Role of MRI in the diagnosis of ankle diseases

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Introduction
Hindfoot and ankle pain is commonly seen in a wide range of patients. MRI has made remarkable progress in the diagnosis and treatment of many musculoskeletal diseases, especially those of the ankle and foot. This study aimed to evaluate the role of MRI in the diagnosis of ankle diseases.

Patients and methods
This study was carried out on 50 patients of either sex with a major ankle pain complaint using 1.5 T MRI over 6 months in the Radiology Department of Assiut University Hospital.

Results
Ligament tears were found in 28% of patients; an anterior talofibular ligament was commonly torn followed by deltoid ligament tears. Achilles tendon pathology was found in 14% of patients, retrocalcaneal bursitis was seen in 4%, osseous lesions were found in 54% of patients, stress fractures in 4%, osteomyelitis in 6%, bone marrow edema in 32%, and degenerative osteoarthritis in 12%. Soft tissue edema and cellulitis was seen in 12%, posterior impingement in 8%, sinus tarsi edema in 4%, anterior impingement in 2%, plantar fasciitis in 2%, and Os navicular syndrome in 2%.

Conclusion
MRI is the method of choice for the diagnosis of other modalities-free-painful ankle joints. It detects subtle abnormalities or detailed anatomical mapping of the disease process which allows precise diagnosis that is effective in further management of these patients.

Keywords:
ankle pain, MRI, musculoskeletal

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Introduction

The ankle is an anatomically complex region having a broad spectrum of pathologies [1,2]. Tendon pathologies of the foot and ankle are very common, and they are increasing in number. The Achilles and peroneal tendons are commonly involved, and less commonly involved are the tibialis anterior and flexor hallucis longus tendons [3]. The ankle's MRI has improved significantly in the last 10 years, as imaging plays a vital role in the treatment and preoperative research [4–6]. There are a lot of etiologies for ankle or hindfoot pain; these different diagnoses have overlapping clinical signs and symptoms, which is why clinicians tend to rely on MRI to accurately diagnose and treat the underlying etiology [4]. MRI in this anatomical area has become the study of choice for musculoskeletal disease, as it has high contrast soft tissue resolution and multi-planer capabilities. Moreover, it provides a quick noninvasive tool to diagnose related injuries, which are often hard to diagnose with other modalities. MRI is particularly beneficial for assessing the structure of soft tissues across the ankle joint, such as tendons, ligaments, nerves, fascia, and occult bone injuries [7].

Aim

This study aims to evaluate the role of MRI in the diagnosis of ankle diseases.

Patients and methods

This study (IRB: 17101190, Assiut Faculty of Medicine approved the study) was conducted on 50 patients in the Radiology Department of Assiut University Hospital for a period of 6 months extended from January 2019 to June 2019, including patients from an orthopedic clinic who were recommended for MRI.

The ethics committee approval was obtained and all selected patients and controls offered an oral consent form.

Complete history was taken, which included the following:

(1) The main complaint usually consists of ankle pain, which may be associated with joint swelling or restrictions on joint movements.
(2) History of trauma or previous imaging, particularly radiograph.
(3) Patients who were contraindicated for MRI scanning had been excluded.

Examination of the ankle joint was performed using 1.5 T MRI, knee coil, imaging matrices of 256 × 192 to 256, 3 mm slice thickness, and 0.5–1 mm interslice gap. In the examination of the Achilles tendon or the entire ankle and foot as in diffuse inflammatory conditions, a larger field of view was required using large imaging matrices (512 × 256).

The patient was kept in the supine position and foot in the neutral position 10–20° of plantar flexion and 10–30° of external rotation. MRI sequences done were gradient echo (sagittal, coronal, and axial), axial T1WI and T2WI, coronal T2WI, STIR, and sagittal STIR.

Results

This study included 50 patients, comprising 32 males and 18 females.

Their age ranged from 11 to 64 years, with a mean of 30 years.

The left ankle was affected in 24 patients and the right in 26 patients.

Clinical history included ankle pain and swelling, and difficulties in walking.

