

# ORTH

*Part of the 2017 UPMC Orthopaedic Surgery Highlights Report*

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## A CONTINUING LEGACY OF PIONEERING SPORTS MEDICINE AND ACL RESEARCH

**Carola F. van Eck, MD, PhD**, is one of the newest faculty members to have joined the department in the second half of 2017. A sports medicine specialist, Dr. van Eck's training in orthopaedic surgery included a post-doctoral research fellowship in the department under the mentorship of Freddie H. Fu, MD, followed by her orthopaedic residency training at the University of Pittsburgh from 2011 to 2016. After completing an orthopaedic surgery fellowship at the Cedars-Sinai Kerlan-Jobe Orthopaedic Institute in Los Angeles, California, Dr. van Eck returned to Pittsburgh to join the department's impressive roster of faculty members who continue to shape and guide the field of orthopaedic surgery nationally and internationally.

Beyond her research interests, which are numerous and include an emphasis on anterior cruciate ligament (ACL) reconstruction techniques and repair (her PhD thesis examined the changing anatomic ACL reconstruction paradigm), and a busy practice of treating sports medicine patients at the UPMC Rooney Sports Complex, Dr. van Eck also serves as the team physician for Robert Morris University (RMU) in Pittsburgh, as well as being a team physician for the Pittsburgh Passion women's football team. Dr. van Eck also played professional women's football herself from 2008 to 2011 while working as a post-doctoral research fellow in Pittsburgh. With RMU, Dr. van Eck is most involved with football, and men's and women's ice hockey, lacrosse, and basketball, although she treats and covers athletes across all of RMU's 16 Division I NCAA sports programs.

### Research Projects in the Pipeline

Dr. van Eck has an extensive research portfolio, co-authoring 69 peer-reviewed publications to date and another 68 abstracts. She is currently engaged in several new projects in collaboration with the department's Orthopaedic Engineering and Sports Medicine Laboratory, which is co-directed by Department Chairman **Freddie H. Fu, MD**, and **Patrick Smolinski, PhD**, from the University of Pittsburgh Department of Mechanical Engineering and Materials Science.



**Monica A. Linde-Rosen, MSIE, RN**, is the technical manager of the lab, and contributes to and supervises all of its activities and investigations. This lab has, and continues to be, a hotbed for research into ACL reconstruction and surgical techniques, and related biomechanical properties and tissue behavior of the ligament itself. Each year a rotating assortment of international fellows comes to work at the lab and contribute to its ongoing research projects.

### Notchplasty and Knee Biomechanics

Dr. van Eck and collaborators in the lab have several new projects in the pipeline and in progress that are focused on aspects of the ACL and reconstruction and repair techniques.

“We are currently working on a grant application to examine the effect notchplasty has on knee biomechanics when performed in the setting of an ACL reconstruction.”

Notchplasty is used routinely in the setting of ACL reconstruction to aid in visualization of the femoral ACL footprint to accomplish anatomic graft placement, as well as to avoid impingement in the intercondylar notch as the graft heals postoperatively. The technique removes a small portion of bone from the lateral femoral condyle. “We think the issue is that the technique leaves the patient with an altered anatomy. The technique is non-anatomic by definition, and we are interested in how this could potentially change a person’s biomechanics,” says Dr. van Eck. The new study in humans would be based on an animal model version<sup>1</sup> previously published by Dr. Fu and colleagues in 2012. The new study would assess changes in knee biomechanics based on the size of the notchplasty performed. Dr. van Eck and colleagues plan to evaluate two different sizes and amounts of bone removal to assess how this change in anatomy would affect the repair and any post-surgical complications.



*Radiological study of porcine knee used in notchplasty study.*

### Repair Versus Reconstruction

Dr. van Eck and the Orthopaedic Engineering and Sports Medicine Laboratory also are engaged in another study related to the ACL regarding the use of internal bracing of surgically repaired ACLs. “There’s been somewhat of a resurgence of late in research into repair of a ruptured ACL versus reconstruction with a graft. This approach, repairing the native ligament, requires the use of some type of internal bracing via a scaffold or other type of rigid suture material while the ACL heals,” says Dr. van Eck. Although the technique is in clinical practice in some settings, Dr. van Eck explains that there is really a lack of quality evidence from a biomechanical and clinical perspective to support whether or not this type of procedure ought to be routinely used, or perhaps confined within a narrow set of clinical indicators. “There are a few case reports and small retrospective examinations of the technique, but nothing concrete exists as to the efficacy and possible complications of this type of repair, and what methodology or type of bracing may be best,” says Dr. van Eck.

