

PENN ORTHOPAEDICS

EXCELLENCE IN MOTION 2015

INNOVATORS

IN ORTHOPAEDIC CARE

>>> THE PENN
MUSCULOSKELETAL
CENTER | Page 3

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LETTER FROM THE CHAIR



Source: Sabina Louise Pierce

Dear Colleague,

It is with great pride that I present the fifth annual issue of *Excellence in Motion*, the newsletter of Penn Orthopaedics.

2014 was a year of great accomplishments for Penn Orthopaedics. In August, the much anticipated Penn Musculoskeletal Center opened at Penn Medicine University City. The Center offers a preeminent patient engagement model framed upon a unique and highly specialized approach to treating musculoskeletal disorders, injuries and other conditions involving the bones, joints or muscles. Treatment within the Center is a collaboration of care across many disciplines including orthopaedics, rheumatology, physical medicine and rehabilitation, pain medicine and musculoskeletal radiology. 2014 also saw the development of the Sarcoma Program under the direction of Kristy Weber, MD. This program, comprised of a multidisciplinary team including orthopaedic oncology, medical oncology, pediatric oncology, radiation oncology, musculoskeletal radiology, musculoskeletal pathology, surgical oncology, neurosurgery and plastic surgery, is devoted to the research and treatment of bone and soft tissue sarcomas.

Among the research completed by Penn Orthopaedics in 2014, this issue of *Excellence in Motion* will discuss the safety of bilateral total knee arthroplasty (TKA) staged one week apart, offer an overview of the effects of systemic ibuprofen on tendon healing, and include a reflection on the indications and successes of the Sternal TALON, a device developed as an alternative to wire closure in sternal nonunion. Each of these reports has the common goal of seeking an answer to a concern facing the orthopaedic community, and each is typical of the breadth of activity at Penn Orthopaedics.

Education, professional awards and honors, and the attraction of the top talent in the region continue to be focal points of interest, and are reviewed herein, as well. Since its origin more than a century ago as the nation's first independent Department of Orthopaedic Surgery, Penn Orthopaedics has been a highly sought after resident training program for medical students, and the almost 800 applications received last year for the eight orthopaedic residency positions at Penn reflect this fact. This issue offers an overview of the department's renowned clinical Fellowship and Visiting Professor programs, as well as recent department highlights including Robert L. Mauck, PhD winning the 2015 Kappa Delta Young Investigator Award from the American Academy of Orthopaedic Surgeons.

Over and above these advances and developments, we look forward in the year ahead to building stronger, lasting relationships with our referring physicians and peers in the orthopaedic community nationwide.

A handwritten signature in black ink that reads "L. Scott Levin". The signature is written in a cursive, flowing style.

L. SCOTT LEVIN, MD, FACS

*Chair, Department of Orthopaedic Surgery
Paul B. Magnuson Professor of Bone and Joint Surgery
Professor of Surgery, Division of Plastic Surgery
Medical Director, Penn Musculoskeletal Center*



INNOVATORS

IN ORTHOPAEDIC CARE: The Penn Musculoskeletal Center

“The Penn Musculoskeletal Center is a representation of Penn Medicine, a collaborative institution where physicians, nurses, administrators and technicians work together to optimize care for the patient.”

—**L. Scott Levin, MD, FACS**, Chair, Department of Orthopaedic Surgery; Paul D. Magnuson Professor of Bone and Joint Surgery; Professor of Surgery, Division of Plastic Surgery; Medical Director, Penn Musculoskeletal Center

The Penn Musculoskeletal Center opened in August, 2014 as a single-setting source for the diagnosis, treatment and follow-up for patients with musculoskeletal disorders and trauma. Located on two floors of Penn Medicine University City, a new 150,000 square-foot facility at 3737 Market Street in Philadelphia, the Center is designed to create an ideal environment for integrated, patient-focused musculoskeletal care. To achieve this goal, the Center offers access to a comprehensive array of therapeutic specialties including orthopaedics, rheumatology, physical medicine and rehabilitation, pain medicine, musculoskeletal radiology and their associated services.

“The Musculoskeletal Center was expressly designed to optimize the experience of the patient with musculoskeletal disease,” says L. Scott Levin, MD, FACS, Chair of The Department Orthopaedic Surgery at Penn Medicine, and Medical Director of the Penn Musculoskeletal Center. “Our objective from the first for the Center was to create a single place where all of a patient’s needs could be met, from diagnosis to rehabilitation, with the purpose of reversing the effects of musculoskeletal pathology and eliminating disabilities.”

One Location for Care

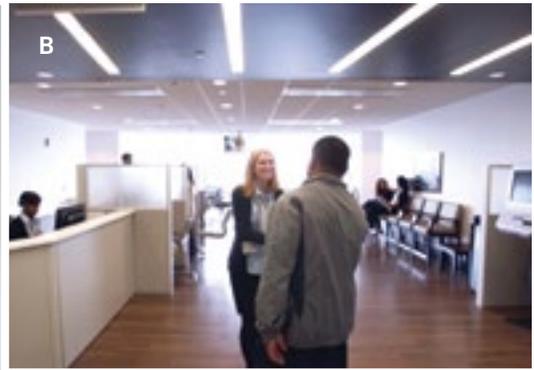
The concept of integrated care in a unified setting has a practical appeal to surgeons like Samir Mehta, MD, the Chief of the Orthopaedic Trauma

“When you’re injured, it’s hard enough to get around the house, let alone be forced to travel to different places to get the care you need,” Dr. Mehta says. “At the Center, it’s all there in a single setting. Patients don’t even have to leave the building.”

With the patient in mind, the emphasis at the Center is on an improved experience to treat a comprehensive range of musculoskeletal disorders, injuries and other conditions affecting bones, joints or muscles.

The Penn Musculoskeletal Center promotes productive interaction between team members. Effective teamwork is an art and a science, involving both cooperative personal relationships, genuine concern for the patient’s well-being and seamless coordination. The importance of these qualities is

(continued on page 4)



(A) Surgery Center, Penn Medicine University City (B) Penn Musculoskeletal Center reception (C) Post-anesthesia care unit

evident when considering the number of potential interactions involved and the diversity of the integrated services available at the Center. Any single patient, for example, might be referred from an initial evaluation to have an x-ray or CT scan in musculoskeletal radiology, or nonoperative therapy by a rheumatologist or physiatrist, or be referred to a spine specialist.

Maximizing Surgical Efficiency

Outpatient orthopaedic surgery is performed at the onsite Surgery Center, located on the fifth floor of Penn Medicine University City.

The Center boasts six brand new operating rooms equipped with the latest surgical and video technology that enable the care teams to deliver the very best patient care, and a staff that has been trained to focus on the patient and family's needs. The surgeons, nurses and staff of the Center are focused on providing minimally invasive orthopaedic procedures that can be appropriately managed in an outpatient facility. The surgeons are all Penn Medicine faculty using the latest techniques and procedures that enable them to deliver the best results.

Patient Experience

Penn Patient Care Coordinators are a new part of the Penn Orthopaedics team at the Penn Musculoskeletal Center to help patients prepare for their visit. If surgery is needed, they will schedule all appointments, review what patients will need prior to surgery and collaborate with the patient and their family to coordinate the discharge plan. It is their job to act as the patient's

advocate, to answer any questions and assist them throughout the process so that the patient can focus on healing.

Upon arrival, patients visiting the Center are escorted by a concierge to dedicated waiting rooms which group patients according to specific conditions. All patient flow areas are organized by particular conditions in common areas, or pods. Thus, on arriving at the Center, patients are directed to the pod relevant to their condition. Within the waiting area for each pod, the patient has access to an array of educational materials including hundreds of videos via Penn Musculoskeletal Center iPads provided to each patient. These materials enable patients to better understand their condition and the treatments available prior to their appointment.

Patients who require imaging services go to the Musculoskeletal Radiology Center, where musculoskeletal radiologists perform digital x-rays, computed tomography (CT) scans, magnetic resonance imaging (MRI scan) and ultrasounds, as needed.

Patients are then evaluated by a specialist to determine or confirm the diagnosis of injury or disease, and an individualized treatment plan is recommended. If the physician would like to consult with a colleague, they are able to do so during the patient's examination. If the patient needs to see another musculoskeletal specialist in the building, they are often able to schedule that appointment on the same day.

If the patient requires outpatient surgery, he or she would receive treatment at the onsite Surgery Center in a following appointment.



(D) Penn Therapy and Fitness Rehabilitation Room (E) Rehabilitation Pool (F) Penn Center for Human Performance

DIAGNOSTIC TOOLS

Within the Penn Center for Human Performance, a variety of diagnostic tools will be available to physicians to help identify the specific nature of the musculoskeletal injury or condition.

Motion Analysis

Neuromuscular Testing

Electromyography (EMG)

Metabolic Measurement System

Maximizing Potential: The Penn Center for Human Performance

Situated within the Penn Musculoskeletal Center, the Penn Center for Human Performance's mission is to provide diagnostics, treatment and rehabilitation for patients seeking to understand their musculoskeletal symptoms, maximize their potential and improve their quality of life.

Here specialists diagnose potential areas of future concern for individuals recovering from musculoskeletal injury or disease or working to improve their performance, provide physical goals and performance targets and guide the patient back to his or her maximum potential by achieving their "personal best." Designed

to permit immediate communication and interaction between physician and patient, the Center offers an extensive clinical evaluation and a range of diagnostic tools to identify the root causes of symptoms or disease progression to assist patients of all abilities to regain their range of motion and level of individual performance. This is especially important to patients whose disease has not progressed to the point of surgical resolution, but remains a source of chronic pain and anxiety.

"The Center for Human Performance takes what has traditionally involved separate processes—patient recovery and physician supervision—and puts them in a single space in a single timeframe," says orthopaedic surgeon Charles L. Nelson, MD. "It allows surgeons to validate therapy with an immediacy not otherwise possible, and to change direction when necessary or offer guidance as the patient is healing from injury or disease."

