Page 2  High-volume Cartilage Repair Center Focuses on Biologic Joint Reconstruction
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Page 4  Fracture Intervention Team Addresses Underlying Bone Metabolism
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Page 6  Researchers Study Outcomes Data and Patient Perspectives to Improve Care
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Page 7  Hand and Upper Extremity Service Provides Full Spectrum of Care
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Orthopedic Surgery Highlights

Experts in musculoskeletal diseases – Orthopedic Surgery and Rheumatology:

- Provide advanced care for nearly 55,000 patients each year;
- Delivers a comprehensive array of innovative surgical treatments and diagnostic techniques and performs more than 8,500 surgical procedures each year;
- Lead an average of 79 clinical trials at a time, including trials that are rapidly expanding treatment options for patients with orthopedic conditions;
- Pioneer research, supported by $42.3 million in funds, that is advancing care for patients with orthopedic disorders.

This issue of Orthopedic Advances highlights a sampling of our latest activities including bone metabolism research, cartilage repair innovations, hand and upper extremity treatments, improved orthopedic outcomes initiatives, and advanced total joint replacement.

Thomas S. Thornhill, MD
Chairman, Department of Orthopedic Surgery

High-volume Cartilage Repair Center Focuses on Biologic Joint Reconstruction

The Cartilage Repair Center at Brigham and Women’s Hospital specializes in complex biologic reconstructive repair methods for patients with cartilage damage and early-stage arthritis. Orthopedic surgeon Tom Minas, MD, founded the Center more than a decade ago solely for the treatment of cartilage disorders. It remains one of a small group of centers dedicated to biologic joint reconstruction and is also notable for the high volume of advanced cartilage procedures performed there.

“Biologic joint reconstruction remains very specialized,” said orthopedic surgeon Andreas Gomoll, MD. A comparatively long recovery makes these procedures better suited for younger patients with cartilage defects resulting from injury or trauma. In specific cases, the Center performs these procedures in middle-aged patients with early degenerative changes who are looking for alternatives to knee replacement.

Drs. Minas and Gomoll perform a range of procedures, including autologous chondrocyte implantation (ACI), osteochondral and meniscal allograft transplantation, osteotomies, minimally invasive partial and total knee replacement, and ligament reconstruction. Their philosophy is to not only repair the cartilage damage itself, but to carefully determine and correct the underlying causes, such as malalignment, ligament instability and loss of meniscal function.

This systematic approach extends to outcomes research and clinical studies on the next generation of improved techniques and technologies. “We have an outcomes database that follows every single one of our cartilage repair patients – more than 800 to date,” said Dr. Gomoll.

ACI, for example, has been criticized for a high rate of reoperation to correct hypertrophy of the periosteal patch. In a recent study published in the American Journal of Sports

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Patellar instability and chondral defect

A 23-year-old female patient presented with a long history of recurrent patellar dislocations. She had previously undergone lateral release and chondroplasty without improvement. She underwent autologous chondrocyte implantation with collagen membrane to the patella, trochlea entry deepening osteotomy, anteromedialization tibial tubercle osteotomy and VMO advancement. She is now two years post-op with no recurrent instability and pain-free activities of daily living.

Pre-operative MRI demonstrating lateral patellar subluxation, trochlear dysplasia and median ridge chondral defect.

Intra-operative imaging demonstrating: (left) patellar defect (after debridement) and trochlear dysplasia (prior to deepening osteotomy); (right) patellar defect after ACI (bleeding from two suture anchors for supplemental fixation) and trochlea after deepening osteotomy and synovial advancement to cover exposed subchondral bone.

Intra-operative image showing multiple defects after debridement; (right) second look arthroscopy at one year.

For more information, contact Principal Investigator, Andreas Gomoll, MD, at (617) 732-9813, agomoll@partners.org. Also, visit cartilagerepaircenter.org to learn more about the Center.

Multiple chondral defects

A 32-year-old female presented with persistent left anterior and medial knee pain, unresponsive to three prior procedures including chondroplasty, microfracture, and artificial plug placement. Anteromedialization tibial tubercle osteotomy was performed with autologous chondrocyte implantation for multiple cartilage defects of the medial femoral condyle, trochlea and patella with a total transplanted area of 14.5cm². She underwent second look arthroscopy during TTO screw removal at one year showing excellent fill and integration of all grafts. She returned to skiing at 15 months and is now functioning well at three years post-op.

Tom Minas, MD
Orthopedic Surgeon,
Director, Cartilage Repair Center

Andreas Gomoll, MD
Orthopedic Surgeon
Fracture Intervention Team Addresses Underlying Bone Metabolism

A new hospital-based strategy to lower the risk of a second fracture in all patients treated for fragility fractures is transforming clinical care. This is based on the pervasive vitamin D deficiency first reported by a Brigham and Women’s Hospital (BWH) team 11 years ago.

