BECOMING ORTHOPAEDISTS

Interns entering orthopaedic residency face a plethora of challenges. They are learning diagnostic and surgical skills, making choices about their careers and their lives, and have a relatively short timeframe in which to go from orthopaedic student to practicing orthopaedist.

"Our residents arrive as nervous interns who have a passion for orthopaedics but little knowledge, and we watch them grow into confident orthopaedic surgeons who will move into fellowships and do great things for patients," said **Dawn M. LaPorte, MD**, associate professor and residency program director, Department of Orthopaedic Surgery at Johns Hopkins University School of Medicine. "They're all amazing individuals."

PRACTICE PRESENTING RESEARCH

Residents' main focus is to become competent orthopaedic surgeons, but they also need to master scientific method, and how to write and present a convincing scientific paper.

▲ Robert S. Sterling, MD with an arthroscopy training model. *Photo courtesy of Dr. Sterling*

"Residents need to understand how to read scientific literature, and that means understanding how it's developed," said **Robert S. Sterling, MD**, associate professor and residency program director for the University of Maryland.

As residency program directors, Drs. LaPorte and Sterling mentor and nurture their residents, helping them face obstacles that may be more challenging than anything they encountered as medical students or interns. One way residency program directors enhance residents' education is to encourage their participation in programs, such as the OREF/ORS Resident Research Symposia.

Last December, Dr. Sterling excused his residents from their clinical duties for a day so that they could attend the 2010 Chesapeake Region OREF/ORS Resident Research Symposium. The University of Maryland requires residents who want to present their research at larger national meetings to submit abstracts for an opportunity to present locally first, and regional OREF/ORS Resident Research Symposia—made possible by educational grants from **Biomet** and **Synthes**—help them meet that criterion.

"Symposia like these are invaluable for residents," said Dr. Sterling, who served on the judges' panel for the 2010 Chesapeake Region Symposium. "It's difficult to cover the expense of traveling to various meetings so it's good to have something that's within driving distance for people from Philadelphia to D.C. The symposia are great opportunities and resources for the residents to get presentation experience."

JUDGMENT CALL

To begin the judging process for the 2010 Chesapeake Region Resident Research Symposium, submitted abstracts were split into clinical and basic research categories. A separate group of judges was assembled to read and review the abstracts in each category, scoring them on uniqueness, feasibility with a resident as principal investigator and the potential impact of the research on patient care. Residents whose abstracts scored highest were selected to present at the symposium.

The same judges who reviewed the abstracts for each category also judged the presentations in the respective

categories. Judges based their scores on:

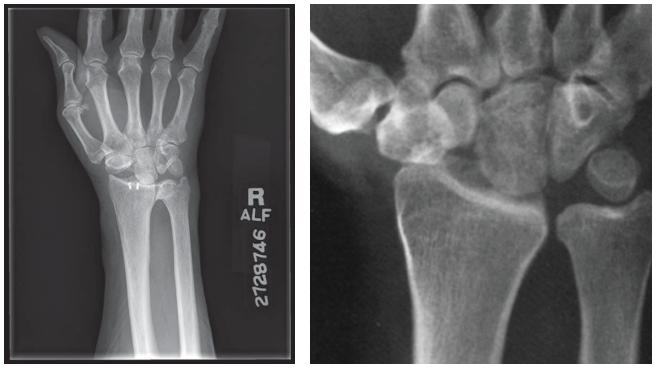
- Feasibility of the study if conducted by a resident;
- Potential impact of the study on patient care;
- Potential changes to clinical technique;
- Study design; and
- How well the data supported the conclusion.

In instances where scores were close, judges took into account how innovative the research was; whether the study could be used as the impetus for further research; presentation quality; and residents' confidence, depth of understanding of the topic and ability to answer questions about their work.

TOMORROW'S ORTHOPAEDISTS

Symposia create an atmosphere that triggers new questions for study and excites residents about research. Both Drs. LaPorte and Sterling agree that residents benefit from watching their peers present, learning what makes a good presentation, finding out about different areas open to investigation—and for those chosen to present, gaining experience in explaining their research.

"Our residents—our students—are the future of orthopaedics, and education is a critical piece of training them to become orthopaedic surgeons," said Dr. LaPorte, who served as co-host and judge of the 2010 Chesapeake Region Symposium. "We need to continue to improve the education process and the opportunities for our residents because they're going to be the orthopaedists who will be taking care of us. They are who will make the future of orthopaedics outstanding."



▲ Postoperative X-rays of patients who have undergone proximal row carpectomies.
Photos courtesy of Mayo Clinic

RESEARCH SYNOPSES from Past Resident Research Symposia Winners part II

▲ Mir H. Ali, MD, PhD
Photo courtesy of OAD Orthopaedics, Ltd.

