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# Role of MRI in Evaluation of Ankle Joint Injuries

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**Abstract Background:** The ankle joint is one of the most frequently injured joints, where ankle sprains are frequently encountered in individuals playing sports, in addition to occurring in the general population. Magnetic resonance image (MRI) is an excellent tool for imaging of the bones, tendons, ligaments, and other structures of the ankle joint as it can demonstrate pathologies before they become evident on other imaging modalities. **Aim of the Work:** The purpose of this study was to highlight the role of MRI in evaluation of ankle joint injuries. **Patients and Methods:** Thirty patients were included in our study. They were suffering from (recent/old) ankle joint trauma. This study was conducted from September 2018 till July 2019 at MRI unit, department of Radiology. Ain Shams University hospitals. MRI examination was performed in the axial, coronal, and sagittal planes at different pulse sequences. **Results:** This study included 30 patients. 17 had bone injury, 11 showed tendons injury, and 15 with ligaments injury, 12 had joint effusion and miscellaneous injuries in 5 patients. **Conclusion:** MRI is the primary imaging modality of choice in assessment of ankle joint trauma due to its excellent soft tissue contrast for optimal detection of pathologies of the tendons, ligaments, and other soft tissue structures of the ankle joint complex. MRI is capable of diagnosing most of the ankle joint osseous abnormalities such as bone contusion, stress and insufficiency fracture before being evident in other imaging modalities.

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**Key words:** Ankle Joint trauma, ligament, tendon injuries, bone marrow edema.

## 1. Introduction

Ankle joint bear massive amounts of force during athletic activities and are naturally susceptible to a vast and ever-expanding array of injuries **(Zoga and Schweitzer, 2003).** The ankle joint is one of the most frequently injured joints. The most common injuries are sprains and fractures, which involve ligaments and bones. Nevertheless, can also tear or strain tendons (**Martella et al., 2016).**

Injuries sustained to the ankle usually result from inversion or eversion. Inversion injuries are significantly more common than eversion injuries, with the result that the lateral ankle ligaments are torn more frequently than the medial **(Adam et al., 2015).**

The complex anatomy of foot and ankle makes imaging of this region challenging. Magnetic resonance imaging (MRI), with its multiplanar capability, superior soft tissue contrast, excellent spatial resolution, ability to image bone marrow, noninvasive and lack of ionizing radiation, has become a valuable tool in evaluating patients with foot and ankle problems. MRI allows a global evaluation of the bones, tendons, ligaments, and other structures with single examination that exceeds the capabilities of all other available techniques **(Christman et al., 2015).** In respect of a better understanding of the ankle joint injuries, a classification based on the anatomic origin are outlined. The spectrum of injuries has been classified into: (1) osseous lesions, (2) ligamentous injuries, (3) tendinous lesions, (4) miscellaneous injuries **(Narváez et al., 2003).**

MRI is very helpful in local staging and surgical planning because it is a unique imaging technique that allows direct confirm the diagnosis in cases when radiographs modality are normal or equivocal **(Zampa et al., 2010).** MRI is fast scan techniques provide improved efficiency and allow dynamic studies to be performed. MR arthrography technique has improved significantly in recent years resulting in more routine use of this technique (**Chun et al., 2015).**

It is easiest to organize the approach to analyzing pathology at the ankle by considering compartmental anatomy. The compartments can simply be divided into the anterior, posterior, lateral and medial compartments. The signal characteristics of the marrow and contour detail of the joints are also described. Lastly the sinus tarsi, plantar fascia, and subcutaneous soft tissues should be surveyed **(Leffler and Disler, 2002).**

When imaging the foot and ankle after an injury, we employ pathology-sensitive and anatomy-specific MR sequences in multiple imaging planes. In most cases a pathology-sensitive sequence in the form of a T2-weighted sequence with fat suppression or short tau inversion recovery (STIR) is obtained in different planes and anatomic T1-weighted sequences are performed. It is important for one bone marrow-specific sequence, usually T1 weighted, to be obtained without fat suppression **(Zoga and Schweitzer, 2003).**

**Aim of the work**

The purpose of this study was to highlight the role of magnetic resonance imaging (MRI) in evaluation of ankle joint injuries.

**Patients and Methods**

**Patients:**

Thirty patients were included in our study suffering from (recent/old) ankle joint trauma. 24 patients presented by ankle joint pain and limitation of movements. 6 cases presented with pain for long time which increased on walking and ankle movement. This study was conducted from September 2018 till July 2019 at MRI unit, department of Radiology, Ain Shams University hospitals, Cairo, Egypt.

Patients with history of non-traumatic ankle joint pain, which included osteoarthritis and rheumatoid arthritis, previous operation for ankle joint, ankle joint tumors and patients known to have contraindications MRI examination (e.g. claustrophobia, cardiac pacemaker, cochlear implants and metallic foreign bodies) were excluded from the study.

**Procedures:**

All patients were subjected to full history taking involving, age and sex, related risk factors i.e. trauma and its mechanism and patient complains such as ankle pain, swelling, or instability.

