lectures for on-demand learning. All morning didactic lectures are recorded on Microsoft Teams and accessible by residents. Grand rounds talks have been recorded and over 50 talks have been uploaded to YouTube.

It is always special to host luminaries of our profession to serve as visiting professors for grand rounds. 2021

saw a return to in-person visits, helping connect our learners with future colleagues and mentors. The first half of the year, we hosted Karen Sutton, MD, from the Hospital for Special Surgery, Andrew Koman, MD, from Atrium Health Wake Forest Baptist, as well as Bert Mandelbaum, MD, from Cedars-Sinai, who served as our graduation honored visiting professor. The second half of the 2021 academic year saw visits from Chip Routt, MD, of the University of Houston, Cynthia Emory, MD, MBA, of Atrium Health Wake Forest Baptist, Matt Schmitz, MD, of San Antonio Military Medical Center, and Antonia Chen, MD, of Brigham and Women's Hospital.

Current strategic work in education is focused on collaborating with our partners at Atrium Health Wake Forest Baptist to identify ways to take the strengths of each of our programs and create the nation's top educational experience. While the 2 residency programs will maintain their independence, the strength of each program will be optimized by this formal combination. As part of this new combined entity, we are excited to be involved in the creation of the new Wake Forest School of Medicine campus in Charlotte as we broaden the scope of our educational impact in orthopaedic surgery and cultivate a new cohort of learners.

We are proud of the learners and educators we are fortunate to call our own here in Charlotte and across Atrium Health. We look forward to 2022 and will continue to provide the highest level of education and patient care.

Joshua C. Patt, MD, MPH, FAOA

Vice Chair of Education
Atrium Health Musculoskeletal Institute

2021 Education Highlights:

- 86% of residents published at least 1 peer-reviewed paper in 2021, with 71% publishing 2 or more, and 52% publishing 3 or more.
- We led 16 presentations at key conferences, including those held by the American Academy of Orthopaedic Surgeons, the American Orthopaedic Association, the American Association of Hip and Knee Surgeons, the Southern Orthopaedic Association and the American Society for Surgery of the Hand.
- Elaine Shing, MD, PGY-4, hosted a national panel on women in sports medicine.
- Our first neurosurgery resident, Tyler Atkins, MD, graduated and is now practicing in Fort Wayne, IN.
- John Parish, MD, completed his enfolded neuroendovascular fellowship. He is now in his final year, serving as the chief resident of the neurosurgery residency program.
- Vincent Rossi, MD, PGY-6, is now completing a year-long international rotation in Melbourne and Mornington, Australia.
- Matthew Braswell, MD, PGY-4, initiated a monthly global health and international orthopaedics conference partnering with residency programs in Tanzania and Uganda. At the conference, Atrium Health Musculoskeletal Institute physicians present on various subspecialty topics and then review cases presented by the African residents.
- We had 2 residents win prestigious awards from the Southern Orthopaedic Association. J. Stewart Buck, MD, won the President's Resident Research Award. Eric Secrist, MD, won the Cynthia Lichtefeld Research Award.
- Dr. Shing and Risa Reid, MD, co-authored a children's book on broken bones, titled "Broken Bones: Mei and the Monkey Bars."



Orthopaedic Trauma

Our Level 1 trauma center at Atrium Health Carolinas Medical Center is among the busiest in the country, serving the Charlotte metropolitan region and patients across the Southeast. Atrium Health Musculoskeletal Institute's orthopaedic trauma team includes 5 fellowship-trained traumatologists and surgeons with specialty training in the management of polytrauma patients, complex periarticular fractures, pelvis and acetabular fractures, non-unions and malunions. We also offer a limb lengthening and deformity program and an osseointegration program for amputations.

Our expertise extends to highly complex trauma patients, including medically complex patients managing comorbidities. We also work with many patients experiencing non-healing fractures, evaluating for patient-specific factors related to bone healing and developing treatment plans for operative stabilization.

Using Virtual Tools to Improve Care and Education

During the pandemic, we started using telehealth services to improve access to care for patients outside of the Charlotte metro area. Through telehealth, we were able to provide consultations for new patients and patient referrals as well as follow-up care. Now, we're continuing to use those tools, offering telehealth options for some appointments so that patients don't always have to travel to our office for care.

We've also maintained fellow and resident education throughout the pandemic and expanded virtual lectures and conferences – helping learners access lectures from

anywhere, at any point in their training. This includes a combined fracture conference with Atrium Health Wake Forest Baptist and Atrium Health Navicent discussing complex fracture cases.

Reducing Length of Stay

We've spent the last year working to improve patient care pathways to reduce length of stay – helping reduce costs and limit time patients spend in the hospital during the pandemic. We've done this by:

- Expanding operating capacity on weekends, when most trauma cases happen, enabling patients to have the procedures they need and start recovering sooner.
- Assigning advanced practice providers (APP) to be primary rounders on patients, working directly with clinical care managers to identify patient needs early in hospitalization and facilitate the transition towards discharge.
- Working with case managers to make sure that trauma patients' homes are equipped and ready for their return.

Creating a Trauma Care Expansion Strategy for the Region

As our region becomes more populated, we've worked to develop a regional trauma strategy aiming to bring fast high-level care as close to home as possible for more patients.



