Ultrasonography in Musculoskeletal Disorders

Eitan Dickman, MD, RDMS[a,*], Marla C. Levine, MD, RDMS[a],
Shideh Shafie, MD[a], John Munyak, MD[b],
Jennifer Hashem, MD[b], Ahmed Saleh, MD[b],
Eric H. Chou, MD[a]

KEYWORDS

• Ultrasonography • Musculoskeletal disorder • Fracture • Dislocation • Effusion • Tendon

KEY POINTS

- Ultrasonography can be useful when assessing patients for joint effusions and occult fractures.
- Anisotropy is a sonographic property of soft tissues that can influence the echogenicity of tendons, nerves, and muscles, and is influenced by the angle of insonation.
- The assessment of tissue stiffness using elastography can complement the information obtained from B-mode and Doppler imaging.
- The ability to assess tendons using dynamic range of motion is a unique advantage of ultrasonography compared with other imaging modalities.
- Visualization of joint dislocation and subsequent reduction can be observed in real time with sonography.

THE NATURE OF THE PROBLEM

Diseases of the musculoskeletal system and connective tissues represent 6.2% of emergency department (ED) visits.[1] Musculoskeletal injuries can often be effectively and efficiently imaged using ultrasonography. Therefore, recent advances in musculoskeletal ultrasonography are pertinent to emergency physicians and emergency patient care and are elaborated in this article. The usefulness of elastography, a method of tissue stiffness assessment, in the evaluation of patients who present with acute musculoskeletal complaints, will also be discussed.

IMAGING PROTOCOLS

Musculoskeletal sonography is typically performed using a high-frequency linear transducer, although a lower-frequency probe may be necessary when imaging deeper structures such as the hip or shoulder joint. Both longitudinal and short-axis images should be obtained of all structures of interest, with the probe held perpendicular to the area of interest. Appropriate training in performing and interpreting musculoskeletal ultrasonography is necessary, particularly because the operator may encounter a variety of tissues and artifacts such as anisotropy, which is a sonographic artifact that is seen less frequently in other areas of sonography.

SONOGRAPHIC DIAGNOSIS OF FRACTURE

Fractures are the most common form of injury among children. The porous nature of children's bones render these structures more pliable and prone to injury, and therefore more vulnerable to fracture. Furthermore, the thick and physiologically active periosteum and associated growth center of

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[a] Division of Emergency Ultrasound, Department of Emergency Medicine, Maimonides Medical Center, 4802 Tenth Avenue, Brooklyn, NY 11219, USA; [b] Department of Orthopaedic Surgery, Maimonides Medical Center, Brooklyn, NY, USA
* Corresponding author.
E-mail address: edickman@maimonidesmed.org

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youth is easily stripped from the bony cortex in the context of injury.[2] Although bony fractures are more common in children than injuries of the supporting structures, radiographs have a high false-negative rate.[3–5] In addition to the inherent limitations of radiographic imaging in the evaluation of extremity injuries, there is a growing concern regarding the untoward effects of ionizing radiation exposure. Ultrasonography has emerged as an alternative imaging modality for the diagnosis of fracture. Although sonography is a newer modality for the diagnosis of bony injury, preliminary studies show considerable promise.[3]

IMAGING TECHNIQUE

Regardless of the bone being interrogated, sonographically intact bones appear hyperechoic and uniform in echotexture.[6] The reflection of the incident sound beam off the bone results in the bright echogenic line tracing the cortical surface.[6] The sonographic evaluation of bones is best performed using a high-frequency linear probe. The bone should be imaged in both the long and short axes in order to evaluate for cortical defects. In the long axis, bone tends to have a linear appearance (**Fig. 1**) and, in the short axis (because small bones curve; eg, ribs), it has a rounded appearance (**Fig. 2**). A long bone appears straight and narrow in the diaphysis and widens and flattens as it reaches the epiphysis. To identify long bone fractures, imaging should proceed in the long axis. In this plane of view, fractures appear as a disruption in the hyperechoic cortical surface (**Fig. 3**).[6]

CLAVICLE

Clavicle fractures represent the most common pediatric fracture.[2] Ultrasonography is an accepted modality for the diagnosis of neonatal clavicle fractures secondary to birth trauma,[7–9] but this modality is not limited to newborns. In a large prospective study involving 653 children following traumatic injury, ultrasonography had greater accuracy than conventional radiographs in the diagnosis of clavicle fracture (**Fig. 4**).[10] Cross and colleagues[7] performed a prospective study of the diagnostic accuracy of ultrasonography for the diagnosis of clavicle fracture. Ultrasonography had a sensitivity of 95%, a specificity of 96%, a positive predictive value of 95%, and a negative predictive value of 96% for the diagnosis of clavicle fracture among a convenience sample of 100 pediatric patients.[7] A study performed by Chien and colleagues[11] showed similar effectiveness of ultrasonography for the diagnosis of clavicle fracture; in their study of 58 patients, they noted a sensitivity of 89.7%, a specificity of 89.5%, a positive predictive value of 94.6%, and a negative predictive value of 81%. These studies consistently show a usefulness of ultrasonography for the diagnosis of pediatric clavicle fractures; however, ultrasonography has not been well studied for the diagnosis of this type of fracture in adults.

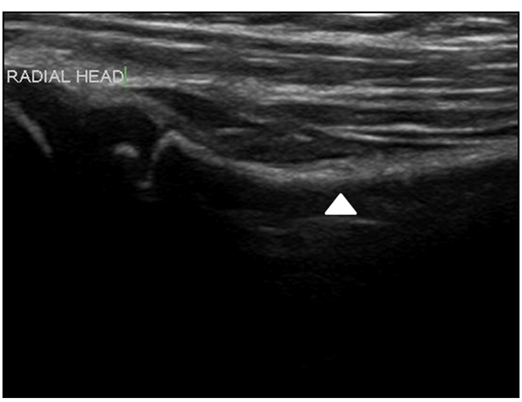

Fig. 1. Long-axis view of the radius. Note the smooth contour of the cortex (*arrowhead*).

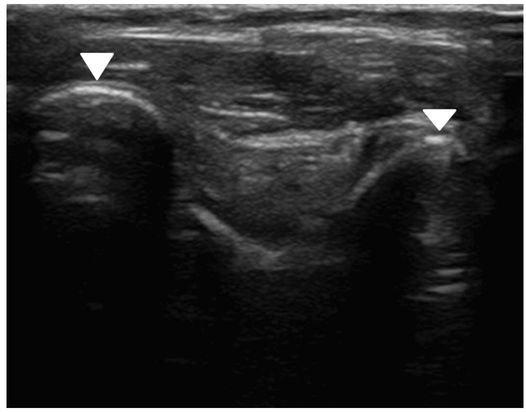

Fig. 2. Transverse view of the radius and ulna (*arrowheads*).

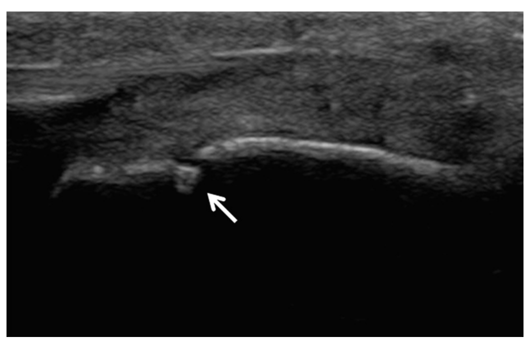

Fig. 3. Fracture of long bone. Note the cortical disruption (*arrow*).