All patients presented mainly with ankle pain. In 31 patients, the pain was associated with joint swelling, and also with limitations of movements in 19 patients and signs of inflammation in four patients, as shown in Fig. 1.

Ankle radiograph: 30 (60%) patients were done radiograph before performing MRI.

MRI ankle lesions

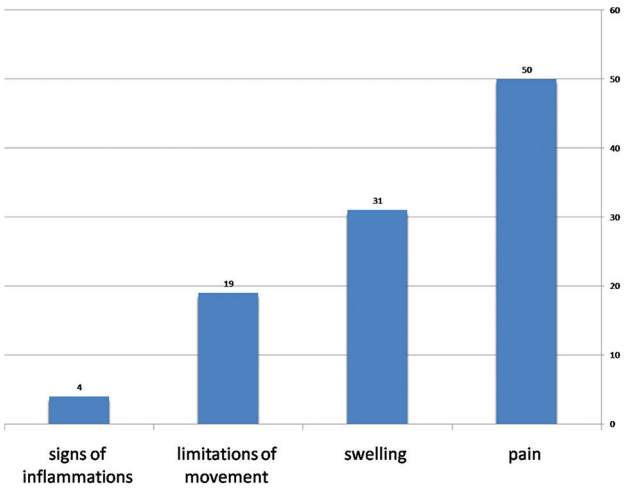
Ligament tears

Ligament tears were found in 14 patients (Table 1). Complete and partial tear of the anterior talofibular ligament (ATFL) was commonly seen followed by deltoid ligament tears (Fig. 2). Ligaments injuries were commonly associated with inversion/twisting injuries.

Tendon injuries

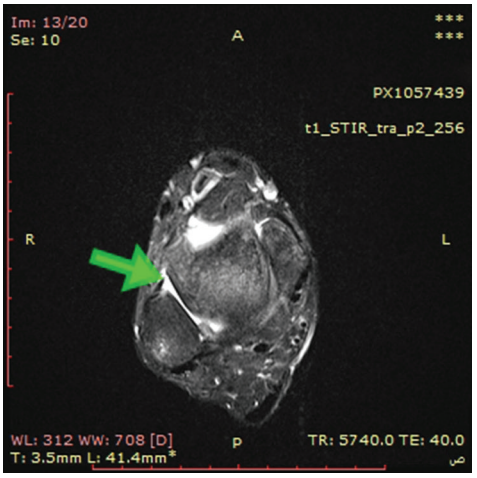
Achilles tendon pathology was found in seven (14%) patients. Five patients had Achilles tendon tear, where two had a complete rupture and three had a partial tear of the tendon. Achilles tendinosis was demonstrated in two patients (Fig. 3).

Figure 1



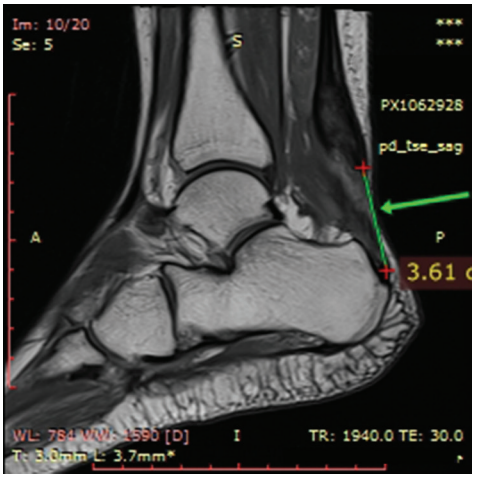
Clinical presentation: 37 (74%) patients gave a history of trauma. Twisting/inversion injury was common and was seen in 23 patients.

Figure 2



Axial T2WI shows complete tear of the upper portion of the anterior talofibular ligament with mild joint effusion.

Figure 3



Sagittal PDWI shows complete Achilles tendon tear.

Osseous lesions

The stress fracture was found in two (4%) patients (Fig. 4). Osteomyelitis of different bones (talus, distal fibula, and tibia) with soft tissue swelling causing ankle and heel pain was found in three (6%) patients, and bone marrow edema was seen in 16 (32%) patients. Degenerative osteoarthritis (OA) was seen in six (12%) patients, including three being posttraumatic, marrow edema was found in five cases, and others were associated with soft tissue edema (two patients), impingement syndrome (one patient), and joint effusion (three patients).

