

# ORTHOPAEDIC

OUTCOMES + RESEARCH

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# A MESSAGE FROM THE CHAIR

Dear Colleagues,

The start of a New Year is always a good time to take stock of what's been accomplished and to identify what's important to focus on in the months ahead. It's in that spirit that I am pleased to present our latest Orthopaedic Outcomes and Research report, which documents the robust research agenda at Jefferson's Department of Orthopaedic Surgery. The theme "Research in Action" was chosen for the report because it speaks to our belief that research is an active, dynamic process that is never complete. Findings build on findings, with improved patient care and outcomes always the ultimate research goals.

Jefferson's Department of Orthopaedic Surgery draws on the expertise of specialists from Rothman Institute at Jefferson and The Philadelphia Hand Center at Jefferson. Their combined research portfolio is impressive. This past year, for instance, orthopaedic experts at Jefferson helped establish universal guidelines for fighting joint infections, identified new approaches to preventing excessive scarring and uncovered a mechanism involved in the debilitating pain related to disc degeneration.

Jefferson's reputation as a leader in orthopaedic care and research is reflected in the fact that it has the largest orthopaedic surgery program in the Delaware Valley. Last year, more than 500,000 patients benefitted from care in eight specialty areas: spine; hip and knee; sports medicine; shoulder and elbow; foot and ankle; hand and wrist; musculoskeletal oncology; and trauma. The confidence shown in us by our patients was confirmed by *U.S. News & World Report*, which named Thomas Jefferson University Hospital to the Best Hospitals 2013–14 Honor Roll, ranking it among the most outstanding hospitals in the country. Jefferson was also singled out as one of the nation's best in orthopaedics.

When I reflect on what makes Jefferson's clinical care and research agenda stand out, three characteristics come to mind:

**Connection:** Our clinicians and research scientists are determined to make connections between discoveries in the laboratory and enhancing patient care. Research is not an isolated activity removed from everyday practice. Research findings inform patient care, and, in turn, experiences gleaned from patient encounters point to new directions for research.

**Collaboration:** Our clinician researchers don't take a narrow view. They regularly work across disciplines and forge partnerships with researchers at other medical institutions in the U.S. and abroad. Such collaborative efforts led last year to Jefferson hosting an international consensus meeting to set strategies for the prevention and treatment of periprosthetic joint infections.

**Commitment:** The quality of our patient care, clinical research and laboratory science flows from a shared commitment to improving the lives of patients with orthopaedic diseases and injuries. Our patients run the gamut from young athletes anxious to get back to their teams to older persons wanting to regain their independence. We take great pride each time we return a patient to action.

I invite you to read more about Jefferson's Department of Orthopaedic Surgery's "Research in Action" in the pages ahead. Information about the services available at Jefferson can be found at [www.jeffersonhospital.org/bonesandjoints](http://www.jeffersonhospital.org/bonesandjoints). To refer a patient, please call Jefferson's physician referral line at 215-503-8888 or have your patient call 1-800-JEFF-NOW (1-800-533-3669). The staff will be happy to help you access the very best care possible for your patients.

I wish you a New Year filled with much joy and success.



Todd J. Albert, MD  
*Richard H. Rothman Professor and Chair*  
*Department of Orthopaedic Surgery*  
*Thomas Jefferson University Hospitals*  
*Jefferson Medical College of Thomas Jefferson University*

**Jefferson’s Department of Orthopaedic Surgery**—which includes specialists from Rothman Institute at Jefferson and The Philadelphia Hand Center at Jefferson—is a recognized leader in orthopaedics, setting high standards for both clinical care and research. In 2012, Jefferson was ranked 13th nationally in orthopaedic research funding from the National Institutes of Health, more than any other orthopaedic program in the region.

The orthopaedics team at Thomas Jefferson University Hospitals offers the latest in diagnostic imaging and testing, surgical techniques and implants, medical treatments, pain management, rehabilitation therapies and prevention measures to ensure that every patient receives high quality, comprehensive and efficient care. Jefferson orthopaedic specialists help to establish best practices not only for common procedures such as hip and knee replacement, but also for the treatment of rare tumors and genetic diseases.

The demand for orthopaedic services is great, and Jefferson is committed to meeting patient needs both on an individual basis and in the community. Patients throughout the region will benefit from the establishment of the

## RESEARCH IN ACTION: AN OVERVIEW

new Jefferson Comprehensive Concussion Center and the Hip Fracture Service, which draw on the expertise of multiple hospital departments.

Every clinic and laboratory of Jefferson’s Orthopaedic Department—from Hand and Wrist to Sports Medicine to Trauma—is immersed in research to develop new therapies, minimize treatment-related complications and enhance patient outcomes.

This report, titled “Research in Action,” offers a look at some of the key findings published or presented over the past year, as well as important research initiatives that are underway.

Jefferson's dual commitment to research that directly improves patient outcomes, and laboratory projects that promote the understanding of orthopaedic conditions means that patients benefit exponentially. Patients can choose to participate in clinical trials, though all care is informed by the latest research.

Among the many research highlights:

- A study of patients with myotendinous Achilles rupture found that patients fare very well with nonoperative treatment. Full healing of the tendon was achieved in all 30 patients.
- A study that compared outcomes for two surgical approaches for anterior cruciate ligament (ACL) rupture found that reconstruction using a bone-patellar tendon-bone (BPTB) allograft was as good as surgery using a tibialis anterior (TA) allograft. Both approaches are appropriate options for primary ACL reconstruction.
- The development and validation of a new evidence-based classification system for thoracolumbar fractures will help clinicians devise better treatment plans for patients.
- A laboratory study revealed the workings of an inflammatory-related protein called Substance P in the pain process associated with degenerative disc disease. An antibody to block a receptor for Substance P is being tested.

The specialty of orthopaedics is at its essence about keeping patients of all ages as active and mobile as possible. Read on for more details on how Jefferson's forward-thinking, patient-centered orthopaedic research—"Research in Action"—is making that possible.



Thomas Jefferson University Hospitals

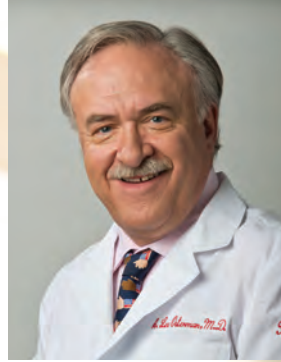
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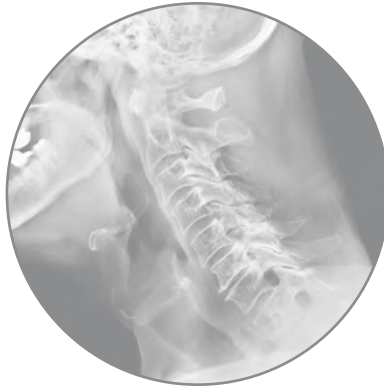


**James Krieg, MD**  
Trauma

# SPINE







## JEFFERSON'S ORTHOPAEDIC SPINE TEAM EXCELS IN THE TREATMENT OF HERNIATED DISC, DEGENERATIVE DISC DISEASE, SPINE DEFORMITY, SPINAL CORD INJURY, FRACTURES, TUMORS AND OTHER SPINAL PROBLEMS.

### SERVICES

- Treatment for cervical, thoracic, lumbosacral and intervertebral spinal conditions
- Treatment for scoliosis, spinal deformities, spinal cord injury, trauma, spinal infections, spinal tumors and spondylolisthesis
- Minimally invasive techniques and image-guided technology
- Comprehensive treatment of degenerative disc disease, including disc replacement

The team collaborates with specialists throughout the Jefferson system to determine the optimal treatment plan for each patient. Patients who arrive in an emergency situation benefit from the expertise that stems from Jefferson being both a designated Level 1 Trauma Center and a federally-designated spinal-cord injury center. Many patients are transferred to Jefferson because of the spine team's experience with complicated cases.

Jefferson's spine surgeons are leaders in their field, both in clinical practice and research, helping to set standards for clinical evaluation, diagnostic imaging, surgical techniques and overall patient management. They also are committed to basic science research that is providing insight into spinal injuries and identifying potential new targets for treatment. The goal is to translate laboratory findings into therapies that will hasten recovery and improve functional outcomes for patients. A good example is laboratory research that is focused on developing an antibody therapy that could prevent or reduce the pain associated with disc degeneration. Here are some details on two spine research projects.

#### **A New Classification System for Thoracolumbar Spinal Injuries**

Many classification systems for spinal fractures have been proposed, but none of them has achieved universal acceptance by practitioners. The various classification systems have been criticized for being too simple, too complex or lacking in sufficient clinical-based evidence to support their use. Having a validated, rational, comprehensive and easy-to-use classification system is critical to ensuring that all patients receive an objective evaluation and timely treatment, whether surgical or nonsurgical, that will promote recovery.

Jefferson spine surgeon Alexander Vaccaro, MD, PhD, Professor of Orthopaedic Surgery, Jefferson Medical College of Thomas Jefferson University, has been leading a group of surgeons from around the globe to develop a reliable evidence-based classification system that could be universally adopted by clinicians. The research team—working under a project of AOSpine Trauma Knowledge Forums—evaluated hundreds of trauma cases from an AOSpine database to arrive at a

# SPINE

## Surgery Volume

Source: Jefferson internal data  
Calendar YTD through September



consensus on an injury classification system specific to each region of the spine—cervical, lumbar, thoracic and sacral injuries.

In a paper published in *Spine*, Dr. Vaccaro and his colleagues detailed their proposed classification system for fractures in the thoracolumbar region of the spine. The classification is based on the evaluation of three basic parameters:

### 1. Morphologic classification of the fracture

Injuries are described as one of three types: Type A, compression injuries; Type B, failure of the posterior or anterior tension band without evidence of other gross translation or the potential for gross translation; Type C, failure of all elements leading to dislocation or displacement in any plane or complete disruption of a soft-tissue hinge even in the absence of translation. Type A and Type B injuries are further divided into subgroup (A0 to A4 or B1 or B3) depending on the specific aspects of the injury.

### 2. Neurologic status

Patients are assigned one of the following statuses: N0, neurologically intact; N1, meaning the patient had a transient neurologic deficit that is no longer present; N2, denoting the patient has signs or symptoms of radiculopathy; N3, incomplete spinal cord injury or cauda equina injury; N4, a complete spinal cord injury; and NX, for a patient who cannot be examined due to a head injury or another condition.

### 3. Clinical modifiers

Depending on the case, patients may be given the classification of M1, to designate fractures with an indeterminate injury to the tension band based on spinal imaging such as MRI or a clinical exam; or M2, to indicate a comorbidity that might argue either for or against surgery.

The research team is working on validating a scoring system to go along with the classification system. In general, patients assigned a low total score would be considered a candidate for nonsurgical treatment; patients with an intermediate score would be treated non-operatively or operatively depending on the surgeon's preference, taking specific case modifiers into consideration; and patients with a high score and who can tolerate surgery would likely benefit from surgical stabilization.

The classification system provides a simple yet comprehensive approach to classifying spinal column injuries. It takes into consideration other factors such as neurologic status that are critical in making a decision about how to proceed with treatment.

Details of the classification system have been disseminated to surgeons worldwide, and the system already has become accepted by the world's largest spine study group, AOSpine International.

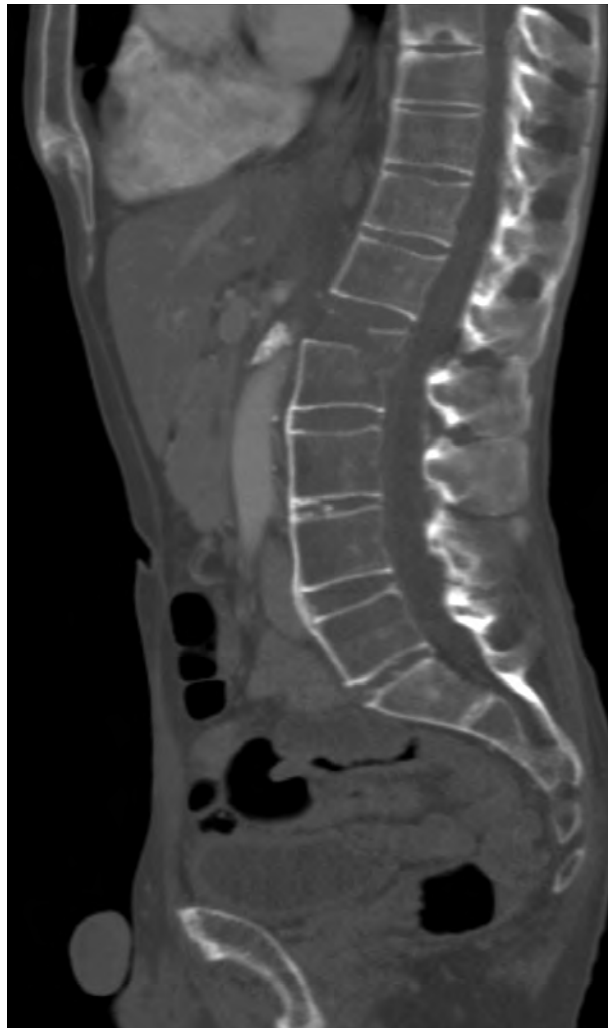
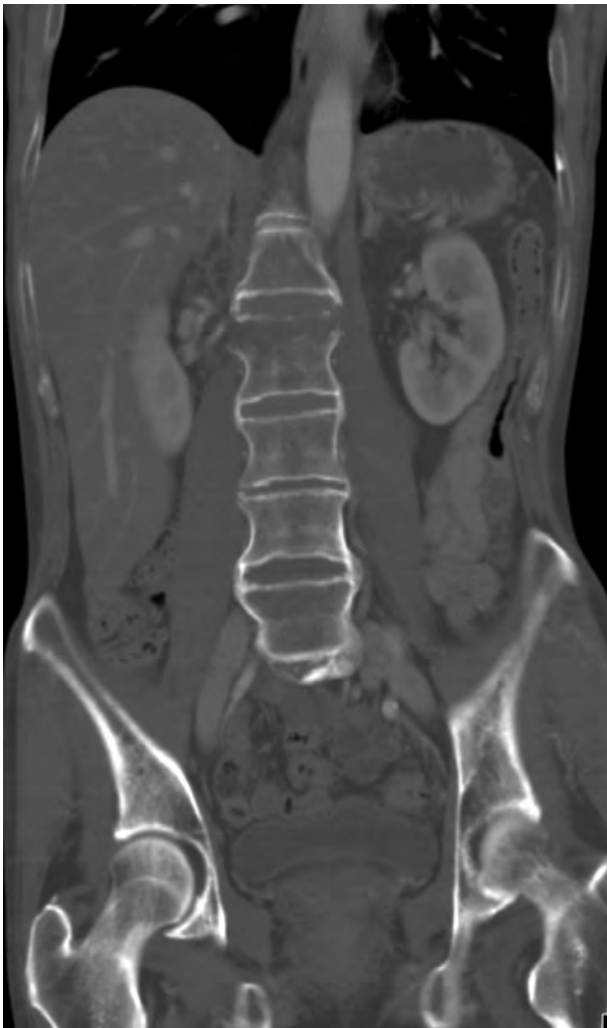
## Substance P and Its Role in Disc Degeneration Pain

Although researchers have begun to uncover the mechanisms that underlie disc degeneration, a detailed understanding of what makes a degenerative disc painful remains elusive. In turn, how best to treat painful disc degeneration is a challenge for clinicians.

