

Advanced Musculoskeletal Center—Uniting Diagnostic, Treatment, and Rehabilitation Services for Optimal Patient Care, Convenience, Dignity, and Education

Advanced orthopedic centers are in the vanguard of managing a newly defined group of patients, those considered orthopedically complex. These patients have extensive conditions and often comorbidities that require careful collaboration among specialists to obtain optimal outcomes.

Mayo Clinic's new W. Hall Wendel, Jr. Musculoskeletal Center leads the way, offering premiere services not only to orthopedically complex patients, but to all patients requiring state-of-the-art orthopedic subspecialty care. (See "At A Glance" sidebar, on page 2.) Opened in December 2007, the center does this through its centralized design that unites imaging, diagnostic services,

treatment, and rehabilitation in the same space. "The design supports Mayo Clinic's traditional goals of offering the best patient-centered care available in a clinical experience that is convenient, efficient, thorough, and pleasant," explains Daniel J. Berry, MD, chair of the Department of Orthopedic Surgery at Mayo Clinic in Rochester, Minnesota. "Our aim



Daniel J. Berry, MD

is to create a complete 1-stop clinical experience in which the patient easily moves from imaging through diagnostic services to treatment and rehabilitation, all without leaving the center."

Consider the following scenario and how smoothly the patient is accommodated by Mayo Clinic's new Musculoskeletal Center.

Case Example

A 50-year-old woman with rheumatoid arthritis is referred for evaluation of a hip replacement that has loosened. Her symptoms include groin and thigh pain, and her referring physician is concerned that her hip replacement may be infected.

Step 1. The patient is first seen by experts in hip and knee replacement to evaluate the hip complaint. They take a careful history, examine the patient, obtain hip radiographs in the radiology suites next door to the examination rooms, and obtain blood tests to screen for infection. They also do a preliminary examination of her upper extremities.

Step 2. She is next seen by the ortho-

Inside This Issue

Multidisciplinary Surgical Approach to Early Acute Total Hip Arthroplasty for Acetabular Fractures in the Elderly.....3

Musculoskeletal Ultrasound Offers Precise Placement of Injections and a Range of Treatments5

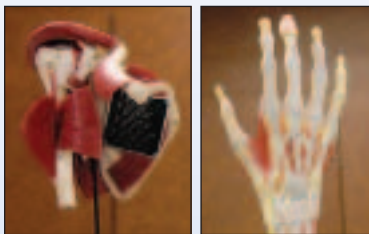
Orthopedic Research6



At a Glance: Mayo Clinic's New W. Hall Wendel, Jr. Musculoskeletal Center

With a 2-story lobby atrium at its core on the 14th and 15th floors of the interconnected Gonda and Mayo buildings in Rochester, Minnesota, Mayo Clinic's new W. Hall Wendel, Jr. Musculoskeletal Center offers patients improved access to the integrated components of comprehensive orthopedic care. They include orthopedic subspecialty care for

- Ankle and foot
- Hand
- Hip and knee
- Oncology
- Shoulder and elbow
- Spine



Other musculoskeletal specialists include

- Physical medicine and rehabilitation consultants
- Rheumatologists
- Endocrinologists to evaluate metabolic bone conditions
- Radiologists and anesthesiologists to perform image-guided injections for pain management
- Pediatric orthopedic specialists from the nearby T. Denny Sanford Pediatric Center

Some features of the Mayo Clinic Musculoskeletal Center are

- **Fully equipped examination rooms** for the orthopedic subspecialty areas of ankle and foot; hand; hip and knee; oncology, shoulder and elbow; spine
- **Outpatient Procedure Center** that offers 8 full-sized operating rooms; 4 image-guided injection rooms; a private family waiting area; and private pre- and postprocedure rooms for patients and families. Most outpatient

orthopedic procedures can be performed here, just 1 floor away from the outpatient clinic. Other specialists operating in the Outpatient Procedure Center include plastic surgeons, general surgeons, and ear, nose, and throat surgeons.