**MRI** examination was performed by using 1.5 T machine (Achieva Philips medical system) using extremity surface coil.

**Examination time:** 35-50 minutes**.**

**The FOV (Field of view):** included the distal tibia and fibula, all of the tarsal bones, and the bases of the metatarsals.

**Slice thickness:** ranged from 3-5mm with 1mm gap.

**Examination protocol:**

All the patients were examined after explaining the procedure to them. All the patients were examined by an extremity surface coil, after lying supine with the foot about 20 degrees plantar-flexion (for better visualization of the calcaneo-fibular ligament and peroneal tendons). Pads will be applied to support and fix the ankle position. The examinations were done by taking different planes (axial, coronal and sagittal) at different pulse sequences. Coronal, planned from an axial scout and parallel to a line joining the medial and lateral malleoli. Sagittal, running perpendicular to the coronal plane. Axial, covering from above the distal tibiofibular joint to the calcaneal heel pad. Axial oblique plane is planned from a sagittal scout showing the peroneal tendons, allowing true axial images through the ankle tendons as they pass around the malleoli.

**Sequences:**

Axial T1W/TSE, Axial T2W/TSE, Axial-STIR and/or PDFS/TSE, Sagittal T2W/TSE, Sagittal –STIR and/or PDFS/TSE, Coronal T1W/TSE, Coronal T2W/TSE.

- T1-weighted (T1W) spin-echo (SE)/proton density-weighted (PDW) fast spin-echo (FSE) images provide optimal anatomical detail.

-Short tau inversion recovery (STIR) or T2-weighted (T2W)/PDW FSE fat-suppressed (FS) images provide optimal assessment of marrow and soft-tissue edema and joint fluid.

**Image interpretation:**

MRI images were analyzed and signal intensity (SI) assessment was performed on PACS work station. We did review the normal anatomy of the Ankle structures including: (bone, muscle, tendon, ligament and fat) by using the variable proper sequence. Description of the pathological finding in bone, tendon and ligaments, fat were performed, and diagnosis was established.

**Statistical Analysis:**

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. **The following tests were done:** Chi-square ($\chi^2$) test of significance was used in order to compare proportions between qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: Probability (P-value) P-value <0.05 was considered significant. P-value <0.001 was considered as highly significant. P-value >0.05 was considered insignificant.

## 3. Results:

This table (Table 1) shows that the female (46.7%) and male (53.3%), ranged age between 20-61 with mean 36.17±13.05.

**Table (1):** Number and percentage distribution of ankle joint traumatic injury cases according to their demographic data.

| Demographic data | No. | % |
|---|---|---|
| **Gender** | | |
| Female | 14 | 46.7% |
| Male | 16 | 53.3% |
| **Age (years)** | | |
| 20- <30 years | 13 | 43.3% |
| 30-<40 years | 7 | 23.3% |
| ≥40 years | 10 | 33.3% |
| Range [Mean ±SD] | 20-63 [36.17±13.05] | |

This table (Table 2) shows that the acute onset was (80%) and the chronic onset was (20%) in the ankle joint traumatic injury cases.

**Table (2):** Number and percentage distribution of the ankle joint traumatic injury cases according to their onset.

| Onset | NO. | % |
|---|---|---|
| Acute | 24 | 80.0% |
| Chronic | 6 | 20.0% |

This table (Table 3) shows that the Pre Achilles burisitis (6.7%), Osteochondral defect (3.3%), Haguland syndrome (3.3%), Sinus tarsi syndrome (10.0%), Impingement Syndrome (6.7%), Joint effusion (40.0%), Achilles tendon total thickness rupture (16.7%), Achilles tendon near total rupture (3.3%), Peroneal tendon tenosynovitis (6.7%), Tibialis posterior tenosynvitis (6.7%), Calcaneofibular ligament complete tear (3.3%), ATFL complete tear (16.7%), ATFL partially tear (10.0%), ATFL sprain (6.7%), Deltoid ligament sprain (6.7%), Calcaneo fibular ligament partially tear (6.7%), Lateral malleolus fracture (10.0%), Tibial fracture (3.3%), Calcaneous fracture (3.3%), Bone marrow edema (33.3%) and Talar bone osteonecrosis (3.3%).