Seeking the underlying causes of fractures, the team of orthopedic surgeons, endocrinologists and basic scientists at BWH had discovered extreme vitamin D deficiency (serum 25OHD<12 ng/ml) in half of 30 postmenopausal women admitted for hip fractures (and in 20 percent of the control group, women with osteoarthritis undergoing elective joint replacement). They reported their findings in the Journal of the American Medical Association (JAMA). A larger follow-up study by BWH researchers and collaborators found that 96 percent of women with fragility fractures of the hip in Boston and Baltimore showed vitamin D insufficiency, with 25 (OH)D levels below 32 ng/ml. Their studies and others also linked low vitamin D with more falls and reduced lower extremity muscle function one year after the original injury, putting patients at additional risk of injury.

The original observation had surprising results, and the follow-up study convinced the team that the problem was widespread. “Our major achievement was going beyond those findings and to systemically develop admission and discharge initiatives to improve patient care in the hospital,” said co-author Julie Glowacki, PhD, Director, BWH Skeletal Biology Research Laboratory, and Co-chair, Musculoskeletal Research Center, BWH Biomedical Research Institute. The initiatives included computer-generated prompts for endocrine results, blood draws for metabolic panel analysis, and initiation of vitamin D and calcium supplements.

**Studies Transform Hospital Care**

“If we can intervene earlier and optimize bone health and get the patients into gait training and balance programs, we may be able to help them avoid falling again,” said co-author Mitchel Harris, MD, Chief, Orthopedic Trauma Service. “The geriatric patient population is increasingly noted to be more active, and they have higher expectations of returning to those activities. We want to determine how to improve treatments and keep the bones as healthy as we can.”

That conversation led to the Brigham Fracture Intervention Team (B-FIT\textsuperscript{©}) for caregivers to evaluate and address the osteoporosis and vitamin D status of patients older than 50 who are admitted with fragility fractures of the hip or femur. Audits of patient records show a 68 percent effectiveness of computer reminders upon admission and 80 percent effectiveness on discharge after the first four years of experience with the evolving program. These results were reported by Drs. Glowacki, Harris and their colleagues in August 2009 in the online International Journal of Endocrinology.

Upon admission, the B-FIT\textsuperscript{©} computer-based reminder prompts the admitting orthopedic trauma service surgeon to order a test for serum 25OHD levels, initiate daily calcium (1,200 mg) and vitamin D (800 IU), and order an endocrinology consultation and a single high dose of vitamin D (50,000 IU). At discharge, the computer prompts oral and written instructions for supplemental calcium (totaling 1,240 mg daily) and vitamin D (1,200 IU daily).

**Evidence-based Care Continues to Evolve**

Endocrinologist Meryl LeBoff, MD, Director, Skeletal Health and Osteoporosis Center and Bone Density Unit, who helped lead the first study, continues to evaluate better ways to transition from acute to long-term care for osteoporosis when patients return to their primary care physician or specialist. “There is greater awareness now, but national data show that only 20 percent of patients with a fragility fracture are evaluated or treated for their underlying osteoporosis,” said Dr. LeBoff. “There is an unprecedented opportunity with the 2004 Surgeon General’s Report on Bone Health and Osteoporosis and the National Action Plan to transform fracture care.” Dr. LeBoff and colleagues are currently evaluating the effects of 2,000 IU vitamin D in the primary prevention of fractures in the NIH-sponsored “Vitamin D and Omega-3 Fatty Acid Trial (VITAL)”
“We know that prevention is better than treatment,” Dr. Harris said. “And prevention after treatment is better than a second fracture.” The team continues to collaborate on integrating research findings into the clinical care pathway, taking observations back into the lab for further insight, and evaluating the effectiveness of their clinical interventions.

“The same evidence-based bone care applies to the growing number of people with total joint replacements who are coming in with fractures,” said Dr. Harris, who is working on novel ways to fix joint replacement fractures for active patients, such as a 70-year-old skier with a total knee replacement who breaks a femur on the slopes. He and his colleagues are analyzing a series of cases to evaluate outcomes and characteristics for repairing the fracture, replacing the joint, or a combination of the two.

“The trauma and total joint services enjoy a uniquely collaborative relationship which allows them to evaluate these injuries and determine preoperatively which patients may in fact benefit from the combination of a revision joint and fixation of the fracture,” said Dr. Harris. “Rather than fixing the fracture initially and then having to subject the patient to a second procedure – a revision of the joint after the fracture heals.”