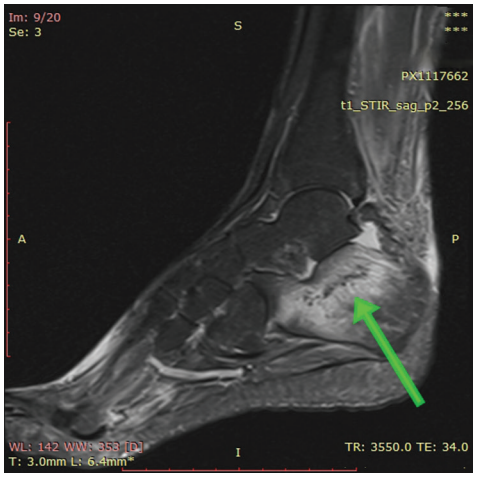
Soft tissue lesions

Soft tissue lesions were seen in 14 patients, where soft tissue edema and cellulitis were the most commonly seen and were found in six (12%) patients who presented with ankle pain and signs of inflammation, then four (8%) patients were diagnosed as having posterior impingement owing to Os trigonum (Fig. 5), one patient was diagnosed as having anterior impingement owing to talar hook, sinus tarsi edema was seen in two (4%) patients, and one patient had a chronic partial tear of the cervical ligament (Fig. 6). Plantar fasciitis was the cause of heel pain in one patient (Fig. 7).

Others lesions

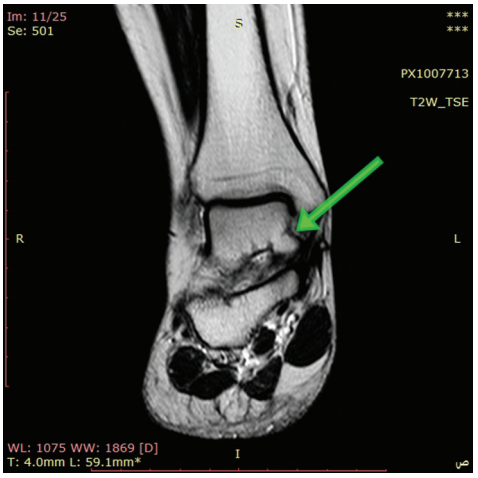
(1) Retrocalcaneal bursitis was found in two (4%) patients with heel pain.
(2) Reactive joint effusion was seen in the ankle in 10 (20%) patients with different ankle pathology.
(3) Os navicular syndrome was the cause of heel pain associated with difficult movement found in one patient. Edema of the accessory navicular bone was seen with an intact posterior tibial tendon (Fig. 8).

Figure 4



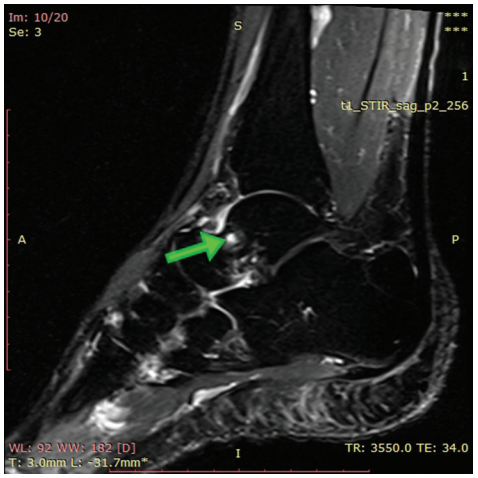
Sagittal STIR shows left calcaneus linear stress fracture with surrounding bone marrow edema.

