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ORIGINAL ARTICLE

Sonographic Evaluation and Sonographic-Guided Therapeutic Options of Lateral Ankle Pain: Peroneal Tendon Pathology Associated with the Presence of an Os Peroneum

Carolyn M. Sofka, MD · Ronald S. Adler, MD, PhD · Gregory R. Saboeiro, MD · Helene Pavlov, MD, FACR

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Abstract Clinical implications of acute injuries of the os peroneum have been described, with the recommendation in some cases being the excision of the bone fragments. We describe the spectrum of sonographic appearances associated with pain in the region of the os peroneum, document associated peroneal tendon pathology, and describe the use of sonography to direct and guide therapeutic and/or diagnostic injections. All sonographic examinations in our ultrasound database from Jan 1, 2001–Jan 30, 2007 with the words "os peroneum" were reviewed. Patients were cross-referenced in our radiology database to find relevant foot or ankle radiographs for correlation. There were 47 patients (18 men and 29 women, age range 16 to 83) referred for sonographic evaluation of lateral foot and/or ankle pain who had an os peroneum identified during the sonographic evaluation. Eighteen patients were referred specifically for targeted injection of the lateral ankle, including peroneal tendon sheath injections (N=10), calcaneocuboid joint injections (N=1), and injections around symptomatic os peroneum (N=7). All 47 patients had tendinosis of the peroneus longus, in varying degrees of severity. Radiographs were available for correlation in 28 patients. The causes of lateral ankle pain with a co-existent os peroneum are multifactorial and may not directly relate to the presence of an os peroneum. Ultrasound can be of value in separating out the specific etiology for pain, as well as provide a method for problem solving by the performance of targeted diagnostic or therapeutic injections in the lateral ankle.

Keywords ultrasound · os peroneum · peroneal tendons

Introduction

Plantar, lateral foot pain is a common presenting symptom to foot and ankle clinics, and while there are many causes of lateral foot pain, including peroneal tendinopathy, arthritis, and anterolateral ankle impingement, pathology related to the os peroneum is an often overlooked cause of plantar lateral foot pain.

The most common method of evaluating for the presence of an os peroneum is certainly plain film radiographs (Fig. 1). More recently, magnetic resonance imaging has been shown to be useful in evaluating for bone marrow edema pattern in the os peroneum suggesting chronic stress reaction [1].

Ultrasound has been shown to be highly efficacious in evaluating foot and ankle pain, especially tendinopathy and tendon tears [2]. High-resolution ultrasound can also be used to evaluate the presence of mineralization, such as calcification or, in the setting of accessory ossicles, cortical bone.

We describe the sonographic appearance of pain in the region of the os peroneum and associated peroneal tendon

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Each author certifies that his or her institution has approved the reporting of these cases, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

Level of Evidence: Level IV: Retrospective Case Series

C. M. Sofka, MD (✉) · R. S. Adler, MD, PhD · G. R. Saboeiro, MD · H. Pavlov, MD, FACR
Department of Radiology and Imaging,
Hospital for Special Surgery,
535 East 70th Street, New York, NY 10021, USA
e-mail: sofkac@hss.edu

C. M. Sofka, MD
Weill Medical College of Cornell University, New York, NY, USA

Fig. 1. This oblique supine radiograph of the foot demonstrates the characteristic appearance and location of an os peroneum (*arrow*)

pathology as well as define the role of sonography in directing treatment options for patients with what may present as a painful "os peroneum syndrome" [3]. The aims of our review were (1) to characterize the types of tendon pathology associated with the presence of an os peroneum and (2) to assess the use of ultrasound in performing therapeutic injections about the os peroneum.

Materials and methods

The study received the Institutional Review Board approval, and waiver of informed consent was obtained. From our ultrasound database, we retrospectively reviewed all foot and ankle ultrasounds performed between January 1, 2001, and January 30, 2007, for the key phrase "os peroneum." All cases were cross-referenced in our imaging database for foot and ankle radiographs performed within 6 months of the ultrasound exams, if available, for correlation.

Ultrasound examinations (N=50) were performed by a fellowship trained musculoskeletal radiologist with special expertise in musculoskeletal imaging using either a Siemens Elegra (Siemens Medical Solutions, Mountainview, CA, USA) or a Philips iU22 (Philips Medical Systems N.A. Bothell, WA, USA) in patients with a history of plantar, lateral foot pain. Exams were performed using a high frequency (12–17 MHz) linear transducer.

