



Study of Traumatic Ankle Injuries in Taif, Saudi Arabia, Using Magnetic Resonance Imaging

Samih Kajoak

Department of Radiological Sciences, College of Applied Medical Science, Taif University. P.O. Box 11099, Taif 21944, Saudi Arabia.

*Corresponding author: Samih Kajoak; s.kajoak@tu.edu.sa

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Abstract

Background: Ankle injuries occur frequently and represent around 10% of all emergency department admissions. The preferred diagnostic modality for evaluating ankle injuries is Magnetic resonance imaging, because of its better soft tissue contrast; noninvasive imaging, as well as its scanning capability in several planes. **Aims:** This study aimed to highlight the importance of MRI in the assessment of patients with Ankle pain as a result of a traumatic injury in Taif, Saudi Arabia. **Methods and materials:** a retrospective study was carried out at King Abdulaziz Specialist Hospital in Taif, from October 2021 to February 2022. 56 traumatic patients were enrolled in the study. All images were evaluated by two expert radiologists. **Results:** Out of 56 patients; 31 (55%) were males and only 25 (45%) were females, the mean age was found to be $34. \pm 12$. Acute onset of pain was (82%) and (18%) was chronic. 44 (79%) of the respondents had joint effusion and 37 (66%) had ATFL Anterior Talofibular Ligament injuries. Regarding tendons injury, the most reported injury was tenosynovitis (14.3%). Deltoid ligament injury is significantly associated with age (P-value = .005), since those 35 years old or less are more frequently prone to have deltoid ligament injury (44%) than those more than 35 years old (9%). **Conclusion:** The MRI is the perfect modality of choice in the assessment of traumatic ankle injuries because it has higher sensitivity detection when compared to other modalities.

Keywords: *Magnetic resonance imaging, Ankle Injuries, Taif*

Introduction

Traumatic ankle (talocrural) joint and rearfoot injuries are considered the most frequent musculoskeletal disorders and represent around 10% of all emergency department admissions [1]. Talocrural joint injuries can occur at whether young or old age. However, men between the ages of 15 and 24 will have ankle sprains at higher rates when compared to women older than 30 years old, who have these injuries at greater rates than men. Sport activity is the cause of around 50% of all ankle sprains [2]. In the United States, about 25,000 people suffer from a sprain in their ankle every day. Additionally, more than a million patients with traumatic injuries of the ankle joint enter emergency departments annually. Ankle joint injuries are also thought to affect 600,000 persons in the Netherlands each year [3]. Sprains and fractures, which affect ligaments and bones in the ankle joint, are the most frequent types of ankle joint disorders. In Europe, the most frequent injury to the lower limb is an ankle sprain, which affects more young athletes and occurs between 5 and 7 times per 1000 people annually [4]. The foot inverted represents the most common type of damage (less frequently eversion). Furthermore, injury or straining of the tendons in the foot and talocrural joint are common causes of foot pain. Injury to the Achilles tendon and the soft tissues around it, is one of the most prevalent overuse disorders in sports [5].

When patients with ankle or hindfoot pain visit their physician, numerous possible etiologies exist. Unfortunately, these numerous disorders' clinical indications and symptoms overlap. Pathologic entities that frequently impact the talocrural joint differ in terms of the tissue structure, how damage is caused, and whether

the presentation is acute or chronic. Because of this, referring physicians routinely use MRI to solidify or confirm a diagnosis and influence decisions about management and treatment choices [6].

