

HSS

**WHAT
MOVES US
FORWARD
MOVES US
ALL**

Hospital for Special Surgery Annual Report 2018–2019
State of the World of Orthopaedic Surgery and Rheumatology

“The complexity of care provided at HSS requires the deepest collaboration between clinicians and staff across the organization. Our dedication to this goal allows us to be the best at what we do.”

LOUIS A. SHAPIRO
President and CEO

“As global leaders in orthopaedics and rheumatology, it is our imperative to constantly innovate, both in the care we provide to our patients and in the basic, translational and clinical research that forms the bedrock of that care.”

BRYAN T. KELLY, MD, MBA
Surgeon in Chief
and Medical Director



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Dr. Bryan T. Kelly
Surgeon-in-Chief

Bryan T. Kelly became Surgeon-in-Chief of HSS in 2019.

A Message from the Surgeon-in-Chief, Physician-in-Chief and Chief Scientific Officer

HSS is an organization in perpetual motion. As global leaders in orthopaedics and rheumatology, it is our imperative to constantly innovate, both in the care we provide and in the basic, translational and clinical research that forms the bedrock of that care.

This cannot be done without cross-disciplinary collaboration. The relationships between our basic scientists, physician-scientists and surgeon-investigators are vital to customizing our approach for patients with complex musculoskeletal issues as well as improving surgical and nonsurgical outcomes. In rheumatology, our clinicians are collaborating with basic-science researchers in our precision medicine laboratories to uncover molecular pathways of disease pathogenesis, which could pave the way toward more targeted approaches to treatment.

This cohesion between lab and clinic allows us to challenge conventional wisdom and bring cutting-edge techniques into practice. The newly established HSS Center for Regenerative Medicine seeks to create an evidence-based approach to optimizing biological therapies, to set the standard for their use in patients and to pioneer new areas of investigation. A concurrent clinical outcomes registry will correlate data on cell specimen samples to identify exactly which cells are being injected as part of these therapies and link them to patients' responses.

We continue to implement new technologies to augment diagnosis and treatment. These include a 3D surface topography imaging platform that, when combined with traditional x-ray, could lessen the need for radiation-emitting scans — a problem particularly relevant to our pediatric orthopaedic patients. We're also bringing robotics into the operating room, studying how these platforms can best serve the unique purposes of orthopaedic surgeries.

As care delivery models grow increasingly complex — and as HSS expands, with new locations open or soon to open on the West Side of Manhattan, in Brooklyn and in Florida — it is vital that every facet of HSS operates with the same superior level of care and support. To that end, we've created an Office of Medical Leadership to help

ensure the highest quality of patient care, education, research and innovation across the organization.

Our professional education programs are a resource we do not underestimate. We are constantly enhancing the training we offer our residents and fellows. We've made surgical simulation a standard part of training for our orthopaedic residents. Our rheumatology fellows are performing vital research in areas such as juvenile idiopathic arthritis. And more than 29,000 medical professionals from 130 countries participate in our HSS eAcademy® for continuing medical education, ensuring that the standards we set here are implemented across the globe.

Part of the dissemination of our knowledge also includes taking a leadership role in areas in which we are positioned to make a difference. Because of its propensity to cause substantial perioperative pain, orthopaedic surgery is an identified risk factor for long-term opioid use and misuse. Our initiative to promote culture change around opioid use resulted in a significant decrease in the number of these drugs prescribed at HSS, as well as a new set of guidelines and best practices. (Read more about this initiative on page 8.) In the coming months and years, we plan to take on shared priority areas of research ranging from bone health to periprosthetic joint infection.

As we look ahead, fresh opportunities to impact the world of musculoskeletal health and rheumatology present themselves, including issues of industry compliance standards, crisis management and sustainability. We are much stronger when we see these trials as occasions to make a true difference — and when we face them united. What moves us forward moves us all.



Mary K. Crow, MD
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Lionel B. Ivashkiv, MD
Chief Scientific Officer
Richard L. Menschel Research Chair
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Professor of Medicine and Immunology

HSS by the Numbers

As the oldest orthopaedic hospital in the United States, and the only hospital of its kind worldwide, HSS is a global leader in musculoskeletal conditions and rheumatologic diseases. Here are some of the ways we measure our impact on complex care.



#1

in the US
for orthopaedics for 10 consecutive years, as ranked by *U.S. News & World Report* on its “Best Hospitals” list (2019–2020).



#3

in the US
for rheumatology, as ranked by *U.S. News & World Report* on its “Best Hospitals” list (2019–2020).



Best

in the New York metro area for pediatric orthopaedics, as ranked by *U.S. News & World Report* on its “Best Hospitals” list (2019–2020).

494,076

hospital outpatient visits in the 2018–2019 academic year

29,300+

medical professionals from 130 countries choose HSS eAcademy® for continuing medical education

\$46 million

value of total federal research grants at the end of the 2018–2019 academic year

33,718

surgeries performed in the 2018–2019 academic year

821

hip and knee revision surgeries performed in the 2018–2019 academic year

7.24 million

unique visitors to our website (HSS.edu) in the 2018–2019 academic year

951

research papers published in the 2018–2019 academic year

25+

professional and collegiate organizations for which HSS provides care and serves as team physicians

84

countries patients traveled from for hospital services in the 2018–2019 academic year

47

active research registries at HSS, with more than 195,000 patients enrolled



Top

ranked orthopaedic residency program in both reputation and research output by the professional healthcare network Doximity



5

consecutive years HSS has received the **Healthgrades Outstanding Patient Experience Award™** (2015–2019)



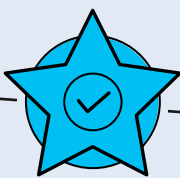
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consecutive years HSS has received the **Press Ganey Guardian of Excellence Award in Patient Experience**, a nationally recognized symbol of achievement in patient experience



First

Press Ganey Pinnacle of Excellence Award in Patient Experience, given to HSS in 2019, for maintaining consistently high levels of excellence over multiple years in inpatient care



11+

years HSS has scored in the **99th percentile — the highest possible rank — on “Likelihood to Recommend,”** a key indicator of customer satisfaction, compared to other Magnet hospitals in the Press Ganey database



4

consecutive **Magnet designations from the American Nurses Credentialing Center**, the highest award for nursing excellence. HSS was the first hospital in New York State to achieve Magnet designation four consecutive times.

LOCAL + GLOBAL LEADERSHIP

From new guidelines for appropriate pain management to the next generation of surgical tools, the innovations tested and developed by HSS experts set global standards. Bringing those advances to hospitals and clinicians around the world is a vital part of our mission.





Orthopaedic surgeon Mathias Bostrom, MD, teaches Chinese surgeons and trainees through the HSS China Orthopaedic Education Exchange.

Opioid Stewardship Initiative Reaps Dramatic Results

In 2017, HSS launched a Controlled Substances Task Force — a major part of a comprehensive effort to promote culture change around opioid prescribing — and implemented guidelines around opioid use. Since that time, HSS clinicians have prescribed approximately 1 million fewer opioid pills, standardized how high-risk patients are identified and also augmented provider and patient education. The pathway below represents a patient journey through the pain management process.

27%

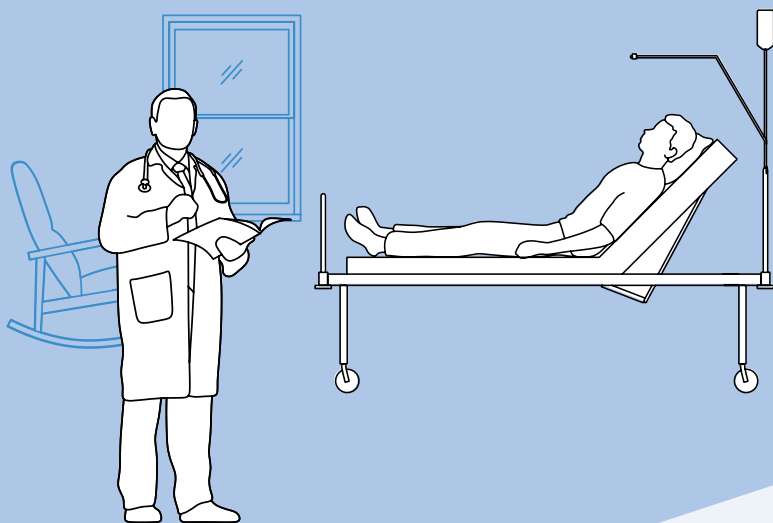
Amount by which doctors who had previously prescribed higher-than-average quantities of opioids lowered their monthly average prescriptions after receiving advanced training

34%

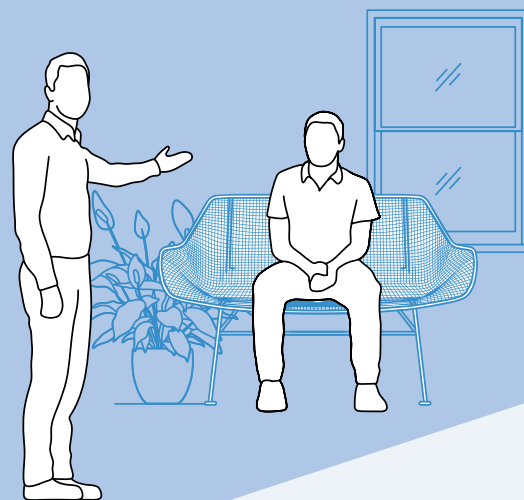
Reduction in length of stay thanks to preoperative screening for complex patients

“We’ve made it consistent for everyone prescribing at every circumstance by standardizing what prescriptions are given according to procedure, though doctors can still use their clinical judgment.”

— Seth Waldman, MD, Director of Pain Management at HSS



2



1

SCREENING

Before surgery, complex patients are screened and those at high risk of opioid dependency are identified. In 2019, HSS began receiving naloxone rescue kits as part of the New York State Opioid Overdose Prevention Program, which are dispensed at discharge to all high-risk surgical patients along with in-person training on how to use them.

EDUCATION

Patients are given materials including opioid fact sheets and videos on proper postsurgical opioid use. Clinicians are also required to complete prescriber education modules and are briefed on short-term surgical patient/provider opioid agreements. Clinical teams implement taper schedules and refer patients to appropriate substance use disorder groups and facilities.

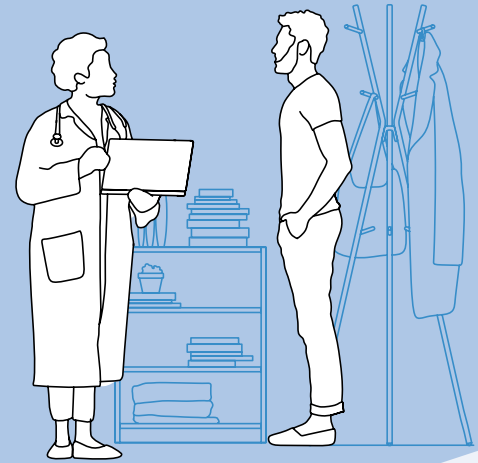
3



MONITORING

As patients move through the pre- and postoperative processes, their progress is scrutinized through electronic health records, including prescription flow, amount of opioids prescribed and whether they are used appropriately.

4



FOLLOW-UP

Clinicians implement strategies to minimize opioid use and wean medications after recovery, including developing a weaning plan, providing tapering educational materials and maximizing adjuvants and non-opioid medications. Patients are encouraged to dispose of unused prescriptions after surgery through a locked drop box provided in an accessible area in the hospital, as well as through DisposeRx® opioid disposal packets. Patients also receive educational materials about opioid disposal.

HSS Pain Management Guidelines

HSS gathered a multidisciplinary panel of experts in 2018 to craft a consensus statement on appropriate pain management for total hip and knee arthroplasty. At right are recommendations for prescribers, clinical teams and institutions.

- **Identify at-risk patients** and their need for complex pain evaluation.
- **Confirm which clinician has responsibility** for each patient's pain management plan.
- **Address risk stratification and mitigation**, including understanding the spectrum of risks and educating clinicians on substance use disorder issues.
- **Establish opioid-responsible prescribing and education.**
- **Align communication**, including scripting uniform messages for clinicians to discuss patients' expectations for surgery and pain management and establishing clear protocols for transitions in care.
- **Ensure non-opioid-based comprehensive pain management**, including multimodal and regional anesthesia strategies and measuring patient-reported outcomes and clinician prescribing patterns.
- **Advance the understanding** of novel analgesics, techniques and care of opioid-tolerant patients.



A Data-Driven Approach to Choosing a Sport

Parents enroll their child in sports for two main reasons — because of their child’s interest and to increase their child’s physical activity, according to a national survey by HSS and the Aspen Institute Sports & Society Program. The Healthy Sport Index, a first-of-its-kind tool that assesses the health benefits and risks of 20 high school boys’ and girls’ sports, including football, soccer, baseball, cross country, volleyball and cheerleading, can help them evaluate which sports may be the best fit.

HSS and the Aspen Institute, an educational and policy studies organization based in Washington, DC, created the tool to provide data-driven analysis of the most popular sports for adolescents. Users can customize which of three priorities is most important in their child’s sport: physical activity, safety or psychosocial benefits. The tool then offers recommendations based on the best available data and expert analysis. Visit HealthySportIndex.com to try it out.

Expanding Use of Regional Anesthesia in Ghana

A training program that began in 2018, led by HSS anesthesiologist Swetha R. Pakala, MD, is enhancing the quality of perioperative care by training physicians in limited-resource settings to perform peripheral nerve blocks. As part of the initiative, Dr. Pakala and anesthesiologist Mark A. Brouillette, MD, traveled to Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana, where they designed and implemented a teaching curriculum tailored to the needs of the hospital. As a result of the training, KATH has reported that over a period of three months before and after the program, peripheral nerve block use as the primary anesthetic for upper extremity surgery increased from 44% to 63%, and the overall number of nerve blocks increased from 48 to 118.

Former HSS fellow Ben Johnson, MD (in blue scrubs), helps train local Ghanaian physicians.





Integrating Virtual Reality into Real-World Training

Pilots have long used flight simulators to learn how to fly new aircraft and perform high-risk maneuvers. Today, surgical simulation plays an increasing role in training orthopaedic residents, for many of the same reasons.

The Bioskills Education Laboratory (BSEL) is home base for simulation education at HSS. It opened in 2000 mainly as a sawbone laboratory and quickly expanded to give residents the opportunity to work with cadavers. From the start it was stocked with state-of-the-art equipment for residents to learn arthroscopy and surgical techniques.

Today, with radiolucent operating room tables, ceiling-mounted operating room lights and video recording — as well as suction, irrigation and electrical power — the lab offers residents and fellows a realistic immersion experience. Recently residents also have been testing virtual reality simulations, as shown above, that take them step-by-step through tasks such as complicated knee surgeries. While not yet a routine part of the BSEL, such simulations could in time provide additional opportunities for residents to learn and practice procedures.

Resident Cynthia Kahlenberg, MD, with Bioskills Education Laboratory manager Justin Dufresne, CST, practicing with virtual reality simulation in the BSEL. Residents first encounter the BSEL during the admissions process, when applicants go to the lab for assessment of hands-on skills like suturing.

Surgical simulation has become such an important element of resident training that a new Simulation Education Advisory Council will provide strategic oversight as HSS continues to innovate with this technology. The lab and its simulation environment also offer opportunities for medical students, physician assistants and others to hone their skills.

ADULT ORTHOPAEDICS

Every member of our multidisciplinary orthopaedics team — from surgeons and radiologists to biomechanics experts and laboratory scientists in the HSS Research Institute — is dedicated to delivering and advancing care for orthopaedic patients, tackling issues from the most common to the most complex. It's this deep expertise that allows us to lead the field with uncommon precision and perspective.





Orthopaedic surgeon Steve Lee, MD, was appointed Chief of the Hand and Upper Extremity Service in 2019, succeeding Edward Athanasian, MD.



Clockwise from top: The 3D printed models shown here include a hemi-pelvis, proximal femur, the carpal bones of a hand with a carpometacarpal implant (in blue), and a patient-specific revision flanged acetabular component.

For patients with multiple failed hip surgeries, 3D customized implants offer an effective solution for cases that would otherwise be nearly untreatable.

The Future of Custom Implants, in Three Dimensions

For five decades, orthopaedic surgeons have been replacing badly damaged and diseased joints with implants made of plastic or metal. They have sought the best materials, shape and porosity to ensure optimal bone growth. When a joint replacement is successful, it's transformative for the patient — vastly improving the individual's function and quality of life.

While off-the-shelf implants work well for the vast majority of patients, they don't succeed in all situations, including complex hip replacement cases and repairs to the carpometacarpal joint in the thumb.

The ultimate goal for joint replacements is to design an implant that optimizes bone ingrowth. This ensures that the components will stay in place for the rest of a patient's life, without the need for bone cement for fixation. Additive manufacturing technology — or 3D printing — offers orthopaedic surgeons a customized solution that can be tailored to an individual patient's needs, akin to precision medicine treatments in cancer. Having a customized implant with enhanced bone ingrowth potential is particularly important for patients with more complex conditions, often from prior implant failure.

HSS has long been an innovator in joint replacement surgery, creating the first modern knee replacement system in 1974. Now HSS surgeons and engineers are playing a leading role in advancing applications of 3D-printed joints for orthopaedic surgery. By mid-2020, HSS and its strategic partner, LimaCorporate, an Italian company that has been using additive manufacturing for joint replacements for more than a decade, will open the first-ever laboratory on a hospital campus to produce customized components for joint replacement through additive manufacturing.

Already under construction, the new facility will mark an important inflection point in the development of 3D-printed implants for orthopaedic surgery at HSS, explains Timothy Wright, PhD, who heads up the institution's Department of Biomechanics upstairs from the site of the new laboratory.

"The ongoing mission of HSS is to improve patient care," Dr. Wright explains. "We are confident that with this new technology, we can solve problems that we can't solve with existing technology. It's exciting to create the opportunity to collaborate with a company that's on the cutting edge of orthopaedic devices."

The FDA-regulated commercial facility will make patient-specific implants, while another arm of the operation will focus on research and development, in collaboration with HSS. "It's going to get us to 3D-printed solutions a lot faster than if we were trying to do it on our own, or they were trying to do it on their own," Dr. Wright says. "It's a marriage made in heaven as far as we're concerned."

An example of the promise of additive manufacturing would be repairing damage to the carpometacarpal joint in the thumb. The joint's deterioration can cause debilitating pain and instability for patients — most of them women over 65 — making it difficult for them to conduct routine tasks. Currently, no surgical implants exist that are effective and long-lasting, explains Dr. Wright. The best that surgeons can often do is to interpose a tendon to provide a cushion between the damaged joint surfaces. This relieves pain, but often doesn't adequately restore full function.

The solution could lie in 3D-printed components that can be tailored to achieve specific porosities and shapes, to better adhere to bone and to fit more snugly within a person's anatomy. That's also the case for total hip replacements, where the surgeon essentially prepares the acetabulum and replaces the hip socket with metal and plastic parts. When these components loosen, surgeons have to perform revision surgery, but serious bone loss often makes an off-the-shelf solution inadequate.

Peter Sculco, MD, is an orthopaedic surgeon at HSS who performs hip and knee replacements, including many revision surgeries. "HSS is the world leader in orthopaedic surgery, and as such is best equipped to handle complex cases," he says. "This collaboration with Lima will allow us to continue to lead the way in discovering innovative ways to manage these challenging cases."

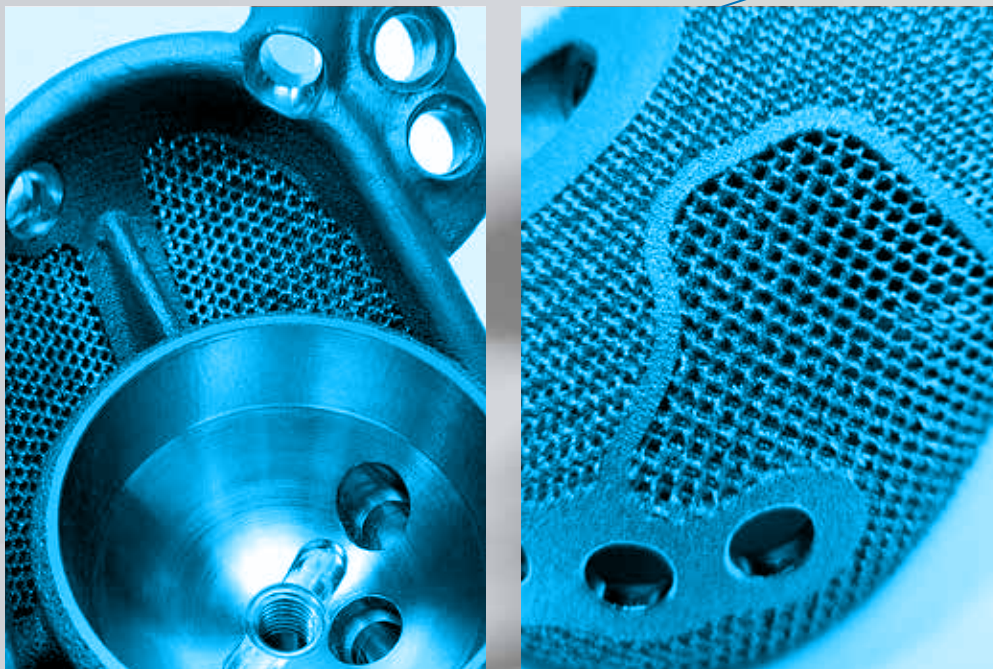
For now, Dr. Sculco remains relatively conservative in employing 3D-printed joints. He reserves the technology for his most complex revision surgeries — about 3 to 5 percent of cases, he says. However, for patients with multiple failed hip surgeries, 3D customized titanium parts offer an effective solution for cases that would otherwise be nearly untreatable. In October 2019, he became the first HSS surgeon

to use a 3D-printed part developed through the Lima partnership.

Dr. Sculco also believes that the application of 3D printing technology will grow with the development of semi-customized implants. He likens the idea to a custom-made suit for which the client chooses between various design options, such as the width of the lapels or the type of vents in the back, as opposed to a totally bespoke suit. He also expects that as the cost of these implants decreases over time, additive manufacturing will be used to solve a growing number of orthopaedic challenges.

Despite the technology's promise, just because something can be 3D printed doesn't mean it should be — a point that's crystal clear to both the surgeons and engineers at HSS, as they look for cost-effective solutions that will produce the best outcomes for patients.

"You can 3D print anything," notes Dr. Wright. "You can 3D print a Tyrannosaurus rex toy for a child; you can see lots of examples on the internet. We're looking for those problems we know we haven't solved yet, and where additive manufacturing can help."



A new collaboration with LimaCorporate will enable HSS to more easily manufacture customized titanium parts like the acetabular cup shown here.



Tailoring Implants to the Finest Detail

HSS researchers are also studying how implant designs might be improved in the future.

Fernando Quevedo González, PhD, who is part of Timothy Wright's team, uses computer modeling, expressed through colorful heat maps, to predict the success rate of different implants—including the currently used and largely unsuccessful metal replacement for the carpometacarpal joint. Bright red represents the most solid materials, while blue shows those that are most porous.

"The main focus of my work is trying to improve the bone-implant interaction," Dr. Quevedo-González explains. "The way they've done it in the past is by changing the geometry of the implant. With 3D printing, we can create porous materials, which means we can control almost everything in there, from the shape to the roughness to the porosity." This means it's possible to construct an implant that is biomimetic, porous titanium that imitates local bone structure, and can range from totally solid to completely porous.

Having the Lima facility right downstairs will be a huge advantage, notes Dr. Quevedo González, who has developed an algorithm that helps determine when additive manufacturing is the best alternative to using off-the-shelf implants. "They have a huge expertise in 3D printing porous material," he says. "What we'll have to figure out is, what is the porosity that works best for our implants? They will hopefully be able to manufacture that."



The Evolving Role of MRI in Joint Arthroplasty

“No one thought we could put a patient with a large piece of metal in their body inside a giant magnet.”

Hollis Potter, MD, Chairman of the Department of Radiology and Imaging at HSS, has spent more than 20 years working to refine a technique that most experts once thought impossible, maybe even unsafe: examining metal joint replacements in the body using MRI.

“This started out as a controversial research question, but it’s become the standard of care here,” Dr. Potter says. “No one thought we could put a patient with a large piece of metal in their body inside a giant magnet.”