**Table (3):** Numbers and percentage distribution of the different types of the ankle joint traumatic injuries.

| Percent of different types of ankle traumatic injuries | NO. | % |
|---|---|---|
| 1- Pre Achilles bursitis | 2 | 6.7% |
| 2- Osteochondral defect | 1 | 3.3% |
| 3- Haguland syndrome | 1 | 3.3% |
| 4- Sinus tarsi syndrome | 3 | 10.0% |
| 5- Impingement Syndrome | 2 | 6.7% |
| 6- Joint effusion | 12 | 40.0% |
| 7- Achilles tendon total thickness rupture | 5 | 16.7% |
| 8- Achilles tendon near total rupture | 1 | 3.3% |
| 9- Peroneal tendon tenosynovitis | 2 | 6.7% |
| 10- Tibialis posterior tenosynovitis | 2 | 6.7% |
| 11- Calcaneofibular ligament complete tear | 1 | 3.3% |
| 12- ATFL complete tear | 5 | 16.7% |
| 13- ATFL partially tear | 3 | 10.0% |
| 14- ATFL sprain | 2 | 6.7% |
| 15- Deltoid ligament sprain | 2 | 6.7% |
| 16- Calcaneo fibular ligament partially tear | 2 | 6.7% |
| 17- Lateral malleolus fracture | 3 | 10.0% |
| 18- Tibial fracture | 1 | 3.3% |
| 19- Calcaneous fracture | 1 | 3.3% |
| 20- Bone marrow edema | 10 | 33.3% |
| 21-Talar bone osteonecrosis | 1 | 3.3% |

Table 4 shows Numbers and percentage of the ankle joint bone injury cases.

**Table (4):** Numbers and percentage of the ankle joint bone injury cases.

| Bone injuries | NO. | % |
|---|---|---|
| Fracture | 5 | 29.4% |
| Bone marrow edema | 10 | 58.8% |
| Osteochondral defect | 1 | 5.9% |
| Talar bone osteonecrosis | 1 | 5.9% |
| Total | 17 | 100.0% |

This table (Table 5) shows that the Fracture (29.4%), Bone marrow edema (58.8%), Osteochondral defect (5.9%) and Talar bone osteonecrosis (5.9)

**Table (5):** Numbers and percentage distribution of the ankle joint tendinousinjuries.

| Tendinous injuries | NO. | % |
|---|---|---|
| Total rupture | 5 | 45.45% |
| Partial rupture | 1 | 9.1% |
| Tendonitis | 5 | 45.45% |
| Total | 11 | 100.0% |

This table (Table 6) shows that the Total rupture (45.45%), Partial rupture (9.1%) and Tendonitis (45.45%).

**Table (6):** Numbers and percentage distribution of the ankle joint ligamentous injury cases.

| Ligamentous injuries | No. | % |
|---|---|---|
| Complete tear | 6 | 40.0% |
| Partially tear | 5 | 33.33% |
| Ligament sprain | 4 | 26.67% |
| Total | 15 | 100.0% |

This table (Table 7) shows that the Complete tear (40%), partially tear (33.33%) and sprain 26.67%) of ligamentous injury cases.

**Table (7):** Numbers and percentage of the ankle joint miscellaneous injury cases.

| Miscellaneous injuries | NO. | % |
|---|---|---|
| Sinus tarsi syndrome | 3 | 60.0% |
| Impingement syndrome | 2 | 40.0% |
| Total | 5 | 100.0% |

This table (Table 8) shows that the sinus tarsi syndrome (60%) and impingement syndrome (40%).

**Table (8):** Relation between onset and MRI finding of different types of the ankle joint traumatic injury cases.

| MRI Finding | Onset | | | | |
|---|---|---|---|---|---|
| | Acute *(n=24)* | | Chronic *(n=6)* | | Total |
| | No. | % | No. | % | |
| **Bone injuries** | **13** | 54.2% | **4** | 66.66% | **17** |
| Fracture | 3 | 12.5% | 2 | 33.33% | 5 |
| Bone marrow edema | 10 | 41.66% | 0 | 0.0% | 10 |
| Talar bone osteonecrosis | 0 | 0.0% | 1 | 16.66% | 1 |
| Osteochondral defect | 0 | 0.0% | 1 | 16.66% | 1 |
| **Tendinous injuries*** | **10** | 41.66% | **1** | 16.66% | **11** |
| Total rupture | 5 | 20.8% | 0 | 0.0% | 5 |
| Partial rupture | 1 | 4.16% | 0 | 0.0% | 1 |
| Tendonitis | 4 | 16.66% | 1 | 16.66% | 5 |
| **Ligamentous injuries** | **11** | 45.8% | **4** | 66.66% | **15** |
| Complete tear | 4 | 16.66% | 2 | 33.33% | 6 |
| Partially tear | 3 | 12.5% | 2 | 33.33% | 5 |
| Ligament sprain | 4 | 16.66% | 0 | 0.0% | 4 |
| **Miscellaneous injuries** | **3** | 12.5% | **2** | 33.33% | **5** |
| Sinus tarsi syndrome | 2 | 8.3% | 1 | 16.66% | 3 |
| Impingement syndrome | 1 | 4.16% | 1 | 16.66% | 2 |

*Using: Chi-square test; *p-value <0.05 S*

This table (Table 9) shows the most common of MRI finding was acute bone injuries (54.2%), followed by ligamentous injuries (45.8%) as well as tendinous injuries (41.66). While the most common of MRI finding in the chronic cases was ligamentous (66.66%) and bone injuries (66.66%), followed by miscellaneous injuries (33.33%).