Understanding the relationship between disc degeneration and pain symptoms is important because pain is often the clinical target of treatment for this condition.

Research interest is growing in the role that the protein Substance P (SP) plays in disc pain. SP is classically described as a neurotransmitter, but it is also known to play a role in regulating inflammatory pathways. The specific action of SP within the disc has not yet been characterized, but it is suspected that it could have a role in the production of pain due to degeneration.

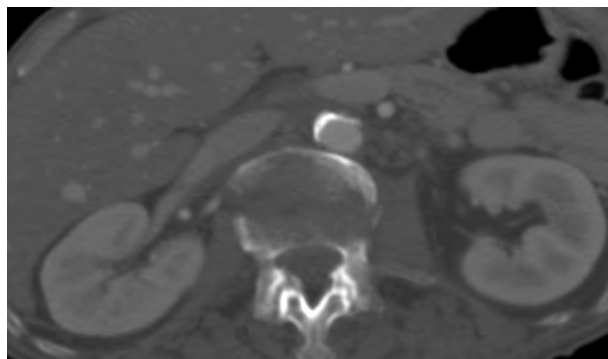
To test that theory, Jefferson researchers, including Christopher Kepler, MD, MBA, Instructor of Orthopaedic Surgery, and Greg Anderson, MD, Professor of Orthopaedic Surgery, conducted laboratory experiments using human disc tissue. In a series of experiments, they confirmed that SP and its specific receptor, NK1R, are expressed by both nucleus pulposus (NP) and annulus fibrosus (AF) cells found in disc tissue. They found that the addition of SP to disc tissue upregulated the



expression of several cytokines involved in the inflammatory process. The findings support the theory that SP plays an important role in disc-related pain.

In a related laboratory experiment, whose results were presented at North American Spine Society and the Orthopaedic Research Society annual meetings, researchers demonstrated that the SP receptor NK1R could be blocked by an antagonist, thus suppressing the expression of a cascade of cytokines associated with the inflammatory process and painful disc degeneration.

The combined findings suggest that Substance P may be an important intermediary between the degenerative cascade and pain symptoms from the disc. Furthermore, the ability to reverse inflammatory changes in the disc associated with painful disc degeneration could one day lead to a treatment for pain associated with disc degeneration, a clinical problem for which current treatment options are suboptimal.



**Spine Classification System**

These images belong to a young man with an L2 distraction injury in the absence of a neurologic deficit. Under the new classification system, his injury would be classified as L2 N3 N0.



HIP  
+ KNEE



MORE THAN 300 MEDICAL EXPERTS FROM 52 COUNTRIES GATHERED AT JEFFERSON IN AUGUST 2013 FOR A CONSENSUS CONFERENCE CONVENED TO ESTABLISH EVIDENCE-BASED GUIDELINES FOR THE PREVENTION AND TREATMENT OF PERIPROSTHETIC JOINT INFECTIONS (PJI).

## SERVICES

- Primary and revision hip replacement and knee replacement
- Anterior-approach total hip replacement
- Minimally invasive hip and knee replacement
- Custom knee replacement
- Adult joint reconstruction
- Hip resurfacing
- Partial knee replacement
- Treatment of hip and knee disorders in young adults
- Rapid-recovery surgery
- Computer-assisted surgery
- Pelvic reconstruction
- Pelvic osteotomy and hip-impingement surgery
- Joint preservation procedures

The International Consensus Meeting on Periprosthetic Joint Infection was chaired by Javad Parvizi, MD, Professor of Orthopaedic Surgery, Jefferson Medical College of Thomas Jefferson University and Thorsten Gehrke, MD, Medical Director for the Helios ENDO-Klinik in Hamburg, Germany.

The consensus process was initiated with a sense of purpose and urgency. Despite the progress made in improving orthopaedic surgical techniques and materials and establishing better infection-control procedures, infection remains a key risk for patients. The potential for PJI, which can cause significant morbidity and even death, continues to challenge every orthopaedic surgeon who steps into the operating room. PJI is the leading reason for revision following knee replacement and the third leading cause of revision after hip replacement. The infections can be difficult to diagnose and treat and can increase the likelihood of mortality, especially among elderly patients.

Surgeons have implemented strategies that may minimize surgical site infection (SSI) and PJI, but many of them are based on little or no scientific evidence. There is remarkable variation in practices across the globe for prevention and management of PJI.

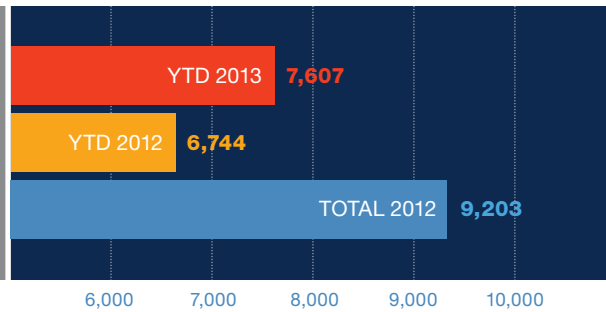
Among the many questions practitioners wrestle with: Should a laminar flow room be used for elective arthroplasty? How much and which antibiotic should be added to cement spacers? What metric should be used to decide on the optimal timing of implantation? What are the indications and contraindications for irrigation and debridement? How much irrigation and debridement in a joint should be attempted before resection arthroplasty needs to be considered? What is the best type of skin preparation prior to surgery?

Against that backdrop of questions, the International Consensus Meeting on Periprosthetic Joint Infection was organized, with backing from the Musculoskeletal Infection Society and the European

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Source: Jefferson internal data  
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Bone and Joint Infection Society. The goal was to assemble a multidisciplinary group of experts to review the medical literature and reach consensus on the management and treatment of SSI/PJI. More than 400 delegates from around the globe—including specialists in orthopedic surgery, infectious disease, musculoskeletal pathology, microbiology, anesthesiology, dermatology, nuclear medicine, rheumatology, musculoskeletal radiology, veterinary surgery and pharmacy, as well as scientists focused on orthopaedic infections—participated.

Over a period of 10 months, 15 work groups evaluated more than 3,500 relevant publications, classifying them based on the weight of evidence. More than 300 of the delegates then convened at Jefferson for a two-day meeting to vote on the specifics of a proposed consensus document. Using electronic keypads, the delegates voted on 207 relevant questions, ranging from pre-infection prevention measures such as the whole-body washing of patients, to what diagnostic tests, in what order, should be obtained to make a firm diagnosis

of PJI. The group also provided a clear definition for what constitutes a case of PJI. The consensus document will serve as a “best practice guide” for the medical community for years to come.

Dr. Parvizi said the consensus document is an excellent example of how medical practitioners of varied backgrounds can come together with a common goal to improve the care of patients worldwide. Reducing the rate of infections and identifying problems sooner should save lives and reduce healthcare costs.

Various components of the consensus documents will be printed in major medical journals in the months ahead. The document is available at [jeffersonhospital.org/pji](http://jeffersonhospital.org/pji).

Jefferson's leadership role in the consensus meeting on PJI exemplifies the commitment of Jefferson's hip and knee specialists to delivering excellent care and improving patient outcome using state-of-the-art research. The hip and knee joint program staffed by Jefferson's Department of Orthopaedic Surgery is one of the busiest in the country. The program has more than 150 active clinical research projects, and the program presented over 400 research abstracts or papers in 2013 at professional meetings and symposiums. The findings of the research projects have been incorporated into clinical practice, ensuring that patients get the very best and most up-to-date care.

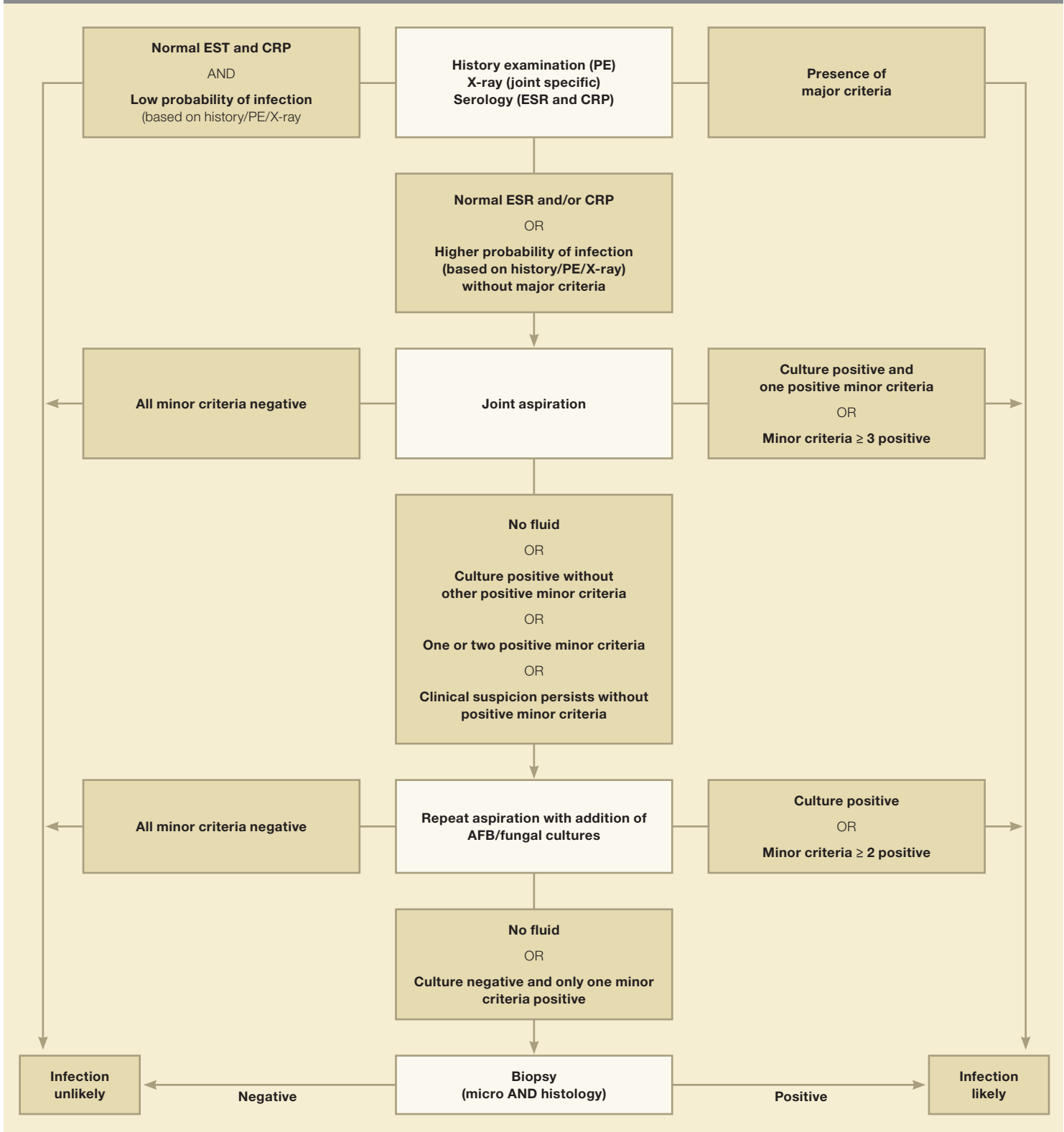
## Algorithmic Approach to Diagnosis of Periprosthetic Joint Infection

### Major Criteria:

Sinus tract communicating with the joint

### Minor Criteria

- Culture
- Leukocyte Esterase
- Synovial white blood cell count
- Synovial neutrophil percentage



Source: Proceedings of the International Consensus Meeting on Periprosthetic Joint Infection



# SPORTS MEDICINE





WHETHER THE PATIENT PLAYS A SPORT FOR FUN OR FOR A LIVING, THE SPORTS MEDICINE TEAM IS DEDICATED TO RETURNING THAT ATHLETE TO AS FULL FUNCTION AS POSSIBLE AFTER AN INJURY. PREVENTION OF INJURIES IS ALSO A KEY COMPONENT OF PATIENT CARE.

## SERVICES

- Arthroscopy of the hip, knee and shoulder
- Cartilage restoration procedures: microfracture, osteochondral allograft transplantation, autologous chondrocyte implantation
- Elbow repair and reconstruction
- Knee ligament reconstruction—ACL surgery
- Meniscal transplantation
- Patellofemoral joint instability
- Reconstruction of the knee, shoulder and elbow
- Rotator cuff repair
- Shoulder and elbow arthroplasty
- Sports bracing—orthotics
- Shoulder instability procedures
- Shoulder labral repair
- Sports cartilage restoration
- Sports hip injury
- Sports concussion
- Female athlete injury
- Throwing athlete injury
- Sports performance training—velocity sports performance

Last year Jefferson specialists in the Sports Medicine program treated more than 40,000 patients with athletic injuries and performed more than 5,000 surgeries related to sports injuries. While the program's specialists serve as team physicians for three of Philadelphia's professional sports teams—the Phillies, Eagles and Flyers—they also care for more casual athletes, whether recreational-league players or weekend warriors.

