In a lab less than a fly ball’s distance from Fenway Park—home of the Red Sox—a team of BIDMC Department of Orthopaedics researchers is studying the uniquely human motion of throwing. Using robotics, computers, and high-speed cameras, they are creating and tracking the movement of the shoulder while pitching to better understand the causes of injuries. Their analysis of the interplay between the scapula, or shoulder blade, and the glenohumeral joint, commonly known as the shoulder joint, may lead to improved diagnosis and treatments for patients.

Arun Ramappa, MD, Chief of the Sports Medicine Division, and Ara Nazarian, DSc, of the Center for Advanced Orthopaedic Studies, launched the study in 2007 with a grant from the Major League Baseball Medical Advisory Board. Over the past six years, they have developed their own farm team—enlisting help from numerous Boston University engineering students, who have gone on to find jobs in industry, as well as post-doctoral fellows, who are now orthopaedic surgeons.

In addition to pitchers, shoulder injuries plague athletes playing a variety of sports involving overhead actions, including football, tennis, basketball, racquetball, and volleyball. But shoulder injuries are also not exclusive to athletes and may result simply from poor posture.

“The majority of people will have pain in their shoulder,” says clinician-scientist Joseph DeAngelis, MD, Director of Sports Medicine Research. “Most of that pain is going to be related to the behavior of the scapula.

“Dyskinesis or abnormal movement of the scapula can lead to chronic inflammation of the rotator cuff tendons,” he adds. “When combined with repetitive use, degeneration of the tendons occurs, often resulting in a rotator cuff tear.”

A complex joint
The shoulder is the most flexible joint in the body but also the most vulnerable. The mobility of the arm

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Letter from the Chairman

Dear Colleagues and Patients:

I am pleased to introduce the inaugural issue of Orthopaedic Connections, an online and print publication highlighting the latest news in clinical care, research, and education in the field of orthopaedics at Beth Israel Deaconess Medical Center (BIDMC). To be published three times a year, the newsletter will feature stories about patient-centered care and innovative research.

In this issue, you will learn about: new insights into shoulder injuries, the potential role of brown fat in treating obesity, and the care we gave to Boston Marathon bombing victims.

The publishing of the newsletter coincides with the 10th anniversary of our revitalized Orthopaedic Department. Over the last decade, we have grown tremendously to meet the needs of our patients—from two full-time faculty surgeons to fifteen and from one non-operative physician to six. We now have physician assistants and nurse practitioners providing patient care as well.

We’ve built a group that is vibrant and collegial, and provides excellent patient care. All of our physicians are board certified and on the faculty of Harvard Medical School. The department includes general musculoskeletal medicine and every subspecialty in adult orthopaedics:

- foot and ankle
- hand, wrist, and elbow
- joint replacement and reconstruction
- orthopaedic oncology
- orthopaedic trauma and geriatric fracture care
- spine (part of BIDMC’s multidisciplinary Spine Center, which also includes Neurosurgery, Anesthesia, and Physical Therapy)
- sports medicine and shoulder surgery.

A major teaching hospital of Harvard Medical School, we train medical students as well as residents through the Harvard Combined Orthopaedic Residency Program. We also offer orthopaedic tumor, hand, and spine fellowships. Our commitment to high quality educational programs has helped ensure that we provide both a superior experience for our trainees and the best care for our patients.

Clinical research is a critical component of our department. We have established a funding program that awards start-up grants for projects involving clinicians and basic scientists from our lab. We also sponsor medical student and resident research. Our support, which extends to biomechanical research as well as biologic, will make possible evidence-based medicine and better decision-making about patient care.

We hope this newsletter will provide you with useful information and serve to connect us. Please give us feedback about our newsletter and let us know if we can provide any service to you or to your patients.

Sincerely,

Mark C. Gebhardt, MD
Chief, Department of Orthopaedics
O
nce thought only to generate heat in babies too young to shiver, brown fat has been discovered in adults, where in response to cold exposure, it can burn more calories, ounce for ounce, than any other tissue in the body. Unlike common white fat, which stores excess calories, brown fat consumes calories to produce heat. Researchers hope to find ways to “rev up” this naturally occurring fat to help people combat obesity and diabetes.

