



**University Hospitals**  
Case Medical Center

Cleveland | Ohio

# UH

# Innovations In Orthopaedics

Department of Orthopaedics

## Melding Medicine and Engineering

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# Introducing Our Newest Specialists



Welcome to this issue of *UH Innovations in Orthopaedics*, which allows us to share the outstanding achievements of the clinicians and scientists in the Department of Orthopaedic Surgery at Case Western Reserve University School of Medicine/University Hospitals Case Medical Center.

Our department is consistently ranked as one of the top orthopaedic departments in the United States. This issue introduces two orthopaedic surgeons whom we've recently recruited to provide additional innovative procedures for our patients:

- **Pediatric orthopaedic specialist Raymond W. Liu, MD:** Dr. Liu subspecializes in the treatment of complex bone and joint deformities, utilizing techniques such as osteotomies, including triple innominate osteotomy of the hip, and limb lengthening procedures. He joined us following a

fellowship at Rady Children's Hospital-San Diego.

- **Sports medicine specialist Michael J. Salata, MD:** Dr. Salata subspecializes in biologic articular cartilage restoration of joints and in-hip arthroscopy. He joined us following a fellowship at Rush University Medical Center in both sports medicine and hip arthroscopy.

We also highlight novel research that has led to more durable total joint replacement components with increased performance. **Clare M. Rinnac, PhD**, in collaboration with our joint replacement surgeons, is primarily responsible for these breakthroughs.

Case Western Reserve University was the first home to the Hamann-Todd Osteological Collection – the world's largest collection of human and non-human primate skeletons. We highlight this collection, now at the Cleveland Museum of Natural History and studied by researchers from around the globe. For example, **Daniel Cooperman, MD**, Professor of Orthopaedics and Pediatrics, uses the collection for his research on the interface between surgical procedures and anatomy and in teaching residents about the variability in bone shapes.

We welcome your comments, questions and suggestions. Feel free to contact us by e-mail or phone, or through our professional referral service.

Randall E. Marcus, MD  
Chairman, Department of Orthopaedics  
University Hospitals Case Medical Center  
Charles H. Herndon Professor  
Case Western Reserve University School of Medicine

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Nancy Hagan, RN, BSN; Raymond W. Liu, MD; Clare M. Rinnac, PhD; Michael J. Salata, MD  
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Among the nation's leading academic medical centers, University Hospitals Case Medical Center is the primary affiliate of Case Western Reserve University School of Medicine, a nationally recognized leader in medical research and education.

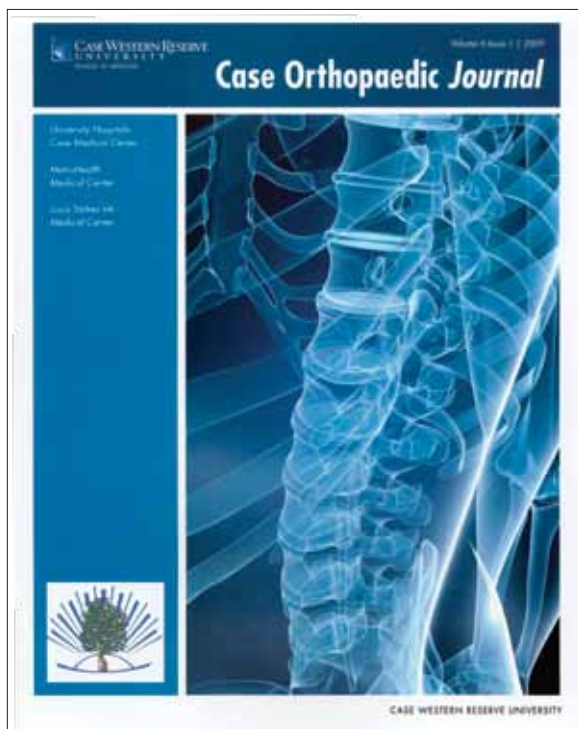
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The commitment to exceptional patient care begins with revolutionary discovery. Faculty at the Case Western Reserve University School of Medicine, who also are physicians at UH Case Medical Center, are at the forefront of medical research and innovation. The School of Medicine is the largest medical research institution in Ohio and among the nation's top medical schools for research funding from the National Institutes of Health.

# A Good Read

2009 *Case Orthopaedic Journal* highlights advances and accomplishments



The 2009 *Case Orthopaedic Journal* features 10 scientific manuscripts focusing on breakthroughs and advances taking place at University Hospitals Case Medical Center's Department of Orthopaedic Surgery, as well as news about the faculty's scientific and academic accomplishments and information about educational programs at Case Western Reserve University School of Medicine.

