

HOSPITAL  
FOR SPECIAL  
SURGERY:  
SPECIALISTS  
IN MOBILITY

FALL 2010

# Horizon

Step by Step:  
Innovations  
in Knee Surgery







### **Footloose and Pain-Free**

Cover: A double total knee replacement by Dr. Friedrich Boettner on August 27, 2010 is enabling Jim Holubis to once again pursue a pain-free and active life. See Mr. Holubis' story in centerfold.

### **Reestablishing Movement with the Greatest of Ease**

This page: Dr. Steven Haas demonstrates how a joint prosthesis functions when implanted using the post-surgical X-ray images of Jane Byron, who had both her knees replaced five months apart. See page 2.

# Step by Step: Innovations in Knee Surgery

**P**ain relief. Taking long walks. Getting back to the gym.  
Resuming my golf game. Chasing after my grandchildren.

These are among the typical responses of patients who suffer with chronic pain in their knee when asked what they hope to achieve with surgery. Doctors at Hospital for Special Surgery have devoted their careers to helping such patients realize a new lease on life; addressing the disability that accompanies chronic knee pain; performing a range of treatments to repair or replace the knee joint; continually exploring new and improved methods of restorative knee surgery; and conducting basic research to help preserve the knee joint and prevent disease progression.

## Understanding Knee Surgery

Whether arthritis or traumatic injury is the culprit, a number of surgical procedures are available to help address the frequently disabling consequences of chronic and severe knee pain. Some 300,000 knee replacement surgeries are performed each year in the United States; more than 3,600 were performed at HSS in 2009.

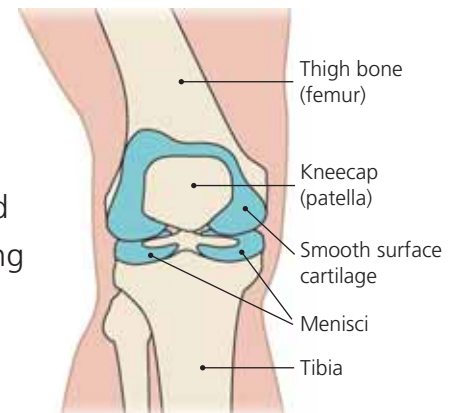
“Understanding the subtle changes within each patient’s unique joint anatomy helps us to define the best procedure for that patient’s circumstance,” says Thomas P. Sculco, MD, Surgeon-in-Chief. “Our recommendation may be surgery or it may begin with a more conservative approach with medication, injections, or physical therapy. Not all visits to surgeons result in surgery.”

“If surgery is advised,” says Steven B. Haas, MD, Chief of the Knee Service, “we take into account a patient’s age, anatomy, health status, amount of cartilage damage, and his or her expectations for the outcome.”

## Advances in Knee Replacement Surgery

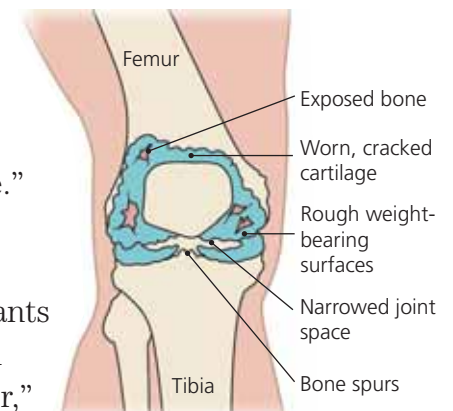
“HSS continues to move the field forward in design development of implants and biomaterials, with a focus on creating prosthetic knee joints that will function at higher levels, last longer, and enable patients to recover faster,” says Douglas E. Padgett, MD, Chief of the Adult Reconstructive and Joint Replacement Division.

Today, nearly 50 of the Hospital’s orthopedic surgeons perform knee replacements. “Many people still believe that knee replacement involves cutting out long segments of bone on either side of the knee joint and inserting a large hinge-like implant,” explains Dr. Haas. “But we only remove about a third of an inch of bone on each end of the joint. We then resurface the end of the bone with a cap that is the thickness of what was removed. Think of it as capping a tooth.”



### The Healthy Knee

With a healthy knee, smooth, weight-bearing surfaces allow for painless movement. Muscles and ligaments provide side-to-side stability. Cartilage lines the joint, acting as a cushion between the femur and tibia. The joint is lubricated by synovial fluid.



### The Diseased Knee

With an arthritic knee, the cartilage cushion wears out. The bones rub together and become rough, causing reduced mobility, pain, and difficulty walking.