MRI is the modality of choice and opened new horizons to evaluate tendinous injuries, traumatic ligamentous of the talocrural joint, and invisible bony injury. It is especially suited to evaluate the complex soft tissues and bone anatomy of the talocrural joint and foot due to its better soft tissue contrast; noninvasive imaging and its capability to image in several planes. Additionally, the performance of dynamic studies is also made possible by new fast MR scan protocols, which increase efficiency. Magnetic resonance arthrography procedure has significantly advanced in recent years, leading to its frequent use. When local staging and surgical planning are required, MRI is particularly valuable because it verifies the diagnosis when normal or ambiguous images and because it is as sensitive but more specific than another diagnostic methods [7]. MR imaging is beneficial for evaluating the soft tissue surrounding the talocrural joint, including ligaments, tendons, fascia, and nerves. Additionally, early diagnosis and evaluation of a number of osseous disorders, like transient bone marrow edema, osteochondral fractures, insufficiency and stress fractures, and bone contusions, are particularly useful uses of MR imaging [8]. MRI is the most reliable diagnostic modality for assessing traumatic ankle disorders like ligamentous injuries because of its improved contrast resolution and sensitivity in identifying bone edema [9]. The main objective of the study is to highlight the importance of MRI in the assessment of patients with Ankle pain as a result of a traumatic injury in Taif, Saudi Arabia

Materials and Methods

This is a retrospective study that was carried out at King AbdulAziz Specialist Hospital in Taif from October 2021 to February 2022.

Throughout this time, MRI exams were performed on 70 individuals (all of whom had severe ankle pain). 14 respondents were excluded from the study even though their MRI results were normal. The study of 56 positive traumatic patients including males and females of different ages who are presenting with ankle pain in the emergency departments of radiology was evaluated by MRI scan.

Inclusion criteria

Any patient suffering ankle pain after a traumatic injury, without regard to one's age or gender

Exclusion criteria

- 1) Patients with MRI contraindications may include those who have metallic foreign bodies in their eyes, cardiac pacemakers, intracranial aneurysmal clips, hearing aids, cochlear implants, (unless titanium), staples or ferromagnetic surgical clips.
- 2) Patients with a history of rheumatoid arthritis or osteoarthritis-related non-traumatic ankle pain, metabolic abnormalities, tumors in their ankle joints, and patients who have ankle joint surgeries.

Methods

56 patients who attended the emergency departments of radiology with ankle injuries were examined using an MRI equipment.

MRI Scan

MRI was carried out with GE scanner (1.5 Tesla).

Patient position and coils

Patient lied supine and the foot is perpendicular to the examination couch, imaging was performed. A conventional extremity coil was typically utilized for the ankle; The knee coil was utilized in the absence of an ankle coil.

Protocol for scanning

Clinical circumstances affected the choice of sequences, scanning planes, and even the choice of an MR coil. The imaging planes are orientated to the foot's anatomy instead of the magnet and the lower leg was rotated externally. In order to maximize the resolution and detail of the MR images, only the extremity with the suspected abnormality is scanned.

3-5 mm were the thickness of the cuts and interval between slices was 1 mm.

Matrix 256/192.

Sequences

1. Whenever the tendons weren't the main area of concern, in all imaging planes, T1-weighted images were applied.
2. Inversion recovery sequence or T2-weighted images fast-spin fat-suppressed echo in all planes (edema-sensitive sequences).
3. Proton-density and T2-weighted sequences in the axial and oblique coronal planes were employed when clinical concern focused on the tendons.

Data Analysis

Two expert radiologists used computer workstations to diagnose and analyze images without any prior knowledge of the patient's history and then performed statistical analysis using SPSS version 23. Quantitative variables were represented as standard deviation and meanwhile qualitative variables were represented as percentages and

frequency. Comparing qualitative variables was done using the chi-square test. P value less than 0.05 (typically ≤ 0.05) was regarded significant.

Results

A total response count of 56 respondents were included in the study, the mean age was found to be 34 ± 12 , minimum of 12, and maximum age of 66. Out of 56 cases included in the study, 31 (55%) were male while female constituted only 25 (45%) showing male preponderance in a traumatic ankle injury.