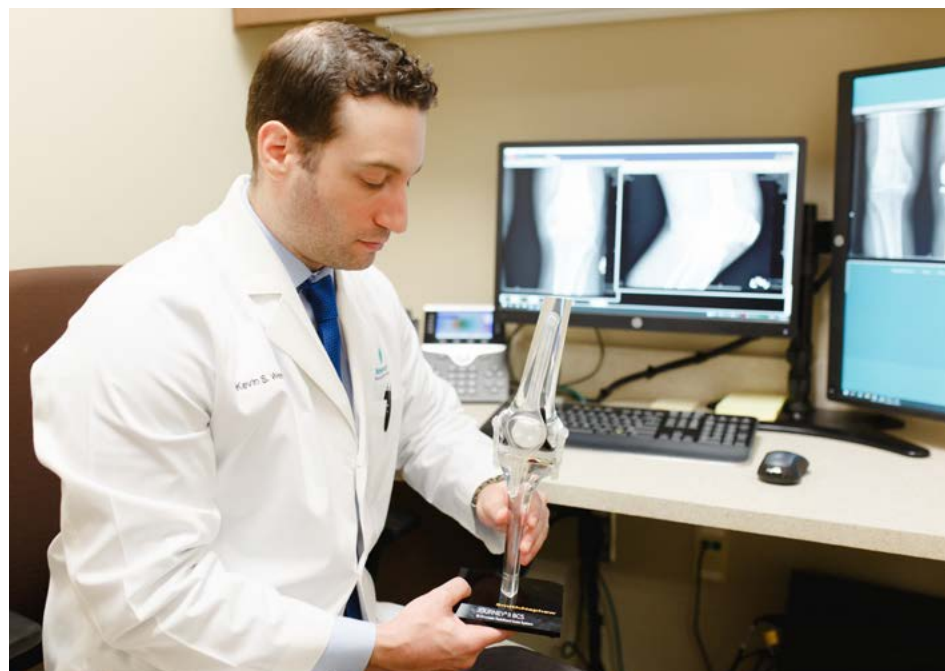
Hip and Knee

Atrium Health Musculoskeletal Institute & OrthoCarolina care for patients who need all types of joint replacement and reconstruction. In 2021, our respective teams continued advancing care by recruiting top surgeons and conducting research with significant clinical implications.

Atrium Health Musculoskeletal Institute:

This year Atrium Health Musculoskeletal Institute welcomed 2 orthopaedic surgeons who specialize in hip and knee arthroplasty: Kevin Weiss, DO, and Matthew Duffin, MD.

Dr. Duffin completed a fellowship at Hoag Orthopaedic Institute and is based in our Atrium Health Musculoskeletal Institute Orthopedics & Sports Medicine practices in Pineville, NC, and Rock Hill, SC. Dr. Weiss did his fellowship training at Wake Forest School of Medicine and is also based in our Pineville and Rock Hill practices.



OrthoCarolina:

OrthoCarolina's recent advances include:

Improving Treatment for Infection in Joint Replacement

In 2021, Thomas Fehring, MD, started research seeking to improve the literature around treating infections of joint replacements. The study aims to inform definitive directions to treat this rare but severe complication.

Examining the Effectiveness of Robot-Assisted Surgery

Robot-assisted hip and knee replacement surgeries are becoming more mainstream, but we still lack clear evidence as to whether these technological advances lead to better outcomes. The OrthoCarolina team is following patients after robot-assisted surgery for knee replacement to help determine if this surgery is actually more beneficial than traditional approaches.

Using Augmented and Virtual Reality During Hip and Knee Replacements

Over the past 2 years, our team has been exploring using virtual and augmented reality tools during hip and knee replacement surgeries. These tools allow surgeons to view CT scans, X-rays and their instruments and get real-time feedback when they're making a resection.

Offering Outpatient Hip and Knee Replacements

In 2019, OrthoCarolina's team conducted research on offering hip and knee replacements as outpatient procedures for patients who meet certain health criteria. We've offered this option to more patients throughout the pandemic, having many go home within 5 hours of surgery. This can significantly lower the cost of care. Throughout the pandemic, this has also helped limit the number of patients in the hospital and ease patients' concerns about COVID-19 while receiving care.



Pediatric Orthopaedics

OrthoCarolina works closely with Atrium Health Levine Children's to provide a wide range of services for children with all types of orthopaedic needs – from sports medicine and fracture care to complex hip surgery, growth-friendly spine procedures and limb lengthening services. For patients with complex needs, our subspecialized orthopaedics team works closely with cardiologists, critical care doctors, nephrologists and other specialists at Atrium Health Levine Children's to provide expert, multidisciplinary care.



Innovative Hip and Limb Procedures

As the only pediatric orthopaedic surgeons in the Charlotte region, we bring advanced orthopaedic surgical care closer to home for families throughout the Southeast. This includes:

- **Complex hip surgery:** OrthoCarolina's Virginia Casey, MD, who specializes in complex hip procedures, is now offering periacetabular osteotomies and hip arthroscopy in young adults and adolescents.
- **Combined techniques for external fixation and intramedullary nail deformity correction:** OrthoCarolina's Brian Brighton, MD, is leading the way in a new technique that combines these approaches. This provides the opportunity to do an acute or gradual correction of limb deformities. It also allows for immediate mobilization and weight-bearing and less time in external fixators.



Now Offering Vertebral Body Tethering for Idiopathic Scoliosis

In 2021, OrthoCarolina's Michael Paloski, DO, started offering vertebral body tethering for children who are still growing and whose idiopathic scoliosis progresses despite bracing. This procedure uses screws along the convex side of the spinal curve and a rope-like tool called a tether near the vertebrae. This helps guide the child's spine into a straighter position as they grow. FDA approved in 2019, vertebral body tethering is an alternative to spinal fusion surgery.

Continually Improving Care

OrthoCarolina's pediatric orthopaedics team is continually publishing research, book chapters and other materials to inform the field. In 2021, this included:

- Publishing research in the Journal of Pediatric Orthopaedics examining appropriate use criteria for management of a pulseless or poorly perfused supracondylar humerus fracture with suspected vascular injury.
- Authoring textbook chapters for the American Academy of Orthopaedic Surgeons on quality, safety and value, and epidemiology of fractures. We also co-authored a chapter on child abuse.



Sports Cardiology

Working with everyone from high school athletes to professional sports teams to older, highly active individuals, Atrium Health Sanger Heart & Vascular Institute's Sports Cardiology Center helps prevent, detect and manage cardiovascular conditions so athletes can perform at their best level – safely.

Our care typically starts with a comprehensive, individualized assessment, where we use advanced imaging and stress testing and tailor each patient's evaluation to their particular sport. The center's multidisciplinary approach brings together cardiologists, pulmonologists, geneticists, exercise physiologists and sports nutritionists to develop personalized prevention, treatment and training programs. Our latest advances and accomplishments include:



- Launching a state-of-the-art metabolic lab:** Our new metabolic lab gives us the tools to conduct advanced cardiopulmonary exercise testing using either a wide-deck treadmill or an upright cycle ergometer designed for athletes. This facilitates breath-by-breath analysis that helps our team understand an individual's physiology, so we can identify the causes of decreased athletic performance and evaluate the impact of any suspected or known heart issues. The lab plays an integral role in both evaluating and understanding cardiopulmonary issues and in identifying ways to improve performance.
- Publishing a sports cardiology textbook:** Our team led the creation of "Sports Cardiology: Care of the Athletic Heart from the Clinic to the Sidelines," the preeminent textbook on sports cardiology.
- Screening participants in the Major League Baseball (MLB) draft combine:** The Sports Cardiology Center's team – including cardiologists, sonographers and nurses – traveled to the MLB Draft Combine and provided cardiology screening for prospective professional baseball players.
- Providing cardiology services to professional sports leagues and teams:** The Sports Cardiology Center's leader, Dermot Phelan, MD, is a member of the NBA and NFL Cardiology Advisory Committees, and also serves as a cardiologist for the Carolina Panthers and the NFL Scouting Combine.
- Evaluating and screening collegiate student-athletes:** We act as cardiology consultants for the University of North Carolina at Charlotte, Davidson University, Winthrop University, Johnson C. Smith University, Catawba College and Queens University of Charlotte.