The peroneal tendons were identified and were analyzed using previously published criteria for tendon morphology [2]. A tendon was considered normal if it had the usual appearance of a compact linear band of echogenic ("bright") tissue containing a fine internal mixed hypo-/hyperechoic fibrillar pattern and as abnormal when thickened and of decreased echogenicity; tears were identified when discrete defects or gaps in the tendon were observed [2]. The degree of tendon degeneration was not standardized between observers; however, all of the sonologists were trained similarly and, anecdotally, have a reasonably high interobserver reliability.

A subset of patients (N=18) were specifically referred for either peroneal tendon sheath injection or os peroneum injection. For the injections, a short 25-gauge needle was used via a short-axis (transverse) approach. A 2-cm^3 mixture of 0.5 cm^3 1% lidocaine (Abbot Laboratories, North Chicago, IL, USA), 0.5 cm^3 0.5% bupivacaine (Sensorcaine, Astra Pharmaceuticals, Westborough, MA, USA), and 1 cm^3 triamcinolone (Kenalog, 40 mg/1 mL) (Apothecon, a Bristol-Myers Squibb Company, Princeton, NJ, USA) was injected into the peroneal tendon sheath, with slightly less total volume injected around the os peroneum. Ten patients had the peroneal tendon sheath injected (three men and seven women, age range 27–83 years), and seven had injections around the os (two men and five women, age range 16–57 years.) One patient was referred for injection specifically of the calcaneocuboid joint.

Standing anteroposterior and lateral radiographs of the foot or ankle were available for review in 28 patients. Lateral ankle radiographs included the base of the fifth metatarsal and calcaneocuboid joint in all cases. The radiographs were evaluated independently by two fellowship-trained musculoskeletal radiologists, blinded to the ultrasound findings. Os peroneum morphology was evaluated using the method of Sobel et al. [3]. Os peroneii were categorized as singular, bipartite, or multipartite, with the morphology of each fragment described as round or elongated, smooth, or fragmented. The relationship of the os to the calcaneocuboid joint and cuboid tunnel was also noted.

Results

Ultrasonography is useful to characterize plantar lateral foot pain around the os peroneum and can be used to characterize the condition of the peroneal tendons. There were 47 patients (50 ultrasound exams) identified. Peroneus longus tendon abnormalities were noted in all cases: tendinosis only (N=28), tendinosis and tears (N=8), tendinosis and effusion (N=7), and tendinosis plus effusion and tears (N=

Table 1 Os peroneum size and morphology (number of cases)

Morphology			
Size	Singular	Bipartite	Multipartite
<5 mm	5	1	
5–10mm	13	3	3
>15 mm	3		

N=28 radiographs

Table 2 Os peroneum size and peroneal tendon pathology

Size of os (on X-ray)	Peroneal tendinosis only	Tendinosis ± tears
<5 mm	7	
5–10 mm	12	3
>15 mm	4	2

N=28 radiographs

7). Of the 28 X-rays available for review, no relationship between the location of the os and full thickness peroneal tendon tears was noted. There was no correlation between the presence of ossified os peroneum, size, and morphology of os and tendon abnormalities (Tables 1 and 2), Of 13 os peroneii at or proximal to the calcaneocuboid joint, eight cases had tendinosis only and five had tendinosis and tears. Of five multipartite os peroneii, four had tendinosis only and one had tendinosis and tears (Fig. 2). All tears were of a chronic, repetitive, degenerative appearance consisting of one to multiple intrasubstance splits in the tendon, concentrated distally near the level of the os (insertional tears) (Fig. 3).

Eighteen lateral sided ultrasound-guided injections were performed as requested by the referring clinician: 10 were peroneal tendon sheath injections and one was a calcaneocuboid joint injection. Of the 10 peroneal tendon sheath injections, four patients had peroneal tendinosis, five had peroneal tendinosis with a moderate peroneal tendon sheath effusion, and one had a moderate tendon sheath effusion with degeneration and intrasubstance splits in the peroneus longus. Seven injections were performed around the os itself, which in two cases, there was communication with the peroneal tendon sheath and five cases filled an adventitial bursa around the os (Fig. 4). In the seven cases where the needle was directed around the os peroneum, one patient had marked peroneal tendinosis with multiple intrasubstance splits, two had moderate to severe peroneal tendinosis, and four had mild tendinosis.