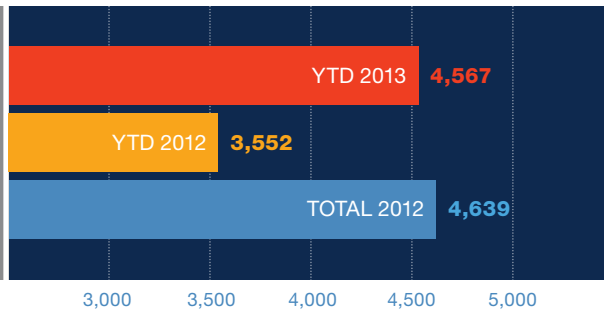
The need for clinicians specially trained in sports medicine is great. Their particular understanding of human performance and body mechanics helps to inform the care they render. Trends in youth and high-school sports are compelling athletes to perform at intense levels, often year round. Young athletes are provided sound guidance by the Sports Medicine specialists on how to avoid the long-term repercussions of repetitive motion and overuse injuries. Appropriate treatment when an initial injury occurs can help prevent problems such as osteoarthritis decades later.

The Sports Medicine team is also committed to helping older athletes remain active and competitive, whether it's with tennis, golf or participation in triathlons. Keeping bones, ligaments, tendons and muscles strong and flexible is essential to aging well.

# SPORTS MEDICINE

## Surgery Volume

Source: Jefferson internal data  
Calendar YTD through September



Clinicians in the Sports Medicine program are also widely-published researchers, helping to advance the diagnosis and treatment of a variety of sports-related conditions. Clinicians routinely apply what they learn through research to the everyday care of their patients.

Here are some recent findings:

### Bone-Patellar Tendon-Bone Allograft versus Tibialis Anterior Allograft for Anterior Cruciate Ligament Reconstruction

Over the past three decades the use of allografts for anterior cruciate ligament (ACL) reconstruction has become more common due to shorter operation times and the absence of donor site morbidity. The most common types of allograft tissue for allograft knee ligaments are bone-patellar tendon-bone (BPTB) and Achilles tendon. Although less common, the use of the tibialis anterior (TA) tendon as an ACL allograft option dates back to 1986.

Although BPTB autografts have been described as the gold standard by several authors, a number of studies have found similar outcomes between BPTB autografts and BPTB allografts for ACL reconstruction. There has been little research on the effectiveness of using TA allografts, and there have been no studies that have directly compared patient-reported outcomes between BPTB and TA allografts for ACL reconstruction. Jefferson researchers, including Steven B. Cohen, MD, Associate Professor of Orthopaedic Surgery, Jefferson Medical College of Thomas Jefferson University, and Michael G. Ciccotti MD, Professor of Orthopaedic Surgery, performed a matched comparison of patient-reported outcomes and graft re-rupture rates for BPTB and TA allograft primary ACL reconstruction in patients under 30 years old.

Patients who underwent primary ACL reconstruction with either BPTB (275 patients) or TA allografts (104 patients) between January 2006 and February 2011 were retrospectively included in the study. All of the

BPTB cases were performed by one of the study authors, and the other author performed the ACL reconstructions using TA. The researchers then selected 20 matched pairs, using criteria such as age, gender, weight and activity level to compare the outcomes of BPTB cases to TA cases.

Patients, who were followed for at least one year, were matched, using factors such as gender, age and weight.

Among the findings:

- Of the total 275 ACL reconstructions performed using BPTB allografts, 13 patients (4.7 percent) required revision ACL reconstruction within approximately 19 months.
- Of the 104 ACL reconstructions using TA allografts, two patients (1.9 percent) required revision ACL reconstruction. Both of those re-rupture rates are relatively low, and the difference between the two groups was not statistically significant.
- At least one year after surgery, the average scores on the Lysholm Knee Scoring Scale were 92.9 for the BPTB group and 93.0 for the TA group.
- The average scores on the IKDC Subjective Knee Evaluation Form were 92.6 for the BPTB patients and 90.3 for the TA group.
- By the end of the follow-up, none of the patients in the matched pairs had any complications that required revision surgery and no patients had any additional surgery on the same knee following ACL revision.

Overall, the study, published in *The American Journal of Orthopedics*, found no statistically significant difference between BPTB allografts and TA allografts for ACL reconstruction in terms of graft re-rupture rates, subjective IKDC score or Lysholm score. The results suggest that BPTB allograft and TA allograft are both appropriate options for primary ACL reconstruction. Re-rupture and re-injury rates are comparable to studies evaluating autograft ACL reconstruction.

It is helpful for clinicians to know they have multiple surgical options as they consider what treatment plan is best for any given patient.

## Outcomes after Distal Biceps Repair in Patients with Workers' Compensation Claims

Distal biceps tendon rupture occurs in approximately 1.2 per 100,000 people and may significantly inhibit the ability to perform daily activities, work functions and sports. While good outcomes have been reported overall with surgical repair of the distal biceps brachii tendon, less favorable postsurgical results for distal biceps tendon repair (DBTR) have been reported with patients who have workers' compensation (WC) claims. Why that is the case is not clear, though some researchers suspect that factors including age and smoking habits may be at least partly to blame.

Jefferson researchers—including Dr. Cicotti, Dr. Cohen, Bradford Tucker, MD, Clinical Assistant Professor of Orthopaedic Surgery, Matthew Ramsey, MD, Professor of Orthopaedic Surgery, and Gerald Williams, MD, Professor of Orthopaedic Surgery—explored the issue further by comparing functional outcomes and return to work for 60 WC patients who underwent unilateral acute DBTR to 63 non-WC patients who had the same surgery. The patients were operated on at Jefferson between July 2002 and December 2009 and were followed on average for 3.55 years after surgery.

A review of patient cases found the following:

- The WC patients and the non-WC patients did not differ in terms of average age at surgery, average time to follow-up or cigarette use.

- When a subgroup of non-WC patients whose work involved physical labor was compared to the WC patients, the average time to return to work was still longer for the WC group.

The findings, published in the *Journal of Shoulder and Elbow Surgery*, indicate that workers' compensation may be a significant factor in outcome and time to return to work following distal biceps tendon repair.

The study was not designed to analyze specifically why patients on workers' compensation tend to take longer to recover and return to work. Therefore, more research is needed to address that question. In the meantime, it's important for clinicians caring for workers' compensation patients to be able to set clear expectations for recovery time for both the patients and their employers.

## Kerlan-Jobe Orthopaedic Clinic Overhead Athlete Scores in Asymptomatic Professional Baseball Pitchers

The Kerlan-Jobe Orthopaedic Clinic (KJOC) Overhead Athlete Shoulder and Elbow score was developed specifically for overhead athletes. While it is a subjective questionnaire, the KJOC score has been validated and found to be more specific to overhead athletes than the American Shoulder and Elbow Surgeons (ASES) scale.



The Sports Medicine team is also committed to helping older athletes remain active and competitive, whether it's with tennis, golf or participation in triathlons. Keeping bones, ligaments, tendons and muscles strong and flexible is essential to aging well.

- The WC group fared more poorly by all measures of functional outcome, including the DASH, DASH–Work Module and DASH–Sports/Performing Arts Module questionnaires.
- The average time to return to full work was 3.95 months in the WC group and 1.35 months in the non-WC group.

To further evaluate the usefulness of the KJOC questionnaire, Jefferson researchers, including Christopher Dodson, MD, Assistant Professor of Orthopaedic Surgery, Dr. Cicotti and Dr. Cohen, administered it to healthy pitchers at all levels in one professional baseball Minor League system at the start of the 2011 season. The questionnaire asks 10 questions, to which the responders can apply a score of 1 (the worst scenario) to 10 (the best). Questions include: How difficult is it for you to get loose or warm prior to pitching? How much pain do you experience in your shoulder or elbow?

# SPORTS MEDICINE

In all, 44 pitchers returned the questionnaire. The average score for each pitcher was 94.82 out of a possible 100. Players in the AAA system had higher scores on average than AA or A players. Also, players with more than five years of professional playing experience had the highest scores on average. Still, just seven of the 44 pitchers who completed the KJOC questionnaire had a score lower than 90, which indicates that a score of 90 or above is generally normal for a healthy pitcher.

These findings, published in the *Journal of Shoulder and Elbow Surgery*, have relevance for clinicians caring for overhead athletes. Team physicians should consider determining baseline KJOC scores for pitchers, particularly professional and collegiate players. Should an injury or soreness develop, the physician can repeat the questionnaire and then compare the pitcher's baseline "healthy" score to the latest one. What is a "normal" score for one player may not be for another.

Utilizing a baseball-specific evaluation tool such as the KJOC would be of great assistance to clinicians caring for overhead throwing athletes. More research is needed to determine a correlation between KJOC scores and a professional baseball player's health status.

## Evaluation of the Quality of Internet Information on ACL Reconstruction

Anterior cruciate ligament (ACL) rupture is the most frequent ligamentous injury of the knee. It is especially common among young athletes and predisposes the knee to subsequent injuries and the potential for early onset of osteoarthritis. ACL reconstruction is a common, relatively safe, and effective method of restoring stability to the knee after injury, with more than 100,000 ACL reconstructions performed annually.

Patients are increasingly researching information on the Internet prior to seeking out medical care or making decisions regarding treatment. However, not all Internet information is accurate, complete or unbiased. It's useful for clinicians to be aware of the quality of information available on the Internet so that they can help their patients sort out facts from unreliable information.

A Jefferson research team, including Ian C. Duncan, MD, Patrick W. Kane, MD, Dr. Dodson, Dr. Cohen and Dr. Ciccotti evaluated the quality of ACL information on 200 websites. They evaluated the content using a variety of criteria, including who sponsored the site, and





LAST YEAR JEFFERSON  
SPECIALISTS FROM  
THE SPORTS MEDICINE  
PROGRAM TREATED  
MORE THAN 40,000  
PATIENTS WITH ATHLETIC  
INJURIES AND PERFORMED  
MORE THAN 5,000  
SURGERIES RELATED  
TO SPORTS INJURIES.

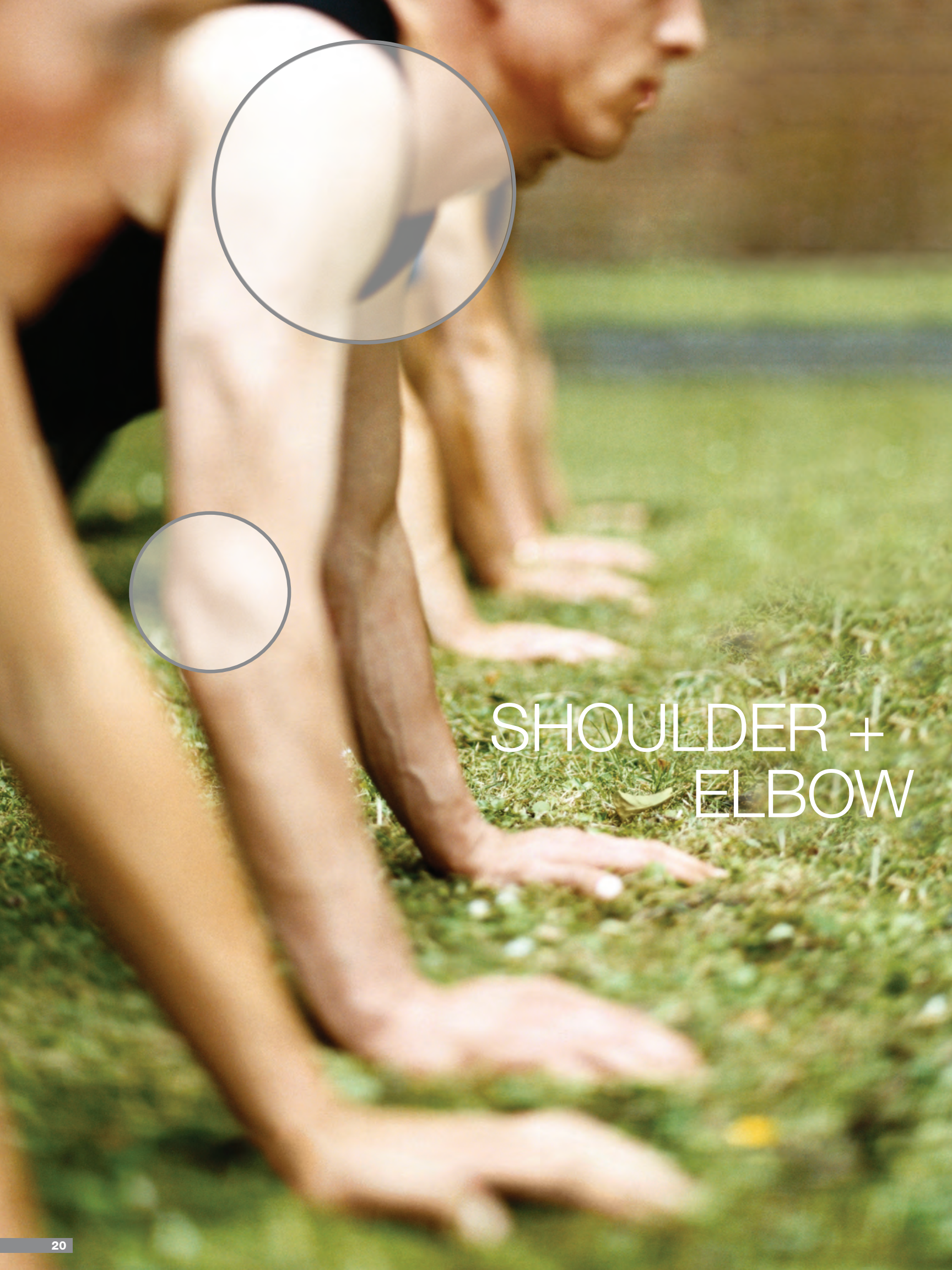
whether the site accurately and fully described an ACL injury and reconstructive surgery.

They found that:

- Of the 200 websites, about 23 percent were affiliated with an academic institution, while 36 percent were authored by private physicians or physician groups. Other sponsors included personal bloggers, news outlets and, in a few cases, industry groups.
- Forty percent of the sites provided either scheduling information or direct access for scheduling an appointment with the website author.
- More than half of the websites gave a detailed description of an ACL injury and reconstruction surgery, but they often did not include information on the potential for concomitant injuries, eligibility criteria for surgery or the potential complications that patients may face.
- Just over one-fourth of the sites included peer-reviewed references.
- Only three of the 200 websites made false claims of painless and bloodless surgery and guaranteed a return to play after ACL reconstruction.