A Design for Collaboration

While the physical design of the Center lends itself to the type of collaboration described, teamwork is more than architecture. It is a method of recognizing the best potential within an organization for the better care and management of patients—and of achieving a long-term mission to resolve musculoskeletal conditions and restore quality of life. ■

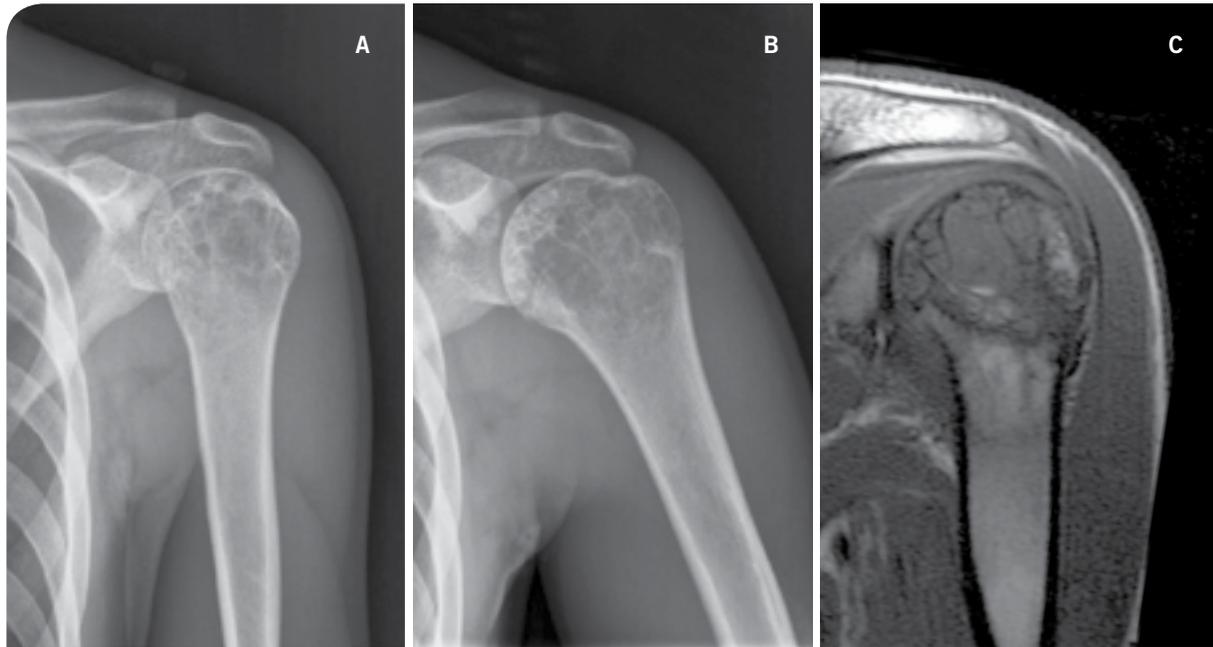
18 year old male patient with clear cell chondrosarcoma of the proximal humerus. A resection of the tumor and reconstruction with cadaveric allograft combined with a partial shoulder replacement (called an allograft-prosthetic composite) was performed.

This particular reconstruction allows the patient to have near normal shoulder range of motion and strength.

(A/B) Preop x-rays

(C) MRI scan of the tumor in a coronal plane

(D) Postop x-ray showing reconstruction



Comprehensive Treatment of Bone and Soft Tissue Sarcoma

The Orthopaedic Oncology Service at Penn Medicine is devoted to the medical and surgical management of benign and malignant tumors of bone and soft tissue.

Bone and soft tissue sarcomas are rare and difficult to diagnose. These cancers include osteosarcoma, Ewing sarcoma and chondrosarcoma, as well as soft tissue malignancies (i.e. undifferentiated pleomorphic sarcoma (UPS), liposarcoma, synovial sarcoma). The care of sarcoma patients requires a team of highly skilled and experienced clinicians, a combination of advanced medical, surgical and technological options, as well as access to new treatments through clinical studies.

In May, 2013, a consortium made up of Penn Medicine, the Abramson Cancer Center, Penn Orthopaedics and the Abramson family partnered to provide the resources for the development of the comprehensive Sarcoma Program at Penn Medicine. It was agreed that the program would have a big vision, and the appointment of Kristy Weber, MD as the program Director was in keeping with this principle. The Abramson Family Professor in Sarcoma Care Excellence at Penn Orthopaedics, Dr. Weber is also Chief of Orthopaedic Oncology and Vice Chair for Faculty Affairs for Penn Orthopaedics.

The vision for the Penn Sarcoma Program entails the development of a strong foundation in basic and translational sarcoma research in order to move scientific discoveries into Phase I clinical trials for sarcoma patients. Achieving this goal involves acquiring new talent, developing collaborative research programs at Penn Medicine, The Children's Hospital of Philadelphia (CHOP), and Penn Veterinary Medicine, and building relationships with other renowned sarcoma programs throughout the United States. This effort is supported by

a number of shared and corresponding resources at Penn.

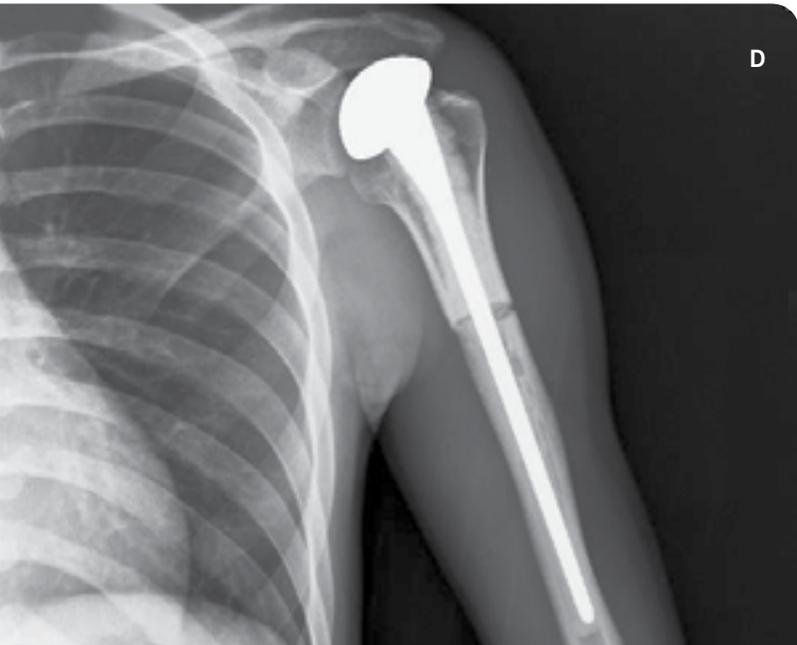
The Foundation: Research

The sarcoma tissue bank at Penn comprises an extensive and robust bio-specimen and data repository. Samples from the tissue bank, as well as from new patients, can be submitted to the Penn Center for Personalized Diagnostics to comprise the foundation for genomic analysis to both identify patient-specific therapeutic targets for treatment and improve outcomes. In addition, physicians and scientists from Penn Medicine, Penn Veterinary Medicine and CHOP gather monthly for a sarcoma research conference to discuss recent clinical trials and advances in diagnostic and treatment strategies.

Recently, four pilot grants were awarded at Penn to investigators pursuing research related to sarcoma. These \$50,000 awards allow new data to be gathered in order to compete for government and foundation funding at a higher level. A sarcoma advocacy group has also been formed from a group of interested patients and families affected by sarcoma and the first fundraising/awareness event is being planned for later this year.

Present and Future World-Class Faculty

The Sarcoma program team is currently expanding. Over the past year, there has been active recruitment of two sarcoma scientists, with a hiring goal of early 2015. Recruitment for an additional senior scientist is currently



underway. The program has also added a musculoskeletal radiologist, Madhura Desai, MD, who has a focused interest in musculoskeletal tumors and leads the imaging aspect of the weekly musculoskeletal tumor conference.

The faculty at the Sarcoma Program at Penn and CHOP are comprised of a multidisciplinary team, to include orthopaedic oncology, medical oncology, pediatric oncology, radiation oncology, musculoskeletal radiology, musculoskeletal pathology, surgical oncology and neurosurgery. Our microvascular plastic surgery team (Stephen J. Kovach III, MD and L. Scott Levin, MD, FACS) provides critical vascularized bone and soft tissue to fill complex defects and facilitate bone healing. Building high level operative teams to take care of the most complex surgical cases such as sacropelvic sarcomas will ensure the best possible treatment despite surgical complexity. ■

GET TO KNOW:

KRISTY WEBER, MD



In October 2013, Penn Sarcoma Program Director Kristy Weber, MD was elected president of the Musculoskeletal Tumor Society (MSTS). Founded in 1977, MSTS is the premier North American society related to the care of patients with musculoskeletal tumors. The organization's primary focus is on surgical treatment of benign and malignant bone and soft tissue tumors and metastatic bone disease.

Dr. Weber's clinical interests include the treatment of patients with bone and soft-tissue tumors, utilizing limb-salvage techniques around the hip, pelvis, knee and shoulder, and her research interests have contributed significantly to the understanding of metastatic bone disease.

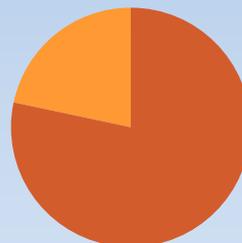
A graduate of the Johns Hopkins University School of Medicine, Dr. Weber continued her training at the University of Iowa, and subsequently completed a fellowship in orthopaedic oncology at the Mayo Clinic. Most recently, Dr. Weber was the Virginia & William Percy Professor of Orthopaedic Surgery and Oncology at Johns Hopkins Medicine, where she also served as the division chief of Orthopaedic Oncology and the director of the Sarcoma program.