Discussion

A painful os peroneum syndrome is a common cause of plantar, lateral foot pain, which can be caused by a spectrum of conditions such as os peroneum fracture, diastasis of a multipartite os peroneum, leading to stenosing tenosynovitis of the peroneus longus or attrition or tear of the peroneus longus [3] (Fig. 3). The prevalence of os peroneii is debated, with variable numbers reported in the literature. One cadaver study demonstrated a 90% prevalence with 96% being bilateral [4]. The aim of this study was to evaluate our experience using ultrasound to characterize plantar lateral foot pain and peroneal tendon pathology as well as to assess the usefulness of this technique in performing specific site therapeutic injections for this condition.

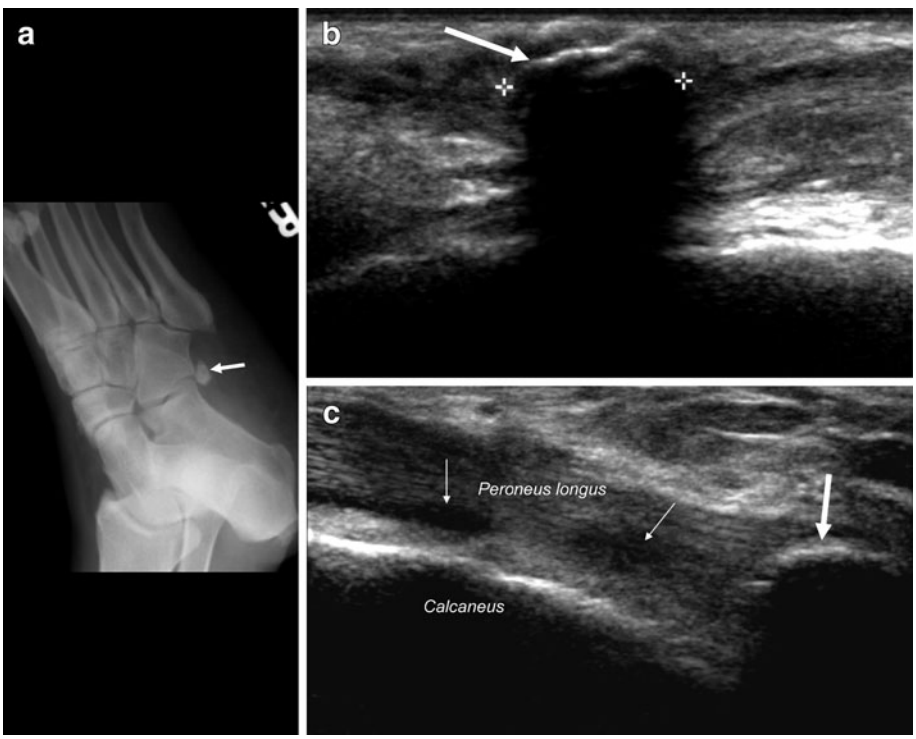

Fig. 2. This 54-year-old women presented with chronic lateral ankle pain. An oblique supine radiograph (**a**) of the foot demonstrates a 12-mm os peroneum at the calcaneocuboid joint (*arrow*). Short-axis sonographic image demonstrates the characteristic ultrasound appearance of the os peroneum, with a curvilinear hyperechoic superficial margin (*arrow*) with posterior acoustic shadowing (**b**). Caliper markers for measurement purposes are present. Longitudinal ultrasound image in the same patient (**c**) demonstrates the os peroneum (*thick white arrow*) with tendinosis of the peroneus longus tendon (labeled) as demonstrated by thickening and decreased echogenicity of the tendon and areas of central cystic degeneration (*thin arrows*) (**c**). The subjacent calcaneus is also labeled for reference

Fig. 3. This 55-year-old woman presented with chronic lateral ankle pain. Oblique supine radiograph of the foot demonstrates a 15-mm os peroneum (*arrow*) (**a**). Short-axis ultrasound images of the peroneal tendons in this same patient demonstrate marked thickening and inhomogeneity of the peroneal tendons with hypoechoic thickening of the tendon sheath (*arrow*) consistent with stenosing tenosynovitis (**b**). Additional short-axis image further proximally demonstrates frank longitudinal splits within both the peroneus brevis and longus tendons (*arrows*) (**c**)

Limitations of our study include the absence of long-term standardized outcome follow-up for the injections. We have no surgical correlation. Power Doppler was not routinely employed, which might have prospectively identified areas of potential inflammation in these potentially directing alternative sites of injection. As this was a retrospective study, we had no controls.