In an unusual collaboration, BIDMC spine surgeon Andrew P. White, MD, has joined forces with endocrinologist Aaron M. Cypess, MD, PhD, of the Joslin Diabetes Center and other Harvard researchers to isolate and analyze brown fat samples from adult volunteers. Significantly, the team has been able to transform precursor fat cells into metabolically active brown fat cells. Findings of the study have been reported in *Nature Medicine* (April 21, 2013), a premier journal for biomedical research.

Diabetes specialist Cypess paired up with White because of a common interest in a protein called BMP7 that influences brown fat. In addition, White frequently performs anterior cervical spine operations in region where PET scans have revealed active brown fat. The study is funded by Harvard Catalyst, a program that encourages interdisciplinary projects, and the National Institutes of Health.

“The brown fat collaboration is about preventing complications of type 2 diabetes and cardiovascular risks associated with obesity,” says White. “Obesity is currently the number one cause of preventable death in the United States, so the project has a very significant translational research aim.”

**Finding calorie-burning fat**

To determine where brown fat can be found and examine its structure and function, the researchers removed fat tissue from five different areas of the neck in 31 patients who were having anterior cervical surgery. Brown fat, they discovered, was most abundant in deep locations near the carotid sheath, which envelops the carotid arteries, and the longus colli muscles, close to nerves that control body temperature.

“It makes sense that the system would evolve that way—deep inside to warm the blood and body effectively,” notes White.

The effects of brown fat have been well studied in mice. Like human infants, mice lose heat rapidly because of a higher ratio of body surface to body volume. Because of this proportionally higher exposure to the cold, they rely on brown fat to warm their bodies.

The researchers found that brown fat from deep locations in humans closely resembled that of mice, which is known to have tremendous calorie-burning capacity. “Experiments done in mice have shown that brown fat can be stimulated to produce heat and waste calories,” says White. “Our study is looking at whether brown fat in humans can be similarly stimulated.”

To do this, the investigators induced precursor human neck fat cells *in vitro* to become brown fat cells. Those cells, when stimulated, expressed higher levels of genes (*UCP1* and *PPARGC1A/PGC-1α*) indicative of the metabolic activity specific for brown fat.

This positive response suggests there may be ways to activate brown fat in people, allowing them to lose weight by burning more calories. Preliminary studies show people who are younger, thinner, and female tend to have more active brown fat. White cautions that it remains to be seen if activating the brown fat of, say, an old, overweight man can make him shed pounds. The next step in the ongoing study is determining the feasibility of brown fat stimulation in the human body.

“This is a potential way to intervene on obesity, the most important public health problem in our country.” says White.
largely depends on the scapula, the triangular bone in the back of the shoulder that connects to the humerus (arm bone) and the clavicle (collarbone). Unlike the hip joint, which lies deep within the body and is intrinsically stable, the shoulder is vulnerable, secured to the chest by muscles only.

The 17 muscles that attach to the shoulder blade need to not only work well but together in a fluid motion. Known as scapula-thoracic rhythm, this coordinated muscle action is easily disrupted by an injury.

“The shoulder is incredibly complex with bones sliding, moving, and pivoting in concert,” says DeAngelis. “Most people, when studying the shoulder, simplify its motion by only looking at how the ball turns in the socket, ignoring the shoulder blade. Our system allows us to model the entire shoulder.”

To have a more realistic view of how the shoulder works, the researchers use cadavers with computer-controlled robotic actuators. A mechanized scaffold moves the cadaver’s arm, mimicking any upper extremity motion, such as pitching. Using markers mounted onto the arm, shoulder blade, and chest wall, high-speed cameras capture the action. Researchers then simulate various conditions like scapular winging, rotator cuff tears, and shoulder separations to assess differences between healthy and problematic shoulders.