More about Sarcoma

- **Approximately 14,000 people are diagnosed with sarcoma in the United States each year, about one percent of total new cancer cases.**

The majority of sarcomas are soft tissue cancers (approximately 11,000). The others are bone cancers.

- **Sarcoma is more common in children and accounts for up to 15% of childhood cancers.**
- **55-60% of soft tissue sarcoma are located in the extremities.**
- **Diagnosing soft tissue sarcomas can be difficult as these tumors often present as a painless lump. Bone sarcomas, however, often present with pain in the bone.**



SARCOMA DIAGNOSES IN THE UNITED STATES ANNUALLY

■ Soft Tissue: ~11,000
■ Bone: ~3,000

- **Sarcoma develops in the connective tissues such as:**
 - Arteries
 - Bone
 - Cartilage
 - Fatty Tissues
 - Fibrous Tissues
 - Muscles
 - Nerves
 - Skin
 - Tendons
 - Veins



Advances in Device Development at Penn Orthopaedics: Sternal Talon for Osteosynthesis in Patients with Sternal Nonunion

Developed by Penn Orthopaedics Chair L. Scott Levin, MD, FACS, the Sternal Talon offers a treatment for patients with sternal nonunion.

Each year, more than 750,000 painful median sternotomies are performed in the United States, primarily for cardiac interventions. Traditionally, following sternotomy, primary repair of the sternum is accomplished using stainless steel wires passed transversely through the bone (cerclage wire fixation). The vast majority of these repairs result in healing without complication. However, as many as 3% of patients will develop sternal nonunion. A condition defined by insufficient healing at the bone-to-bone interface, sternal nonunion may be associated with mediastinitis, chronic pain, wound dehiscence and mechanical instability. In the absence of a secondary repair for nonunion, frequent hospitalizations and severe compromise in quality of life can occur.

As with primary surgery, the goal of secondary sternal nonunion repair is to achieve a durable, mechanically stable restoration of the sternum resulting from osteosynthesis. Traditionally, the standard for secondary sternal repair for nonunion is sternal rewiring. However, nonunion recurrence following sternal rewiring is high and the procedure carries a higher risk of morbidity in older patients.

To improve upon the standard for both primary and secondary sternal nonunion repair, Penn Orthopaedics Chair L. Scott Levin, MD, FACS developed a device at Duke University School of Medicine based upon rigid sternal plating to treat nonunion following median sternotomy. While rigid fixation is the standard of care for almost all bone fixation except post-sternotomy, the technique has been shown to provide high rates of sternal union as well as greater stability, lower pain

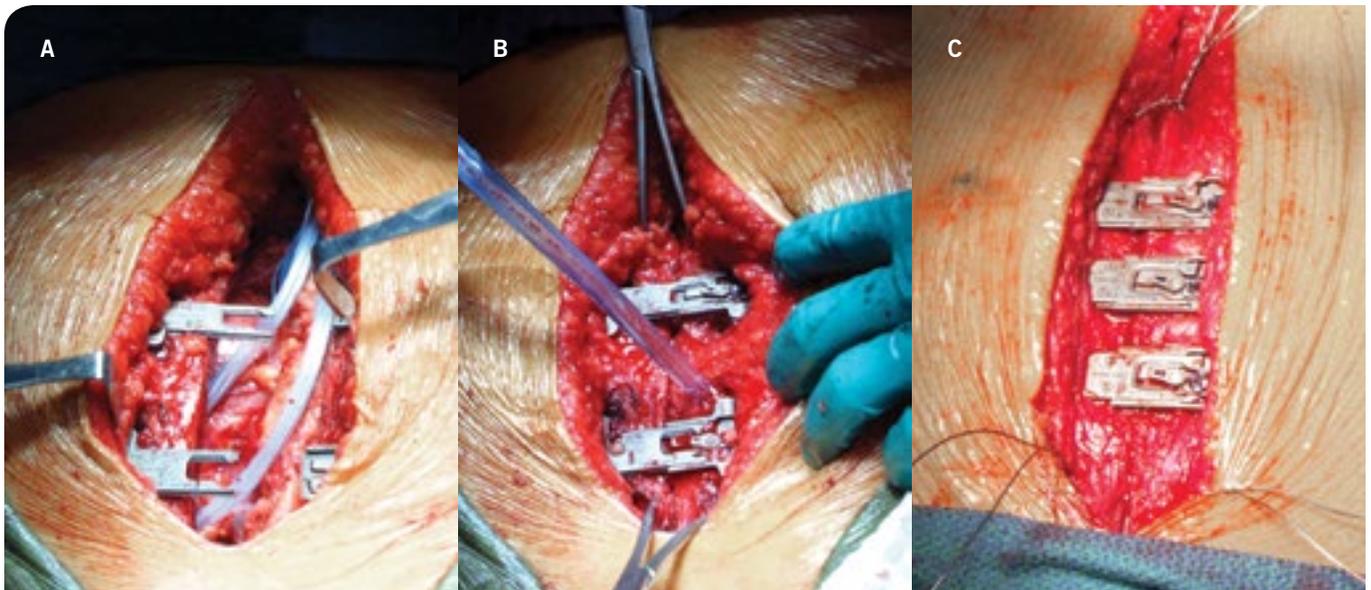
scores and quicker recovery than cerclage wire fixation in cases of sternal nonunion.

Called the Sternal Talon, the new device increases the potential for successful sternal osteosynthesis by drawing the sides of the sternum together and locking them in place to restore the integrity of the bone. The Sternal Talon has previously been studied as an alternative to metal wire suture closure in the primary setting, producing excellent results with low complication and nonunion rates.

Each year, more than 750,000 painful median sternotomies are performed in the United States, primarily for cardiac interventions. As many as 3% of these patients (22,500) will develop sternal nonunion.

Given these favorable initial results and the clear benefit of rigid fixation, a five-year retrospective review of patients who had received the Sternal Talon at both Penn Medicine and Duke was conducted with the objective of evaluating the device for secondary closure of persistent nonunion and/or mediastinitis after previously failed sternal wire closure.

The data gathered included date of median sternotomy, date of Sternal Talon placement, indication for secondary Sternal Talon closure, number of Sternal Talon devices placed,

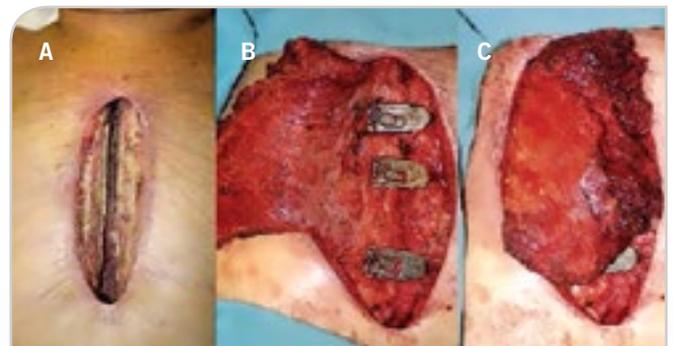


(A) Sternal plates seated in intercostal spaces (B) Plates engaged but not compressed—reduction forceps holding sternum (C) Final compression with plates locked

adjunctive procedures performed during Sternal Talon closure (i.e. pectoralis turnover flap), and any subsequent complications or mortality events after Sternal Talon closure.

The Sternal Talon was placed in all patients to correct sternal nonunion or sternal dehiscence. A total of 24 patients whose medical history involved both Sternal Talon placement after failed wire closure and sufficient follow-up were identified. Some of these patients had been experiencing persistent sternal nonunion for up to 34 months. Among the majority of patients (79.2%), the primary indication for initial median sternotomy with wire closure was coronary artery disease requiring coronary artery bypass grafting (CABG). The average time from initial wire closure to Sternal Talon placement was 12.6 months. The number of devices each patient received was determined by defect size and sternal stability. Of the 24 patients, 17 (70%) received three or more devices.

Overall, 23 of 24 (95.8%) patients eventually achieved sternal union. Among all patients, a 33% complication rate was observed; however, the majority of these events were minor, with only four patients requiring surgical intervention. Although the study population was of insufficient size for any meaningful analysis, these initial retrospective data demonstrate that the Sternal Talon offers a viable option for nonunion in the secondary setting as well as the primary setting. Further study, ideally in the form of a randomized controlled trial, would be required to further define the place of the Sternal Talon in cardiothoracic surgery. ■



A 75-year-old man with a 2-month duration of symptomatic nonunion after coronary artery bypass grafting (CABG). (A) Sternum nonunion. (B) Placement of 3 Sternal Talon devices, reapproximating the sternal bone. (C) Right pectoralis turnover muscle flap for soft tissue coverage of hardware.



A 57-year-old man with sternal nonunion of 1 year duration and epigastric hernia after coronary artery bypass grafting (CABG). (A) Sternal nonunion and epigastric hernia. (B) Placement of 3 Sternal Talon devices and correction of epigastric hernia. Yellow asterisks mark inferior sternum in each image.

Reference // DeLong MR, Hughes DB, Gaca JG, Fischer JP, Bond JE, Hargrove WC, Atluri P, Levin LS, Erdmann D. **Sternal talon offers a solution for secondary sternum osteosynthesis in patients with nonunion.** *Ann Thorac Surg.* 2014 Nov;98(5):1804-8. doi: 10.1016/j.athoracsur.2014.06.048. Epub 2014 Sep 18.



Academics, Research and Clinical Care: Orthopaedic Education at Penn Medicine

The Penn Orthopaedic residency program continues to advance its mission to educate.

The orthopaedic residency program at the University of Pennsylvania has been a prominent leader in the training of orthopaedic surgeons since its inception in 1877 when DeForest Willard, MD became the nation's first Clinical Professor of Orthopaedic Surgery.