The study—published in *Arthroscopy: The Journal of Arthroscopic and Related Surgery*—found overall that the quality of information on the Internet relating to ACL injury and surgery is mixed, though little of it is outright false. In many cases, the sites lack details that are important for patients to know.

The Internet can be a valuable source of information for patients, but it's not enough. While patients may be arriving at their appointments having done a lot of Internet research, clinicians need to take time to educate their patients about the specifics of their injury, treatment options and expectations for recovery. ACL reconstruction is a complex surgery that requires tremendous expertise on the part of the clinician. Patients may have gathered inaccurate or incomplete information from the Internet or unrealistically think that they will have a quick and easy return to a sport or other physical activity. Educating patients thoroughly about ACL reconstruction and rehabilitation is part of providing excellent surgical care.



SHOULDER +  
ELBOW



THE PACE OF ADVANCES IN SHOULDER ARTHROPLASTY IS IMPRESSIVE. NEW AND BETTER DESIGNED IMPLANT MATERIALS, REFINED SURGICAL TECHNIQUES AND A GROWING UNDERSTANDING OF PATIENT-SPECIFIC CHARACTERISTICS ARE COMBINING TO MAKE SHOULDER ARTHROPLASTY ONE OF THE MOST SUCCESSFUL PROCEDURES IN ORTHOPAEDICS.

## SERVICES

- Surgery for arthritis in the shoulder and elbow
- Shoulder and elbow surgery, both arthroscopic and open
- Shoulder and elbow replacement
- Treatment of shoulder and elbow fractures
- Distal bicep and triceps rupture repair
- Treatment of rotator cuff injuries
- Treatment of shoulder and elbow sports injuries, fractures and dislocations
- Treatment of shoulder and elbow instability
- Treatment of tendonitis

Jefferson's Department of Orthopaedic Surgery's shoulder and elbow service is among the busiest programs in the country, performing more than 2,100 joint surgeries a year. The team is committed to providing a comprehensive treatment plan for patients that extends from diagnosis to treatment to rehabilitation. The team is experienced in identifying which patients would benefit from surgical intervention and which would do well with a non-invasive approach. The staff works with patients and families to ensure that needed support services, such as in-home nursing care, adaptive equipment and physical therapy, are in place to promote a timely recovery. The goal is always to minimize pain and discomfort and restore a good quality of life.

Our shoulder and elbow specialists are also active researchers. Their research portfolio—from venous thromboembolism to scar formation—contains a dynamic mix of laboratory science, clinical trials and patient-outcomes studies. The group regularly presents their research at national and international professional meetings, and the findings help establish best practices for the field of shoulder and elbow care. The program is also a major training center for shoulder and elbow surgeons around the country who seek to complete an advanced fellowship in shoulder and elbow surgery.

Here's a look at some ongoing research projects:

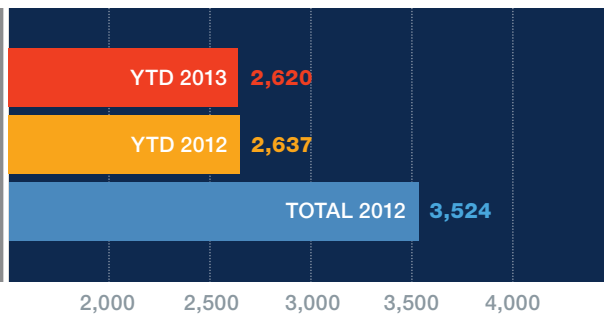
### Reducing Post-Traumatic Joint Stiffness and Contracture

A Jefferson research team was recently awarded a three-year \$1 million grant by the U.S. Department of Defense (DOD) to develop a novel antibody therapy that could help prevent joint stiffness and contracture following traumatic injury. The antibody is designed to curtail the excessive buildup of collagen in joint tissue after a traumatic injury or surgery, a condition which can cause stiffness and loss of range of motion (ROM). The antibody therapy, if proven to be effective, could be used to treat military members who suffer joint injuries during combat or

# SHOULDER + ELBOW

## Surgery Volume

Source: Jefferson internal data  
Calendar YTD through September



combat-related work. The project is a collaborative effort of research scientist Andrzej Fertala, PhD, Professor of Orthopaedic Surgery, shoulder surgeon Joseph Abboud, MD, Associate Professor of Orthopaedic Surgery, and hand surgeon Pedro Beredjikian, MD, Associate Professor of Orthopaedic Surgery.

A number of studies involving members of the U.S. military suggest that traumatic joint injuries and joint stiffness not only cause loss of ROM, but also are major risk factors for developing osteoarthritis. While collagen production is part of normal healing and scarring, the process can go into overdrive and cause problems. Following a traumatic injury, an excessive buildup of collagen can occur in joint tissue, leading to localized fibrosis and joint stiffness.

In 2008, Dr. Fertala, and colleagues discovered an antibody named chlgG that curtails the production of collagen after trauma, preventing the buildup of fibrotic tissue. The DOD-funded study will analyze the effectiveness of the antibody in an animal model that mimics post-traumatic joint stiffness. The results should help researchers decide how best to proceed to test the therapy in humans.

## Risk of VTE after Upper Extremity Arthroplasty in the Medicare Population

Venous thromboembolic disease (VTE) is a common and potentially fatal complication after orthopaedic surgery. Pharmacologic prophylaxis is considered a standard of care following hip and knee arthroplasty, but guidelines for prophylactic treatment of VTE following upper extremity arthroplasty have not been well established, in part because the extent of the problem is not fully understood. Currently, the standard of care following upper extremity arthroplasty is no chemoprophylaxis.

To better understand the issue, Jefferson researchers, including Gerald R. Williams, MD, Professor of Orthopaedic Surgery, and Matthew L. Ramsey, MD, Professor of Orthopaedic Surgery, analyzed Medicare claims for a six-year period to determine the national incidence of symptomatic VTE for total shoulder arthroplasty (TSA),

The team is experienced in identifying which patients would benefit from surgical intervention and which would do well with a non-invasive approach. The goal is always to minimize pain and discomfort and restore a good quality of life.



shoulder hemiarthroplasty (SHA) and total elbow arthroplasty (TEA). They also analyzed the Medicare data for VTE related to total hip arthroplasty (THA), hemi hip arthroplasty (HHA) and total knee arthroplasty (TKA).

The incidence of VTE was compared between upper and lower extremity arthroplasty and patient-specific risk factors for pulmonary embolism were determined for shoulder arthroplasty. The findings, which have been submitted for publication, include:

- VTE complications occurred in 1.2 percent of lower extremity arthroplasties and 0.56 percent of upper extremity arthroplasties.
- During the index admission, the crude incidence of PE was lower following TSA than all other upper and lower extremity arthroplasties. The crude incidence of PE during the index admission following SHA and TEA was greater than THA, but less than HHA and TKA.
- The crude incidence of DVT during the index admission was lower following TSA than all other upper and lower extremity arthroplasties. The crude incidence of DVT was higher for all lower extremity arthroplasties compared to upper extremity arthroplasties.

- The rates of readmission for PE and DVT were lowest following TSA and highest following HHA. For all upper extremity arthroplasties, the prevalence of readmission for PE and DVT was similarly high for TEA and SHA and lowest for TSA.

- Patient factors that were associated with an increased risk of VTE included a principal diagnosis of fracture, history of VTE, cardiac arrhythmia, presence of a metastatic tumor, coagulopathy, congestive heart failure, alcohol abuse and obesity.

- Wound hematoma rates were similar between upper and lower extremity procedures.

The study demonstrates that the risk of VTE following upper extremity arthroplasty is lower than VTE following lower extremity arthroplasty, even though chemoprophylaxis is not the standard of care following upper extremity arthroplasty. The Jefferson researchers said the findings suggest that the use of mechanical prophylaxis combined with aspirin is sufficient following upper extremity arthroplasty in patients who are not at increased risk of VTE. Chemoprophylaxis with agents other than aspirin may be warranted in patients with a demonstrated risk of VTE.



FOOT +  
ANKLE





THE FOOT AND ANKLE TEAM TOGETHER ARE CALLED UPON EACH DAY TO PERFORM A HUGE WORKLOAD. WHILE THEY ARE DESIGNED TO SUPPORT THE DEMANDS OF STANDING, WALKING, CLIMBING, RUNNING AND OTHER PHYSICAL ACTIVITY, THE FOOT AND ANKLE ARE ALSO PRONE TO INJURY.

## SERVICES

- Ankle arthritis
- Arthritis of the foot joints
- Achilles tendon conditions
- Posterior tibial tendonitis
- Flat foot
- Bunions
- Claw toe and hammer toe
- Trauma
- Ankle sprains and fractures
- Fracture of the talus
- Lisfranc fracture
- Tarsal tunnel syndrome
- Diabetic foot problems
- Athlete's foot
- Corns
- Foot, heel and arch pain; plantar fasciitis
- Sports injuries of the foot and ankle
- Tendonitis of the foot and ankle
- Ankle joint replacement/arthroplasty
- Post-traumatic reconstruction
- Ankle arthroscopy
- Charcot
- Deformity correction
- High arches/CMT
- Foot drop

Problems of the foot and ankle can be extremely debilitating if not properly treated in a timely fashion. Good foot and ankle health is key to optimizing a person's mobility, stability and overall body mechanics.

Last year more than 13,000 new patients sought care from Jefferson's Foot and Ankle Services for a wide range of problems, from acute injuries to nagging pain. The team of foot and ankle specialists employs the latest in imaging technology and clinical diagnostic techniques to design individualized patient treatment plans. Whether the treatment is surgical, nonsurgical or a combination of the two, the goal is to return patients as quickly as possible to their normal lifestyle, free of pain.

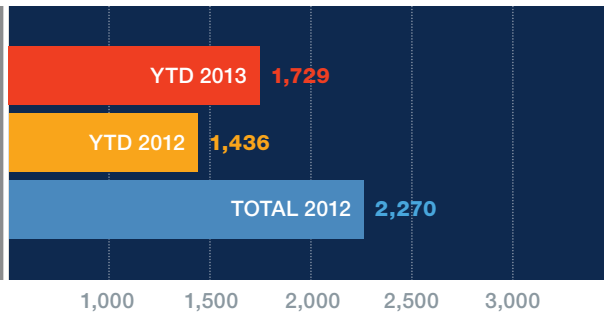
Over 2,250 patients underwent foot or ankle surgery at Jefferson in 2012. Jefferson's foot and ankle team is the regional leader in total ankle replacement, often for cases involving severe arthritis. The team is frequently requested to perform complex revision procedures for patients with prior surgical failures.

The team's clinicians are also leading researchers in the field and they frequently publish findings that offer new insights into how best to diagnose and treat foot and ankle conditions.

# FOOT + ANKLE

## Surgery Volume

Source: Jefferson internal data  
Calendar YTD through September



Here is a look at some of their research work:

### Nonsurgical Treatment of Myotendinous Achilles Rupture

The Achilles tendon is the most commonly injured tendon in the lower extremity. Most of these injuries occur after indirect trauma in which a strong dorsiflexion force is applied to the ankle as the gastrocnemius-soleus muscles simultaneously contract to plantarflex the ankle. Acute Achilles tendon ruptures can occur in three locations: 75 percent occur at the midsubstance; 10 to 20 percent at the distal insertion; and 5 to 15 percent at the myotendinous zone.

There is little information in the medical literature about acute myotendinous Achilles injuries, and most of that research is limited to the diagnosis and imaging of the injury as opposed to treatment and outcomes. Jefferson researchers, led by Jamal Ahmed, MD, Assistant Professor of Orthopaedic Surgery, Jefferson Medical College of Thomas Jefferson University, and Steven M. Raikin, MD, Professor of Orthopaedic Surgery, conducted a retrospective review of cases involving patients with acute myotendinous Achilles injury who were treated nonsurgically. The goal was to determine outcomes as measured by function, pain and patient satisfaction.

The study involved 30 patients who presented at Jefferson between November 2005 and 2011 with an acute myotendinous Achilles rupture, which was confirmed by magnetic resonance imaging (MRI). The patients, 21 men and nine women, ranged in age from 24 to 54. The patients were given nonsurgical treatment that involved three weeks of non-weight bearing activity followed by three weeks of progressive to full weight-bearing activity in an Achilles boot. Physical therapy was provided for four to six weeks after the period of immobilization. Patients were followed an average of 40.5 months post-injury.

The study, published in *Foot & Ankle International*, found overall that all patients experienced improved function and less pain at their latest follow-up. Specific findings included:

- The average score on the Foot and Ankle Ability Measure–Sports (FAAM–Sports) scale increased from 20.2 out of a possible 100 points at the time of the initial presentation to 95.2 at the latest follow-up.
- The average score on the Visual Analog Scale for pain decreased from an average of 8.2 out of 10 (with 10 being the worst) to 1.3 at the latest follow-up.
- When asked to rate their satisfaction with their treatment outcome, 23 (76.7 percent) patients rated it as excellent; six (20 percent) said it was good; and one patient (3.3 percent) said it was fair.
- All patients were able to return to full activity at work at an average of 11.8 weeks after their injury.
- No patient displayed clinical Achilles weakness on examination and none developed a recurrent myotendinous Achilles rupture by the end of follow-up.

The results demonstrated that the described nonsurgical treatment protocol used at Jefferson to manage myotendinous injuries was effective in restoring Achilles function and strength, alleviating pain and providing a high rate of patient satisfaction. Clinicians should strongly consider the use of nonsurgical treatment for acute myotendinous Achilles tendon ruptures.

### Conversion Arthrodesis for Failed First Metatarsophalangeal Joint Hemiarthroplasty

End-stage hallux rigidus is a painful condition that results in decreased range of motion and altered gait mechanics. The current “gold standard” surgical option is arthrodesis of the joint, which typically leads to good long-term clinical outcomes and fusion rates reported to be from 77 percent to 100 percent. But concern about stiffness after fusion, difficulty with wearing fashionable high heels and concern about subsequent arthritis in adjacent joints, have fostered the development of other surgical options. These include hemiarthroplasty and total joint replacement of the hallux MTP joint, both of which pose challenges and have shown poor clinical outcomes in numerous studies. Despite these poor results,



# FOOT + ANKLE

hemiarthroplasty procedures continue to be frequently performed for hallux MTP arthritis. Failed hemiarthroplasty can prompt the need for a surgical conversion to arthrodesis. There has been little research done on whether such conversions result in as favorable outcomes as would be achieved with initially doing arthroplasty.

