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Advancing Orthopaedic Knowledge and Techniques

As one of the top orthopaedic departments in the United States, clinicians and scientists in the Department of Orthopaedic Surgery at Case Western Reserve University School of Medicine and University Hospitals Case Medical Center are continually advancing orthopaedic knowledge and techniques.

In this issue of UH Innovations in Orthopaedics, we feature two outstanding surgeons whose research is improving clinical practice. Robert J. Gillespie, MD, has developed new treatments for patients with shoulder instability. Steven Fitzgerald, MD, was part of a research team whose findings provide new ways to prevent joint replacement infection and loosening.

We also profile neuromuscular specialist Christina K. Hardesty, MD, one of a handful of surgeons nationwide who specialize in performing procedures to treat spasticity and deformity in children with neuromuscular disorders. She joined University Hospitals Rainbow Babies & Children’s Hospital and Case Western Reserve University School of Medicine in 2011 after completing two fellowships.

Ozan Akkus, PhD, director of the Case Western Reserve University Orthopaedic Mechanics and Materials Laboratory, is developing electrochemically aligned collagen for potential use in replacing or repairing tendons and ligaments. He is also developing a point-of-care, low-cost Raman spectroscopy system to improve the diagnosis of gout and pseudogout. We describe Dr. Akkus’ work, which is funded by the National Science Foundation, the National Institutes of Health and the Alfred Mann Institute at Purdue University.

Our new state-of-the-art orthopaedic learning center enables residents, fellows and medical students to practice joint replacement, fracture repair and arthroscopy. Finally, the 2011 Case Orthopaedic Journal, featuring scientific articles, news about the faculty’s accomplishments, and information about medical educational programs, is now available.

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
Charles H. Hernon Professor and Chairman
Department of Orthopaedics
Case Western Reserve University School of Medicine
University Hospitals Case Medical Center

The commitment to exceptional patient care begins with revolutionary discovery. University Hospitals Case Medical Center is the primary affiliate of Case Western Reserve University School of Medicine, a national leader in medical research and education and consistently ranked among the top research medical schools in the country by U.S. News & World Report. Through their faculty appointments at Case Western Reserve University School of Medicine, physicians at UH Case Medical Center are advancing medical care through innovative research and discovery that bring the latest treatment options to patients.
Perfecting Surgical Skills
Orthopaedic Learning Center Established

A new state-of-the-art University Hospitals/Case Western Reserve University Orthopaedic Learning Center enables residents, fellows and medical students to practice joint replacement, fracture repair and knee arthroscopy. Opened in August 2011 in the Department of Orthopaedics at University Hospitals Case Medical Center, the learning center has surgical instruments for use with plastic bones and an arthroscopy simulator. The arthroscopy simulator, one of a few in the United States, has a validated teaching program, which includes anatomy and identification of pathology.

“It allows residents, fellows and medical students to learn, practice and perfect their psychomotor skills long before they’re in the operating room,” says Randall E. Marcus, MD, Charles H. Herndon Professor and Chairman, Department of Orthopaedics, Case Western Reserve University School of Medicine/University Hospitals Case Medical Center.

The University Hospitals/Case Western Reserve University Orthopaedic Learning Center is dedicated in honor of Mrs. Dottie O’Neill Donahey, who led fundraising efforts for the center. She provided $150,000 in seed money through two family foundations: the O’Neill Foundation ($100,000) and the Donahey Foundation ($50,000). Donations from orthopaedic faculty, alumni nationwide and the Department of Orthopaedics’ Orthopaedic Leadership Council provided the remainder of the funding.

Breakthroughs and advances taking place at Case Western Reserve University School of Medicine’s Department of Orthopaedics and affiliated hospitals are featured in the 2011 Case Orthopaedic Journal. Published annually by the department’s residents, the journal features scientific articles, news about the medical school faculty’s scientific and academic accomplishments, and information about medical educational programs.