Published annually by the department's residents, the 2009 issue is dedicated to **Victor M. Goldberg, MD**, Chairman of the Department of Orthopaedic Surgery from 1989–2002. When Dr. Goldberg retired from clinical practice in 2008, he had been at the Department of Orthopaedic Surgery for 36 years. His research interests include bone allografts and transplantation, joint and implant biomechanics, orthopaedic biomaterials and outcomes of total joint replacement. He has authored or co-authored hundreds of scientific articles and book chapters. In 2008, Dr. Goldberg received the Orthopaedic Research Society/Orthopaedics Research and Educational Foundation's Distinguished Investigator Award. Dr. Goldberg also served as President of the Orthopaedic Research Society and the Knee Society. He continues to enjoy working with our residents at the VA Medical Center and participating in orthopaedic research.

The 2009 *Case Orthopaedic Journal* is available online at [UHhospitals.org/case](http://UHhospitals.org/case), keyword "Orthopaedic Journal."

## \$999,250 GRANT FOR RESEARCH ON NON-FUSION TREATMENT OF PROGRESSIVE SCOLIOSIS

SpineForm LLC, located in the City of Cincinnati, in collaboration with Cincinnati Children's Hospital Medical Center, University Hospitals Case Medical Center, Reynolds Consulting and E-Prime Group, was awarded \$999,250 for its clinical study and commercialization of an idiopathic scoliosis growth modulation system project. The grant is from the 2010 Ohio Third Frontier Biomedical Program Awards.

The project will support clinical studies of SpineForm's HemiBridge System, which addresses the need for non-



George Thompson, MD

fusion treatment of progressive scoliosis. The project's team of researchers includes **George Thompson, MD**, Division Chief, Pediatric Orthopaedics, University Hospitals Case Medical Center, UH Rainbow Babies & Children's Hospital, and Professor of Orthopaedics, Case Western Reserve University School of

Medicine; Eric Wall, MD, Cincinnati Children's Hospital Medical Center; and Joe Reynolds, SpineForm.

The Ohio Third Frontier Biomedical Program supports research and development to help Ohio companies make progress toward commercializing biomedical-related products for future applications.

## HENRY H. BOHLMAN, MD, AWARDED UNIVERSITY HOSPITALS MATHER DISTINGUISHED PHYSICIAN AWARD POSTHUMOUSLY

In September 2010, Henry H. Bohlman, MD, received the Society of 1866's University Hospitals Mather Distinguished Physician Award. The Society of 1866, named after the year in which University Hospitals was founded, is comprised of its major supporters. Dr. Bohlman's widow accepted the award on his behalf at the Society of 1866's annual dinner.

A pioneer in spine surgery, a former Director of the Spine Center at University Hospitals Case Medical Center and a mentor to leading spine surgeons nationwide, Dr. Bohlman died on May 27, 2010. He was the Henry H. Bohlman Chair in Spine Surgery at University Hospitals Case Medical Center and Professor of Orthopaedic Surgery at Case Western Reserve University School of Medicine.

"No single surgeon has made greater contributions to the field of spine surgery," says Randall Marcus, MD, Chairman, Department of Orthopaedic Surgery, University Hospitals Case Medical Center, and Charles H. Herndon Professor, Case Western Reserve University School of Medicine.



Victor M. Goldberg, MD, Emeritus Chairman of the Department of Orthopaedic Surgery



Spine surgery pioneer Henry H. Bohlman, MD

# Tapping New Orthopaedic Talent

Pediatric and sports medicine specialists expand the expertise at University Hospitals Case Medical Center



Raymond W. Liu, MD, Attending Surgeon, Department of Orthopaedic Surgery, University Hospitals Case Medical Center

Pediatric specialist **Raymond W. Liu, MD**, and sports medicine specialist **Michael J. Salata, MD**, have joined the Department of Orthopaedic Surgery at University Hospitals Case Medical Center. Both also are returning to Case Western Reserve University School of Medicine – Dr. Liu completed his internship and residency here and Dr. Salata graduated from the medical school.