Mir H. Ali, MD, PhD

Long-term Follow-up of Proximal Row Carpectomy: Minimum 15-year Follow-up

Nearly one in five adults is affected by arthritis, which is also considered a leading cause of work disability. For post-traumatic and degenerative wrist arthritis patients, proximal row carpectomy, a salvage procedure, may relieve pain and allow partial wrist movement. But is this procedure effective?

"It is a long-unanswered question," said **Mir H. Ali, MD, PhD**, first-place winner at the 2009 Minnesota Orthopaedic Research Society Annual Meeting Resident Research Symposium. "There are investigators who have looked at five-to-10-year outcomes who think it's a very nice operation, but surgeons I work with were getting anecdotes from their patients telling a different story. We decided to take the anecdotal consensus and turn it into tangible data."

Dr. Ali and his research team tracked 65 long-term—15 years or more—proximal row carpectomy patients from Mayo Clinic in Rochester, Minn., which performs a high volume of these procedures.

Dr. Ali and his research team studied data from the last 40 years, and followed up with proximal row carpectomy patients by asking them to complete surveys and speaking with them. The researchers also X-rayed any available patients.

"Our study showed that patients who have had a proximal row carpectomy don't do well beyond 15 years," Dr. Ali said. "Only about 1% go back to a manual labor job, only 20% go back to the level of function they had before the procedure and about 40% complain they still have problems with their

wrists that require them to take daily pain medication."

According to Dr. Ali, these results indicate that orthopaedists should consider performing proximal row carpectomies only on certain patients—those who have neuromuscular problems with their hands or rheumatoid arthritis, for example.

"Neuromuscular patients would be favored by proximal row carpectomy, but it's not something you could use reliably for degenerative or wrist arthritis patients and have a predictably positive outcome."

▲ Alfred Atanda, Jr., MD
Photo courtesy of Dr. Atanda

Alfred Atanda Jr., MD

A Novel Biomechanical Method to Assess the Risk for Slipped Capital Femoral Epiphysis in Children

Although orthopaedic surgeons are able to treat slipped capital femoral epiphysis and know how to deal with its complications, they don't have many options to prevent it.

"Obesity is probably the most important factor that leads to a slipped capital femoral epiphysis, and we're doing what we can about it, but as orthopaedic surgeons we can't prevent obesity," explained **Alfred Atanda Jr., MD**, first-place winner in the clinical science category at the 2009 Midwest Resident Research Symposium.

The growth plate sits on the front part of the femur and can slip off if it is weakened due to obesity, endocrine problems such as hypothyroidism or sickle cell, or steroid or radiation treatment. If it slips, not only will the patient be in a lot of pain, Dr. Atanda said, but he or she could also endure further complications including hip impingement, arthritis or death to part of the femoral head. Orthopaedists treat a slipped hip by pinning it.

"If we could predict who is going to slip, we could preemptively pin patients before they have complications," said Dr. Atanda.

Using software developed by **John M. Martell, MD**, associate professor of surgery and director, Institute of Biomedical Imaging Analysis at University of Chicago Medical Center, to assess biomechanical properties and kinematics of total hip replacement, Dr. Atanda analyzed X-rays of patients who had slipped on one side. He X-rayed the anterior-posterior view of each patient's pelvis. Since the view shows both sides of the hip, Dr. Atanda was able to input data to the software, which consists of a radiographic algorithm that calculates shear stress, joint reactive force and biomechanical properties based on the patient's age, X-ray and body weight.

"If a boy comes in and he's slipped his right side, I can analyze his X-rays to determine the percentage chance that his left side will slip, and if it's really high, then I can pin the left side before it slips and prevent further complications," explained Dr. Atanda.

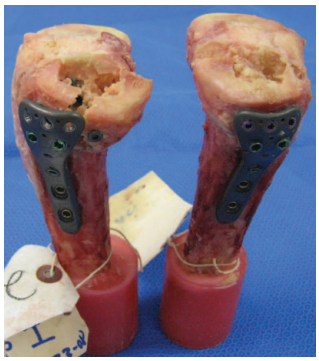
By pinning the hip before it slips, Dr. Atanda said, orthopaedists can reduce risks of further complications that lead to total hip replacements, which only last about 15 years, almost guaranteeing the need for revisions if done at a young age.

Currently, the algorithm is purely mathematical, Dr. Atanda said, and orthopaedists should also consider behavioral factors. Pinning as a preventive measure may not be necessary if, for example, the orthopaedist can trust the patient to report the first twinges of pain.

William W. Cross, MD

Raft Constructs and Fracture Stability in Split-depression Tibial Plateau Fractures

Placing a layer of screws—a raft construct—just below the subchondral surface to treat a tibial plateau fracture helps support the joint surface when a patient starts early motion following injury. **William W. Cross, MD**, who won best poster at the 2009 Minnesota Orthopaedic Society Annual Meeting Resident Research Symposium, would like to know if one raft construct is better than another.