“As implants were refined over the years, we have been able to scale down the size of the incision and be less invasive in our surgical approaches,” adds Dr. Haas. “The Hospital’s large volume of knee replacement cases also enables us to have a variety of knee implant systems available on-site to provide for differences among patients.” Today, implants are also more anatomically shaped; are made for right and left knee joints; incorporate gender differences; and are available in hundreds of combinations of sizes so that the surgeon can assemble a prosthesis that is matched to the patient as precisely as possible.

Traditionally, knee replacement surgery was reserved for patients older than 60, nearing retirement, and wanting to remain mobile in their golden years. Over the past decade, there has been a noticeable change in the age of patients coming to Special Surgery. Orthopedic surgeons are now

evaluating many more young, active patients in their late 40s and 50s, whose expectations not only include pain relief, but who seek to maintain a lifestyle of high-energy activities and athletic pursuits. As the age of the population has shifted, so have the data that the Hospital’s orthopedic surgeons have begun collecting on patients. “We ask questions about skiing, golf, racquet sports, cross-country running, biking, and all types of exercise,” says Dr. Haas. “We need to incorporate these types of questions into our studies so we can best address the needs of these patients.”

Russell E. Windsor, MD, notes that newer designs are taking into account performance expectations of younger patients. “The big issue is durability of the implant,” says Dr. Windsor. “With improvements in manufacturing technology, there is a greater availability of rotating platform designs. These designs are meant to preserve the wear of the polyethylene component, allowing the polyethylene to endure for a longer period, thereby providing a more resilient knee implant for the active adult.”

### When Circumstances Call for Custom Knees

Mark P. Figgie, MD, Chief, Surgical Arthritis Service, performs knee replacement surgery on patients with specialized circumstances, including adolescents with growth disturbances who may have developed arthritis while the knee or joint was still growing. “Diseases such as juvenile inflammatory arthritis, hemophilia, and skeletal dysplasia affect growing bone and can cause horrific deformities within the joint,” says Dr. Figgie. “These patients are often not only small in size and stature, but their deformities are more challenging because the bone doesn’t grow normally. For those patients we’ve often had to make custom implants.”



#### **A Tale of Two Knees**

(Top photo) On August 5, Dr. Steven Haas, observed by orthopedic surgery fellow Michael Rob Fraser, MD, examines Jane Byron’s right knee, which was replaced in April 2010. (Photo left) On August 16, Dr. Haas replaces Jane’s left knee. (Bottom photo) Just two days later Jane has her first post-op visit. Dr. Haas is pleased with her progress.

While the need for a custom-designed implant is extremely rare – perhaps two to five a year at HSS – when it is necessary, Dr. Figgie works closely with Timothy M. Wright, PhD, Director of the Department of Biomechanics, and Joseph D. Lipman, MS, Director of Device Development, to tailor an implant to the patient's anatomy. The process may include the creation of actual models of a patient's anatomy based on three-dimensional CT or MRI images.

"We are now reviewing all of our custom cases to determine if there is a way to create standard 'custom' implants that would help other patients," says Dr. Figgie. "Custom implants are expensive and time-consuming, so we are trying to develop a line of modular designs that can accommodate patients with these challenging anatomies and deformities."

### The Case for Partial Knee Replacement

Partial knee replacement – also referred to as unicondylar or unicompart-mental knee replacement – may be performed in patients who have disease localized to one compartment of the joint. At the present time, it is estimated that only six to ten percent of patients may be considered a candidate for partial knee replacement given the current implants available.

Partial knee replacement is performed through a very small incision, typically two to three inches in size. "It involves no muscle cutting and most of the knee is left alone because we don't want to disrupt the normal area of the knee," says Michael M. Alexiades, MD. "The area that is worn is replaced with a prosthesis resulting in a realignment of the leg."

"The advantage of partial knee replacement is that the surgery is usually less invasive so recovery is quicker, the ligaments remain intact, and the normal kinematics of the knee are generally maintained since the majority of the knee is unaffected," explains Friedrich Boettner, MD.

"With a partial knee replacement, patients often have shorter stays in the hospital than with total knee replacement and will usually meet rehabilitation goals at four weeks, while a patient with total knee replacement may need up to 12 weeks," adds Dr. Boettner.