Scientific articles featured in the 2011 Case Orthopaedic Journal cover topics such as engineered cartilage, sickle cell disease, range of motion after total knee arthroplasty, and a reprint of an article on harmony and discord in physicians’ marriages. The last article, written by psychiatrist Irwin M. Marcus, MD (father of department chair Randall E. Marcus, MD), was first published in 1980 and presented in 1991 at a meeting of the Charles H. Herndon Alumni Society (Case Western Reserve Orthopaedic Alumni Association). The issue is dedicated to John T. Makley, MD, professor emeritus at Case Western Reserve University School of Medicine and orthopaedic oncologist at University Hospitals Case Medical Center. Dr. Makley has taught orthopaedic oncology to many residents and fellows. The annual Carter-Makley Lecture on musculoskeletal oncology at the medical school honors Dr. Makley and pathologist John Carter, MD.

The 2011 Case Orthopaedic Journal is available online at UHhospitals.org/case, keyword “Orthopaedic Journal.”
Recurrent shoulder instability and infections in joint replacement patients are key issues in orthopaedics. Based on a retrospective study of patients who had an open revision procedure for recurrent shoulder instability, Robert J. Gillespie, MD, and colleagues have developed algorithms for treating patients who have failed shoulder instability surgery. Steven Fitzgerald, MD, was part of a research team that is investigating the relationship between joint replacement infection and periodontal disease. Their findings support the 2010 AAOS recommendations to consider antibiotic prophylaxis for joint replacement patients prior to dental and any invasive procedures. Drs. Gillespie and Fitzgerald are Attending Surgeons, Department of Orthopaedic Surgery, University Hospitals Case Medical Center; and Assistant Professors, Orthopaedics, Case Western Reserve University School of Medicine.

Recurrent Shoulder Instability Recurrence Rates
Recurrent shoulder instability is the most common complication after shoulder instability surgery. “This is a difficult problem,” says Dr. Gillespie. During his fellowship at the Rothman Institute, Dr. Gillespie worked with shoulder and elbow surgeons Mark D. Lazarus, MD, and Gerald R. Williams Jr., MD, on a retrospective study examining the clinical outcomes of 53 patients who had open revision instability surgery between 2005 and 2009.

The cohort comprised 40 (75 percent) men and 13 (25 percent) women, with a mean age at time of revision surgery of 28.7 years and an average of 1.3 procedures prior to the open revision operation (range 1–5). Average follow-up was 3.07 years (range 1.1–6.3 years). The investigators reported a recurrence rate of 3.7 percent and average postoperative WOSI and SANE scores of 66.6 percent and 66.2 percent, respectively.

The investigators developed three algorithms to guide the treatment of complex instability through open surgery based on glenoid and humerus bone loss and the integrity of the surrounding soft tissue. “Our algorithms show a number of procedures you can do depending on how bad the soft tissue or bone loss is. But you have to get the diagnosis correct,” says Dr. Gillespie. This requires a complete physical examination and history and advanced imaging, with CT scans preferable to identify bone problems and MRI as necessary for soft tissue injury. The work-up should also include infection, a rare cause of instability. Dr. Gillespie, here at University Hospitals Case Medical Center, and surgeons at the Rothman Institute use the algorithms in treating patients who have recurrent shoulder instability.

Linking Oral Cavity Infection and Implant Infection
It has been hypothesized that bacteremia associated with acute infection in the oral cavity contributes to

Far left: A 23-year-old patient with a prominent Hill-Sachs deformity who had undergone two instability surgeries.

Left: The same patient after open instability surgery with bone allograft of both the glenoid and humerus.
infection in total joint replacement patients. One possible trigger for the inflammatory cascade that is a factor in inflammatory arthritis is bacteria from the teeth and gums traveling through the bloodstream to the synovium lining the joint. A recent study by a multidisciplinary team of investigators from Case Western Reserve University, funded in part by the National Institutes of Health and forthcoming in the Journal of Clinical Rheumatology, examined the presence of bacterial DNA in synovial fluids around native or aseptically failed prosthetic joints from 36 subjects with periodontal disease and arthritis to determine whether bacteremia spread from the oral cavity to the joints.