Figure 5



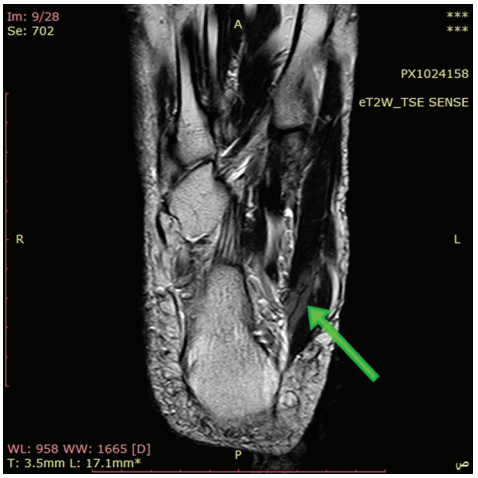
Coronal T2WI shows posterior impingement syndrome caused by Os trigonum.

Figure 6



Sagittal STIR image shows sinus tarsi syndrome.

Figure 7



Axial T2WI shows right plantar fasciitis (increase in thickness with hyperintensity signal).

Figure 8

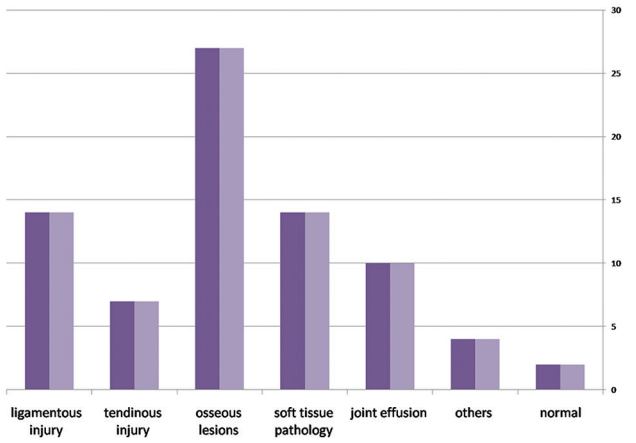


Chart shows different MRI ankle lesions.

Table 1 Ligaments tears

Ligaments	*n* (%)
Anterior talofibular ligament	7 (50)
Posterior talofibular ligament	3 (21)
Deltoid ligament	6 (42.8)
Anterior tibiofibular ligament	3 (21.4)
Posterior tibiofibular ligament	2 (14.3)

Discussion

Ankle and foot pain is a common clinical issue due to a multiplicity of soft tissue and osseous lesion. Sharma *et al.*[8] stated plain radiograph is the usual first line of investigations for the assessment of osseous structures and high-frequency ultrasound for soft tissue lesions. However, owing to the inherent restriction of assessment of deeper soft tissue and subtle soft tissue and osseous lesions with these imaging modalities, MRI is the gold standard problem-solving noninvasive imaging tool [8]. This was in agreement with our study, as only 60% of patients did radiograph before performing MRI and noted that the cause of pain in some cases could not be explained, so MRI was requested. Kaushik[9] published that the most common causes of ankle pain were trauma-related, and most of the ankle injuries were mostly associated with inversion/twisting injuries. Ankle pain was nontraumatic only in a small percentage of cases, which was consistent with our study, as we found 74% of patients had a history of trauma. Of these, due to an inversion of the ankle, 46% of injuries were reported, and 28% of them with injury to the ligaments.

The ATFL is the weakest and therefore the most often torn ligament; a complete and partial tear of the ATFL was commonly seen followed by deltoid ligament injuries [10]. This study concurs with the published data with seven patients having ATFL tears among all patient with ligament injuries (n = 14).

Achilles tendon pathology was found in 14% of patients with no significant radiograph findings. Five patients had Achilles tendon tear, and two of them had a complete rupture and three had partial tendon tear. Complete tendon tear showed a high signal fluid-filled tendon gap that is most evident on STIR and T2WI, but partial Achilles tendon tears appear as heterogeneous signal intensity and tendon thickening without complete disturbance, as stated by Masala *et al.* [1]. Two patients with Achilles tendinosis have been shown to have increased signal intensity with increased thickness at the insertional site of the tendon, calcaneal marrow edema, and distended retrocalcaneal bursitis, which agreed with Pierre-Jerome *et al.* [11].

MRI is the best way to image the structure of the sinus tarsi, particularly the interosseous and cervical ligaments. 4% of patients with sinus tarsi syndrome that alters the tarsal sinus fat presented with diffuse, low-signal-intensity infiltration on both T1WI and T2WI, which is consistent with the study by Corazza *et al.* [12].