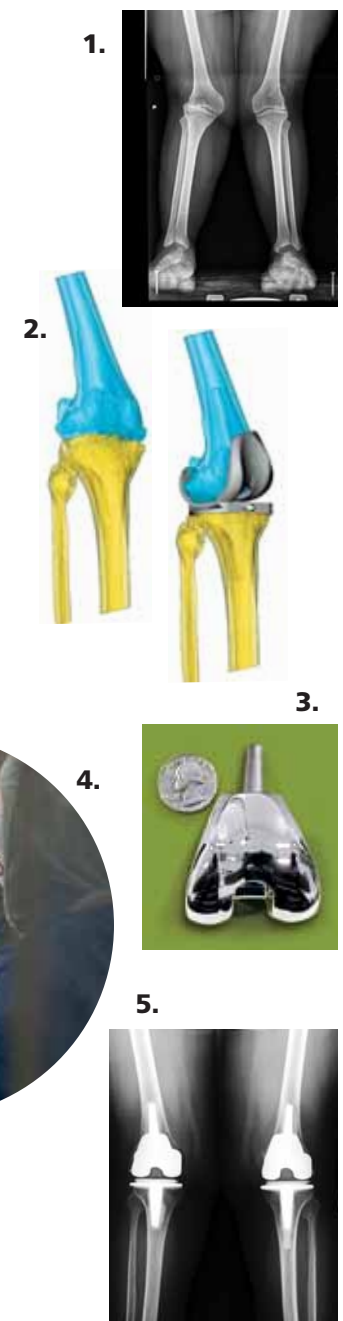
"Because unicondylar knee replacement preserves the cruciate ligaments, patients are expected to achieve better function and have the ability to be more athletic than those patients undergoing total knee replacement," says Andrew D. Pearle, MD. "I advise patients that total knee replacement is our best operation for pain relief; unicondylar knee replacement, while also a good operation for pain relief, may allow a more comfortable return to sporting activities."

According to Dr. Boettner, the selection of the appropriate patient for partial knee replacement is crucial to the overall success of the surgery. "We are now conducting cartilage, biomechanical, and imaging studies to develop guidelines that can help the surgeon decide who is a candidate for partial knee replacement and who is not."

*(continued on page 10)*

### Custom Knee Implants

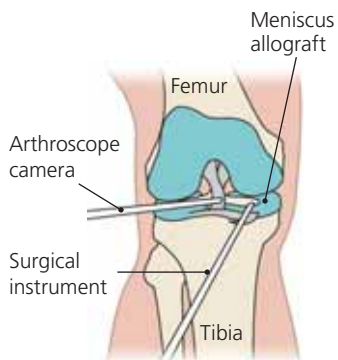
**1)** The creation of a custom knee implant begins with 3-D MRI or CT scans. **2)** A computerized model is then generated and a prototype of the knee with the implant is constructed. **3)** Specifications are sent to an orthopedic device company, which manufactures the implant. **4)** Dr. Mark Figgie provides custom surgical solutions for patients with severe deformity. **5)** A follow-up X-ray shows placement of the custom implants.





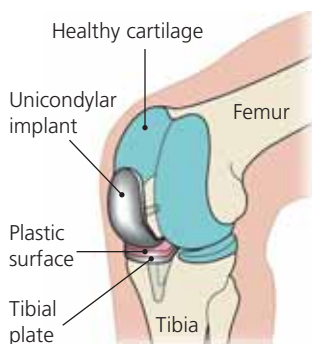
## Arthroscopic Knee Repair

Natalie Lewis-Ross had her first arthroscopy with Dr. Riley Williams nearly 15 years ago for a meniscal tear. "I knew if I needed any future surgeries hands down Dr. Williams was my man," says Ms. Lewis-Ross. That time came in February 2010, when she developed knee pain after exercising, "perhaps too aggressively," she says. Dr. Williams again performed arthroscopy and Ms. Lewis-Ross has resumed her favorite pastimes.



## Partial Knee Replacement

More than 30 years ago, Michael Lax suffered a football injury that set the stage for severe arthritis in his fifties. Fortunately, the arthritis was confined to one section of his right knee joint making him a candidate for partial knee replacement. Performed by Dr. David Mayman, the surgery not only alleviated Mr. Lax's pain, it enabled him to regain complete flexibility.