Whether we're treating a high schooler with an abnormal cardiac screening, a master's athlete or a professional football player, our providers go to great lengths to understand each patient's lifestyle and athletic ambitions, and we work with them to develop a plan that gets them back to their activities. We provide individualized exercise plans based on the underlying condition, and stress testing so that people with cardiac conditions can continue to enjoy their sport as safely as possible.



Launched in 2019, Atrium Health Sanger Heart & Vascular Institute's Sports Cardiology Center is quickly establishing a national footprint and making fast progress toward our goal of becoming the nation's preeminent sports cardiology program.

Orthopaedic Sports Medicine

Atrium Health Musculoskeletal Institute and OrthoCarolina’s respective teams are conducting innovative research to improve hip, knee and shoulder care, while ensuring that patients and professional athletes across the Charlotte region have access to the highest quality care and latest surgical techniques.

Honoring Pat Connor, MD, Longtime Head Team Physician for the Carolina Panthers

OrthoCarolina’s Pat Connor, MD, stepped away from his position as head team physician for the Carolina Panthers after more than 20 years in that role.

Dr. Connor is an orthopaedic surgeon specializing in arthroscopic and reconstructive knee surgery, shoulder care and shoulder surgery. He and his colleagues evaluated and provided immediate treatment for a broad range of substantial acute injuries while working on the sidelines for the Panthers. They also played a pivotal role in helping many of those players recover from those injuries and safely return to play.

It is remarkable for a physician to hold this position for such a long tenure, and it reflects Dr. Connor’s incredible skill and dedication. Everyone at OrthoCarolina and Atrium Health Musculoskeletal Institute admires his service and has been proud to have him as a colleague.

Dr. Connor has been awarded Emeritas Status in the National Football League Physicians Society for this longstanding, dedicated service as Carolina Panthers head team physician. He will be recognized alongside a distinguished group of 9 fellow physicians on the NFLPS website and directory.

As we continue our partnership with the Carolina Panthers, we are proud to announce that internist and Atrium Health Board of Commissioners member Nancy Gritter, MD, has been named the new head team physician for the Panthers. Dr. Gritter is the first female to hold this position in the NFL. Additionally, Durham Weeks, MD, has been named the new head team orthopaedist for the Panthers. He will continue his tenured service to the team with support from assistant team orthopaedist Jonathan Riboh, MD.



Atrium Health Musculoskeletal Institute:

As the Charlotte region’s population experiences rapid growth, particularly in the South Charlotte and Union County communities, it presents an opportunity to expand Atrium Health Musculoskeletal Institute’s team and extend our innovative sports medicine care. We have embraced this opportunity by recruiting top surgeons like Eric Kropf, MD.

“Atrium Health Musculoskeletal Institute has established an extensive sports medicine foundation in Union County, which includes building a primary care network and providing athletic trainers and team physicians to

many local schools,” Dr. Kropf says. “We’re adding to that by giving patients access to the latest surgical management techniques without having to travel to central Charlotte or beyond.”

Dr. Kropf is particularly excited about Atrium Health Union West, our new hospital in Matthews, NC.

“This is another big advancement, because it gives patients access to a state-of-the-art surgical suite that is much closer to where they live and work,” he says.



Elevated Care at Atrium Health Union West

The new hospital in Matthews, NC features:

- 40 licensed patient beds
- 3 operating rooms
- Emergency department and helipad
- 4 ICU beds
- Imaging services (MRI, cardiac CT, X-ray, ultrasound)
- Lab services

OrthoCarolina:

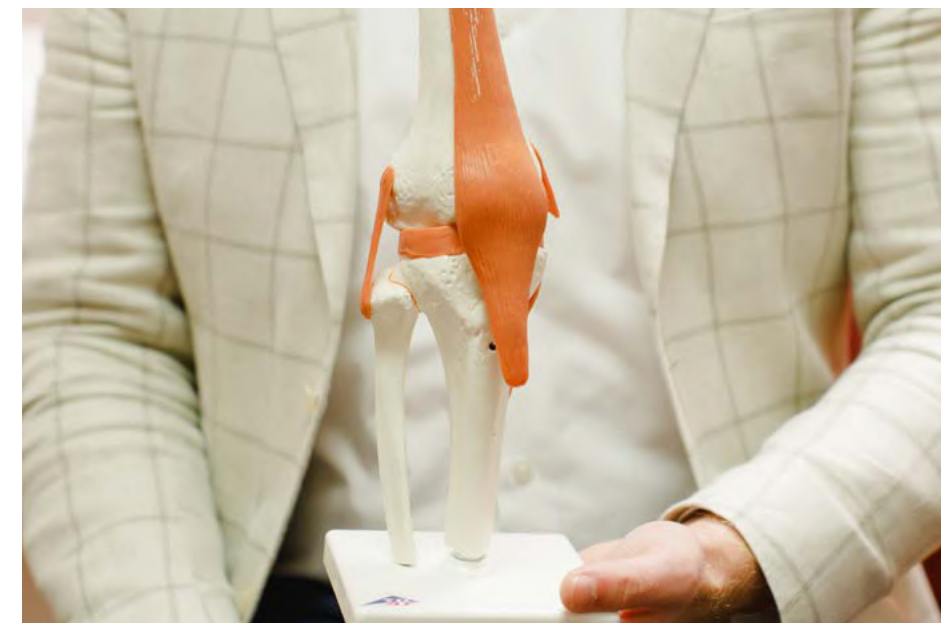
OrthoCarolina's 2021 highlights include:

Advancing Innovative Research

Atrium Health Musculoskeletal Institute has spearheaded a program to support clinician-scientists pursuing innovative research. In 2021, this program awarded OrthoCarolina's Jonathan Riboh, MD, funding for a pilot study that takes steps towards using banked synovial tissue to improve outcomes for ACL reconstruction. The study aims to demonstrate the feasibility of arthroscopic synovial harvest at the time of ACL reconstruction, subsequent isolation of cells and RNA from these samples, successful cryopreservation of them, and successful implementation of CyTOF, bulk RNA sequencing and single-cell RNA sequencing analysis. This could be a key step toward developing a large, prospective synovial tissue bank that could help develop risk-stratification models to better predict ACL reconstruction outcomes and route patients toward appropriate treatment.