Propelling her and her HSS colleagues forward was a belief that MRI would provide distinct advantages over other imaging modalities used to help diagnose complications after arthroplasty. These complications include inflammatory synovitis, caused when plastic or metal debris from an implant wears off, tears in the surrounding tendons and loosening of the implant where it attaches to the bone. Although HSS has very low infection rates after implant surgery, those can occur as well.

Today, Dr. Potter and colleagues have published numerous studies showing that not only is MRI safe for total joint imaging, it's also very efficacious. "An x-ray doesn't show the soft tissue, only the alignment of the implant related to the bone," Dr. Potter explains. "Bone scanning is sensitive, but it's not specific. It can show us signs of abnormal bone turnover but can't explain why it's happening. We've demonstrated that MRI is far and away the most accurate, noninvasive means by which to assess for adverse tissue reactions to the implants."

Orthopaedic surgeon Eduardo Salvati, MD, credits Dr. Potter with helping to advance the understanding of thromboembolism after total hip replacement. "We have learned that clots can on occasion extend to the proximal iliac veins and vena cava," he says. "Likewise we determined the efficacy of pneumatic compression and intraoperative heparin in preventing clots and the adverse effect of prosthetic wear debris to the periprosthetic tissues."

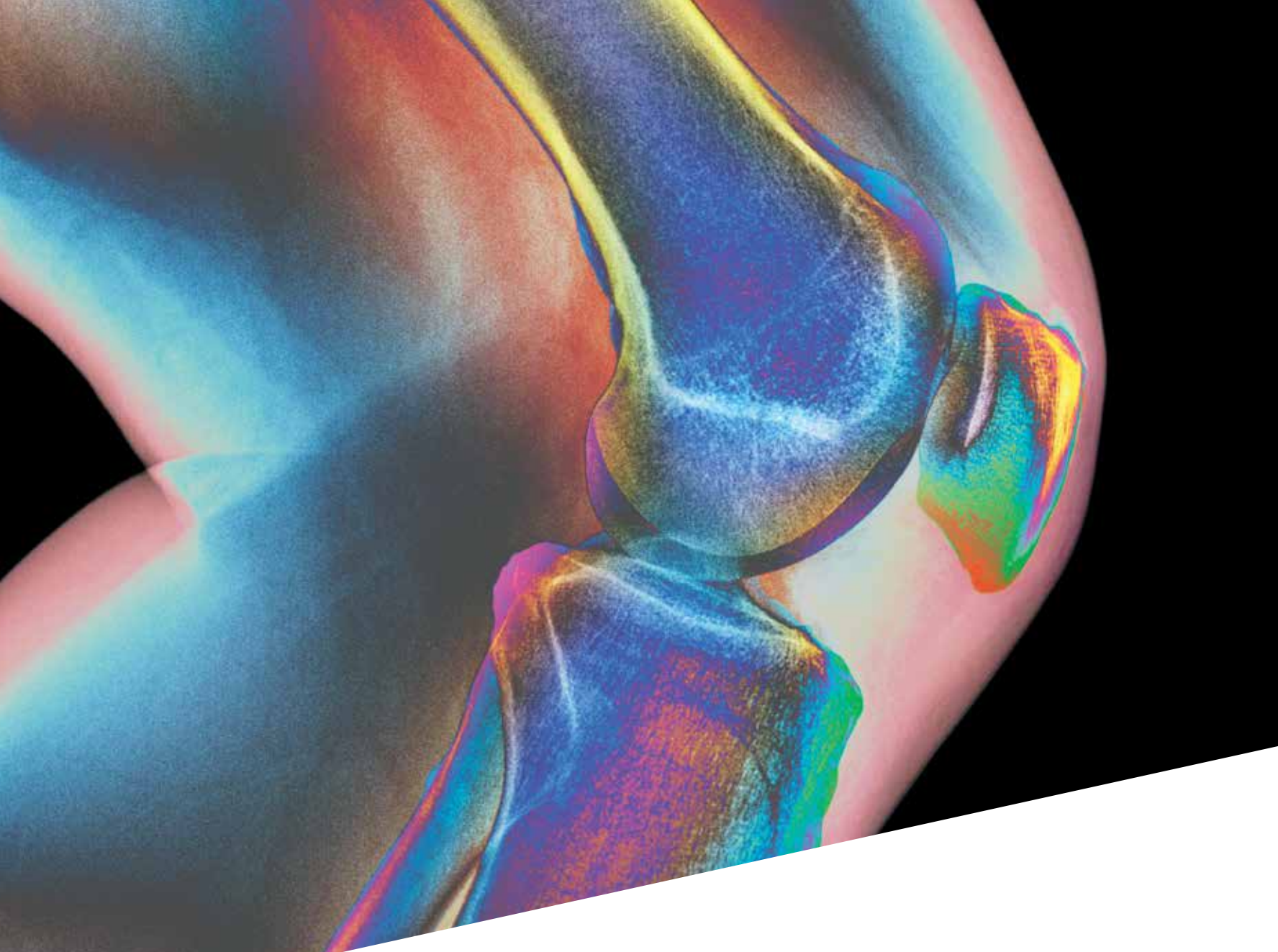
There is a learning curve to the interpretation of MRI following joint replacement, says Dr. Potter, and HSS is fortunate to have radiologists who subspecialize in this area. They collaborate closely with surgeons and pathologists to identify the precise cause of the pain and help develop a means by which to address it. That may entail surgical revision of the implant or repair of the surrounding tissues. In other cases, complications can be addressed with physical therapy and other less-invasive treatments.

"There's a huge demand for this technology, not only from HSS surgeons but from outside surgeons who refer patients experiencing pain related to complications after surgery," Dr. Potter says. "It's so fulfilling to be able to figure out what's going on and to help come up with a treatment plan."

MRI has also emerged as an important study tool for learning how to improve implants. Analysis of the wear from a retrieved implant correlates to findings from the prerevision MRI, suggesting new ways to predict which implants are likely to fail and potentially make corrections. Another promising area of research concerns periprosthetic joint infections, says Dr. Potter. "We're applying different pulse sequences that we believe will be more sensitive to joint infections, in turn helping us make a more accurate diagnosis."



Among other collaborations, radiologist Hollis Potter, MD (above and left), and colleagues have worked closely with physicians both inside and outside HSS to develop better computer code for correcting the distortion that can occur during the processing of MRI images due to the presence of metal in the external magnetic field.



Creating a Novel Model of Post-Traumatic Osteoarthritis

Anterior cruciate ligament (ACL) injury affects as many as 250,000 people in the United States each year, many of them young and physically active. ACL injury, whether managed surgically or not, substantially increases the risk of developing post-traumatic osteoarthritis (PTOA), a faster-progressing form of osteoarthritis that often requires patients to undergo knee replacement at an early age.

New methods to detect PTOA in those with known risk factors are needed, but a lack of symptoms early on in the disease process has hindered their development. Now Scott Rodeo, MD, and colleagues have established a novel model of PTOA in mice, induced by noninvasive ACL rupture, which could help elucidate the factors leading to PTOA and lead to early interventions.

“The next frontier in ACL injury is finding out how we can intervene immediately following injury to maximize protective factors while minimizing harmful ones,” says Dr. Rodeo. “The model will further our understanding of how mechanical loading and metabolic factors affect cartilage adaptation.” Ultimately, Dr. Rodeo hopes the work will result in rehabilitation protocols that can help to normalize joint mechanics and improve cartilage health in at-risk patients.

Researchers and clinicians in the lab of Scott Rodeo, MD (far right), are investigating the basic cellular and molecular mechanisms of healing damaged tissues, including in the knee.

To Advance Regenerative Medicine, Laying a Foundation of Evidence

The field of regenerative medicine is rapidly evolving. In the new Center for Regenerative Medicine at HSS, clinicians are studying these cutting-edge therapies and overseeing their use in patients. Director Scott Rodeo, MD, a sports medicine orthopaedic surgeon who was recently appointed Vice Chair of Orthopaedic Research at HSS, leads the institution's efforts in this area.

WHAT IS THE GOAL OF THE CENTER FOR REGENERATIVE MEDICINE?

Regenerative medicine holds tremendous promise for many musculoskeletal conditions, including arthritis, tendon and ligament injuries, spine disorders, avascular necrosis, scleroderma and arthrofibrosis. But there is an urgent need for clinical and translational research studies that allow physicians to devise, test and evaluate evidence-based treatment plans. Our research program partners with the HSS Research Institute as well as clinicians and researchers across HSS to do that work. Our goal is to carry out the necessary studies to ensure safe treatment options are available for patients as quickly as possible. We also are studying the composition and biologic activity of the specific formulations given to each patient and correlating those formulations with clinical outcomes.

WHAT CHALLENGES DOES THE CENTER ADDRESS?

Laboratory studies suggest strong potential for biologics such as platelet-rich plasma injections and cell-based therapies to improve the healing of tissues with relatively poor intrinsic healing ability. But the clinical data to support use of these techniques are currently very limited. A large number of unproven therapies are being marketed directly to consumers, with unsubstantiated claims of efficacy and lack of information about risks, product manufacturing and realistic expectations of outcomes. Our center is ideally positioned to work through these issues given our substantial patient volume and our highly specialized clinicians and scientists.

WHAT CLINICAL STUDIES ARE CURRENTLY UNDERWAY AT HSS?

Current research includes studies of cell-based therapy to facilitate tendon healing following surgical repair of rotator cuff tears and recombinant growth hormone use to prevent muscle atrophy in patients undergoing anterior cruciate ligament reconstruction and then returning to full activity.

Ankle Replacement Shows Potential as Alternative to Fusion

Arthroplasty for the treatment of osteoarthritis is much less common for the ankle than the knee and the hip, largely due to challenges posed by the anatomic constraints and biomechanics of the ankle itself.

Increasingly, however, HSS surgeons are taking a second look at ankle arthroplasty as an alternative to ankle fusion. Over the past several years, HSS has expanded its program in ankle arthroplasty, offering it not only as an alternative to fusion surgery but also as part of revision surgery to correct or repair previous fusions.

“Compared with fusion surgery, ankle arthroplasty has a greater potential to minimize pain and restore function and range of motion — particularly when it’s conducted at a high-volume hospital like HSS,” says Constantine Demetracopoulos, MD, an orthopaedic surgeon on the Foot and Ankle Service at HSS.

In 2018, Dr. Demetracopoulos and colleagues published a retrospective analysis of 64 ankle arthroplasties done at HSS between July 2014 and April 2016. All the patients in the study received the Infinity total ankle implant. Results were positive: More than 95% of people were able to keep the implant, and most complications were minor and were successfully treated, either with a single reoperation procedure or nonoperatively.



Because these implants are still relatively new, the team is currently working on another study with longer-term follow-up. Moreover, as newer ankle implants are introduced, surgeons at HSS maintain their commitment to studying how these implants perform in patients over time.

Many of the advances in ankle surgery at HSS can be credited to collaborations between surgeons and members of the biomechanics team, who have published studies involving a cadaveric robotic gait simulator, which can directly measure ankle and hindfoot kinematics after ankle arthroplasty. This research has allowed the team to assess how different arthroplasty implants and designs behave once implanted in the ankle.

The biomechanics and surgical teams are continuing to work together on this project. “We hope to uncover the clinical implications for implant design and positioning and how these factors affect ankle movement and pain,” Dr. Demetracopoulos says.

The robotic gait simulator shown below is designed to reproduce the human step. Researchers utilize the information gained from the simulator to build finite element analysis models.



Taking Back Pain into the Lab

Back pain is one of the top reasons that workers take sick days. Experts estimate that it costs the US economy hundreds of billions of dollars a year in lost productivity and medical expenses.

Yet despite its prevalence, there is still a lot that remains unknown about back pain and how best to treat it. Researchers at HSS are going into the lab to address some of the most fundamental questions about back pain and its causes. Their ultimate goal is to develop new interventions that are more effective and longer lasting.

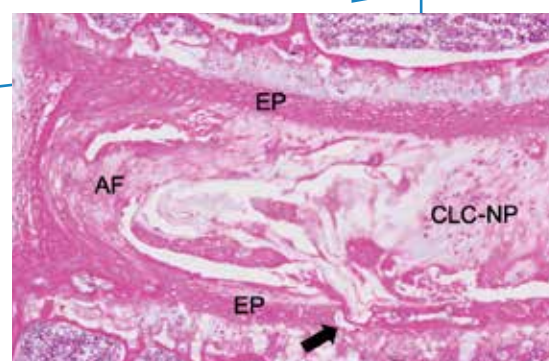
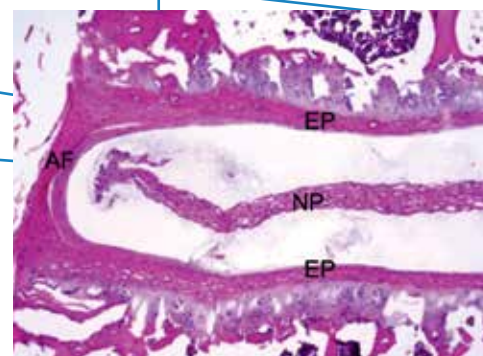
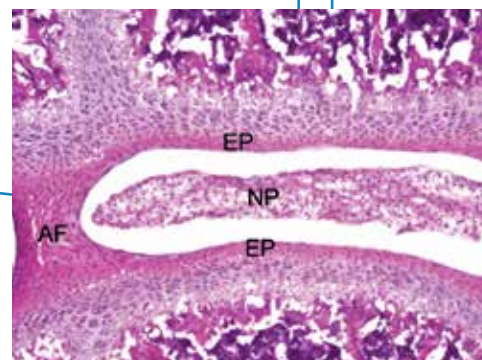
“We know that many of the back problems we see — such as herniated discs, spinal stenosis and pressure on the nerves and spinal cord — are caused by disc degeneration,” says HSS orthopaedic surgeon Todd Albert, MD, Surgeon-in-Chief Emeritus. “Unfortunately, disc degeneration is a natural part of the aging process.

“There’s currently no cure for the degeneration of intervertebral discs,” he adds. “Treatments like pain medication and physical therapy are only palliative. They are not effective long term and don’t get at the root of the problem. Even surgery doesn’t always eliminate pain, because problems can move to other parts of the back. We’re interested in developing a better way.”

Scientist Chitra Dahia, PhD, of the HSS Research Institute, is studying the role of molecular signaling, which is crucial for embryonic development, in the growth and maintenance of spinal discs. The goal is to find whether targeting these signals in aging adults can recapitulate developmental processes, inducing degenerating discs to form new tissue and replace what’s been lost.

She has created mouse models for studying the molecular signals involved in the growth and maintenance of healthy spinal discs that are lost in degenerated discs. In a number of studies published over the past several years, she has described the role of Sonic hedgehog, an important regulator of embryonic development, in the process. “We are hoping to identify a small molecule that’s capable of reactivating these key signaling pathways in the aging and degenerated discs,” she says.

One important part of this work has been validating that mice are a reasonable model for studying a very human phenomenon. “Because mice are quadrupeds and humans walk on two legs, there may be differences in our spines,” Dr. Dahia notes. “But we have found that intervertebral discs in mice age in a way that’s physiologically similar to humans.” Another crucial aspect of the research involves studying samples of disc tissues taken from patients, to confirm that the signaling pathways seen as crucial in mice are the same as the ones in humans.



The above are representative images of H&E stained mid-coronal sections through the mouse lumbar disc at (from top) one week, one year and two years of age. Age-related pathological changes include loss of nucleus pulposus (NP) cells and differentiation into chondrocyte-like phenotype (CLC-NP), cleft and rears in annulus fibrosus (AF) cells and formation of Schmorl’s node (arrow) in the end plate (EP) by two years.

The researchers hope to eventually develop medical treatments that could trigger the regeneration of lost disc tissue. “Ideally, we’d like to be able to replace surgery with a therapy that is a better long-term solution and doesn’t carry surgery’s risks,” Dr. Albert says.

“There is still so much we don’t know,” he concludes. “Some people have a lot of degeneration but don’t experience any pain. Others have very little degeneration but have horrible pain. The holy grail is to be able to figure out how to prevent discs from degenerating in the first place, and to predict which people are likely to need interventions to prevent it.”

PEDIATRIC ORTHOPAEDICS

This year, innovations in technology drove a large portion of our efforts to enhance the care we offer our youngest patients at the Lerner Children's Pavilion at HSS. Initiatives at HSS are seeking to minimize exposure to unnecessary treatments, optimize procedures for younger populations and collect feedback on patient and family experience to customize care that fits their needs.





Roger Widmann, MD, Chief of the Pediatric Orthopaedic Surgery Service at HSS, regularly performs complex spinal procedures using surgical robots.



A Robotic Solution for Complex Pediatric Spinal Surgeries

Surgical navigation has been integrated into operating rooms across the country, including at HSS, even as huge advancements have taken place in robot-assisted technology. HSS was an early advocate and adopter of this new generation of surgical robots, recently implementing two Mazor X Stealth robots in the main operating room for use in complex spinal surgeries.

Technologically, the platform provides redundant spine navigation systems, with outstanding surgical planning software that offers greatly enhanced real-time visualization, says Roger Widmann, MD, Chief of the Pediatric Orthopaedic Surgery Service at HSS, who has been using the technology since June 2019 to assist with the placement of pedicle screws during surgery for pediatric spinal deformities caused by scoliosis or kyphosis. "It's like surgical navigation on steroids," he adds.

Dr. Widmann says he has found that the robotic image guidance system enhances the accuracy and reliability of screw placement, and hopes this will translate into improved safety and better clinical outcomes for patients. Over time, he envisions the technology leading to secondary benefits including smaller incisions, less blood loss and lower infection rates. Preliminary accuracy and reliability data are outstanding, he adds, and utilization of the robots for all types of spine surgery continues to accelerate at HSS.

In the future, Dr. Widmann expects the robotic navigation capabilities to be expanded to include many other aspects of pediatric orthopaedic surgery.

Dr. Widmann says he has found that the robotic image guidance system enhances the accuracy and reliability of screw placement.

Getting a Better View during Complicated Foot and Ankle Surgeries

Pediatric orthopaedic surgeons at HSS have incorporated a variety of surgical navigation and other enhanced visualization technologies into foot and ankle procedures over the last several years to improve accuracy — and potentially results. Here, Peter Fabricant, MD, MPH, and David Scher, MD, explain in their own words how blending these techniques has helped make them more precise and confident during these often-challenging repairs.

PETER FABRICANT

About a year ago, I began merging intraoperative scanning with arthroscopy for minimally invasive surgery on adolescent patients with transitional ankle fractures. This is a relatively rare fracture involving a still-open growth plate.

Arthroscopy offers both functional and cosmetic benefits. Since these fractures tend to be in the front of the ankle where we lace shoes, a big incision can be uncomfortable there. The incision for an arthroscopic procedure is about 5 mm wide, as opposed to the 5 cm one required in the traditional open approach, with much less dissection of the soft tissues around the ankle joint and growth plate. Furthermore, visualization of the entire joint is frequently better with an arthroscope than with an open approach, which is best suited for seeing the front of the joint.

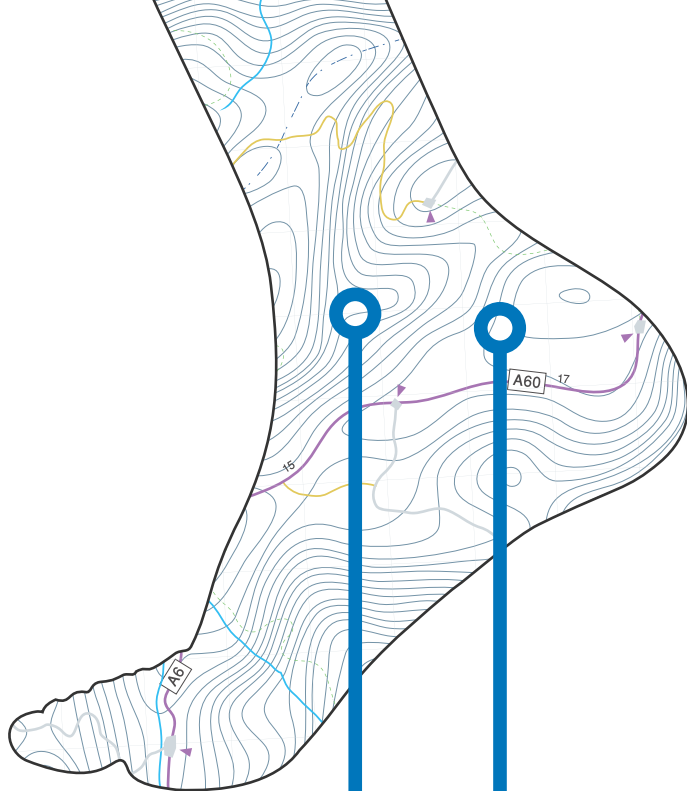
Intraoperative scanning also offers enhanced view with more detail than x-ray, but without the radiation level of a CT scan. These two techniques together provide sufficient visualization to help me obtain anatomic joint alignment and avoid placing screws too close to the growth plate or joint surface, which is vital to preventing potential bone deformities or osteoarthritis later on.

DAVID SCHER

I use intraoperative 3D fluoroscopic imaging along with surgical navigation to improve the accuracy of tarsal coalition surgery, a procedure that removes an abnormal connection between bones in the foot that can cause pain and limit motion.

We began using intraoperative 3D fluoroscopy in pediatric foot and ankle procedures at HSS about five years ago to improve the outcomes of our surgeries. About two years ago I added surgical navigation to enhance the accuracy of the surgery. This technology allows me to be very confident I'm getting out exactly what I want, not leaving any bone behind and not injuring any healthy bone or cartilage.

At the moment, we're prospectively studying our results to better understand who will benefit most from these procedures and assess their outcomes. Down the road, these technologies may allow us to develop minimally invasive techniques.



An arthroscopic view of the anatomically aligned tibial joint surface after image-guided reduction and fixation of a triplane ankle fracture.



A navigated probe is used to optimize the location of the incision for resection of a talocalcaneal tarsal coalition.

Revolutionizing Spinal Imaging — without Radiation

In 2019, HSS embarked on implementing a novel method of spinal imaging that does not require ionizing x-ray radiation — particularly important for adolescent idiopathic scoliosis patients.

For years, experts have sought new and innovative methods to minimize radiation exposure for adolescent idiopathic scoliosis patients, who typically require between 10 and 25 x-rays over the course of their treatment to assess skeletal alignment and curve progression. In 2013, HSS took a major step toward that goal with the introduction of EOS imaging, an ultra-low-dose x-ray system that scans patients in a standing position. While the technology has dramatically reduced radiation exposure in these patients versus traditional x-rays, in 2019 HSS embarked on implementing a novel method that does not require ionizing x-ray radiation.

The initiative will focus on refining the use of 3D surface imaging technology to map skeletal alignment in scoliosis patients and has brought together more than 20 different experts from across HSS, including those from pediatric orthopaedics, motion analysis and radiology, as well as scientists from Technion Israel Institute of Technology.

The imaging process used by the technology, called 3dMD, is known as stereophotogrammetry. A patient stands in a small room while 30 high-resolution cameras capture images of their body. “The images are extremely precise, with sub-millimeter accuracy,” says Howard Hillstrom, PhD, Director of the Leon Root, MD Motion Analysis Laboratory at HSS. “We may also capture this 3D topographic data for slow movements, such as forward bending, at 10 frames per second.” The overarching goal is to feed the observed surface topography into a machine learning algorithm to estimate spinal alignment in a variety of poses — without any radiation.



“Unlike EOS imaging, which takes 5 to 10 seconds to capture an image, with 3dMD it takes only two thousandths of a second to get a 3D assessment of the patient’s entire body, from the top of their head to the bottom of their toes,” says Roger Widmann, MD, Chief of the Pediatric Orthopaedic Surgery Service at HSS. While the technology has been used for years for cranial facial reconstruction, HSS is leading the development and implementation of high-resolution scanning in orthopaedics.

Before 3dMD can be adopted as the primary screening tool in scoliosis patients, the team of researchers at HSS and Technion must develop and validate surface topography-based parameters that can reliably estimate spinal alignment and body symmetry, says Dr. Hillstrom. “There’s sometimes a significant discordance between internal anatomy — which can be seen on an x-ray or CT scan — and how the spine looks from the outside,” explains Dr. Widmann.