# The Right Knee Surgery for the Right Patient

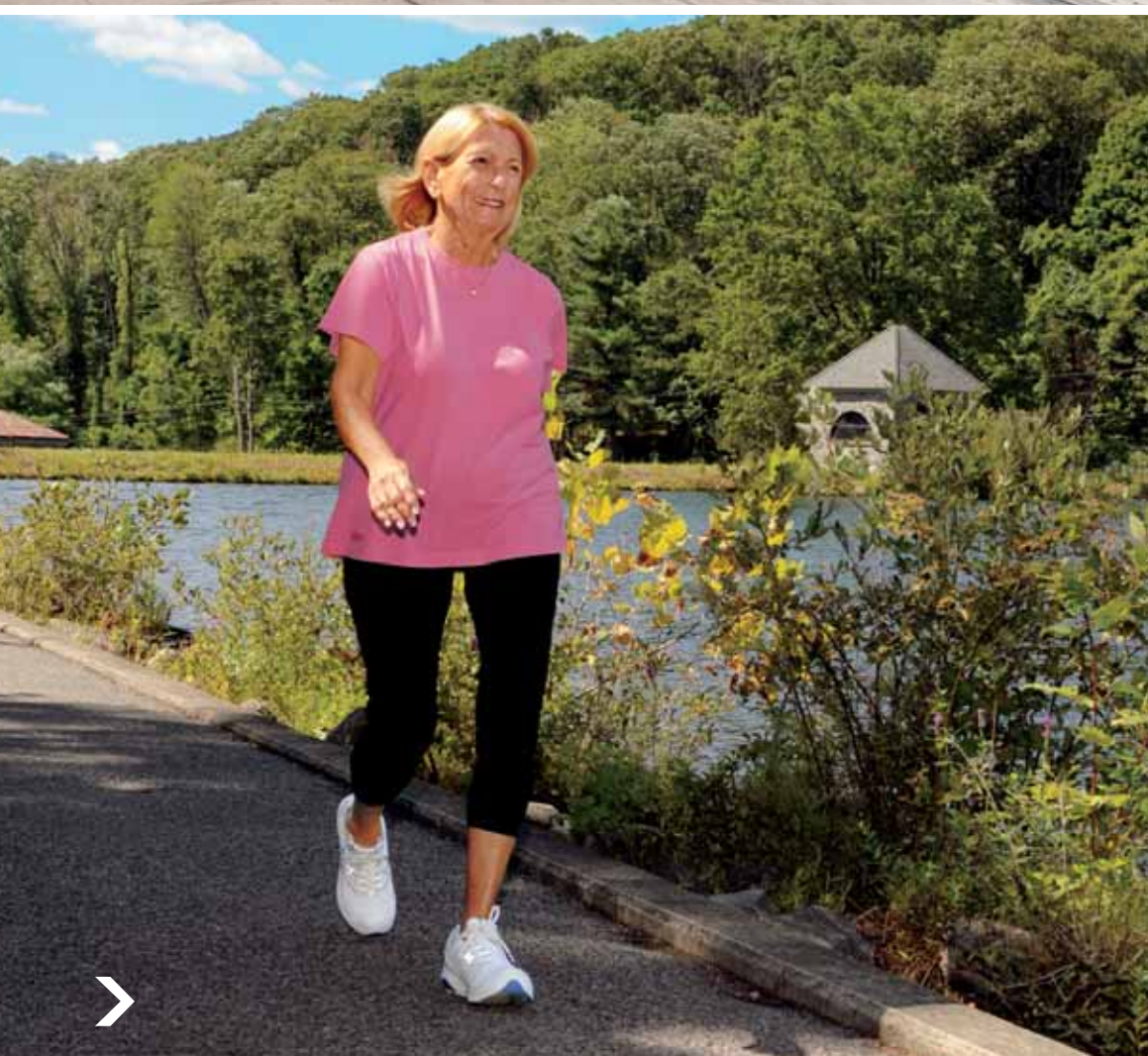
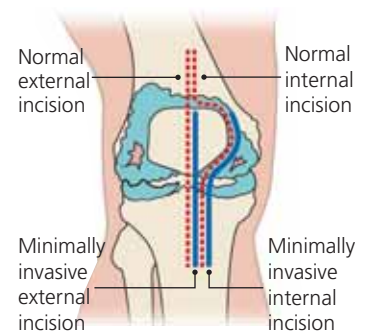






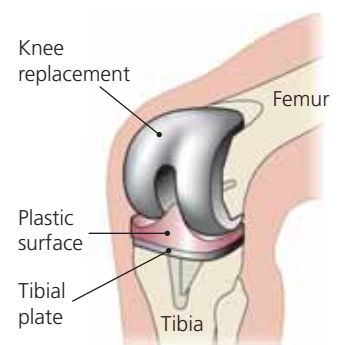
## Minimally Invasive Knee Surgery

When Chad Narz came in to see Dr. Russell Windsor he was unable to walk due to advanced osteoarthritis. Dr. Windsor was able to use a minimally invasive surgical approach to replace the diseased component of Mr. Narz's knee. This meant smaller incisions and a quicker recovery for 39-year-old Mr. Narz, who says, "I could not believe that I was up and active in three days."



