MAYO CLINIC

Clinical Update

Focus on Physical Medicine and Rehabilitation

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Ultrasound Offers Advantages in Diagnosis and Treatment of Musculoskeletal Disorders

INSIDE THIS ISSUE

Recent advances in high-resolution ultrasound imaging are presenting new opportunities for improving the care of patients with musculoskeletal injuries. Ultrasound uses sound waves to provide real-time, high-resolution images of tendons, ligaments, muscles, and nerves throughout the body. Skilled practitioners in Mayo Clinic's Department of Physical Medicine and Rehabilitation and Sports Medicine Center are now using musculoskeletal ultrasound to diagnose and treat a wide range of tendon, muscle, and joint disorders.

Ultrasound as a Diagnostic Tool

Ultrasound offers several advantages over other available imaging tools such as live x-ray imaging (fluoroscopy), CT, and MRI. "Ultrasound is a readily available and cost-effective imaging technique that can help us evaluate tendons, muscles, ligaments, and nerves with a resolution that equals or surpasses MRI," notes Jonathan T. Finnoff, DO, of Mayo Clinic's Department of Physical Medicine and Rehabilitation and Sports Medicine Center. Ultrasound can also be performed "live," allowing dynamic evaluation of 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.

Ultrasound can be an effective tool for diagnosing problems in patients with difficult-to-evaluate conditions. For example, to determine whether a tendon tear is the source of a patient's ankle pain, the practitioner can use ultrasound to precisely inject anesthetic into the tendon sheath and assess the patient's response. This diagnostic injection can help differentiate "incidental" from symptomatic structural abnormalities.

Ultrasound can also help diagnose the source of painful movement-related snaps and pops. By evaluating patients dynamically while they demonstrate their symptoms, practitioners can identify unstable tendons, snapping calcifications within tendons,

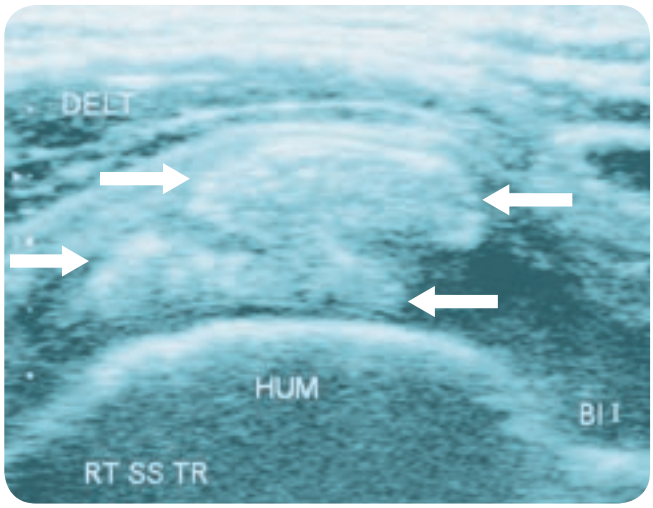

Figure 1. *Using ultrasound to identify the source of painful shoulder snapping. The image shows an S-shaped calcification (arrows) within and deforming the supraspinatus tendon in a patient presenting with pain and shoulder snapping. The large calcification was snapping in and out of the subacromial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

and other sources of motion-induced pain.

Common applications of diagnostic musculoskeletal ultrasound include

- identification of tendon or ligament tears, inflamed bursa, compressed nerves, cysts, and joint fluid
- evaluation of painful pops and snaps
- diagnostic injections into joints and tendon sheaths or around nerves

Therapeutic Ultrasound-Guided Procedures

In many cases, the use of ultrasound also allows the skilled practitioner to precisely and safely deliver therapies to the affected tissue. During ultrasound-guided injections or aspirations, practitioners can directly visualize the needle passing to the target. Direct visualization ensures accurate injectate placement and offers a greater margin of safety. Smaller needles may also be used, thus improving patient comfort and potentially reducing risk.