As some of the stress fractures can be detected only on radiograph, tarsal bone stress fractures are often missed [13]. The MRI appears Either as rather defined abnormal signal intensity of the bone marrow with an ill-defined area of T1WI hypo intensity and T2WI and STIR hyper intensity Or the stress continues and the fracture appears to be irregular, hypo intense within the edematous and hyperemic area, associated with collection or hemorrhage in the surrounding soft tissue in some of the cases [14].

As mentioned by Agaja and Ayorinde, calcaneus is a frequent location of osteomyelitis of the foot that may result from either hematogenous spread or secondary spread from a contiguous soft tissue septic focus or a penetrating wound. MRI is useful for defining the extent of osteomyelitis associated with soft tissue infection and for differentiating soft tissue infection without osteomyelitis, manifests as ill-defined areas of decreased marrow signal intensity on T1-weighted images that increase in signal intensity on T2-weighted or STIR images [15,16]. This study showed that osteomyelitis of different bones (talus, distal fibula, and tibia) with soft tissue swelling causing ankle and heel pain was similar to MRI findings in 6% of secondary patients.

Bone marrow edema of the calcaneus is the most commonly seen and commonly associated with ligament, tendon, or soft tissue pathology, with low signal on T1WI and high on T2WI and STIR [17].

In this study, OA was seen in 12% of patients, three of whom were posttraumatic. Primary OA was found in

the other three patients. In agreement with Barg and colleagues, evaluation of OA ankle joint begins with a professional examination of balance and integrity and calculation of motion range, and then weight-bearing foot and ankle radiograph may help to determine the underlying causes of ankle OA [18,19]. We found in this study most patients (n = 5) did not have radiograph imaging before MRI, most patients had radiograph for the history of trauma, and radiograph showed early signs of OA, but did not explain the patient's complaint.

MRI on sagittal and coronal planes is helpful in the diagnosis of plantar fasciitis, increased thickness (up to 7–8 mm) with intermediate signal intensity on T1WI and PDWI, and hyperintensity on T2WI [20]; this is in agreement with our study, where one patient had heel pain, small calcaneus spur on radiograph, thickened fascia more than 4 mm, and increased signal and calcaneus spur on STIR images.

Posterior impingement of the ankle is triggered by a prominent talar trigonal process, either a discrete separate Os trigonum or prominent posterior talus process (Stieda's process). MRI helps verify the diagnosis of posterior impingement (Os trigonum) as well as in removing any potential triggers of posterior ankle discomfort such as osteochondral talus lesion, bone contusions of the lateral talar tubercle, and Os trigonum, which are prevalent MRI findings [21]. Anterolateral ankle impingement owing to a talar hook associated with affection of multiple ligaments, and the axial images were considered most helpful in making the diagnosis [22]. In this study, four patients had posterior impingement of the ankle due to Os trigonum, and one patient was diagnosed as having anterolateral ankle impingement owing to talar hook.

Soft tissue edema and cellulitis were seen in 12% of patients with ankle pain and signs of inflammation. Soft tissue edema and cellulitis appeared as diffuse high signal intensity on T2WI or STIR [23].

The one condition of the navicular bone that may cause heel discomfort is the extra bone or piece of cartilage found on the inside of the foot just above the arch and incorporated into the posterior tibial tendon. Most individuals may not know that they have this congenital disorder because it does not trigger complications. Some people, however, develop painful syndrome as the posterior tibial tendon and/or the bone worsen by trauma, irritation from poor footwear, or overuse [8]. In this study, one patient had heel pain associated with difficult movement. MRI showed edema of the accessory navicular bone with an intact posterior tibial tendon.

Conclusion

MRI is the choice method for the diagnosis of other modalities-free painful ankle joint with or without a history of trauma. It detects subtle abnormalities or detailed anatomical mapping of the disease process that allows precise diagnosis, which is effective in further management of these patients.

Recommendation

From this study, we recommended MRI examination of the ankle joint for all patients complaining of ankle pain.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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