This study, in the development phases, will evaluate the biomechanical properties of an internal bracing construct in the setting of ACL and MCL repair or reconstruction to determine whether and to what degree the construct aids in stabilizing the knee after the ligament repair is performed.

“One of my concerns about this approach is if you’re putting something into the knee joint that is more rigid than the native ACL to temporarily stabilize it, this may lead to overconstraining the ligament, thereby putting abnormal forces on the knee joint. We know from other studies that if you overconstrain the knee, it can lead to abnormal wear and osteoarthritis,” says Dr. van Eck. The procedure may also radically change or increase the load to failure point on the ligament by significant degrees, the consequences of which are completely unknown at this point.

There is also the question in ACL repair or reconstruction as to the degree of knee flexion angle the surgeon should tension the device. Most surgeons doing repairs such as these at present are using the same flexion angle as would be done in an anatomic reconstruction. “But that’s purely anecdotal. We do not have good evidence to support that right now. These are the questions we hope to answer with this study,” says Dr. van Eck.

One of Dr. van Eck’s collaborators on this study, Monica Linde-Rosen, suggests that after this initial study concludes, the team ought to conduct an investigation in a living animal model that looks at how the suture or bracing material within the knee joint changes over time. Does it have any wear particles, or resorb into the body, and does it cause an inflammatory response within the knee? These are all secondary aspects of the procedure for which there is no evidence or understanding of the potential long-term consequences.

DR. VAN ECK SERVES AS TEAM PHYSICIAN FOR THE PITTSBURGH PASSION WOMEN'S PROFESSIONAL FOOTBALL TEAM, AND ALSO SERVES AS A TEAM PHYSICIAN FOR ROBERT MORRIS UNIVERSITY. DR. VAN ECK HERSELF PLAYED PROFESSIONAL WOMEN'S FOOTBALL FROM 2008 TO 2011 WHILE WORKING AS A POST-DOCTORAL RESEARCH FELLOW IN PITTSBURGH.





## NEW FRONTIERS IN HIP AND KNEE ARTHROPLASTY

**Michael J. O'Malley, MD**, assistant professor of medicine, is a hip and knee replacement surgery specialist who joined the Department of Orthopaedic Surgery in September 2016. Dr. O'Malley completed his fellowship training at the Rothman Institute of Thomas Jefferson University, preceded by residency training at the University of Pittsburgh and medical school at Temple University. Dr. O'Malley trained under some of the most respected and talented orthopaedic surgeons in the field while at the University of Pittsburgh. He credits Drs. Larry S. Crossett, Brian A. Klatt, and Freddie H. Fu for their mentorship and guidance, shaping the direction of his clinical practice and research, and ultimately being responsible for his return to the department as a faculty member. "Drs. Crossett and Klatt instilled in me their passion and philosophy toward joint replacement and research, how people's lives can be changed with this surgery, and I have carried that forward in my approach and focus as a surgeon and researcher," says Dr. O'Malley.

### Hip Arthroplasty-The Direct Anterior Approach

Dr. O'Malley is a proponent and active user of the direct anterior approach to total hip arthroplasty, having trained extensively in the procedure during his fellowship at the Rothman Institute where he gained a proficiency in the technique that has carried forward to his surgical practice in Pittsburgh. "There are pros and cons to this approach, much as there are with any type of surgical procedure. With the direct anterior approach, there is less disruption to muscle attachments, specifically the hip abductors. Some of the literature also suggests faster recovery, less pain, and a quicker discontinuation of the use of walking aids," says Dr. O'Malley. Hip precautions are something not typically needed with the direct anterior approach. With other approaches, there are potential downsides such as increased instability and the need to violate the abductors.