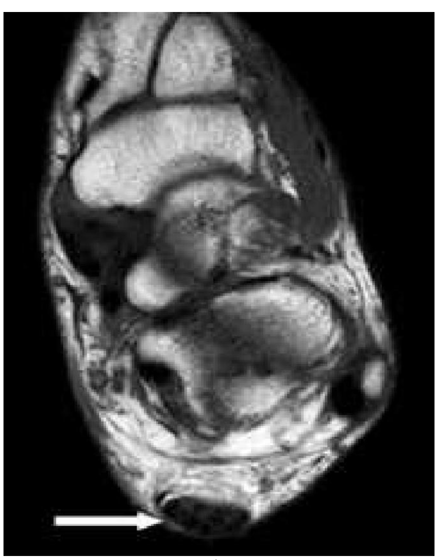
**Table (9):** Relation between age (years) and MRI finding of the ankle joint traumatic injury cases.

| MRI Finding | Age (years) | | | | Total |
|---|---|---|---|---|---|
| | ≤35 years *(n=19)* | | >35 years *(n=11)* | | |
| | No. | % | No. | % | |
| **Bone injuries** | **11** | 57.9% | **6** | 54.5% | **17** |
| Fracture | 3 | 15.8% | 2 | 18.2% | 5 |
| Bone marrow edema | 7 | 36.8% | 3 | 27.3% | 10 |
| Talar bone osteonecrosis | 0 | 0 | 1 | 9.1% | |
| Osteochondral defect | 1 | 5.3% | 0 | 0.0% | 1 |
| **Tendinous injuries*** | **5** | 26.3% | **6** | 54.5% | **11** |
| Total rupture | 1 | 5.3% | 4 | 36.4% | 5 |
| Partial rupture | 0 | 0.0% | 1 | 9.1% | 1 |
| Tendonitis | 4 | 21.1% | 1 | 9.1% | 5 |
| **Ligamentous injuries** | **10** | 52.6% | **5** | 45.5% | **15** |
| Complete tear | 5 | 26.3% | 1 | 9.1% | 6 |
| Partially tear | 3 | 15.8% | 2 | 18.2% | 5 |
| Ligament sprain | 2 | 10.5% | 2 | 18.2% | 4 |
| **Miscellaneous injuries*** | **1** | 5.3% | **4** | 36.4% | **5** |
| Sinus tarsi syndrome | 1 | 5.3% | 2 | 18.2% | 3 |
| Impingement syndrome | 0 | 0.0% | 2 | 18.2% | 2 |

*Using: Chi-square test; *p-value <0.05 S*

This table shows the most common of MRI finding of ≤35 years was bone injuries (57.9%), followed by ligamentous injuries (52.6%), tendionous injuries (26.3%) and as well as miscellaneous injuries (5.3%) of ankle traumatic injury cases, while the most common of MRI finding of >35 years was tendinous injuries (54.5%); followed by ligamentous injuries and bone injuries (45.5%), as well was miscellaneous injuries (36.4%).

**Case 1: Male patient 41 years old exposed to left ankle trauma one week ago.**



**A**

**B**

C

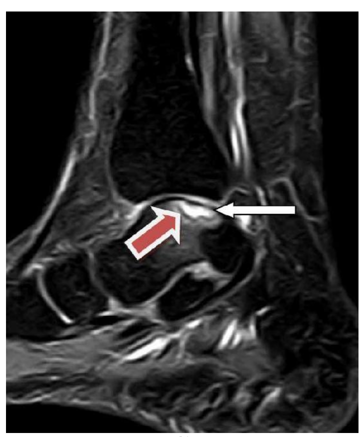
D

**Figure 1 (A-D):** Axial T1WI (A), sagittal T2WI (B), sagittal STIR (C & D) images respectively demonstrate complete thickness rupture of the distal Achilles tendon fibers located 52 mm proximal to the calcaneal attachment (arrow) with gap measuring 15mm in length. Surrounding soft tissue edema is noted (red arrow).

**CASE 2:** Male patient 30 years old presented with left ankle pain sever on walking had history of recurrent trauma.

A

B



C

**Figure 2 (A-C):** Coronal T2WI (A), sagittal T2WI (B) and sagittal STIR (C) images show high signal sub-chondral focal lesion at upper medial part of talus bone (arrow) with hypointense line surrounding it (red arrow in C), denoting osteochondral defect of talus.

