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MRI in the Evaluation of Ankle Pain

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1. Introduction

Magnetic resonance (MR) imaging has opened new horizons in the diagnosis and treatment of many musculoskeletal diseases of the ankle and foot. It demonstrates abnormalities in the bones and soft tissues before they become evident at other imaging modalities. The exquisite soft-tissue contrast resolution, noninvasive nature, and multiplanar capabilities of MR imaging make it especially valuable for the detection and assessment of a variety of soft-tissue disorders of the ligaments (e.g., sprain), tendons (tendinosis, peritendinosis, tenosynovitis, entrapment, rupture, dislocation), and other soft-tissue structures (eg, anterolateral impingement syndrome, sinus tarsi syndrome, compressive neuropathies [eg, tarsal tunnel syndrome, Morton neuroma], synovial disorders). MR imaging has also been shown to be highly sensitive in the detection and staging of a number of musculoskeletal infections including cellulitis, soft-tissue abscesses, and osteomyelitis. In addition, MR imaging is excellent for the early detection and assessment of a number of osseous abnormalities such as bone contusions, stress and insufficiency fractures, osteochondral fractures, osteonecrosis, and transient bone marrow edema. MR imaging is increasingly being recognized as the modality of choice for assessment of pathologic conditions of the ankle and foot. MRI provides optimal assessment of muscles, tendons, hyaline and fibrous cartilage, joint capsules, fat, bursae and bone marrow. MRI with or without intraarticular contrast is the most accurate imaging modality for evaluating ankle pathology allowing visualization of the soft tissues that are often the source of pain.

2. Materials and Methods

The study was conducted on a total of 50 eligible patients having ankle pain who were referred to the Department of Radiodiagnosis and Imaging for MRI evaluation of ankle. Informed and written consent was taken from the patients prior to exam. All the cases had undergone MRI scan **using SIEMENS MAGNETOM SYMPHONY 1.5 TESLA TIM (SIEMENS HEALTHCARE, GERMANY).** Post contrast studies using gadolinium based iv contrast agent with a dosage of 0.1mmol/kg body weight were administered by manual injection in the patients where required. Imaging of the ankle and foot was done with the foot at right angles to the lower leg with the patient in a supine position. A standard extremity coil generally was employed for the foot and ankle. Routine ankle MR imaging was performed in the axial, coronal, and sagittal planes parallel to the table top. Different pulse sequences were used based on the clinical indications. Generally, we do a combination of T1 and some type of T2 sequences in all three orthogonal planes to show the different anatomic structures and pathologic entities well. Marrow abnormalities were best evaluated with fat suppression techniques such as fat-suppressed proton-density–weighted imaging or with short inversion-time inversion recovery (STIR) sequences (1, 500/20; inversion time msec = 100–150). However, susceptibility to gradient inhomogeneity makes fat suppression techniques less optimal than STIR techniques in imaging the ankle and foot. Cartilage abnormalities were visualized with two-dimensional or three-dimensional (3D) gradient-echo sequences.

3. Observations and Results

In this study, distribution of patients with ankle pain according to the decade of life was : 10% patients in < 20 years of age group, 26% patients in 20-30 years age group, 16% patients in 30-40 years age group, 20% patients in 40-50 years age group, 24% patients in 50-60 years age group and 4% patients in > 60 years age group. Majority of patients with ankle pain were in the 20-30 years age group (26%). The sample size in our study (100) comprised of 26 male patients (52%) and 24 female patients (48%). In our study, 30% patients had history of trauma while 70% patients had no history of trauma. In our study on 50 patients, 11 had tendinous lesions. The most commonly involved were Flexor hallucus longus and peroneus longus followed by Tendoachillis. Out of 11 (22%) patients with tendinous lesions, 54.6% demonstrated tenosynovitis, 36.3% demonstrated partial tears while 9 % demonstrated complete tears.

In our study on 50 patients, 7 (14%) had ligamentous abnormalities. Most commonly involved was the Anterior talofibular involved in 3 patients (42.8%) followed by Posterior talofibular in 2 patients (28.5%) and Posterior tibiofibular, Posterior tibiofibular, Fibulocalcaneal ligaments in 1 patient each (14.2%) respectively.