- **A cast and splint room** in which 10 private bays afford patients focused care from physicians, as well as easy access to adjacent radiology facilities and anesthesia services.
- **Multiple on-site radiographic imaging**, with 15 radiology suites and 1 ultrasound room.
- **Respect for patient dignity** by providing expanded space for private dressing rooms in the radiology suites.
- **Enhanced clinic-based treatments**, including ultrasound-guided injection procedures for improved accuracy in difficult-to-access anatomic locations.
- **Patient education center** fully equipped with anatomic models, touch-screen computer education services, video on demand, high-speed Internet work stations, and brochures and other explanatory literature. In addition, a patient classroom is available to accommodate Mayo-designed educational sessions to help patients maximize recovery through understanding their injuries, treatments, and rehabilitation regimens.
- **On-site staff social worker** to assist families and patients cope with the changes orthopedic injuries or conditions impose on their lives.



pedic infectious disease group to further evaluate the possibility of infection of the failed hip replacement.

Step 3. The hip and knee team summons colleagues in the shoulder and elbow group to evaluate new problems with those joints, indicated by pain and decreased shoulder and elbow range of motion. Further radiographs are obtained, which show arthritis of those joints. A plan for interval nonoperative care is made until after the hip problem can be treated. At the same time, longer-term plans for upper extremity joint replacement are discussed.

Step 4. The patient also has impaired hand function from her rheumatoid arthritis. She is evaluated by a specialist in the hand surgery group, as well as by a specialist in the hand occupational therapy group.

Step 5. The patient is noted to have increasing cervical spine pain, orthopedic spine colleagues are consulted and mild C1-C2 instability is diagnosed. Plans are made with the anesthesia team to manage

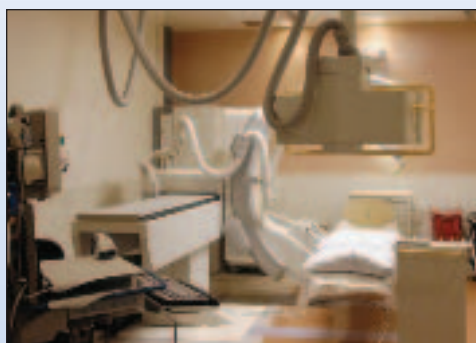
this problem safely during hip surgery.

Step 6. The patient is seen by Mayo rheumatologists to optimize rheumatologic management of her disease.

Step 7. Physiatrists and physical therapists are called in to help the patient optimize ambulatory and functional status before anticipated revision hip surgery.

Step 8. The patient is seen by the metabolic bone group to optimize management of diminishing bone density related to long-term corticosteroid use.

By the end of the evaluation, this patient has a better understanding of her health status, increased confidence in her care, and renewed optimism to support optimal recovery. "We are committed to giving our patients the best patient-centered, evidence-based, multidisciplinary orthopedic care possible," says Dr Berry. "I think the design and comprehensive functionality of our new Mayo Clinic Musculoskeletal Center reflects that commitment."



Concentrated Care—New Musculoskeletal Clinic Provides Optimal Care and Easy Access to Multiple Specialties in 1 Stop

The Musculoskeletal Clinic is just one of the specialty areas located in the new Mayo Clinic W. Hall Wendel, Jr. Musculoskeletal Center. The Musculoskeletal Clinic is staffed by orthopedic, family medicine, rheumatology, and physical medicine physicians who specialize in musculoskeletal medicine.

“The biggest advantage of this new, integrated space is that it provides optimal access to staff clinicians, technicians, and equipment. This ease of all the necessary appointments in 1 space enhances

both the efficiency and the quality of the patient’s clinical experience,” explains orthopedic consult-

ing physician James M. Beckley, MD. “Patients may be referred here internally by their Mayo Clinic physicians or externally by their family physicians.”