## Total Knee Replacement

Carole Stark has just returned from a two-mile walk. A retired school teacher, Ms. Stark was used to being on her feet for hours at a time. So when unrelenting pain in her knee – the result of a torn meniscus a decade earlier – required her to curtail her activities, she came to see Dr. Geoffrey Westrich. Dr. Westrich performed a total knee replacement in July 2009 and, says Ms. Stark, "I am back on track."





# Jim Holubis: Taking the Right Steps

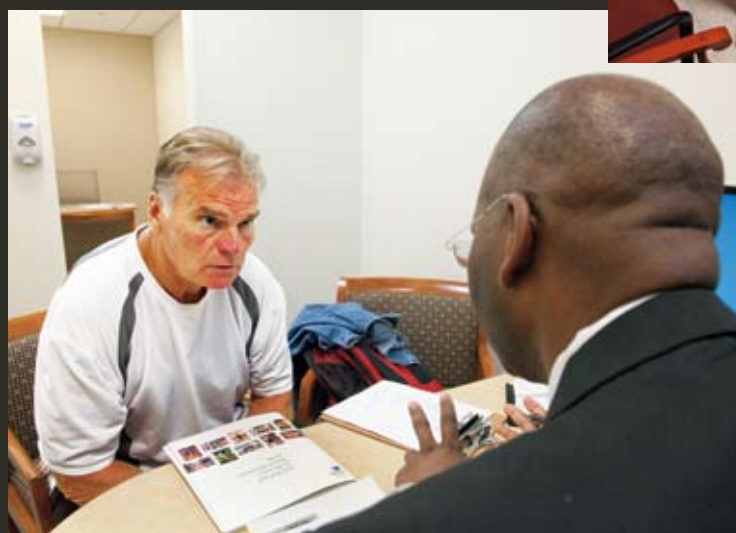
**H**aving advanced arthritis in both his knees, Jim Holubis was otherwise in good health and a perfect candidate for having both knees replaced at the same time. On August 15, he set a pathway to recapture his mobility and continue his life on his terms. An active person all his life, Jim, at 62, wants to resume his interest in sports and return to his physically demanding career as a professional actor.



## A Season for Change

2:34 PM: Two weeks prior to his surgery, Jim, a former football and basketball player, and golf enthusiast, discusses his expectations for actively participating in sports after bilateral knee replacement.

## Preparing for Surgery



### Taking Care of Pre-Surgical Details

10:00 AM: Nine days before surgery, Jim spends a full day at HSS preparing for his procedure. When he arrives, he reviews his medical history, insurance information, and other details of the

surgery with Merritt Jones, Admitting Assistant.

11:00 AM: (Above) An hour later, he is given a pre-op medical examination by Dr. Jill M. Rieger and a final review of his medical history and has an opportunity to ask any questions about what to expect.



### In Radiology

1:45 PM: Following his medical appointment, Jim proceeds to the Department of Radiology and Imaging for a full array of X-rays. Radiology technologist Michael Weber, RT, positions Jim's legs in various configurations so that his surgeon – Dr. Friedrich Boettner – can review the subtleties of his knee joint prior to surgery.

Inset: An X-ray taken while Jim is standing shows a weight-bearing frontal view of the knees.



### An Educated Patient

3:15 PM: After a short lunch break, Jim participates in an education class taught by

Lisa Briskie, BSN, RN. The class provides a practical review of what patients should expect before, during, and after surgery and how they can aid in their recovery.



## Day of Surgery

### In the Holding Area

7:40 AM: Dr. Boettner visits Jim just prior to surgery for a final review, to answer any last minute questions Jim might have, and to "sign" the site of surgery as part of the Hospital's surgical protocol.

7:50 AM: (Right) Dr. Nigel E. Sharrock, Jim's anesthesiologist, explains the type of medications he will use during the procedure and for pain management following surgery.