In our study on 50 patients, 7 (14%) had inflammatory conditions. Among the inflammatory conditions of ankle, plantar fascitis was the most common finding in patients with ankle pain 4 pateints (57.1%) followed by sinus tarsi syndrome in 2 patients (28.5%) and retrocalcaneal bursistis in 1 patient (14.2%).

In our study over 11 out of 50 patients (22%) had synovial abnormalities.Among synovial abnormalities, 9 (81.8%) had Synovial hypertrophy with uniform post gad enhancement (synovitis) followed by Synovial hypertrophy with hypointense areas on T1 and T2 sequences (PVNS) in 2 patients (18.2%).

In our study over 11 out of 50 patients (22%) had bone abnormalities. Among bony abnormalities, 8 patients (72.7%) had **bone** marrow edema, 2 patients (18%) had Os trigonum syndrome, 1patient (9%) had bone erosion and 1 patient (9%) had Bone Island.

In our study over 8 out of 50 patients (16%) had joint effusion.

Table 1: Age wise distribution of cases

Age group (years)	Number of patients	Percentage
<20	5	10%
20-30	13	26%
30-40	8	16%
40-50	10	20%
50-60	12	24%
>60	2	4%
Total	50	100%

Table 2: Gender wise distribution of cases

Sex	Number of patients	Percentage
Male	26	52%
Female	24	48%
Total	50	100%

Table 3: History of Trauma in patients of ankle pain

History of trauma	Number of patients	Percentage
Present	15	30%
Absent	35	70%
Total	50	100%

Table 5: MRI diagnosis of ankle pain

Various Disorders	Number of patients	Percentage (n=50)
Tendinous lesions	11	22%
Ligamentous lesions	7	14%
Inflammatory conditions (sinus tarsi, plantar fasciitis, bursitis)	7	14%
Synovial abnormalities (synovitis, PVNS)	11	22%
Bone abnormalities including bone edema	11	22%
Joint effusion	8	16%

Sagittal T2 WI showing increased thickness of tendoachillis with increased signal intensity in its substance suggestive of partial tear

STIR coronal image showing bulky posterior talofibular (denoted by white arrow) and fibulocalcaneal ligaments (denoted by white asterisk) with hyperintense signal suggestive of partial tear

STIR coronal image showing bulky and hyperintense posterior talofibular ligament suggestive of partial tear.

