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Ultrasound-guided Needle Localization to Aid Foreign Body Removal in Pediatric Patients

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ABSTRACT

Patients with podiatric foreign body injury commonly present to the emergency department. Often, the foreign object cannot be easily located or removed, and radiographs are frequently obtained to aid in localization. In cases requiring tissue dissection to remove the foreign bodies, accurate localization is required for safe removal of small and difficult to visualize bodies. We present 2 pediatric cases in which an ultrasound-guided needle localization technique was used to facilitate successful removal of small, difficult to visualize foreign bodies from the plantar foot. Ultrasound-guided needle localization reduced the required incision length and depth and helped to minimize the risk of damage to surrounding tissue.

Patients with superficial foreign body (FB) injury often present to the emergency department (ED), in particular, the pediatric ED. Plantar puncture wounds account for about 0.8% of all ED visits (1). With the exception of wounds to the hands, plantar puncture wounds have had the greatest complication rates compared with other sites in the body (2). These complications have included infection, retained FBs, and structural damage.

FB retention itself predisposes to inflammation, infection, and damage to, or dysfunction in, the surrounding structures (3). Therefore, efforts are usually made to remove FBs. The initial methods for FB retrieval include wound irrigation and superficial wound exploration, easily performed in the ED or clinic. Plantar surface wounds are particularly difficult to irrigate and explore, secondary to the rigid and sensitive nature of the skin and underlying tissue (2,3). In some scenarios, the object cannot easily be visualized or removed without deep dissection. In these situations, surgical methods can be required to safely remove the FB.

Radiographs can be useful for localization and are commonly obtained as part of the initial evaluation. However, many materials, including wood, plastic, fish bones, and even aluminum are not radiopaque (4,5). Also, the item could be so small that it cannot be clearly resolved using radiographs or fluoroscopy. Ultrasonography is a useful tool for FB detection, especially in cases in which localization of the object cannot be achieved with other imaging modalities. Most FBs are hyperechogenic and distinguishable from the surrounding soft tissue (5–7). We describe 2 cases of FB removal in which ultrasonography was used with needle localization, allowing for targeted dissection and successful removal of small plantar FBs.

Patients and Methods

Two patients presented sequentially to our pediatric ED with soft tissue FB retention. In both cases, the patients presented with complaints of FB injury to the plantar aspect of the foot. Initial radiographs were obtained, revealing faintly visible subcentimeter foreign objects. Initial attempts at FB removal in the ED were unsuccessful in both cases, predominantly owing to the FB location and small size. A consultation with interventional radiology and podiatry was obtained, and image-guided dissection with the patient under local anesthesia was recommended. The patients were scheduled for FB removal in the interventional radiology suite, with radiology and podiatry teams both present for the procedure. General anesthesia care was provided by pediatric anesthesiology in both cases. Ultrasound-guided localization was performed under sterile conditions using intraoperative ultrasound (iU22 Ultrasound, Philips Medical Systems, Andover, MA) with a 15-7 MHz compact linear array transducer (L15-7io), and either a 20- or 22-gauge needle. Dissection tools included a 15-blade scalpel, small tissue retractors, an iris scissor, and forceps.

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Fig. 1. Photograph of the right foot in a 2-year-old patient showing a 1-cm hyperkeratotic, hyperpigmented, cutaneous lesion (*arrow*) in the region of the third metatarsal head delineating the location of the foreign body entrance.

Case 1

A 2-year-old female presented to the ED with a FB lodged in her right foot. The patient's mother reported that the child had come to her crying, with blood on her right foot. The mother removed what appeared to be shards of glass from the patient's foot and bandaged the skin abrasion. Two weeks later, the mother reported that her child was limping and favoring her right foot, at which point she brought the patient to the hospital for additional evaluation. The physical examination showed a hyperkeratotic area measuring approximately 1 cm × 1 cm on the plantar aspect of the right foot in the region of the third metatarsal head (Fig. 1). Radiographic images of the foot demonstrated 2 linear, faint radiopaque structures in the area of the cutaneous lesion (Fig. 2*A*). Image-guided removal was scheduled, and the patient returned 4 days later for the procedure.

The patient was brought to the interventional radiology suite for removal of the FB. Fluoroscopy performed just before the procedure failed to resolve the FB. Preoperative ultrasonography clearly revealed a 5-mm linear echogenic FB in the plantar soft tissues of the foot, deep to the hyperkeratotic area over the third metatarsal head (Fig. 2*B*). A second deeper linear FB was also seen in a tendon overlying the third metatarsal head (Fig. 2*C*), measuring 2 mm. The patient's foot was prepared and draped in sterile fashion, and the ultrasound probe was prepared for use with a sterile probe cover. Under ultrasound guidance, a needle was directed to a position adjacent to the superficial FB (Fig. 3*A*). A small, vertical incision approximately 2 cm in length was made at the plantar foot, and blunt dissection was performed to the region of the needle tip (Fig. 3*B*). Intermittently, ultrasonography was used to relocate the FB, which at times was slightly displaced during the soft tissue dissection. After exploration at the site, a 5 mm × 1 mm shard of glass (Fig. 3*C*) was extracted from the foot. Attention was then directed to the second, smaller FB within the tendon. Again, using ultrasound guidance, the needle was adjusted to a location directly above the FB in the tendon, and local dissection was performed through the same incision. During exploration in this region, it was clear the risk of tendon damage was increased while attempting to retrieve the second FB. The procedure was then terminated at this point, and the fascial, subcutaneous, and skin layers were sutured closed. After 1 hour in the recovery area, the patient was discharged home.

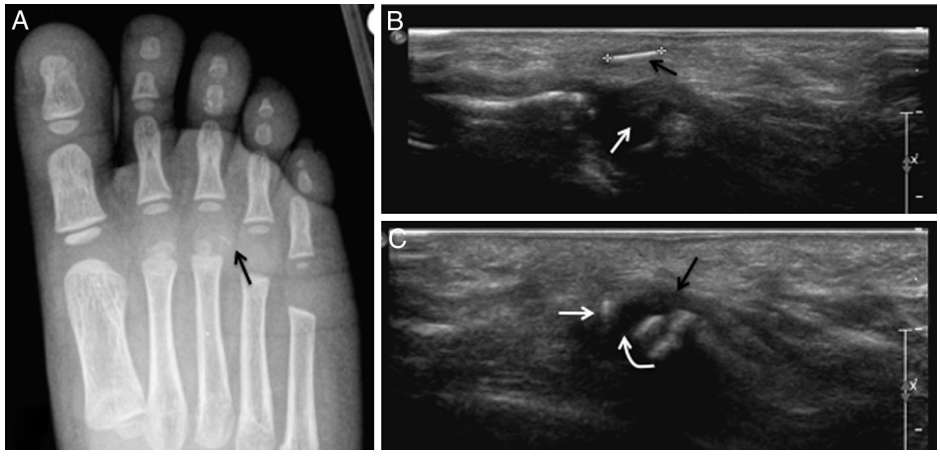

Fig. 2. (*A*) Oblique radiograph of the right foot in a 2-year-old patient showing 2 perpendicular, faint, linear, dense structures in the region of the third metatarsal head (*arrow*). (*B*) Sagittal ultrasound image at the plantar foot revealing a 5-mm linear structure consistent with a foreign body (*black arrow*) in the subcutaneous tissues over the third metatarsal head (*white arrow*). (*C*) Sagittal ultrasound image showing 2-mm linear object (*straight white arrow*) embedded in a tendon (*black arrow*) overlying the third metatarsal head (*curved white arrow*).