The investigators detected bacterial DNA in synovial fluid samples, taken during total knee arthroplasty by Dr. Fitzgerald, in five subjects. Two subjects had identical bacterial clones in the synovial fluid and the dental plaque samples, suggesting the possibility that bacteria spread from the periodontal tissue to the synovium. The investigators recommended that patients scheduled to undergo total joint replacement surgery be examined first for periodontal disease and, as necessary, treated. The study was conducted in the School of Dental Medicine's Department of Periodontics in conjunction with the Division of Rheumatology and the Department of Orthopaedic Surgery. Randall E. Marcus, MD, Charles H. Herndon Professor and Chairman, Department of Orthopaedics, Case Western Reserve University School of Medicine/University Hospitals Case Medical Center, was also an investigator. Dr. Fitzgerald and other investigators are conducting follow-up research.

Using Antibiotic Prophylaxis in Joint Replacement Patients

The study’s findings provide evidence to support the current AAOS recommendations to consider antibiotic prophylaxis for joint replacement patients prior to dental or any invasive procedures that may cause transient bacteremia. Orthopaedic surgeons performing total joint arthroplasties should educate patients about the need to inform their dentists and other physicians about their implant, and be available to answer questions about prophylactic antibiotic recommendations, says Dr. Fitzgerald. “We currently recommend our patients continue antibiotic prophylaxis for the rest of their life.”

Shoulder Instability Study Procedures

- 25 soft tissue only repairs
- 9 soft tissue repairs with bone grafting of the Hill-Sachs lesion on the humerus
- 8 glenoid reconstructions with allograft or open reduction internal fixation
- 8 isolated Latarjet procedures
- 3 combination procedures involving bone grafting of the glenoid and the humerus

AAOS Information Statement on Antibiotic Prophylaxis

The AAOS “Information Statement: Invasive Procedures and Antibiotic Prophylaxis in Patients with Total Hip and Total Knee Arthroplasty” contains more information, including other risk factors for infection among joint replacement patients and prophylactic antibiotic recommendations for dental, ophthalmic, orthopaedic, vascular, gastrointestinal, head and neck, obstetric and gynecologic, and genitourinary procedures. The statement is available online at: aaos.org/about/papers/advistmt/1033.asp.

Contact Our Experts

For more information about Dr. Gillespie, please call 216-844-0209. For more information about Dr. Fitzgerald, please call 216-844-2486.
Physician Highlight

Neuromuscular Specialist Christina K. Hardesty, MD

Healing and improving function one child at a time

The ability to heal or improve the function of children drew Christina K. Hardesty, MD, to pediatric orthopaedics. “I get the chance to make some patients instantly better. For others, I improve their function so that their quality of life is better,” says Dr. Hardesty, a pediatric orthopaedic neuromuscular specialist who joined University Hospitals Rainbow Babies & Children’s Hospital and Case Western Reserve University School of Medicine in 2011 after completing her fellowships.

Broad Neuromuscular Expertise

Dr. Hardesty is one of a handful of surgeons nationwide who subspecialize in procedures to treat spasticity and deformity in children with cerebral palsy and other neuromuscular disorders, including intrathecal baclofen pump insertion to decrease spasticity and muscle contractures; procedures to release contractures, improve motion and gait, and prevent deformities; and BOTOX injections to relax muscles. She learned these procedures as a fellow at Nemours/Alfred I. duPont Hospital for Children and performs them as part of the multidisciplinary neuromuscular disorders clinic at UH Rainbow Babies & Children’s Hospital. This clinic brings together specialists such as orthopaedic surgeons, neurosurgeons, urologists, developmental pediatricians and physical therapists.

Spinal fusion surgery for scoliosis is another area of expertise for Dr. Hardesty. For neuromuscular scoliosis and salvage cases, she and other surgeons at UH Rainbow Babies & Children's Hospital use specialized spinal instrumentation to surgically correct the spine without screws. “This instrumentation provides better correction with less risk of neurologic injury compared to pedicle screws,” says Dr. Hardesty, who also sees patients with other spinal deformities, general orthopaedic problems and sports injuries.