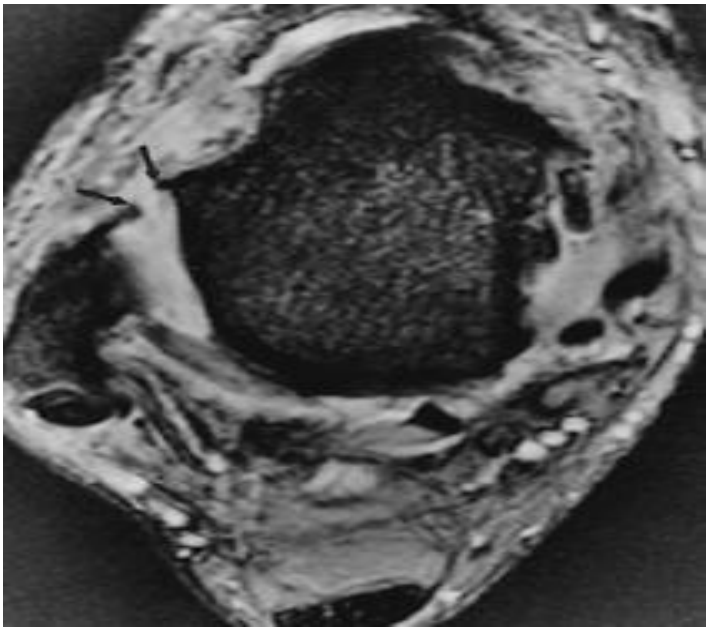
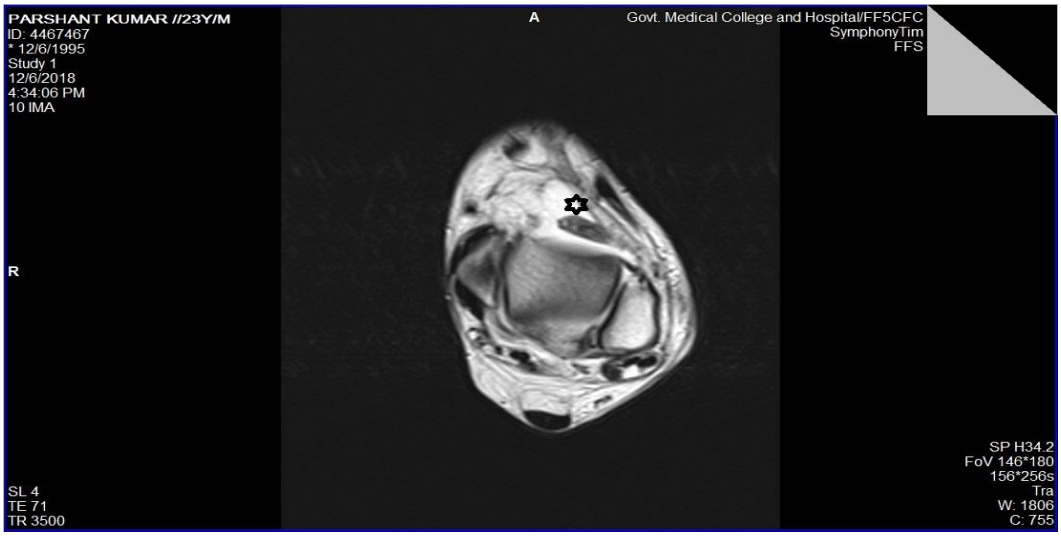
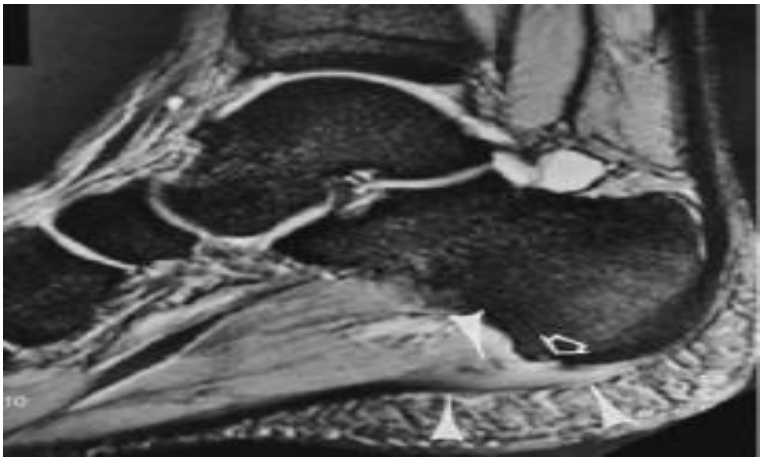


Figure 12: T2WI axial image of ankle showing torn edeges of anterior talofibular ligament.

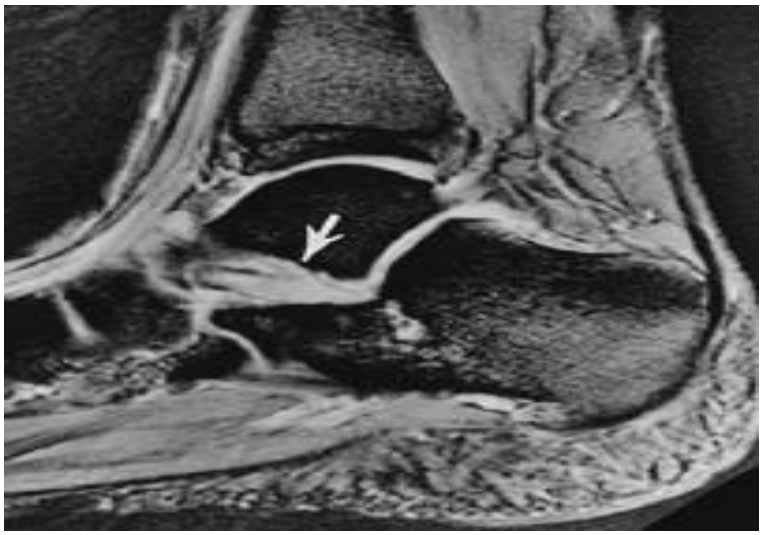
STIR saggital image of foot showing elongated steida process of talus with edema in it suggestive of posterior impingement