OrthoCarolina's team is also involved in studies investigating a wide array of innovative techniques, including hybrid transtibial drilling for ACL reconstruction, multi-ligament knee reconstruction, biologics and cartilage restoration. Current research includes:

- A study to determine whether a novel form of external focus of attention feedback can mitigate biomechanical risk factors of post-traumatic osteoarthritis in patients after ACL reconstruction. Bryan Saltzman, MD, is a co-principal investigator on the study and its sole enrolling surgeon. The research is funded by the Arthritis Foundation.
- Dr. Saltzman is leading a project to evaluate screw vs. knotless anchor fixation for the backup of tibial-sided BTB graft fixation. This is funded by an Arthrex global research grant.



- Dr. Saltzman is the enrolling surgeon in a randomized concurrent controlled study investigating use of the GID SVF-2 device to produce autologous adipose-derived stromal vascular fraction for treatment of osteoarthritis of the knee. Dr. Saltzman and Atrium Health Musculoskeletal Institute's Claude T. Moorman, MD, are co-investigators on this study. This study is funded by GID Bio Inc.
- Dr. Saltzman is a co-investigator and enrolling surgeon on the multicenter STaR trial for multi-ligament knee injuries. This trial investigates the effects of surgery timing (early vs. delayed) and timing of post-operative rehabilitation (early vs. delayed) for treatment of military personnel and civilians that sustain a multiple ligament knee injury. The study hypothesizes that early surgery, early rehabilitation – and the combination of the 2 – will lead to an earlier, more complete return to pre-injury military duty, work and sports, and better patient-reported physical function. This research is funded by a Department of Defense grant.
- Dana Piasecki, MD, Dr. Saltzman and their colleagues recently completed a multicenter study investigating the impact of COVID-19 on the mental health of high school and collegiate athletes. Their findings were recently submitted for publication. This work was funded by Columbia University, which was the study's primary site.

OrthoCarolina Featured Publications

OrthoCarolina physicians published dozens of papers in 2021, including:

Intraoperative and Early (90-Day) Postoperative Complications and Associated Variables with Multiligamentous Knee Reconstruction: Longer Procedure Time Leads to Increased Deep Infections and Arthrofibrosis. Axibal DP, Yeatts NC, Hysong AA, Hong I, Trofa DP, Moorman CT, Piasecki DP, Fleischli JE, Saltzman BM. *Arthroscopy*. 2021; [Epub ahead of print]. PMID 34052381.

Outcomes of Posterior Labral Repair With or Without Concomitant High-Grade Glenohumeral Chondral Pathology: A Retrospective Cohort with Minimum 2-year Follow-up. Young BL, Corpus KT, Scarola GT, Trofa DP, Connor PM, Piasecki DP, Saltzman BM, Fleischli JE. *J Shoulder Elbow Surg*. 2021; [Epub ahead of print]. PMID 33964429.

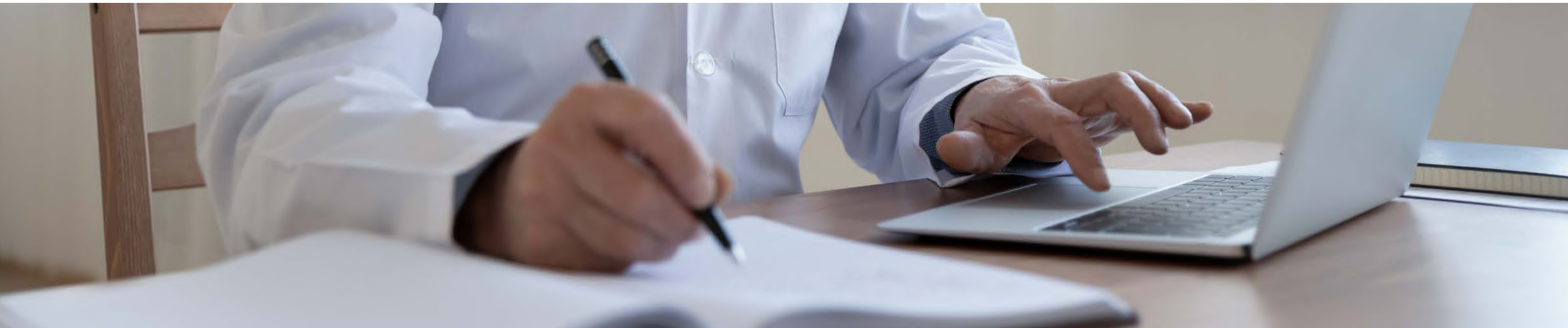
Clinical Outcomes of a Novel Ulnar Collateral Ligament Reconstruction Hybrid Technique with Ulnar-Sided Suspensory Fixation. CarlLee TL, Rao AJ, Scarola GT, Yeatts NC, Trofa DP, Hamid N, Schiffern SC, Connor PM, Fleischli JE, Saltzman BM. *J Shoulder Elbow Surg*. 2021; 30(7S): S2-S7. PMID 33753270.

Current Trends in Orthobiologics: An 11-Year Review of the Orthopaedic Literature. Obana KK, Schallmo MS, Hong IS, Ahmad CS, Moorman CT, Trofa DP, Saltzman BM. *Am J Sports Med*. Accepted, Apr 2021. Awaiting print.

Isolated Osteochondral Autograft versus Allograft Transplantation for the Treatment of Symptomatic Cartilage Lesions of the Knee: A Systematic Review and Meta-Analysis. Trofa DP, Hong IS, Lopez CD, Rao AJ, Yu Z, Odum SM, Moorman CT, Piasecki DP, Fleischli JE, Saltzman BM. *Am J Sports Med*. Accepted, Jul 2021.

Total Joint Arthroplasty and Golf Play: Analysis of Regional Handicap Database. Gorbaty J, Rao A, Varkey DT, Muna K, Saltzman BM, Hamid N. *J Am Acad Orthop Surg*. 2021; 29(10): e513-517. PMID 33002961.