Research on Balance and Coordination

Dr. Hardesty’s current research focuses on the treatment of spinal deformities. She and colleagues are planning a clinical trial to study whether interactive devices such as Wii and Kinect video games help children with movement disorders improve their balance and coordination. The study will be conducted in a motion analysis laboratory. While Dr. Hardesty was Chief Resident in Orthopaedics at the University of Arkansas, she received grants from the Orthopaedic Research and Education Foundation and Smith & Nephew Mobilab to use arthroscopy simulation and cadavers to train residents to perform surgery.

Among the awards she has won, Dr. Hardesty is most proud of the Carl L. Nelson Leadership Award (2010) and the White Coat Award (2004), both from the University of Arkansas. The leadership award honors the best graduating chief resident each year, as determined by the medical school faculty. For the White Coat Award, Dr. Hardesty’s classmates and medical school faculty chose her as the person who most exemplified the ideal physician.

Education Foundation and Smith & Nephew Mobilab

Professional Highlights

Fellowships:

- University Hospitals Rainbow Babies & Children’s Hospital/Case Western Reserve University
- Nemours/Alfred I. duPont Hospital for Children

Residency:

- Chief Resident, Orthopaedics, University of Arkansas

Medical School:

- University of Arkansas

Contact Our Expert

For more information about Christina K. Hardesty, MD, please call her at 216-844-8350.

A 5-year-old girl with severe spasticity secondary to cerebral palsy can now sit comfortably in a wheelchair and get out in the community thanks to this pump, which delivers baclofen through an intrathecal catheter.
Alleviating the effects of musculoskeletal diseases and injuries by developing biomaterials and engineered tissues and improving diagnostic technologies are the goals of the Case Western Reserve University Orthopaedic Bioengineering Laboratory. Two current projects are the development of electrochemically aligned collagen and the use of Raman spectroscopy in the diagnosis of gout and pseudogout.

**A Collagen-Based Tendon and Ligament Replacement**

Electrochemically aligned collagen (ELAC), made by subjecting collagen solutions to electrochemical gradients, has the potential to be used to replace or repair tendons and ligaments and in sutures. “ELAC is an ideal material because it has strength similar to that of tendons or ligaments and it is pure collagen,” says Ozan Akkus, PhD, Director, Orthopaedic Mechanics and Materials Laboratory, Department of Mechanical and Aerospace Engineering, Case Western Reserve University. Dr. Akkus also holds secondary faculty appointments in Biomedical Engineering and Orthopaedics at Case Western Reserve University.

With funding awarded to Case Western Reserve University from the National Science Foundation, the National Institutes of Health (NIH) and the Alfred Mann Institute for Biomedical Development at Purdue University, Dr. Akkus and his colleagues have developed the ELAC thread and tested it in small animal models. Results showed that in the rabbit model, ELAC degrades over months, does not promote ectopic bone formation, does not induce severe inflammatory reaction, and significantly increases the volume fraction of fascicles in the tendon.

Dr. Akkus and colleagues then demonstrated that ELAC can differentiate marrow-derived stem cells into tenocytic cells only by topographical cues and in the absence of bioinductive factors. They are now working on optimizing ELAC by braiding and weaving the threads to deliver the biomaterial in forms and shapes for repair of large defects. Recently, through a collaboration with orthopaedic surgeons at Case Western Reserve University School of Medicine, Dr. Akkus’ laboratory is assessing potential use of ELAC as a suture for repair of lacerated or ruptured tendons.

**Improved Diagnosis of Gout**

In another line of research, being conducted under a grant to Case Western Reserve University from the NIH, Dr. Akkus and colleagues are using Raman spectroscopy, a vibrational spectroscopy for fingerprinting species, to improve diagnosis of gout and pseudogout. In one study of 35 synovial fluid samples from symptomatic joints, they found that Raman spectroscopy can detect monosodium urate and calcium pyrophosphate crystals with good sensitivity and specificity at concentrations as low as 5 µg/mL and 2.5 µg/mL, respectively.