Applications for ultrasound-guided injections include

- 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
- injection into tendon sheaths or bursae
- aspiration and injection of ganglion cysts
- diagnostic or therapeutic nerve blocks, including carpal tunnel syndrome
- percutaneous treatment of calcific tendonitis

Emerging and Experimental Applications

Mayo Clinic physiatrists are also using ultrasound to guide emerging therapies, including tendon fenestration (percutaneous tenotomy), and platelet-rich plasma (PRP) injections."During tendon fenestration, the practitioner uses ultrasound to make multiple needle passes through areas of tendon degeneration to stimulate tissue healing," explains physical medicine and rehabilitation physician Jay Smith, MD, who specializes in sports medicine and musculoskeletal ultrasound at Mayo Clinic in Rochester.

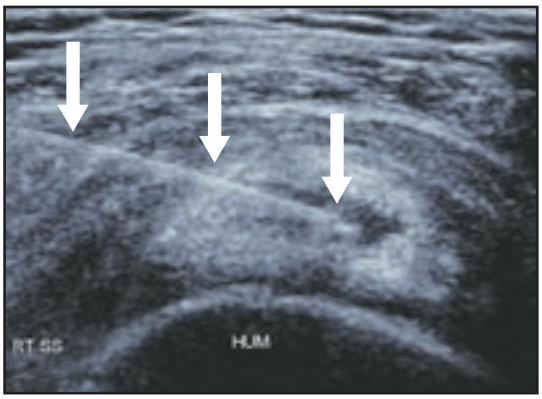

Figure 2. *Treatment by lavage. A symptomatic rotator cuff calcification was successfully treated by ultrasound-guided percutaneous disruption, lavage, and aspiration. The central cavitation was created by the procedure as the calcium was aspirated. The arrows indicate the needle passing through the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

Used for more than a decade to facilitate the healing of difficult wounds, PRP is rich in growth factors linked to healing. Using ultrasound guidance, practitioners inject the PRP into the affected tendon, usually following a tendon fenestration procedure."The fenestration breaks up the abnormal tissue, and then we inject the platelets into the prepared area to promote healing," explains Dr Smith.

A team of Mayo Clinic researchers is now evaluating the efficacy of combining musculoskeletal ultrasound, PRP therapy, and tendon fenestration in patients with chronic tendon injuries."We anticipate increasing use for ultrasound in the diagnosis of tendon, ligament, and other soft tissue disorders and in the delivery of biologic therapies to promote healing," note Drs Smith and Finnoff.

Enhancing Advocacy Skills in Patients With Traumatic Brain Injury

A patient's ability to advocate for him- or herself after traumatic brain injury (TBI) is an important part of recovery and rehabilitation that can impact quality of life and overall health. Teaching basic self-care and activities of daily living skills has always been an important component in a comprehensive rehabilitation program for TBI patients. Teaching advocacy skills is the subject of a Mayo Clinic–led clinical trial now under way.

The Brain Injury Associations of Minnesota, Iowa, and Wisconsin are partnering with the Mayo Clinic TBI Model System (TBIMS—see related sidebar and Figure) in a research study

Traumatic Brain Injury Model System (TBIMS)

In 1998, Mayo Clinic successfully competed for a grant from the National Institute on Disability and Rehabilitation Research (NIDRR) and was designated as a Traumatic Brain Injury Model System Center.

The TBIMS Centers contribute to a database that allows prospective, longitudinal multicenter study of the course of recovery and outcomes after TBI. NIDRR also supports center-specific research and collaborative research among centers.

One of 16 TBIMS Centers in the United States, the Mayo Clinic TBIMS Center is currently in its third consecutive 5-year funding cycle and provides services along the continuum of care after TBI, from the initial physical examination after injury to community participation.

The Mayo Clinic TBIMS Center is part of the Department of Physical Medicine and Rehabilitation at Mayo Clinic in Rochester, Minnesota. Mayo Clinic providers from multiple disciplines, specialties, and subspecialties work as an integrated team to achieve NIDRR's ultimate goal: to maximize inclusion and social integration, health and function, employment and independent living of individuals of all ages with disabilities related to TBI.