HSS has started a registry to track patients who have undergone both 3dMD scans and EOS studies — data that can be used in conjunction with clinical and patient-reported outcomes measures so that researchers can begin to develop and validate clinically relevant and patient-centered parameters. The end goal is to enroll 2,000 patients. “It’s going to take a lot of data to draw accurate conclusions,” Dr. Widmann says. “We do have a specific question here, whether we can accurately and reliably correlate 3D skeletal anatomy with surface topography. There are also many other interesting questions that you can answer with such a huge data set.”

Down the line, Dr. Widmann hopes to not only expand use of the 3dMD system among adult spine and arthroplasty surgeons at HSS, but also to explore using it in other innovative ways, such as in combination with motion capture technology to analyze patients’ walking patterns and joint movements. Another possibility may be to use it for scanning residual limbs for prosthetics, instead of using plaster casting. “The 3dMD system has the potential to become a standard imaging modality in orthopaedic surgery,” says Dr. Widmann. “Here at HSS, we have to prove it, so that’s exactly what we’re doing.”

These surface reconstruction images were created by the 3dMD system, showing a patient in a torso twist, with arms elevated at a 45-degree angle, and in the standard posture for EOS imaging.



Pain



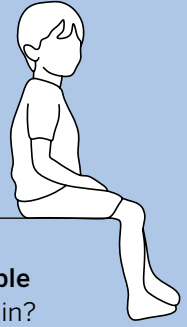
Did you ever **miss school** because of your injury?

Activity



Are you **able to have fun** with your friends?

Rest



Did you ever have **trouble sleeping** because of pain?

Mobility



Did your injured **knee ever get stuck** in place (lock) so that you could not move it?

Emotion



Was it hard to **get along with other people** because you were in pain?

Function



Can you do **very hard activities**, like jumping or turning fast, in basketball or soccer?

The questions above are based on examples of pediatric PROMs measures taken at HSS.

The Advent of Age-Appropriate PROMs

For most 12-year-olds, ease of commute on public transit is not an appropriate question to measure the success of an orthopaedic surgery outcome. In recent years, the need to change adult-centric questions on pediatric patient-reported outcomes measures (PROMs) — and instead to compile relevant, actionable data — became apparent to the HSS Pediatric Orthopaedic Surgery Service. A major initiative to collect these data from new patients has resulted in an immense uptick in responses, positioning HSS to leverage this information for enhanced clinical decision-making as well as clinical outcomes research.

The HSS clinical team successfully overcame shifts in culture, workflow and technology use to universally implement the new pediatric PROMs over the past year, gathering data from about 98% of pediatric patient new visits.

“As of this year [2019], we now consider this part of the standard of care, like recording height, weight and blood pressure at the beginning of an exam,” explains HSS pediatric orthopaedic surgeon Peter Fabricant, MD, MPH, who has helped lead the effort. “We’re collecting PROMs from every new patient and most postoperative patients to understand how our treatment is performing not only in any given patient but also across groups of injury types. Because we’re collecting this as patients come into the office — seamlessly, electronically and while protecting patient privacy — we’re getting much more complete data.”

Meanwhile, Dr. Fabricant and team are working to make continual improvements to the actual outcomes measures themselves. Future versions of PROMs can be computer adaptive and will tailor questions to specific patients and conditions, paring down the number of questions asked based on patients’ prior responses.

“This is something people are really buying into on a national level,” he adds. “The hurdle is really the implementation. It takes time, effort and resources, but it’s doable and it’s going to be a good thing for our field.”

Focus on ACL Tears: Keeping Young Athletes on the Field

Anterior cruciate ligament (ACL) tears are becoming increasingly common among children and teenagers, as more young people participate in competitive sports. This type of knee injury can be debilitating for young athletes and can lead to long-term risks including reinjury and arthritis. Yet there is no single standard of care for treating them.

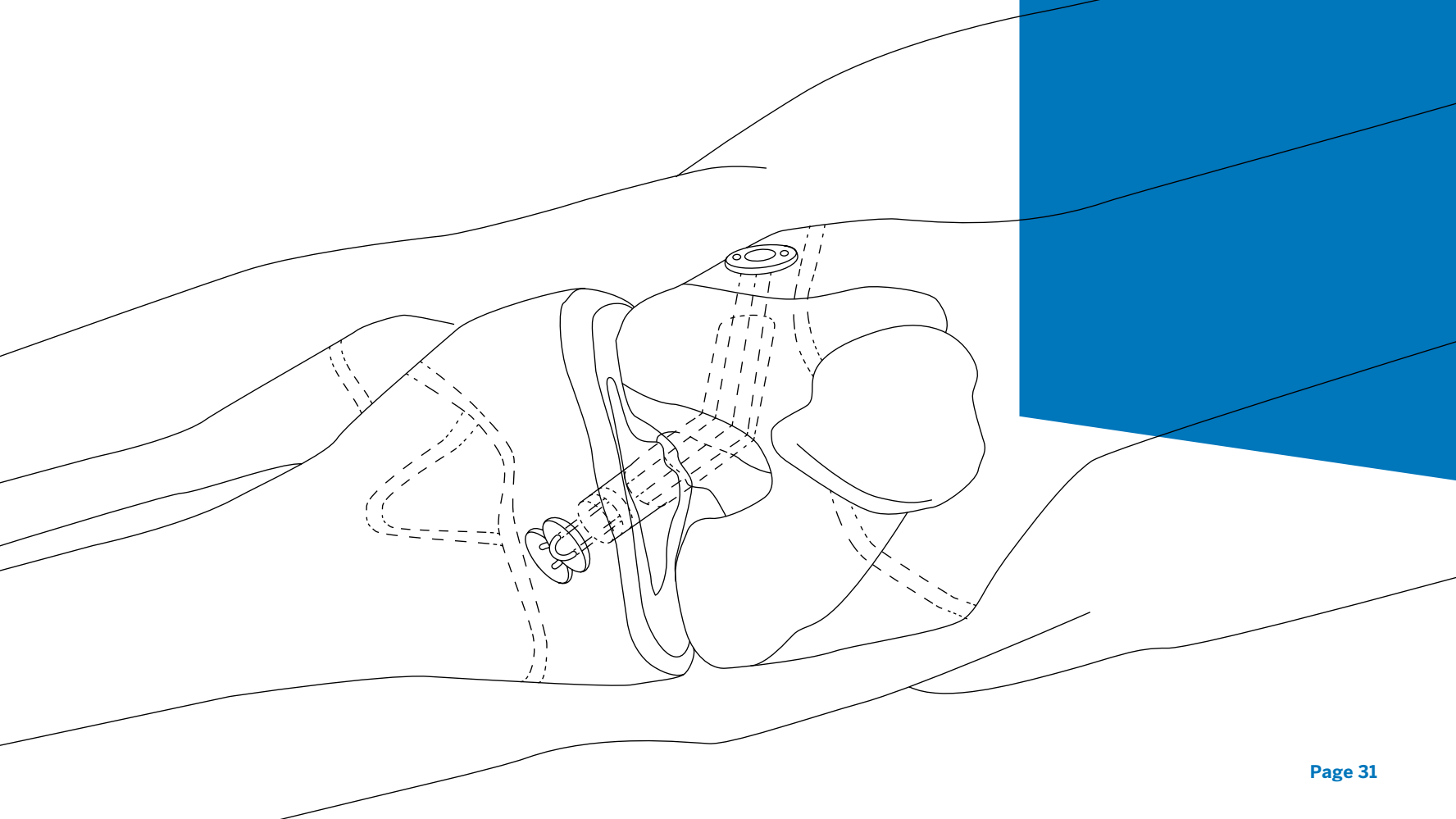
HSS pediatric orthopaedic surgeon Daniel Green, MD, says he now sees younger people with ACL injuries on a weekly basis. In 2019, Dr. Green and colleagues published a study in the *American Journal of Sports Medicine* that prospectively looked at 324 athletes under age 20 who underwent surgery for ACL reconstruction. It evaluated surgical effectiveness based on the rate at which the participants returned to sports and the number of second surgeries required over at least two years of follow-up.

The study reported that patients who underwent partial transphyseal and complete transphyseal surgery with a hamstring autograft had higher re-injury rates than those who underwent either the all-epiphyseal technique with hamstring autograft or a bone-tendon-bone autograft. The research also confirmed that adolescents ages 12 to 15 have a higher rate of recurrence than patients under 12 years of age or between 15 and 20.

To get to a deeper understanding of the optimal treatment for young people with these injuries, HSS is one of 10 hospitals around the United States participating in a multicenter trial called PLUTO (Pediatric ACL: Understanding Treatment Outcomes), which compares four different surgical procedures as well as nonoperative treatments.

“One thing that’s important to note about this study is that no patients will get experimental treatments,” Dr. Green adds. “We are hopeful that by comparing treatment methods, we’ll learn much more about their short-term and long-term effects, so that we can find the best way to get our young patients back to their active lives as quickly and safely as possible.”

The diagram below illustrates an all inside, all epiphyseal pediatric ACL reconstruction, one of several types of pediatric ACL reconstructions done at HSS. Recent studies of HSS patients have demonstrated an ACL re tear rate of only 6% with this type of reconstruction.



RHEUMATOLOGY

The rheumatologists at HSS are among the best and most experienced in the nation. Every day, our clinicians and scientists collaborate across departments, including with colleagues in adult and pediatric orthopaedics, to solve the mysteries of rheumatologic diseases, while helping those with the most complex cases live more full lives.





*Dr. Medha Barbhaya
Department of Medicine*

Michael D. Lockshin, MD

Rheumatologists Medha Barbhaya, MD, MPH, and Michael Lockshin, MD, are members of the Barbara Volcker Center for Women and Rheumatic Diseases at HSS. The first of its kind in the United States, it brings together scientists, rheumatologists, orthopaedists, endocrinologists and obstetrician/gynecologists to improve quality of life for women with rheumatic disease.

A New Outlook on Pregnancy in Women with Lupus

Until just a few decades ago, women of reproductive age with certain rheumatic diseases were told that they should not become pregnant because of the risks both to them and to their unborn children. Fortunately, advances in diagnosis and treatment have dramatically improved outcomes for people with rheumatic disease, including women wishing to become pregnant.

“In the 1980s, experts started to recognize that women needed to be in remission from their disease when they tried to get pregnant,” says rheumatologist Bella Mehta, MBBS, MS. “There also began to be more emphasis placed on good communication between rheumatologists and maternal-fetal medicine specialists.”

“This study showed us that ... women are having successful deliveries,” says Dr. Mehta.

But to what degree these advances have impacted pregnancy in women with rheumatic disease has not been clear. In 2019, Dr. Mehta and colleagues published a study in the *Annals of Internal Medicine* that looked at pregnancy outcomes between 1998 and 2015 in women with systemic lupus erythematosus using data from the National Inpatient Sample database. They found that during that period, in-hospital maternal deaths in women with lupus decreased significantly, from 442 per 100,000 to less than 50 per 100,000. Complications such as preeclampsia also decreased.

The improvements observed in this study were good news for women with lupus — and their doctors. “This study showed us that more women are attempting pregnancy, most physicians are not recommending against it and women are having successful deliveries,” says Dr. Mehta.

But she emphasizes that further progress is still needed. Maternal death rates in women with lupus were still much higher than those in women without the disease (for whom deaths numbered 10 per 100,000 in 2015). Other specific concerns noted in the study included higher risks of fetal death, higher incidence of preeclampsia and eclampsia, longer hospital stays and increased rates of caesarian sections and hospital admissions not related to delivery.



Bella Mehta, MBBS, MS (top),
and Lisa Sammaritano, MD



Addressing Reproductive Health at Every Stage of Life

In addition to Dr. Mehta's study, recent work led by rheumatologist Lisa Sammaritano, MD, focuses on new comprehensive guidelines for the reproductive health of women with lupus and other rheumatic conditions.

"Questions about reproductive health and pregnancy come up again and again with our patients," says Dr. Sammaritano. "This is especially true because autoimmune disorders tend to affect women at much higher rates than men—including women of childbearing age."

The forthcoming American College of Rheumatology guidelines address aspects of reproductive health at every stage of a woman's life. This includes direction on the most effective and safe forms of birth control for an individual patient, the use of various medications for rheumatoid disease during pregnancy and while breastfeeding and the benefits and drawbacks of taking hormone replacement drugs to relieve menopause symptoms.

"The guidelines are directed at rheumatologists, but we think they will also be helpful to obstetrician-gynecologists," Dr. Sammaritano says. "They are very specific in that they give recommendations for a number of different rheumatic diseases. This was important to include because not all autoimmune disorders call for the same management."

Dr. Sammaritano is also involved in setting up a reproductive health center within the Barbara Volcker Center for Women and Rheumatic Diseases at HSS.

"For years we've been treating pregnant women and consulting with their obstetrician-gynecologists," she says. "Formally establishing the new center will make the care we offer more structured and more widely available. It will also provide a way for us to involve our fellows and improve their education, collaborate more fully with our obstetrics and gynecology colleagues and further our research into the specific challenges for people with rheumatic disease."



New Registry Tracks a Surprising Rheumatologic Side Effect of Cancer Treatment

Immunotherapy drugs called checkpoint inhibitors have been a game changer for a subset of people with certain cancers, especially melanoma and lung and bladder cancers. But these drugs, which unleash the immune system to attack cancer cells, are not without side effects. In fact, it is the intended mechanism of such drugs — the activation of immune cells — that leads to many of these adverse events, including damage to healthy tissues.

“Beginning in 2017, about two years after the second generation of checkpoint inhibitor drugs were approved, we started to see an influx of reports about patients with inflamed joints,” says Anne Bass, MD, a rheumatologist at HSS. “They had checkpoint therapy-induced arthritis.”

In response to this, in May 2018 Dr. Bass and colleagues started a registry of people with this new type of arthritis who are receiving checkpoint inhibitors at New York City–area hospitals. They have already recruited about 50 participants and continue to add three or four people each month.

“There’s so much we hope to learn from this registry,” says rheumatologist Karmela Chan, MD. “How common is treatment-induced arthritis? How is it similar to rheumatoid arthritis and psoriatic arthritis, and how is it different?”

“These patients are given a medicine to stimulate their immune system, and it gets rid of the cancer, but then we have to suppress the immune system to get rid of this adverse event,” Dr. Bass explains. “The holy grail is to figure out how to either prevent or treat these adverse events without having a negative impact on the cancer treatment.”

Another important area to explore is how long the condition continues after the completion of cancer treatment. “Other autoimmune responses that come from these drugs, like colitis, tend to go away within a month or two,” Dr. Bass says. “This arthritis seems to persist much longer.”

Charting a Course for Personalized RA Treatment

The standard approach for treating patients with rheumatoid arthritis (RA) is based on trial and error. When patients fail initial treatment, permanent joint damage can occur.

“The longer someone takes a drug that’s not working for them, the greater the risk of permanent damage to their joints,” says rheumatologist Vivian Bykerk, MD. “Finding the right medication early in the course of the disease is important.”

Scientists at HSS are using cutting-edge laboratory techniques to make sense of RA at a cellular level, with the hope of cultivating a more targeted treatment approach and advancing drug development.

In 2018 and 2019, Laura Donlin, PhD, co-director of the Derfner Foundation Precision Medicine Laboratory, and a team of collaborators published research characterizing the full range of immune cell types found in the joints of people with RA. The research revealed new clues about why not everyone benefits from the same drugs and suggested an approach in which treatment selection could be personalized.

In one study, published in *Nature Immunology*, the researchers studied tissue samples from 36 people, including from joint replacement surgeries at HSS. They used advanced sequencing technologies to define the immune cells at the single-cell level and ultimately gain an understanding of the cells that drive the damaging inflammation characteristic of RA. They identified 18 unique cell populations in RA joints, including two types of fibroblasts that appear to be highly enriched. Work can now begin to determine how these cells may impact RA and whether medications targeting them can be a new therapeutic direction.

A second study, published in *Science Translational Medicine*, focused on a subset of macrophages that appear to be abundant in RA-afflicted joints. These white blood cells play a major role in the destruction of bone and cartilage, and thus irreversible joint damage, in people with RA. Using patient samples, they

gained insights into how these disease-associating macrophages are most effectively targeted by medications. “We plan to do a more detailed study to look at possible connections between the differences in the cells found in patient tissues and variations these patients have to medications,” Dr. Donlin says.

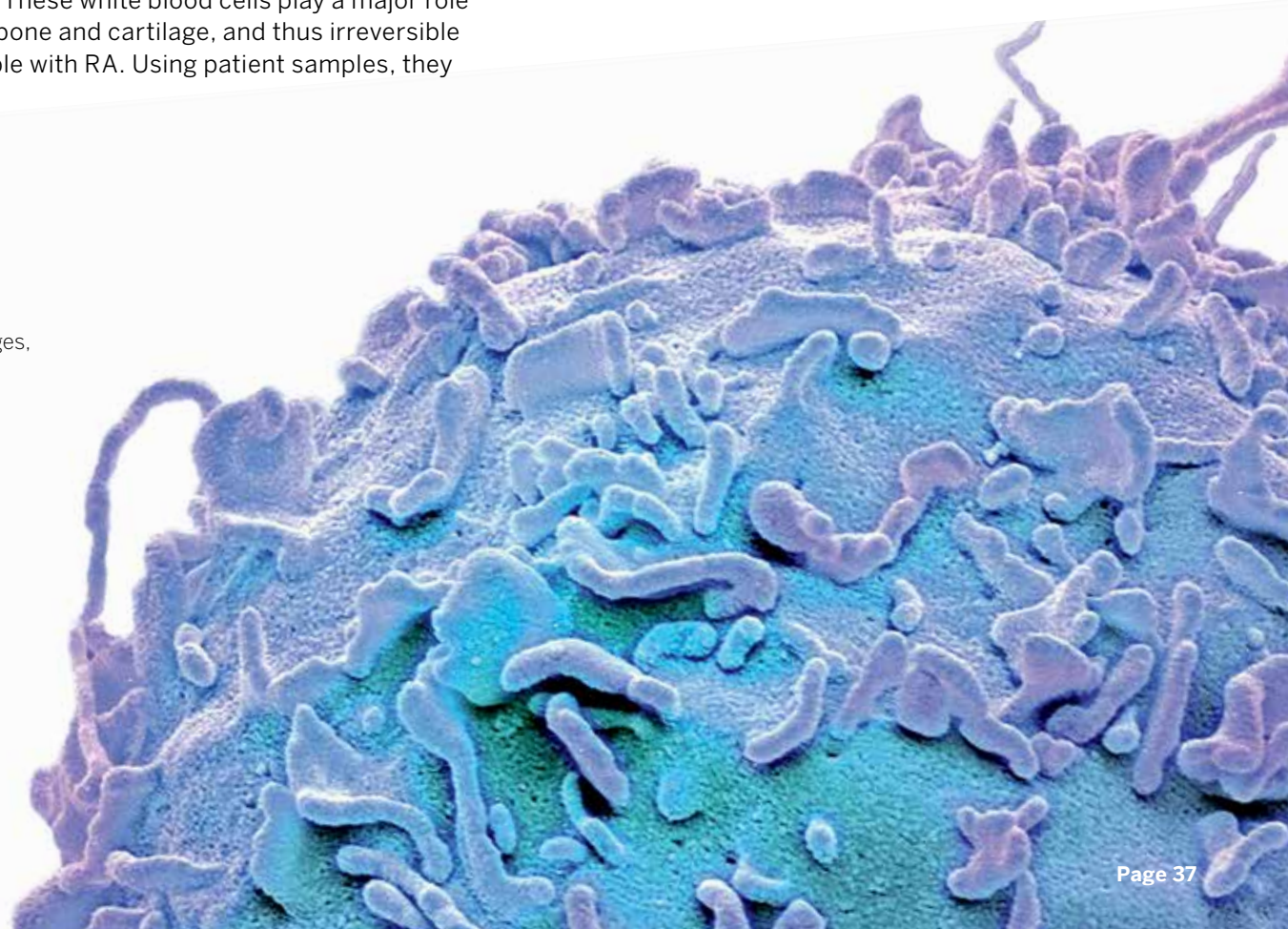
Both studies were part of the Accelerated Medicines Partnership in Rheumatoid Arthritis and Lupus Network, an innovative public-private collaboration created to find promising biologic targets in rheumatic disease. HSS is a major contributor to this effort.

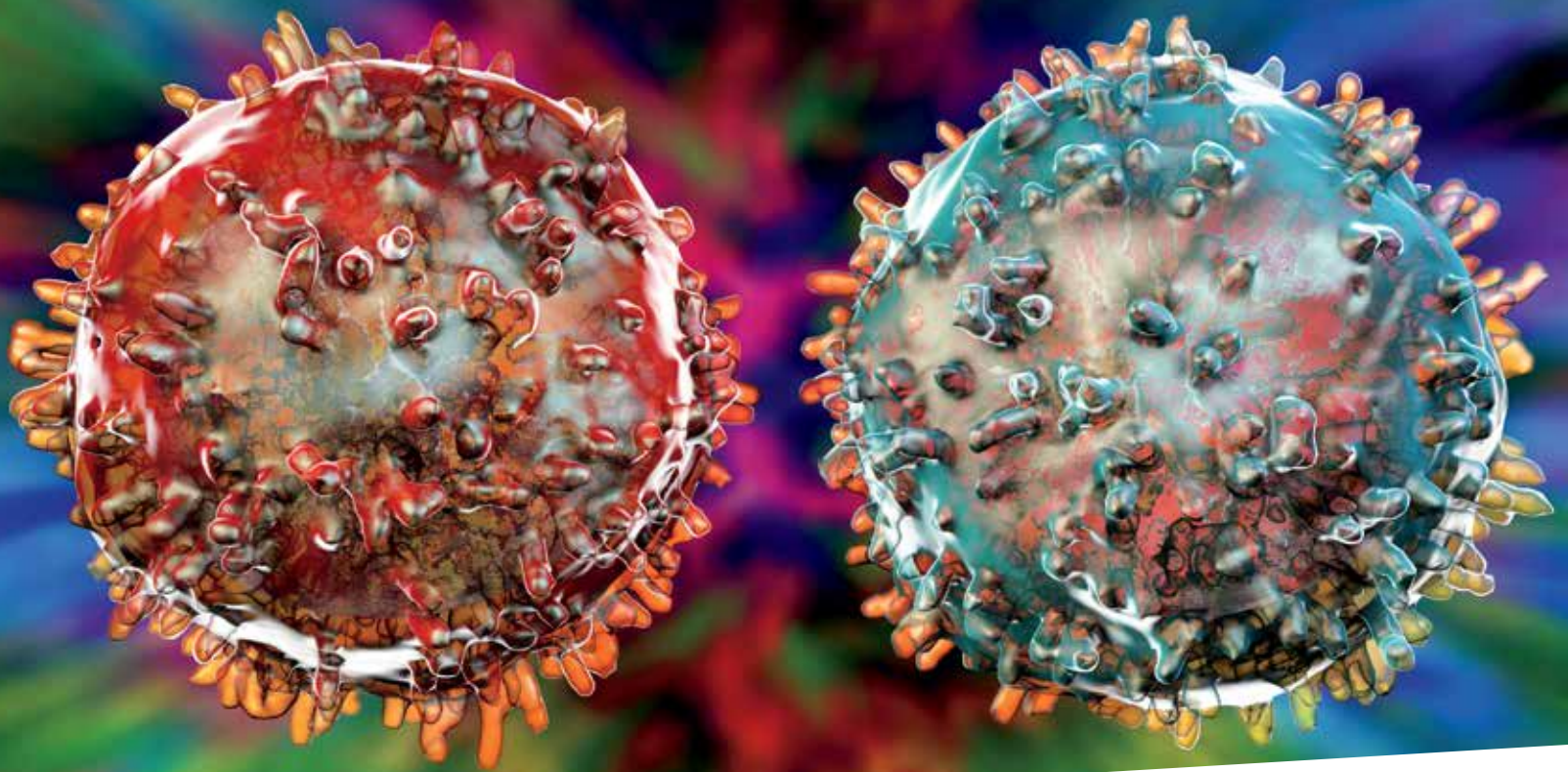
“This research could lead to a more direct way of predicting drug response,” says rheumatologist Susan Goodman, MD. “Although more research needs to be done to validate the findings clinically, it has the potential to be valuable.”