Dr. Akkus and colleagues are now developing a point-of-care, low-cost Raman spectroscopy system that uses microfiltration to concentrate the crystals for use in clinicians’ offices. “The physician aspirates the fluid, filters it through a microfluidic holder, inserts the holder in the Raman device and pushes a button to get the verdict on whether it’s a crystal and, if so, what type of crystal,” says Dr. Akkus. They also will be conducting a study with 200 synovial fluid samples to compare Raman spectroscopy and clinical diagnosis.

**Contact Our Experts**

For more information, please call 216-368-4175.

**Professional Highlights: Ozan Akkus, PhD**

**Education:**
- PhD, Mechanical Engineering, Case Western Reserve University
- MS, Engineering Sciences, Middle East Technical University (Turkey)

**Selected Grants:**
- Alfred Mann Institute for Biomedical Development
- Department of Defense
- Musculoskeletal Transplant Foundation
- National Institutes of Health
- National Science Foundation

**Recent Honors and Awards:**
- Fellow, American Society of Mechanical Engineers
- Career Award, National Science Foundation
- J.R. Neff Award, Musculoskeletal Transplant Foundation
Your Feedback Is Important

As a medical professional, your input is invaluable in helping us shape future issues of 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 iPad 2s! Simply visit UHhospitals.org/innovations.

Call Our Spine Surgery Experts

As part of a tertiary care center, spine surgeons at University Hospitals Case Medical Center have extensive experience with complex and rare spinal disorders. Patients who should be considered for referral to the Department of Orthopaedic Surgery at UH Case Medical Center are those with:

- Radiculopathy (any pathological condition of the spinal nerve roots) or myelopathy (any disease or disorder of the spinal cord or bone marrow) with unacceptable symptoms and/or neurologic deficits with significant nerve or spinal cord compression on imaging studies
- A pathologic lesion (tumor, infection or fracture)
- Severe back pain lasting more than six weeks that has not improved after physical therapy
- Any patient with back or neck pain and changes in bowel or bladder function must be referred for emergent consultation, says Nicholas U. Ahn, MD, Attending Surgeon, Department of Orthopaedic Surgery, University Hospitals Case Medical Center, and Associate Professor, Orthopaedics, Case Western Reserve University School of Medicine.

"Unless a condition is emergent, we always try nonoperative treatment first, with the hope that the patient will improve without requiring surgical intervention," says Dr. Ahn. "Only in cases where patients have unacceptable symptoms that have not responded to nonoperative treatment is surgery indicated. It is the patient who tells us when it’s time for surgery."

Conditions We Treat

- Degenerative and acquired conditions of the cervical, thoracic and lumbar spine
- Disc herniations and spinal stenosis
- Severe spinal cord compression with myelopathy and paralysis
- Spinal spondylolisthesis
- Scoliosis and spinal deformities
- Pathologic lesions of the spine: tumors, infections and fractures

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 216-983-0393 to access orthopaedic specialists and refer patients to University Hospitals Case Medical Center’s Department of Orthopaedic Surgery.

Grand Rounds

Feb. 22: Distal Femur Fractures
Brendan Patterson, MD, Professor of Orthopaedics, Case Western Reserve University School of Medicine

Feb. 22: HCAHPS Survey – How do we Improve?
William Annable, MD, Chief Quality Officer and Director, UH Quality Institute

For further information about these events, held at the Wolstein Research Building Auditorium, including directions, please contact Ellen Greenberger, Education Coordinator, Department of Orthopaedic Surgery, at 216-844-3233 or Ellen.Greenberger2@UHhospitals.org.

UH Transfer Referral Center Hotline

Expedite adult and pediatric transfers with one call. Services include:
- Basic or ALS transports
- Ground and air medical evacuation
- Critical care transports
216-844-1111 or 1-800-421-9199