**CASE 3:**Female patient 29 years old presented with left ankle pain following inversion trauma 3 weeks ago.

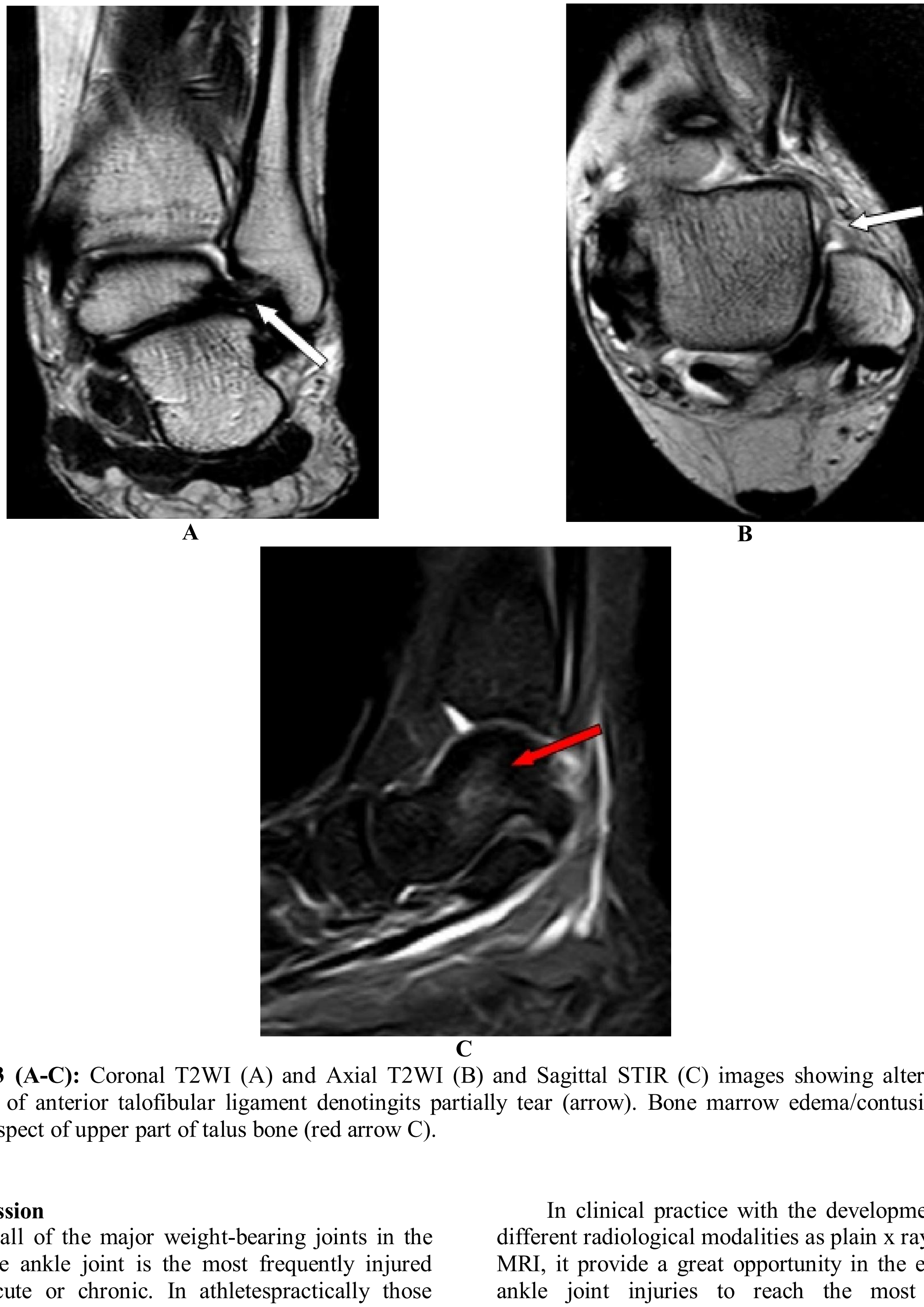


**Figure 3 (A-C):** Coronal T2WI (A) and Axial T2WI (B) and Sagittal STIR (C) images showing altered signal intensity of anterior talofibular ligament denotingits partially tear (arrow). Bone marrow edema/contusion at the medial aspect of upper part of talus bone (red arrow C).

**4. Discussion**

Of all of the major weight-bearing joints in the body, the ankle joint is the most frequently injured either acute or chronic. In athletespractically those who running, jumping and rapid change in direction. Ankle injuries account for up to one fourth of sports-related injuries. But they also occur to people that not any sport at all **(Elina, 2015)**.

In clinical practice with the development of the different radiological modalities as plain x ray, CT and MRI, it provide a great opportunity in the evaluation ankle joint injuries to reach the most accurate diagnosis and so the proper treatment either conservative or surgical **(Nazarenko et al., 2013).**

Plain x-ray is the first imaging method used in ankle joint injuries to detect fractures and bone gaps, but many ankle joint injuries were undiagnosed by plain radiography therefore we need further evaluation to diagnose soft tissues ( tendons, ligaments and muscles) as well as bone injuries as stress fracture and a vascular necrosis **(Martella et al., 2016)**.

CT scan allows an excellent assessment of skeletal fractures; however it shows low accuracy in soft tissue evaluation and presents a higher radiation exposition compared to x-ray **(Martella et al., 2016)**.

Ultrasound imaging is a powerful diagnostic tool to evaluate superficial soft tissue lesions and study abnormalities in certain tendons, especially the Achilles tendon, but it has restricted role due to failure of the sound wave to penetrate the bone precisely in ankle joint due to complex anatomy of the ankle region **(Martella et al., 2016)**.