Dr. O'Malley trained on the direct anterior approach at the Rothman Institute in a carefully controlled and rigorous manner. "If you look at the research, there is a learning curve with the direct anterior approach of 50 to 100 cases to achieve proficiency. My focus from the start has been on using this technique and thoroughly understanding how to best conduct the procedure. The training I did as a fellow allowed me to be proficient in the technique immediately during my practice at UPMC, and I believe this has been to the benefit of my patients," says Dr. O'Malley.



Because of Dr. O'Malley's training and proficiency with the direct anterior approach, more than 95 percent of his cases of total hip arthroplasty (more than 200 cases since joining the department) are done in this manner. Only when certain anatomical anomalies exist in a patient will Dr. O'Malley employ an alternate technique.

Another aspect of Dr. O'Malley's direct anterior approach to hip arthroplasty is manifesting in work to develop a clinical pathway of same-day discharge for appropriate hip arthroplasty patients. This pathway is in the early stages of development and may be of great benefit to those patients who are appropriate candidates, as well as the the entire UPMC system.

“Several randomized studies by other groups have shown safety and efficacy of same-day discharge in hip arthroplasty. We are now currently evaluating this approach for our patients to determine if it is viable, safe, and effective.”

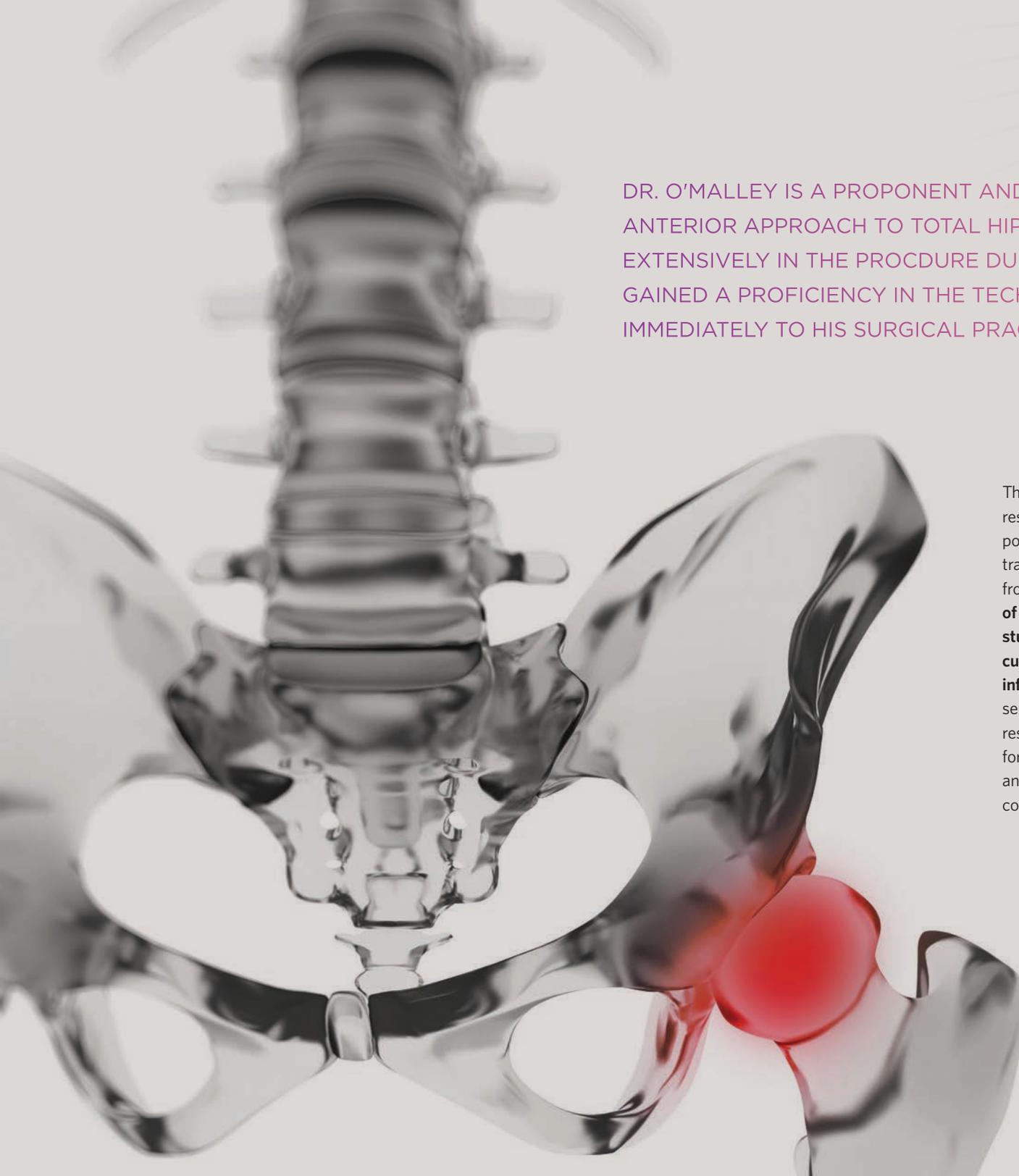


### Periprosthetic Joint Infections and the Use of Sonication in Clearance and Culture

Periprosthetic joint infections continue to be a leading cause of failure and revision surgeries in hip and knee arthroplasty. Bacteria and organisms that invade a joint and device are known to form a biofilm that is resistant to treatment, and clearing the infection while the device is still in the patient is generally not a viable option.

The use of sonication, an ultrasound-based technique for clearing a device of infectious agents and subsequent gathering of materials for culturing, is relatively new in the field of orthopaedic surgery. Dr. O'Malley and the department were early adopters of the technique from both a clinical use and research standpoint, and they continue these efforts in recently published<sup>1</sup> and ongoing studies.