Mayo Clinic's research program is directly aligned with the NIDRR mission of improving the lives of individuals who experience TBI and of their families and communities, by creating and disseminating new knowledge about the natural course of recovery, rehabilitation, treatment, and outcomes after TBI.

to identify how best to teach advocacy skills to people affected by TBI. The Midwest Advocacy Project (MAP) represents the first randomized, practical behavioral trial studying how a community-based advocacy experience can impart effective self-advocacy and systems-advocacy skills to individuals with TBI as well as their families and significant others.

The intent of the project is to help survivors of TBI and their family members to be effective self-advocates, advocates for others, and community organizers. The anticipated long-term outcome is the nationwide use of an effective advocacy training program. The target populations for the MAP are individuals affected by TBI—patients, their families and significant others—in 3 contiguous Midwest states, each state's Brain Injury Association, public policymakers, the TBI research community, and other health care professionals.

Study participants will be asked to attend 4 monthly sessions in Minneapolis/St. Paul, Des Moines, or Madison, depending on their state of residence. Assistance with travel expenses will be offered for those residing more than 60 miles from the training site. All participants will receive a research stipend on completion of the 4 sessions.

This project represents an opportunity for the public to contribute to important TBI research and join with others eager to gain better advocacy skills. For additional information and an application, people interested in participating in this study can contact the Brain Injury Association of Minnesota at 800-669-6442; the Brain Injury Association of Iowa at 800-444-6443; or the Brain Injury Association of Wisconsin at 800-882-8292.

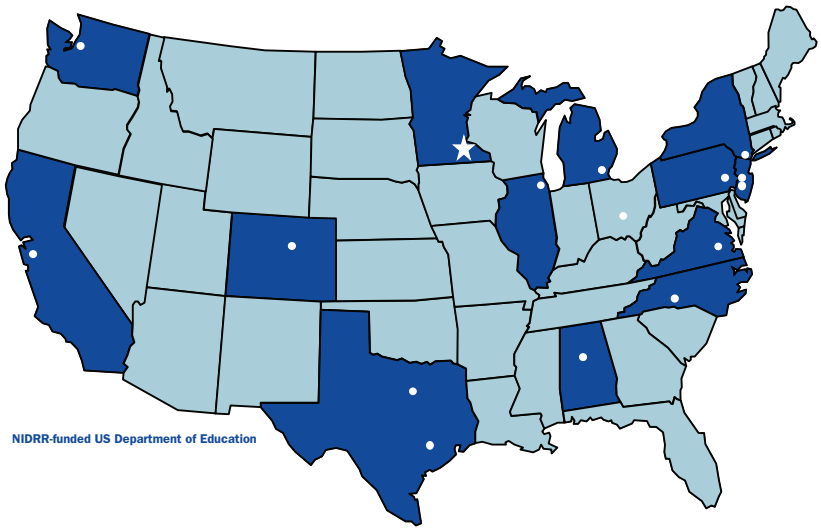

Figure. *Mayo Clinic is one of 16 Traumatic Brain Injury Model System Centers in the United States.*

Slowing and Reversing Bone Loss in Persons With Spinal Cord Injury

Early and severe bone loss is a serious problem in persons with spinal cord injury (SCI). Loss of bone calcium can occur in any of the bones below the level of injury.

Fracture incidence is reported to be as high as 4.6% per year in persons with chronic SCI, with a prevalence of 15% to 34% and rising. More than 90% of fractures in persons with chronic SCI are in the lower limb, largely in the distal femur and proximal tibia. These are usually low-velocity fractures, with falls from a wheelchair as the most common cause. Hormonal deficiency, nutritional changes, alterations in circulation, and loss of autonomic nervous system influences all seem to contribute to bone loss associated with SCI, but loss of mechanical strain appears to be the single most important factor.