The MRI is excellent soft tissue contrast for optimal detection of pathologies of the tendons, ligaments, and other soft tissue structures of the ankle joint complex. It holds an advantage over conventional radiography and computed tomography for early detection and assessment of osseous abnormalities. All this features made it the primary imaging modality of choice in evaluating ankle joint pathologies. So in our study we chose the role of MRI in evaluating ankle joint injuries **(Kharat et al., 2019)**.

Our study comprised 30 subjects; 16 males and 14females their ages ranged from20-61 years with mean age. The most common age groups affected were 20–30 years, followed by age groups of 41-61 years. The least affected group was 30-40 years of age. In **2019Kharat et al.** stated that the most common age groups affected were 31–40 years and 41–50 years, showing equal occurrence, followed by age groups of 21–30 years. The least affected group was <20 years of age. In my opinion, this disagreed is due to the difference in the sample size and the study population.

Our patients were subdividing into four groups according to the tissue injured: Group I: Bony injuries, Group II: Tendinous injuries, Group III: Ligamentous injuries and Group VI: Miscellaneous injuries.

**In group I:** 17 cases with bone injury of the total pathologies in the study group, 10 cases of bone marrow edema in our study, and 4cases were diagnosed with bone marrow edema only while the others 6 cases were diagnosed with concomitant structural injuries, (2 cases with bone injuries, 4 cases with ligamentous injuries).

Similarly, in **2011, Rios et al.** reported that focal bone marrow edema is a common finding in the posttraumatic ankle joint, isolated to the bone or accompanied by other structural injuries related to stress/occult fractures, or ligamentous avulsions.

In **2003, Narvaez et al.** stated that MRI diagnosis of bone marrow edema plays an important role in the management of sports-related injuries. It has been suggested that a delay in the resumption of normal sports activities should be considered in the presence of bone marrow edema to avoid the progression of any weakening of the mechanical properties of bone related to the trabecular microfracture. On the other hand, bone contusions are often associated with ligament injuries.

In our study 5 cases with bone fracture, and one case of osteochondal defect of the superomedial aspect of the talar dome. The talus is the third most commonly affected anatomical site of osteochondral defect after the knee and the elbow joints. In **2003, Narvaez et al.** stated that MRI has proven to be effective in characterizing all stages of osteochondral defect of talus, but is most useful in the identification of radiographically occult osteochondral defect of talus and the stratification of in situ lesions into stable and unstable subsets.

In our study one case with talar bone osteonecrosis, the osteonecrosis is a terrible sequel to the traumatic injury, with the chances increasing with the severity of trauma and the associated damage to the already precarious blood supply which can be a cause of significant disability. In **2000, Rosenberg et al.** stated that magnetic resonance imaging is beneficial in early diagnosis and evaluating the presence, size and fragment viability of post traumatic osteonecrosis.

**In group II:** 11 cases with tendenous injury of the total pathologies in the study group. In our study 5 cases with achilles tendon complete full thickness rupture, and one case partially achilles tendon rapture, Their ages ranged from 30 to 60 years and showed male predominance, we found also that the most common location of the Achilles injured to be preinsertional 2–5 cm from the calcaneal insertion.

Our study found achilles tendon is most vulnerable tendon injured in state of ankle joint trauma, followed by posterior tibialis, peronealtendon and pre achilles bursitis. Where injuries of tendon ranged tendon rupture, tendonitis and tendenopathy, this is in agreement with study done by **El-Liethy and Kamal, 2016** which was carried out on 35 patients where they said, achilles tendon is the most commonly injured ankle tendon, Their ages ranged between 35 and 60 years and showed male predominance, with the site of pathological findings is typically a zone of relative avascularity 2–6 cm from the calcaneal insertion, followed by tibialis posterior and peroneal tendons, while those of the anterior compartment were the least encountered ones. While we disagree in ranged of pathology in their study was tendinotis the most encountered tendon pathology followed by partial tear and tenosynovitis.

Also in **2014, McLean** stated that achilles tendon is most commonly affected tendon, followed by tibialis posterior, Peroneus brevis and peroneus longus also are affected frequently. Common ankle tendon pathologies are partial or complete tear secondary to degeneration, trauma, then tenosynvitis followed by tendenpathy, this is total agreement with our study result.

In our study, tibialis posterior tendon showed 2 case of tenosynovitis, the tibialis posterior tendon was the most frequently affected of those three medial ankle tendons. Their ages ranged between 35 and 53 years, this result were in agreement with **Shahla et al., 2014** who stated that the posterior tibialis tendon dysfunction most commonly injured tendon on the medial side of the ankle and occurs in age over 50, but can also occur in young athletes participating in sports that require rapid change of direction, and it has been reported in ballet dancers and soccer and basketball players.

Our study included 2 cases of peroneal tendon tenosynovitis, peronealtendon injuries are uncommon; however, they can occur secondary to local repetitive stress/trauma. Similarly, in **2015, Taljanovic et al.** reported that the Injuries of the peroneal tendon complex are rare but should be considered in every patient who presents with chronic lateral ankle pain. These injuries occur as a result of trauma (including ankle sprains), or repetitive microtrauma. MR imaging is valuable imaging modality in the diagnosis of peroneal tendon disorders.