## MELDING MEDICINE AND ENGINEERING

Dr. Liu was studying bioengineering when he found his interest in biology growing and decided to pursue medicine. As a specialist in complex osteotomies for hip dysplasia and slipped capital femoral physis and limb lengthening procedures for congenital limb deformities and growth plate injuries, he combines his engineering and medical training. “Bringing engineering principles into clinical practice is very appealing to me,” says Dr. Liu, who is joining the Division of Pediatric Orthopaedics.

During his fellowship in pediatric orthopaedics at Rady Children’s Hospital-San Diego, Dr. Liu focused on osteotomies of the proximal femur and foot. He also performs triple innominate osteotomy in adolescent patients with severe hip deformity to increase the stability of the joint. In this procedure, he divides the ilium, pubis and ischium, repositions the acetabulum, and stabilizes it with a bone graft and metal pins. In limb lengthening procedures, Dr. Liu achieves precise control over bone realignment by using the Taylor spatial frame, a circular fixator that allows gradual repositioning of bone fragments. This technique also protects nerves, ligaments and skin.

Dr. Liu’s research interests are complex limb deformity and trauma. In a study of the effect of varus and valgus osteotomies on femoral version (*Journal of Pediatric Orthopaedics*, 2009; 29(7):666-675), Dr. Liu and Case Western Reserve University School of Medicine colleagues used 72 preserved adult femora from the Hamann-Todd Osteological Collection to present and validate the concept of inclination, the true anatomical angle of the femoral neck. This is more accurate than version in determining where to place a pin in the femoral neck. The concept explains how a varus osteotomy decreases anteversion while a valgus osteotomy increases anteversion. Now at the Cleveland Museum of Natural History, the Hamann-Todd

Osteological Collection was started at Case Western Reserve University. Dr. Liu also presented the study at the American Academy of Pediatrics’ 2008 national conference, where he received the second-place Orthopaedics Research Award.

For his anatomical study on 26 pediatric distal femoral epiphyses, also from the Hamann-Todd Osteological Collection, Dr. Liu received an AO North America Trauma Research Grant and third place in the American Academy of Pediatrics’ 2009 Orthopaedics Research Awards. Using high-resolution three-dimensional scans to study the bones, he found that the central peak, lateral ridge and medial peak are the three major undulations in the distal femoral physis. These data could help identify fracture patterns with a higher risk of growth disturbance and guide reduction.

## FOCUSING ON ARTICULAR CARTILAGE RESTORATION AND HIP ARTHROSCOPY

Dr. Salata grew up playing sports, including high school football and basketball. Watching his brother’s treatment for and recovery from bilateral torn ACLs, he became interested in sports medicine. “You can’t put a price on how important staying physically active and getting back to play is, no matter what the level – professional or recreational,” says Dr. Salata, who is joining the Division of Sports Medicine.

During his fellowship in sports medicine and shoulder surgery at Rush University Medical Center, Dr. Salata worked with the Chicago White Sox and Bulls as assistant to the head team physician, and Chicago Steel of the United States Hockey League as co-head team physician. He also assisted the University of Michigan’s hockey and football teams during his residency and has worked with the football team at Eastern Michigan University. In his new role, Dr. Salata will cover some of Case Western Reserve University’s teams. He also completed subspecialty training in hip arthroscopy.

Dr. Salata specializes in sports medicine with a focus on articular cartilage restoration and hip arthroscopy. In patients with identifiable focal defects in knee and shoulder cartilage, he can perform several procedures that may provide patients with pain relief and improved function. These techniques include autologous chondrocyte implantation (ACI), which involves



Michael J. Salata, MD, Attending Surgeon, Department of Orthopaedic Surgery, University Hospitals Case Medical Center

This 13-year-old female with adolescent Blount's had failed a previous osteotomy, and was treated with gradual correction of her varus and procurvatum tibial deformity with a 5 cm leg length discrepancy. Through the use of computer-assisted guidance, her deformity will be precisely corrected over a six-week period, followed by a three-month consolidation period before removal of the frame.

harvesting autologous chondrocytes from non-weight-bearing surfaces in the knee or shoulder, culturing them in vitro to expand them and reimplanting them into the cartilage defect. Dr. Salata also performs allograft cartilage transplants, particulate juvenile chondrocyte implantation and allograft meniscal transplants.

At the 2010 International Cartilage Repair Society World Congress, Dr. Salata, Brian J. Cole, MD, MBA (principal investigator), and other colleagues from Rush presented outcomes from prospective evaluations of ACL (29 patients) and meniscal transplantation (22 patients) at seven-years post-surgery or longer. The researchers found that both procedures reduced pain and improved function and are viable and durable treatment options for appropriate patients.