Some of the services offered at the Mayo Clinic Musculoskeletal Clinic are

- A 10-examination-room corridor in which non-operative musculoskeletal and orthopedic specialists conduct complete evaluations for all anatomic complaints
- Fast-track referrals to Mayo orthopedic surgeons, when a surgeon’s evaluation is indicated
- Easy access to on-site radiographic imaging
- Enhanced clinic-based treatments, including casting and ultrasound-guided injection procedures
- Support through patient education and social services



James M. Beckley, MD

Multidisciplinary Surgical Approach to Early Acute Total Hip Arthroplasty for Acetabular Fractures in the Elderly

Acetabular and pelvic fractures are typically high-energy injuries in younger patients and are often related to vehicular accidents. However, in the elderly, acetabular and pelvic fractures often occur during low-energy falls from standing height because of poor bone quality. As the baby boom population ages, this condition is becoming increasingly common. To meet this demand for services with improved clinical outcomes, Mayo Clinic orthopedic surgeons have devised a multidisciplinary surgical approach.

“Conventional experience with fracture fixation in elderly patients has resulted in less than optimal outcomes. At Mayo the availability of orthopedic surgery subspecialists has enabled us to develop a new technique that combines trauma and hip surgery in the same operation,” explains Mayo Clinic orthopedic and trauma surgeon Stephen A. Sems, MD. “The result is a single-surgery early acute total hip arthroplasty (THA) procedure, which provides

for faster return to function and faster recovery of mobility.”

Limitations of Late Arthroplasty

Poor bone quality in the elderly compromises the effectiveness of standard fixation methods in maintaining reduction of an acetabular fracture. A poor functional outcome may necessitate a late THA. Alternate approaches to treating this injury focus on nonoperative management initially, allowing the fracture to unite in a malreduced position. After several months, when bone is consolidated, a combined procedure—bone reconstruction and THA—is performed.

The long lag time between injury and surgery is a major limiting factor in late THA because it impairs the patient’s quality of life and contributes to patient deconditioning. This deconditioning affects both the ability to obtain secure fixation of the total hip components and the patient’s func-



Stephen A. Sems, MD

This series of images records the presenting injury and recovery of a 79-year-old woman who had a relatively low-energy fall off a single step in her home. She landed on her right side and injured her hip (Figures 1 and 2). She was transferred from an outside hospital to Mayo Clinic, Rochester, Minnesota, where she underwent early THA (Figure 3).

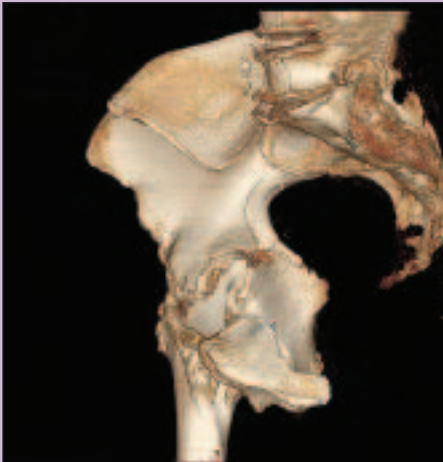


Figure 1. Preoperative 3-dimensional reconstruction.

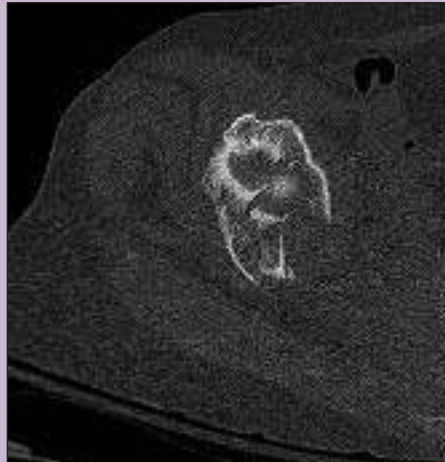


Figure 2. Preoperative CT showing impaction of the articular surface and involvement of the ilium.



Figure 3. Postoperative follow-up radiograph shows healed fractures and a well-seated cup with no loosening.

tional recovery of preinjury mobility.

A New Approach: Early Arthroplasty

Mayo Clinic orthopedic specialists are finding that acetabular and pelvic fractures that are not amenable to reconstruction may be best managed with a single surgical procedure during which the pelvic anatomy is restored with the aid of internal fixation techniques and the prosthesis is implanted. By the end of 2007, Mayo surgeons had used this technique on 12 patients.