# The Surgery



## In the OR

8:15 AM: (Above) Prior to donning his "space suit" for entering the sterile surgical field, Dr. Boettner examines the X-ray images taken of Jim's knee joints during his pre-surgical preparation.

10:05 AM: (Right) The bilateral total knee replacement, performed by Dr. Boettner, assisted by Kathleen Forson, surgical technician (left), and Danielle Perkins, physician assistant (right), will take three hours during which time Jim's diseased joints are replaced with metal and plastic implants.



## Rehabilitation Begins

On the same day as surgery, a physical therapist will visit knee replacement patients to begin the process of rehabilitation.

8:00 AM: Three days post-op, physical therapist Marla Ranieri, DPT, (above left), works with Jim to continue the first phase of rehabilitation using a continuous passive motion machine. This gently facilitates range of motion and aids in recovery. Oasia Holback, RN, simultaneously monitors Jim for any distress and discomfort.



## Home Again

12:20 PM: After a five-day stay at Burke Rehabilitation Hospital, Jim continues his therapeutic exercise program at home. He has made great strides in strength and flexibility just two weeks after surgery.

# Restoration and Recovery



## Testing the New Knees

1:00 PM: Just six weeks after surgery, Jim is out and about testing his new knees. His decision to have both knees operated on at the same time is enabling him to return to life as he once knew it without further interruption.

Monday, August 30

Saturday, September 11

Friday, October 8



David J. Mayman, MD, Clinical Co-Director of the Hospital's Computer Assisted Surgery Center, makes extensive use of MAKOpasty® in patients who undergo partial knee replacement. "I use a robotic guide to drill the bone in order to make sure we are very accurate when we are putting these implants in place," explains Dr. Mayman. Unparalleled accuracy is at the heart of computer assisted surgery. "The goal after replacement is to have the center of the hip, the knee, and the ankle line up perfectly straight or within three degrees. With the computerized guides, we achieve alignment within three degrees over 95 percent of the time," he notes.

### The Role of Arthroscopy

Knee arthroscopy is a minimally invasive procedure commonly performed to treat a meniscus injury, for reconstruction of the anterior cruciate ligament, or for cartilage repair. When it comes to treatment of patients with knee injuries, Riley J. Williams III, MD, Director of the Institute for Cartilage Repair at HSS, says simply, "I try to prevent the need for the knee replacement."

Dr. Williams' use of arthroscopic techniques in conjunction with biological solutions to repair damaged cartilage is at the cutting edge of a new surgical subspecialty. He also oversees a clinical registry of approximately 900 patients, where clinical outcomes from cartilage repair procedures are catalogued and analyzed.

Injuries to cartilage in the knee usually lead to arthritis in the future. Adolescents and young athletes sustain many of these injuries and the arthritic lesions that go with them. "We try to come up with clinical options that will obviate the need for any kind of metal usage in these young people, as well as biological solutions to treat pre- or early arthritic problems," notes Dr. Williams.

Dr. Williams and his colleagues are engaged in an ongoing clinical trial for an off-the-shelf cartilage repair scaffold that he has used with positive results in more than 350 cases over the past five years, and he is tenaciously pursuing a new cartilage repair scaffold seeded with a patient's own cells that has shown very good results in trials. "The cell-seeded patch is literally placed into the defect to fill a hole, almost like you would fill a pothole," says Dr. Williams.

### Improving Surgical Outcomes

Hospital-wide quality and safety programs are improving overall care and enhancing surgical outcomes of patients who come to HSS. A critical factor in patient outcomes is infection prevention and control, and because of efforts in this area, HSS has one of the lowest, if not the lowest, infection rates for orthopedics in the world. Each operating room dedicated for joint replacement surgeries contains a plexiglass enclosure within which the surgery takes place. This enclosure is equipped with a unique ultra filtration air system



#### Back in the Swing of Things

A partial knee replacement by Dr. Michael Alexiades, followed by physical therapy, transformed Patricia Giustino's life from one of pain to one of pleasure.



#### Arthroscopic Surgery

During arthroscopy, Dr. Riley Williams (above left) makes small incisions in the joint, and then inserts a tiny camera and fiber optics to light the interior space. Images obtained with the camera are projected onto a screen in the operating suite to guide the surgery.



developed by the Hospital and custom made for its ORs. The surgical team wears space suit-like garb that is itself an air enclosure system. “Bacterial infections often occur because of airborne bacteria, which begin as dust particles,” explains Thomas P. Sculco, MD, Surgeon-in-Chief. “So we filter out all the dust particles and no one enters the enclosed plexiglass area unless they are in the suit, and any items we need are passed through openings in the plexiglass so that an ultra-sterile environment is maintained.”