It is also part of a broader effort to study patient samples rather than using lab models — an area in which HSS can make unmatched contributions. “To get results that are statistically significant, we need to be able to look at the detailed cellular and molecular pathways in hundreds of patients,” Dr. Bykerk says. “We have one of the largest populations of RA patients anywhere. This will enable us to take advantage of this resource.”

The collaborators expect to eventually conduct clinical trials testing different drugs for patients based on the specific populations of cells in their joints.

HSS researchers have identified an abundant subset of macrophages, referred to as HBEGF+ inflammatory macrophages, in RA tissue samples.





Research has shown that B cells play an important role in scleroderma pathogenesis.

Solutions for Scleroderma May Lie in Antibody-Based Drugs

Diffuse scleroderma is associated with higher rates of mortality and disability than any other rheumatic disease. The few proven therapies currently available to treat the illness primarily address its symptoms, which include skin thickening, arthritis or arthralgia, Raynaud's phenomenon and pyrosis.

A clinical study now underway at HSS aims to provide a new option. The double-blind, placebo-controlled trial will evaluate whether two biologics — belimumab (Benlysta) and rituximab (Rituxan) — that target a key component of the immune system can provide benefit to people with diffuse scleroderma. All participants will also get mycophenolate, a standard treatment.

“Over the past 10 years, there has been emerging evidence that B cells are activated in scleroderma, and that targeting them might be a good approach,” says rheumatologist Robert Spiera, MD, who is leading the trial. Belimumab blocks B cell-activating factor, or BAFF (also called B-lymphocyte stimulator, or BLYS), and rituximab targets CD20, which depletes overall numbers of B cells.

The motivation for the trial was a pilot study published in *Arthritis & Rheumatology* in 2018 that looked at the safety and efficacy of adding belimumab to mycophenolate. Researchers at HSS compared adding belimumab or placebo to mycophenolate in a one-year randomized placebo-controlled trial. Although the study was too small to be statistically significant, trends suggested a possible benefit. When the researchers analyzed gene expression in skin biopsies taken from both the treatment and placebo groups, they found that those treated with belimumab who showed clinical improvements had a significant decrease in the expression genes and pathways related to B cell activity.

“There has been emerging evidence that B cells are activated in scleroderma, and that targeting them might be a good approach,” says Dr. Spiera.

Belimumab is already approved to treat systemic lupus, and the combination of belimumab and rituximab is being studied in lupus, Sjögren's syndrome and idiopathic thrombocytopenic purpura.

“HSS has a lot of expertise treating the most difficult scleroderma cases,” Dr. Spiera concludes. “We hope that what we've learned about the pathways involved in this disease will translate into practical therapies for patients.”

“The idea behind this research is to identify or exclude CRMO faster so that we can get patients the care they need and spare families years of uncertainty whenever possible,” says Dr. Onel.

A Debilitating Bone Disorder, Hiding in Plain Sight

Chronic recurrent multifocal osteomyelitis (CRMO) is a rare autoinflammatory bone disorder that is poorly recognized in children and adults. Its primary symptoms are intermittent bone pain and fever, and on bone scans it tends to resemble infectious osteomyelitis or even cancer. Once identified, CRMO often has a good prognosis and can be managed using conventional disease-modifying antirheumatic drugs such as methotrexate, TNF inhibitors or bisphosphonates. However, because CRMO is an exclusion diagnosis, it’s common for families to go through a lengthy and difficult process of elimination.

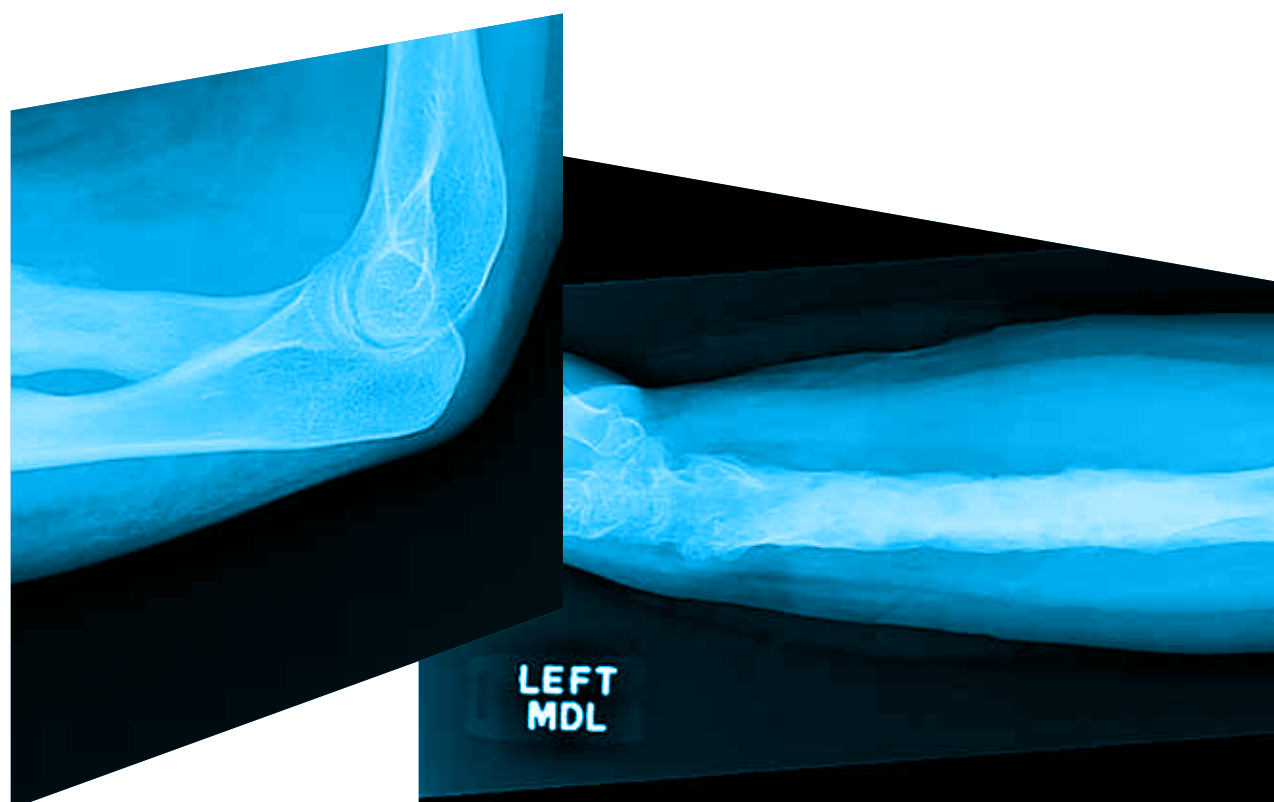
Now two new studies at HSS led by Karen Onel, MD, Chief of Pediatric Rheumatology, are underway to speed CRMO diagnosis: a retrospective study focused on classifying commonalities among patients at the time of diagnosis and a prospective study looking at the identifying characteristics of patients

who are suspected to have the disease but who turn out to have something else. “Right now we know very little about CRMO,” explains Dr. Onel. “We don’t have a definitive test or other means to identify the disease. The idea behind this research is to identify or exclude CRMO faster so that we can get patients the care they need and spare families years of uncertainty whenever possible.”

Dr. Onel hopes that the research will also raise awareness among physicians of the existence of the condition. Although it is believed that CRMO affects around one in a million children each year, Dr. Onel says, “the pediatric rheumatologists who treat this disease know the number is likely far greater.”

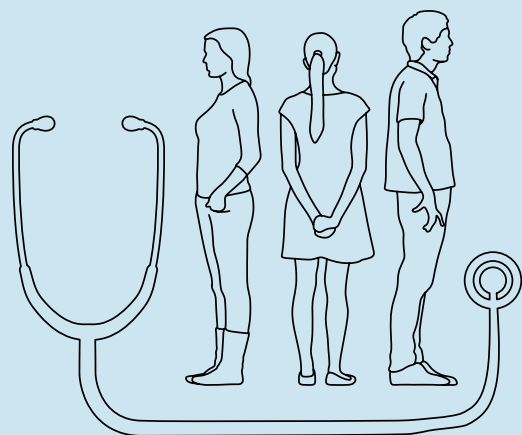
She also stresses the importance of recognizing as-yet-undiagnosed CRMO in adults. “There are adults out there who’ve lived with mysterious bone pain for years,” she says. “A CRMO diagnosis can change their life.”

This x-ray image of the left wrist and forearm shows extensive diaphyseal sclerosis of the radius and ulna, with hypertrophy of bone and multiple lucencies. Distal areas of fusion of the wrist are also present. Both findings are in keeping with the diagnosis of CRMO.



The Innovations That Propelled Us

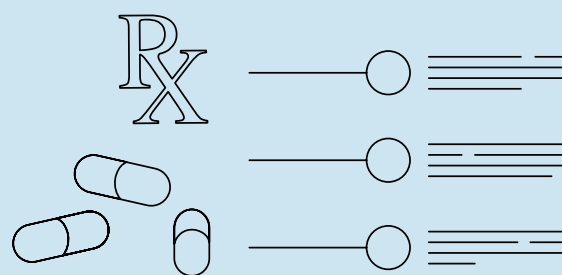
Enhancements to patient care come from all over HSS. Here, our leaders of Anesthesiology, Nursing, Pathology, Physiatry, Rehabilitation and Radiology share with us what moved them forward in the 2018–2019 academic year.



ENHANCED CARE FOR NONOPERATIVE PATIENTS

The Department of Physiatry continues to expand access to care as it strives to meet the needs of patients experiencing any type of musculoskeletal pain. During the 2018–2019 academic year, the physiatry team oversaw the continued success of a new triage system for patients who have low back pain but do not present with any red or yellow flags. The approach, which brings together a multidisciplinary team of experts, including those from rehabilitation and surgery, focuses on triaging patients to the right practitioner at the right time, ensuring escalation of care if necessary. Patients are seen within 24–48 hours, and this immediate access provides a number of benefits, among them helping to lessen patient anxiety and minimize the need for narcotics by providing education and exercise-based therapies.

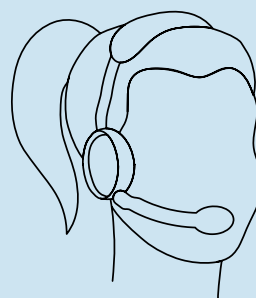
Joel Press, MD
Physiatrist-in-Chief



PREOPERATIVE PAIN SCREENING

A big component of the success HSS has had in opioid stewardship has hinged upon the Anesthesiology Department's preoperative screening program for patients with complex pain. All presurgical patients must complete a detailed questionnaire designed to identify those who are at high risk for difficult pain control after surgery and to have them seen by a pain management specialist. Patients are asked about prior opioid prescriptions including those above a certain dosage, strong or long-acting opioids and opioids given by infusion pump. They also have the opportunity to report any history of substance abuse or poor postsurgical pain management. This approach has reduced length of stay to less than 2.5 days for those complex patients who undergo the prescreening.

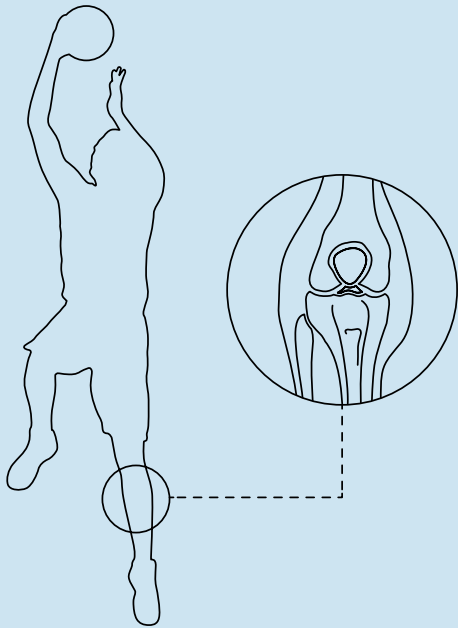
Gregory Liguori, MD
Anesthesiologist-in-Chief



TELEHEALTH

Telehealth for rehabilitation services promises to revolutionize how patients access high-quality physical therapy care. This year, HSS Rehabilitation launched a pilot project called HSS@Home that allows patients to have virtual physical therapy sessions in their home with a licensed HSS physical therapist. During a typical appointment, the therapist can check in on the patient's progress, give instructions for new exercises and address questions and concerns. Thus far, HSS@Home has been offered to patients following primary lower extremity joint replacement surgery. Programs last for around three weeks, at which point the therapist recommends either continuing to do exercises from home or seeking care from an outpatient provider. Patient feedback has been extremely positive.

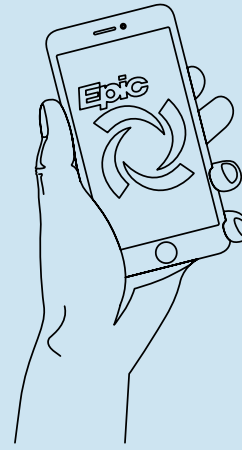
JeMe Cioppa-Mosca
Senior Vice President, Rehabilitation



QUANTITATIVE IMAGING TECHNIQUES

Quantitative imaging is an advanced imaging technology that allows us to study the functional capacity of tissue. In MR, quantitative techniques provide a high level of detail about early damage to collagen structure so that the clinician can make recommendations to help protect the joint or structure in question. Quantitative ultrasound, on the other hand, allows us to measure the stiffness of various structures, such as tendons or ligaments, and is especially valuable because patients can move around during the scan, reproducing their symptoms in real time. At present, our team is carrying out a study funded by the National Basketball Association and GE looking at patellar tendinopathy in professional basketball players. We are assessing the changes we see in the patellar tendon at the start of the season using MR and ultrasound techniques and comparing those assessments to how well the tendon is functioning at the end of the season. Our ultimate goal is to develop enhanced imaging approaches to assess the ability of tendon and other structures to withstand load.

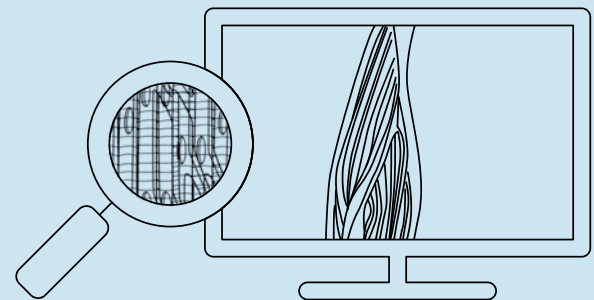
Hollis Potter, MD
Chairman, Department of Radiology and Imaging



EPIC ROVER MOBILE TECHNOLOGY

Epic Rover is a mobile app designed to allow clinicians to access patient information in the medical record, which at HSS is stored in a software called Epic. The HSS nursing staff adopted Epic Rover in 2019 and have used the technology to access and update medical records, administer medications and more. The nursing staff have reported improved communication with the interprofessional teams and found that it enables them to be at the bedside more often, tending to the needs of patients.

Jennifer O'Neill, DNP, APN, NEA-BC
Senior Vice President, Patient Care Services, and
Chief Nursing Officer



DIGITAL PATHOLOGY

Digital pathology technology is gaining steam, and at HSS our Department of Pathology and Laboratory Medicine is leading an initiative with colleagues in Information Technology to integrate whole-slide imaging (WSI) technology with laboratory information systems and the electronic medical record. While scanning a microscope slide may add an extra step to the diagnostic workflow, integration with other systems opens up a world of efficiencies, creating optimized workstations for pathologists, placing pathology findings at a surgeon's fingertips and giving radiologists the ability to compare imaging studies and histology side-by-side. HSS plans to go live with WSI for primary diagnosis in 2020.

Thomas Bauer, MD, PhD
Pathologist-in-Chief

Message from the Surgeon-in-Chief

This is an exciting time for HSS, as we enter a period of growth and reflection that will generate the insights needed to advance our institution into 2020 and beyond. As the No. 1 hospital for orthopaedics in the United States for the 10th year running, HSS sets the worldwide standard. As the 13th Surgeon-in-Chief of the organization, I believe that participating in ongoing self-reflection is crucial to our success. I would like to use this opportunity to share some guiding principles born of that evaluation that will serve as the cornerstone of our work as we move HSS — and the field we are proud to lead — forward.

First is our commitment to clinical excellence and incomparable quality, both of our medical staff and of the care we provide. On the individual level, we've undertaken an initiative to define new quality metrics based on data we are already collecting that can further objectively assess performance beyond the standard measures. Examples of these are reinjury rates after anterior cruciate ligament reconstruction within the first two years after surgery, and early implant loosening within 10 years after total joint replacement.

We are also focused on identifying strengths and areas of improvement within each service and department. One avenue for this is our Multispecialty Peer Review Committee, which is creating a more transparent means of collecting and presenting complications data to the hospital and individual services for educational purposes.

We are making a strong effort on the clinical front to better integrate operative and nonoperative specialties to increase patients' entry points to nonoperative care. While our patients have access to the best orthopaedic surgical care available, it is not the right solution for every individual. By partnering with our colleagues in physiatry, sports medicine, rehabilitation and rheumatology, we are devising innovative solutions that enhance our ability to provide more patients with the right care at the right time.

A second guiding aim is enabling our research and innovation enterprise to flourish, as well as raising the visibility of our incomparable science both within and outside of HSS. As part of this effort, we have created a Surgeon-in-Chief Advisory Council to further integrate science and clinical care.

Innovation has constituted the core of our identity since the inception of HSS. As with modern healthcare itself, the field of musculoskeletal health is constantly evolving. We are using our extraordinary capabilities in data science, digital health, artificial intelligence, predictive analytics, materials and implant development and more to lead the way in these areas. Our partnership with LimaCorporate on 3D printing technologies is an outstanding example of how innovation will continue to drive the field of orthopaedics forward.

The education and training of tomorrow's physicians and surgeons through exposure to the world's best musculoskeletal care and education is another of our chief motivations. We take tremendous pride in the unsurpassed quality of our 13 orthopaedic fellowship programs and our orthopaedic residency program, which has been named the top program in the country by Doximity since 2015.

Other efforts to support our medical staff address the external challenges inherent to the medical profession. Recent statistics show that more than 80% of doctors are moderately to severely stressed, and it is essential that medical leadership provide enhanced support. We're tackling that task head-on through a variety of initiatives to ensure these concerning statistics remain top of mind. We are also prioritizing leadership development. By fostering, developing and encouraging future leaders both within and outside our institution, and by equipping our current leadership team to evaluate and improve their abilities, we can ensure our standards remain unimpeachable and advance the field for all practitioners.

There is no other institution in the country, or the world, like HSS for musculoskeletal healthcare. We have the unique opportunity to use our standing to advance the field for clinicians worldwide.

Bryan T. Kelly, MD, MBA

Surgeon-in-Chief and Medical Director
Chief Emeritus, Sports Medicine Institute
Korein-Wilson Professor of Orthopaedic Surgery



Adult Reconstruction and Joint Replacement Service



Michael Parks received the Diversity Award from the American Academy of Orthopaedic Surgeons at the AAOS Annual Meeting in March 2019.

The Adult Reconstruction and Joint Replacement (ARJR) Service comprises 32 world-class surgeons dedicated to providing our patients with innovative care. Our team performs more than 11,000 surgeries per year, more than any other hospital in the country. We're at the forefront of developing novel techniques and process improvements that enable our patients to return to an active lifestyle as much as possible.

55,131
Patient visits

11,071
Surgeries

6
Fellows

32
Attendings

146
Published studies

160
Presentations at conferences

101
Academic visitors

Chief: Mathias P. Bostrom, MD

Chief, Knee Service: Steven B. Haas, MD

Chief, Surgical Arthritis Service:

David J. Mayman, MD

Faculty: Michael P. Ast, MD; Michael M. Alexiades, MD; Jason L. Blevins, MD; Friedrich Boettner, MD; Robert L. Buly, MD; Alberto Carli, MD; Charles N. Cornell, MD; Michael B. Cross, MD; Fred David Cushner, MD; Mark P. Figgie, MD; Alejandro Gonzalez Della Valle, MD; Andrew Grose, MD, MSc; Allan E. Inglis, Jr., MD; Seth A. Jerabek, MD; Alexander S. McLawhorn, MD, MBA; Douglas E. Padgett, MD; Michael L. Parks, MD; Amar S. Ranawat, MD; Chitranjan S. Ranawat, MD; Daniel S. Rich, MD; Jose A. Rodriguez, MD; Eduardo A. Salvati, MD; Peter K. Sculco, MD; Thomas P. Sculco, MD; Edwin P. Su, MD; Jonathan M. Vigdorchik, MD; Bradford S. Waddell, MD; Geoffrey H. Westrich, MD; Russell E. Windsor, MD

LEADERSHIP

Dr. Padgett was appointed Associate Surgeon-in-Chief and Deputy Medical Director at HSS, after having led ARJR from 2008 to 2019. In his new role, Dr. Padgett oversees quality initiatives, M&M conferences and Grand Rounds. He also works closely with medical directors across all HSS locations and seeks to develop novel ways to improve patient care.

Dr. Bostrom succeeded Dr. Padgett as Chief of ARJR. Dr. Bostrom is committed to advancing the Service through innovative research, geographic reach of patient care and national and international educational initiatives.

Dr. Parks, Clinical Director of Orthopaedic Surgery, received the Diversity Award from the American Academy of Orthopaedic Surgeons (AAOS) in recognition of his commitment to making orthopaedics more representative of and accessible to the diverse populations it serves, as well as his contributions to research on socioeconomic and racial disparities, particularly as relates to access to total joint replacement surgery and arthritis care. Dr. Parks is a member of the steering committee of the Movement Is Life Caucus, which seeks to address disparities in musculoskeletal care, and is active with Nth Dimensions, a nonprofit group that works to increase the representation of women and minorities in orthopaedic surgery.

PATIENT CARE

Increasing access to care remains a high priority for the Service, with expanded availability at HSS Paramus and HSS Long Island in Uniondale. We've also begun the process, in collaboration with the Department of Medicine, of bringing presurgical testing to patients at facilities outside Manhattan to ease the burden of travel into the city.

INTERDISCIPLINARY COLLABORATION

In a new partnership with the Department of Medicine, ARJR surgeons are referring select patients to a comprehensive weight management and nutrition program prior to joint replacement surgery to optimize their health before surgery.

CONTINUING OPIOID STEWARDSHIP

As part of the HSS-wide effort to reduce opioid use, our team is developing a pain management pathway for patients following joint procedures. It emphasizes multimodal analgesia, which involves a combination of local anesthetic, NSAIDs, IV acetaminophen and in some cases opioids. The pathway has led to a significant decrease in opioid use with no sacrifice in pain control.

A multidisciplinary team including ARJR surgeons is currently assessing opioid alternatives, such as intraoperative and postoperative acupuncture, as well as alternative treatments in the form of nerve blocks. In addition, we are studying prescribing patterns and how those influence patients' use of medications. (See page 8 for more on opioid reduction efforts at HSS.)

RESEARCH

Recognizing the need to maximize the impact of our research, in 2019 the Service committed to four research priority areas in primary joint replacement: periprosthetic joint infection (PJI), bone health and implant longevity, perioperative care and value. In addition, ARJR continues to support the Stavros Niarchos Foundation Complex Joint Reconstruction Center (SNF-CJRC), which focuses on revisions and complex primaries.

PERIPROSTHETIC JOINT INFECTION (PJI)

- We are making strides in the development of new diagnostic techniques for PJI. Dr. Cross has begun a collaboration with researcher Laura Donlin, PhD, to investigate the role of the microbiome on PJI risk in vivo. They are also exploring new approaches in novel murine models of PJI.
- Dr. Cross also presented research at AAOS showing that a one-stage revision technique for PJI after total hip replacement may offer lower cost, quicker restoration of function and lower morbidity than a two-stage revision with comparable infection control. The study provided the preliminary data needed to support the continuation of a randomized trial.

BONE HEALTH AND IMPLANT LONGEVITY: IMPLANT LOOSENING

- Research led by Dr. Bostrom and team has allowed us to determine the molecular signaling involved in aging versus young implant osseointegration. A murine model of implant loosening with validation in human loose implants is in the works.

ACETABULAR BONE LOSS

- In June, the SNF-CJRC, led by Thomas P. Sculco, MD, Surgeon-in-Chief Emeritus, held a one-day consensus meeting on acetabular bone loss in the revision setting. Leading experts from around the world addressed complex challenges in preoperative planning and postoperative assessment; implant selection and management of osteolysis and massive bone loss; management of acetabular bone loss with additional treatment challenges of pelvic discontinuity, PJI, instability and poor bone biology; and principles of reconstruction and classification of acetabular bone loss. A consensus document is in the works.