Hip arthroscopy enables Dr. Salata to access the hip joint with minimal neurovascular risk and lower morbidity than open arthrotomy. This procedure is indicated for many conditions, including labral tears of the hip, femoroacetabular impingement and removal of loose bodies from the hip.

Dr. Salata's research also covers ACL reconstruction, knee biomechanics, outcomes research and shoulder surgery. In a biomechanics study conducted under a grant from Major League Baseball, Dr. Salata and another Rush Fellow seek to identify the optimal treatment for pitchers with SLAP (superior labrum, anterior to posterior) tears.

His research has been published in *American Journal of Sports Medicine*, *Clinical Orthopaedics and Related Research* and *Journal of Bone and Joint Surgery*. He has also published chapters on cartilage restoration, indications for revision ACL surgery and other topics.



## Professional Highlights: Raymond Liu, MD

Fellowship: Rady Children's Hospital-San Diego,  
University of California, San Diego  
Residency: Case Western Reserve University School of  
Medicine  
Medical school: Johns Hopkins University  
Undergraduate: University of California, San Diego  
For information about referring patients to Dr. Liu,  
please call **216-844-7613**.

## Professional Highlights: Michael J. Salata, MD

Fellowship: Rush University Medical Center  
Residency: University of Michigan Hospitals  
Medical school: Case Western Reserve University School  
of Medicine  
Undergraduate: University of Notre Dame  
For information about referring patients to Dr. Salata,  
please call **216-844-6097**.

# A Better Way

Pioneering Case Western Reserve University researcher Clare M. Rimnac, PhD, works to improve joint replacement components and their evaluation



Clare M. Rimnac, PhD, Associate Dean for Research, Case School of Engineering, Wilbert J. Austin Professor of Engineering, Department of Mechanical and Aerospace Engineering, and Professor, Departments of Orthopaedics and Biomedical Engineering, Case Western Reserve University

Two important advances in orthopaedic surgery in the past five years are the use of more durable polyethylene total joint replacement components and more accurate evaluation of the performance of total hip replacement components. These breakthroughs are the result of research by **Clare M. Rimnac, PhD**, in collaboration with researchers from Case Western Reserve University's engineering and medical schools, as well as external research partners. Dr. Rimnac, who joined Case Western Reserve University in 1996, is Associate Dean for Research in the Case School of Engineering, Wilbert J. Austin Professor of Engineering in the Department of Mechanical and Aerospace Engineering, and a Professor of both Orthopaedics and Biomedical Engineering at Case Western Reserve University. She is also currently President of the prestigious national Orthopaedic Research Society. In the Department of Orthopaedics, she works closely with **Matthew J. Kraay, MD**, Kingsbury G. Heiple and Fred A. Lennon Professor of Orthopaedics, Case Western Reserve University School of Medicine, and Director, Division of Joint Reconstruction and Arthritis Surgery, University Hospitals Case Medical Center.

Dr. Rimnac was one of the first researchers to recognize that degradation of polyethylene joint replacement components occurred in vivo. Under a multicenter implant retrieval program study supported by the National Institutes of Health from 2001 to 2005 to research oxidative degradation and its effect on the

clinical performance of polyethylene joint replacement components, she and other researchers identified the processes that lead to this degradation.

"Due in part to our research, orthopaedic manufacturers introduced new formulations of polyethylenes with better wear resistance and better oxidation resistance. They also changed their sterilization procedures," says Dr. Rimnac, who was a co-investigator through a subcontract to Drexel University, the grantee. Dr. Rimnac and her colleagues received the 2006 Otto Aufranc Award for a study article titled "Significance of In Vivo Degradation for Polyethylene in Total Hip Arthroplasty," published in 2006 in the journal *Clinical Orthopaedics and Related Research*.

Under a continuation of the NIH grant through 2011, this work was extended. In a study of changes in polyethylene sterilization procedures, published in 2009 in the *Journal of Bone and Joint Surgery*, Dr. Rimnac and other researchers found:

- Lower oxidation and oxidation potential in conventional acetabular liners and tibial inserts gamma sterilized in inert gas than in historical components gamma sterilized in air.
- Strong evidence that conventional components undergo mechanisms of in vivo oxidation similar to those observed following gamma irradiation in air.
- Gamma sterilization in inert gas did not significantly improve polyethylene's wear resistance compared with gamma sterilization in air, except for a lower incidence of delamination in the first decade of implantation for tibial inserts.

