Radiologic Approach to Musculoskeletal Infections

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KEYWORDS

• Musculoskeletal infections • Necrotizing fasciitis • Periprosthetic joint infection
• Osteomyelitis • Spondylodiscitis • Septic facet joint • MRI

KEY POINTS

- Conventional radiography should always be the first imaging examination performed in all suspected musculoskeletal infections.
- Normal radiographs should not delay further diagnostic workup with cross-sectional imaging in suspected musculoskeletal infections.
- Aspiration should be performed after radiographs on all suspected cases of periprosthetic joint infection, septic arthritis, bursitis, and tenosynovitis.
- MRI, which can evaluate both bone and soft tissue, is the preferred imaging examination for diagnosis and evaluation of soft tissue infections, spine infections, and osteomyelitis.
- Intravenous gadolinium should be administered when performing MRI in all suspected musculoskeletal infections unless contraindicated.

INTRODUCTION

Approximately 2 million patients are treated annually within the United States for musculoskeletal infections.[1] Imaging is often used to establish a diagnosis and evaluate the full extent and severity of disease, ultimately impacting treatment. Although often nondiagnostic, imaging should always start with radiographs, which provide an important anatomic overview and can impact both the choice and interpretation of the subsequent advanced imaging examination. MRI is the test of choice in most musculoskeletal infections secondary to its superior soft tissue contrast resolution and high sensitivity for pathologic fluid.[2–4] However, MRI is not always available and when available may not be possible secondary to multiple contraindicated implanted devices or severe claustrophobia. Alternative imaging modalities including ultrasound scan, computed tomography (CT), and radionuclide imaging may be used. This article reviews the individual imaging modalities including how and when they should be used

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and discusses specific musculoskeletal infections and how they should be approached from an imaging perspective.

CONVENTIONAL RADIOGRAPHS

Radiographs should be the first imaging examination performed for all suspected musculoskeletal infections. Whether as an outpatient or inpatient or in an emergency setting, radiographs are readily available and inexpensive. Although radiographs are typically nondiagnostic early in the disease process, they aid in the selection and interpretation of follow-up cross-sectional imaging.[5]

COMPUTED TOMOGRAPHY

CT has a high spatial resolution providing the best bony detail of all the imaging modalities and can detect changes of osteomyelitis earlier than conventional radiographs. The superior evaluation of the osseous structures makes CT the best imaging modality for identifying the sequestra, cloacae, or involucra associated with chronic osteomyelitis.[5] CT has the added value of being able to evaluate the surrounding soft tissues and provide detailed analysis of compartmental anatomy. Evaluation of the soft tissues is improved with the use of intravenous contrast, allowing better depiction of fluid collections, joint effusions, and soft tissue inflammation. Furthermore, the ability of CT to survey a large area in a very short time makes it the cross-sectional test of choice in emergency departments.[1] CT remains less desirable than MRI because of decreased soft tissue contrast and inability to detect early changes of osteomyelitis. Additional disadvantages of CT include its use of ionizing radiation and degraded images secondary to metallic artifact.

ULTRASOUND SCAN

Ultrasound scan is typically used when evaluating fluid collections, such as a soft tissue abscess or joint effusion. Aspiration can then be performed under ultrasound guidance when needed. Ultrasound scan can be used for acute osteomyelitis in the pediatric population by identifying a subperiosteal abscess and guiding aspiration.[6] The benefit of ultrasound scan in the pediatric population is that it can be rapidly performed, does not require sedation, and does not use ionizing radiation. However, ultrasound scan is operator dependent and of little value in adult osteomyelitis because of its inability to penetrate the cortex of the bone.

RADIONUCLIDE IMAGING

Radionuclide imaging is the most confusing and nuanced imaging modality, with multiple different examinations and radiopharmaceuticals, which can be combined to improve accuracy. All examinations are plagued by low spatial resolution, which can be improved by the use of single-photon emission computed tomography (SPECT) or preferably integrated SPECT-CT. Likewise, the utility of PET imaging has also increased with the introduction of combined PET-CT. This article reviews the most commonly used and available of these examinations.

THREE-PHASE BONE SCINTIGRAPHY

Bone scintigraphy is performed with technetium-99m (^{99m}Tc)-labeled diphosphonates. The 3 phases include a blood flow, blood pool, and delayed bone phases. The test is completed in 2 to 4 hours and is extremely sensitive for osteomyelitis.