Early THA relies on the combined skills of an orthopedic trauma surgeon to reconstruct the pelvis and an orthopedic arthroplasty surgeon to perform the THA. "Our goal is patients to be mobile as soon as possible and to avoid a second surgery later on," says Dr Sems. Early THA allows the patient to begin rehabilitation sooner, so functional outcomes may be better, recovery of preinjury levels of activity may be faster, and quality of life may be improved.

Indications for the New Approach

The first prerequisite of early THA is the collaboration of a skilled orthopedics team that includes

trauma and arthroplasty surgeons. The decision to proceed with early THA is based on preoperative radiographs and CT scans that show evidence of fractures of the acetabulum and pelvis, including

1. Severe comminution of the acetabular articular surface
2. Severe femoral head injuries
3. Fractures that normally require an extensile approach in an elderly patient
4. Fractures that have had prolonged periods of hip dislocation
5. Advanced patient age. The older a patient is, the more likely he or she is to be a candidate for THA rather than hip joint salvage
6. Sufficiently robust health to undergo surgery

Early results are encouraging. Notes Dr Sems: "This is an evolving procedure—but we agree that this may be a better approach to treating this increasingly common type of injury in elderly patients. We're pleased with the results and continue to refine the method. Our team approach has enabled us to avoid the use of revision cups or components and to stay with a standard implant."

Musculoskeletal Ultrasound Offers Precise Placement of Injections and a Range of Treatments

Recent advances in high-resolution imaging are presenting new opportunities for improving orthopedic clinical care. At comprehensive orthopedic centers, skilled practitioners are now using musculoskeletal ultrasound to diagnose a wide range of tendon, muscle, and joint disorders. They are also using it to precisely deliver therapeutic agents to affected areas. Common applications of musculoskeletal ultrasound include

- diagnostic and/or therapeutic injections into joints and tendon sheaths or around nerves (Box, see page 8)
- evaluation of painful pops and snaps (Figure 1)
- identification of sources of pain
- percutaneous fenestration and possible therapeutic injection for the treatment of chronic tendinitis
- percutaneous disruption, lavage, and aspiration of calcific deposits in the rotator cuff and other tendons (Figure 2)

Visualizing Vasculature, Nerves, and Soft Tissue

Live x-ray imaging, otherwise known as fluoroscopy, has traditionally been used to visualize many types of sports medicine injuries as well as to guide therapeutic injections. “However, this technique is limited by the inability to image nerves, tendons, ligaments, and vessels,” explains physical and rehabilitation medicine physician Jay Smith, MD, who specializes in sports medicine and musculoskeletal ultrasound at Mayo Clinic in Rochester, Minnesota. “In addition, the radiation associated with this technique may limit its application in certain patients, such as pregnant women. Although MRI provides excellent soft tissue imaging and does not produce radiation, its use for interventional and dynamic procedures in sports medicine and orthopedics is currently impractical,” Dr Smith says.

Jonathan T. Finnoff, DO, of the Department of Physical Medicine and Rehabilitation, notes that in comparison, ultrasound is a readily available and cost-effective imaging technique that can evaluate tendons, muscles, ligaments, and nerves with a resolution that equals or surpasses MRI. Furthermore, ultrasound can be performed “live,” allowing dynamic evaluation of



Figure 1. Using ultrasound to identify the source of painful shoulder snapping. The image shows an S-shaped calcification (arrows) within and deforming the supraspinatus tendon in a patient presenting with pain and shoulder snapping. The large calcification was snapping in and out of the subacromial space during arm motion. DELT, middle deltoid muscle; HUM, humeral head.