Jefferson researchers, led by Dr. Raikin, conducted a retrospective review of 18 cases in which patients underwent salvage of the first MTP joint hemiarthroplasty using conversion to arthrodesis. The patients—13 women and five men, ranging in age from 41 to 68—had presented to Jefferson after they developed problems following hemiarthroplasty performed at other institutions. The indications for conversion to fusion were pain, transfer metatarsalgia and cock-up deformities of the hallux.

The average time to conversion surgery following the initial implantation was 46.8 months. Local autologous bone graft was used in 12 of the patients, while six required tricortical iliac bone graft for treatment of extensive bone loss. Patients were followed on average for 4.3 years.

The review of the 18 cases found that:

- Fusion was achieved in all 18 patients.
- The average time to fusion was 12.1 weeks, which is longer than the six to 12 weeks reported for primary arthrodesis.
- The average score on the Visual Analog Pain Scale (VAS) decreased from 7.8 (out of a possible 10) preoperatively to 0.75 at final follow-up.
- The average score on the AOFAS Hallux Metatarsophalangeal Interphalangeal scoring system (AOFAS-HMI) improved from 36.2 out of 100

preoperatively to 85.3 out of 90 postoperatively (modified to exclude first MTP motion).

- The average score on the Foot and Ankle Ability Measure (FAAM) postoperatively was 97.3 for activities of daily living and 91.3 for sports out of a possible 100 points. Both scores demonstrate a good return to function after conversion.
- The findings, published in *Foot & Ankle International*, indicate that conversion from hemiarthroplasty to arthrodesis was as successful as primary arthrodesis, with the majority of cases being done with regional bone graft for small defects. However, the time to fusion was longer than that of primary arthrodesis and it sometimes required structural bone graft for augmentation. There was also a correlation between the time from implantation to fusion and the need for structural grafting, which resulted in slower healing times and inferior overall outcomes.

## Nonoperative Management of Displaced Oblique Spiral Fractures of the Fifth Metatarsal Shaft

While there is an abundance of literature discussing proximal fifth metatarsal fractures, there has been little research on displaced oblique spiral fractures of the metatarsal shaft—a condition sometimes referred to as “dancer’s fracture.”

Nonoperative management has been the preferred treatment of these fractures, though that approach was largely based on anecdotal information. Outcomes are believed to be good, with high healing rates and satisfactory outcomes with either a short leg cast or fracture shoe treatment. Some clinicians opt for open reduction and internal fixation if certain displacement criteria are met.



Problems of the foot and ankle can be extremely debilitating if not properly treated in a timely fashion. Good foot and ankle health is key to optimizing a person’s mobility, stability and overall body mechanics.

Jefferson researchers, led by David I. Pedowitz, MD, Assistant Professor of Orthopaedic Surgery, Jefferson Medical College of Thomas Jefferson University, and Dr. Raikin, conducted a study involving 2,990 patients who were seen at Jefferson for metatarsal fractures from June 1, 2006 through December 20, 2010. Of that group, 142 acute displaced, distal oblique spiral fractures of the fifth metatarsal shaft (dancer's fractures) were diagnosed, for an incidence of 4.8 percent. Diagnosis was made by x-ray.

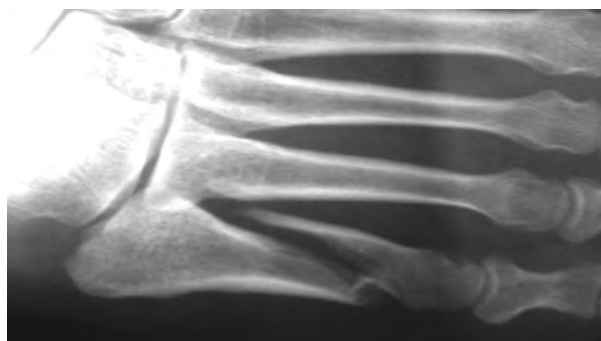
The 142 patients included 117 females and 24 males, with an average age of 55.2, with the two most common causes of injury being a twisting injury to the foot or a mechanical fall. All of the patients were treated non-surgically and instructed to be weight bearing as tolerated in a hard-soled shoe or fracture boot as comfort allowed for six weeks. They were then transitioned to full weight-bearing and regular shoes. Clinical healing typically occurred in six weeks.

Patients were seen for follow-up evaluation at six weeks, 12 weeks and after a minimum of two years after their injuries, with an average final follow-up of 3.5 years. Patients overall healed well and returned to a high level of physical function.

Some key findings were:

- Of the 142 patients, 97 percent (137 fractures) healed uneventfully.
- There were two delayed unions which subsequently healed with additional nonoperative modalities, one asymptomatic nonunion treated nonoperatively and two painful nonunions that required open reduction internal fixation with bone grafting.

- At the time of their final follow-up, patients scored an average of 95.5 (out of a possible 100 points) on the activities of daily living subscale of the Foot and Ankle Ability Measure (FAAM).
- Patients averaged 92.7 (out of a possible 100) on the FAAM sports subscale.
- The average score on the Short Form-12 scale was 51.5 (out of a possible 70) for physical and 50.3 (out of a possible 72) for mental health.



X-ray of dancer's fracture

This research, published in *Foot & Ankle International*, represents the largest study ever done of displaced oblique spiral fractures of the fifth metatarsal shaft. The results demonstrate far beyond previous anecdotal reports that excellent results can be obtained with nonoperative treatment. Even patients who had delayed union or nonunions (including those requiring surgery) experienced encouraging results. Once a fracture has healed and function is regained, it is expected that long-term results will remain unchanged.

Based on the excellent clinical outcomes of the fractures presented in this report, the researchers strongly suggest nonoperative management of these fractures.



# HAND + WRIST





EVERY YEAR THOUSANDS OF PATIENTS ARE EVALUATED BY HAND AND UPPER EXTREMITY SPECIALISTS WITH JEFFERSON'S DEPARTMENT OF ORTHOPAEDIC SURGERY FOR PROBLEMS STEMMING FROM INJURIES, OVERUSE AILMENTS OR DISEASES SUCH AS OSTEOARTHRITIS.

## SERVICES

- Hand and wrist surgery
- Hand and wrist arthroscopy
- Upper-extremity surgery
- Microvascular surgery
- Hand arthritis surgery
- Brachial plexus reconstruction
- Treatment of ligament and tendon disorders of the hand and wrist
- Treatment of carpal and cubital tunnel syndromes
- Treatment of Dupuytren's disease
- Treatment of complex nerve conditions
- Treatment of hand and wrist sports injuries
- Joint reconstruction for thumb arthritis
- Minimally invasive nerve surgery
- Joint replacement for hand arthritis

Patients often don't realize how much they depend on their hands or wrists until they aren't functioning properly.

Jefferson's hand and wrist team, which includes experts from The Philadelphia Hand Center at Jefferson and Rothman Institute at Jefferson, treat no case as routine. They understand the interplay among the ligaments, tendons, muscles, joints and bones that make up the upper extremities and know that good function depends on many different parts working well together. The specialists approach each case not as an isolated procedure, but as a multi-prong care plan. Injuries to the fingers, hand and wrist, whether acute or due to everyday wear and tear, can have life-limiting repercussions if not properly treated. Likewise, timely attention to a loss of normal movement due to an underlying disease can mean the difference between successfully resuming an active lifestyle or not.

Jefferson hand and wrist surgeons are leaders in academics, serving as editors for two textbooks, *Rehabilitation of the Hand: Surgery and Therapy* and *Review of Hand Surgery*. Physicians from The Philadelphia Hand Center at Jefferson established the Hand Rehabilitation Foundation. The Foundation hosts an annual symposium with renowned faculty who teach and demonstrate current advances.

Research-informed care is at the core of every service they provide for patients. Whether it's surgical, medical or rehabilitative, treatments are based on what will generate the best outcome for the patient. The hand and wrist team regularly conducts studies of new surgical techniques and materials, participates in clinical trials and carries out basic science projects that are advancing the understanding of important issues, such as scar formation during the healing process. One promising approach being explored at Jefferson involves the use of antibody therapy to block the formation of the excessive collagen-rich fibrotic deposits that characterize abnormal scarring.

# HAND + WRIST

## Surgery Volume

Source: Jefferson internal data  
Calendar YTD through September



Here are some specific details on hand and wrist research:

### One-Stage Integra Coverage for Fingertip Injuries

The treatment of hand trauma draws on the knowledge of multiple surgical principles, including neurovascular repair, tendon repair, fracture fixation and wound coverage. Fingertip injuries can present special challenges to clinicians. One commercially available product used for fingertip wound coverage is Integra, which consists of an acellular dermal matrix composed of bovine collagen that is covered by a layer of silicon. The product is normally applied in two stages, initially following the injury and several weeks later. A team headed by Sidney M. Jacoby, MD, Associate Professor of Orthopaedic Surgery, investigated whether Integra would be effective with just one application.

Nine patients who sustained fingertip injuries were treated with one-stage Integra coverage, with the product being placed directly on bone. The outcomes resulted in a durable, sensate and functional fingertip.

For small tissue and bone defects involving the fingertips, one-stage reconstruction using Integra appears to be safe and effective, as it limits donor site morbidity and the need for a second surgery.

Despite mild sensory deficits, patients were satisfied with the results and were fully functional during short-term follow-up.

### The Effect of a Therapy Protocol for Increasing Correction of Severely Contracted Proximal Interphalangeal Joints Caused by Dupuytren's Disease and Treated with Collagenase Injection

Although there is no cure for Dupuytren's disease, numerous surgical and nonsurgical treatments have been developed. The results of those interventions show more successful outcomes for the treatment of metacarpophalangeal (MCP) joint contractures as compared to proximal interphalangeal (PIP) joint

contractures. The introduction of clostridium collagenase histolyticum provides another nonsurgical treatment option for Dupuytren's disease, though early results indicate those with severe PIP joint contractures experience much less impressive outcomes than mild PIP joint and MCP joint contractures.

Jefferson researchers, including Dr. Jacoby and A. Lee Osterman, MD, Professor of Orthopaedic Surgery, conducted a study to test the hypothesis that severe PIP joint contractures could be considerably improved with a specific orthotic and hand rehabilitation protocol following collagenase injection.

All patients with a PIP joint contracture of at least 40 degrees by Dupuytren's disease were invited to participate in the study. Following standard collagenase injection and cord rupture by a hand surgeon, a certified hand therapist evaluated and treated each patient based on a defined treatment protocol that consisted of orthotic intervention to address residual PIP joint contracture. In addition, exercises were initiated emphasizing reverse blocking for PIP joint extension and distal interphalangeal joint flexion exercises with the PIP joint held in extension to lengthen a frequently shortened oblique retinacular ligament.

Patients were assessed before injection, immediately after injection and one and four weeks later. There were 22 fingers in 21 patients, who ranged in age from 37 to 80.

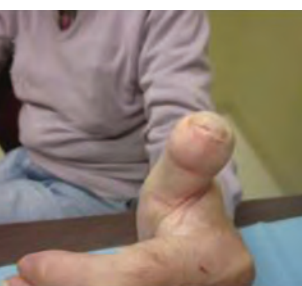
The results, published in the *Journal of Hand Surgery*, were:

- At baseline the average passive PIP joint contracture was 56 degrees. At cord rupture, the average was 22 degrees.
- One week after rupture and therapy, the contracture decreased further to 12 degrees, and by four weeks the average contracture was 7 degrees.
- The results represent an 88-percent improvement of PIP joint contracture.

In the short term it appears that severe PIP joint contractures benefit from specific post-injection orthotic intervention and targeted exercises. Longer-term study is needed to determine lasting value of hand therapy after collagenase injection.

### Screw Sizes for Distal Interphalangeal Joint Arthrodesis: Is There a Mismatch?

Distal interphalangeal joint (DIP) arthrodesis is frequently performed using headless compression screws, but not much is known about what size of screws is ideal for the



One commercially available product used for fingertip wound coverage is Integra, which consists of an acellular dermal matrix composed of bovine collagen that is covered by a layer of silicon.

procedure. Using a wrong size screw can be problematic. Jefferson researchers, including Pedro K. Beredjikian, MD, Associate Professor of Orthopaedic Surgery, Kevin Lutsky, MD, Assistant Professor of Orthopaedic Surgery, and Jonas Matzon, MD, Assistant Professor of Orthopaedic Surgery, conducted a study to determine the dimensions of the joints commonly affected by arthritis of the hand and to compare those measurements to commercially available screw devices used to treat affected patients in the clinical setting.

Using standard radiographs of the hand in 60 patients captured prospectively, the researchers measured the dimensions of the distal and middle phalanges of all fingers. The measurements were then compared to the diameters and lengths of 16 commercially available screws commonly used to perform joint fusions. The goal was to determine if the screws were a good match for the bone sizes.

The findings, presented as a podium presentation at the annual meeting of the American Society for Surgery of the Hand in San Francisco, included:

- In general, available screw diameters were too large given the anatomic dimensions of the bones of the distal interphalangeal joint.
- When all fixation devices were combined, screws were oversized relative to the bony anatomy in 66 percent of index fingers, 53 percent of long fingers, 49 percent of ring finger and 72 percent of small fingers.
- The mismatch was greater in the index and small fingers, and in women.
- Only one of the compression screws tested demonstrated a compatibility rate greater than 90 percent for each of the index and small fingers.

The findings suggest that surgeons must be cautious in considering the size of screws chosen for DIP arthrodesis. The goal is to avoid problems related to screw prominence in the narrow aspects of the distal and middle phalanges, including nail deformity. Having a good fit with the anatomy is of paramount importance.

### **Pronator Quadratus Repair Following Volar Plate Fixation of Distal Radius Fractures**

Distal radius fractures are among the most common fractures of the skeleton and are estimated to account for 2.5 percent of all visits to the emergency department. As treatment of this injury has evolved,

internal fixation with the volar locking plate has gained popularity in surgical management. The method has the advantages of obtaining articular fragment stability, a relatively low rate of tendon rupture and early return to motion and functional strength. However, to gain access to the fracture site through the volar approach, the pronator quadratus (PQ) muscle must be released and elevated. Controversy surrounds the merits of subsequent repair of the PQ. Proponents say the repair improves function, stability of the distal radioulnar joint and soft tissue coverage over the hardware. Opponents of PQ repair say that the quality of the muscle tissue often precludes a durable repair and that outcomes following the initial surgery are good regardless of whether the repair is done.