“Everything is conducted automatically, so you can program the system to study upper extremity movements of any kind,” says biomedical engineer Nazarian. “This experiment allows us to collect accurate, precise, and real-time data as the arm moves in a predetermined path.”

He adds that this research is part of BIDMC’s effort to make medicine more evidence-based, providing physicians with treatments that are grounded in scientific rigor. Results from the study may help the effort to eliminate pain and prevent surgery for patients as well as to provide more effective physical therapy for those who have had surgery.

As with all research, each time a question is answered, more questions arise. “We investigate what other research teams cannot do, because of the accuracy and complexity of this model,” says DeAngelis. “We are even revisiting the fundamental understanding of how the ball turns in the socket. We have an infinite amount of work to do. The game just gets played again and again.”

For further reading:

“The effect of simulated scapular winging on glenohumeral joint translations,” July 2013 issue of the Journal of Shoulder and Elbow Surgery

“Preliminary evaluation of a robotic apparatus for the analysis of passive glenohumeral joint kinematics,” published online July 24, 2013 in the Journal of Orthopaedic Surgery and Research

Visiting Professor

W. Ben Kibler, MD, Lexington Clinic orthopaedic surgeon and medical director of The Shoulder Center of Kentucky, visited BIDMC’s Center for Advanced Orthopaedic Studies on October 24, 2013. The nationally known shoulder expert gave a talk on the role of the scapula in shoulder injuries. Following his presentation, BIDMC researchers gave Kibler a tour of the shoulder biomechanics lab facilities, and Post-doctoral Research Fellow Aidin Masoudi, MD, presented an overview of the team’s research on shoulder injuries.
On April 15, 2013, the sounds of sirens seemed to go on continuously as ambulances transported badly injured victims of the Boston Marathon bombing to BIDMC. Surgeons and other caregivers from Orthopaedics rushed to treat the incoming patients.

Orthopaedic Connections recently spoke to Edward Rodriguez, MD, PhD, BIDMC’s Chief of Orthopaedic Trauma Surgery, who treated many of the victims and together with Alok Gupta, MD, of the Department of Surgery, directed the efforts of a multidisciplinary team who cared for the postoperative needs of these severely injured patients.

Q. As a trauma surgeon, you care for patients with serious injuries from home, industrial, and traffic accidents. How was treating Marathon bombing victims different?

A. The injuries we saw were not that different from what we, unfortunately, treat on a daily basis. If your limb is severely damaged in a bomb blast or by crashing a motorcycle going 100 miles an hour, the result is often similarly devastating. But because the bombs exploded low on the ground, no one who survived the initial blasts died, as most injuries were, thankfully, below the waist. Often this is not the case with high-speed accidents, which may result in thoracic, head, and spine injuries as well.

What was remarkably different was that more than 20 people came into the hospital at the same time. A mass casualty event of this magnitude had never happened before in Boston. With a serious traffic accident, we may have one or two victims at most at one time. The hospital’s response to a high volume of simultaneously injured people is a credit to the institution’s preparedness. And it’s a credit to the Orthopaedics Department that care providers came in immediately without being told to.

Q. What helped make the bombings not as devastating as they could have been?

A. First, the setting of the Marathon was in a city that had plans in place for dealing with mass casualties. Also, the number of physicians on-site at the end of the Marathon meant there was medical capability to deal immediately with some of the injuries. In addition, the event happened to be geographically equidistant between five level-one trauma centers. Finally, we were thankful it was not a more powerful explosive like a car bomb, which could have killed hundreds.

Q. Where were you when you heard about the bombings?

A. It was school vacation week, and I had just arrived in San Diego with my family. We were in a Mexican restaurant eating lunch when the first news flash came on TV. Just as I turned to watch, my phone started going off. So I left my family in California and flew back that night.

I missed the initial day, but my partner Dr. Paul Appleton was here to take charge in Orthopaedics, and everything went very smoothly.