Dr. Rimnac, in collaboration with Dr. Kraay and other associates at Case Western Reserve University and the University of Chicago, also evaluated a widely used hip wear measurement software program, Hip Analysis Suite, and helped the developer refine the software by correcting mathematically for projectional distortion of the femoral head and the acetabular shell on the radiograph. Published in a 2010 article in the *Journal of Bone and Joint Surgery*, their evaluation of a newer version of the software, Hip Analysis Suite version 8.0.3.0, determined it to be "a user-friendly, efficient and accurate method of assessment of polyethylene wear following total hip arthroplasty."

## Professional Highlights: Clare M. Rimnac, PhD

### Education:

- PhD and MS, Metallurgy and Materials Engineering, Lehigh University

### Previous position:

- Cornell University Medical College and The Hospital for Special Surgery, 1985–1996

### Grants:

- 17 NIH grants
- 21 grants from device manufacturers and foundations

### Publications:

- 99 journal articles
- 20 chapters in books and proceedings

### Recent Honors and Awards:

- President, Orthopaedic Research Society, 2010–2011
- Deputy Editor for Research, *Journal of Bone and Joint Surgery*, 2003–2010
- Steering committee and trainer, NIH Training Program in Musculoskeletal Research, 2007–present

## Contact Our Expert

For more information about the research of Clare M. Rimnac, PhD, please call her at **216-368-6442**.

# Consequential Collection

A world-famous supply of bones dates back a century at Case Western Reserve University

In the scientific quest for a better understanding of the human body, researchers have an invaluable resource at their disposal – the Hamann-Todd Osteological Collection. The world's largest collection of human and non-human primate skeletons started at Case Western Reserve University School of Medicine (then called Western Reserve University) in 1912 and is now housed at the Cleveland Museum of Natural History. For each of the 3,100 human skeletons, researchers from across the globe have access to information that includes height, weight, age at death, gender, race, cause of death and more than 60 measurements. The collection also has more than 900 non-human primate skeletons.

Scientists from fields such as medicine, anthropology and anatomy access the collection. "It's a watering hole for anybody who has an interest in the shape of the human body in an osteological sense," says **Daniel Cooperman, MD**, Attending Surgeon in the Department of Orthopaedic Surgery at University Hospitals Case Medical Center, and Professor of Orthopaedics and Pediatrics at Case Western Reserve University School of Medicine. "Over 1,000 papers and over 600 Master's and PhD theses have been generated from the collection."

## TANGIBLE RESULTS

Dr. Cooperman is Chairman of the Hamann-Todd Osteological Collection Coordinating Committee for the Cleveland Museum of Natural History and an "emissary" for the collection at Case, introducing it to orthopaedic residents and faculty. He also is Director of the Orthopaedic Anatomic Research program in the Hamann-Todd Collection laboratory, and uses the collection to conduct research focused on the interface between surgical procedures and anatomy.

For example, in a recent study, he and residents characterized 100 pairs of clavicles and used the results to determine how well precontoured plates for clavicle fracture fixation fit on actual clavicles. They published their results, which provide information that can be used for future clavicular plate designs and applications, in the *Journal of Bone and Joint Surgery* (2007; 89:2260-2265). In other research, he and colleagues studied 1,056 calcanei to determine the implications of variation in subtalar joint anatomy in calcaneal lengthening osteotomy (*Journal of Pediatric Orthopaedics*, 2003; 23:79-83).

Along with conducting research using the Hamann-Todd Osteological Collection, Dr. Cooperman uses it to show residents the variability in the shape of bones, an important consideration in orthopaedic surgery. "The collection," he says, "gives them a preview of what they're going to see in the operating room."



Working with the Hamann-Todd Osteological Collection are, from left, a Case Western Reserve University medical student, Randall E. Marcus, MD, Daniel Cooperman, MD, Heather Vallier, MD, and a Case Western Reserve University medical student.



Daniel Cooperman, MD, Attending Surgeon, Department of Orthopaedic Surgery, University Hospitals Case Medical Center

Dr. Cooperman also notes that some of the most amazing finds in the 20th and 21st centuries have a relationship to the Hamann-Todd Osteological Collection. The ancient bones of King Tut, Lucy (australopithecus afarensis) and Ardi (ardipithecus ramidus) were all brought to Cleveland to be characterized by scientists affiliated with the collection.