In our study, two cases of pre achilles bursitis were diagnosed representing 6.7% of the total pathologies in the study group. It is usually a result of repetitive trauma due to athletic over activity, particularly in runners. MR imaging capable of identifying the size and extension as well as allows direct depiction of all osseous and soft-tissue structures that surround of the bursa.

In agreement with **Pierre et al., 2010** reported that the presence of pre achilles bursitis in up to 10% of patients with mechanical injury like repetitive trauma. Normally, the bursa contains 1–2 ml of bursal fluid. In bursitis there is fluid distension of the bursa on all imaging modalities. MR imaging is superior in demonstrating the anatomical relationship between the inflamed pre achilles bursa and adjacent achilles tendon, ability to confirm the presence of marrow and also useful for assessing the adjacent achilles tendon for the presence of concomitant insertional tendinosis.

In our study, one case of Haglund's syndrome, with insertional tendenopathy and calcification at insertional site. In Haglund's syndrome repeated trauma leads to degenerative changes to the achilles tendon insertion and loss the fat planes of the bursa secondary to retrocalcaneal bursitis. Similarly, in **2019, Kharat et al.** reported that achilles insertional tendinopathy is often associated with a prominent calcaneal tuberosity (Haglund's syndrome) and calcification at the insertion site. MR imaging is preferable method used to assessment calcaneal tuberosity, excessive fluid in retrocalcaneal bursa and retroachillesbursa.

**In group III:** Comprised 15 cases with ligamentous injury of the total pathologies in the study group, 6 cases with complete ligament tear, 5 cases with partially ligament tear and 4 cases with ligament sprain. The most frequently ligament injured in our study is the anterior talofibular ligament (ATFL), followed by calcneofibular ligament and deltoid ligament.

Several studies such as**, Kharat et al.**, **2019**; **El-Liethy and Kamal 2016** and **Young et al., 2016** they all stated that the lateral ankle ligaments are the structures that are most frequently damaged, specifically the anterior talofibular ligament followed by the posterior talofibular ligament, and calcaneofibular ligament, deltoid ligament was the least ligament injured. The results of these studies are identical to the results of our study.

Our study showed that the MRI can be diagnoses and detect all of the ligamentous lesions. This has also been proven by several studies such as **Martella et al., 2016; El-Liethy and Kamal 2016,** who stated that MRI is the gold standard and the most accurate diagnostic procedure for the evaluation of traumatic ligamentous injuries.

**Associated pathology with ankle injuries:** There were 12 cases associated with joint effusion in our study, the different countered joint abnormality ranged from big joint effusion, moderate to mild joint effusion. The presence of a large ankle effusion of radiographs after ankle joint trauma suggests an underlying injury. An ankle effusion of ≥15 mm is a reasonable threshold to prompt additional imaging. MR imaging provides good visualization of subtle bone injuries and may detect clinically imported soft-tissue injuries. Our results were similar to the results achieved by **Crema et al.,2019** who mentioned that presence of effusions is mostly associated with an increased risk for severe concomitant structural injury in ankle trauma. MRI can be easily detected and quantified amount of joint effusion would potentially reflect a more severe structural injury.

**In group VI:** 5 cases in miscellaneous injuries of the total pathologies in the study group, 3 cases had sinus tarsi syndrome. The most common cause of sinus tarsi syndrome is ankle sprain and this syndrome is important cause of a persistent pain after ankle joint trauma. Plain radiographs are usually normal in early stage; however in advanced cases may be evident. Subtalar arthrography was a modality used before the advent of MRI but the sensitivity is low. Currently MRI is the imaging modality of choice for diagnosing sinus tarsi syndrome. This is quite similar findings noted by **Narvaez et al., 2003**studythat founds inus tarsi syndrome commonly develops after an inversion injury (70%) and is often associated with tears of the lateral collateral ligaments. MRI is the imaging method of choice in the evaluation of tarsal sinus and in the diagnosis of associated conditions.

In our study 2 cases had impingement syndrome (one case anterior impingement and one case anteriolateral impingement syndrome) in chronic ankle joint trauma. Since the soft tissue and osseous impingement syndromes of the ankle are a potential cause of chronic post- traumatic pain. In our study we found that the MRI is the modality of choice in cases of impingement syndromes of the ankle that's because MRI is capable of identifying a space-occupying lesion and it can often further evaluate the nature of the lesion. Spurs and further characterize the synovial thickening, ligaments, articular cartilage and associated soft tissues.

Our results are consistent with what **Berman et al., 2017**whoreported that ankle impingement syndromes are common and important post-traumatic causes of morbidity in athletes. In general, the diagnosis of ankle impingement is clinical, with supporting information provided by radiographs and more advanced imaging MRI, which can help further elucidate the anatomic of impingement and localize pathology to guide diagnostic, therapeutic injections and assist presurgical planning. **Sawantand Sanghvi, 2018** stated that chronic repetitive stress lead to formation granulation/scar tissue or fibrosis in the anterolateral gutter resembles a "meniscus" known as anterolateral impingement syndrome, which can be adequately diagnosed by MRI.