EDUCATION

The Service is constantly looking for new ways to enhance the training it offers to fellows. In 2018-2019, we narrowed the number of open fellowship positions from nine to six. This change has allowed us to expose fellows to a higher volume of complex cases and expanded mentorship opportunities with senior surgeons.

This year Dr. Su was named Fellowship Director, succeeding Dr. Bostrom, who held the position for 17 years. Earlier in the year, Dr. Bostrom was recognized with the Nancy Bischoff Mentor Award. The award is presented to an attending physician who has consistently demonstrated concern for the interest and welfare of the residents and who acts as a trusted guide and mentor.

NOTABLE PUBLICATIONS

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- Premkumar A, Lovecchio FC, Stepan JG, Sculco PK, Jerabek SA, Gonzalez Della Valle A, Mayman DJ, Pearle AD, Alexiades MM, Albert TJ, Cross MB, Haas SB. Characterization of opioid consumption and disposal patterns after total knee arthroplasty. *Bone Joint J*. 2019 Jul;101-B(7_Supple_C):98-103. doi: 10.1302/0301-620X.101B7.BJJ-2018-1518.R1.

Foot and Ankle Service



Jonathan Deland received the 2019 Lifetime Achievement Award from HSS in June.

The Foot and Ankle Service is the largest program of its kind in the United States, performing more than 3,000 procedures each year. Our multidisciplinary approach allows us to expertly treat the broad range of foot and ankle conditions that can occur at any stage of life, from nonoperative conditions to the most complex trauma and deformities.

30,890
Patient visits

3,028
Surgeries

3
Fellows

37
Published studies

87
Presentations at conferences

16
Academic visitors

Chief: Matthew M. Roberts, MD

Faculty: Steve B. Behrens, MD; Elizabeth A. Cody, MD; Jonathan T. Deland, MD; Constantine A. Demetracopoulos, MD; Mark C. Drakos, MD; Andrew J. Elliott, MD; Scott J. Ellis, MD; Anne Holland Johnson, MD; David S. Levine, MD; Martin J. O'Malley, MD

LEADERSHIP

Dr. Ellis served as president of the American Orthopaedic Foot & Ankle Society (AOFAS) Foundation, which raises money for research, patient care, teaching and humanitarian work. He also received the Distinguished Research Award at the European Foot and Ankle Surgery Congress Meeting in Geneva, Switzerland, in 2018.

Dr. Johnson completed a humanitarian mission with AOFAS to China to establish a future location for a joint US-Chinese foot and ankle surgical mission site in southwestern China, in an impoverished province near the Myanmar border.

Drs. Deland, Ellis and Demetracopoulos won the International Federation of Foot and Ankle Societies Best Paper Award at the AOFAS Annual Meeting for their abstract "Influence of Tibial Component Position on Altered Kinematics Following Total Ankle Arthroplasty During Simulated Gait."

Dr. Deland also received the HSS 2019 Lifetime Achievement Award.

Dr. Roberts received the 2019 Nancy Kane Bischoff Award, given by graduating HSS residents for being a trusted guide and mentor, and demonstrating consistent concern for their interests and welfare.

PATIENT CARE

The Service is seeking to lead the advancement of foot and ankle care through novel research and innovation. Our foot and ankle registry, comprising more than 35,000 patients, allows us to draw on patient outcomes to constantly improve care and set new standards.

The HSS foot and ankle registry, comprising more than 35,000 patients, allows the Service to draw on patient outcomes to constantly improve care and set new standards.

RESEARCH

The Service is committed to an active basic and clinical research program to improve techniques and treatments for complex conditions of the foot and ankle.

BIOMECHANICS

- Drs. Deland and Demetracopoulos, along with colleagues in the Department of Biomechanics, are principal investigators of an Orthopaedic Research and Education Foundation grant studying the mechanics of the ankle and adjacent joints after total ankle replacement.
- Drs. Ellis, Deland and Drakos, also with colleagues in the Department of Biomechanics, are principal investigators of an AOFAS research grant.

IMAGING AND MEASUREMENT

- Drs. Deland and Ellis, along with colleagues in the Department of Radiology, presented research of a weightbearing CT study of instability of the first ray and hallux valgus in patients with adult-acquired flatfoot deformity at the AOFAS Annual Meeting.
- Drs. Demetracopoulos, O'Malley, Deland, Cody and Ellis presented findings on the correlation of single photon emission computed tomography results with clinical and intraoperative findings in the painful total ankle replacement at the AOFAS Annual Meeting.
- Drs. Deland, Ellis and Demetracopoulos presented research on the use of three-dimensional biometric measurements to predict additional alignment procedures in total ankle replacement on Specialty Day of the American Academy of Orthopaedic Surgeons Annual Meeting.

OUTCOMES

- Drs. Drakos and Deland and colleagues presented outcomes following treatment of talar osteochondral lesions with a mixture of particulate allogenic cartilage extracellular matrix and bone marrow aspirate concentrate.

EDUCATION

Fellowship training is primarily focused on adult reconstructive surgery, but also includes sports-related injuries, pediatric foot and ankle surgery and trauma. Fellows are assigned to two to three primary attendings, with whom they spend dedicated time in the operating room and the outpatient clinic. This provides a valuable mentoring experience over the course of the rotation, as fellows have the opportunity to follow patients from their outpatient clinic visits all the way through to surgery.

NOTABLE PUBLICATIONS

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Hand and Upper Extremity Service



Duretti Fufa (center) serves as Director of the Orthopaedic Residency Program.

The Hand and Upper Extremity Service is internationally renowned for its treatment of adults and children suffering from bone and soft-tissue conditions of the hand, wrist, forearm, elbow and shoulder. Our Hand and Upper Extremity Therapy Center provides specialized rehabilitation services designed to ensure optimal restoration of function and includes occupational and physical therapists with dedicated training.

25,826
Patient visits

3,015
Surgeries

4
Fellows

47
Published studies

79
Presentations at conferences

15
Academic visitors

Chief: Steve K. Lee, MD

Faculty: Edward A. Athanasian, MD; Michelle G. Carlson, MD; Aaron Daluiski, MD; Duretti Fufa, MD; Robert N. Hotchkiss, MD; Lana Kang, MD; Daniel A. Osei, MD, MSc; Samir K. Trehan, MD; Scott W. Wolfe, MD

LEADERSHIP

In November 2019, Dr. Lee succeeded Dr. Athanasian as Chief of the Service.

In June 2019, members of the Service attended the 14th Triennial Congress of the International Federation of Societies for the Surgery of the Hand (IFSSH) in Berlin, Germany, where they presented original research and moderated sessions. Andrew J. Weiland, MD, Surgeon-in-Chief Emeritus, was also named a Pioneer of Hand Surgery by the IFSSH, recognizing his leadership contributions to the development of hand surgery internationally.

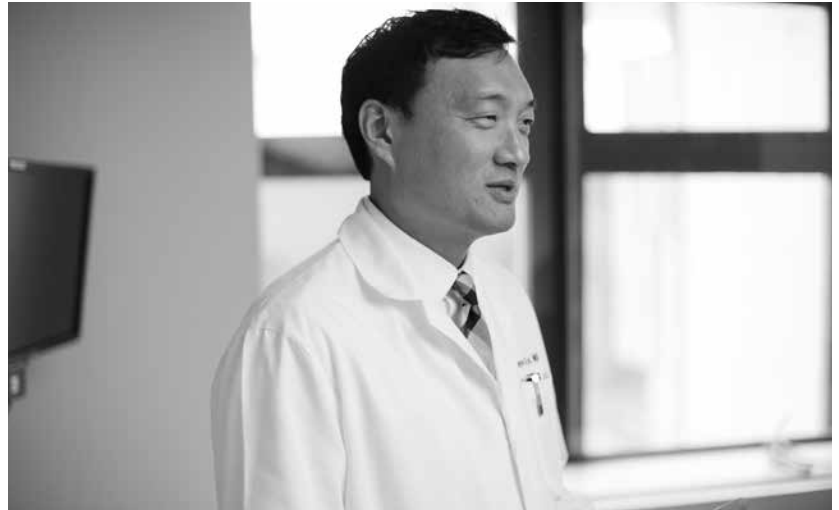
Dr. Wolfe presented a paper, "The Lesion of Anterior Interosseous Nerve Syndrome Is Not in the Forearm," at the 62nd annual meeting of the Japanese Society for Surgery of the Hand in Saporro, Japan.

Dr. Trehan received the Emanuel B. Kaplan Award at the American Society for Surgery of the Hand annual meeting.

PATIENT CARE

Our surgeons continue to be at the forefront of pioneering novel therapies for complex issues of the hand and upper extremities. Dr. Wolfe has developed an innovative reconstruction method for scapholunate interosseous ligament injury with dorsal intercalated segment instability. Drs. Wolfe and Lee have identified internal constrictions in some patients with Parsonage-Turner Syndrome (PTS), also known as acute brachial neuropathy, who do not recover spontaneously. They have found that by releasing these constrictions, clinical recovery is possible. Dr. Wolfe has also developed a technique for successful surgical treatment for PTS.

Additionally, Dr. Fufa has studied opioid use patterns and has developed strategies for reduction of narcotic use following surgery.



Hand and upper extremity surgeon and Service Chief Steve Lee

RESEARCH

One main research goal of the Service is to better understand and treat patients with wrist ligament injury. Studies led by Drs. Wolfe and Lee are currently underway assessing which ligaments are crucial for biomechanical stability.

SURGICAL INNOVATIONS

- Drs. Wolfe, Lee and Fufa conducted an anatomic evaluation of the obturator branch to the gracilis muscle to optimize its use as a free functional muscle transfer for elbow flexion reanimation.
- Dr. Carlson is studying scaphoid dorsal subluxation in scapholunate-deficient wrists.
- Drs. Carlson and Fufa are evaluating factors associated with scaphoid nonunion following open reduction internal fixation surgery. They also presented a paper, "Evaluating Factors Associated with Scaphoid Nonunion Following Open Reduction and Internal Fixation," at the American Association for Orthopaedic Surgery annual meeting.

OPTIMIZING OUTCOMES

- Drs. Fufa and Osei are also investigating the pain-related psychological factors that influence postoperative opioid use after ambulatory hand surgery.

EDUCATION

Residents in our fellowship program have the opportunity to hone their talents in our Bioskills Education Laboratory, which uses state-of-the-art technology, including virtual reality simulations to take them through complicated surgical tasks. As Director of the Orthopaedic Residency Program at HSS, Dr. Fufa organizes the annual "Surgical Games," which provides objective assessment of each fellow's progress as well as structured feedback. Dr. Fufa has also presented nationally on the success of the program.

NOTABLE PUBLICATIONS

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- Jew N, Lipman J, Carlson MG. The use of 3D printing for complex scaphoid fractures. *J Hand Surg Am*. 2019 Feb; 44(2): 165.e1-165.e6.
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Hip Preservation Service



Robert Buly (left), Hip Preservation Service Chief Emeritus, with S. Robert Rozbruch

The Hip Preservation Service takes a multidisciplinary approach to diagnosing and treating patients' complex hip pain. Members of the Service work closely with specialists in sports medicine, physiatry, physical therapy, radiology and biomechanics. Our diverse perspectives allow us to provide the highest quality care while advancing research.

Chief: Ernest L. Sink, MD

Co-Director: Bryan T. Kelly, MD, MBA

Faculty: Robert L. Buly, MD; Struan H. Coleman, MD, PhD; David L. Helfet, MD; Douglas N. Mintz, MD; Peter J. Moley, MD; Danyal H. Nawabi, MD, FRCS; Anil S. Ranawat, MD; Chitranjan S. Ranawat, MD; Edwin P. Su, MD

Surgical volume, published studies and academic presentations at conferences are reflected in data for other service lines.

LEADERSHIP

In November 2019, Dr. Sink succeeded Dr. Buly as Chief of the Service.

The Service finished a prospective randomized controlled study on the use of tranexamic acid in patients undergoing periacetabular osteotomy (PAO) that was nominated for best paper at the Pediatric Orthopaedic Society of North America annual meeting.

PATIENT CARE

The Service is focused on updating and improving patient education materials. We are also critically evaluating patient satisfaction measures after PAO to improve outcomes.

RESEARCH

Dr. Ranawat is co-investigator of a study evaluating the Calypso Knee System, an investigational device designed to treat knee osteoarthritis by absorbing excess load placed on the joint. He has also been named an investigator of the Surgical Timing and Rehabilitation Trial for Multiple Ligament Knee Injuries, as well as a randomized controlled trial looking at accelerated rehabilitation versus standard protocol following arthroscopic treatment of femoroacetabular impingement.

The Service has been named co-investigator for a Department of Defense grant through the Academic Network of Conservational Hip Outcomes Research, studying the effects of timing of surgery and postoperative rehabilitation on time to return to pre-injury level of military duty, work and sports and patient-reported physical function for patients with multiligament knee injuries.

We have also revamped our low back pain registry and begun enrollment, as well as developed a nonoperative hip registry.



Ernest Sink (left) with Surgeon-in-Chief Bryan Kelly

EDUCATION

Dr. Sink will serve a second term as the Pediatric Chair of the American Academy of Orthopaedic Surgeons (AAOS) Council of Education, overseeing all pediatric AAOS education.

He also gave three poster presentations at the AAOS annual meeting, on a propensity-matched analysis of arthroscopy versus surgical hip dislocation in the surgical treatment of femoroacetabular impingement; the results of a multicenter prospective cohort study of 621 patients following surgical treatment of femoroacetabular impingement, to find predictors of failure; and how gender differences in outcomes after corrective surgery for femoroacetabular impingement reflect differences in preoperative baseline scores.

The Service trained one fellow during the 2018–2019 academic year.

NOTABLE PUBLICATIONS

- Lee JJ, Nguyen ET, Harrison JR, Gribbin CK, Hurwitz NR, Cheng J, Boachie-Adjei K, Bogner EA, Moley PJ, Wyss JF, Lutz GE. Fluoroscopically guided caudal epidural steroid injections for axial low back pain associated with central disc protrusions: a prospective outcome study. *Int Orthop*. Epub 2019 Jun 5.
- Moley PJ, Gribbin CK, Vargas E, Kelly BT. Co-diagnoses of spondylolysis and femoroacetabular impingement: A case series of adolescent athletes. *J Hip Preserv Surg*. 2018 Nov 27;5(4):393-398.
- Air ME, Harrison JR, Nguyen JT, Kelly BT, Bogner EA, Moley PJ. Correlation of measurements of the prearthritic hip between plain radiography and computed tomography. *PMR*. 2019 Feb;11(2):158-166.
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- Nwachukwu BU, Chang B, Beck EC, Neal WH, Movassaghi K, Ranawat AS, Nho SJ. How should we define clinically significant outcome improvement on the iHOT-12? *HSS J*. 2019 Jul;15(2):103-108.
- James EW, Blevins JL, Gausden EB, Turcan S, Denova TA, Satalich JR, Ranawat AS, Warren RF, Ranawat AS. Increased utilization of constraint in total knee arthroplasty following anterior cruciate ligament and multiligament knee reconstruction. *Bone Joint J*. 2019 Jul;101-B (7_Supple_C): 77-83.
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- Grammatopoulos G, Beaulé PE, Pascual-Garrido C, Nepple JJ, ANCHOR Group, Clohisey JC. Does severity of acetabular dysplasia influence clinical outcomes after periacetabular osteotomy? A case-control study. *J Arthroplasty*. 2018;33(7S):S66-S70.
- Sankar WN, Novais E, Koueiter D, Refakis C, Sink E, Millis MB, Kim YJ, Clohisey J, Wells J, Nepple J, Zaltz I. Analysis of femoral version in patients undergoing periacetabular osteotomy for symptomatic acetabular dysplasia. *J Am Acad Orthop Surg*. 2018;26(15):545-551.
- Dodwell E, Pathy R, Widmann R, Green D, Scher D, Blanco J, Doyle S, Daluiski A, Sink EL. Reliability of the modified Clavien-Dindo-Sink complication classification system in pediatric orthopaedic surgery. *JB JS Open Access*. 2018 Oct 23;3(4):e0020.
- Piker AM, Fields KG, Wong AL, Sink EL. What is the relationship between acetabular femoral version in dysplastic patients undergoing periacetabular osteotomy (PAO)? *Am J Sports Med*. 2019.
- Novais EN, Maranhão DA, Heare T, Sink E, Carry PM, O'Donnell C. The modified dunn procedure provides superior short-term outcomes in the treatment of the unstable slipped capital femoral epiphysis as compared to the inadvertent closed reduction and percutaneous pinning: A comparative clinical study. *Int Orthop*. 2019;43(3):669-675.

Limb Lengthening and Complex Reconstruction Service



Austin Fragomen provides training at the Bobby Menges Memorial HSS Limb Deformity Course in February 2019.

The Limb Lengthening and Complex Reconstruction Service is the only comprehensive limb lengthening and deformity program that is part of an academic orthopaedic surgery department in the United States. We perform bone reconstruction and limb lengthening procedures and work to correct limb mal-alignment, discrepancy, knock-knee, bowleg, foot and ankle deformities and post-traumatic injuries. Our Limb Salvage and Amputation Reconstruction Center is unique in the United States. We use cutting-edge approaches including internal bone transport and limb replacement with osseointegration surgery.

2,896
Patient visits

581
Surgeries

2
Fellows

31
Published studies

56
Presentations at conferences

7
Academic visitors

Chief: S. Robert Rozbruch, MD
Faculty: Austin T. Fragomen, MD

LEADERSHIP

Dr. Fragomen was elected President of the Limb Lengthening and Reconstruction Society, a subspecialty society of the American Academy of Orthopaedic Surgeons.

Dr. Rozbruch was an invited international professor at limb deformity conferences in Medellin, Colombia, and Tianjin City, China. He was also an invited grand rounds speaker at Xi'an Honghui Hospital, in Xi'an, China, and a keynote speaker at the Advances in Lower Extremity Amputation Conference in New Jersey.

Dr. Fragomen was an invited keynote speaker at grand rounds at the University of Calgary, McGill University, Rutgers University and Peking University, in Peking, China.

PATIENT CARE

Along with colleagues across HSS, we are working to decrease the use of opioids and increase the use of nonsteroidal anti-inflammatory medications after surgical procedures. We also work together with clinicians in the Sports Medicine Institute and on the Foot and Ankle, Hip Preservation and Orthopaedic Trauma services on collaborative procedures.

Other patient-care priorities are continuing to pioneer osseointegration surgery for both lower and upper extremity amputees and joint preservation and realignment of the knee and ankle.

The Service is continuing to pioneer osseointegration surgery for both lower and upper extremity amputees as well as joint preservation and realignment of the knee and ankle.

RESEARCH

Our clinical research program seeks to improve patient outcomes and optimize promising tools and techniques for these complex procedures.

ASSESSING POSTOPERATIVE HEALTH

- We are currently conducting studies of the long-term outcomes of limb lengthening in children with Russell-Silver syndrome. Despite their challenges, these patients experience excellent bone healing. We are also evaluating core psychosocial issues for children and adolescents in the context of limb lengthening and reconstructive surgical treatment.

IMPROVING SURGICAL TECHNIQUES

- We have recently shown that the accuracy of deformity correction and lengthening when using a fully internal method is enhanced with the use of the adjuvant techniques of fixator-assisted nailing and blocking screws. We have also found that the lengthening nail can be used for patients with high-risk osteotomies in a compressive mode to compress and repair difficult nonunions.

ENHANCING OSTEOTOMIES

- We have found that the accuracy of internal and external fixation in the correction of mal-alignment of the knee with osteotomy is similar when dealing with uniplanar deformities under 10 degrees. We have also found that PACS osteotomy planning yields similarly accurate findings as traditional CORA planning techniques, while also saving time.

EDUCATION

The inaugural Bobby Menges Memorial HSS Limb Deformity Course featured hands-on lab training in limb deformity and limb lengthening. Bobby received care for over a decade at HSS to lengthen and realign his left leg, which was fractured and deformed during a skiing accident at age 8. The course was established as a result of a donation to HSS from the I'm Not Done Yet Foundation, which was created in Bobby's memory to expand awareness of the unique requirements of adolescents and young adults during medical treatment.

NOTABLE PUBLICATIONS

- Fragomen AT, Kurtz A, Barclay JR, Nguyen J, Rozbruch SR. A comparison of femoral lengthening methods favors the magnetic internal lengthening nail when compared with lengthening over a nail. *HSS J*. 2018 Jul;14(2):166-176. doi: 10.1007/s11420-017-9596-y.
- Buly RL, Sosa B, Poultides L, Caldwell E, Rozbruch SR. Femoral derotation osteotomy in adults with version abnormalities. *J Am Acad Orthop Surg*. 2018 Oct 1;26(19):e416-e425. doi: 10.5435/JAAOS-D-17-00623.
- Gruskay J, Fragomen AT, Rozbruch SR. Idiopathic rotational deformities of the lower extremity in children and adults. *JBJS Rev*. 2019 Jan;7(1):e3. doi: 10.2106/JBJS.RVW.18.00016.
- Sheeha ED, Steinhaus ME, Kim HJ, Cunningham ME, Fragomen AT, Rozbruch SR. Leg-length discrepancy, functional scoliosis, and low back pain. *JBJS Rev*. 2018 Aug;6(8):e6. doi: 10.2106/JBJS.RVW.17.00148.
- Hamdy RC, Bernstein MA, Fragomen AT, Rozbruch SR. What's new in limb lengthening and deformity correction. *J Bone Joint Surg Am*. 2018 Aug 21;96(16):1527-34. doi: 10.2106/JBJSO.00298.
- Richardson SS, Schairer WW, Fragomen AT, Rozbruch SR. Cost comparison of femoral distraction osteogenesis with external lengthening over a nail versus internal magnetic lengthening nail. *J Am Acad Orthop Surg*. 2018 Oct 1. doi: 10.5435/JAAOS-D-17-00741.
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- Makhdom AM, Fragomen A, Rozbruch SR. Knee arthrodesis after failed total knee arthroplasty. *J Bone Joint Surg Am*. 2019 Apr 3;101(7):650-660. doi: 10.2106/JBJS.18.00191.
- Steinhaus ME, Buksbaum J, Eisenman A1, Kohli M, Fragomen AT, Rozbruch SR. Tranexamic acid reduces postoperative blood loss in distal femoral osteotomy. *J Knee Surg*. 2019 Feb 12. doi: 10.1055/s-0039-1678540.
- Fragomen AT, Wellman D, Rozbruch SR. The PRECICE magnetic intramedullary compression nail for long bone nonunions. *Arch Orthop Trauma Surg*. 2019 Jun 19. doi: 10.1007/s00402-019-03225-4.

Orthopaedic Trauma Service



William Ricci leads the Orthopaedic Trauma Service.

The Orthopaedic Trauma Service collaborates with NewYork-Presbyterian/Weill Cornell Medical Center to provide unrivaled orthopaedic traumatic care. Patients with complex orthopaedic trauma come to HSS from around the world. By partnering with services across HSS, we have created a truly multidisciplinary team to give patients better continuity of care and enhance our ability to manage complex problems.

17,978
Patient visits

45
Published studies

2,849
Surgeries

23
Presentations at conferences

3
Fellows

9
Academic visitors

Chief: William M. Ricci, MD

Faculty: Steve B. Behrens, MD; Gregory S. DiFelice, MD; Duretti Fufa, MD; Andrew Grose, MD, MSc; Derek Hansen, MD; David L. Helfet, MD; Joseph M. Lane, MD; John P. Lyden, MD; Andrew Sama, MD; William W. Schairer, MD

LEADERSHIP

The HSS Trauma Service faculty hold or have held leadership positions in major national and global organizations dedicated to orthopaedic trauma, including Dr. Ricci's role as immediate Past President of the Orthopaedic Trauma Association. Throughout the academic year, our surgeons have been recognized for their significant work by being invited to present at professional association meetings across the country and internationally. A sample of these activities include:

- Dr. Lane discussed the nonoperative treatment of pelvic fractures in achieving functional outcomes at the American Academy of Orthopaedic Surgeons (AAOS) annual meeting.
- Dr. Helfet shared research on the effects of dual plating on the vascularity of the distal femur at the Canadian Orthopaedic Association annual meeting.
- Dr. Behrens presented work examining clinical and radiographic outcomes of revision total ankle arthroplasty using an intramedullary-referencing implant at the American Orthopaedic Foot & Ankle Society annual meeting.
- Dr. Ricci presented on the factors associated with collapse of intertrochanteric femur fractures at the AAOS annual meeting.