The process of sonication quite literally shakes the microbial agents off the device in the lab. For patients deemed to have a chronic infection with a duration of more than three weeks, the standard of treatment entails removal of the implant, followed by the placement of a type of antibiotic-laden spacer, after which the patient is closed and the implant is sent to the lab for sonication and culturing. Bacterial-laden fluids from the sonication process are aliquoted, centrifuged into pellets, and then resuspended and cultured. Patients typically are started on intravenous antibiotics for a defined period and then retested using multiple means. Patients successfully cleared of infection are typically reimplanted about three months after the initial removal procedure.



DR. O'MALLEY IS A PROPONENT AND ACTIVE USER OF THE DIRECT ANTERIOR APPROACH TO TOTAL HIP ARTHROPLASTY. HE TRAINED EXTENSIVELY IN THE PROCEDURE DURING HIS FELLOWSHIP, AND GAINED A PROFICIENCY IN THE TECHNIQUE THAT CARRIED FORWARD IMMEDIATELY TO HIS SURGICAL PRACTICE AT UPMC.

The technique of sonication has been shown in research by Dr. O'Malley and colleagues to produce positive cultures at a much higher rate than the traditional means of using needle aspiration of fluid from the joint. **"With current methods, the success of cultures is approximately 67 percent. Our recent studies with sonication have yielded a positive culture rate of 95 percent in patients with active infections.** The technique is proving to have high sensitivity and specificity. Knowing the bacteria responsible for the infection is crucially important for treatment and results in a much more effective and long-term eradication. This has important consequences for the field," says Dr. O'Malley.

“THE USE OF ROBOTIC PARTIAL KNEE ARTHROPLASTY  
AFFORDS A SMALLER INCISION AND VIRTUALLY NO  
INCIDENCE OF MALALIGNMENT.”



Dr. O'Malley is also involved in several other periprosthetic joint infection-related studies, primarily with **Brian A. Klatt, MD**, assistant professor of orthopaedic surgery. One study, a multicenter investigation attempting to use next generation PCR sequencing to identify the bacteria in a periprosthetic joint infection, would eliminate the need for culturing. A second study that Dr. O'Malley and colleagues are currently in the midst of researching is an evaluation of a diagnostic test from CD Diagnostics called Synovasure®. "Essentially, what this testing does is look for a molecular marker called alpha defensin as an indicator of infection in the evaluation of synovial fluid. There is a lot of excitement about this test because it has been shown to be both sensitive and specific, and we can obtain results prior to surgery. Our study will compare this test and the use of sonication to see how well the two correlate. This is such interesting and meaningful work, because while the rates of periprosthetic joint infection are low, when they do happen, the consequences are severe," says Dr. O'Malley.