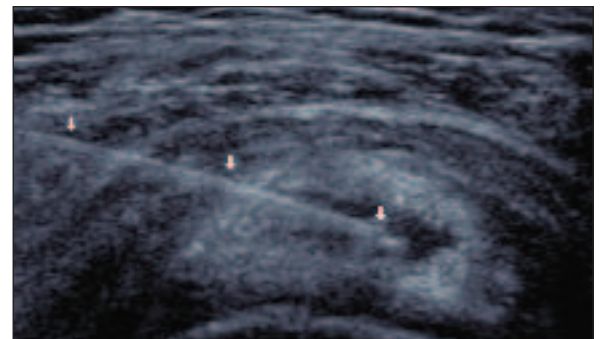


Figure 2. Treatment by lavage. A symptomatic rotator cuff calcification was successfully treated by ultrasound-guided percutaneous disruption, lavage, and aspiration. The central cavitation was created by the procedure as the calcium was aspirated. The arrows indicate the needle passing through the muscle and into the center of the calcification.

ligaments and tendons, as well as guiding needles to target areas throughout the body. Finally, ultrasound does not use radiation and is therefore safe during pregnancy.

Capitalizing on these advantages, skilled practitioners have been able to expand the range of interventional procedures they can perform safely and effectively for patients with musculoskeletal disorders.

Safety and Comfort of Ultrasound-Guided Injection

In general, the thicker the needle, the easier it



Jonathan T. Finnoff, DO, and Jay Smith, MD

Continued on page 8

Orthopedic Research

Intralesional Curettage for Carefully Selected Cases of Chondrosarcoma of the Long Bones

A subset of patients with grade I chondrosarcoma of the long bones may be treated successfully with a less invasive intralesional curettage procedure rather than en bloc resection, according to results of a retrospective review of 70 patients treated at Mayo Clinic between 1980 and 2001.

The findings were published recently in *Clinical Orthopaedics and Related Research* (Clin Orthop Relat Res. 2007;463:166-172). Other researchers have reported less encouraging outcomes with intralesional curettage. The Mayo team ascribes those earlier results to the inclusion of all grades of sarcoma in the study group and failure to exclude lesions of the axial skeleton, which typically behave differently from long bone lesions and have a worse prognosis.

Results

The Mayo team evaluated 2 approaches, intralesional curettage and wide resection, considering local recurrence and metastasis of grade I chondrosarcoma of the long bones in patients of similar age and sex. The timeframe chosen reflected improvements in surgical and imaging tools such as CT and MRI. Diagnosis was based on blinded review of histologic slides from biopsy and surgi-

cal specimens, as well as on various radiographic means to identify tumor stage and evaluate surgical margins.

Results demonstrated that

- patients in the group with wide resection had more cortical disruption and soft tissue extension than patients in the intralesional curettage group, none of whom had cortical disruption.
- overall disease-free survival rates were similar between patients treated with intralesional curettage and those treated with wide resection.

Conclusion

Less extensive surgery such as intralesional curettage can be used effectively in selected patients, without compromising patient outcome. These patients include those who have less aggressive chondrosarcoma of the long bones, characterized by absence of cortical disruption and soft tissue extension. Because grade I chondrosarcoma presents across a wide spectrum of biological behaviors, a multidisciplinary team that includes experts in radiology, pathology, and orthopedic oncology is best equipped to prevent local recurrence and metastasis.

CME Opportunity

Call for Abstracts for the Fourth Mayo Clinic International Spine Surgery Symposium, January 31-February 4, 2009, Maui, Hawaii

Mayo Clinic's annual comprehensive, highly interactive Spine Surgery Symposium is designed for orthopedists, neurosurgeons, neuroscientists, nonoperative clinicians, and allied health professionals united by their special interest in managing spinal disorders. Internationally renowned speakers address the most clinically compelling topics in the field using a variety of dynamic formats. Discussions

Multidisciplinary Investigation Shows New Sonication and Culturing Method Improves Diagnosis of Prosthetic Joint Infection

More than a decade ago a National Institutes of Health Consensus Development Conference statement on total hip replacement identified inaccurate diagnostic tests as a source of the diagnostic difficulties associated with prosthetic infection. A new orthopedic study by a multidisciplinary Mayo Clinic team, published recently in the *New England Journal of Medicine* (N Engl J Med. 2007;357:654-663), suggests an effective alternative for improving the diagnosis of prosthetic-joint infection caused by microorganisms. The team obtained microbial samples by sonicating—using high frequency sound waves to dislodge cells—the removed prostheses, then plating the sonicate fluid and culturing the resulting growth.