Jefferson researchers Rick Tosti, MD, orthopaedic resident, and Asif M. Ilyas, MD, Assistant Professor of Orthopaedic Surgery, analyzed the outcomes of volar plate fixation with and without PQ repair.

A total of 60 consecutive distal radius fractures treated with a volar plate were assigned to either PQ repair or no repair. Surgical exposure, reduction and rehabilitation were otherwise the same for each group.

Clinical outcomes with a minimum follow-up of 12 months were assessed via range of motion, grip strength, Disabilities of the Arm, Shoulder, and Hand (DASH) scores, and visual analog scale (VAS) scores. Full follow-up data were available for 33 patients in the PQ repair group and 24 in the non-repair group.

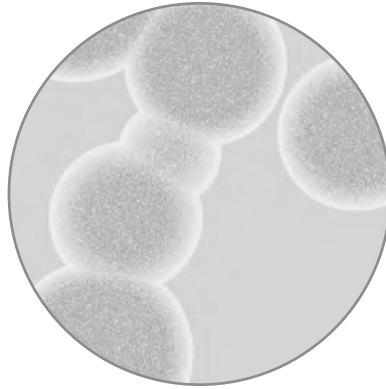
The findings, published in *Journal of Hand Surgery*, included:

- At 12 months, the average DASH score was 8 for the repair group and 5 for the control group.
- Range of motion, grip strength and VAS scores were not significantly different between the groups.
- No significant differences in any of the parameters were found at the two, six or 12-week intervals.
- Reoperation was required for four patients with PQ repair and one in the non-repair group.

The findings indicate that PQ repair after volar plating of a distal radius fracture did not significantly improve outcomes one year out. Based on the results of this study, it appears that repair of the PQ muscle does not confer any clinical advantages in patients treated for fractures of the distal radius.



# MUSCULOSKELETAL ONCOLOGY



## THE JEFFERSON MUSCULOSKELETAL ONCOLOGY CENTER TREATS PATIENTS WITH SOME OF THE MOST COMPLEX AND RARE CASES OF CANCER.

### SERVICES

- Management of extremity bone sarcoma
- Management of extremity soft tissue sarcoma
- Pelvis sarcoma resection, bone and soft tissue
- Computer-navigated bone tumor resection
- Treatment of benign bone tumors
- Treatment of benign soft tissue tumors
- Management of skeletal metastatic disease
- Management of spine lesions in conjunction with spine service
- Subspecialty imaging review
- Subspecialty pathology review
- Complex joint reconstruction
- Custom joint reconstruction
- Acetabular revision joint procedures

The Jefferson Musculoskeletal Oncology Center treats not only complex and rare bone and soft tissue primary cancer cases, but also more common and equally devastating metastatic disease to the skeleton. Each year hundreds of patients with bone or soft tissue tumors are treated at the Center, which offers the combined expertise of surgeons from Jefferson's Department of Orthopaedic Surgery and cancer experts at the NCI-designated Kimmel Cancer Center at Jefferson. Among the cancers regularly treated at the center are primary cancers, such as osteosarcoma, Ewing sarcoma and chondrosarcoma, as well as metastatic disease that has spread from breast, prostate, renal and other primary sites.

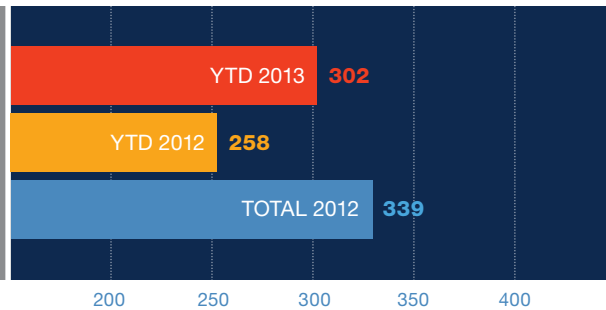
As a major referral program, the Center's clinicians often see patients with uncertain diagnoses that were unable to be treated elsewhere, or whose cases are particularly complicated. The Center's team of specialists takes a multidisciplinary approach to each case, tailoring individualized treatment plans that include the latest diagnostic and imaging services, surgery, specialized anesthesiology, bone and soft tissue tumor pathology, sarcoma medical oncology, radiation therapy and oncology rehabilitation. The Center's director, John A. Abraham, MD, Assistant Professor of Orthopaedic Surgery, Jefferson Medical College of Thomas Jefferson University, is considered a national leader in the development of computer-assisted surgical navigation for resection and reconstruction of malignant bone tumors. Dr. Abraham has a particular interest in the use of this technology for the treatment of malignant tumors of the pelvis, which present some of the biggest challenges in musculoskeletal oncology.

The Center also has an active research component, including ongoing clinical trials, basic science research and clinical research studies, that focuses on furthering the understanding of musculoskeletal tumors.

# MUSCULOSKELETAL ONCOLOGY

## Surgery Volume

Source: Jefferson internal data  
Calendar YTD through September



Here is a look at a couple of the Center's recent research projects:

### Intramedullary Nail Stabilization of Impending and Completed Pathological Fractures without Curettage or Cementation

The goals of surgical fixation for impending or completed pathological fractures are to stabilize the bone, reduce pain and provide rapid recovery, allowing for a quick return to cancer treatment and weight bearing. A recent survey of Musculoskeletal Tumor Society members revealed the popular belief that metastatic long bone lesions require curettage and cementation in addition to stabilization with intramedullary nail fixation to avoid failure. However, with modern surgical hardware and techniques, along with advances in radiation, chemotherapy and bisphosphonate or denosumab therapy, the practice of curettage and cementation may not be necessary, thus avoiding additional surgical exposure, morbidity and recovery time.

Jefferson researchers, led by Dr. Abraham, conducted a retrospective study involving 324 cases in which patients

with impending or completed long bone fracture from metastatic cancer were treated with IM nail fixation without intra-lesional curettage and cementation. The patients ranged in age from 28 to 94, and the most common types of primary cancer were lung, breast and multiple myeloma.

The study revealed that 4 percent (13/324) of patients suffered mechanical failure, 2.8 percent (9/324) suffered wound complications and 3.4 percent (11/324) of patients experienced nonsurgical complications. Comparable historical studies demonstrate failure rates of approximately 9 percent and reoperation rates ranging from 1.8 to 8.5 percent. Jefferson's low rate of failure in patients who did not undergo curettage and cementation is thought by Dr. Abraham to be primarily due to advances in medical therapies and bone-specific medications such as bisphosphonates and denosumab over the last decade, all of which contribute to increased ability for bone to regenerate at the site of a pathologic lesion. Dr. Abraham feels these data support the efficacy of intramedullary nailing alone without additional curettage and cementation. Although these findings need to be confirmed with further study, the decreased morbidity of avoiding additional surgery in this patient population, coupled with the shorter time required to recover from a smaller scale operation, make these data representative of a potentially major advance in the treatment of patients with metastatic skeletal disease.

These findings were presented at the annual meeting of the Musculoskeletal Tumor Society in San Francisco this year, and will be presented at the annual meeting of the American Academy of Orthopaedic Surgeons in New Orleans in 2014.

Long bone fracture from metastatic cancer treated with IM nail fixation



## Distribution and Characterization of Hemangiomas in the Spine

Hemangiomas are the most common benign tumor of the vertebral column, with 90 percent of them found incidentally through imaging. More frequently distributed in the lumbar and thoracic regions, vertebral hemangiomas (VHs) are thought by many radiologists and spinal surgeons to almost exclusively occur in the vertebral body. Only 0.9 to 1.2 percent of VHs are symptomatic, but when they are discovered outside the thoracolumbar vertebral body region, their identity may be doubted in spite of typical radiographic findings, and unnecessary workup and biopsies may follow.

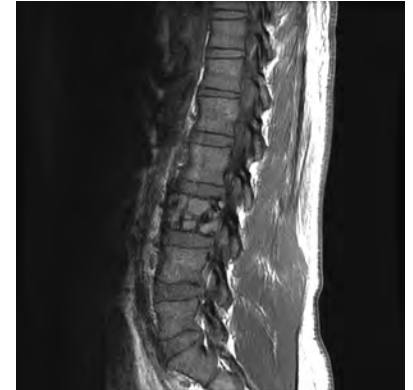
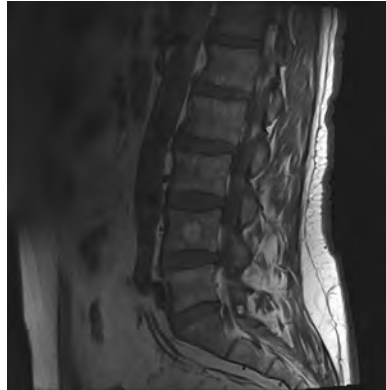
Jefferson researchers, led by Dr. Abraham, conducted a study to determine the distribution and characteristics of VHs with computed tomography (CT) and magnetic resonance imaging (MRI). The study—which was presented at the International Society of Limb Salvage meeting in Bologna, Italy—involved a retrospective review of a radiological database to identify CT and MRI images showing suspected VHs. Two independent musculoskeletal radiologists confirmed the diagnosis of hemangioma by imaging characteristics and stability over time. Each case was then evaluated for patient demographics, location of the tumor and tumor volume.

In all, 998 cases of VHs were identified on 683 MRIs and 43 CTs. In the MRI group, the average patient age was 59.1, with a male-to-female ratio of 1 to 3. Nearly 37 percent of the patients presented with multiple VHs, and 22.7 percent of the tumors had an atypical appearance. The location of the VHs within the vertebral body varied widely. Although tumors were seen in the posterior elements, including lamina and spinous processes, none extended onto the transverse processes. The average volume of a VH was larger as its location moved caudally within the spine, ranging from 0.67 cm. in the cervical region to 2.62 cm. in the lumbosacral region.

In the CT group, the average age was 65.2, with a male to female ratio of 3 to 1, and 11.6 percent of patients presented with multiple VHs. The average tumor volume was 3.64 cm. On CT, VHs largely distributed to the lumbar region, but not infrequently in the cervical and upper thoracic regions as well.

This review of nearly 1,000 cases of VHs demonstrated that while these benign tumors are most commonly found in the thoracolumbar spine and vertebral body, their diagnosis cannot be discounted when found in

Spinal hemangioma (top L and R)



Aggressive hemangioma



Hemangioma axial

other parts of the vertebral column, both in the cephalad to caudal orientation, as well as within an individual vertebrae. The findings characterize the distribution of these benign tumors and should help increase the accuracy of diagnosing asymptomatic vertebral hemangiomas. In addition, the findings will potentially help avoid additional work up and biopsy, which increases cost to the medical system and anxiety for the patient and family.

# TRAUMA







ACCIDENTAL INJURY IS A LEADING CAUSE OF DEATH IN THE U.S. AND THE NUMBER ONE CAUSE OF DISABILITY. THE HOURS IMMEDIATELY FOLLOWING A TRAUMATIC INJURY ARE CRITICAL, WITH THE LEVEL OF AVAILABLE MEDICAL AND SURGICAL CARE SOMETIMES MEANING THE DIFFERENCE BETWEEN LIFE AND DEATH.

## SERVICES

- Treatment of fractures, both simple and complex, using both nonoperative and operative methods. Includes articular fractures and pelvic/acetabular fractures
- Assessment and treatment of problem fractures, those which have gone on to malunion or nonunion
- Functional treatment of fragility fractures of the elderly
- Treatment of post traumatic bone infections

Jefferson is a federally-designated Level 1 Trauma Center, treating patients from all over the Philadelphia region. Our specialists who are experienced in orthopaedic trauma focus not just on the immediate care plan that enhances the chances for survival, but also on a longer-term treatment plan that improves the chances that patients will experience a positive recovery.

The orthopaedic trauma team has a broad portfolio of research projects that is helping to inform the care of traumatic injury both at Jefferson and at other medical centers nationwide and around the globe. Here are some areas of research that are of particular interest to the Jefferson team:

### Hip Fractures

Hip fractures are debilitating for all ages, but they can be life altering for elderly patients who may not be able to return to an independent lifestyle. With the goal to improve recovery from hip fractures, Jefferson orthopaedists played an integral role recently in the creation of the Thomas Jefferson University Hospital Hip Fracture Service. The service—which began in July 2013 and draws on the expertise of orthopaedic surgery, emergency medicine, internal medicine, pharmacy, rehabilitation, nursing and social services—provides comprehensive care for all hip fracture patients. Evidence suggests that such a multidisciplinary approach will improve survival rates, maximize functional outcomes, minimize complications and provide better value for the healthcare system.

As part of its commitment to improving the care of hip fracture patients, Jefferson is also a participating site for a multicenter study of hip fixation techniques. The study, titled “Fixation Using Alternative Implants for Treatment of Hip Fractures,” or FAITH, should add insight into the best methods to treat some of the most common types of hip fractures.

# TRAUMA

## Compartment Syndrome

Any patient who sustains an orthopaedic injury is at risk for compartment syndrome. The condition, which results from excessive swelling, can be extremely difficult to diagnose and a failure to do so can result in contractures and functional loss, infection, renal failure, amputation or death.

Clinical signs and symptoms of compartment syndrome include pain out of proportion to the injury, pain with passive stretch of the muscles, paralysis of the same muscles, paresthesia in the distribution of the peripheral nerves involved, pallor of the skin and firmness of the affected compartments. A clinical exam is not always conclusive, however, and some patients require measurement of their compartment pressures to make an appropriate diagnosis.

James Krieg, MD, Professor of Orthopaedic Surgery, Jefferson Medical College, Thomas Jefferson University, is conducting research on compartment syndrome and how best to measure compartment pressures. He is part of a research team that has presented the results of a study at the Orthopaedic Trauma Association Meeting in October 2013 in Phoenix, Arizona. Their work should help physicians gain insight into why it is difficult to measure pressure in limbs at risk for compartment syndrome.