### Sleep Quality After Total Joint Arthroplasty

Dr. O'Malley received a grant in 2017 from The Pittsburgh Foundation to study sleep quality and disruption patterns in patients undergoing total joint arthroplasty. The study will monitor patient sleep cycles using Fitbit® devices and questionnaires to determine whether patient sleep is disturbed. The intervention in the study will be a placebo-controlled trial using the nerve medication gabapentin, which is an atypical pain medication with some sedating side effects. Patients enrolled in the study will receive either a dose of 300 mg of gabapentin or placebo, at night before bed, to see if their sleep improves. "We know sleep can be disrupted in the post-surgical period, and it is one of the biggest complaints of patients. They feel great during the day, but their leg hurts at night and their sleep is disrupted. Gabapentin

has been used empirically, but there is no real evidence to support its use as a therapeutic agent. Using the Fitbit® device will really help us to quantify and qualify the sleep disturbances that occur in these individuals, and with the devices we can also track and analyze their activity levels," says Dr. O'Malley.

### Partial Robotic-Assisted Knee Arthroplasty

Dr. O'Malley is currently using a robotic-assisted platform for his partial knee replacement surgeries. The robotic system uses computer-controlled navigation to control the burr, removing bone from the joint. "Not all patients are candidates for this approach, but those that are may be afforded a faster recovery period and more normal postoperative feeling in the knee," says Dr. O'Malley.

Another benefit of the robotic approach is that it allows for a more accurate placement of the implant with repeatable results. "By using the robotic approach," says Dr. O'Malley, "you end up with a smaller incision and virtually no incidence of malalignment."



*The robotic system uses computer-controlled navigation to control the burr, removing bone from the joint in a precise manner.*



# GERIATRIC FRACTURES: CAUSES, COMPLICATIONS, AND CONTRIBUTING FACTORS

Orthopaedic trauma surgeon **Gele B. Moloney, MD**, joined the Department of Orthopaedic Surgery in September 2016 and currently practices at UPMC Mercy. Dr. Moloney's training included the clinical scientist research track residency at UPMC from 2009 to 2014, followed by an orthopaedic surgery trauma fellowship at the Hospital for Special Surgery in New York City. Dr. Moloney is currently an assistant professor of orthopaedic surgery and is the site principal investigator for the Major Extremity Trauma Research Consortium (METRC), a large, multicenter group conducting a wide range of prospective studies in orthopaedic trauma. As an orthopaedic trauma surgeon, Dr. Moloney sees all manner and type of primary trauma cases and post-traumatic reconstructive procedures. "As an orthopaedic trauma surgeon, every case is different and requires us to try to very quickly understand patient goals and then optimize and individualize their care, often without having the luxury of knowing them prior to the day of their injury. It's a constant challenge, and one of the things that drew me into this area of orthopaedic care," says Dr. Moloney.

## Geriatric Fracture Care and Management

Dr. Moloney and **Ivan S. Tarkin, MD**, chief of the Division of Orthopaedic Traumatology, have previously studied and written on the rates and complications associated with geriatric distal femur fractures. Their findings highlight some of the challenges in caring for these individuals. A retrospective cohort study examined local and systemic complications in a cohort of 176 cases of low-energy distal femur fracture in elderly patients. At one-year post-surgical fixation, 25 percent of the patients were deceased. Of the remaining individuals, 24 percent developed a nonunion and went on to require further surgery. More than 80 percent of patients were discharged to a skilled nursing and rehabilitation facility, and 38 percent of individuals had at least one postoperative complication.

Hip fractures in geriatric patients have garnered a lot of attention in the literature and in the general population, and rightly so. However, as Dr. Moloney explains, they are not the only type of fracture that portends patient health declines and bad outcomes. "We started to look at patients with distal femur fractures and found that, while there are similarities to hip fractures in terms of mortality, distal femur fracture patients are much more likely to require secondary surgeries, increasing the burden on both the patient and the health care system trying to manage these challenging cases," says Dr. Moloney.