## 5. Conclusion

Based on the results obtained by this study, we conclude that the MRI is the primary imaging modality of choice in assessment of ankle joint trauma due to its multiplanar capabilities and excellent soft tissue contrast for optimal detection of pathologies of the tendons, ligaments and other soft tissue structures of the ankle joint complex. In additional to that the MRI is capable diagnose most of the ankle joint osseous abnormalities such as bone contusion, stress and insufficiency fracture before evident in others imaging modalities.

## References


1. Adam A., Dixon A., Gillard J., et al. (2015): Grainger & Allison's Diagnostic Radiology: A Textbook of Medical Imaging. 6th ed. Volume 1. chapter 46: p 1172.
2. Berman Z., Tafur M., Ahmed S., et al. (2017): Ankle impingement syndromes: an imaging review. Br J Radiol. 90: 735-744.
3. Christman R., Marchis-Crisan C., and Cohen R. (2015): Osteonecrosis and Osteochondrosis in Foot and ankle radiology.2nd ed. Chapter. 17: 922-924.
4. Chun K., Choi Y. and Lee S., et al. (2015): Deltoid Ligament and Tibiofibularsyndesmosis Injury in Chronic Lateral Ankle Instability: Magnetic Resonance Imaging Evaluation at 3T and Comparison with Arthroscopy. Korean Journal of Radiology. 1096-1103.
5. Crema M., Krivokapic B., Guermazi A., et al. (2019): MRI of ankle sprain: the association between joint effusion and structural injury severity in a large cohort of athletes. European Radiology. 19:156-165.
6. Elina N. (2015): Acute Osseous Injury to the Ankle and Foot in musculoskeletal imaging. 2nd ed. Chapter. 31: 841-842.
7. El-Liethy N. and Kamal H. (2016): High resolution ultrasono-graphy and magnetic resonance imaging in the evaluation of tendinoligamentous injuries around ankle joint. Egyptian Society of Radiology and Nuclear Medicine. 47: 543-555.
8. Kharat A., Ghosh A., Jain K., et al. (2019): magnetic resonance imaging in evaluation of traumatic and Nontraumatic ankle joint and foot pathologies. Medical Journal of Dr. D. Y. Patil Vidyapeeth.12 (3): 239-249.
9. Leffler S. and Disler D. (2002): MR imaging of tendon, ligament, and osseous abnormalities of the ankle and hind foot. Radiol Clin N Am. 40: 1147–1170.
10. Martella I., Azzali E., Milanese G., et al. (2016): MRI in acute ligamentous injuries of the ankle. Acta. Biomed. 87(3): 13-19.
11. Mc Lean I. (2014): MR Ankle in Clinical Imaging with Skeletal, Chest, and Abdominal Pattern Differentials, 3rded. chapter 20: p1160.
12. Narvaez JA, Cerezal L and Narvaez J. (2003): MRI of Sports-Related Injuries of the Foot and Ankle: Part 1. Curr Probl Diagn Radiol. 32:139-155.
13. Nazarenko A., Beltran L., Bencardino J. (2013): imaging evaluation of traumatic ligamentous injuries of the ankle and foot. Article in Radiologic Clinics of North America. 455-480.
14. Pierre-Jerome C., Moncayo V. and Terk M. (2010): MRI of the Achilles tendon: A comprehensive review of the anatomy, biomechanics and imaging of overuse tendinopathies. Acta Radiol. 438-454.
15. Rios A., Rosenberg Z., Bencardino J., et al (2011): Bone Marrow Edema Patterns in the Ankle and Hind foot: Distinguishing MRI Features. AJR. 720–729.

16. Rosenberg S., Beltran J., and Bencardino T. (2000): MR Imaging of the Ankle and Foot. Radio Graphics. 20:153–179.
17. Sawant Y. and Sanghvi D. (2018): Magnetic resonance imaging of ankle ligaments: A pictorial essay, Indian J Radiol Imaging. 28:419-426.
18. Shahla M., Daria M. and Cecilia J. (2014): Ankle MRI in Basic Musculoskeletal Imaging. Chapter. 18:379-383.
19. Taljanovic M., Alcala J., Gimber L., et al (2015): High-Resolution US and MR Imaging of Peroneal Tendon Injuries. Radio Graphics. 35:179–199.
20. Young K., Park Y., Jin S., et al. (2016): Misdiagnosis of talarbody or neck Fractures as Ankle Sprains in Low Energy Traumas. Clinics in Orthopedic Surgery 8(3):303-309.
21. Zampa V., Roselli G. and Beltrami G. (2010): MRI of bone tumors: advances in diagnosis and treatment assessment, Imaging in Medicine. (3): 325-340.
22. Zoga A. and Schweitzer M. (2003): Imaging sports injuries of the foot and ankle. Magn Reson Imaging. Clin N Am. 295–310.

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