▲ Group 1—Raft construct outside of the plate (left); Group III—locking raft construction (right). Group 1 shows more severe depression and displacement.
Photo courtesy of Dr. Cross

"The question of what is the best raft construct has not been answered, so we investigated whether employing locking screw technology enhanced the raft construct in comparison to more traditional raft constructs that use nonlocked screws," Dr. Cross said.

Dr. Cross and his mentors developed a reproducible cadaver model based on previously published studies. The model allowed Dr. Cross to create a split-depression tibial plateau fracture in the cadavers and test three different raft constructs. Each construct had the same plate, but different screw fixation.

"Using an Instron machine, we tested them in cyclic displacement followed by load-to-failure analysis," said Dr. Cross.

He found that with his split-depression tibial plateau fracture model, there was no advantage to using the locking screws over the nonlocking screws.

"By comparing fracture constructs and looking at their stability, we'll be able to devise the best method to stabilize a fracture and allow the patient to start safe early motion," Dr. Cross explained. "Given the nonlocked screw raft construct is less expensive, but equally stable when compared to the locked screw raft construct, it may be more fiscally responsible for treating split-depression tibial plateau fractures."

Jacqueline A. Geissler, MD

Does the Resident Selection Process Predict Performance?

Orthopaedics is a competitive field, but while many prospective residents show potential, it can be difficult to select who will become good orthopaedists based on an application and a short interview.

"The residency selection process seems a little random and unpredictable," said **Jacqueline A. Geissler, MD**, first-place winner at the 2009 Minnesota Orthopaedic Society Annual Meeting Resident Research Symposium. "I think if we could reliably predict who will do well in residency, we'd improve treatment for our patients."

Dr. Geissler wanted to know if the ranking system developed by and used for her residency program reliably predicted which candidates performed better than others as residents.

Candidates for the University of Minnesota resident program are ranked by their desirability using a group consensus method. After an initial screening process, each invited applicant is interviewed by a minimum of 10 faculty members. Each interviewer generates an individual rank list based on a candidate's interview and application. Faculty members have an opportunity to discuss the applicants prior to submitting their individual rank list; historically, minimal changes are made during this discussion. The average rank and standard deviation of each candidate is then calculated, creating a master rank list. If two applicants earn the same score, the person with the lower standard deviation is scored more favorably than the one whose deviation is greater.

Dr. Geissler asked, "Can we find a performance difference between residents who were ranked 1 through 5 versus those who were ranked greater than 5; greater than 15? Can we identify applicants who will ultimately perform better than their peers in the future as residents?"

▲ (counterclockwise from right) Under the direction of orthopaedic hand surgeon **Scott A. McPherson, MD**, residents Jacqueline A. Geissler, MD and **David A. Nordin, MD** fix a distal biceps tendon rupture.
Photo courtesy of Dr. Geissler

To answer the questions, Dr. Geissler compared how residents ranked against three different measures of how they performed in the program. These included: orthopaedic in-training examinations, which residents are required to take annually; results of the American Board of Orthopaedic Surgery exams; and faculty evaluations, which had been recorded electronically for each resident.

The residents who were ranked 1 through 5 outperformed those with less favorable rankings on E-value™, the University of Minnesota faculty evaluation that takes into account eight subcategories that are part of the Accreditation Council for Graduate Medical Education core competencies.

"That finding was supportive of our resident selection method," Dr. Geissler noted. "If selecting residents is something we can do reliably well, then we may be able to choose who will be a good doctor. If we can get the very best in orthopaedics, it would have a positive impact on patients."

Aaron Nauth, MD, FRCSC

▲ Aaron Nauth, MD, FRCSC

Endothelial Progenitor Cells for Healing and Angiogenesis in a Segmental Bone Defect Model: A Comparison with Mesenchymal Stem Cells

About one out of every 10 fractures orthopaedists treat has delayed or a complete absence of healing. Scientists are investigating several ways to resolve this problem.

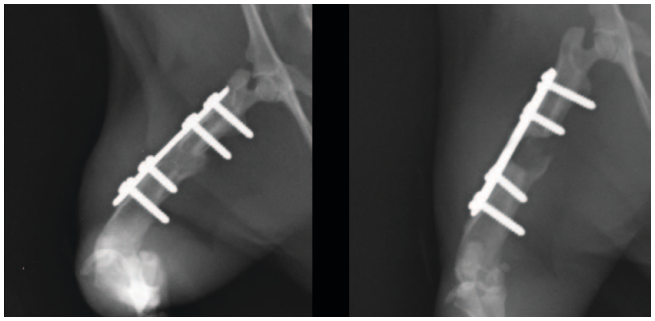
"The two different areas my mentor, **Dr. Emil H. Schemitsch**, is working on are gene therapy and stem cell therapy for fracture healing," said **Aaron Nauth, MD, FRCSC**, first-place winner at the 2009 Rochester Resident Research Symposium. "I'm involved in both, but more heavily in stem cell research."