Q. What orthopaedic surgery did the victims require?

A. The patients we saw had lower extremity blast injuries. Most of their wounds were heavily contaminated, so we did debridements [removal of damaged tissue and foreign objects]. Since injured tissue can further degrade with time, the true nature of their injuries often was not apparent for a few days. Most of the amputations that were needed came in a staged manner, a series of many operations. Our goal was to prepare the limb to be healthy enough to be fitted with a prosthctic. To get to this point involved a lot of orthopaedic and plastic surgery. Prosthetics have made huge advances recently—some have hydraulic knees for above the knee amputations—but we make every effort to preserve the knee whenever possible.

Q. What kind of postop care did you offer?

A. After the first few days, a Mass Casualty

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A freak skiing accident in 1983 led to years of painful knee problems for Sheila Schlesinger. While she was standing still on a mountain slope in British Columbia, an out-of-control skier suddenly collided with her, tearing three of the four bone-connecting ligaments in her right knee. Unable to walk, Schlesinger underwent major joint reconstruction in a New York City hospital, close to her home. She was in a long leg cast for a month, which led to ongoing knee joint stiffness. Despite several additional arthroscopic surgeries in New York and Vail, Colorado, she continued to have pain, a bowed leg, and a pronounced limp.

When she found herself lagging behind her six young grandchildren, she knew it was time for a knee joint replacement. “I wanted to be able to keep up with our kids and grandchildren and enjoy leading an active lifestyle with them,” says Schlesinger, a retired psychologist.

She searched for medical care based on two criteria: the surgeon had to specialize in lower extremity joint replacement, and the hospital had to have a very low post-op infection rate. Based on recommendations from two physicians, she came to Douglas K. Ayres, MD, MBA, Chief of the Division of Arthroplasty at BIDMC.

“When I first saw Sheila Schlesinger in 2006, she had progressive deterioration of the knee with severe stiffness due to arthrofibrosis [a build-up of scar tissue],” says Ayres. “After her fourth surgery, she had reached a plateau. She was dealing with a lot of pain and wasn’t able to do the activities she wanted to do.”

On October 10, 2006, Ayres performed very successful total knee replacement surgery, which enabled Schlesinger to return to the sports she loves. The first 10 days were “hellish,” as Ayres had warned, but with rehab, the pain gradually lessened, and her muscles grew stronger. Five months after her operation, she was downhill skiing in Utah, and six months out, she was windsurfing in Hawaii.

“I received incredible care in the hospital,” says Schlesinger. “Doug Ayres checked on me daily, and the nursing staff was phenomenal. It was very nice to see the same faces every day. Everyone was careful to take infection prevention precautions, including wiping down every surface in my hospital room.”

The value of education
In gratitude for her outstanding care, Sheila and her husband, Richard, made a donation in honor of Ayres to fund a study at BIDMC to determine if patients have better outcomes if they are more informed about their upcoming operation and attend an educational class prior to surgery.

The collaborative study will involve Ayres and fellow BIDMC joint replacement surgeons Ayesha Abdeen, MD, and Robert Davis, MD. “The study will evaluate the efficacy of our current education program by comparing functional outcome and patient satisfaction of those who attend the teaching classes with those who decide not to take the course,” says Abdeen, the principal investigator. “We will measure patient-reported functional outcome scores and expectations before and after joint replacement surgery.”

BIDMC’s joint replacement team began offering preop classes to patients and family members in 2006. During the two-hour session, physical therapists, nurses, and case managers discuss the surgical procedure, medications, precautions, postop rehabilitation, and recovery time.

“I believe preop education is absolutely necessary, and we’re working to validate that,” says Ayres. “Joint replacement is a significant surgery that is so dependent on the patient for the best possible outcome. They need to know about what to expect and the commitment necessary to have an excellent outcome.”