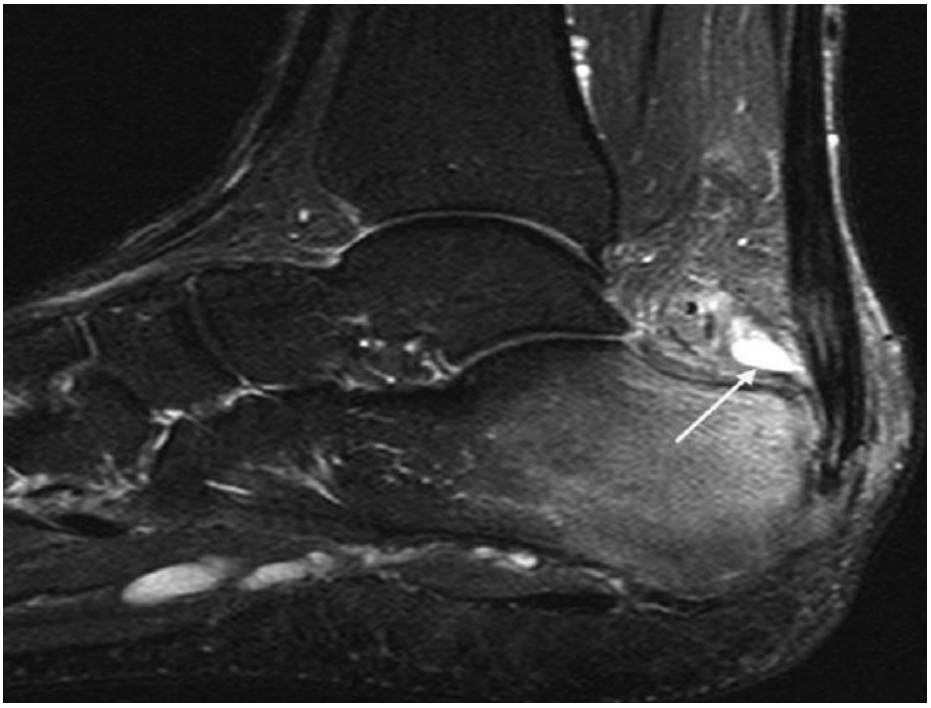
T2 WI axial images showing synovial proliferation with hypointense areas in it suggestive of PVNS.



T2 WI sagittal image showing thickened plantar fascia with increased signal intensity in its substance suggestive of plantar fasciitis



T2 WI sagittal images showing hyperintense signal of sinus fat suggestive of inflammatory changes Sinus tarsi syndrome



T2WI showing a inflamed retrocalcaneal bursae

4. Discussion

Magnetic resonance imaging is an efficient investigation in ankle joint assessment. It has excellent resolution, soft tissue contrast and provides multiplanar imaging. It is a reliable technique and offers excellent depiction of both soft tissue and osseous structures. MRI also has been used for the observation of extraarticular anatomy (**Cerynik et al, 2008).** This study included fifty cases with ankle pain to evaluate the role of MRI in assessment of different pathologies of the ankle joint especially those related to ankle tendons and ligaments. **Rosenberg et al** found MRI for diagnosing ruptures of the tendons to be sensitive in (**95%)** of cases and specific in (**100%)**. Eleven tendon injuries were diagnosed in this study which represented about (**22%)** of the total ankle pathologies. Although the achillis tendon is the strongest tendon in the human body, all literature agreed that it is the most commonly injured ankle tendon. In a severe injury of the Achilles tendon, too much force on the tendon can cause it to tear partially or rupture completely.

In our study only three cases (**27.3% of all tendinous pathologies**) were diagnosed as Achilles tendon injuries. Of all the tendon of the ankle, the Achilles is the only one for which disorder have a male predominance. In our study also this finding was corroborated.

Complete ruptures of the Achilles tendon occur typically at one of two locations. One site is low, 3 to 5 cm just proximal to the calcaneal insertion; this is a relatively hypo-vascular watershed region. The second site is relatively high, up at the musculotendinous junction.