The section that Dr. Willard joined was the first free-standing department of orthopaedic surgery in the United States. The list of renowned pioneers and scientists originating from the Department of Orthopaedic Surgery at Penn and its long and storied history continues under the leadership of L. Scott Levin, MD, FACS. Since arriving from Duke University in 2009, Dr. Levin has guided the residency through a period of unparalleled growth.

The tenets of academics, research and clinical care all receive substantial support from the University as well as the Department of Orthopaedic Surgery. As a result, this year Penn received nearly 800 applications for eight highly coveted and competitive orthopaedic residency positions. *US News & World Report* now ranks Penn Orthopaedics #22 in the nation, a rank that will undoubtedly rise in the years ahead with the fulfillment of new programs and new developments.

This year more than 10,000 surgical procedures and 84,000 patient visits took place at Penn Orthopaedics, providing a fertile environment for education and research. Program residents are provided expertise in all subspecialties of orthopaedic surgery. The competencies attained and resulting

publications and presentations put the residency at the top of all these categories. As a result, orthopaedic residents garner elite fellowships throughout the country, joining many fellow Penn graduates who have embarked on academic careers, including a number of department Chairs. The prestigious fellowship program at Penn Orthopaedics, which includes adult reconstruction, foot and ankle, hand and wrist, and shoulder and elbow, is also a highly sought after program for these students.

A Mission to Educate

The education of residents and fellows continues to be a great strength of the Department of Orthopaedic Surgery, one emphasized by the faculty and at the highest levels of the department, including the department chair, vice chairs and division chiefs. This team-wide commitment offers an explanation for the consistent academic success of the department.

Currently there are forty-two orthopaedic residents at Penn. At this point, the continued growth of the department in faculty recruitment and volume has reinforced the need for an additional resident per year. Institutional approval has already been granted for this purpose to support the departmental mission.

Curriculum

Penn Orthopaedics continues to strive for a balanced and well structured core curriculum, and to recognize the value and importance of integrative communication throughout

the residency program. Thus, the academic curriculum is now constructed on an electronic media base accessed by iPads issued to residents upon their arrival at Penn—a technology that has been enthusiastically embraced and integrated into the daily activities of every resident. Each resident has the ability to locate all department activities, read journals for journal clubs and review lectures, and communicate directly with fellows, peers and educators from his or her dedicated Penn Orthopaedics iPad.

Currently, the curriculum is run on two year cycles and covers all orthopaedic specialties. Grand rounds are required and take place every Thursday morning with four continuous hours of protected educational time. Additionally, each subspecialty delivers at least one academic didactic session each week. These morning conferences are comprised of faculty within the division, fellows, residents and students (Penn and visiting) and are reviewed, critiqued and discussed with each division chief in order to maintain updated goals and objectives for each section.

The visiting professor lecture series occurs each month. These sponsored and named sessions are comprised of renowned national and international faculty representing the spectrum of orthopaedic subspecialties. This year, for example, David Ruch, MD was the Leo Leung Lecturer for the hand surgery section. The Leo Leung lectureship was established in memory of Dr. Leung, an orthopaedic surgery resident at Penn who passed away suddenly in 2002. His colleagues and mentors founded the lectureship to honor his dedication to research and learning. Dr. Ruch is a professor of orthopaedic surgery and Chief of the Hand Surgery Service at Duke University Medical School. During his visit at Penn, Dr. Ruch led a cadaveric demonstration of elbow arthroscopy, led Grand Rounds with lectures on the avoidance of complications in the management of distal radius fractures and traumatic elbow instability.

In addition to visiting faculty, our residents and fellows are encouraged to attend numerous off-site courses to enhance their learning each year, and to pursue global outreach programs. The current affiliation has been with clinics in Nicaragua with up to four residents participating with faculty support each year.

Meeting the Standard for Sound Surgical Principles

While the main mission of the residency program at Penn Orthopaedics is education, the evaluation of our residents is even more critical. The department provides a strong mentorship program which pairs faculty to incoming trainees, and all active faculty are required to evaluate each resident regarding knowledge and professionalism. Newly developed milestone evaluations are now electronically documented. Evaluations are submitted to the Clinical Competency Committee (CCC), which is comprised of the chairman, program director and assistants, and a faculty member of



L. Scott Levin, MD, FACS instructs Penn Orthopaedics residents at The Children's Hospital of Philadelphia

each division. Careful and meaningful evaluations are then documented with respect to each resident's academic and professional growth and recommendations are made regarding their advancement in the program. This newly developed CCC has been invaluable to real time evaluation of residents for promotion or remedial work.

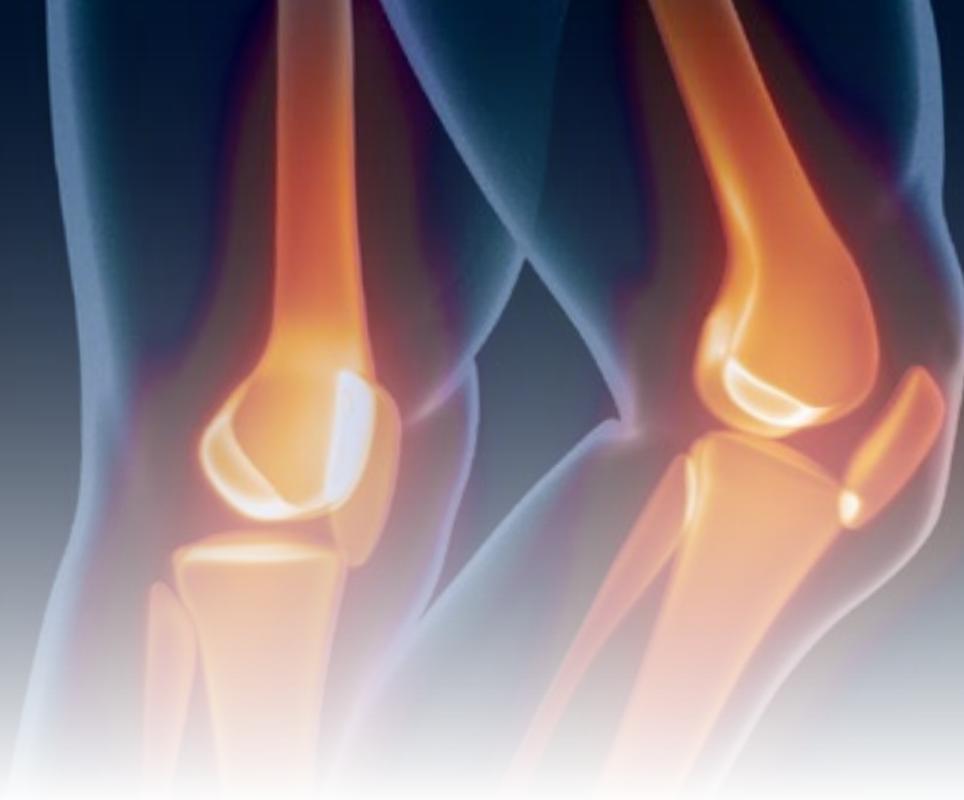
Finally, and perhaps the best measure of our residency program, is the opportunities afforded to our graduating residents. Our residents are coveted by the most prestigious fellowship programs in the country with the vast majority receiving their first choice of fellowship. Beyond that, many fellows who complete residencies at Penn now serve in academic departments across the nation as well as here at Penn. ■

Contributors // David J. Bozentka, MD and Craig Israelite, MD

Penn Orthopaedics Fellowship Programs

Penn Orthopaedics has been training academic surgeons for more than a century, a tradition continued in the current postdoctoral fellowship programs for physicians wishing to train in specific sub-specialties. These are highly competitive programs, and have the mission of furthering clinical expertise, scientific development and therapeutic progress. Fellowships are currently available in adult reconstructive surgery, foot and ankle surgery, hand surgery and shoulder and elbow surgery.

>>> For more information about fellowships at Penn Orthopaedics, visit www.uphs.upenn.edu/orthopaedics/education/fellowship



Bilateral Staged Total Knee Arthroplasty: A Safe Alternative to Simultaneous TKA?

The timing of bilateral total knee arthroplasty (TKA) remains an issue in the orthopaedic community, with clinical journals regularly reporting the respective advantages and deficits of both simultaneous TKA and TKA performed as a staged procedure generally three or more months apart. Safety is among the chief concerns for surgeons performing TKA, but to date, these reports have demonstrated no clear-cut advantage for either simultaneous or staged bilateral TKA provided that the patients do not have excessive pre-existing cardiac or pulmonary disease.

The controversy arising from the timing of bilateral total knee arthroplasty (TKA) has become a point of contention in the orthopaedic community, in part because both staged and simultaneous bilateral TKA have distinct advantages. Simultaneous bilateral TKA is seen as the preferred option for patients with severe bilateral disease and deformities or contractures which would severely compromise post-operative rehabilitation or younger patients, particularly those remaining in the workforce, who may benefit from a single hospital stay and recovery and less time out of work. Staged bilateral TKA is seen as an option most beneficial for patients with advanced degenerative joint disease of both knees who have medical comorbidities that might put them at excessive risk during simultaneous bilateral TKA. In addition, for patients whom are not candidates for blood transfusion such as Jehovah's Witnesses, most surgeons favor staging TKAs with a sufficient interval to restore a normal Hgb/Hct level prior to the second TKA procedure to decrease risk for the patient.

The ideal timing of such staging, however, has not been determined, but for some surgeons a period of three or more months has been preferred. For patients for whom simultaneous bilateral TKA is preferable (due to severe deformity or contractures, or for the patient for work or personal reasons),

but whom the risk of bilateral simultaneous TKA may be excessive (due to advanced age or underlying major medical comorbidities), staged bilateral TKA at a one week interval is another option. One potential safety advantage of staged bilateral TKA one week apart compared with simultaneous bilateral TKA is the ability to postpone the second procedure should the patient experience difficulties or unforeseen complications after the first TKA.