Determining how to slow or reverse bone loss in patients with SCI is an important area of study. The simple act of falling out of a wheelchair can cause painful fractures that can lead to many problems, including pressure ulcers, deep vein thrombosis, neuropathic pain, and autonomic dysreflexia, all creating secondary disability. As neuroscientists get closer to understanding how to restore motor function in patients with SCI, identifying effective methods to strengthen weight-bearing bones so patients can stand again will be an important development.

Numerous published studies have examined whether active or passive verticalization in SCI patients affects bone demineralization. To date, studies using techniques like passive standing or standing on a vibrating surface have failed to establish that any of these therapies used alone significantly slows or reverses SCI-induced osteoporosis. Approaching this problem from a new angle, a team of Mayo Clinic researchers plans to study whether repeated exposure to vertical oscillation, rather than just a vibrating surface, will help restore bone mass.

Previous studies have shown heavy loading is not necessary to produce results. Mayo researchers are looking for a very specific pattern of motion that is osteogenic, something that mimics the "rapid on–rapid off" motion that occurs when a person walks.

The Mayo project uses a standing frame that supports patients (those with no voluntary motor control in the legs and trunk) and positions their feet on a unique foot plate that oscillates vertically (Figure). The team will enroll 20 patients in a pilot study and follow them for 6 months. Half the study subjects will use the standing frame and vertical oscillator for 20 minutes daily, 5 times a week. The other half will continue their usual activity and serve as a comparison group. All study subjects will undergo bone densitometry testing of the distal tibia after 6 months and again at 12 months to allow researchers to measure both the response to the treatment and what happens to subjects' bone density after treatment stops.

Mayo researchers are hopeful that this study will yield results that can benefit care of patients with SCI and also help shed light on how to slow or reverse bone loss in people with mobility impairment due to other disabilities.

Figure. *Patients with no voluntary motor control in the legs and trunk are placed in a frame that positions their feet on a unique foot plate that oscillates vertically.*

Recognition

Brain Injury Program Named State Lead Center of Excellence

The Sarah Jane Brain Project is a national plan to develop a seamless, standardized system of care that is universally accessible to children and young adults with brain injuries and their families. The Sarah Jane Brain Foundation recently named Mayo Clinic's Brain Injury Program the Minnesota State Lead Center of Excellence.

Sherilyn W. Driscoll, MD, director of Mayo Clinic's Pediatric Physical Medicine and Rehabilitation Program, says that as a State Lead Center, Mayo will have certain essential operating capabilities and will work with other health care institutions to develop and implement a statewide master plan. "This program allows us to better coordinate both care and research with like-minded professionals nationally. Its great promise is to ensure that children with brain injuries are provided for throughout the United States," says Dr Driscoll.

Dr Driscoll completed her residency at Mayo Clinic and has worked in pediatric medicine and rehabilitation at Mayo since 1999.

Family Centered, Culturally Sensitive

Pediatric patients at Mayo Clinic in Minnesota are cared for at the T. Denny Sanford Pediatric Outpatient Center. The center brings together many pediatric subspecialty staff and services, including physical therapy, orthopedic therapy, and physical medicine and rehabilitation, in a single location dedicated to the care of children and their families. "Patients with brain injury enter intensive care and then see pediatrics and rehabilitation specialists as needed," says Dr Driscoll, who notes, "Mayo care will follow the child into adulthood if necessary."

Sherilyn W. Driscoll, MD

Profile

Clinical Trials Advance Human Tissue Regeneration

The major barrier to the treatment of cardiovascular disease is the inability of the myocardium to self-renew. At Mayo Clinic, Carmen M. Terzic, MD, and her laboratory team are developing a stem cell–based strategy to repair diseased cardiac tissue.

"We're working from a basic level and translating it into clinical outcomes—practical applications," says Dr Terzic. Using data from animal-based research, her team is currently conducting its first human trials toward the development of clinical outcomes for myocardial infarction.