In our study, we had the same result with male predominance, while we found all cases at low location. Of the three medial tendons of the ankle, the posterior tibial is the most prone to tear, characteristically along the portion that curves around the medial malleolus.

In our study, no any case of posterior tibial tendon injury was diagnosed by MRI.

Of the remaining medial ankle tendons, the flexor digitorum longus tendon is rarely affected by traumatic insults. Traumatic injuries of flexor hallucis longus tendon has been reported more frequently than the flexor digitorum longus**.** Our study also included no cases of FDL injuries while we found four cases of FHL tenosynovitis which were diagnosed by MRI (36% of tendinous lesions).

Our study did not include any case of anterior tendons injuries.

Among the lateral tendons our study found four cases involving the peroneus longus tendon (36.3% of all tendinous pathologies).Two cases of peroneus longus tenosynovitis were seen while the other two cases were of partial tears of peroneus longus.

Helms *et al.* stated that the anterior talofibular ligament is the most commonly torn ligament of the ankle. It is often an isolated tear, but if the traumatic forces are great enough, the other ligaments may tear in a sequential fashion. That is, after the anterior talofibular ligament tears, the calcaneofibular ligament tears, followed, only rarely, by the posterior talofibular ligament. In our study seven ligamentous injuries were diagnosed which representing (**14 %)** of the encountered total ankle joint pathologies. Anterior talofibular ligament was the most frequently injured ligament representing (**42.8%)** of the whole ligamentous injuries followed by posterior talofibular (**28.5%)**. This coincides with different literatures evaluating ankle ligaments.

Eight cases with joint effusion were diagnosed in the present study, which representing (**16%)** of the different encountered joint abnormalities. Our results coincided with those of **Jacobson *et al.* (14)** who concluded that MRI was more sensitive than ultrasonography in ankle effusion detection. MRI could detect intra-articular fluid of 1 ml while sonography could reproducibly detect 2 ml of fluid. They also agreed that for both imaging types, evaluation of ankle in plantar flexion allowed the greatest sensitivity.

The sinus tarsi syndrome is a pain syndrome characterized by lateral foot pain and the subjective feeling of hindfoot instability. MRI does not consistently show the ligaments of the sinus tarsi even when they are present and intact, so not identifying these ligaments has no significance. Abnormalities of the sinus tarsi on MRI include obliteration of the fat by low signal intensity material on T1W images and either high or low signal intensity (or a combination) on T2W images (**Klein M Spreitzer).** In our study, two patients were diagnosed with findings consistent with sinus tarsi syndrome.

Plantar fasciitis is an inflammatory condition of the plantar fascia that causes pain and tenderness, usually near its attachment to the anteromedial calcaneal tuberosity. The two groups most commonly affected by this condition are running athletes and obese middle-aged women because of chronic repetitive microtrauma and overuse (**Berkowitz JF).** MRI of plantar fasciitis shows thickening of the fascia, usually near the attachment to the calcaneus, with intermediate signal on T1W and high signal on T2W images. In our study, four patients were diagnosed as having plantar fascitis.

The os trigonum syndrome (also known as the posterior ankle impingement syndrome) occurs when the trigonal process of the talus or the os trigonum is compressed between the posterior tibia and the posterior calcaneus during forced plantar flexion, resulting in posterior ankle pain. MRI shows altered signal intensity in the marrow of talus appearing low signal intensity on T1 and high on T2 WI. In our study two patients were diagnosed as having features of posterior impingement.

Patchy increased T2 signal is often seen scattered about multiple bones in the foot and ankle in patients with generalized pain not attributable to any source. This has been termed *bone marrow edema syndrome (***Zanetti M, et al).** Its etiology is unknown. It affects all ages, but we tend to see it more frequently in young patients. It is self limiting, but can last for many months or a year (**Fernandez-Canton G**).In our study bone marrow edema was one of the most

common bony pathology affecting eight individuals (72.7% of all bony lesions).

5. Conclusion

In this study majority of the lesions involved the soft tissues. This shows that MR is superior imaging tool especially where soft tissue lesions are suspected. It has an excellent soft tissue contrast and its multiplanar capabilities make it a superior tool in ankle imaging.