Few studies have addressed the safety of staged bilateral TKA one week apart, but those that have demonstrated equal or improved safety compared with simultaneous bilateral TKA. To clarify the issue, Penn Orthopaedics surgeons recently performed a retrospective, comparative, match-controlled study involving a consecutive series of 234 patients having either a simultaneous or staged bilateral TKA over a five-year period compared to a control group of unilateral TKA patients matched for age and medical comorbidities. The primary purpose of this study was to determine if patients with bilateral knee osteoarthritis selected to have a staged procedure at a one-week interval had statistically different rates of complications compared to patients having a unilateral TKA or a simultaneous bilateral surgery.

>>> Side by Side Comparison:

Bilateral Total Knee Arthroplasty Staged One Week Apart & Simultaneous Bilateral TKA

Use of matched controls within a single institution addresses a few of the issues that have hampered clinical studies of bilateral TKA, particularly the lack of genuinely comparative data between patient populations. The classification and stratification of post-surgical complications were based upon definitions from the TKA Complications Workgroup of the Knee Society.

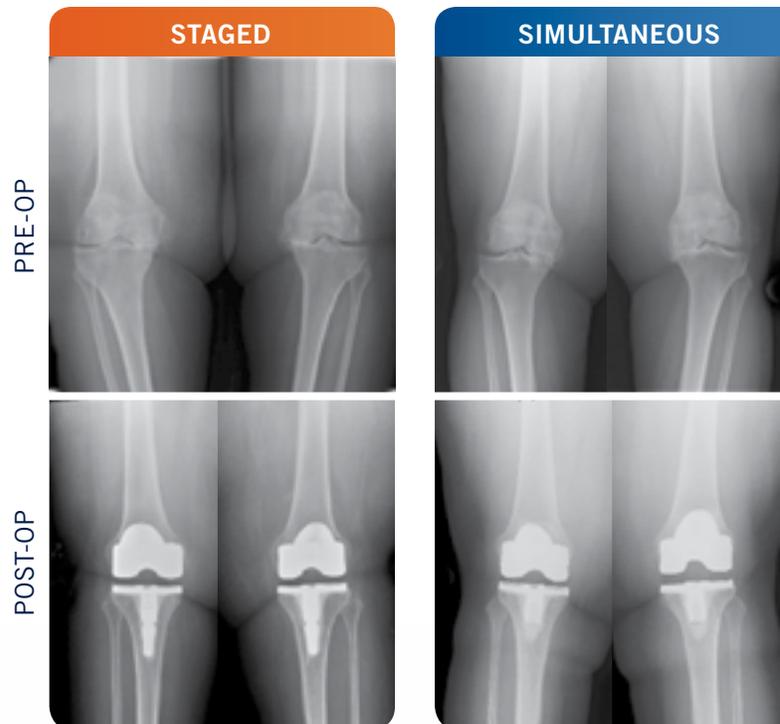
Following statistical analysis, the authors of the study found no statistically significant difference among the three groups with regard to perioperative complications, major grade IV complications, one-year complication rates or 90-day readmissions (see Table 1) and concluded that in selected patients with bilateral knee OA, TKA staged at a one-week interval is a safe alternative to simultaneous bilateral TKA.

Complications (%)	Unilateral (n = 131)	Staged (n = 131)	Simultaneous (n = 103)	P value
Perioperative Complication	9 (7)	13 (10)	14 (14)	0.231
One-year Complication	19 (15)	19 (15)	20 (19)	0.512
90-Day Readmission	5 (4)	10 (8)	4 (4)	0.295

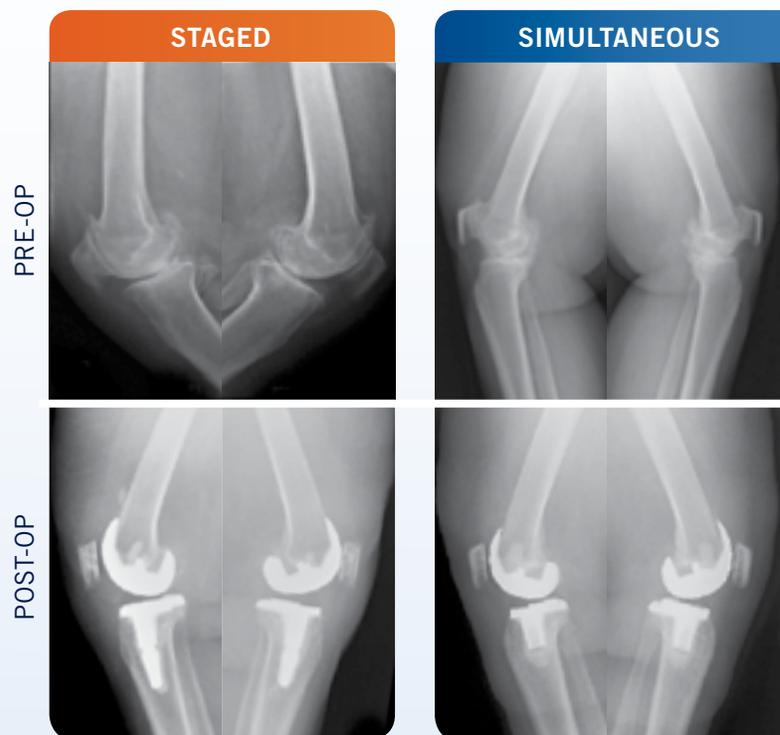
It is important to note that the demographic characteristics of patients within the indicated populations for bilateral staged and simultaneous procedures vary by age and health status. Surgeons are much more likely to select younger, healthier patients to undergo a simultaneous operation. To sustain the greater intraoperative time required of simultaneous procedures, patients must have sufficient cardiac, pulmonary and vascular health, as well as the strength, to undergo symmetrical rehabilitation. In the Penn study, the authors' data confirm this, as the simultaneous group was younger and had lower ASA scores, Charlson Comorbidity Index, and BMI than their peers in the staged group.

Bilateral TKA surgery is generally indicated for advanced, equivalent degenerative osteoarthritis in both knees. Simultaneous bilateral and staged bilateral TKA offer different sets of advantages and drawbacks to the surgeon and patient. Staging the procedure a week apart is an attractive option for patients with advanced degenerative disease and deformities of both knees who desire a single rehabilitation period, particularly for those with medical comorbidities precluding a simultaneous operation. Though further study is needed to determine optimal stage timing, bilateral TKA staged one week apart should be considered a safe option for patients. ■

Anterior View



Lateral View



The Role of Local NSAID Administration in Tendon Healing

The biomechanics and histology of tendon composition, healing and repair are focal research missions at the McKay Orthopaedic Research Laboratory at Penn Medicine. In 2014, researchers at the McKay Lab investigated systemic nonsteroidal anti-inflammatory drugs (NSAIDs), specifically ibuprofen, to determine the effects of the drug on tendon healing.

Ibuprofen is a nonselective cyclooxygenase inhibitor and perhaps the most common nonsteroidal anti-inflammatory drug (NSAID) remedy for moderate muscle and joint pain and inflammation in the United States. Despite the analgesic benefits of NSAIDs, recent reports suggest that the drugs have the potential to negatively influence bone remodeling through inhibition of prostaglandin synthesis.

The effects of nonselective NSAIDs on tendon healing remain unclear, however. In vitro studies have demonstrated that NSAIDs may inhibit tendon cell migration and proliferation. In animal studies, NSAIDs have been shown to inhibit tendon-to-bone healing via suppression of the formation and maturation of collagen at the tendon insertion site. More recently, the findings from a scattering of studies reveal an association between time of NSAID administration and tendon healing. These reports suggest that NSAIDs may be detrimental to early tendon healing, but that these negative effects can be avoided if the drugs are administered later in the repair process.

This study suggests that timing is critical to adequate tendon healing. Early administration of ibuprofen in the postoperative period was detrimental to tendon healing, while delayed administration did not affect tendon healing.

To evaluate this premise, a team of investigators at Penn and the Translational Musculoskeletal Research Center of the Philadelphia VA Medical Center initiated a study in an animal model to evaluate the biomechanical and histologic effects of systemic ibuprofen administration on tendon healing when delivered immediately (for only the first week



after surgery) or in a delayed fashion (for only the second week after surgery), compared to a control group that received no ibuprofen therapy. The principal investigators of the study comprised researchers from the McKay Laboratory and Penn Orthopaedics specialists, who together perform hundreds of tendon surgeries each year.

Tendon injury was produced in rats via bilateral supraspinatus detachment and repair. The rats were then divided into groups and given ibuprofen orally for either Days 0 to 7 (early) or Days 8 to 14 (delayed) after surgery; a control group did not receive ibuprofen. Healing was evaluated at 1, 2 and 4 weeks post-surgery through biomechanical testing and histologic assessment.

Study results seemed to confirm that tendon healing was affected by the time of NSAID administration. When biomechanical evaluations were performed at 4 weeks post-surgery, rats receiving early ibuprofen delivery were found to have decreased stiffness and modulus (measures of strength and elasticity, respectively), as well as decreased maximal load and maximal stress when compared to the control group. There were no differences, however, between the delayed ibuprofen group and the control group. Histology confirmed mechanical results with reduced fiber reorganization over time in the early ibuprofen group.

This study suggests that timing is critical to adequate tendon healing. Early administration of ibuprofen in the postoperative period was detrimental to tendon healing, while delayed administration did not affect tendon healing. The authors note that in addition to informing future clinical studies focused on post-surgery drug protocols, this work could have implications for individuals who self-medicate after smaller-level injuries and for overuse or repetitive fatigue injuries resulting from accumulation of low-level damage in the tendon. Based on the study, abuse of this widely available drug could exacerbate or accelerate the progression of small-level injuries. Further study in this area is warranted to confirm these effects in humans. ■

PENN ORTHOPAEDICS SPECIALTY HIGHLIGHTS

Penn Orthopaedics provides patients with the most advanced comprehensive diagnostic, surgical and rehabilitative treatments in nine specialties. The following are recent highlights from each specialty—including the renowned McKay Orthopaedic Research Laboratory and The Children’s Hospital of Philadelphia (CHOP).