On the basic science front, Drs. LeBoff and Glowacki recently found that human bone marrow stromal cells have the molecular “machinery” both to metabolize and respond to vitamin D, which appears linked to the cells’ ability to produce more bone-building osteoblasts, according to their report in the January 2010 *Endocrinology*.

**Researching Atypical Fractures**

“The other side of the story is osteoclasts,” said Dr. Glowacki, who with her colleagues is unraveling the mechanisms of why older patients’ bone marrow generates five times more osteoclasts than the marrow of younger patients. This project started with studies of people coming in with fractures.

Clinically, Dr. Harris and his colleagues are seeing a new pattern of atypical fractures in people taking alendronate and other bisphosphonates, which block the bone resorption of osteoclasts and interferes with the dynamic laying down and removal of bone. “Whereas the medication protects the ‘hip area’ of the femur where we see the majority of fractures, we are seeing a small spike in fractures below the hip,” Dr. Harris said.

Dr. Glowacki and the team also have followed up on the other surprising finding in their earlier *JAMA* paper: *The Co-existence of Osteoporosis in Patients with Osteoarthritis*. The researchers had originally enrolled osteoarthritis patients undergoing joint replacement as the control group, because the conventional thinking, based on a small 1972 study by others, held that osteoporosis and osteoarthritis of the hip do not normally occur together. It was surprising that one-quarter of the 68 women had hidden osteoporosis, a finding replicated in more recent studies by others. Improving vitamin D status and evaluating osteoarthritis patients for osteoporosis may protect against worsening disease and fragility fractures.
Researchers Study Outcomes Data and Patient Perspectives to Improve Care

The Orthopedic and Arthritis Center for Outcomes Research (OrACORe), a clinical and health policy research unit embedded in Brigham and Women’s Orthopedic Surgery Department since 2006, studies treatment efficacy and cost effectiveness of prevalent musculoskeletal conditions, as well as the implications of these conditions and treatments for patients, clinicians, health-care providers and society.

“We try to fill in the evidence base about what works and what doesn’t work,” said rheumatologist and Center director Jeffrey Katz, MD. “Clinicians and patients need information for making better decisions. Other major stakeholders – the United States government and insurance companies – need good evidence to inform policy making and to understand how people’s health is affected by their decisions.”

Selected projects and the latest findings from some of the OrACORe projects range from enhancing clinical decisions to assessing the societal impact of disease:

- **Osteoarthritis Policy (OAPol) Model** – Center Co-director and principal investigator Elena Losina, PhD, and her colleagues have built and validated a computer simulation model of the natural history and outcome of knee osteoarthritis. The model is designed to translate research into effective prevention and treatment strategies. In a recent publication (Osteoarthritis and Cartilage, online October 2010), the team projected that 35 percent of obese adults in the United States aged 60 to 64 will have advanced knee OA by 2020, compared to 10 percent among the non-obese cohort. At the American College of Rheumatology’s 2010 Annual Scientific Meeting in November, preliminary findings addressed several areas – disparities in total knee replacement in African American men and women, earlier onset OA in the general U.S. population from obesity and other factors, and the increased lifetime risk of knee OA after an ACL tear at a young age.

- **Meniscal Tear in Osteoarthritis Research (MeTeOR)** – Despite 500,000 arthroscopic partial meniscectomy operations every year, it’s unclear if the procedure is better than a rigorous physical therapy regimen in patients with osteoarthritis of the knee and symptomatic meniscal tears. To answer that, Dr. Katz is leading a randomized controlled clinical trial that will enroll 340 patients at seven U.S. centers by summer 2011. The trial is coordinated at BWH and funded by the National Institutes of Health, including stimulus funding from the American Recovery and Reinvestment Act. The study is roughly 90 percent enrolled as of December 2010.

- **National Institute of Arthritis and Musculoskeletal and Skin Multidisciplinary Clinical Research Center (MCRC)** – Among three current projects, Dr. Katz is directing a comprehensive population-based study of the determinants of revision of total hip arthroplasty. The research team will study more than 800 U.S. Medicare patients with revisions and 800 without revisions from 1995 to 2008.

- **Adding Value in Knee Arthroplasty (AViKA)** – Dr. Losina, AViKA principal investigator, and John Wright, MD, Chief Surgical Investigator, lead a four-part study of patients undergoing total knee arthroplasty at BWH. In part one, focus group interviews revealed general patient satisfaction with TKR-related care and elicited suggestions of better coordination between hospital and rehabilitation personnel and better delineation of recovery milestones. Next comes a detailed evaluation of the all procedure and hospital costs. In a preliminary retrospec-
Hand and Upper Extremity Service Provides Full Spectrum of Care

The Hand and Upper Extremity Service in the Brigham and Women’s Department of Orthopedic Surgery specializes in the full spectrum of diseases of the hand and upper extremity, including fractures, ligament injuries and tendonitis. For more than 30 years, the Service has emphasized care of the full upper extremity.

