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Ultrasound in Emergency Medicine

ANATOMIC RELATIONSHIP AND IMAGING RELEVANCE OF THE PERFORATING BRANCHES OF THE PERONEAL VESSELS TO THE ANTERIOR TALOFIBULAR LIGAMENT

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☐ **Abstract—Background: Patients frequently present to the emergency department after ankle injuries, and the anterior talofibular ligament (ATFL) is commonly damaged. Musculoskeletal ultrasound (US) can help to make a rapid diagnosis. There is a paucity of literature describing techniques to image the ATFL with US, and the complex ankle anatomy and potential pitfalls make imaging challenging. Objective: Our aim was to estimate prevalence of perforating branches (PBs) of the peroneal vessels and determine their most frequent position relative to the ATFL. If these vessels are located in a predictable position at the level of the ATFL, they may serve as a sonographic landmark for the correct imaging plane. Methods: Magnetic resonance imaging (MRI) scans of 105 ankles were reviewed to determine the PB prevalence and location at the ATFL. Inter-observer agreement was determined. Additionally, 16 ankles from 8 asymptomatic subjects were scanned using a high-frequency linear transducer and PB prevalence and location were noted. Results: By MRI, PBs were detected in 85% of the ankles and 93% of ankles after consensus. In 73% of cases with agreed PB visualization, vessels assumed a medial position with respect to the ATFL. By US, PBs could be seen in 100% of cases, with the arterial PB seen in 81% of cases and assuming a medial position in 88%. Conclusions: PBs are often present, have a predictable course, and may be useful to help optimize US probe positioning when assessing the ATFL.** © **2017 Elsevier Inc. All rights reserved.**

☐ **Keywords—ultrasound; MRI; anterior talofibular ligament; ATFL; peroneal; artery; radiology; emergency medicine**

INTRODUCTION

Several investigators have reported a high diagnostic accuracy of ultrasound (US) to determine the integrity of the anterior talofibular ligament (ATFL) (1–5). In the emergency medicine literature, there is only one such article to date, which describes a sensitivity of 94%, a specificity of 100%, and a diagnostic accuracy similar to that of magnetic resonance imaging (MRI) (3). In this article, trained nonblinded emergency physicians assessed the ATFL of patients presenting with an inversion-type ankle injury by placing the transducer over the ATFL and parallel to the sole of the foot. Because no sonographic landmarks were described, the imaging plane was presumably selected on the basis of physical inspection of the

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ankle. However, the oblique orientation of this thin ligament, adjacent tibiotalar joint capsule, and nearby anterior inferior tibiofibular ligament can make selection of the correct field-of-view during sonographic evaluation challenging. This can be appreciated in another study evaluating the diagnostic value of US and MRI in the diagnosis of ATFL injury when arthroscopy was used as the gold standard (4). In this study, sonography is noted to have a diagnostic accuracy of 91%, compared with 97% for MRI. However, the location of ATFL injury coincided with that seen on arthroscopy in only 63% of cases with US compared to 93% of cases with MRI (4). Use of a patient cohort with a high prevalence of ATFL damage (30 of 34 in this case), such as those presenting with an acute ankle injury, may render the meaning of the test's predictive value to be less reliable. In the study mentioned, which looked at 34 patients with ankle sprain, the decreased surgical concordance of injury location with US compared to MRI may indicate that such a reliability issue is present. Additionally, in this same study, US had a 33% specificity in the detection of ATFL injuries (4). In a more recent study, authors describe inherent challenges in imaging the ATFL with US and propose a complex multistep method to interrogate the ATFL (6). In addition, there is inherent bias introduced when scanning a patient with US because the interpreter can converse with the patient, palate the ankle, and visualize soft-tissue swelling. Therefore, despite the high reported sensitivity, specificity, and accuracy of diagnostic US in the detection and grading of ATFL injuries, more rigorously designed prospective case-control studies are necessary. However, technical difficulties and pitfalls associated with the lack of a standardized scanning technique should be considered before performing these studies.

To help position the probe appropriately, branches of the peroneal artery and veins known as the perforating branches (PBs) can be used as a road map (7). The PBs arise from the peroneal artery and veins and pass anteriorly through the syndesmosis just above the ankle joint. These branches have been shown to be present in most patients and to have a predictable course. In a study of 47 cadaveric legs looking at the vascular supply to the anterior inferior tibiofibular ligament and syndesmosis, three principle arterial supply patterns were noted (7). In all cases, there was an arterial anastomosis between the arterial PB and the dorsalis pedis (peroneal and anterior tibial arterial communication). In 84% of these legs, a sizeable arterial PB was detected, which provided substantial blood supply to the anterior inferior tibiofibular syndesmosis. In the remaining 16% of cases, the dominant blood supply to the anterior inferior tibiofibular ligament/syndesmosis was from the dorsalis pedis and, as a result, small but identifiable arterial PBs were present. After supplying the syndesmosis, the PB passes distally and superficial to the ATFL, where extracrural fascia has been reported to bind the ATFL to the PB (8). After passing distal to the ATFL, the PB often gives rise to a branch that enters the sinus tarsi. Because the sinus tarsi is medial to the syndesmosis, the PB needs to move from lateral to medial as it moves from proximal to distal (Figures 1 and 2) (9). If the dominant vessel feeding into the sinus tarsi arises from the dorsalis pedis, it may be more challenging to trace the PB by MRI.

The purpose of this study is to estimate the prevalence of the PBs, determine their most frequent position relative to the ATFL and whether the PB anatomy can be seen with both MRI and US. Our hypothesis is that these branches are usually present, have a predictable course, and may be used in conjunction with bony and soft-tissue landmarks to accurately position the probe during sonographic interrogation of the ATFL.

MATERIALS AND METHODS

MRI Case Selection

A waiver of informed consent was obtained from the Institutional Review Board for this Health Insurance Portability and Accountability Act–compliant retrospective study. All images were acquired with a 3-mm slice thickness on either a 1.5- or 3-Tesla magnet. A database

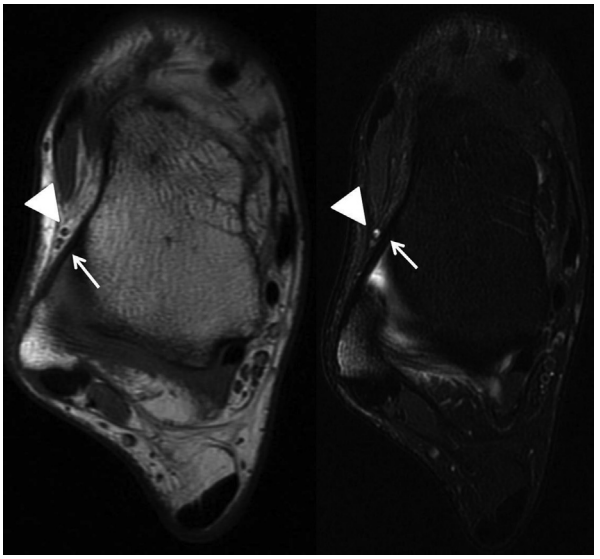

Figure 1. A 38-year-old man with ankle pain. Axial proton density without (left) and with (right) fat suppression demonstrates an intact normal anterior talofibular ligament (ATFL) (white arrow) with the perforating branches anterior to the medial half of the ATFL (white arrowhead).