## Pelvic Fracture Care

Pelvic fractures are among the most severe orthopaedic injuries, causing disability and mortality. Once the domain of younger patients with multiple traumatic injuries, pelvic fractures are now seen more frequently

in elderly patients. In recent years, the biggest advance in care of pelvic fractures has been the ability to stabilize fractures with less invasive surgical techniques, such as placement of percutaneous screws. A recent study, coauthored by Dr. Krieg and presented at the American Academy of Orthopaedic Surgeons annual meeting, documented the effectiveness of using transiliac-transsacral screws in the most unstable (C-type) fracture patterns. Another study, accepted for presentation at the annual meeting of the Orthopaedic Trauma Association, documented the effectiveness of percutaneous sacro-iliac screws (SI) in treating moderately severe injuries (APC-II) that traditionally were only treated with anterior pelvic plating. The study found that the failure rate of such a fixation strategy was 4.5 percent, compared to the historical norm of 22 percent without SI screw fixation.

## Humeral Shaft Fractures

Fractures of the humeral shaft are relatively common. Although many injuries do well with nonsurgical treatment, there are many patients who benefit from the easier soft-tissue management, predictable healing and functional outcome achievable with operative treatment. The “gold standard” of surgical care is open reduction and internal fixation with plates and screws. An alternative is the use of an intramedullary nail. Although the surgery is less invasive, the nails are typically placed through the rotator cuff, raising concerns about shoulder pain and function. To better understand the source of shoulder dysfunction after IM nailing of the humerus, Dr. Krieg is conducting cadaver studies. The goal is to better refine the technique and improve functional outcomes.



The orthopaedic trauma team has a broad portfolio of research projects that is helping to inform the care of traumatic injury both at Jefferson and at other medical centers nationwide and around the globe.



**Above:** Case example of transiliac-transsacral screw fixation

**Right:** An “open book” pelvic fracture fixed with plating of the symphysis pubis, supplemented by a fixation screw across the left SI joint.



# CONCUSSION





DELIVERING RESEARCH-INFORMED CARE TO INJURED ATHLETES  
OF ALL AGES AND ABILITIES IS THE GOAL AT THE  
NEW JEFFERSON COMPREHENSIVE CONCUSSION CENTER.

## SERVICES

- Baseline testing for athletes
- ImPACT (Immediate Post-Concussion Assessment and Cognitive Testing)
- BESS (Balance Error Scoring System) test
- Neuropsychological testing
- Vestibular therapy
- Visual/tracking therapy

The Jefferson Comprehensive Center offers patients the expertise of practitioners from the fields of sports medicine, neurology, ophthalmology, psychiatry, physical therapy and occupational therapy who are experienced in the care of youth and adult patients with concussions.

Once viewed as an inconvenient price to pay for playing sports, concussion is now seen as a serious injury with potentially long-term neurologic ramifications. A growing understanding of the seriousness of concussions (as witnessed by the recent lawsuit brought by former NFL players) has prompted legislation in multiple states regarding preseason assessments of athletes, injury assessment and management, and rules on when to return to school and play. A bigger issue is whether concussions make athletes susceptible to long-term effects of depression and dementia.

A prompt and thorough evaluation at the time of injury, a well-reasoned treatment plan and follow-up assessments can help ensure that athletes return to being physically and mentally fit as well as return to play.

Stephen Stache, MD, a sports medicine physician at the Center, said the staff will follow the latest guidelines set forth by the Fourth International Conference on Concussion in Sport and also draw on the findings of a growing body of research on the incidence, management, treatment and prevention of concussions. While most people who suffer a concussion achieve a full recovery within a week or two, some patients will have lingering symptoms and impaired cognitive function that might last for months.

Dr. Stache cited a study published recently in the *Journal of the International Neuropsychological Society* conducted by a well-respected concussion research team that followed more than 18,000 high school and collegiate athletes over a 10-year period. The results showed that 90 percent of

# CONCUSSION

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concussed athletes had a typical recovery (within two weeks), while 10 percent experienced a prolonged recovery. The prolonged recovery group had more severe symptoms initially, such as unconsciousness, and had persistent cognitive impairment on follow-up assessments. Nearly a quarter of those athletes who didn't recover quickly continued to report symptoms six to 12 weeks after concussion, according to the study. The study found benefit in not rushing players back to the field. For instance, the longer a player was kept from competition and allowed a symptom-free waiting period, the lower the risk of prolonged recovery.

Dr. Stache said the Jefferson Comprehensive Concussion Center will also conduct research. Among the topics of research interest are medical management of concussions and further development and validation of standardized diagnostic and assessment tools.

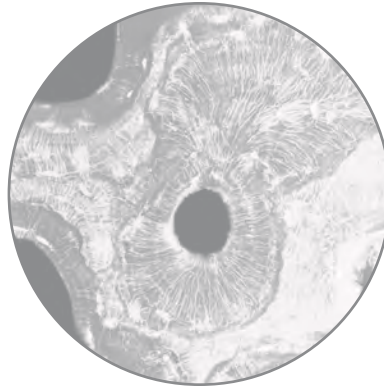






BASIC  
SCIENCE





RESEARCH BY FACULTY IN THE DIVISION OF ORTHOPAEDIC RESEARCH HAS HELPED POSITION JEFFERSON AS A LEADER IN BOTH FUNDAMENTAL AND CLINICAL RESEARCH ENCOMPASSING THE PATHOGENESIS AND TREATMENT OF DISEASES OF BONE, CARTILAGE AND THE INTERVERTEBRAL DISC.

## KEY RESEARCH AREAS

- Pathogenesis of degenerative disc disease
- Novel treatments for implant-related infections
- Post-traumatic and post-operative fibrosis of musculoskeletal tissues
- Use of non-thermal plasma technology to enhance bone and cartilage healing
- Diagnosis and treatment of osteoarthritis

Irving Shapiro, PhD, Professor of Orthopaedic Surgery, Jefferson Medical College, Thomas Jefferson University, and other Jefferson scientists are contributing to the understanding of normal tissue development and architecture, and are providing many new insights into the causes of connective tissue disease. The scientists routinely collaborate with Department clinicians to conduct basic research that is informing the development of novel clinical treatments and diagnostic tests.

Here is a look at research inside the labs:

### **From the Laboratory of Theresa Freeman, PhD, Associate Professor of Orthopaedic Surgery:**

In collaboration with engineers and physicists from Drexel University, Dr. Freeman is investigating the application of non-thermal atmospheric dielectric barrier discharge plasma (NT-plasma) to promote the repair of bones and joints. Although the exact mechanism by which NT-plasma interacts with cells and tissues is undefined, the plasma generates both ionized species and electric fields that enhance the induction of intracellular reactive oxygen and nitrogen species. Recent studies in Dr. Freeman's lab have shown NT-plasma application promotes differentiation of both osteoblasts and chondrocytes in vitro. Further work on a tissue model of differentiation indicates that after NT-plasma treatment there is enhanced limb development.

The combined efforts of physicists and biologists creates exciting new possibilities for NT-plasma that could lead to a multitude of advances in medicine.

**From the Laboratory of  
Andrzej Fertala, PhD,  
Professor Orthopaedic Surgery:**

Fibrosis, which results from excessive and disorganized collagen production, can affect almost all tissues. Following knee injury or knee replacement surgery, for instance, arthrofibrosis can cause a painful and debilitating condition known as stiff knee.

Dr. Fertala is examining novel ways to block excessive collagen production, with the goal of preventing abnormal scarring and improving recovery. Inhibition of the extracellular process of collagen fibril formation represents a new approach to limiting posttraumatic or postsurgical localized fibrosis. It has been demonstrated that a monoclonal antibody that targets the C-terminal telopeptide of the  $\alpha 2$  chain of human collagen I is able to block critical collagen I-collagen I interaction, thereby reducing the amount of collagen deposits in vitro and in animal models.

The approach has been tested in vitro using cultures representing fibrotic processes occurring in the skin, tendon, joint capsule and gingiva. The potential toxicity of the novel antibody was analyzed through its impact on the viability and proliferation of various cells and by testing its tissue cross-reactivity in sets of arrays of human and mouse tissues. Test results show that the antibody can limit the accumulation of collagen-rich deposits without harming other tissues. Laboratory assessments of the antibody are laying the groundwork for eventual testing of the approach in humans.

**From the Laboratory of  
Noreen Hickok, PhD,  
Associate Professor of  
Orthopaedic Surgery:**

While surgical techniques and materials for joint replacement have never been better, the potential for infection remains a serious concern. Implant-associated infections contribute to patient morbidity and healthcare costs. Prosthetic joint infections (PJI) are difficult to diagnose and hard to treat, thus it is critical to find effective prevention strategies. In one such effort, researchers are studying whether surface modification of titanium fracture hardware with vancomycin would support bone healing and prevent bacterial colonization of the implant.

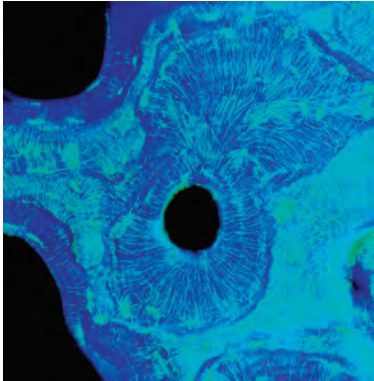
Typically antibiotics are included around the implant for a short time during insertion. Jefferson researchers are testing whether it would be more effective to utilize implant hardware that comes pre-loaded with antibiotics, which would be activated if necessary. This concept has been expanded to other systems. In one case, allograft bone used in spinal fusions has also been made to resist infection. Another application involves light-activated therapy that could be used during an operation to reduce the risk of infection. Finally, studies are ongoing to explore how the microbiome contributes to arthritis and the need for knee replacement therapy.

**From the Laboratory of  
George Feldman, DMD, PhD, Research  
Assistant Professor of Orthopaedic Surgery:**

Developmental Dysplasia of the Hip (DDH) is a debilitating condition characterized by incomplete formation of the acetabulum and/or femur. This can lead to dislocation of the femur, suboptimal joint function and accelerated wear of the articular cartilage resulting in a crippling arthritis of the hip. DDH affects 1 in 500 – 1,000 newborns in the U.S. with well defined pockets of high prevalence in Japan, Italy and other Mediterranean countries. Although reasonably accurate for detecting gross forms of hip dysplasia, existing techniques fail to find milder forms of this condition. A sensitive and specific test for DDH has remained a desirable yet elusive goal in orthopaedics for a long time.

The primary goal of current research is to develop a diagnostic DNA test to identify individuals at risk for this disorder. Once identified, non-invasive therapeutic interventions may be possible. Jefferson researchers studying the DNA of a four-generation family have found a potentially harmful mutation in the CX3CR1 receptor. In another family, a potentially harmful mutation in the teneurin3 gene has been identified. Both of these DNA changes are thought to delay the maturation of stem cells in forming the cartilage anlage of the labrum of the acetabulum.

It is possible that these mutations may lay the foundation for an accurate diagnostic test in newborns. Early identification and treatment of DDH would prevent hip dysplasia from developing into osteoarthritis.



Scientists routinely collaborate with Department clinicians to conduct basic research that is informing the development of novel clinical treatments and diagnostic tests.

**From the Laboratory of  
Makarand V. Risbud, PhD,  
Professor of Orthopaedic Surgery  
and Irving M. Shapiro, PhD**

The intervertebral disc is a complex structure that separates opposing cartilage-covered bone (vertebrae), permits a range of motions and accommodates high biomechanical forces. The interaction between the semifluid nucleus pulposus and the tight molecular lattice of the annulus fibrosus provides the biomechanical properties necessary for spinal stability.

Disturbing this relationship by compromising the stability of the nucleus pulposus, the annulus fibrosus or the endplate cartilage results in disc degeneration, a condition that can lead to excruciating pain and loss of function, and which often results in costly surgical interventions. Because the degenerative process is chronic, the nucleus pulposus cells are required to function for long periods in what can be described as a suboptimal microenvironmental niche.

Researchers are studying what specific conditions enhance nucleus pulposus cell survival as well as factors that disregulate the disc microenvironment and promote degenerative disc disease. The lab is focused on two particular factors. The first is the high osmotic pressure of the disc compartment that serves to accommodate the forces applied to the spine. Studies from the lab have shown that nuclear pulposus cells respond to changes in osmotic pressure by upregulating a unique transcription factor, TonEBP (tonicity enhancer-binding protein). The second factor being studied is the hypoxic environment of the disc, which is due to an absence of permeating blood vessels. The lab is focused on the role and function of the transcription factor HIF (hypoxia-inducible factor) that is upregulated in discal tissue.

Understanding the role of those two factors should help scientists better understand the process of disc degeneration and identify ways to prevent it.