“Much progress has also been made in the management of pain following total knee replacement surgery,” says Dr. Mayman. “This has greatly improved the patient experience and helps with the start of physical therapy, which is so important to recovery.” In addition, the Hospital has established a clinical pathway for patients based on functional milestones, such as when patients are ready to advance to the cane or to stairs.

Geoffrey H. Westrich, MD, Co-Director of Joint Replacement Research, is maximizing the potential of the Hospital’s knee replacement registry. “This database tracks all of our knee replacement patients to see who does well and who doesn’t do well, as well as potential complications – such as implant wear and loosening, infection, and instability,” says Dr. Westrich. “If we see there’s a potential problem, we’re able to go back and improve upon the design, thereby benefiting future patients.”

Information gleaned from the knee replacement registry is further supported by the Hospital’s total joint replacement registry, an initiative under the Center for Education and Research on Therapeutics (CERT). Through this registry, Co-Director Lisa A. Mandl, MD, MPH, and her colleagues are evaluating the overall success of total knee, total hip, and shoulder replacements by evaluating both patient reported outcomes and objective outcomes. “By following a large number of joint replacement patients over time, we hope to learn what makes patients satisfied with their joint replacement. This will allow us to focus on the things that will help ensure patients achieve optimal outcomes.”

### Pursuing Research to Preserve the Joint

Mary B. Goldring, PhD, Director of the Laboratory of Cartilage Biology, Tissue Engineering Repair and Regeneration, is investigating why joint replacement surgery becomes necessary at the most fundamental level. “We’re trying to understand the molecular biology of the cells within the cartilage under normal conditions and how the activities of those cells change when cartilage is damaged, as in osteoarthritis,” says Dr. Goldring. “We are asking how molecular signals in these cells are altered and predispose them to cause disease.”

### GPS Assisted Surgery

In the OR, Dr. David Mayman uses a computer navigation system, which looks and functions much like a GPS, to set the cutting guides to remove precise amounts of bone.



### Data-Driven Outcomes

Dr. Lisa Mandl interviews a knee replacement patient to obtain information for the total joint replacement registry that will be used to evaluate implant success over time.



Dr. Goldring is addressing this question from several angles, hoping to provide information that can lead to early intervention strategies. She has recently been awarded a new National Institutes of Health stimulus grant to define common molecular parameters for onset and progression of osteoarthritis. “In models of genetic osteoarthritis and of post-traumatic osteoarthritis that occurs as a result of meniscus injury, we are profiling the changes in gene and protein expression, and comparing the identified molecules in tissues from knees of patients undergoing total knee replacement,” says Dr. Goldring. “We want to profile changes in joint tissues to identify at what point the osteoarthritis may develop. In collaboration with a multidisciplinary team of HSS investigators, we are looking at the role of inflammation in patients following injury of the anterior cruciate ligament. Understanding how molecules are altered in response to mechanical and inflammatory stress may provide insight into approaches to slow cartilage damage, if not to help stimulate repair.”

In the Hospital’s Laboratory of Functional Tissue Engineering, Suzanne A. Maher, PhD, and her colleagues are focused on novel solutions to treat cartilage defects before they can lead to the development of arthritis and ultimately prevent the need for a total joint replacement. “My research is intended to help young, active patients who may have injured their knee resulting in a damaged meniscus, a local cartilage defect, or other soft tissue problems,” explains Dr. Maher. “We are trying to develop approaches that will enable us to intervene at a much earlier stage of the disease and slow down the progression to osteoarthritis.”

Dr. Maher is seeking to design a cartilage substitute that could function in the knee. “The challenge is to encourage cartilage cells to move into this foreign material and be resilient enough to withstand the stress we put on our knee joints, which is about three to five times our body weight every time we walk,” says Dr. Maher. “Our goal is to design a synthetic polymer that, when implanted into the knee, will function comparably to the tissue it is intended to replace.” Dr. Maher and her colleagues have already had a breakthrough in the laboratory, demonstrating that chondrocytes – the cells giving rise to cartilage – can move across to the polymer scaffold they created with very little stimulus.