## Rich History

Thomas W. Todd, MD, a Professor of Anatomy at Western Reserve University (now called Case Western Reserve University), began collecting skeletons and cadavers in 1912, soon after Ohio state law changed to allow anatomy professors to retain the skeletons from the cadavers that their medical students dissected. Carl Hamann, MD, Dean of the School of Medicine, assisted Dr. Todd in enlarging the collection. By Dr. Todd's death in 1938, the Hamann-Todd Osteological Collection had records of more than 3,000 skeletons. During the 1950s and 1960s, the collection of skeletons was transferred to the Cleveland Museum of Natural History. Today, it is one of the most researched museum collections in the world.

## Discover More

For more information about research and educational use of the Hamann-Todd Osteological Collection at Case, please call **216-844-8350**.

To learn more about the Hamann-Todd Osteological Collection, please call **216-231-4600**.



## WHEN TO REFER/GRAND ROUNDS

# Call Our Hand Experts

The reasons to refer a patient for evaluation by a hand specialist in the Department of Orthopaedic Surgery at University Hospitals Case Medical Center are as diverse as hand disorders, and include:

- Lacerations in the hand involving tendons, nerves or arteries
- Osteoarthritis in the wrist or fingers that is not controlled by conservative measures
- Rheumatoid arthritis, especially if there is a threat of tendon rupture or contracture or joint imbalance
- Severe acute traumatic injuries such as significant distal radial fractures or carpal bone fractures
- Congenital abnormalities of the hand
- Carpal tunnel syndrome that is not controlled by conservative measures
- Failed hand surgery requiring revision surgery

Other conditions treated are ganglion cysts and trigger finger problems, as well as scaphoid fractures and tumors of the hand.

Our hand specialists perform a high volume of hand surgery, including hand and wrist arthroscopy and wrist arthroplasty. They are also skilled in other minimally invasive procedures, reconstruction of congenital abnormalities and microvascular surgery.

In diagnosing hand disorders, UH Case Medical Center uses a 3 Tesla MRI system equipped with extremity coils for clearer, higher-resolution images of the small structures in the hand. To enhance the results of the department's cutting-edge treatments, hand therapists work with physical and occupational therapists to develop a personalized rehabilitation program for each patient.

To refer a patient, please call **216-844-7200**.

## Your Feedback Is Important

As a medical professional, your input is invaluable in helping us shape future issues of *UH Innovations in Orthopaedics*. We want to know what's important to you. Do you want to read about cutting-edge research, learn about the latest technology, or hear firsthand case studies of how others in your specialty are improving and saving lives? Tell us what you want to read about and your name will be entered to **win one of two Apple iPads!** Simply visit [UHhospitals.org/innovations](http://UHhospitals.org/innovations).



Image courtesy of Apple

## Grand Rounds

### ■ Feb. 2: "Infections in Children"

Allison Gilmore, MD, Assistant Professor of Orthopaedics, Case Western Reserve University School of Medicine

### ■ March 2: "Upper Extremity Injuries in Children"

Jochen Son-Hing, MD, Assistant Professor of Orthopaedics, Case Western Reserve University School of Medicine

### ■ March 9: "Complications of Distal Radius Fractures"

J. Robert Anderson, MD, Attending Surgeon, Department of Orthopaedic Surgery, University Hospitals Case Medical Center, and Assistant Professor of Orthopaedics, Case Western Reserve University School of Medicine

### ■ May 11: "Spine Surgery Update"

James Kang, MD, Professor of Orthopaedic Surgery and Director of Spine Surgery, University of Pittsburgh Medical Center – Annual Bohlman Spine Visiting Professor

### ■ June 29: "Complications of Fracture Treatments"

Michael Patzakis, MD, Professor and Chairman, Department of Orthopaedic Surgery, University of Southern California School of Medicine – Annual Resident Research Day Visiting Professor

For further information about these events, held at the Wolstein Research Building Auditorium, including directions, please contact Ellen Greenberger, Education Coordinator, Department of Orthopaedics,

at **216-844-3233**  
or [Ellen.Greenberger@UHhospitals.org](mailto:Ellen.Greenberger@UHhospitals.org).



Nancy Hagan, RN, BSN

## Orthopaedic Triage Service

Clinical Nurse Manager Nancy Hagan, RN, BSN, answers physicians' questions, triages patients and ensures that appointments are made within 48 hours when necessary. Call **216-983-3089** to access orthopaedic specialists and refer patients to University Hospitals Case Medical Center's Department of Orthopaedic Surgery.