The study, funded in part by a grant from the National Institutes of Health's National Heart, Lung, and Blood Institute, focuses on the use of stem cells to regenerate human tissue. "One of the most important areas of medicine in the future is tissue regeneration. Stem cell use is one of the main areas of research moving us in that direction," says Dr Terzic, who also serves as a reviewer for other, unrelated NIH program grant applications.

A specialist in cardiac regeneration, Dr Terzic spends 75% of her time in stem cell research and the remaining 25% in cardiac rehabilitation clinical practice. She has studied and practiced medicine at Mayo Clinic for 17 years.

Carmen M. Terzic, MD

2009 Research Highlights

Diagnostic and interventional musculoskeletal ultrasound: part 1. Fundamentals
Smith J, Finnoff JT. *PM R.* 2009 Jan;1(1):64-75.

Diagnostic and interventional musculoskeletal ultrasound: part 2. Clinical applications
Smith J, Finnoff JT. *PM R.* 2009 Feb;1(2):162-77.

Injury severity and disability in the selection of next level of care following acute medical treatment for traumatic brain injury
Malec JF, Mandrekar JN, Brown AW, Moessner AM. *Brain Inj*. 2009 Jan;23(1):22-9.

A prospective trial of elective extubation in brain injured patients meeting extubation criteria for ventilatory support: a feasibility study
Manno EM, Rabinstein AA, Wijdicks EF, Brown AW, Freeman WD, Lee VH, Weigand SD, Keegan MT, Brown DR, Whalen FX, Roy TK, Hubmayr RD. *Crit Care*. 2008;12(6):R138. Epub 2008 Nov 10.

The detection and treatment of cancer-related functional problems in an outpatient setting
Cheville AL, Beck LA, Petersen TL, Marks RS, Gamble GL. *Support Care Cancer*. 2009 Jan;17(1):61-7. Epub 2008 May 14.

Junction kinematics between proximal mobile and distal fused lumbar segments: biomechanical analysis of pedicle and hook constructs
Hongo M, Gay RE, Zhao KD, Ilharreborde B, Huddleston PM, Berglund LJ, An KN, Zhao C. *Spine J.* 2009 Aug 4. [Epub ahead of print].

Biomechanical evaluation of a new fixation device for the thoracic spine
Hongo M, Ilharreborde B, Gay RE, Zhao C, Zhao KD, Berglund LJ, Zobitz M, An KN. *Eur Spine J.* 2009 Apr 29. [Epub ahead of print]

Analysis of joint laxity after total ankle arthroplasty: cadaver study
Watanabe K, Crevoisier XM, Kitaoka HB, Zhao KD, Berglund LJ, Kaufman KR, An KN. *Clin Biomech* (Bristol, Avon). 2009 Jul 23. [Epub ahead of print]

Experimental validation of a tibiofemoral model for analyzing joint force distribution
Miller EJ, Riemer RF, Haut Donahue TL, Kaufman KR. *J Biomech*. 2009 Jun 19;42(9):1355-9. Epub 2009 Apr 22.

Shoulder demands in manual wheelchair users across a spectrum of activities
Morrow MM, Hurd WJ, Kaufman KR, An KN. *J Electromyogr Kinesiol*. 2009 Mar 5. [Epub ahead of print]

Relationships between knee valgus, hip-muscle strength, and hip-muscle recruitment during a single-limb step-down
Hollman JH, Ginos BE, Kozuchowski J, Vaughn AS, Krause DA, Youdas JW. *J Sport Rehabil*. 2009 Feb;18(1):104-17.

Electromyographic sensitivity of peroneus tertius relative to abductor hallucis in assessment of peripheral neuropathy
Boon AJ, Harper CM. *Muscle Nerve*. 2009 Jul 30. [Epub ahead of print]

Safety, acceptance, and physiologic effects of sauna bathing in people with chronic heart failure: a pilot report
Basford JR, Oh JK, Allison TG, Sheffield CG, Manahan BG, Hodge DO, Tajik AJ, Rodeheffer RJ, Tei C. *Arch Phys Med Rehabil*. 2009 Jan;90(1):173-7.