“We also knew that if we could attach something to our polymer that could hook onto cartilage tissue when implanted, it may give us a physical anchor to the patient’s own tissue,” says Dr. Maher. Having identified a type of bacteria that attaches to, but also attacks, the cartilage, she and her colleagues have recently been able to develop a similar hook without the bacteria and show that the hook will attach to their polymer implants. “Out of everything that I’m doing, this is potentially the most intriguing.” ■



### **Revealing the Basics of Joint Destruction**

In the basic research laboratories of Dr. Suzanne Maher (left) and Dr. Mary Goldring, scientists are investigating cartilage and the reasons behind its destruction at the molecular level with a goal of identifying approaches to ultimately preserve the knee joint.



### **A Walk in the Park**

Larry Dais' participation on his high school track team included the high jump and pole vaulting. Over the years, he remained very active until arthritis set in. "I tried all the other remedies," noted Mr. Dais. "Finally it got to the point where it was just bone-on-bone." His research led him to Hospital for Special Surgery and Dr. Mark Figgie, who replaced both of Mr. Dais' knee joints. Now spending time with his six-year-old grandson or walking 18 holes on the golf course is a "walk in the park."





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*Editor-in-Chief*  
Rachel Sheehan

*Managing Editor*  
Linda Errante

*Assistant Editor*  
Adrienne Stoller

*Design*  
Arnold Saks Associates

*Photography*  
Robert Essel

*Illustration*  
Al Granberg

External Affairs Department  
Hospital for Special Surgery  
535 East 70th St., Suite 842W  
New York, NY 10021  
[horizon@hss.edu](mailto:horizon@hss.edu) [www.hss.edu](http://www.hss.edu)

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## The F.M. Kirby Foundation: Supporting Innovations in Knee Research

In 1994, when Fred M. Kirby II sought relief from a painful knee condition, Stephen A. Paget, MD, referred Mr. Kirby to Russell E. Windsor, MD, for knee replacement surgery. Dillard Kirby remembers that his father was in his mid-70s at the time and was concerned that the surgery would lead to additional surgery in the future if the knee implant wore out. Happily, further knee surgery has not been necessary, and "at 90, he's now up in the Adirondacks and riding around on his four-track."

At the time of the senior Kirby's surgery, HSS had already been the beneficiary of the F.M. Kirby Foundation's generous support for almost a decade. In 1987, Aldo Papone, Co-Chair of the Hospital's Board of Trustees and then President and Chief Operating Officer of American Express Travel Related Services Company, introduced Mr. Kirby II to the Hospital. They had come to know each other during Mr. Kirby's service as a member of the Board of American Express.

The Foundation, which was endowed in 1931 by Fred Morgan Kirby, one of the founders of the F.W. Woolworth Company, provides funding to a wide variety of non-profit organizations. Under the outstanding stewardship of F.M. Kirby II, the Foundation experienced impressive growth over the last 40 years. His son, Dillard Kirby, became President of the Foundation in April 2010, and F.M. Kirby II continues to serve on the Board as a Director.

Over a 10-year period, early F.M. Kirby Foundation support for HSS projects evolved into targeted funding that was consistent with the Foundation's interest in basic medical research.

Since 1997, grants have been focused on biomechanics, and the Hospital has received over \$2.2 million from the Foundation for research in this area. As a result of the Foundation's resolute commitment, life-altering progress has been made towards the

Hospital's goal of relieving pain and restoring mobility to the millions of people around the world who suffer from bone and joint disease.

Timothy M. Wright, PhD, holds the F.M. Kirby Chair in Orthopedic Biomechanics, which was endowed by the Foundation. Having achieved tremendous advances in treatment for older patients with knee implants, he is pursuing methods of prevention and early treatment in younger, active individuals. Under Dr. Wright's direction,



**Timothy M. Wright, PhD, Director of Biomechanics, demonstrates the equipment used to test stress on a joint.**

a multidisciplinary team of biomechanical engineers, orthopedic surgeons, radiologists, biologists, and biostatisticians conducts research in joint restoration. Among the team's achievements is the development of new biomaterials to replace damaged joint tissue, slowing or even preventing the onset of osteoarthritis. The end goal is to create a functional implant for cartilage defects.

"Our Foundation is very interested in supporting cutting-edge research," says Dillard Kirby. "When we met Dr. Wright, he was the right man at the right time – someone with devout, novel approaches to joint restoration and bone health."

"The willingness of the Foundation to support such research in its earliest stages is invaluable," says Dr. Wright. "Hospital for Special Surgery is privileged to continue to share in the visionary thinking of F.M. Kirby II and is deeply grateful to the Kirby family for its enduring commitment and generosity." ■