Dr. Nauth and his research team applied various stem cell treatments to a rat model of nonhealing fractures. Specifically, they were investigating the application of endothelial progenitor cells (EPCs) to learn if this type of stem cell would not only accelerate fracture healing, but also increase the blood supply to the fracture.

"We wanted to know if we could accelerate and induce fracture healing. We found that all of the untreated fractures in our model failed to heal, but those treated with this specific type of stem cells (EPCs) healed the majority of the time," Dr. Nauth explained.

While other types of stem cells have been used to heal fractures, this is one of the first investigations to apply EPCs for fracture healing. Dr. Nauth and his research team decided to test EPCs in particular because they are already in phase 2B clinical trials locally, at St. Michael's Hospital and the University of Toronto, for cardiac and vascular diseases.

"They're taking these cells from patients who have had a vascular problem or heart attack, growing them in culture and then giving them back to these patients to treat their vascular disease or heal damaged heart tissue," Dr. Nauth said. "We're encouraged by the infrastructure that has already been developed in context of clinical problems other than fracture healing, and if the animal research continues to show promise, I think EPCs have the potential to be investigated for fracture healing in a clinical context in the future."



▲ Radiographs taken six weeks after bone defect creation and treatment with EPCs (left) and control—no treatment (right). Note the robust bone-healing response in the EPC-treated defect versus no significant bone healing in the control-treated defect.

Photos courtesy of Dr. Nauth

Michael D. Tseng, MD

Biomimetic Calcium Phosphate Coatings as Bone Morphogenetic Protein Delivery Systems in Spinal Fusion

▲ (third from left): **Harry N. Herkowitz, MD**, co-investigator and residency director, with graduating residents (l-r) Michael D. Tseng, MD, **Marcus J. Haemmerle, MD** and **Nicholas J. Cook, MD**.
Photo courtesy of Dr. Tseng

In traditional spine fusions, orthopaedic surgeons use iliac crest autografts—bone from the patient's own hip. But even with modern rods and screws, potential for healing to fail and other risks for patients remain.

"For that reason, using biologics like bone morphogenetic protein (BMP) has value. You don't have to subject patients to taking bone from the hip and it may also increase fusion rates," said **Michael D. Tseng, MD**, first-place winner in the basic science category at the 2009 Midwest Resident Research Symposium.

Unfortunately, BMP is not a perfect solution. The Food and Drug Administration has approved BMP only for anterior fusion with a cage in the lumbar spine, and tests for other uses have shown complications such as swelling, bone resorption and unintended bone formation that can pinch nerves. Dr. Tseng and his research team decided to test alternate BMP delivery methods that could prevent these adverse effects.

Using a New Zealand white rabbit model, Dr. Tseng investigated posterior lumbar fusions with several different graft materials and no instrumentation. He looked at a representative traditional method—a calcium phosphate-coated sponge with physically absorbed aqueous BMP.

Other experimental methods included a collagen sponge with a calcium phosphate and BMP coating, and a calcium phosphate plus BMP-coated sponge with additional aqueous BMP infused. A calcium phosphate-coated sponge served as the control.

The researchers followed the fusion process for each of six weeks and recorded radiographic fusion scores. Then, they assessed the fusion masses by manipulating them manually and using CT scans to determine size. The CT scans also revealed whether the fusion was localized at the intended site and if any bony resorption was taking place. In addition, a histologist examined the samples under a microscope.

"We found that physically incorporating the BMP into a calcium phosphate coating resulted in more localized bone formation and less bony resorption," Dr. Tseng explained.

This could be good news for patients in need of spinal fusion.

"Down the line you may be able to apply these types of coatings to interbody fusion devices or bone graft substitutes that could be used in the spine while minimizing some of the complications," Dr. Tseng said.

OREF thanks outgoing, welcomes new board members

OREF would like to thank **Oheneba Boachie-Adjei, MD**, **Mr. Charles W. Federico**, **Joshua J. Jacobs, MD** and **Regis J. O'Keefe, MD, PhD** for their years of service on its board of trustees. The Foundation values the time and dedication these individuals invested in accomplishing OREF's mission to support orthopaedic advancements through research and education projects conducted by promising investigators, academicians and clinicians.

Joining the Board in 2011 are **R. Tracy Ballock, MD**, **Mr. James G. Borovsky**, **Richard F. Santore, MD** and **Mr. Richard R. Tarr**.

S. Terrance Canale, MD will serve his second year as president. **Ramon L. Jimenez, MD** is the new president-elect and will continue to serve as vice chair, development until he begins his term as president in 2012. **Richard J. Haynes, MD** will take over for Dr. Jimenez as secretary.