Seven years after receiving her artificial knee, Sheila Schlesinger continues to do very well. In fact, her “new” knee is now better than her other knee. “I’m grateful to be able to live my life the way I want to live it,” she says.
Orthopaedic Training at BIDMC

This summer the Department of Orthopaedics welcomed a new cadre of residents and fellows. A major teaching hospital of Harvard Medical School, BIDMC has a long history of training excellent physicians. Residents train in BIDMC’s Department of Orthopaedics as part of the five-year ACGME approved Harvard Combined Orthopaedic Residency Program (HCORP), a long-standing collaborative program of four Boston teaching hospitals.

A total of 47 residents from many different medical schools come to BIDMC each year to gain experience in both medical and surgical treatment of orthopaedic patients. Their comprehensive training includes faculty lectures, specialty conferences, and surgical skill sessions.

Arun Ramappa, MD, is the BIDMC site Program Director and a member of the Educational Committee for HCORP. Department Chief Mark Gebhardt, MD, is a member and the current Chair of the Harvard Medical School Executive Committee for the Department of Orthopedic Surgery, which has oversight of the residency program and medical student education in orthopaedics.

PGY-1 residents (interns) spend four months rotating through Orthopaedics, Neurosurgery, General Surgery, and Plastic Surgery. PGY-2 residents train for three to six months on the hand, joints, trauma, or sports service. PGY-4 residents spend one or two months on any of the following services: trauma, spine, or sports/foot and ankle. PGY-5 residents spend two months honing their skills in either trauma or sports.

In addition, four PGY-2 residents from Dartmouth-Hitchcock Medical Center train for three months each per year on Orthopaedic Oncology at BIDMC. Four residents come to BIDMC each year for a rotation that includes exposure to pediatric oncology at Boston Children’s Hospital.

“We are fortunate to have really high caliber residents who rotate through here,” says Orthopaedic Chief Mark Gebhardt, MD. “A few years ago, we increased the length of rotations, so residents have a better chance to learn how our system works. We’ve made it one of the best educational experiences in the residency program. They are taught, treated well, and given appropriate responsibility.”

The Department of Orthopaedics also offers one-year ACGME post-residency fellowship training in spine and hand services. One spine and two hand fellows began the program in August. Besides working with BIDMC faculty, the hand fellows spend time on the hand plastic surgery service at Boston Children’s Hospital (BCH) and the Shriners Hospital for Children.

In addition, BIDMC shares a combined fellowship in orthopaedic oncology with Massachusetts General Hospital (MGH). There are two fellows per year, and each spends six months at BIDMC/BCH and MGH.

BIDMC also helps to train third- and fourth-year medical students. As part of a core clerkship rotation, third-year students from Harvard Medical School spend two weeks in all of the orthopaedic services as well as casting and splinting. The fourth-year students, who come from any medical school in the world, train for two weeks in the trauma service and two weeks in the service of their choice.

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Service was organized to provide patients with multidisciplinary care. Members of Orthopaedics, Neurosurgery, Plastic Surgery, and General Surgery would meet each morning for combined rounds and then discuss patient treatment plans.

Later, as patients’ needs became more specific, most of the limb surgical care was divided between Orthopaedics and Plastic Surgery. But we continued to offer integrated multi-service postop care, so patients could see different doctors in one setting on the same day.

Q. Will these patients need long-term follow-up care?

A. A couple of the more severely injured are from Maryland and Texas, and are receiving care there. The Boston-based patients we treated are basically doing very well but are likely to come back for common long-term problems like residual shrapnel showing up, small skin graft erosions, and bony overgrowth at stump ends. A trauma patient is usually my patient forever. I probably have 2,000 or more active patients who come to see me regularly even many years after their initial treatment.

Q. What three words would you say sum up the response of BIDMC and your department?

A. Prompt, professional, and selfless.
Physiatrists Join BIDMC Orthopaedics

Two physiatrists recently joined the Sports Medicine team in the Department of Orthopaedics. These non-operative specialists care for people with musculoskeletal injuries related to sports, exercise, and daily activities. Working closely with surgeons, occupational therapists, physical therapists, and exercise physiologists, physiatrists oversee and coordinate rehabilitative care. Their focus is on restoring mobility and function and enabling people to return to physical activity.