In our series, there was a higher detection rate of os peroneii with ultrasound, with 10% of os peroneii not seen on radiographs. The higher incidence in this series may be that it is a direct anatomic study with direct inspection as opposed to an X-ray study [4].

Os peroneii have been shown anatomically to have variable histologic structure with different degrees of ossification, composed of differing degrees of fibrous tissue, cartilage, and bone [5]. Sesamoid bones form from cartilaginous rests leading to enchondral ossification [5]. This may explain higher detection rates with ultrasound, as ultrasound is going to be exquisitely sensitive to detecting structures with differing acoustic impedence properties. Ultrasound also is a cross-sectional imaging modality, and it is possible to follow the course of the tendon in real time.

Our findings are similar to that reported by Peacock et al., noting that proximal migration of the os peroneum is not a consistent finding with fractures of the os peroneum [6]. In our series, we found no relationship between the location or morphology of the os peroneum and the degree of peroneus longus abnormalities. These are differing obser-

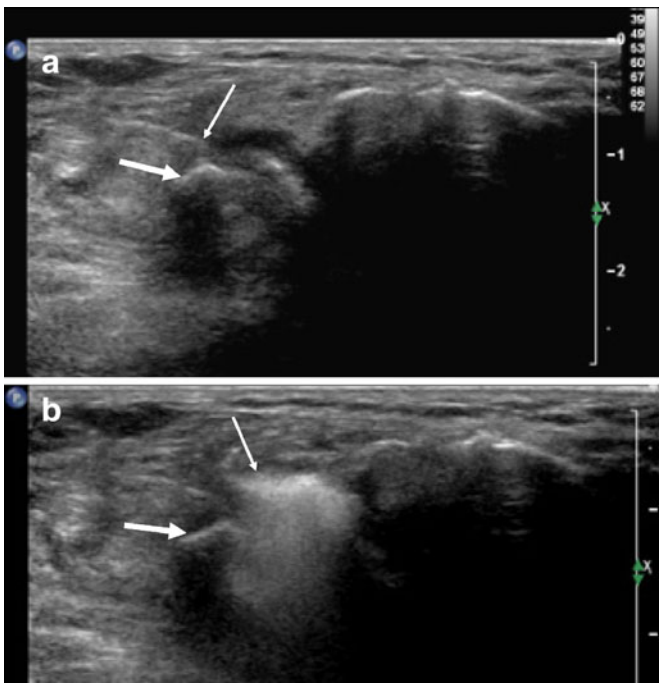

Fig. 4. An example of an ultrasound-guided steroid/anesthetic injection around the os is shown. The linear hyperechoic needle tip (*thin white arrow*) is directly adjacent to the os peroneum (*thick white arrow*) (**a**). Injection of the steroid/anesthesia mixture preferentially fills an adventitial bursa around the os (*thin white arrow*). The os is still partially visible (*thick white arrow*) (**b**)

vations from those reported from Brigido et al., although theirs was a specific subset of patients with documented os peroneum fractures [7].

There are variable genetic and mechanical factors leading to the development of an os peroneum. Age, sex, and race have not been shown to correlate with the presence of an os peroneum [4]. Interestingly, the presence of an os peroneum has been shown to be genetically linked to the presence of a fabella. It has been suggested that since the peroneus longus is an adductor of the hallux, the lack of hallux opposability in homo sapiens may result in a lack of mechanical stimulus for formation and maintenance of an os peroneum, with changes in degree of plantar flexion in contrast to lower primates leading to lack of stimulus for formation of an os peroneum [5, 8].

There are multiple soft tissue tethers that anchor the os peroneum to the plantar fascia, fifth metatarsal base, cuboid, and peroneus brevis tendon [7]. Mechanical factors, soft tissue abnormalities, and biomechanics of the foot affect peroneal tendons more than just the os peroneum. With regards to the injections, there is a bare synovial sheath about the os at the cuboid tunnel, which may explain the communication of fluid injected around the os with the peroneal tendon sheath.

In conclusion, peroneal tendon and os peroneum abnormalities are a cause of plantar, lateral foot pain. The complementary use of imaging, both X-rays and ultrasound, can help define both osseous and soft tissue abnormalities. Ultrasound can be utilized both as the primary diagnostic modality for diagnosis as well as a method to guide for therapeutic injections in this cohort of patients.

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