2009 Continuing Medical Education Opportunities

19th Annual Mayo Clinic Symposium on Sports Medicine

Kahler Grand Hotel, Rochester, MN
November 13-14, 2009

This course is a case-oriented program that provides an integrated approach to the injured athlete. Case presentations, lectures, and video demonstrations make this course interesting to all sports medicine practitioners. This course was developed for health care professionals with an interest in sports medicine and athletic trainers.

Contact: 800-323-2688 or e-mail cme@mayo.edu

Mayo Clinic Primary Care Update: Back and Neck Pain 2010

Disney Boardwalk Inn, Lake Buena Vista, FL
January 21-23, 2010

This course is for spine pain, including shoulder pain. The content is geared toward the primary care physician at all levels of experience and other musculoskeletal care providers, including specialists of various training backgrounds, midlevel providers, therapists, and nurses/educators. It is designed to cover the breadth of medical considerations in adult patients with spine and shoulder pain, with some surgical content as well over the 3-day course. The format includes lectures, independent study options, hands-on physical examination skills training, and case studies. The course offers 2 clinical tracks, one for low back pain and one for neck and shoulder pain.

Contact: 507-284-2608/507-266-0940 or e-mail cme@mayo.edu

To read more about Mayo Clinic physical medicine and rehabilitation research and patient care, visit www.mayoclinic.org.

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Recognition

Jay Smith, MD, Receives First PASSOR Legacy Award and Lectureship From AAPM&R

Mayo Clinic Department of Physical Medicine and Rehabilitation congratulates Jay Smith, MD, for recently becoming the first recipient of the Physiatric Association of Spine, Sports and Occupational Rehabilitation (PASSOR) Legacy Award and Lectureship. This award is granted by the American Academy of Physical Medicine and Rehabilitation (AAPM&R) and recognizes individuals in mid career who have advanced musculoskeletal physiatry through clinical care, education, service, and scholarship (research). Dr Smith presented his work on musculoskeletal ultrasound at the 2009 AAPM&R Annual Assembly.

Jay Smith, MD

Physician Update

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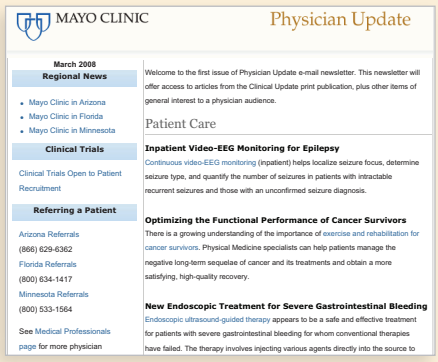
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Regional News

- Mayo Clinic in Arizona
- Mayo Clinic in Florida
- Mayo Clinic in Minnesota

Clinical Trials

Clinical Trials Open to Patient Recruitment

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See Medical Professionals page for more physician

Welcome to the first issue of Physician Update e-mail newsletter. This newsletter will offer access to articles from the Clinical Update print publication, plus other items of general interest to a physician audience.

Patient Care

Inpatient Video-EEG Monitoring for Epilepsy
Continuous video-EEG monitoring (inpatient) helps localize seizure focus, determine seizure type, and quantify the number of seizures in patients with intractable recurrent seizures and those with an unconfirmed seizure diagnosis.

Optimizing the Functional Performance of Cancer Survivors
There is a growing understanding of the importance of exercise and rehabilitation for cancer survivors. Physical Medicine specialists can help patients manage the negative long-term sequelae of cancer and its treatments and obtain a more satisfying, high-quality recovery.

New Endoscopic Treatment for Severe Gastrointestinal Bleeding
Endoscopic ultrasound-guided therapy appears to be a safe and effective treatment for patients with severe gastrointestinal bleeding for whom conventional therapies have failed. The therapy involves injecting various agents directly into the source to


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A Randomized Controlled Trial of Vertebroplasty for Osteoporotic Spine Fractures

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