Allograft Augmentation of Hamstring Autograft in Anterior Cruciate Ligament Reconstruction Results in Equivalent Outcomes to Autograft Alone. Rao A, Macknet D, Trofa D, Stuhlman CR, Lastra JL, Roberts K, Thompson C, Odum S, Yeatts N, Saltzman BM, Fleischli JE. *Arthroscopy*. 2021; 37(1): 173-182. PMID 32679297.



Primary Care Sports Medicine

Atrium Health Musculoskeletal Institute is home to 20 board-certified sports medicine physicians providing non-operative musculoskeletal and medical care – ranging from experts in the latest approaches to injury and concussion care to physiatrists who provide interventional care focused on the spine.

We serve patients of all ages with all types of sports or activity-related conditions at our 18 sports medicine

locations throughout the Charlotte region, including our newest location in south Charlotte at Rea Village. We focus not only on treating these conditions, but also on understanding their cause and how to prevent recurrence. We're also home to well-established residency and fellowship programs, shaping the next generation of sports medicine physicians and keeping our team on the leading edge of our field.



Caring for Athletes at Every Level

Atrium Health and OrthoCarolina providers offer sports medicine care at clinics throughout the region and support many schools, universities and professional teams – including the Carolina Panthers, Davidson College, Johnson C. Smith University and Winthrop University.

In 2021, new Atrium Health Musculoskeletal Institute partnerships included:

- The Kannapolis Cannon Ballers minor league baseball team
- Davidson University Health Center
- Union County Public Schools
- Naming 2 physicians medical directors of the Combine Academy, a boarding school for elite young athletes.

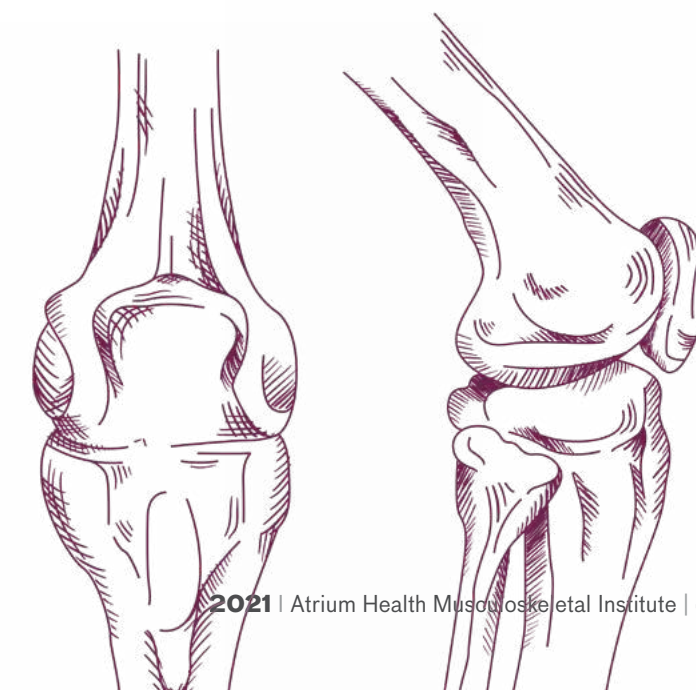
Leading Nonsurgical Care for Osteoarthritis

We've expanded nonsurgical care options for osteoarthritis, including:

- Offering a full array of injection therapy from steroid to ortho biologic agents.
- Using musculoskeletal ultrasound for injections that would have otherwise been done in a surgical or procedure suite. This approach is less expensive and exposes the patient to less radiation than traditional approaches.
- Providing recommendations for improving muscle fitness or endurance to help improve overall health. For example, we may recommend a specific strengthening program to help with improving the muscles around an arthritic joint or recommend a specific nutrition program in preparation for a triathlon.

Shaping Safety Guidelines for High School Sports During the Pandemic

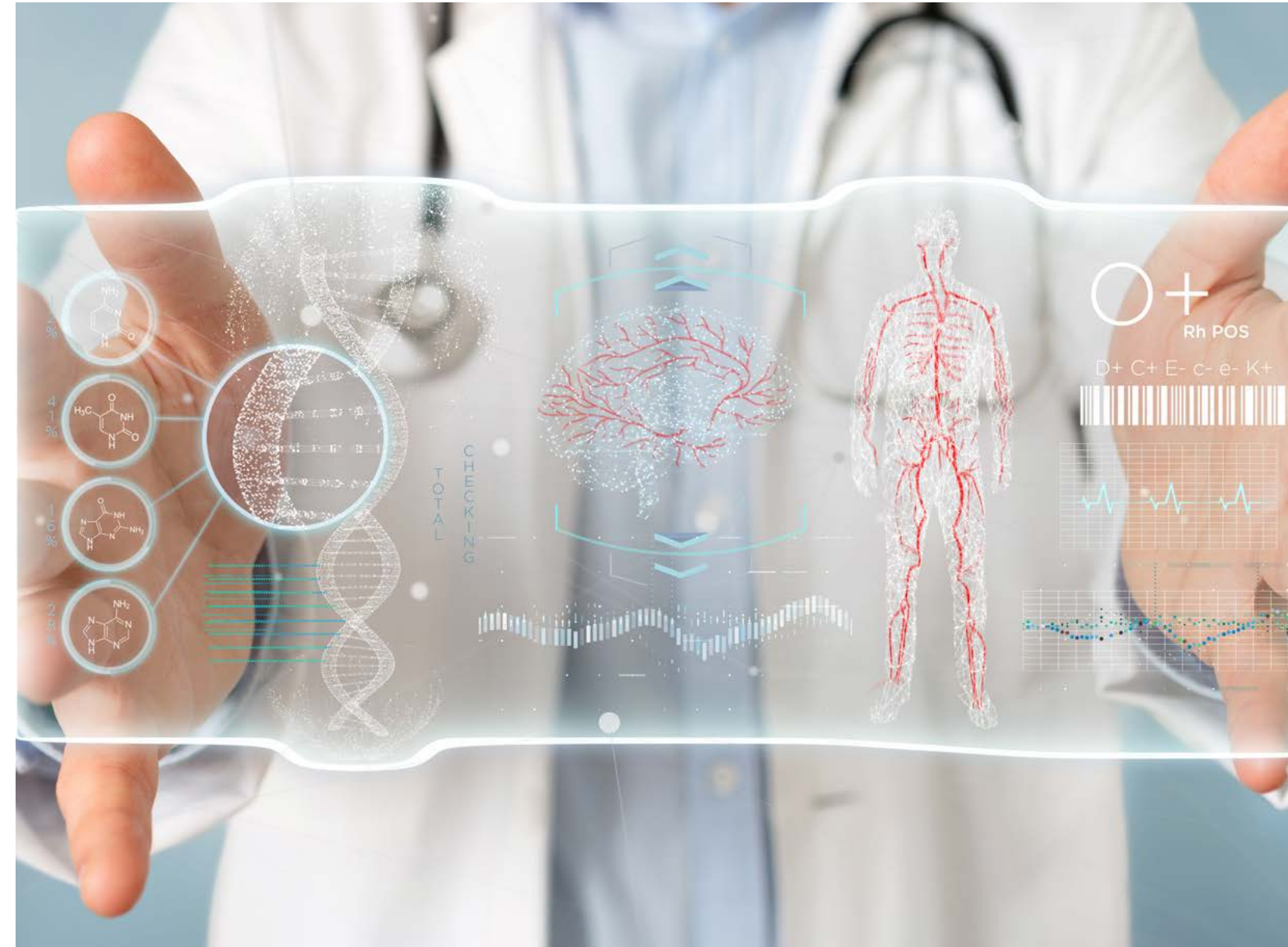
In 2021, we created a standard protocol for return-to-sports participation for athletes exposed to or infected with COVID-19 and included other key recommendations to help make school sports as safe as possible. This protocol was based on colleagues' work with the North Carolina High School Athletic Association, the American College of Cardiology and the American Medical Society for Sports Medicine.