Brigham and Women’s reputation in rheumatology and orthopedic care attracts a large volume of patients with arthritis with a spectrum of conditions ranging from the more common osteoarthritis to the less common rheumatoid arthritis, lupus, scleroderma, and psoriatic arthritis. When this involves the upper limb, the upper extremity service performs tendon and joint reconstructions, including total joint replacements of the shoulder, elbow, wrist and digits.

“We’re on the cutting edge and give patients the best care with good long-term followup,” said Barry Simmons MD, Chief, Hand and Upper Extremity Service.

Injections for Dupuytren’s Disease

In addition to arthritis treatment, the Service has particular expertise in entrapment neuropathies (such as carpal tunnel syndrome), Dupuytren’s contracture, traumatic disorders, and sports injuries of the hand and upper extremity.

One major change in care in Dupuytren’s, involves injection of the cord with clostridium collagenase (Xiaflex), which allows the cord to be ruptured, correcting the contracture. “For close to 200 years, the only treatment available was surgery,” said orthopedic surgeon Philip Blazar, MD, fellowship director of the program who served as the local principal investigator in a national clinical trial that led to U.S. FDA approval in February 2010. The findings of the randomized, double-blind, placebo-controlled study of more than 308 patients were published September 3, 2009, in the New England Journal of Medicine:

- 64 percent reached the primary endpoint of straightening the finger within five degrees of fully straight, compared to six percent in the placebo group.
- 85 percent of patients experienced 50 percent or more improvement in range of motion;

• On average, patients went from 40 degrees of motion to 80 degrees of motion, compared with the placebo group, which went from 45 degrees to 49 degrees of motion.

Outcomes Research

A randomized study by Dr. Blazar and his colleagues evaluated a recent popular trend for repairing volar locked plating. One year following the procedures, both the open reduction and internal fixation with a volar plate and the closed reduction with percutaneous pin fixation worked equally well. Volar plate fixation resulted in much more rapid recovery of function which is, in part, responsible for the recent enthusiasm for volar locked plating of distal radial fractures, the

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Researches study outcomes data and patient perspectives to improve care ... continued from page 6

tive study, the team identified major components of the costs of care on a cohort of BWH patients undergoing TKR. The data show that nursing costs, implant costs and costs of surgical supplies constitute about 3/4 of all inpatient costs, with implants contributing to about 28 percent of total inpatient costs. From there, researchers will examine the relationship between outcomes and costs in a cohort study of TKR recipients. Finally, the team will conduct a proof of concept randomized trial to establish the efficacy and cost effectiveness of a post-surgery navigator, a person who helps patients comply with their rehabilitation regimes and ensure that all milestones are reached on time.

- Program for Research Incubation and Development (PRIDE) – Orthopedic Department faculty collaborate productively with OrACORe faculty and staff to move their clinical research ideas forward. In a recent example, Mitchell Harris, MD, Chief, Orthopedic Trauma Service, and his OrACORe co-authors reported high mortality rates (greater than 27 percent) at one year following surgery cervical spine fracture, regardless of surgery or non-operative management, a risk that increases with age and comorbidities. “The chosen method of treatment for these injuries (operative or non-operative) should not be emphasized to the patient or the family as the critical determinant of either short-term (three-month) or long-term (one-year) mortality. It is but one variable to be considered in the decision-making process,” Drs. Harris, Katz and their co-authors concluded in the March 2010 paper, “Mortality in Elderly Patients After Cervical Spine Fractures,” Journal of Bone and Joint Surgery, March 2010.

Hand and Upper Extremity Service Provides Full Spectrum of Care... continued from page 7


Dr. Simmons and his colleagues have studied outcomes and patient satisfaction in a number of procedures. In general, they have found that patient satisfaction has more to do with self-image, relief of pain, and return to functionality, rather than with the more traditional objective measurements – such as range of motion, grip, and pinch strength. Orthopedic surgeon Brandon Earp, MD, is conducting a long-term follow-up study on treatment for carpal tunnel syndrome release to assess whether patients maintain postoperative relief of symptoms.

Training and Education

Through the Harvard Hand/Upper Extremity Surgery Fellowship, the Service has trained three decades of leaders in the field across the country. The year-long fellowship includes experience at Brigham and Women’s Hospital and nearby Children’s Hospital, West Roxbury VA Center, and our community partner Faulkner Hospital.