10 LOCATIONS



71 FULL-TIME
CLINICAL/RESEARCH/
CHOP FACULTY



10,832 TOTAL CASES



84,526 PATIENT VISITS

>> Foot and Ankle

- In conjunction with L. Scott Levin, MD, FACS, the Foot and Ankle service continues to develop methods of utilizing vascularized bone grafts for the salvage of failed fusions and reconstruction techniques in the face of avascular necrosis.
- A novel Z cut calcaneal osteotomy has been developed for reconstruction of the acquired flat foot secondary to Posterior Tibial Tendon dysfunction. This allows for lateral column lengthening and medial displacement of the calcaneus through one incision rather than requiring two separate incisions.
- In conjunction with the Department of Radiology, the Foot and Ankle service is conducting research with the use of a new weight bearing CAT scan to better define the impact of structural changes in the foot and ankle following reconstructive surgery.

Selected Articles // Mao, H, Shi, Z, Yin, W, Dong, W, Wapner, K, **Reconstruction of Great Toe Soft-Tissue Defect with the Retrograde-Flow Medial Pedis Island Flap.** *Plast Reconstr Surg.* 134(1):120e-127e, July 2014. // Asai S1, Otsuru S, Candela ME, Cantley L, Uchibe K, Hofmann TJ, Zhang K, Wapner KL, Soslowsky LJ, Horwitz EM, Enomoto-Iwamoto M. **Tendon Progenitor Cells in Injured Tendons Have Strong Chondrogenic Potential: The CD105-Negative Subpopulation Induces Chondrogenic Degeneration,** *Stem Cells.* Dec;32(12):3266-77, 2014. // Mao H1, Shi Z, Wapner KL, Dong W, Yin W, Xu D., **Anatomical study for flexor hallucis longus tendon transfer in treatment of Achilles tendinopathy.** *Surg Radiol Anat.* Dec 27, 2014.



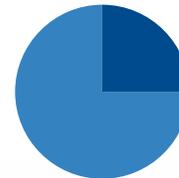
Section Chief:

Keith L. Wapner, MD

2014 PATIENT VISITS:
15,178

**2014 PATIENT SURGICAL
VOLUMES:** 1,048

■ Inpatient: 263
■ Outpatient: 785



>> Hand and Wrist

- The Hand and Wrist service has partnered with the Children’s Hospital of Philadelphia and Shriners Hospitals for Children in preparation for a bilateral hand transplant in a pediatric patient.
- The Hand and Wrist service participates as a site for a NIH supported multi-center study involving the treatment of distal radius fractures in the elderly.
- L. Scott Levin, MD, FACS has been named co-director of the United Network for Organ Sharing Vascularized Composite Allograft committee. In addition, Dr. Levin is the recipient of the I.S. Ravdin Master Clinician Award. The award recognizes an active master clinician who is a skillful, compassionate practitioner with a long and consistent record of contributions to the Perelman School of Medicine and Penn Medicine.
- David Steinberg, MD is involved in bench research evaluating tendon healing with systemic and local delivery of non-steroidal anti inflammatory drugs. Dr. Steinberg also lectured on replantation at the Pennsylvania Orthopedic Society meeting in Pittsburgh, PA in October. David Bozentka, MD is involved in a clinical study using ultrasound to evaluate wrist instability. He has lectured at the Argentina Association of Hand Surgery annual meeting in Buenos Aires, Argentina in October.

Selected Articles // Park MJ, Gans I, Lin I, Levin LS, Bozentka D, Steinberg D. **Timing of forearm arterial repair in the well-perfused limb.** *Orthopedics.* 2014 Jun;37(6):e582-6. // Haddock NT1, Chang B, Bozentka DJ, Steinberg DR, Levin LS. **Technical implications in proximal forearm transplantation.** *Tech Hand Up Extrem Surg.* 2013 Dec;17(4):228-31. doi: 10.1097/BTH.000000000000025. // Levin LS, et al **Attitudes towards Vascularized Composite Allotransplantation of the Hands and Face in an Urban Population.** (Accepted for publication – Vascularized Composite Allotransplant). October 2014. // Levin LS **Management of Soft Tissue Defects of the Hand.** (Submitted for publication *Journal of Hand Surgery* (December 2014).



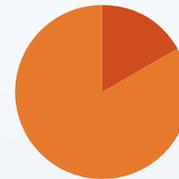
Section Chief:

David J. Bozentka, MD

2014 PATIENT VISITS:
12,409

**2014 PATIENT SURGICAL
VOLUMES:** 1,533

■ Inpatient: 259
■ Outpatient: 1,274



>> Joint Replacement

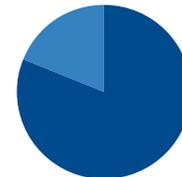
- Penn Orthopaedics continues to be designated as a Blue Distinction Center of Excellence: Hip and Knee Program and remains accredited by The Joint Commission as a disease specific Hip Program and Knee Program.
- Between 2012 and 2014, Penn Orthopaedics expanded from four to seven Adult Reconstruction surgeons providing comprehensive management of hip and knee problems from hip and knee preservation to complex revision surgery.
- In 2014, Penn Orthopaedics held the 2nd Annual Philadelphia Revision Hip and Knee CME Course in partnership with the International Congress for Joint Replacement. Leaders from across the country joined the Penn faculty in a two-day didactic and hands-on cadaveric course designed to improve surgeon's knowledge and skills in caring for patients with failed hip and knee replacements.



Section Chief:
Charles L. Nelson, MD

2014 PATIENT VISITS:
22,949

2014 PATIENT SURGICAL VOLUMES: 3,533



■ Inpatient: 2,872
■ Outpatient: 661

Selected Articles // Nelson, CL, Jones, RB, Wingert, N, Foltzer, MA, Bowen, TR. **Sonication of antibiotic spacers predicts failure during two-stage revision for prosthetic knee and hip infections.** Clin Orthop Rel Res, 472: 2208-2214, 2014. // Courtney, PM, Melnic, C, Shah, R, Alosk, H, Nelson, CL, Israelite, CL. **Is Bilateral Total Knee Arthroplasty Staged at One-week Interval Safe? A Matched Cohort Study.** Epub ahead of print, J Arthrop. May, 2014. // Basu, S, Kwee, TC, Saboury, B, Garino, JP, Nelson, CL, Zhuang, H, Parsons, M, Chen, W, Kumar, R, Salavait, A, Werner, TJ, Alavi, A. **FDG PET for Diagnosing Infection in Hip and Knee Prostheses. Prospective study in 221 prostheses with subgroup comparison with combined 111In-labeled leukocytes and 99mTc-Sulfur Colloid Bone Marrow Imaging in 88 patients.** Clin Nucl Med, 39: 609-14, 2014. // Wu CH, Gray CF, Lee GC. **Arthrodesis should be strongly considered after failed two stage reimplantation TKA.** Clin Orthop Relat Res; Feb 2014 [Epub ahead of print]. // Courtney PM, Whitaker CM, Gutsche JT, Hume EL, Lee GC. **Predictors of the need for critical care after total joint arthroplasty: an update on our institutional risk stratification model.** J Arthroplasty; Mar 2014 [Epub ahead of print]. // Alosk H, Kamath AF, Baldwin KD, Keenan M, Lee GC. **Outcomes of total hip arthroplasty in spastic patients.** J Arthroplasty; Mar 2014 [Epub ahead of print].

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>> Neuro-Orthopaedics

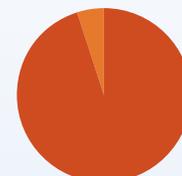
- In collaboration with the Joint Replacement, Trauma, and plastic surgery faculty, the Neuro-Orthopaedics service provides high level care to neuro-orthopaedic populations including tendon releases/transfers, nerve transposition, total joints and osteotomies in one surgical episode.
- The Neuro-Orthopaedics service has been collecting patient related outcomes, clinical photos and gait videos to share with the patients as before and after evidence to document patient related outcomes. Additional, faculty have been working in the new Penn Gait and Biomechanics Laboratory to provide high quality diagnostic services to gait disorders which guide treatment in a very systematic way.
- In the near future, we look to transitioning to new clinic space at the new Penn Neuroscience Center to work closely with the neurology faculty to provide high level collaborative neuro-orthopaedic care.



Section Chief:
Keith D. Baldwin, MD,
MPH, MSPT

2014 PATIENT VISITS:
762

2014 PATIENT SURGICAL VOLUMES: 327



■ Inpatient: 311
■ Outpatient: 16

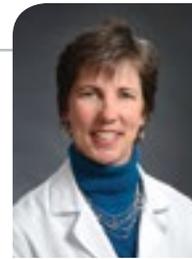
*Includes volume from
The Children's Hospital
of Philadelphia

Selected Articles // Alosk H, Kamath AF, Baldwin KD, Keenan M, Lee GC. **Outcomes of total hip arthroplasty in spastic patients.** J Arthroplasty. 2014 Aug;29(8):1566-70. doi: 10.1016/j.arth.2014.03.005. Epub 2014 Mar 13. // Ruzbarsky JJ, Beck NA, Baldwin KD, Sankar WN, Flynn JM, Spiegel DA. **Risk factors and complications in hip reconstruction for nonambulatory patients with cerebral palsy.** J Child Orthop. 2013 Dec;7(6):487-500. doi: 10.1007/s11832-013-0536-1. Epub 2013 Oct 15. // Namdari S, Baldwin K, Horneff JG, Keenan MA. **Orthopedic evaluation and surgical treatment of the spastic shoulder.** Orthop Clin North Am. 2013 Oct;44(4):605-14. doi: 10.1016/j.ocl.2013.06.012. Epub 2013 Aug 1. Review. // Baldwin K, Yannascoli SM, Namdari S, Spiegel DA, Keenan MA. **What's new in orthopaedic rehabilitation?** J Bone Joint Surg Am. 2013 Nov 20;95(22):2071-7. doi: 10.2106/JBJS.M.01037. Review. No abstract available.