PATIENT CARE

Through collaboration with the HSS Metabolic Bone Service, a Fracture Liaison Program with a dedicated nurse practitioner was initiated this year. This program will assure all patients at risk for fragility fractures are treated for their osteoporosis. We have further improved excellence in patient care through interactions with other HSS services. Interesting and complex cases are presented regularly at multidisciplinary conferences with the HSS Hand, Foot and Ankle, Pediatrics, Limb Lengthening and Adult Reconstruction and Joint Replacement Services to foster a multidisciplinary approach to treatment. Further, the Trauma Service works with non-orthopaedic teams including infectious disease, hospital medicine, anesthesia, physical therapy and occupational therapy to assure optimal pre- and postoperative management protocols.

By partnering with surgeons across HSS, the Service has created a truly multidisciplinary team to give patients better continuity of care and enhance our ability to manage complex problems.

RESEARCH

There are a multitude of new research initiatives underway. These include a new computer-based outcomes data collection system and collaborations with other HSS teams and with colleagues at other institutions for multicenter studies. Investigations with other services across HSS also allow us to study complex orthopaedic conditions, tissue development and vascular anatomy and vascular-preserving surgical approaches. Major investigative initiatives include:

OUTCOMES

- Through generous philanthropic support, we are embarking on new state-of-the-art computer-assisted systems to obtain patient reported outcomes. These systems will be efficient for patients and provide the most accurate and precise outcomes measures available.

INJURY PREVENTION

- Along with colleagues at Weill Cornell Medicine, we are performing flow cytometry analysis of mesenchymal stem cell populations composing bone marrow aspirate to elucidate the biological and biomechanical markers of bone quality.
- We are also working to characterize the younger hip fracture population by comparing patients under age 65 presenting for hip fracture to assess fracture morphology and underlying comorbidities.

EDUCATION

Educating trainees at all levels, medical students, residents and fellows is a priority for the Trauma Service. We also host academic visitors from around the world on a regular basis. The educational curriculum is undergoing a significant update. A two-year repeating syllabus that better utilizes modern adult-learning techniques has been developed that includes didactic lectures, reverse classroom case based presentations, one-on-one surgical skills sessions with interns and attending surgeons and cadaveric anatomic surgical approach dissections in the state-of-the-art Bioskills Education Laboratory at HSS. Incorporating virtual reality computer simulation that provides real-time feedback of surgical competencies is underway.

NOTABLE PUBLICATIONS

- Cosgrove CT, Spraggs-Hughes AG, Putnam SM, Ricci WM, Miller AN, McAndrew CM, Gardner MJ. A novel indirect reduction technique in ankle syndesmotic injuries: A cadaveric study. *J Orthop Trauma*. 2018;32(7):361-367.
- Gausden EB, Sin D, Gausden EB, Sin D, Levack AE, Wessel LE, Moloney G, Lane JM, Lorich DG: Gait analysis after intertrochanteric hip fracture: Does shortening result in gait impairment? *J Orthop Trauma*. (2018) 32:554-558.
- Jonkergouw A, van der List JP, DiFelice GS. Arthroscopic primary repair of proximal anterior cruciate ligament tears: Outcomes of the first 56 consecutive patients and the role of additional internal bracing. *Knee Surg Sports Traumatol Arthrosc*. 2019;27(1):21-28.
- Christ AB, Chawla H, Gausden EB, Villa JC, Wellman DS, Lorich DG, Helfet DL. Radiographic and clinical outcomes of periprosthetic distal femur fractures treated with open reduction internal fixation. *J Orthop Trauma*. 2018;32(10):515-20.
- Verbeek DO, van der List JP, Moloney GB, Wellman DS, Helfet DL. Assessing postoperative reduction after acetabular fracture surgery: A standardized digital computed tomography-based method. *J Orthop Trauma*. 2018;32(7):e284-e8.
- Zhang JY, Tornetta P 3rd, Jones B, Zheng Y, Whitten A, Cartner J, Ricci WM. Locking hole inserts: Effect of insertion torque on fatigue performance and insert loosening in locking plates. *J Orthop Trauma*. 2019 Mar;33(3):120-124.
- Putnam SM, Collinge CA, Gardner MJ, Ricci WM, McAndrew CM. Vascular anatomy of the medial femoral neck and implications for surface plate fixation. *J Orthop Trauma*. 2019 Mar;33(3):111-115.

Pediatric Orthopaedic Service



Our surgeons, including (from left) Emily Dodwell, John Blanco and David Scher, deliver the highest quality orthopaedic care in a family-centered, child-focused environment.

The Lerner Children's Pavilion Pediatric Orthopaedic Service provides comprehensive diagnostic, medical, surgical and rehabilitative care to help children with musculoskeletal disorders improve their quality of life and achieve the highest level of function.

Our Service manages complex cases every day. We routinely perform complex spinal deformity surgery and revision spinal surgery, limb reconstruction and limb lengthening, ACL reconstruction and reconstruction of the multiligament-injured knee, as well as periacetabular osteotomies (PAOs) for severe hip dysplasia and single-event, multilevel surgeries for children with cerebral palsy.

Our pediatric orthopaedic surgeons routinely collaborate with physicians on the adult orthopaedic services at HSS to share knowledge and technical advances. We frequently operate together to achieve the best outcomes for our patients and hold weekly academic conferences to discuss challenging cases. With a commitment to clinical and surgical excellence, academic productivity and care for the underserved, our team is the highest-volume provider of elective pediatric orthopaedic surgery in the tristate area.

38,314
Patient visits

58
Published studies

3,283
Surgeries performed

71
Presentations at conferences

Chief: Roger F. Widmann, MD

Pediatric Orthopaedic Service Faculty: John S. Blanco, MD; Emily R. Dodwell, MD, MPH; Shevaun M. Doyle, MD; Peter D. Fabricant, MD, MPH; Daniel W. Green, MD, MS; Cathleen L. Raggio, MD; David M. Scher, MD; Ernest L. Sink, MD

Affiliated Orthopaedic Faculty: Matthew E. Cunningham, MD, PhD; Aaron Daluiski, MD; Austin T. Fragomen, MD; Han Jo Kim, MD; S. Robert Rozbruch, MD; Samir K. Trehan, MD

LEADERSHIP

Dr. Widmann specializes in spine deformity correction, robotic spine surgery and pediatric limb deformity correction. He serves as the American Academy of Orthopaedic Surgeons representative to the American College of Radiology's ACR Appropriateness Criteria Expert Panel on Pediatric Imaging and on the editorial boards of the *Journal of Children's Orthopaedics* and the *Spine Deformity Journal*.

Dr. Blanco specializes in pediatric limb and spine deformity correction. He is an editorial board member of the *Spine Deformity Journal* and serves as director of surgical quality assurance for the Service.

Dr. Dodwell is a clinician-scientist who specializes in cerebral palsy, limb deformity correction and trauma. She is deputy editor (pediatric orthopaedics) for the *Journal of the American Academy of Orthopedic Surgeons* and vice president of the Pediatric Orthopaedic Club of New York. She is also a member of the Traveling Fellowship Committee at the Pediatric Orthopaedic Society of North America (POSNA). She serves as coordinator of global initiatives for the International Hip Dysplasia Institute and is on the pediatric orthopaedic faculty of AO Trauma.

Dr. Doyle specializes in clubfoot, nonoperative scoliosis management and trauma. She is an Own the Bone committee member for the American Orthopaedic Association. She completed the Neubauer Clubfoot Fellowship and is a faculty member of Ponseti International. She is a consultant reviewer for the *Journal of Pediatric Orthopaedics*, *Clinical Orthopaedics and Related Research (CORR)* and the *HSS Journal*.

Dr. Fabricant specializes in pediatric sports medicine and trauma. He is a director-at-large of the Executive Committee of the Pediatric Research in the Sports Medicine Society and co-chair/clinical director of the HSS Patient-Reported Outcomes Measures Lab. He is also the associate editor of *CORR*. He is a member of both the POSNA Evidence Based Practice and E-Editorial committees. He serves as education director for the Service.

Dr. Green specializes in pediatric sports medicine and trauma. He is chairman of both the POSNA Development Committee and Pediatric ACL Research for the Sports Cohort Outcomes Registry. He sits on the board of the Patellofemoral Research Foundation and the Pediatric Research in Sports Medicine Society, for which

he is also chairman of the Patella Research Interest Group. He is the associate director of the HSS Orthopaedic Surgery Residency Program and serves as team physician for USA Volleyball.

Dr. Raggio specializes in skeletal dysplasia. She is a member of both the Medical Advisory Council of the Osteogenesis Imperfecta Foundation and the International Scoliosis Genetics Interest Group.

Dr. Scher specializes in cerebral palsy and clubfoot. He is the founder and leading member of the New York Cerebral Palsy Consortium and co-chair of the HSS Residency Selection Committee. He is the co-medical director for the Leon Root, MD Motion Analysis Laboratory and is a faculty member of Ponseti International. He serves as a faculty mentor for several resident research grants, including an Orthopaedic Research and Education Foundation (OREF) Resident Research Grant and an HSS Surgeon-in-Chief Research Grant for studying “The Effects of Medial-Sided Procedures on Reconstruction of the Adolescent Idiopathic Flatfoot: A Prospective Clinical Trial.”

Dr. Sink was appointed Chief of the Hip Preservation Service in 2019. He also serves on the Annual International Pediatric Orthopaedic Symposium Advisory Board and is on the Medical Advisory Board of the International Hip Dysplasia Institute.

PATIENT CARE

The singular focus on musculoskeletal health at HSS enables our team of physicians to deliver the highest level of orthopaedic care in a family-centered and child-focused environment. HSS pediatric orthopaedic surgeons offer multiple age-specific surgical options for ACL reconstruction in children, depending on the level of skeletal maturity and the size of the patient. We also have among the highest volumes of PAOs and spinal deformity surgeries for pediatric patients in the tristate area. Our surgeons were among the earliest adopters of and are experts in the use of the Taylor Spatial Frame and intramedullary lengthening rods for limb lengthening and limb deformity in children. We also embrace the use of new technologies, including intraoperative 3D surgical navigation across a spectrum of pediatric orthopaedic surgeries, robotic spine surgery and onsite neuromonitoring for spine and limb deformity surgery to enhance safety and improve surgical outcomes for our patients.

Our current areas of focus to enhance care include:

- **Improving the patient experience.** Our child life team utilizes virtual reality goggles and other means of distraction therapy to decrease patient anxiety and discomfort during procedures such as pin, cast and suture removal, as well as deformity casting.
- **Minimizing anesthesia exposure.** At HSS, the new standard for young children is to perform MRIs without anesthesia. Our radiologists and child life staff work collaboratively to prepare children in advance of their visit, and then guide them through the procedure. Our dedicated team has almost eliminated the need for anesthesia during MRIs in children ages 4 and up.
- **Integrating intraoperative navigation** into the surgical management of pediatric fractures as the standard of care.
- **Utilizing pediatric activity scales and treatment algorithms** that Dr. Fabricant created, validated and published during his residency and fellowship training, our Pediatric Sports Medicine team sets the standard for the care of pediatric ACL tears.
- **Decreasing exposure to radiation.** Using 3dMD stereophotogrammetry in conjunction with EOS imaging, we are validating the use of 3D surface topography in the diagnosis of scoliosis.
- **Enhancing the accuracy of tarsal coalition resections.** We routinely use surgical navigation and intraoperative 3D fluoroscopy to perform these procedures.

RESEARCH

Our group encourages the pursuit of clinical research through the development of a unique, collaborative and highly productive research initiative that involves every surgeon and a motivated research staff. Our surgeons have access to unique resources, such as a 3D whole-body imaging suite and the Leon Root, MD Motion Analysis Laboratory, which is used by both children with neuromuscular diseases and high-level athletes who want to improve their performance. One of only 12 laboratories in the US to be accredited by the Commission for Motion Laboratory Accreditation, the lab allows us to perform preoperative gait analysis to optimize surgical decision-making, as well as conduct research on movement.

Currently, there are six pediatric orthopaedic gait research investigations underway. The 3D body scanner is being used in conjunction with EOS low-dose imaging to provide an alternative imaging modality that has minimal ionizing radiation with the added benefit of creating a robust clinical and research registry. (Read more on page 28.) In addition, our surgeons actively participate in national and international pediatric orthopaedic study groups and have received competitive grants from the National Institutes of Health, AO North America, POSNA, OREF and the American Academy for Cerebral Palsy and Developmental Medicine.

NOTABLE PUBLICATIONS

- Swarup I, Silberman J, Blanco J, Widmann R. Incidence of intraspinal and extraspinal MRI abnormalities in patients with adolescent idiopathic scoliosis. *Spine Deform.* 2019 Jan; 7(1):47-52. doi: 10.1016/j.jspd.2018.06.006.
- Nwachukwu BU, So C, Zhang Y, Shubin-Stein BE, Strickland SM, Green DW, Dodwell ER. Adolescent and caregiver-derived utilities for traumatic patella dislocation health states. *J Ped Ortho.* 2019 Jan 25. doi: 10.1097/BPO.0000000000001341.
- Cordasco FA, Black SR, Price M, Wixted C, Heller M, Asaro LA, Nguyen J, Green DW. Return to sport and reoperation rates in patients under the age of 20 after primary anterior cruciate ligament reconstruction: risk profile comparing 3 patient groups predicated upon skeletal age. *Am J Sports Med.* 2019 Mar;47(3):628-639. doi: 10.1177/0363546518819217.
- Jones KJ, Kelley BV, Arshi A, McAllister DR, Fabricant PD. Comparative effectiveness of cartilage repair with respect to the minimal clinically important difference. *Am J Sports Med.* 2019 Nov;47(13):3284-3293. doi: 10.1177/0363546518824552.
- Dodwell ER, Pathy R, Widmann RF, Green DW, Scher DM, Blanco JS, Doyle SM, Daluiski A, Sink EL. Reliability of the modified Clavien-Dindo-Sink complication classification system in pediatric orthopaedic surgery. *JBJS Open Access.* 2018 Oct 23;3(4):e0020. doi: 10.2106/JBJS.OA.18.00020.

Spine Service



Orthopaedic surgeons Andrew Sama (left) and Harvinder Sandhu

The Spine Service is world-renowned for its innovative and research-based treatment of children and adults with all levels of spine disease and deformity. We perform more complex spinal reconstruction and minimally invasive spine procedures than any other hospital in the country.

22,196
Patient visits

325
Presentations
at conferences

3,957
Surgeries

39
Academic
visitors

150
Published
studies

Co-Chiefs: Andrew A. Sama, MD, and Harvinder S. Sandhu, MD, MBA

Faculty: Todd J. Albert, MD; John S. Blanco, MD; Frank P. Cammisa, Jr., MD; Matthew E. Cunningham, MD, PhD; James C. Farmer, MD; Federico P. Girardi, MD; Charles B. Goodwin, MD; Russel C. Huang, MD; Alexander P. Hughes, MD; Sravisht Iyer, MD; Yoshihiro Katsuura, MD; Han Jo Kim, MD; Darren R. Lebl, MD, MBA; Steven J. McAnany, MD; Patrick F. O'Leary, MD; Sheeraz Qureshi, MD, MBA; Bernard A. Rawlins, MD; Frank J. Schwab, MD; Roger F. Widmann, MD

LEADERSHIP

In October 2019, Drs. Sama and Sandhu succeeded Dr. Schwab as co-Chiefs of the Spine Service.

Dr. Schwab was named Vice Chair of Innovation for HSS.

In 2019, HSS celebrated the investiture of Dr. Qureshi as the Patty and Jay Baker Chair in Minimally Invasive Spine Surgery. This program will be centered on clinical excellence in minimally invasive surgery along with a significant research and educational component to continue to expand the field.

Dr. Kim was named the IMAST Program Chair for the Scoliosis Research Society and a member of the Board of Trustees for the Foundation of Orthopedics and Complex Spine.

Dr. Albert received the Nicolas Andry Award for Lifetime Achievement from the Association of Bone and Joint Surgeons. He also became the treasurer of the Executive Committee of the American Orthopaedic Association.

PATIENT CARE

In the last year, the Service has cemented its place as the local, national and international leader in complex spine surgery and minimally invasive spine (MIS) procedures. The hospital acquired several surgical spine robots (Globus, Mazor) and several additional navigation systems (Brainlab, Globus Medtronic), allowing more of our surgeons to provide highly complex procedures with greater precision and MIS procedures for patients. We are also in the process of acquiring these capabilities for our spine program at HSS Stamford.

Spine Service faculty published a total of 150 peer-reviewed manuscripts in the 2018–2019 academic year.

RESEARCH

During the 2018–2019 academic year, a total of 150 peer-reviewed manuscripts have been published by members of the Service, making us one of the most productive spine services in the world.

PREDICTING PATIENT OUTCOMES

- HSS investigators are actively collaborating with the International Spine Study Group and the European Spine Study Group to develop artificial intelligence tools enabling the prediction of outcomes of adult spinal deformity surgery. Preliminary findings demonstrated that the use of AI not only permits the classification of patients based on objective criteria but can also predict clinical outcomes, complications and risk for return to surgery.
- Drs. Hughes, Sama, Girardi and Cammisa have expanded their Connective Tissue and Bone Quality Research Group. The mission of the group is to define a clinically accessible marker for bone and connective tissue quality.

IMPROVING POSTOPERATIVE CARE

- The Service has adopted an enhanced recovery after surgery (ERAS) pathway, under the guidance of colleagues from the Department of Anesthesiology, based on an extensive review of the literature to optimize patient recovery. In a recent publication in *Spine*, HSS anesthesiologist Ellen Soffin, MD, PhD, demonstrated that this evidence-based ERAS tailored for MIS spine procedures resulted in shorter length of stay, minimal complications and no readmissions within 90 days of surgery.
- Dysphagia is a common complication in the setting of anterior cervical discectomy and fusion (ACDF) surgery. In a study led by Dr. Albert, the Service aims to evaluate the effectiveness of local intraoperative corticosteroids (LIC) in decreasing the severity of swallowing difficulty following ACDF. Our analysis showed that the LIC arm using this delivery method had significantly better dysphagia scores than the control arm in the immediate postoperative period and was sustained at one month. This method of delivering LIC can be incorporated as part of the standard of care for ACDF patients to better their outcomes postoperatively.
- Drs. Sandhu and Iyer are leading a randomized, double-blinded trial enrolling patients undergoing 1-2 level lumbar fusion in which they received either IV-ketorolac, IV-acetaminophen or IV-placebo every six hours for 48 hours postoperatively. In addition to the IV study medication, patients received as-needed oral opioid medications and patient-controlled analgesia. Preliminary results from this trial demonstrated that IV-ketorolac reduced opioid use compared to placebo by 40% and compared to acetaminophen by 30% and improved pain control postoperatively in patient-reported outcomes. There was also a trend toward decreased length of stay and seemingly no increase in in-hospital complications.

EDUCATION

In the last academic year, the Service hosted 22 international visitors and 17 domestic visitors.

NOTABLE PUBLICATIONS

- Diebo BG, Shah NV, Boachie-Adjei O, Zhu F, Rothenfluh DA, Paulino CB, Schwab FJ, Lafage V. Adult spinal deformity. *Lancet*. 2019 Jul 13;394(10193):60-172.
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Sports Medicine Institute



Orthopaedic surgeon and sports medicine specialist Andrew Pearle

Members of the Sports Medicine Institute are dedicated to treating athletic injuries of the musculoskeletal system in patients of all abilities, including professional and amateur athletes and active adults. Our specialized services include the HSS Ortho Injury Care location for urgent, acute-onset injuries; the Center for Professional Sports Medicine, which brings together practitioners across disciplines to provide integrated care for professional athletes; the Women's Sports Medicine Center; the Institute for Cartilage Repair; the Patellofemoral Center; the Sports Rehabilitation and Performance Center and the Non-surgical Foot and Ankle Service.

77,691
Patient visits

10,232
Surgeries

8
Fellows

70
Published
studies

17
Presentations
at conferences

7
Academic
visitors

Surgeon-in-Chief: Bryan T. Kelly, MD, MBA
Chief, Sports Medicine Institute: Andrew D. Pearle, MD
Chief, Primary Sports Medicine: John P. DiFiori, MD
Chief, Hip and Knee Sports Medicine:
 Anil S. Ranawat, MD
Chief, Shoulder and Elbow Sports Medicine:
 Lawrence V. Gulotta, MD

Faculty: Answorth A. Allen, MD; David W. Altchek, MD; Theodore A. Blaine, MD; William W. Briner, Jr., MD; Lisa R. Callahan, MD; James B. Carr II, MD; Struan H. Coleman, MD, PhD; Frank A. Cordasco, MD, MS; David M. Dines, MD; Joshua S. Dines, MD; Stephen Fealy, MD; Andreas H. Gomoll, MD; Marci A. Goolsby, MD; Brian C. Halpern, MD; Jo A. Hannafin, MD, PhD; Anne M. Kelly, MD; James J. Kinderknecht, MD; Osric S. King, MD; Ryan J. Lingor, MD; John D. MacGillivray, MD; Robert G. Marx, MD, MSc; Michael J. Maynard, MD; Moira M. McCarthy, MD; Kathryn D. McElheny, MD; Jordan D. Metzl, MD; Danyal H. Nawabi, MD; Benedict Nwachukwu, MD, MBA; Stephen J. O'Brien, MD, MBA; Scott A. Rodeo, MD; Howard Anthony Rose, MD; William S. Schairer, MD; Daphne A. Scott, MD; Nicholas Sgrignoli, MD; Beth E. Shubin Stein, MD; Sabrina M. Strickland, MD; Karen M. Sutton, MD; Samuel A. Taylor, MD; Brett G. Toresdahl, MD; David A. Wang, MD; Russell F. Warren, MD; Thomas L. Wickiewicz, MD; Riley J. Williams III, MD; Warren K. Young, MD

LEADERSHIP

Dr. Kelly was appointed Surgeon-in-Chief and Medical Director at HSS, after having led the Sports Medicine Institute from 2014 to 2019.

Dr. Pearle succeeded Dr. Kelly as Chief of the Sports Medicine Institute in July 2019.

HSS had a strong showing at this year's American Medical Society for Sports Medicine (AMSSM) Annual Meeting, the premier meeting for primary sports medicine physicians. Several of our physicians serve in leadership roles for AMSSM. Dr. Goolsby is currently serving on the board of directors, Dr. DiFiori is a past president and serves on the foundation board and Dr. Scott served on the program planning committee for the meeting. Dr. DiFiori lectured on the NBA perspective of early single-sport specialization and presented new research in this area at the AMSSM Youth Early Sport Specialization Summit, and Dr. Toresdahl led a breakout session on youth running.

Also at the AMSSM meeting, leaders of the Sports Medicine Institute gave two podium presentations. Dr. Toresdahl shared his study on risk factors associated with injuries in first-time marathon runners, and 2018 sports medicine fellow Samantha Smith, MD, shared her study on collegiate basketball player characteristics associated with patellar tendon shear wave elastography.

The Institute is conducting the largest observational study of runners training for a marathon to date.

Dr. Metzl received the 4th Annual AKTIV Against Cancer Award, which is presented annually to a community member who demonstrates impactful philanthropic efforts through health and fitness. He was honored for his work in establishing the first physician-led fitness community to promote health through activity.

Dr. Rodeo and researcher Suzanne Maher, PhD, received an R01 grant from the National Institutes of Health (NIH) to study how partial meniscectomy affects contact mechanics and tissue response.

Postdoctoral fellow Tony Chen, PhD, received an NIH grant to study performance evaluation of a non-degradable synthetic device for chondral and osteochondral defects of the knee.

Dr. Marx received the International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine Clinical Outcomes Research Grant for his study of cluster RCT of implementation strategies for ACL injury prevention.

Dr. Goolsby presented a lecture at the Association of Academic Physiatrists as well as participated in the ESPNW-sponsored “Keep Her in the Game” program with Dr. Callahan.

Dr. Kinderknecht co-chaired the American Orthopaedic Society for Sports Medicine Football Sports Medicine: Youth to the NFL Conference.