*Pre- and Postoperative  
Distal Femur Nonunion X-rays.*

*Preoperative image (left) shows incomplete healing of the fracture. Postoperative image (right) is following secondary reconstruction with supplemental plating and the addition of a bone graft resulting in fracture union.*



### New Research: Geriatric Distal Femur Fracture and Malnutrition

A new pathway of research that Dr. Moloney and her research colleagues in the trauma division are investigating is to what extent, and to what degree, patient nutrition and malnutrition play in improving outcomes of geriatric patients that suffer a distal femur fracture. Her team began to look at serum markers of nutrition in these patients, primarily albumin levels, and were surprised

to find alarmingly high rates of deficiency, pointing to significant rates of malnutrition in patients 65 and older with low-energy ground level falls and femur fractures. Right away, the associations were clear that independent of other factors, malnutrition was turning out to be a likely good predictor of mortality, nonunion, and postoperative infections. Dr. Moloney and colleagues have much more in the way of findings with this patient cohort and submitted a manuscript for publication that they hope to have published in 2018.

“This line of investigation really coincides with a much bigger trend at UPMC related to the concept of prehabilitation and pre-surgical care, and how these concepts and associated interventions can help to optimize care of these patients. This kind of research and evolving approach to patient care can help us understand and modify care patterns and practice to achieve better outcomes.”

### Designing an Intervention Protocol

Coming out of their research into malnutrition and distal femur fracture is the natural question: What can be done from an intervention standpoint to modify patient risk? Dr. Moloney indicates that from a corollary standpoint, they looked at younger patients with high-energy trauma and fractures to their ankle. “Tibial pilon fractures are notoriously bad injuries. However, in patients with this injury who were receiving nutritional supplementation in the hospital, specifically amino acid, vitamin, and protein supplementation, we were seeing lower complication rates and lower reoperation rates. The hypothesis is that perhaps we can extrapolate those results and findings to this geriatric population of distal femur fractures and see if it can improve outcomes,” says Dr. Moloney. Dr. Moloney and colleagues are working on an intervention that would start nutritional supplementation on the same day as the injury and prospectively study patient outcomes.

## New Research: Tibial Pilon Fracture Surgery and Nutritional Prehabilitation

As mentioned previously, tibial pilon fractures as the result of high-energy traumatic events are exceptionally difficult injuries to repair surgically and achieve long-term successful outcomes. New research by Dr. Moloney and collaborators **Ivan S. Tarkin, MD**, and **Nicholas J. Greco, MD**, is investigating the role and ability of nutritional prehabilitation to stave off post-surgical complications and suboptimal outcomes in patients with this injury.

Dr. Moloney and colleagues have submitted for publication their findings from a recent two-year study that tracked patient outcomes and complications following tibial pilon fracture in a cohort of 90 patients. Their study looked at infection rates, and rates of nonunion to see if nutritional supplementation was able to show a positive effect on long-term outcomes. Preliminary findings are promising, and more research will need to be conducted, but this could point toward and supply tangential evidence for using nutritional supplementation in geriatric distal femur fractures in order to minimize complications.



## About the Department of Orthopaedic Surgery

Founded in 1953 as a separate department of the University of Pittsburgh School of Medicine, the Department of Orthopaedic Surgery is committed to delivering the highest quality of diagnostic and therapeutic patient care to both adults and children for a diverse spectrum of orthopaedic disorders. To this aim, the department seeks to meet the needs of 21st century orthopaedic care not only by integrating the latest biological and technological advancements in orthopaedic science, but equally by leading the development of novel treatment modalities through distinguished basic science and clinical research programs. In addition, the Department of Orthopaedic Surgery seeks to be a leader in educating the next generation of orthopaedic surgeons through its residency and fellowship training programs, which include comprehensive, in-depth exposure to all specialties of orthopaedic care and advanced surgical experience.

**Freddie H. Fu, MD, DSc (Hon), DPs (Hon)**  
**Chairman**

## Centers of Excellence

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- Concussion
- Foot and Ankle Surgery
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- Orthopaedic Trauma
- Pediatric Orthopaedics
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## References and Further Reading

### A Continuing Legacy of Pioneering Sports Medicine and ACL Research

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### New Frontiers in Hip and Knee Arthroplasty

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### Geriatric Fractures: Causes, Complications, and Contributing Factors

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