Atrium Health Musculoskeletal Institute Featured Presentations

The Atrium Health Musculoskeletal Institute team led many presentations and discussions over the past year, including:

- Point-of-Care Ultrasound (POCUS) in Family Medicine and Sports Medicine Settings, presented at the Ultrasound Research Symposium by Wake Forest School of Medicine, academic core of Atrium Health
- Musculoskeletal Issues in Pediatrics, presented at North Carolina Association of Family Physicians (NCAFP) Winter Family Physicians Meeting
- Common Musculoskeletal Issues in Pediatric Population: Diagnosis and Treatment, a discussion at the Regional Family Medicine Conference
- Prevention of Pregnancy but Production of Ankle Pain? Presented at the American Medical Society for Sports Medicine (AMSSM) Annual Meeting
- Drug-Induced Lupus from OCPs, presented at the AMSSM Annual Meeting
- Common Causes of Shoulder Pain, presented at the NCAFP Annual Winter Meeting
- Teaching Ultrasound, presented as part of the Research Symposium Series by Wake Forest School of Medicine, academic core of Atrium Health
- Knee Pain in Adults and Adolescents, presented at the NCAFP Summer Symposium
- Baseline Concussion Symptoms and Severity of Depression in Adolescent Athletes, presented as part of the National Athletic Trainers' Association Annual Symposia
- Symptoms, Exam or ECG findings that Suggest an Athlete is at Risk for a Heart Condition, presented at the Southeast Sports Medicine Fellowship Conclave
- Case Study: An Isolated Complete Rupture of the Medial Head Gastrocnemius Tendon From its Origin With 4.37 CM of Distal Retraction, presented at the 2021 AMSSM Annual Meeting



Spine

During another unprecedented year of COVID-19, Atrium Health Musculoskeletal Institute's spine program has continued to achieve significant recognition, increase its focus on quality and move to more patient-centered care.

Key 2021 advances include:

Earning the state's first Joint Commission advanced certification in spine surgery: Atrium Health Carolinas Medical Center, in partnership with Carolina NeuroSurgery & Spine Associates, earned this new recognition, underscoring that our patients receive top-quality care, from initial consultation to surgical care to post-hospitalization.

Domagoj Coric, MD, expands his spine surgery leadership: Dr. Coric took on new leadership positions in 2021, continuing to be a driving force in organizations that advance the field. He was named chair of the American Association of Neurosurgeons / Congress of Neurological Surgeons Joint Section of Disorders of Spine and Peripheral Nerves. He was also elected president of the International Society for the Advancement of Spine Surgery, which is made up of neurosurgical and spine surgeons from 78 countries.

Innovations in spine motion preservation: Since the early 2000s, our team has been a key contributor to artificial disc research, exploring motion-preserving alternatives to spinal fusion procedures. This year, our research in this area included:

- Shaping lumbar motion-preserving artificial disc type protocols, including implanting novel devices.
- Being a leading enroller for one of the first trials comparing one type of artificial disc to another. These trials, through an investigational device exemption, are exploring a new generation of artificial discs made of the latest materials and biomechanical technology.
- Examining an approach to placing artificial discs from behind the lumbar spine, which aims to understand if these motion-preserving discs will offer outcomes that are as good as – or better than – standard devices.



Leading the way in documentation improvements: Spine leaders from OrthoCarolina and Carolina NeuroSurgery & Spine Associates have partnered with Atrium Health Musculoskeletal Institute to improve efforts in coding and documentation. These efforts impact the value we provide by appropriately documenting the acuity of our services. Specific efforts on manual clarification response and timeliness of discharge summaries have yielded significant improvements – with discharge summary timeliness improving by 109% since January 2021.

COVID-19 pivot in patient education: The Atrium Health Musculoskeletal Institute spine program created patient-centered education materials focused on preparing patients for surgery and safe discharge in 2020. These materials were initially designed around pre-COVID-19 care coordination, leveraging in-person education and hard copies of materials. As COVID-19 cases continued to be a concern in 2021, we shifted our approach to meet patients safely – and virtually. All of our education materials are now available online.

Brad Segebarth, MD, recognized by AO Spine: OrthoCarolina's Brad Segebarth, MD, was elected to serve a 3-year term on the AO Spine North America Education Committee. Dr. Segebarth will also serve as the chairman of the 2022 Toronto AO spine principles course.

Becoming a Walmart center of excellence in spine surgery: Atrium Health and Carolina NeuroSurgery & Spine Associates became the eighth center of excellence for Walmart employees. The Walmart centers of excellence program was established to provide their employees access to world-class medical specialists. Now, Walmart employees can travel to Charlotte for care—and can have surgery at Atrium Health Carolinas Medical Center and Carolina Center for Specialty Surgery. They can also receive non-surgical treatment at Carolina NeuroSurgery & Spine Associates offices.