Dr. Maher was keynote speaker at the World Congress of Biomechanics and the Joint Meeting of Pre-Clinical Implants section at the Orthopaedic Research Society (ORS) annual meeting and gave poster presentations at the Summer Biomechanics, Bioengineering and Biotransport Conference and the ORS annual meeting.

PATIENT CARE

HSS Ortho Injury Care, led by Dr. Lingor, offering same-day or next-day evaluations and care for patients with sprains, strains and possible fractures, opened November 12, 2018, and has seen impressive volume in its first year of operation. Patients receive appointments with the appropriate HSS provider for their injury, usually within 24 hours, for those who need to be seen quickly for diagnosis and care. Services include x-ray imaging, medical diagnosis, care and nonsurgical management of musculoskeletal injuries and recent-onset, acute joint pain.

RESEARCH

The Institute has formalized its commitment to running-related medicine research initiatives through the creation of a monthly meeting focused on the topic. We have also initiated a research partnership with Strava and the New York Road Runners to conduct the largest observational study to date of runners training for a marathon and facilitated a new study involving the AMSSM and the International Institute for Race Medicine to collect data on race-day medical events at road races across the United States.

EDUCATION

We have created a new musculoskeletal ultrasound curriculum for fellows and junior attendings as well as conducted a course on exercise as medicine for Weill Cornell Medical College, including lectures from attendings and fellows.

NOTABLE PUBLICATIONS

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Department of Biomechanics



From left: Fernando Quevedo-González, Timothy Wright and Joseph Lipman are exploring additive manufacturing technologies within the Department of Biomechanics.

Engineers in the Department collaborate with orthopaedic surgeons, radiologists, pathologists and basic scientists to design implant systems that are customized to HSS patients as well as licensed to orthopaedic companies throughout the world. The Department's Orthopaedic Implant Registry System contains more than 25,000 implants retrieved at HSS since 1977, the largest such database in the world.

42
Patient-specific implants created

142
Surgeon requests for assistance in implant selection

6
Fellows

22
Department engineers

30
Presentations at conferences

5
Academic visitors

Director: Timothy M. Wright, PhD

Faculty: Suzanne Maher, PhD; Carl Imhauser, PhD

LEADERSHIP

Dr. Wright was named to the Research Grants Committee of the Orthopaedic Research and Education Fund (OREF). The committee is responsible for overseeing the OREF independent peer-review process and for making decisions regarding the awarding of funds for research consistent with OREF's mission, goals and objectives.

Dr. Maher holds several key leadership positions within the Orthopaedic Research Society (ORS). She is a member of the Nominations Committee, chair of the section chairs of the society's various research sections and a member of the society's Translational/Clinical Task Force.

Dr. Maher is also a permanent reviewer of grant proposals for the Musculoskeletal Tissue Engineering Study Section at the National Institutes of Health and has served as a reviewer of grant proposals for musculoskeletal biology and medicine resource-based centers, funded by the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) at the National Institutes of Health.

Dr. Imhauser received a "high-risk, high-reward" research grant from NIAMS to develop a comprehensive understanding of the biomechanical function of the soft tissues of the knee that integrates computer, experimental and statistical modeling. This work will establish a basis for developing more personalized techniques for reconstructing injured knee ligaments tailored to the geometry and properties of an individual's knee.

PATIENT CARE

Partnering with orthopaedic surgeons at HSS, the Department has developed joint replacements for the hip, knee, ankle, shoulder, elbow and wrist, as well as devices for enhancing spine fusion.

- Dr. Maher and postdoctoral fellow Tony Chen, PhD, continue their development and commercialization of implants for cartilage replacement. Dr. Maher was awarded a Phase II Small Business Innovation Research Award from the NIH through AGelity Biomechanics, a life-sciences company she founded with orthopaedic surgeon Russell Warren, MD.
- Dr. Wright and Joseph Lipman, MS, Director of Device Development, collaborated with clinical colleagues Robert Hotchkiss, MD, Aaron Daluiski, MD, and Daniel Osei, MD, MSc,

to continue their work on developing a replacement system for the carpometacarpal joint in the thumb. The effort is combining innovative optimization techniques to determine shape and material properties for the implant components, with the goal of eventually fabricating the components using additive manufacturing techniques.

- Dr. Imhauser and colleagues confirmed the reliability of a new instrument to assess knee laxity in multiple anatomic planes. This clinical tool will be used to understand the role of knee laxity in noncontact injury to the anterior cruciate ligament (ACL), early failure of ACL reconstruction surgery and dissatisfaction after total knee replacement.

RESEARCH INITIATIVES

The mission of the Department is to apply principles of engineering and materials science to solve orthopaedic problems by conducting basic and applied research that translates to the development of devices and instrumentation aimed at improved patient care.

DEVELOPING PREDICTIVE MEASURES

- Previous research on how partial meniscectomy affects contact mechanics in the knee joint is being translated into the clinical setting under a new grant awarded by the NIH to Dr. Maher and orthopaedic surgeon Scott Rodeo, MD. The plan is to combine the use of imaging, surgery, computer modeling and statistics to unearth the mechanical factors that are predictive of outcome after partial meniscectomy surgery. Streamlined sensors that can be arthroscopically implanted at the time of surgery are being developed to provide a real-time, intraoperative method of directly quantifying joint contact forces during surgery.
- Tibial geometry and knee laxity have been identified as risk factors for ACL rupture, yet their role in affecting the biomechanics of the knee are not well understood. Using a robotic manipulator, the relative contributions of sagittal tibial slope, medial tibial eminence volume and anterior knee laxity on joint kinematics were determined in both ACL-intact and ACL-sectioned cadaveric knees. Sagittal slopes of the medial and lateral tibial plateaus were predictive of kinematics with the ACL intact, while medial tibial eminence volume and anterior laxity were predictive of kinematics with the ACL sectioned.

PIONEERING MODELS OF MEASUREMENT

- Using an experimental electrochemical corrosion chamber established in the Department, engineers and arthroplasty surgeons have been exploring the role of design factors, such as taper geometry and implant materials, on the susceptibility for fretting and corrosion in modular implants for total hip replacement.
- Computer models used to assess mechanical interactions between orthopaedic implants and surrounding bone are limited because they apply simplified load cases, usually based on peak forces. To overcome this limitation, the Department has developed an integrated approach to determine the most critical scenario for the interaction between implant and bone. Computer simulations were performed across a demanding activity, climbing stairs, using in vivo experimental forces combined with knee kinematics for patients who had received a knee replacement. Interestingly, the worst conditions did not arise from the maximum loads, so future studies should focus on multiple load cases to best reflect variations in the mechanical burden placed on the implant.

EDUCATION

Dr. Imhauser organized a workshop at the 2019 ORS Annual Meeting to address the topic of reproducibility in modeling and simulation. The workshop brought together experts from academia, industry and regulatory agencies to discuss ongoing efforts to establish reproducibility using knee modeling as a case example. An invited paper summarizing the results of the workshop will be published in the *Journal of Orthopaedic Research*.

Dr. Wright co-chaired a committee to transition the Clinician Scholar Career Development Program from the American Academy of Orthopaedic Surgeons to the ORS, including securing partial funding for the program through a Support for Scientific Conferences (R13) grant from the NIH.

NOTABLE PUBLICATIONS

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- Wang D, Kent RN 3rd, Amirtharaj MJ, Hardy BM, Nawabi DH, Wickiewicz TL, Pearle AD, Imhauser CW. Tibiofemoral kinematics during compressive loading of the ACL-intact and ACL-sectioned knee: Roles of tibial slope, medial eminence volume, and anterior laxity. *J Bone Joint Surg Am*. 2019 Jun 19;101(12):1085-1092.
- Jones CW, Choi DS, Sun P, Chiu YF, Lipman JD, Lyman S, Bostrom MPG, Sculco PK. Clinical and design factors influence the survivorship of custom flange acetabular components. *Bone Joint J*. 2019 Jun;101-B(6_Supple_B):68-76.
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Message from the Physician-in-Chief

It is an honor to share with you our progress in advancing care for patients everywhere with complex rheumatic diseases. Our clinicians and laboratory scientists collaborate to gain insights and improve outcomes. We aspire to understand the pathogenesis of disease, identify therapeutic targets and develop novel therapies. Rheumatologists and orthopaedic surgeons at HSS work together to characterize the modifiable factors that can impact the course of a chronic disease or a surgical procedure. And we partner with staff across HSS to identify and reduce the disparities that lead to worse outcomes among those who are at a social and economic disadvantage.

A longstanding area of focus at HSS has been the reproductive health of women with lupus and other rheumatic diseases. This year, Bella Mehta, MBBS, MS, who joined the faculty in 2018 after completing her fellowship at HSS, published a retrospective study in the *Annals of Internal Medicine* demonstrating that pregnancy outcomes in the past two decades have significantly improved for women with lupus. More notable improvement in maternal mortality among women with lupus compared to those without it suggests that factors beyond advances in obstetrics were responsible.

Meanwhile, Lisa Sammaritano, MD, continued to serve as primary investigator for new American College of Rheumatology (ACR) guidelines on the management of reproductive health in patients with rheumatic diseases. Among the soon-to-be-published recommendations include those related to contraception, fertility and menopause assessment; pregnancy management; and maternal and paternal medication use. Dr. Sammaritano is also working to establish a new reproductive health center at HSS to provide consultation across the spectrum of reproductive issues faced by women with rheumatic disease, particularly in preparation for and during pregnancy.

In 2019, the collaborative efforts of clinical rheumatologists, immunologists and pathologists supported through the National Institutes of Health Accelerating Medicines Partnership were rewarded with important insights about the cells and molecular mechanisms involved in synovial inflammation and joint damage in rheumatoid arthritis. This work — initiated by Susan Goodman, MD, and Vivian Bykerk, MD, and carried out in the laboratory of Laura Donlin, PhD, of the HSS Research Institute — was made possible through single-cell RNA sequencing technology, which allowed us to see the complexity of the cell populations in RA tissue for the first time. We were excited to see Dr. Donlin's research, describing an *in vitro* system to study the effects of RA medications on immune system cells, highlighted at the Year in Review session of the 2019 ACR annual scientific meeting. Further down the research pipeline, we are running clinical trials to explore new therapeutic targets for scleroderma, vasculitis and a number of other diseases.

Looking ahead to 2020, we are especially enthusiastic about the work that Michael Lockshin, MD, and Medha Barbhuiya, MD, MPA, are doing on the implications of diagnostic uncertainty. Almost half of patients in some rheumatology practices have ambiguous diagnoses — symptoms and laboratory findings that resemble, but are insufficient to justify being labeled, a known illness. Lacking a named diagnosis, these patients are not recruited for medical studies, are not accurately coded in administrative documents and can have difficulty gaining approval for reimbursement of medications. Drs. Lockshin and Barbhuiya are organizing a multidisciplinary workshop for 2020 to guide us toward consensus on the place undefined diagnoses should hold in clinical, research and administrative

medicine; prioritize representation of affected patients in these areas; and identify next step strategies to accomplish these goals.

In our commitment to training the next generation, we remain unwavering. Karen Onel, MD, who joined HSS as Chief of Pediatric Rheumatology three years ago, has worked tirelessly to bolster our fellowship program in pediatric rheumatology, and we are especially proud of the accomplishments of the pediatric fellows in the 2018–2019 academic year, which include an HSS Fellow Research Award, a Hope Award from the Childhood Arthritis and Rheumatology Research Alliance (CARRA) and a CARRA Fellow Grant.

Lastly, I would like to reflect on the life and career of our colleague Charles Christian, who, sadly, died in August 2019. From 1970 until his retirement in 1995, Dr. Christian served with distinction as Physician-in-Chief and Director of Rheumatic Diseases at HSS, as well as Chief of the Division of Rheumatology at Weill Cornell Medical College. His seminal contributions to the field of rheumatology are too numerous to list but include his classic paper, with Dorothy Estes, on the natural history of systemic lupus erythematosus. Dr. Christian also mentored with grace and kindness hundreds of young rheumatologists, including not only members of our own rheumatology division but those who lead rheumatology programs around the world. First and foremost, however, Dr. Christian was an insightful and dedicated clinician, committed to improving the lives of patients.

We keep his legacy in mind as we strive to model our own professional and personal lives on his example, as the qualities that made Dr. Christian so extraordinary are the same ones that continue to motivate and inspire HSS rheumatologists today.

As always, I thank you for your interest in rheumatology at HSS and encourage you to share your thoughts, questions and ideas.

Mary K. Crow, MD

Physician-in-Chief

Chair, Department of Medicine

Chief, Rheumatology Division

Benjamin M. Rosen Chair in Immunology and Inflammation Research

Joseph P. Routh Professor of Rheumatic Diseases in Medicine



*Peggy Crow,
Physician - U*

HSS

Bone Health and Osteoporosis



Rheumatologist Linda Russell directs the Metabolic Bone Health Center at HSS.

Patients with bone health disorders can receive care through our multidisciplinary Metabolic Bone Health Center, which brings together experts from rheumatology, orthopaedics, endocrinology, nephrology and pediatrics. We offer advanced care for patients with osteoporosis and other disorders, with a robust screening program that aims to treat bone loss proactively with the goal of preventing fractures. We have a special interest in the relationship between preoperative bone quality and outcomes after orthopaedic procedures, as well as the creation of clinical trials investigating whether different pharmacologic therapies can improve these outcomes.

PATIENT CARE

For patients with osteoporosis and other bone disorders, we offer the most advanced screening options, which allow us to treat bone loss proactively and, in some cases, prevent fractures. In addition to DXA, our screening technology includes body composition analysis, which measures a patient's fat-to-muscle ratio; vertebral fracture assessment; trabecular bone score, which measures the strength of the vertebral body; and quantitative CT scans. We also conduct femur fracture assessments at the time of the bone density test. This practice is especially helpful for patients who take bisphosphonates or denosumab, which have been shown to increase the risk of atypical femur fracture.

Our multidisciplinary approach helps to ensure patients are medically ready for procedures. We have particular expertise in the use of anabolic agents in the orthopaedic setting to optimize postsurgical outcomes.

RESEARCH

Our experts are currently studying the effects of secukinumab, a medication used to treat ankylosing spondylitis (SpA), on bone health. People with SpA have double the risk of osteoporosis, due to bone that is abnormally weak and suffers small fractures that can be crippling and painful. We are using bone density testing and spine imaging as well as testing for various markers of bone growth and inflammation to help us understand the effect of this drug on bone metabolism.

We are currently leading research into the pathophysiology of avascular necrosis, a debilitating bone disorder associated with vascular injury. Our current efforts are focused on identifying risk factors for the disease, with the ultimate goal of developing improved treatment options.

Another area of investigation concerns characterization of the younger hip fracture population. We are comparing patients who present to the Orthopaedic Trauma Service with patients over 65 for fracture morphology and underlying comorbidities.

We take a multidisciplinary approach to bone health, bringing together rheumatologists, orthopaedic surgeons, endocrinologists, nephrologists and pediatricians.



Orthopaedic surgeon Joseph Lane leads the Metabolic Bone Disease Service at HSS.

EDUCATION

At the 2018 Annual Meeting of the American Society for Bone and Mineral Research (ASBMR), Joseph M. Lane, MD, gave a poster presentation on functional outcomes of nonoperatively treated LC-1 pelvic ring fractures. Dr. Lane and colleagues also gave an oral presentation on the nonoperative treatment of pelvic fractures at the 2019 Annual Meeting of the American Association of Orthopaedic Surgeons.

Richard S. Bockman, MD, PhD, lectured on the topic of osteoporosis in men at ASBMR. He also gave a lecture at the 2019 Advances in Mineral Metabolism Conference on the loss of anabolic momentum with brief nonadherence to denosumab therapy.

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Inflammatory Arthritis



Rheumatologist Vivian Bykerk (right), with laboratory scientist Laura Donlin. Their research is helping to characterize the cells involved in rheumatoid arthritis.

Our experts place a strong emphasis on the benefits of early detection and treatment of RA.

Our specialists are world leaders in clinical and basic research to advance the understanding of and treatment options for inflammatory arthritis. Our Inflammatory Arthritis Clinic assesses and treats patients affected with these conditions. We place a strong emphasis on the benefits of early detection and treatment for rheumatoid arthritis (RA). Our research is focused on advancing our understanding of how and why RA develops and how we can use those insights to advance patient care. Our experts are part of an internationally recognized Inflammatory Arthritis Center of Excellence, which is helping to train the next generation of providers.

LEADERSHIP

Vivian Bykerk, MD, continues to serve as principal investigator of the Accelerated Medicines Partnership (AMP), a multiyear National Institutes of Health–funded translational research project across numerous sites in the United States. Co-PIs are Lionel B. Ivashkiv, MD; Laura Donlin, PhD; and Alessandra Pernis, MD, as well as rheumatologist Susan Goodman, MD; pathologist Edward DiCarlo, MD; and radiologist John A. Carrino, MD. Dr. Donlin gave a talk on myeloid cells in RA synovium during the AMP Consortium held during the 2019 Annual Meeting of the Federation of Clinical Immunology Societies.

VALUE-BASED CARE

This past year we embarked on a collaboration with the HSS Center for the Advancement of Value in Musculoskeletal Care designed to develop patient-reported outcome measures for inflammatory arthritis. This work is motivated by the knowledge that the highest-value care is that which prevents long-term disease or joint damage. This work will result in an algorithm designed to help expedite care to the appropriate specialist. Ultimately, this work will enhance our ability to treat patients early and aggressively with the therapeutic approach best suited to each individual.

CHECKPOINT INHIBITOR RESEARCH

Checkpoint inhibitors are a class of drugs that stimulate T cells to recognize and attack cancer cells. This type of immunotherapy has dramatically changed the outlook for people with certain late-stage cancers, but it is also known to have troubling side effects, including a new form of inflammatory arthritis affecting around 5 percent of checkpoint patients. Anne R. Bass, MD, has been working to define this new form of arthritis and, with Karmela Kim Chan, MD, has opened a new registry to follow patients who experience this side effect. (See page 36 to read more.)

EARLY RA STUDY

CATCH-US is a prospective observational study of usual care for patients with early rheumatoid arthritis. We are looking at the efficacy of recommended treatments, with the goal of determining which factors may predict a patient's disease progression over time. This study began as a single-site study at HSS with 35 patients who had new-onset synovitis consistent with RA; it has since expanded to a national, multicenter study.

TRANSLATIONAL RA RESEARCH

We continue to make advances in our work to identify the specific subtypes of cells that drive disease progression in RA through our collaboration with AMP as well as our strong partnerships with labs in the HSS Research Institute. Over the past year, Dr. Donlin and colleagues published results identifying previously unknown subsets of cells found in RA and provided new insights about how some of these cell types interact to drive disease progression. This analysis was made possible through the use of cutting-edge single-cell RNA sequencing technology. Our hope is that through a better understanding of the cell populations in individual patients, we can provide a means by which we can treat them with precision medicine strategies at the earliest stages of disease.

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Gout



HSS rheumatologists, including Theodore Fields, take a multidisciplinary approach to treating gout.

Our Division's gout focus has been on optimizing gout patient care and studying ways of improving education for and monitoring of gout patients. This focus is driven by a broad literature showing that only a minority of gout patients worldwide receive optimal care despite excellent available treatment options. We are especially interested in taking a multidisciplinary approach to gout, and our recent work has brought together the expertise of rheumatologists and pharmacists as well as social workers, nurse practitioners, rheumatology nurses, biostatisticians and research assistants. These diverse perspectives allow us to provide the highest-quality care to patients with difficult cases while at the same time contributing knowledge with the potential to improve outcomes for all gout patients.

LEADERSHIP

Theodore R. Fields, MD, has lectured on challenges in gout patient education, including a presentation at the 2019 International Symposium on Urate Deposition Disease, and works with the American College of Rheumatology (ACR) on issues specific to gout. He currently sits on the ACR Gout Guidelines Committee and has served on the ACR Gout Abstract Selection Committee for the past three years.

PATIENT CARE

As a part of our study of a multidisciplinary approach to gout patient education and monitoring, we developed a new written curriculum for gout patients to supplement existing education materials. Nurses taught the curriculum to new patients and conducted follow-up review sessions at six and 12 months. There was also a 12-item questionnaire designed to evaluate the patient's gout self-care knowledge, which the nurse scored and then reviewed with the patient. The curriculum and questionnaire used in the study are now available to nurses as part of routine gout patient care upon request from the treating rheumatologist. Patients who have been involved in this program have reported that the nurse education has been especially valuable, and rheumatologists whose patients have participated have reported a significant time savings and improved patient satisfaction.

RESEARCH

Our specialists carry out studies of gout under the auspices of the Inflammatory Arthritis Center of Excellence at HSS. In addition to our ongoing focus on patient education, our research interests include the wide spectrum of gout presentations along with evaluation of newer gout treatments such as anakinra and pegloticase.

Currently we are looking to build on results of a gout patient needs assessment we first reported on in 2016 by expanding the assessment to include a more diverse population of patients across race, socioeconomic status and educational background.

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Osteoarthritis



Bella Mehta is leading an initiative focused on leveraging machine learning to improve treatment options for knee osteoarthritis.

Our rheumatologists work closely with orthopaedic surgeons, sports medicine specialists, biomedical engineers and basic scientists to advance our understanding of and treatment options for osteoarthritis. This multidisciplinary approach ensures that each patient receives the most comprehensive and personalized care possible.

LEADERSHIP

Bella Mehta, MBBS, MS, received the American College of Rheumatology's Distinguished Fellow Award in 2018 prior to joining the faculty.

RESEARCH

Dr. Mehta is leading an initiative focused on leveraging machine learning to improve treatment options for knee osteoarthritis (KOA). Despite the huge burden of KOA on individuals and health economies, current therapy for KOA is simply aimed at reducing pain. Identifying treatment targets for disease modification has been challenging, as clinically and biologically relevant KOA subtypes are not defined. The goal of the study is to define clinically relevant phenotypes along with ultrasound features that could predict tissue subtypes in KOA, so that personalized disease-modifying therapy can be used. Precise KOA subtypes would make selection of patients for clinical trials cost effective and safe, and lead to consistent scalable results to develop KOA treatments.

Our OA specialists are also deeply involved in research focused on racial and socioeconomic disparities in healthcare, specifically regarding the use of joint replacements for the management of end-stage osteoarthritis. For example, one recent HSS study found that patients coming from socioeconomically deprived neighborhoods were more likely to be discharged to an institution like a nursing home rather than sent home.

NOTABLE PUBLICATIONS

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Integrative Rheumatology



Rheumatologist Susan Goodman works closely with orthopaedic surgeons, including Mark Figgie, as Director of the Integrative Rheumatology and Orthopaedics Center.

We leverage close collaborations among rheumatologists, orthopaedic surgeons and scientists to study specimens removed at the time of surgery.

The integrative rheumatology program at HSS brings together rheumatologists, orthopaedic surgeons and basic scientists with the goal of improving outcomes for people with rheumatic disease, including those who are at risk for worse outcomes when undergoing orthopaedic surgery as a result of socioeconomic factors. We leverage our close collaborations between rheumatologists, scientists and orthopaedists to study specimens routinely removed at the time of surgery. We are leaders in establishing best practices for perioperative management of antirheumatic medications in patients undergoing joint replacement surgery. We have a particular interest in racial disparities related to hip and knee arthroplasty. Our research activities are carried out under the Integrative Rheumatology and Orthopaedic Center, and we are ecumenical in our research interests. Our diverse work uses classic “big-data” epidemiology as well as prospective cohort studies to better identify the outcomes and risk factors for poor outcomes seen in our target populations of rheumatic disease patients or those from impoverished neighborhoods. We are also trying to develop methods to better study these patients and their outcomes by developing patient-reported outcomes measures to provide more uniform measures for outcomes of importance to patients, such as pain relief, improved function and satisfaction.

LEADERSHIP

Susan M. Goodman, MD, served on the American College of Rheumatology (ACR) guidelines subcommittee in 2018 and is the rising chair in 2019. She’s also co-chair of the Glucocorticoid Working Group of the Outcome Measures in Rheumatology (OMERACT) Network. In addition, she serves on the Total Joint Replacement and Polymyalgia Rheumatica OMERACT Working Groups.