>> Orthopaedic Oncology

- The Orthopaedic Oncology service continues to see patients of all ages with musculoskeletal tumors and other lesions in the Abramson Cancer Center, utilizing a multidisciplinary, team-based approach including the Multidisciplinary Sarcoma Conference (a weekly meeting of providers from seven departments to discuss patient care).
- Kristy L. Weber, MD was elected President of the Musculoskeletal Tumor Society (MSTS), Chair of Fellowship Milestones of the Working Group for Orthopaedic Oncology, and endowed Chair of the Abramson Family Professorship in Sarcoma Care Excellence, and was added to the faculty of Philadelphia Multidisciplinary Bone/Soft Tissue Tumor Course and the faculty of ICL at 2014 and 2015 AAOS meeting on TeamSTEPS™ Training. Dr. Weber also completed the national update of the Appropriate Use Criteria topic of 'Treatment of Bone Metastasis' as part of the working group for the American College of Radiology.
- The service is preparing to open a clinical trial shortly for patients with inoperable PVNS (pigmented villonodular synovitis)—an aggressive process that affects joint synovium. Penn will be one of two US sites.

Selected Articles // Sanders J, Bozic K, Glassman SD, Jevsevar DS, Weber KL: **Clinical Practice Guidelines: Their use, misuse and future directions.** *J Amer Acad Ortho Surg* 22:135-144, 2014. // Weber KL: **Musculoskeletal Oncology and Systemic Disease (Section Editor) In AAOS Comprehensive Orthopaedic Review – 2nd Ed,** M Boyer (ed), AAOS, (2014).

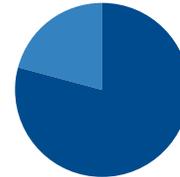


Section Chief:
Kristy L. Weber, MD

2014 PATIENT VISITS:
961

2014 PATIENT SURGICAL VOLUMES: 131

■ Inpatient: 104
■ Outpatient: 27



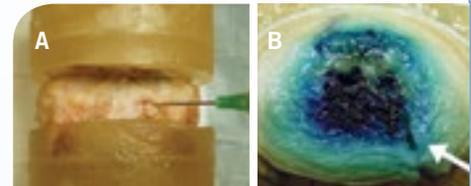
>> Research

- Lou Soslowsky, PhD was appointed to the Editorial Board for Matrix Biology.
- Robert L. Mauck, PhD was the recipient of the 2015 Kappa Delta Young Investigator Award from the American Academy of Orthopaedic Surgeons
- In collaboration with Robert L. Mauck, PhD, Lachlan Smith, PhD received a 4 year, \$1.1 million VA Merit Grant to develop and conduct preclinical evaluation of minimally invasive therapeutics for intervertebral disc degeneration and low back pain.
- Eileen Shore, PhD was elected Program Chair of Basic Science for the American Society of Bone and Mineral Research (ASBMR) at their Annual Meeting in Houston, Texas.
- Robert Pignolo, MD, PhD initiated the first randomized, placebo-controlled clinical trial for episodic treatment of Fibrodysplasia Ossificans Progressiva entitled "A Phase II Clinical Trial of a Novel RAR-Specific Agonist (Palovarotene) in the Treatment of Preosseous Flare-ups in Adults who Have Fibrodysplasia Ossificans Progressiva."
- Foteini Mourkioti, PhD developed a technique to measure telomere length in a cell-type specific manner in diseased cardiac sections that will allow us to identify other cardiomyopathies with telomeric defects.
- Xiaowei (Sherry) Liu, PhD received her first NIH funding (NIH R03) to study lactation related bone recovery.

Selected Articles // Beason, D.P.; Tucker, J.J.; Edelman, L.; Lee, C.S.; Abboud, J.A.; Soslowsky, L.J.; **Rat Rotator Cuff Tendon-to-Bone Healing Properties are Adversely Affected by Hypercholesterolemia,** *J Shoulder Elbow Surg*, 23(6):867-72, 2014. (PMCID 4029875) // Connizzo BK, Yannascoli SM, Tucker JJ, Caro AC, Riggan CN, Mauck RL, Soslowsky LJ, Steinberg DR, Bernstein J.: **The Detrimental Effects of Systemic Ibuprofen Delivery on Tendon Healing Are Time-Dependent,** *Clin Orthop Relat Res.*, 472(8):2433-9, 2014. (NIHMS 573832) // Dunkman AA, Buckley MR, Mienaltowski MJ, Adams SM, Thomas SJ, Kumar A, Beason DP, Iozzo RV, Birk DE, Soslowsky LJ. **The Injury Response of Aged Tendons in the Absence of Biglycan and Decorin,** *Matrix Biol*, 35:232-8, 2014. (PMCID 3994176). // Smith LJ, Gorth DJ, Showalter BL, Chiaro JA, Beattie EE, Chen W, Elliott DM, Mauck RL, Malhotra NR. (2014) **In Vitro Characterization of a Stem Cell-Seeded Triple Interpenetrating Network Hydrogel for Functional Regeneration of the Nucleus Pulposus.** *Tissue Engineering: Part A.* 20:1841-9. // Chiaro JA, O'Donnell P, Shore EM, Ponder KP, Malhotra NR, Haskins ME, Smith LJ. (2014) **Effects of Neonatal Enzyme Replacement Therapy and Simvastatin Treatment Cervical Spine Disease in Mucopolysaccharidosis I Dogs.** *Journal of Bone and Mineral Research.* In press. // Brennan, TA, Egan, KP, Lindborg, CM, Chen, Q, Sweetwyne, MT, Hankenson, KD, Xie, SX, Johnson, FB, Pignolo, RJ (2014) **Mouse models of telomere dysfunction phenocopy skeletal changes found in human age-related osteoporosis.** *Disease Models & Mechanisms* (2014) 7:583-592. // Martin TJ, Milby AH, Chiaro JA, Kim DH, Hebel NM, Smith LJ, Elliott DM, Mauck RL, **Translation of an Engineered Nanofibrous Disc-like Angle Ply Structure for Intervertebral Disc Replacement in a Small Animal Model,** 2014, *Acta Biomaterialia*, 10(6):2473-81.



Section Chief:
Louis J. Soslowsky, PhD



TRIPLE-NETWORK HYDROGEL FOR NUCLEUS PULPOSUS REGENERATION:

(A) Injection of the hydrogel into the NP of an L5-S1 human intervertebral disc using a 19-gauge needle, following creation of a nucleotomy defect. (B) Macroscopic evaluation of an axially bisected disc following 10,000 cycles of loading in axial compression at 2Hz between applied stresses of 0.12 and 0.96 MPa, which correspond to 0.25 and 2 times body weight. No evidence of hydrogel (blue) extrusion was observed through the annular defect (arrow) used to create the nucleotomy, and the hydrogel appeared well-integrated with the native tissue.

>> Shoulder and Elbow

- Close collaboration with researchers from the McKay Research Lab help to form one of the largest, shoulder research laboratories in the world.
- The Shoulder and Elbow service was the recipient of a variety of research grants in 2014, including NIH, Veterans Affairs, health system and industry grants.
- Penn Shoulder and Elbow faculty presented 23 talks at international, national, regional and local organizations and meetings in 2014.
- Faculty also participated in a number of national committees in 2014, including the Arthroscopy Association of North America (education and research); the American Academy of Orthopaedic Surgeons subcommittee (2011-2015); American society for shoulder and elbow therapists and the Accreditation Committee for Graduate Medical Education (nationally accredited fellowship).
- Two members of the Penn Shoulder and Elbow faculty have served as president of the American Society of Shoulder and Elbow Therapists.
- The Penn Shoulder and Elbow faculty published 13 articles in peer-reviewed journals in 2014.

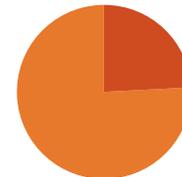
Selected Articles // Hsu JE, Namdari S, Baron M, Kuntz AF, Abboud JA, Huffman GR, Williams GR, Glaser DL. **Glenoid perforation with pegged components during total shoulder arthroplasty.** Orthopedics. 2014 Jun;37(6):e587-91. // Reuther KE, Thomas SJ, Tucker JJ, Sarver JJ, Gray CF, Rooney SI, Glaser DL, Soslowsky LJ. **Disruption of the anterior-posterior rotator cuff force balance alters joint function and leads to joint damage in a rat model.** J Orthop Res. 2014 May;32(5):638-44. // Blonna D, Huffman GR, O'Driscoll SW. **"Delayed onset ulnar neuritis after release of elbow contracture: Clinical presentation, pathology and treatment."** Am J Sports Med 33 (2014). // Thomas SJ, Reuther KE, Tucker JJ, Sarver JJ, Yannascoli SM, Caro AC, Voleti PB, Rooney SI, Glaser DL, Soslowsky LJ. **Biceps detachment decreases joint damage in a rotator cuff tear rat model.** Clin Orthop Relat Res. 2014 Aug;472(8):2404-12. doi: 10.1007/s11999-013-3422-8. // Reuther KE, Thomas SJ, Tucker JJ, Yannascoli SM, Caro AC, Vafa R, Kuntz AF, Soslowsky LJ. **Scapular Dyskinesia is Detrimental to Shoulder Tendon Properties and Joint Mechanics in a Rat Model.** J Orthop Res 2014 Nov;32(11):1436-43. PMID: 25070580 // Riggan CN, Tucker JJ, Soslowsky LJ, Kuntz AF. **Intra-Articular Tibiofemoral Injection of a Nonsteroidal Anti-Inflammatory Drug has no Detrimental Effects on Joint Mechanics in a Rat Model.** J Orthop Res 2014 Nov;32(11):1512-9. PMID: 24981310 // Reuther KE, Thomas SJ, Tucker JJ, Vafa RP, Gordon JA, Liu SS, Caro AC, Yannascoli SM, Kuntz AF, Soslowsky LJ. **Overuse Activity in the Presence of Scapular Dyskinesia Leads to Shoulder Tendon Damage in a Rat Model.** Ann Biomed Eng. 2014 Sep 30. [Epub ahead of print] PMID: 25266934.