Hand

The OrthoCarolina Hand Center is home to leading-edge orthopaedic surgeons who are developing new innovative treatments and solutions for patients worldwide. The OrthoCarolina Brachial Plexus Clinic, Congenital Hand Clinic and Reconstructive Center for Lost Limbs are some of the highest volume specialized clinics in the country. The OrthoCarolina team offers the most advanced comprehensive care, and is committed to educating other orthopaedic surgeons on the latest upper extremity procedures.

Welcoming World-Renowned Orthopaedic Surgeon, Peter Waters, MD

Dr. Waters, one of the most internationally known pediatric upper extremity specialists, has joined Atrium Health and OrthoCarolina. Previously, Dr. Waters was orthopaedic surgeon-in-chief at Boston Children’s Hospital, where he was a leading surgeon for 25 years. Dr. Waters has been president of the Pediatric

Orthopaedic Society of North America and is currently co-president of the International Pediatric Orthopaedic Think Tank. He has published extensively and is recognized for helping to shape the standard of care for brachial plexus and congenital hand patients.

At Atrium Health and OrthoCarolina, he will help lead the brachial plexus and congenital hand clinics, which are among the highest volume clinics in the country. At the

Brachial Plexus Clinic, we serve approximately 60 patients per month and average 1 brachial plexus surgery per week. Our Congenital Hand Clinic serves patients with all types of congenital deformities – including radial club hand, duplicate thumbs, absent thumbs and the entire spectrum of upper limb birth anomalies.

Dr. Waters will continue to shape the future for these injuries and ensure the best possible outcomes.

New Nonprofit Aims to Provide Arms for All

Amy Reamer is a mother of 4 young children, a cancer survivor and a forequarter amputee. After recovering from surgery to remove her left arm, shoulder and part of her chest wall, she submitted for a prosthesis through her medical insurance. She was denied.

Glenn Gaston, MD, says this is a common problem for amputee patients. In 2020, the hand team at the OrthoCarolina Reconstructive Center for Lost Limbs started a nonprofit called Arms for All to help patients, like Amy, who don’t have the financial means or insurance to obtain a prosthetic that will help them function in their daily life. In September 2021, Amy was the first patient to receive a prosthetic arm from Arms for All.

“We want to be able to take care of every amputee who walks in our doors, regardless of insurance status,” Dr. Gaston says.

In late 2021, a second patient was awarded a prosthetic arm through the nonprofit. The patient is an African immigrant who came to the US after his arm was cut off with a machete. He’s a cab driver, but aimed to become a truck driver – a job that requires a prosthetic hand. Now, equipped with his fully functioning prosthetic, he can obtain a commercial driver’s license and pursue his career.

To date, Arms for All has been funded by the OrthoCarolina hand team physicians and the Atrium Health Foundation. In 2022, Arms for All will officially launch for public donors to make contributions. The goal is to expand to help more patients in need at OrthoCarolina and, eventually, beyond our region.



Increasing Wide-Awake Surgeries for Routine Procedures

OrthoCarolina is now performing more than 1,000 in-office surgeries per year for common conditions, such as carpal tunnel syndrome, trigger finger and tendonitis. These procedures are completed with local anesthesia at the clinic, and studies show patients have significantly lower costs, lower complication rates, faster recovery times and higher satisfaction than traditional surgeries in the operating room. All of our hand surgeons perform wide-awake surgeries and are industry leaders in this growing trend.



Foot and Ankle

OrthoCarolina Foot and Ankle Institute is the largest foot and ankle center in the Southeast and is committed to national leadership, educating the next generation and engaging in research that has an impact far beyond our region.

Leading the AOFAS in 2020-21

Bruce Cohen, MD, CEO of OrthoCarolina and member of the Foot and Ankle Institute, served as the 2020-21 president of the American Orthopaedic Foot and Ankle Society (AOFAS). Dr. Cohen led the effort to organize the 2021 annual meeting, which took place in September in Charlotte. Carroll Jones, MD, was the overall program chair with Kent Ellington, MD, directing the pre-meeting program. Our team presented research and outcomes for ankle arthroplasty, Charcot arthropathy as well as multiple other areas of foot and ankle surgery.

Training Future Foot and Ankle Leaders

At OrthoCarolina, a top priority is to provide some of the world's best training and education. Milestones in our team's foot and ankle education programs include:

- **Having a nationwide impact:** To date, more than 60 physicians have completed OrthoCarolina's foot and ankle fellowship program and gone on to practice in more than 20 states. Many of these graduates are in leadership positions.
- **Developing a top fellowship program:** OrthoCarolina's Carroll Jones, MD, directs the program, which currently has 4 fellows. We attract the best applicants, as they are drawn to our surgical volume, breadth of cases and 1-on-1 mentorship opportunities.
- **Providing unique educational opportunities:** OrthoCarolina's W. Hodges Davis, MD, an internationally known orthopaedic foot and ankle surgeon, joined the team this year. A world leader in ankle replacement surgery and other procedures as well as medical technology, Dr. Davis offers senior leadership and diverse experience to the fellowship program.
- **Attracting chief residents:** In the past 2 years, 3 of the 10 chief residents in the Atrium Health Carolinas Medical Center orthopaedic residency program selected foot and ankle as their subspecialty.
- **Adding top physicians:** Samuel Ford, MD, completed the orthopaedic residency program at Atrium Health Carolinas Medical Center in 2019, followed by a fellowship in foot and ankle orthopaedic surgery at Baylor Scott and White Orthopaedic Associates of Dallas. OrthoCarolina was excited to welcome Dr. Ford back to its team in 2020. He has quickly become as productive as other providers and a leader to current residents.

Pursuing Clinical and Research Advances

Todd Irwin, MD, directs OrthoCarolina's foot and ankle research effort. Highlights include:

- OrthoCarolina is currently involved in more than 25 active research projects, as well as 4 registries that prospectively collect data on multiple clinical entities, including total ankle arthroplasty and Charcot arthropathy.
- Dr. Irwin and Dr. Ford have implemented an electronic patient database in order to complete retrospective studies more efficiently and accurately. Now, case data collected through these studies will be easily searchable to compare outcomes and measures.
- Scott Shawen, MD, currently participates annually in the Congressionally Directed Medical Research Program and is on the selection board for the Peer-Reviewed Orthopaedic Research Program.
- We have published multiple articles in top journals, including Foot and Ankle International; Journal of Orthopaedic Trauma; Injury; Foot and Ankle Clinics and Clinics in Sports Medicine.
- We regularly present at conferences and meetings. For example, we presented multiple abstracts and were involved in numerous symposia at the 2021 AOFAS meeting.