# ONGOING CLINICAL TRIALS

Funded Clinical Trial	Investigator(s)
Prospective Post Market Clinical Follow-Up Study of the Zimmer Trabecular Metal Humeral Stem. <i>Zimmer</i> (04/05/2012—ongoing)	Joseph A. Abboud, MD
Retrospective, Post-Market, Clinical and Radiographic Follow-Up Study of the DePuy Delta Xtend Reverse Shoulder System. <i>DePuy Synthes</i> (9/24/2013—ongoing)	Joseph A. Abboud, MD, Gerald R. Williams, Jr., MD
A Phase II Randomized, Double-Blind, Placebo Controlled Study to Assess Safety, Tolerability and Effect on Tumor Size of MCS110 in Patients with Pigmented Villonodular Synovitis (PVNS). <i>Novartis</i> (10/1/2013—ongoing)	John A. Abraham, MD, Atrayee Basu-Mallick, MD
Treatment of Plantar Fasciitis with Xeomin: A Randomized, Placebo-Controlled, Double-Blinded, Prospective Study. <i>Merz</i> (4/05/2012—ongoing)	Jamal Ahmad, MD
A Prospective, Randomized Clinical Investigation of the Cervitech, Inc. Porous Coated Motion Artificial Disc for Stabilization of the Cervical Spine between C3-C4 and C7-T1. <i>NuVasive</i> (02/03/2005—ongoing)	Todd J. Albert, MD, Alan S. Hilibrand, MD, Ashwini D. Sharan, MD
A Multicenter Prospective Randomized Controlled Clinical Trial Comparing the Safety and Effectiveness of PRODISC-C to Anterior Cervical Discectomy and Fusion (ACDF) Surgery in the Treatment of Symptomatic Cervical Disc Disease (SCDD)—Non randomized PRODISC-C continued access arm. <i>Synthes Spine</i> (04/28/2005—ongoing)	D. Greg Anderson, MD, Todd J. Albert, MD, Alexander R. Vaccaro, MD, PhD
A Prospective, Randomized, Double Blind, Controlled Investigation Evaluating the Intracept Intraosseous Nerve Ablation System for the Reduction of Pain in Patients with Chronic Axial Low Back Pain. <i>Relieva</i> (04/2012—ongoing)	D. Greg Anderson, MD, Kris E. Radcliff, MD
Efficacy of Cryopreserved Amniotic Tissue (Neox 100) in Pain Reduction and Improvement of Function in the Low Back and Leg Pain and Discectomy Patients. <i>Amniox Medical</i> (5/25/2011—ongoing)	D. Greg Anderson, MD
Proximal Femoral Morphology and Fit of Different Types of Dual Wedge Taper Femoral Stems. <i>Stryker</i> (05/09/2012—ongoing)	William V. Arnold, MD, PhD
Post-Market Clinical Follow-Up Study of the Zimmer Vivacit-E Highly Crosslinked Polyethylene Liner Used with the Continuum Acetabular Shell. <i>Zimmer</i> (10/1/2013—ongoing)	William V. Arnold, MD, PhD, Javad Parvizi, MD
Evaluation of OR Costs and Operative Efficiencies Comparing 3 Total Knee Arthroplasty Techniques. <i>Stryker</i> (03/22/2012—ongoing)	Matthew S. Austin, MD
Prospective Post-Market Clinical Follow-Up of the Zimmer Trabecular Metal Reverse Shoulder System. <i>Zimmer</i> (08/2011—ongoing)	Luke S. Austin, MD, Matthew D. Pepe, MD, Bradford S. Tucker, MD
Clinical Outcomes of Distal Radius Fractures: Immobilization with Long-Arm Versus Short-Arm Splints in Operative and Non-Operative Patients	John M. Bednar, MD, Sidney M. Jacoby, MD
Prospective Clinical Evaluation Treating Subchondral Bone Marrow Lesions with Subchondroplasty for Pain Relief. <i>Knee Creations LLC</i> (3/15/2012—ongoing)	Steven B. Cohen, MD
Clinical Outcomes Following Biceps Tendon Repair with the Hemi-Krackow Suture Technique	Randall W. Culp, MD
Trabecular Metal Femoral Hip Stem Used within the Zimmer Hip Registry. <i>Zimmer</i> (02/09/2012—ongoing)	Gregory K. Deirmengian, MD
THA Using Small, Direct Anterior Incision: The Role of Short Femoral Stem. <i>Zimmer</i> (8/11/2011—ongoing)	Gregory K. Deirmengian, MD, Javad Parvizi, MD

Funded Clinical Trial	Investigator(s)
Prospective Post-Market Clinical Follow-Up of the Zimmer Trabecular Metal Reverse Shoulder System. <i>Zimmer</i> (08/23/2011—ongoing)	Charles L. Getz, MD, Matthew L. Ramsey, MD
Ascension Radial Head. <i>Integra Life Sciences</i> (09/2012—ongoing)	Charles L. Getz, MD, Matthew L. Ramsey, MD, Joseph A. Abboud, MD
Multicenter Trial of the Sidus Stem Free Shoulder Arthroplasty System. <i>Zimmer</i> (7/18/2013—ongoing)	Charles L. Getz, MD, Matthew L. Ramsey, MD, Joseph A. Abboud, MD
Prevalence of Radiographic Findings of Carpal Instability in Patients with Thumb Basal Joint Arthritis	Sidney M. Jacoby, MD
Validation of a Computer-Based Assessment Tool for Dupuytren's Contracture in the Hand	Sidney M. Jacoby, MD
The Development of a Reliable and Valid Patient Rated Questionnaire Specific for Dupuytren's Disease	Sidney M. Jacoby, MD
The Use of Pre-Operative Antibiotic Prophylaxis for Elective Soft Tissue Hand Surgery by Members of the American Society for Surgery of the Hand	Sidney M. Jacoby, MD
Mechanics and Performance of Traceable UHMWPE. <i>National Institute of Health (R01-AR047904)</i> (9/15/2010—ongoing)	Steven M. Kurtz, PhD, Clare Rimnac, PhD, John Garino, MD, William J. Hozack, MD, James J. Purtill, MD, Peter F. Sharkey, MD, Javad Parvizi, MD
A Prospective, Randomized, Controlled, Single Blinded, Multicenter Study to Evaluate the Efficacy and Safety of Floseal for Hemostasis in Primary, Unilateral Total Knee Arthroplasty (TKA). <i>Baxter</i> (09/14/2011 – 6/1/2013).	Alvin C. Ong, MD
Post-Market Study of the Stryker Orthopaedics Triathlon TS Total Knee System. <i>Stryker Orthopaedics</i> (4/1/2012—ongoing)	Fabio R. Orozco, MD, Alvin C. Ong, MD
Persona Outcomes Knee Study (POLAR). <i>Zimmer</i> (3/1/2013—ongoing).	Fabio R. Orozco, MD, Alvin C. Ong, MD, Matthew S. Austin, MD
A Randomized Controlled Trial Comparing Combination Therapy of Ibuprofen and Acetaminophen Versus Hydrocodone and Acetaminophen for the Treatment of Pain after Carpal Tunnel Surgery	A. Lee Osterman, MD, Sidney M. Jacoby, MD
The Role of Splinting, Serial Casting and Therapy Following Collagenase Injection for Severe Dupuytren's Contracture at the PIP Joint	A. Lee Osterman, MD
Radiographic Carpal Changes after Trapeziectomy for Thumb Basal Joint Arthritis	A. Lee Osterman, MD, Sidney M. Jacoby, MD
The Interplay of RhoA and Rac1 Activity in Human Mesenchymal Stem Cell Tenogenesis	A. Lee Osterman, MD, Rowena McBeath, MD, PhD
The Cellular Basis of Human Enthesis Formation	A. Lee Osterman, MD, Rowena McBeath, MD, PhD
The Role of Hypoxia in Human Tenocyte Transdifferentiation	A. Lee Osterman, MD, Rowena McBeath, MD, PhD

# ONGOING CLINICAL TRIALS

Funded Clinical Trial	Investigator(s)
Histopathologic Changes in DeQuervain's Tendinosis: A Correlation Between Clinical and Pathologic Severity	A. Lee Osterman, MD, Rowena McBeath, MD, PhD
Retrieval of Discarded Surgical Tissue. <i>National Disease Registry Institute</i> (1/12/2004 – 6/30/2013)	Javad Parvizi, MD, Peter F. Sharkey, MD, James J. Purtill, MD, William J. Hozack, MD, Richard H. Rothman, MD, PhD
An Open-Label, Randomized, Multicenter Phase IIIb Study to Assess the Efficacy, Safety, and Tolerance of BERIPLEX P/N Compared with Plasma for Rapid Reversal of Coagulopathy Induced by Coumarin Derivatives in Subjects Requiring Emergency Surgery or Invasive Diagnostic Intervention. <i>CSL Behring</i> (9/1/2008 – 3/1/2013)	Javad Parvizi, MD
Multicenter Trial of the Continuum Ceramic Bearing System in Total Hip Arthroplasty. <i>Zimmer</i> (08/05/2010—ongoing)	Javad Parvizi, MD, William J. Hozack, MD, Matthew S. Austin, MD
<i>American Joint Replacement Registry</i> (12/23/2010—ongoing)	Javad Parvizi, MD
A Prospective, Randomized, Controlled, Single-Blinded, Multicenter Study to Evaluate the Efficacy and Safety of Floeal for Hemostatis in Primary, Unilateral Total Knee Arthroplasty (TKA). <i>Baxter</i> (09/14/2011 – 6/1/2013)	Javad Parvizi, MD
A Phase II Study to Determine the Efficacy and Safety of Allogeneic Human Chondrocytes Expressing TGF- $\beta$ 1 in Patients with Grade 3 Chronic Degenerative Joint Disease of the Knee (09/01/2011—ongoing)	Javad Parvizi, MD, Marc I. Harwood, MD, Peter C. Vitanzo, Jr., MD
Evaluation of In-vivo Wear of Ceramic Femoral Head Against Highly Cross-Linked Polyethylene: A Comparative Study. <i>Ceramtec</i> (11/2011—ongoing)	Javad Parvizi, MD
Medium Term Survivorship of Cementless THA Performed Using the Bone Preservation Tri-Lock Femoral Stem. <i>DePuy</i> (2/16/2012—ongoing)	Javad Parvizi, MD, William J. Hozack, MD, Alvin C. Ong, MD, Fabio R. Orozco, MD, Zachary D. Post, MD, Gregory K. Deirmengian, MD
An Open-Label, Multicenter, Randomized Study to Evaluate the Safety and Efficacy of Oral Fusidic Acid (CEM-102) in Combination with Oral Rifampin for Prosthetic Joint Infection, in Comparison with Standard of Care Intravenous Antibiotic Treatment Regimens, During Two-Stage Prosthesis Exchange. <i>Cempra</i> (2/20/2014—ongoing)	Javad Parvizi, MD, Gregory K. Deirmengian, MD, Matthew S. Austin, MD
A Post-Market, Prospective, Single Center, Randomized, Pilot-Phase Investigation of the Effects of PlasmaBlade™ Dissection and Coagulation on Soft Tissue Inflammation Parameters Following Total Knee Arthroplasty. <i>Medtronic</i> (5/17/2013—ongoing)	Javad Parvizi, MD
Evaluation of the Clinical Utility of the Cobas® MRSA/SA Test for Detection of Staphylococcus Aureus and Methicillin Resistant Staphylococcus Aureus from Nasal Swabs. <i>Roche Molecular Systems</i> (7/1/2013—ongoing)	Javad Parvizi, MD
Patient Satisfaction after TKA. <i>Smith and Nephew</i> (12/27/2012—ongoing)	Javad Parvizi, MD
Tantalum Acetabular Component Study. <i>Zimmer</i> (04/2012—ongoing)	James J. Purtill, MD, Javad Parvizi, MD

Funded Clinical Trial	Investigator(s)
A Prospective, Randomized, Controlled, Multicenter, Pivotal Human Clinical Trial to Evaluate the Safety and Effectiveness of Augment Injectable Bone Graft Compared to Autologous Bone Graft as Bone Regeneration Device in Hindfoot Fusions. <i>BioMimetic</i> (4/7/2011—ongoing)	Steven M. Raikin, MD, Javad Parvizi, MD
Skelkast Surpass Post-Approval Active Surveillance. <i>Skelkast</i> (10/2012—ongoing)	Peter F. Sharkey, MD
Characterization of Bone Marrow Lesions in Retrieved Tibial Plateaus. <i>Knee Creations LLC</i> (8/3/2011—ongoing)	Peter F. Sharkey, MD, Susan Yaron, MD
Outcomes of Patients following Primary Total Knee Replacement. <i>Stelkast</i> (6/7/2013—ongoing)	Peter F. Sharkey, MD
Botulinum Toxin A to Treat Flexion Contracture After Total Knee Arthroplasty: A Double-Blinded Randomized Controlled Study. <i>Sharpe-Strumia Research Foundation</i> (07/01/2012—ongoing)	Eric B. Smith, MD, Ari C. Greis, DO, Jess H. Lonner, MD
Comparing Pain Relief between Exparel® Injection Versus On-Q Catheter as the Postsurgical Analgesia Following Total Knee Arthroplasty (TKA). <i>Sharpe-Strumia Research Foundation</i> (07/01/2013—ongoing)	Eric B. Smith, MD, Jess H. Lonner, MD, Peter F. Sharkey, MD
Treatment of Trigger Finger with Steroid Injection Versus Steroid Injection and Splinting: A Randomized Controlled Trial	Stephanie Sweet, MD, Sidney M. Jacoby, MD
The Use of a Multi-Laminar Extracellular Matrix (AxoGuard®) for the Treatment of Recalcitrant Carpal Tunnel and Cubital Tunnel Syndromes	John S. Taras, MD
Distal Radius Fracture Repair Using a Threaded, Cannulated Pin	John S. Taras, MD
Efficacy of Riluzole in Patients with Cervical Spondylotic Myelopathy Undergoing Surgical Treatment, A Randomized, Double-Blind Placebo-Controlled, Multicenter Study. <i>AOSpine North America</i> (02/16/2012—ongoing)	Alexander R. Vaccaro, MD, PhD, Todd J. Albert, MD, Alan S. Hilibrand, MD, D. Greg Anderson, MD, Jeffrey A. Rihn, MD, Kris E. Radcliff, MD
Surgical Versus Nonoperative Treatment of Metastatic Epidural Spinal Cord Compression (MESCC). Quality of Life and Cost-Effectiveness Outcomes. <i>AOSpine North America</i> (02/14/2008—ongoing)	Alexander R. Vaccaro, MD, PhD, Todd J. Albert, MD, Alan S. Hilibrand, MD, D. Greg Anderson, MD, Jeffrey A. Rihn, MD, Kris E. Radcliff, MD
An Assessment of P-15 Bone Putty in Anterior Cervical Fusion with Instrumentation Investigational Plan. <i>Cerapedics</i> (06/07/2007—ongoing)	Alexander R. Vaccaro, MD, PhD, Todd J. Albert, MD, James S. Harrop, MD, Ashwini D. Sharan, MD, Srinivas Prasad, MD, Jack Jallo, MD, PhD, FACS
Addendum to Investigational Plan 1003 Version 5.3 IDE Protocol G050178: An Assessment of P-15 Bone Putty in Anterior Cervical Fusion with Instrumentation. <i>Cerapedics</i> (03/11/2010—ongoing)	Alexander R. Vaccaro, MD, PhD, Todd J. Albert, MD, James S. Harrop, MD
A Multicenter, Randomized, Double-Blind, Phosphate Buffered Saline-Controlled Study to Evaluate Effectiveness and Safety of a Single Intra-Articular Injection of Gel-One® for the Treatment of Osteoarthritis of the Knee with Open-Label Safety Extension. <i>Seikagaku Corporation</i> (9/25/2013—ongoing).	Peter C. Vitanzo, Jr., MD, Barry Kenneally, MD, Marc I. Harwood, MD, Javad Parvizi, MD
Prospective, Multicenter Single Arm Study to Assess Clinical Outcomes in Primary Open or Mini-Open Rotator Cuff Repair Using Conexa Graft Reinforcement. <i>Tornier/LifeCell</i> (2/18/2010—ongoing)	Gerald R. Williams, MD

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