Musculoskeletal Imaging

Types and Indications

Peter H. Seidenberg, MD[a,*], Allyson H. Howe, MD[b]

KEYWORDS

- Musculoskeletal imaging • Radiology • Injury evaluation • Radiographs
- Magnetic resonance imaging • Computed tomography
- Musculoskeletal ultrasonography • Nuclear medicine

KEY POINTS

- No imaging modality can surpasses the value of a well performed history and physical examination. Radiographs are indicated to evaluate suspected fracture, dislocation, or arthritis. The history and physical examination will guide as to which views are required.
- Magnetic resonance imaging (MRI) is an effective tool in the evaluation of soft tissue disorders. However, its use is contraindicated in patients with pacemakers, defibrillators, and spinal stimulators.
- Ultrasonography is effective in examining tendons, cysts, and peripheral nerves. Tears, tenosynovitis, and tendinosis are readily differentiated on sonograms. Dynamic evaluation is helpful in confirming the severity of the tendon injury.
- Computed tomography (CT scan) is able to reconstruct images in both two and three dimensional images. This can assist in the evaluation of complex fractures. However, caution is advised in overuse of this imaging modality due to the high dose of radiation utilized.

INTRODUCTION

Musculoskeletal imaging has come a long way since the discovery of x-rays by Wilhelm Conrad Röntgen in 1895.[1] Today, in addition to conventional radiographs, clinicians have numerous options available to assist in the care of their patients. However, knowing which modality is best for evaluating the presenting complaint is of upmost importance to the physician wishing to practice efficient and cost-effective medicine. This article reviews the indications for common musculoskeletal imaging modalities to assist in the evaluation of acute and chronic musculoskeletal pathology.

Radiographs are most advantageous in the evaluation of bony abnormalities such as fractures, dislocations, and osteoarthritis. Radiography is the least expensive imaging modality, but its drawbacks include difficulty evaluating complex fractures, stress fractures, and soft-tissue structures. In addition, radiographs require the use of low levels

[a] Penn State Sports Medicine, Penn State University, State College, 1850 East Park Avenue, Suite 112, PA 16803, USA; [b] University of Southern Maine, Portland, ME, USA
* Corresponding author.
E-mail address: pseidenberg@hmc.psu.edu

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of ionizing radiation to produce an image. In skeletally immature patients, contralateral views should be obtained to increase the detection of growth-plate injuries.

By contrast, computed tomography (CT) scans use much higher doses of radiation. However, this technology is able to produce high-resolution images in both 2 and 3 dimensions, compensate for overlapping structures, and provide finer cuts of the area of interest.[2] CT is useful in the evaluation of stress fractures and complex fractures or dislocations. It can also evaluate ligaments, masses, and fluid collections.

Bone scintigraphy (bone scan) is a nuclear medicine study used in the investigation of stress fractures, occult fractures, and bone tumors or infections.[3] The procedure requires intravenous injection of a radioactive material that is taken up by metabolically active bone. Because bone metabolism is increased in pathologic conditions, abnormalities will appear as "hot spots" on the images acquired by the gamma camera. The modality also uses radiation, and requires the patient to return after the injection at specified times for the different phases of the scan. Each phase can take from 20 to 70 minutes to complete. The radiation exposure is higher than for radiography but lower in comparison with CT.

Magnetic resonance imaging (MRI) carries no risk of radiation exposure, as it uses magnetic coils to produce pictures. It is typically used in the evaluation of soft-tissue disorders involving ligaments, tendons, cartilage, intervertebral discs, and masses. In addition, MRI is effective in further characterizing bony injuries, including subtle fractures and contusions. However, because of the magnetic field, the modality is contraindicated in patients with metallic implants such as pacemakers, defibrillators, and spinal stimulators.[4] The study time is approximately 30 minutes, which can be difficult for patients with claustrophobia. To combat this, open MRI scanners have been developed. However, in general, open scanners have poorer resolution in comparison with closed units.

Musculoskeletal ultrasonography (US) uses sound waves to produce images. US carries no radiation risk, is relatively low in cost, and is able to evaluate structures dynamically. It is effective in evaluation of effusions (joint and paratenon), cysts, ligaments, muscles, and tendons.[5] US readily demonstrates the disorganized connective tissue of the tendinosis in distinct contrast to the normal fibrillar pattern of healthy tendon.[6] Calcium deposits within the tendon (calcific tendinosis) may also be demonstrated. With the use of power Doppler, neovascularization can also be identified. In addition to its diagnostic benefits, US is used to guide aspirations and injections. However, this modality is limited by the body habitus of the patient and the skill of the sonographer.

Although the aforementioned modalities are available to clinicians, it must be emphasized that musculoskeletal imaging does not replace a thorough history and physical examination. Instead, radiologic studies should be regarded as methods to confirm the suspected diagnosis.

NECK

When cervical spine injury is suspected, radiographs should be obtained. The series should include anteroposterior (AP), lateral, odontoid, and bilateral oblique views. **Fig. 1** demonstrates common lines used to assist in interpreting the films.[7] In nonemergent settings, if no fracture is seen but the history suggests radicular symptoms that are positional in nature, lateral flexion and extension views should be obtained.[8] A CT scan can demonstrate more subtle fractures and ligament injuries, and is often used in emergency cases. The sensitivity for detecting acute cervical spine injury for plain radiographs and CT imaging is 52% and 98%, respectively.[9]

MRI is reserved for the evaluation of radicular symptoms that have not responded to conservative therapy, and can demonstrate nerve-root impingement caused by disc