Orthopaedic Oncology

At Atrium Health Musculoskeletal Institute, we care for patients with all types of bone and soft tissue tumors and malignancies. This includes benign musculoskeletal tumor conditions, primary bone and soft tissue sarcomas and metastatic disease. We work closely with Atrium Health Levine Cancer Institute (LCI) and Atrium Health Levine Children's, holding weekly tumor boards that allow our team to provide the highest level of comprehensive, multidisciplinary care for patients of all ages.

We're home to one of the region's most experienced and busiest sarcoma team and the region's only orthopaedic surgeons trained in orthopaedic oncology. We evaluate all referrals within 24 hours of receipt and are available by phone for all emergent referrals. We use the latest technology – including intraoperative CT scans and computer-assisted navigation for tumor resection – to help patients have happier, healthier futures.

Orthopaedic oncology program highlights include:

Rapidly Expanding Basic Science Research

Our team is engaged in all levels of research aiming to advance treatment and care for bone and soft tissue sarcomas. In 2021, we rapidly expanded our basic science research, examining tumor markers and potential therapeutic pathways related to individualized tumor markers. By finding markers that identify tumors at the highest risk of poor outcomes, we can further individualize treatment plans. This work also aims to create more targeted, personalized treatments for these cancers.



Philanthropy Fuels Research and Patient Care

Last year, our orthopaedic oncology program received several generous donations and grants to support orthopaedic oncology research and care. This includes:

- The Paula Takacs Foundation for Sarcoma Research made a \$225,000 gift aiming to fuel discoveries that improve the lives of adults and children treated for sarcomas at LCI and Levine Children's. This brings the foundation's overall contribution to \$1.3 million.
- The Lauren Marie Kimsey Foundation for Synovial Sarcoma has contributed \$120,000 to support special needs for synovial sarcoma patients and families. The foundation was established in memory of a synovial sarcoma patient treated at LCI.
- Swim Across America generated \$40,000 to support research at LCI.
- Fraternity brothers from Sigma Alpha Epsilon at Western Carolina University donated over \$4,300 to members of LCI's orthopaedic oncology care team to advance the research and treatment of sarcomas. The gift was deeply personal, as 2 of their fraternity brothers have been diagnosed with osteosarcoma in recent years.
- The Ganatra Family Fund for Excellence in Orthopaedic Surgery was established to honor Joshua Patt, MD. The \$250,000 fund will support advances that directly impact patient experience, patient satisfaction and care within orthopaedic surgery at Atrium Health.



Community Outreach and Partnerships

Atrium Health partners with 64 secondary schools, 5 collegiate schools and several professional sports teams in the Carolinas – including the Carolina Panthers – to provide comprehensive sports medicine programming. This innovative partnership continues to grow, ensuring that all the athletes we see receive the best care possible, whether on or off the field.

Comprehensive Care for More than 32,000 High School Student-Athletes

In 2021, Atrium Health Musculoskeletal Institute added partnerships with Union County Public Schools and the Combine Academy, a boarding school for elite young athletes. This means we now provide comprehensive sports medicine programming to more than 32,000 athletes in more than 60 schools across the Carolinas. Our services include injury prevention measures, injury care, sports rehabilitation, sports nutrition and EMS coverage.

Our care often helps athletes find ways to address off-the-field health issues. A significant percentage of our partner schools are home to underserved populations who face challenges accessing healthcare. For many of these adolescents, our athletic trainers are the only healthcare provider they see. This relationship opens the door to other types of care: Our trainers become trusted partners who can identify non-sports ailments and conditions, as well as mental health issues, in student-athletes and connect them with providers who can help meet their health needs.



Our Latest Collegiate Partner: Wingate University

We welcomed Wingate University as a new collegiate partner this past year. Wingate joins Davidson College, Johnson C. Smith University and Winthrop University as schools that receive sports medicine care from Atrium Health Musculoskeletal Institute and OrthoCarolina providers. Atrium Health also provides sports nutrition services to student-athletes at the University of North Carolina at Charlotte.

Helping Our Partners Respond to COVID-19

Throughout the COVID-19 pandemic, we have extended our work with our partners far beyond traditional sports medicine. Our partners have turned to us to help their teams and student-athletes navigate the pandemic and figure out how to safely return to in-person instruction and to the playing field. Our return-to-play contributions include:

- The development of return-to-play protocols for North Carolina high school sports. The North Carolina High School Athletic Association's 12-person sports medicine advisory committee includes 3 Atrium Health representatives: Dr. Claude Moorman, Dr. Kevin Burroughs and Scott Barringer, who manages our athletic training services.
- Atrium Health Musculoskeletal Institute's outreach team has provided COVID-19 testing for Davidson College, University of North Carolina at Charlotte, Johnson C. Smith University and Charlotte Motor Speedway.
- Atrium Health Musculoskeletal Institute athletic trainers have been building school safety plans while following NCHSAA, MCISAA and SCHSAA guidelines.





Atrium Health Musculoskeletal Institute Partnerships

We provide onsite medical services to the following partners and events:

- ACC Baseball Championship
- Association races
- Carolina Panthers, Bank of America Stadium
 - Carolina Panthers Fan Fest
 - Carolina Panthers game day coverage
 - Carolina Panthers training camp
 - Rolling Stones concert
 - Top Cats
 - Weekend Warrior
- Charlotte Convention Center
- Charlotte Knights
- Duke's Mayo Bowl Kickoff & Duke's Mayo Bowl
- Kannapolis Cannonballers
- NASCAR Events
- Stumptown Athletics
- The Combine Academy
- Wells Fargo Championship (a PGA Tour event)
- ZMAX National Hot Rod
- Anson County Public Schools
- Cabarrus County Schools
- Charlotte Mecklenburg Schools
- Fort Mill Schools
- Lincoln County Schools
- Rock Hill Schools
- Stanly County Schools
- Union County Public Schools
- York School District 1

OrthoCarolina Sports Partnerships

- Carolina Panthers
- Charlotte Knights
- Davidson College
- University of North Carolina at Charlotte
- Johnson C. Smith University
- Winthrop University
- Wingate University
- Stumptown AC
- Charlotte Cobras Football
- Charlotte Soccer Academy
- American Legion World Series
- Charlotte Mecklenburg Schools
- Fort Mill Schools
- Cabarrus County Schools