Section Chief:
David L. Glaser, MD

2014 PATIENT VISITS:
10,029

2014 PATIENT SURGICAL VOLUMES: 971



■ Inpatient: 235
■ Outpatient: 736

>> Spine

- Harvey Smith, MD, was the recipient of a career development award presented by the Veteran's Affairs (VA) Medical Center, elected to the FDA panel for Orthopaedic Rehabilitation and Devices and was selected and participated in the United States Bone and Joint young investigators initiative program.
- Over the past two years, the Veteran's Affairs (VA) Medical Center has been elected as the regional referral center and is now where all regional spine VA cases are sent for care by the Penn Orthopaedics Spine service
- Penn Orthopedics has become a reference center for complex spine and spinal deformities with 450 spine operations in 2014 (including 100 cases of adult scoliosis).
- The Spine service performed the most cervical disc replacements in Pennsylvania.
- The Spine service was the recipient of a \$2 million grant to study intervertebral disc regeneration.
- Faculty from the Spine service completed medical missions in Trinidad to perform surgery for children with complex spinal deformities.

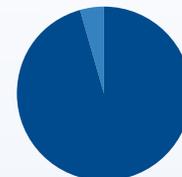
Selected Articles // Arlet V. **Spinal osteotomy in the presence of massive lumbar epidural scarring.** Eur Spine J. 2014 Nov 27. 25427670 // Reames DL, Kasliwal MK, Smith JS, Hamilton DK, Arlet V, Shaffrey CI. **Time to Development, Clinical and Radiographic Characteristics, and Management of Proximal Junctional Kyphosis Following Adult Thoracolumbar Instrumented Fusion for Spinal Deformity.** J Spinal Disord Tech. 2014 Jul 29. 25075994 // Awwad W, Al-Ahaideb A, Jiang L, Algarni AD, Ouellet J, Harold MU, Arlet V. **Correction of severe pelvic obliquity using maximum-width segmental sacropelvic screw fixation: an analysis of 20 neuromuscular scoliosis patients.** Eur J Orthop Surg Traumatol. 2014 May 6. 24799089 // Arlet V. **Expert's comment concerning Grand Rounds case entitled "Bilateral reconstructive costoplasty for Razorback deformity correction in adolescent idiopathic scoliosis" (Eyal Behrbalk, Ofir Uri, Jonathan A. Clamp, Marcus Rickert, Bronek M. Boszczyk).** Eur Spine J. 2014 Dec 2. 25448616. // Martin JT, Collins CM, Ikuta K, Mauck RL, Elliott DM, Zhang Y, Anderson DG, Vaccaro AR, Albert TJ, Arlet V, Smith HE. **Population average T2 MRI maps reveal quantitative regional transformation in the degenerating rabbit intervertebral disc that vary by lumbar level.** Journal of Orthopaedic Research, 2014 // Zannikos S, Lee L, Smith HE. **Minimum Clinically Important Difference and Substantial Clinical Benefit: Does one size fit all diagnoses and patients?** Seminars in Spine Surgery 26:1; 8-11, 2014. // Sullivan MP, Smith HE, Schuster JM, Donegan D, Mehta S, Ahn J. **Spondyloepelvic Dissociation.** Orthop Clin of North America 45(1) 65-75, 2014.



Section Chief:
Vincent Arlet, MD

2014 PATIENT VISITS:
2,184

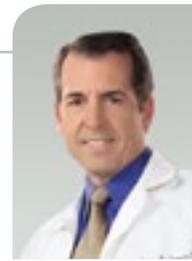
2014 PATIENT SURGICAL VOLUMES: 415



■ Inpatient: 397
■ Outpatient: 18

>> Sports Medicine

- Brian J. Sennett, MD was selected as one of the Inaugural Academy of Masters Clinician Inductees. This award is considered to be the “highest clinical award for a Penn Medicine physician” and the Academy has been established to provide guidance in the development of clinical excellence across Penn Medicine.
- James L. Carey, MD, MPH, was selected to be the Associate Editor of Epidemiology and Statistics for the American Journal of Sports Medicine (AJSM), and served as the Vice Chair of the Work Group that formulated the AAOS Clinical Practice Guideline for Anterior Cruciate Ligament injuries.
- Penn Sports Medicine added another outstanding physician to their staff in Arsh S. Dhanota, MD. He completed his Primary Care Sports Medicine Fellowship at the Children’s Hospital of Philadelphia and provides care at both the Penn Sports Medicine Center and the newly opened Penn Musculoskeletal Center.



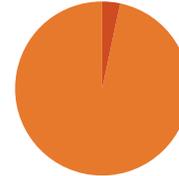
Section Chief:

Brian J. Sennett, MD

2014 PATIENT VISITS:
12,998

2014 PATIENT SURGICAL VOLUMES: 1,441

■ Inpatient: 40
■ Outpatient: 1,401



Selected Articles // Krych AJ, Carey JL, Marx RG, Dahm DL, Sennett BJ, Stuart MJ, Levy BA.

Does arthroscopic knee surgery work? Arthroscopy. 2014 May; 30(5):544-5. // Pontillo M, Spinelli BA, Sennett BJ. **Prediction of in-season shoulder injury from preseason testing in division I collegiate football players.** Sports Health. 2014 Nov; 6(6):497-503. doi: 10.1177/1941738114523239. 25364482 // Jacobs JC Jr, Shea KG, Oxford JT, Carey JL. **Fluoroquinolone use in a child associated with development of osteochondritis dissecans.** BMJ Case Rep. 2014 Sep 16;2014. pii: bcr2014204544. doi: 10.1136/bcr-2014-204544. 25228675 // Carey JL, Grimm NL. **Treatment algorithm for osteochondritis dissecans of the knee.** Clin Sports Med. 2014 Apr;33(2):375-82. doi: 10.1016/j.csm.2014.01.002. Review. 24698050.

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>> Trauma and Fracture

- Samir Mehta, MD was elected to the Board of AO Trauma and also as Chair of the AO North America Fracture Course in Atlanta, GA.
- Jaimo Ahn, MD, PhD joined the faculty of the AO Foundation International Trauma Course in Davos, Switzerland.
- The Penn Orthopaedics Trauma Service was selected as one of the few sites to host International Orthopaedic Trauma Scholars and also participate in the AO Outcomes Program.
- Faculty from the Trauma and Fracture service completed medical missions to Managua, Nicaragua.
- Faculty serve in leadership positions within several orthopaedic organizations including American Academy of Orthopaedic Surgeons (AAOS), the Orthopaedic Trauma Association (OTA), the Foundation for Orthopaedic Trauma (FOT), the Musculoskeletal Infection Society, the Pennsylvania Orthopaedic Society, AO North America and AO Trauma.



Section Chief:

Samir Mehta, MD

2014 PATIENT VISITS:
7,056

2014 PATIENT SURGICAL VOLUMES: 1,433

■ Inpatient: 1,215
■ Outpatient: 218



Selected Articles // Schenker ML, Mauck RL, Ahn J, Mehta S. **J Pathogenesis and prevention of posttraumatic osteoarthritis after intra-articular fracture.** Am Acad Orthop Surg. 2014 Jan;22(1):20-8. // Lopas LA, Belkin NS, Mutyaba PL, Gray CF, Hankenson KD, Ahn J. **Fractures in geriatric mice show decreased callus expansion and bone volume** Clin Orthop Relat Res. 2014 Nov;472(11):3523-32. // Scolaro JA, Schenker ML, Yannascoli S, Baldwin K, Mehta S, Ahn J. **Cigarette smoking increases complications following fracture: a systematic review** J Bone Joint Surg Am. 2014 Apr 16;96(8):674-81. // Schenker ML, Ahn J, Donegan D, Mehta S, Baldwin KD. **The Cost of After-Hours Operative Debridement of Open Tibia Fractures.** J Orthop Trauma. 2014 Feb 18. // Mutyaba PL, Belkin NS, Lopas L, Gray CF, Dopkin D, Hankenson KD, Ahn J. **Notch signaling in mesenchymal stem cells harvested from geriatric mice.** J Orthop Trauma 2014;28 Suppl 1:S20-3. doi: 10.1097/BOT.000000000000064. // Ayalon OB, Patel NM, Yoon RS, Donegan DJ, Koerner JD, Liporace FA. **Comparing femoral version after intramedullary nailing performed by trauma-trained and non-trauma trained surgeons: is there a difference?** Injury. 2014 Jul;45(7):1091-4. // Donegan DJ, Seigerman DA, Yoon RS, Liporace FA. **Gerdy’s Tubercle: The Lighthouse to the Knee.** J Orthop Trauma. 2014 Jul 21 // Moore RE, Baldwin K, Austin MS, Mehta S. **A systematic review of open reduction and internal fixation of periprosthetic femur fractures with or without allograft strut, cerclage, and locked plates.** J Arthroplasty. 2014 May;29(5):872-6 // Hannigan GD, Hodkinson BP, McGinnis K, Tyldsley AS, Anari JB, Horan AD, Grice EA, Mehta S. **Culture-independent pilot study of microbiota colonizing open fractures and association with severity, mechanism, location, and complication from presentation to early outpatient follow-up.** J Orthop Res. 2014 Apr;32(4):597-605.



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