Results

The Mayo team conducted a prospective trial of 331 patients who underwent removal of a total knee or hip prosthesis for aseptic failure or presumed infection at Mayo Clinic, Rochester, Minnesota, between August 2003 and December 2005. The sonication method demonstrated superior sensitivity over the

conventional microbial tissue sampling technique: 78.5% versus 60.8%. The Mayo team emphasized the need for performing both aerobic and anaerobic sonicate-fluid culture—11% of positive cultures were obtained only on anaerobic plates and 5% of positive cultures only on aerobic plates. In addition to superior sensitivity, another advantage of the sonicate-fluid culture is that it appears to improve detection of polymicrobial prosthetic-joint infection. Overall, results were best in patients who received antimicrobial therapy within 14 days before surgery.

Conclusion

The study is helpful because complications of prosthetic joint infection, including aseptic failure and infection, threaten to undermine the gains in quality of life that joint replacement surgery offers to the thousands of patients who have hip or knee replacement surgery every year. The Mayo team hopes to help change that and believes this new technique warrants further study.

of current concepts, techniques, case presentations, and lively debates all combine to make this annual 5-day symposium a highlight of professional medical education for spine practitioners.

The deadline for submission of abstracts is October 1, 2008. For more information about registration or to submit an abstract for an electronic poster presentation, contact Kathy Adams Hayward at (800) 323-2688 (USA only) or (507) 284-0026; fax (507) 538-7234; e-mail: hayward.kathryn@mayo.edu.

Musculoskeletal Ultrasound...continued from page 5

guide it to the target. However, thicker needles are generally more painful and in some cases may increase the risk of bleeding, a particular concern if a patient is on blood thinners. In many cases, the use of ultrasound will allow the practitioner to use a thinner needle for the procedure than would otherwise be used, thus improving patient comfort and potentially reducing risk.

The Diagnostic Potential of Ultrasound

Ultrasound can also be a clinical problem-solving tool to aid in diagnosis. For example, to determine whether a small tear in a tendon is causing symptoms, the practitioner can precisely inject anesthetic into the tendon sheath using ultrasound guidance and assess the patient's response. This diagnostic tendon sheath injection can differentiate "incidental" versus symptomatic structural abnormalities on imaging studies.

The source of painful movement-related snaps and pops can also be diagnosed with ultrasound. By evaluating patients dynamically while they demonstrate their symptoms, practitioners can identify unstable tendons, snapping calcifications within tendons, and other sources of motion-induced pain. Identification of the source of these difficult-to-evaluate problems is a key component in management decision making.

Common Uses of Ultrasound-Guided Injections

1. Needle placement into joints for aspiration or injection, particularly in patients with challenging anatomy, those on blood thinners, or those in whom a nonguided injection has failed
2. Injection into tendon sheaths or bursae
3. Identification, drainage, and injection of ganglion cysts
4. Diagnostic or therapeutic nerve blocks, including carpal tunnel syndrome
5. Percutaneous treatment of calcific rotator cuff tendonitis

Emerging and Experimental Applications

1. Tendon fenestration. Using ultrasound to make multiple needle passes through areas of tendon degeneration—ie, tendon fenestration—to stimulate tissue healing. While not commonly available, this procedure is potentially promising as a component in the nonoperative treatment of chronic tendinitis.
2. Injection of platelet-rich plasma (PRP). Either in isolation or after a tendon fenestration procedure, PRP is injected under ultrasound guidance into the affected tendon. PRP carries an array of growth factors linked to tendon healing.

Orthopedic Update

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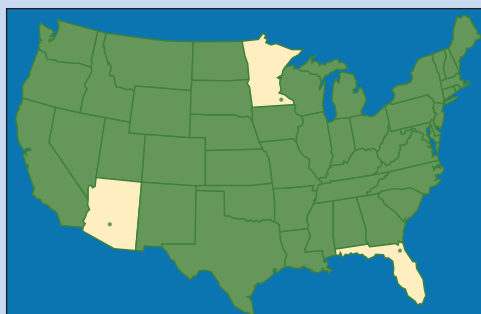
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