The new arrivals in the Division of Sports Medicine are:

**John-Paul Hezel, MD** — Growing up in Bedford, Mass., Hezel was an avid fan of all the Boston sports teams and a baseball player himself. While in college at Georgetown University in Washington, D.C., he toyed with going into journalism and covered high school sports for The Washington Post. But instead, he decided to bring his love of sports to a career in medicine. After graduating from the University of Massachusetts Medical School, he completed a preliminary year in internal medicine at Saint Vincent Hospital in Worcester. He then served as a medical resident, specializing in physical medicine and rehabilitation, at Temple University Hospital/Moss Rehabilitation Hospital in Philadelphia. Before coming to BIDMC, he completed a clinical fellowship in the Sports Medicine Department at the University of Illinois at Chicago. He is board certified in physiatry.

With his appointment at BIDMC, Hezel has returned to his hometown, where he acts as the team physician for the Bedford High School football team. His hobbies still include writing, baseball, and cheering on his favorite sports teams.

**Preeti Shastri, MD, FAAPMR** — A native of Buffalo, N.Y., Shastri began playing tennis at age 5 and later participated in high school tennis, soccer, softball, and basketball. Her interest in sports led her to pursue a career in sports medicine.

In 2000, she graduated *magna cum laude* from Boston College with a degree in psychology. She earned her medical degree from Jagiellonian University, Collegium Medicum, in Krakow, Poland, where she enjoyed immersing herself in a new culture. After returning to the US, she completed an internship at Michael Reese Hospital in Chicago and a residency in physical medicine and rehabilitation at Georgetown University Hospital/National Rehabilitation Hospital in Washington, D.C. She then completed a clinical fellowship in primary care sports medicine at St. Louis University School of Medicine in Belleville, Illinois. Most recently, she worked at Mid-County Orthopaedic Surgery and Sports Medicine in St. Louis, Missouri, where she specialized in sports medicine and rehabilitation. She is board certified in physical medicine and rehabilitation as well as sports medicine.

In her spare time, she enjoys running, working out at the gym, biking, and watching her favorite football team—the Buffalo Bills.

### Faculty Activities

**Kevin McGuire, MD**, Co-Director of the BIDMC Spine Center, was awarded a grant from the Cervical Spine Research Society to study whether patients’ preoperative expectations regarding the outcome of their spine or joint surgery affects the actual outcomes of the surgery.

**Ayesha Abdeen, MD**, Joint Replacement and Reconstruction, became a joint surgery subject matter expert in a study supported by the Dartmouth Hitchcock Medical Center-based High Value Healthcare Collaborative examining shared patient-surgeon decision making in the evaluation of surgical and medical treatment options for patients with hip pain and indications for surgery.

**Ara Nazarian, DSc**, Center for Advanced Orthopaedic Studies, and **Edward Rodriguez, MD, PhD**, Trauma Surgery, were awarded a 3-year NHLBI R21 grant to study the development of a reversible hydrogel-based foam as a portable system for emergent homeostasis of intracavitary and extremity wounds, local analgesia, disinfection, and supplemental skeletal/soft tissue stabilization in remote trauma rescue scenarios.

**Tamara Rozental, MD**, Hand, Wrist, and Elbow Surgery, and **Mary Bouxsein, PhD**, Center for Advanced Orthopaedic Studies, presented “Poor Bone Microarchitecture in Premenopausal Women with Recent Distal Radius Fracture Persists after Adjusting for Ultradistal Radius BMD” at the annual meeting of the American Society of Bone and Mineral Research.

**Megan Anderson, MD**, Orthopaedics Oncology, authored a paper on “Frozen Section versus Gross Examination for Bone Marrow Margin Assessment During Sarcoma Resection,” which was published in the journal *Clinical Orthopaedic and Related Research*.

**Paul Appleton, MD, and Edward Rodriguez, MD, PhD**, Trauma Surgery, recently published “Financial implications of non-operative care at an academic trauma center” in the *Journal of Orthopaedic Trauma*. 