Anne R. Bass, MD, is the director of the HSS Rheumatology Fellowship Program. She is the former chair of the ACR Committee on Training and Workforce Issues and will be joining the ACR Board of Directors.

EDUCATION

Mark P. Figgie, MD, gave a poster presentation at the 2019 Annual Meeting of the American Academy of Orthopaedic Surgeons on complications following total knee arthroplasty in inflammatory arthritis versus osteoarthritis.

Dr. Goodman gave a presentation at the 2019 Annual Meeting of the International Federation of Societies for Surgery of the Hand entitled “Does the rheumatologist cure rheumatoid arthritis?” She also presented during the review course of the 2018 ACR Annual Meeting on perioperative outcomes and management for patients with rheumatic diseases.

Our experts help establish best practices for perioperative management of antirheumatic medications in joint replacement patients.

NOTABLE PUBLICATIONS

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Lupus and Antiphospholipid Syndrome



HSS Physician-in-Chief Mary K. Crow receives the Presidential Medal of Honor from the American College of Rheumatology in November 2018.

Among our areas of particular expertise are lupus and reproductive health as well as APS-related thrombosis.

Our specialists offer unique expertise in challenging areas of systemic lupus erythematosus (SLE) and antiphospholipid syndrome (APS). They are world leaders in clinical and basic research to advance the understanding of and treatment options for the disease. Due to the highly variable nature of these conditions, our rheumatologists work closely with nephrologists, OB-GYNs, dermatologists, psychiatrists, neurologists, cardiologists, oncologists, pain management specialists, social workers and highly trained nurses at HSS. This multidisciplinary approach ensures that each patient receives the most comprehensive and personalized care possible. Among our particular areas of expertise are lupus and reproductive health as well as APS-related thrombosis.

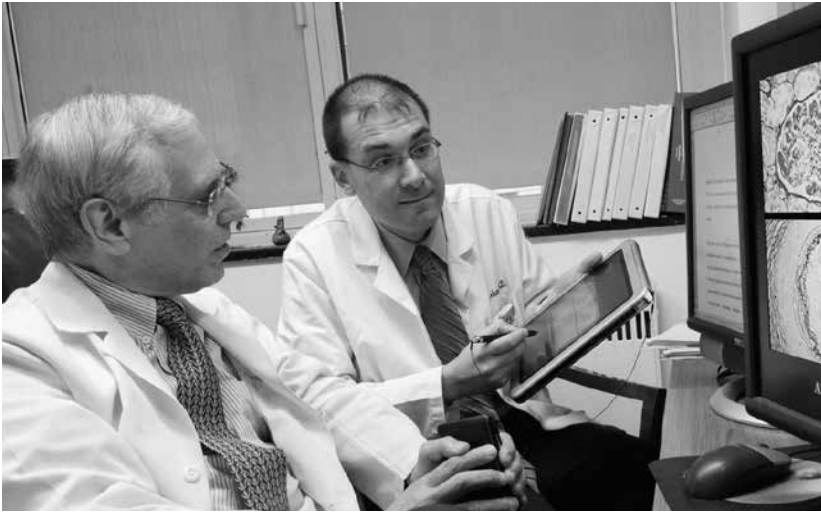
LEADERSHIP

Mary K. Crow, MD, received the Presidential Gold Medal from the American College of Rheumatology (ACR) in 2018. The medal is the highest honor the ACR can bestow and recognizes outstanding achievements in rheumatology over the course of a career.

Michael D. Lockshin, MD, continues his efforts to understand the natural history of SLE and other autoimmune diseases. He penned an editorial called "To Eat the Elephant" that was published in the February 2019 issue of *Arthritis & Rheumatology*. He also co-authored a paper in *Lupus Science & Medicine* called "SLE: Reconciling Heterogeneity," also published in February.

Lisa R. Sammaritano, MD, chaired the ACR committee responsible for developing the forthcoming Reproductive Health in Rheumatic and Musculoskeletal Diseases Guidelines.

Doruk Erkan, MD, MPH, continues to serve as Executive Committee Co-Chair of the international APS research network APS Action (APS Alliance for Clinical Trials and International Networking).



Rheumatologists Michael Lockshin (left) and Doruk Erkan

RESEARCH

Jane E. Salmon, MD, continues to enroll patients in the IMPACT study (IMprove Pregnancy in APS with Certolizumab Therapy), which is evaluating the addition of certolizumab to usual treatment to prevent preeclampsia in pregnant women with APS and repeated positive tests for lupus anticoagulant.

Research by Alessandra Pernis, MD, has led to the discovery of a previously unknown signaling pathway in autoimmunity related to age-associated B cells. This work could lead to the development of new therapies targeting SLE.

Theresa P. Lu, MD, PhD, is studying the expression and activity of Langerhans cell ADAM17 in human SLE skin. Dr. Lu and colleagues have found that Langerhans cells play an important role in photosensitivity, an immune system reaction to sunlight that can trigger severe skin rashes and is common in lupus patients, often leading to disease flares. Future research will focus on determining why lupus patients are susceptible to this condition.

Dr. Erkan is co-principal investigator on an international, multidisciplinary effort to develop rigorous new classification criteria that can identify patients who are likely to develop APS. The group presented phase II results at the 2019 ACR Annual Scientific Meeting. Medha Barbhैया, MD, MPH, has an Investigator Award from the Rheumatology Research Foundation to support new APS classification criteria development efforts and to perform spin-off projects investigating the role of thrombosis risk factors in APS.

Dr. Barbhैया is studying the role of important environmental factors and SLE risk within the ongoing Nurses' Health Study cohorts, including more than 250,000 women followed prospectively for incident disease for up to 40 years. She has also studied the role of environmental risk factors in the Black Women's Health Study, comprised of 59,000 women followed prospectively for 20 years. With her colleagues, she has examined the association between factors such as cigarette smoking, alcohol consumption, diet, ultraviolet radiation and childhood psychosocial factors on the risk of developing SLE. Given the severe consequences of SLE, the identification of modifiable risk factors for its development could lead to new and important knowledge about disease pathogenesis, as well as to potential strategies for disease prevention.

QUALITY-OF-LIFE RESEARCH

The Department of Social Work undertook a national survey of men with SLE to assess the impact of the disease on activities of daily living and health status. The majority reported fatigue and pain as the most impactful effects of lupus, and more than half reported high levels of depression. Nearly half indicated an interest in support, primarily online, suggesting an opportunity to better serve this population.

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Pediatric Rheumatologic Conditions



Karen Brandt Onel leads the Division of Pediatric Rheumatology at HSS.

The Division of Pediatric Rheumatology is dedicated to caring for pediatric patients with complex musculoskeletal inflammatory conditions. Our physicians and scientists are leading experts in advancing clinical research and establishing best treatment practices for patients with rheumatologic diseases such as juvenile idiopathic arthritis (JIA), systemic lupus erythematosus (SLE), juvenile dermatomyositis and chronic recurrent multifocal osteomyelitis (CRMO). We work closely with pediatric orthopaedic surgeons, radiologists, infectious disease specialists, pathologists and anesthesiologists to provide patients with the most comprehensive care possible.

LEADERSHIP

Karen Brandt Onel, MD, is serving as the primary investigator on a new set of guidelines from the American College of Rheumatology and the Arthritis Foundation for the management of JIA. The guidelines will focus on systemic JIA and oligoarthritis and are expected to publish in 2021.

Our fellows received numerous accolades in the 2018–2019 academic year. Rebecca Trachtman was the recipient of the HSS Fellow Research Award for her paper “PROMIS Computer Adaptive Tests (CATs) and Their Correlation with Disease Activity in Juvenile Idiopathic Arthritis.” Natalie Rosenwasser received the 2019 Childhood Arthritis and Rheumatology Research Alliance (CARRA) Hope Award, an honor bestowed by families to recognize basic science research likely to improve life for children with rheumatic diseases. Nadine Saad was awarded a CARRA-AF Fellow Grant for her project “Creation and Validation of a Modified Auto-Inflammatory Disease Index (AIDAI) in Periodic Fever, Aphthous Stomatitis, Pharyngitis, and Cervical Adenitis (PFAPA) Syndrome.”

PATIENT CARE

We are constantly seeking new ways to enhance quality of care for pediatric rheumatology patients. Nancy Pan, MD, is the site primary investigator for the Pediatric Rheumatology Care and Outcomes Improvement Network, a quality-improvement collaborative that develops and evaluates JIA disease management strategies to increase remission rates, improve functional status and decrease pain levels. Dr. Pan is also working with colleagues in the Department of Social Work and other groups to improve the documentation of patients’ sexual orientation and gender identity.

We are partnering on a variety of initiatives aimed at enhancing our patients’ overall quality of life. We recently collaborated with pediatric rehabilitation to develop an amplified musculoskeletal pain program. Alexa B. Adams, MD, is working with colleagues in sports medicine, physical therapy and other areas to establish a return-to-sports program for patients with JIA.

CLINICAL RESEARCH

We continue to enroll patients in the CARRA registry, which includes nearly 10,000 children and young adults with childhood-onset rheumatic diseases. The registry provides disease and treatment data.

Additionally, we participated in STOP-JIA, a first-in-kind study looking at children with new-onset polyarthritis to determine best treatment practice. Dr. Onel continues to lead CARRA studies aimed at defining best treatment practices for systemic JIA as well as CRMO. Dr. Pan is involved in a CARRA study to better understand the diagnosis and treatment of children with arthritis of the temporomandibular joint. Sarah Taber, MD, is working on a CARRA study aimed at preventing extension of oligoarthritis to polyarthritis in childhood. Dr. Taber is also site primary investigator for the CARRA SCORE study, which is studying localized and systemic sclerosis in children.

Our team is leading the development of a new set of ACR guidelines for systemic JIA and oligoarthritis set to publish in 2021.

BASIC RESEARCH

Theresa T. Lu, MD, PhD, is studying the effect of immune cells on pediatric tissues in rheumatic diseases that include SLE. She is the recipient of a National Institutes of Health grant to study vascular-stromal function and regulation in immunity. This work could provide new insights into a potential link between cardiovascular health and the immune system, which is especially relevant for autoimmune diseases such as lupus that are characterized by both vascular and immune system dysfunction.

Dr. Lu is also studying the expression and activity of Langerhans cell ADAM1. Dr. Lu and colleagues have found that Langerhans appears to play an important role in photosensitivity, an immune system reaction to sunlight that can trigger severe skin rashes and is common in lupus patients. Future research will focus on further elucidating the biological underpinnings of photosensitivity and determining why lupus patients are susceptible to this condition.

EDUCATION

We are one of the premier institutions in the nation for pediatric rheumatology training. Drs. Onel and Adams lead our fellowship program, one of only 30 pediatric rheumatology programs in the nation. Dr. Taber also serves as course director for the Weill Cornell Medicine pediatric rheumatology elective for medical students. Additionally, we are engaged in efforts to address the shortage of pediatric rheumatologists nationwide by growing awareness of these conditions and their management. Dr. Taber serves as a consult editor of rheumatology for Medscape and is overseeing a pediatric rheumatology lecture series for community physicians in underserved areas.

NOTABLE PUBLICATIONS

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Psoriatic Arthritis and Ankylosing Spondylitis



Our rheumatologists, including Karmela Chan, bring deep expertise to the care of patients with psoriatic arthritis.

We are focused on optimizing patient care for spondylitis and improving treatment options. We are especially interested in psoriatic arthritis (PsA) and have a large validated cohort of PsA patients who may participate in clinical trials. We are also involved in collaborations to identify new therapeutic options. These diverse interests allow us to provide the highest-quality care to patients with difficult cases while at the same time contributing knowledge that could improve outcomes.

LEADERSHIP

Sergio Schwartzman, MD, sits on the Medical Board of the National Psoriasis Foundation. He is also a member of the Spondyloarthritis Research and Treatment Network (SPARTAN) Registry Committee.

RESEARCH

HSS researchers led a study on the use of complementary or alternative medicine (CAM) in patients with PsA and found that nearly 53 percent of respondents reported using CAM in a 12-month period. Dr. Schwartzman and colleagues found that nearly 90 percent of patients using these modalities reported CAM was somewhat helpful. CAM users also were less likely to use biologics and targeted synthetics, however the finding was not statistically significant.

Researchers including Lisa A. Mandl, MD, MPH, are also running a study to evaluate pain sensitization in well-phenotyped inflammatory bowel disease (IBD) patients with musculoskeletal pain, comparing them with both positive controls (patients with psoriasis-associated arthritis) and negative controls (IBD patients without musculoskeletal pain). Pain is one of the most complex and pernicious symptoms of IBD, and joint pain is its most common extra-intestinal manifestation. Measuring pain processing in IBD patients would allow accurate stratification by type of pain, and thus inform choice of targeted therapy. More-effective treatment of acute and

sub-acute pain is known to minimize the transition to chronic pain, and could potentially decrease opioid use in this high-risk population. In addition, if abnormal pain processing correlates with SpA disease activity, more-aggressive treatment of even mild SpA may be important to prevent the development of pain sensitization. Preliminary data would form the basis for future longitudinal studies evaluating the effect of abnormal pain sensitization in response to standard therapies for IBD and IBD-associated pain and the effect of musculoskeletal pain control on the evolution of abnormal pain sensitization in patients with IBD.

Asymptomatic MRI changes in patients with Crohn's disease could be a marker of underlying systemic inflammation, which is a risk factor for poor outcomes in Crohn's-associated SpA. HSS rheumatologists are interested in correlating the changes in whole spine MRIs with patient-reported outcomes to identify patients at risk for SpA earlier. Detecting inflammation in the absence of clinical symptoms would provide an opportunity to intervene with therapies such as biologics.

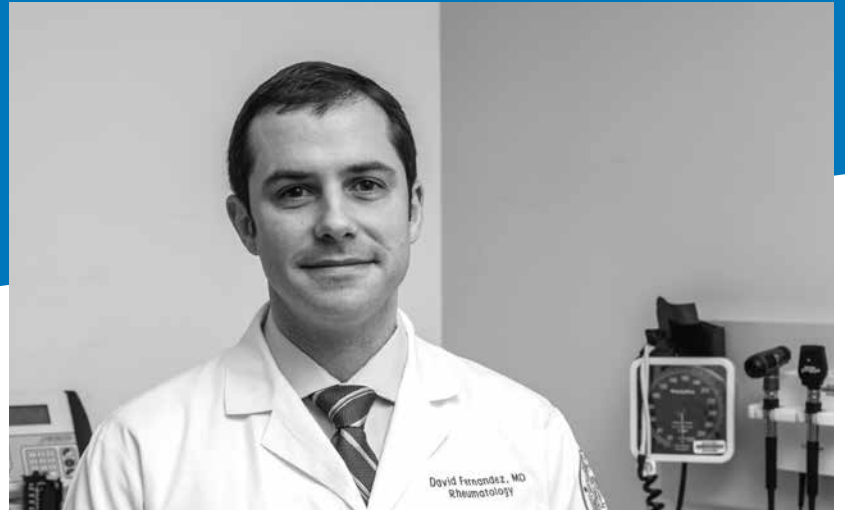
EDUCATION

Dr. Schwartzman gave an update on axial spondyloarthritis and ankylosing spondylitis at a meeting of the Spondylitis Association.

NOTABLE PUBLICATIONS

- Ford AR, Siegel M, Bagel J, Cordoro KM, Garg A, Gottlieb A, Green LJ, Gudjonsson JE, Koo J, Lebwohl M, Liao W, Mandelin AM, Markenson JA, Mehta N, Merola JF, Prussick R, Ryan C, Schwartzman S, Siegel EL, Van Voorhees AS, Wu JJ, Armstrong AW. Dietary recommendations for adults with psoriatic arthritis from the Medical Board of the National Psoriasis Foundation: A systemic review. *JAMA Dermatol*. 2018 Aug 1;154(8):934-950. doi: 10.1001/jamadermatol.2018.1412.
- Bagel J, Schwartzman S. Enthesitis and dactylitis in psoriatic arthritis: A guide for dermatologists. *Am J Clin Derm*. 2018 Dec;19(6):839-852.
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- Kiwalkar S, Rosenbaum J, Schwartzman S, Dutz JP, Van Den Bosch F. Axial Spondyloarthritis. Extraarticular Manifestations: Uveitis, Colitis, Psoriasis. In: Mease P, Kahn A, eds. *Axial Spondyloarthritis*. Seattle: Elsevier, 2019.

Inflammatory Muscle Disorders



Rheumatologist David Fernandez has special expertise in the care of patients with myositis and other inflammatory muscle diseases.

Inflammatory muscle disorders are marked primarily by muscle inflammation and weakness. In general, muscle inflammation is referred to as “myositis,” regardless of the cause. However, myositis is frequently used as shorthand to refer to common causes of inflammatory muscle disorders or idiopathic inflammatory myopathies (IIM). Different forms of myositis include polymyositis, dermatomyositis, inclusion body myositis and autoimmune necrotizing myopathy.

The myositis experts at HSS are dedicated to caring for patients with this rare condition with a multidisciplinary approach. Our physicians are leading experts in advancing clinical research and establishing best treatment practices, and we typically have one or more ongoing clinical trials enrolling patients at any one time. We work closely with social workers and other experts to provide patients with the most comprehensive care possible. Physical therapy specialists at the HSS Motion Analysis Lab perform comprehensive and quantitative strength measurement of patients, aiding in monitoring of myositis activity and damage. The radiology department has extensive experience in myositis imaging and has worked to advance novel methods of using MRI to evaluate myositis patients. Our patient support group, led by the Department of Social Work, is the only group of its kind in New York City and is an invaluable resource to many patients.

The Myositis Registry at HSS is helping us to gain a better understanding of this rare disease.

INVITED LECTURES

David Fernandez, MD, PhD, was an invited lecturer at the Rheumatology Grand Rounds at Albert Einstein College of Medicine and the Medicine Grand Rounds at NewYork-Presbyterian Queens on updates in myositis.

CLINICAL RESEARCH

We regularly participate in multicenter trials testing new therapies to enhance treatment options for patients with myositis as well as related side effects. There are several clinical trials focusing on polymyositis and dermatomyositis that are actively recruiting patients at this time, and we hope to participate in more trials in patients with inclusion body myositis as well in the future.

We also maintain a myositis registry to gather as much information as we can about as many patients as possible who have this rare condition. Our goal with the registry is to develop a better understanding of the clinical features, pathobiology and genetic underpinnings of myositis. We are currently using samples from patients enrolled in the myositis registry to undertake a study of T cell abnormalities in patients with inclusion body myositis. With this increased knowledge, our investigators hope to identify the unmet needs of patients with myositis and develop new and better treatments to improve disease outcomes and quality of life.

Scleroderma and Vasculitis



Jessica Gordon is an investigator in several clinical trials and observational studies focusing on scleroderma.

Our scleroderma and vasculitis experts are dedicated to diagnosing and caring for patients with these rare conditions. We are leading experts in advancing clinical research and establishing best treatment practices. We also work closely with laboratory scientists to enhance our understanding of clinical features, pathobiology and genetics of these diseases as well as develop possible interventions. We frequently partner with social workers who specialize in the unique concerns of scleroderma and vasculitis patients to ensure our patients receive extensive education and support. This work is carried out through our Scleroderma, Vasculitis and Myositis Center of Excellence.

LEADERSHIP

Robert F. Spiera, MD, and Jessica K. Gordon, MD, are members of the National Medical and Scientific Advisory Board of the Scleroderma Foundation.

Dr. Spiera also serves as Chair of the Scleroderma Foundation Tri-State Medical Advisory Board as well as a consultant for the Vasculitis Foundation.

AWARDS

Fellow Sebastian Sattui received a Vasculitis Clinical Research Consortium-Vasculitis Foundation Fellowship. He is analyzing the prevalence and impact of frailty in patients with polymyalgia rheumatica and giant cell arteritis, which often strike people over the age of 50.

Fellow Kimberly Showalter received a Scleroderma Clinical Trials Consortium Working Group Grant for her project on synchronizing systemic sclerosis skin gene expression and histology data with a machine-learning approach.

RESEARCH

Research is a particular area of strength for our group and is integrated into the clinical care of our patients. We offer a robust clinical trial program focused on both scleroderma and vasculitis. We conduct novel, investigator-initiated studies of promising new agents and actively participate in multicenter federal and industry-sponsored clinical trials. Our disease-focused registries facilitate enrollment in clinical trials and serve to identify patients for collaborative studies on disease mechanisms, as well as clinical observational studies. Our close working relationships with laboratory scientists allow us to continue to explore potential new therapeutic targets. This level of care has resulted in numerous national and international referrals each year.

We conduct novel, investigator-initiated studies of promising new agents and actively participate in multicenter clinical trials.



Robert Spiera is the Director of the Vasculitis and Scleroderma Program at HSS.

SELECTED INVITED LECTURES

Dr. Spiera was an invited lecturer at the 2018 Pan American League of Associations for Rheumatology in Argentina on the topics of therapy for giant cell arteritis and treatment of systemic sclerosis. He also gave Division of Pulmonary, Critical Care and Sleep Medicine Grand Rounds at Mount Sinai Medical Center, on the topic of vasculitis; Division of Rheumatology Medicine Grand Rounds at Mount Sinai Medical Center, on the topic of scleroderma; and NYU Rheumatology Grand Rounds, on the topic of updates in scleroderma.

Dr. Gordon gave Internal Medicine Grand Rounds at Dartmouth Hitchcock Medical School on the topic of scleroderma management and at Bronx Lebanon Hospital on the topic of scleroderma diagnosis and management; she also gave Dermatology Grand Rounds at Weill Cornell Medical College on the topic of scleroderma diagnosis and management.

David R. Fernandez, MD, PhD, gave Medicine Grand Rounds at NewYork-Presbyterian/Weill Cornell Medicine on the topic of updates in rheumatology for internists.

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- Ah Kioon MD, Tripodo C, Fernandez D, Kirou KA, Spiera RF, Crow MK, Gordon JK, Barrat FJ. Plasmacytoid dendritic cells promote systemic sclerosis with a key role for TLR8. *Sci Transl Med*. 2018 Jan 10;10(423). pii: eaam8458. doi: 10.1126/scitranslmed.aam8458. PMID: 29321259.
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- Becetti K, Kwakkenbos L, Carrier ME, Gordon JK, Nguyen J, Mancuso CA, Mouthon L, Nguyen C, Rannou F, Welling J, Thombs BD, Spiera RF; SPIN Investigators. Physical or occupational therapy utilization in systemic sclerosis: A scleroderma patient-centered intervention network cohort study. *J Rheumatol*. 2019 May 1. pii: jrheum.181130. doi: 10.3899/jrheum.181130.
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Timothy M. Wright, PhD, Director of the Department of Biomechanics; Mark P. Figgie, MD, Chief of the Surgical Arthritis Service and Attending Surgeon; Robert N. Hotchkiss, MD, Medical Director of the Innovation Institute and Associate Attending Orthopaedic Surgeon; and Joseph Lipman, MS, Director of Device Development, are designers of, and receive royalties for, certain products manufactured and sold by LimaCorporate S.p.A.

AGELITY BIOMECHANICS

AGelity BioMechanics was formed as a part of HSS's strategic growth and diversification plan to develop and commercialize technology and patents based on research performed at HSS by Russell F. Warren, MD, Attending Orthopaedic Surgeon, and Suzanne Maher, PhD, Associate Director of the Department of Biomechanics and Senior Scientist. Dr. Warren, Dr. Maher and HSS each hold equity interests in AGelity.

About HSS

Founded in 1863, Hospital for Special Surgery (HSS) is a world leader in orthopaedics, rheumatology and rehabilitation. HSS is ranked #1 in the US for orthopaedics and #3 for rheumatology on the *U.S. News & World Report* "Best Hospitals" list (2019–2020). We are also ranked best in New York City for pediatric orthopaedics and #21 nationally on the same *U.S. News* list. HSS is the first hospital in New York State to receive the Magnet® Designation for Excellence in Nursing Service from the American Nurses Credentialing Center four consecutive times. Located in New York City, HSS also serves patients in the regional area with outpatient centers in Westchester County, New York; Connecticut; New Jersey and Long Island, with an additional location opening in West Palm Beach, Florida, in 2020. Patients come to HSS from across the US and around the world. HSS has one of the lowest infection rates in the country. The HSS Research Institute is internationally recognized as a leader in the investigation of musculoskeletal and autoimmune diseases.

To learn more, please visit [hss.edu](https://www.hss.edu).

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