Table 1: The study participants' demographic details (n = 56)

Variable	Frequency	Percent
Gender		
Male	31	55%
Female	25	45%
Age (average 34.1 ± 12.2 range from 12 to 66)		
≤ 35 years	34	61%
> 35 years	22	39%

Regarding the onset of ankle pain, more than two-thirds 46 (82%) were of acute onset and 10 (18%) were chronic. 44 (79%) have Joint Effusion on MRI, 37 (66%) have ATFL Anterior Talofibular Ligament injuries, 17 (30%) have Deltoid ligament injury, Tenosynovitis 8 (14%).

Table 2: Onset of ankle pain and MRI Findings

Variable	Frequency	Percent
Onset of ankle pain		
Chronic	10	18%
Acute	46	82%
MRI Findings		
ATFL (Anterior Talofibular Ligament)	37	66%
Ach (Achilles)	9	16%
Del (Deltoid)	17	30%
Ten (Tenosynovitis)	8	14%
CFL (Calcaneofibular Ligament)	3	5%
FR (Fracture)	9	16%
JE (Joint Effusion)	44	79%
OL (Osteochondral Lesion)	5	9%
BC (Bone Contusion)	4	7%

A total of 37 of the 56 patients had ligament injuries. While 37 patients were diagnosed with ATFL injuries, 17 patients had Deltoid ligament injuries.

Only nine patients (24.3%) of the 37 patients with ligament injuries present with a sprained ligament, while 16 patients (43.2%) had a complete tear and 12 patients (32.5%) had a partial tear. (Fig 1).

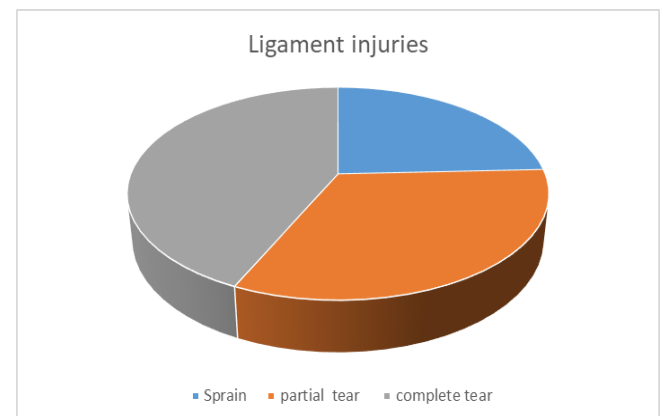


Figure 1: MRI findings of various ligament injuries

14 out of 56 patients in our study suffered tendon disorders. Four patients (29%) had partial tears, two (14%) had complete tears, and eight patients (57%) had tenosynovitis. (Fig 2).

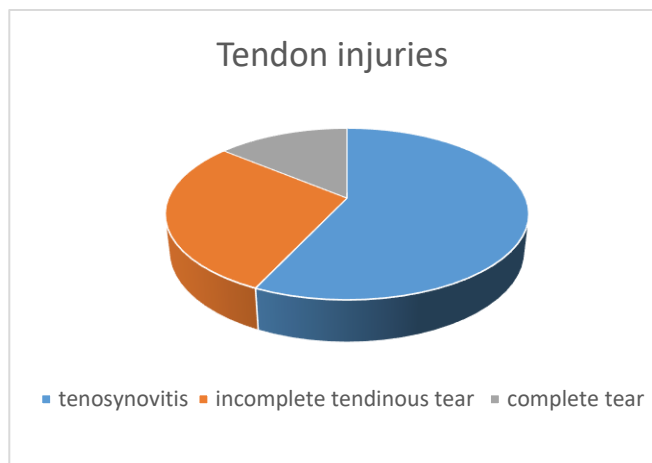


Figure 2: MRI findings of various tendon injuries

Among the 56 patients who were included, 18 suffered osseous disorders. Bone contusions were present in 4 patients (22%), 5 patients (28%) had osteochondral lesions, while 9 patients (50%) suffered fractures. (Fig 3).

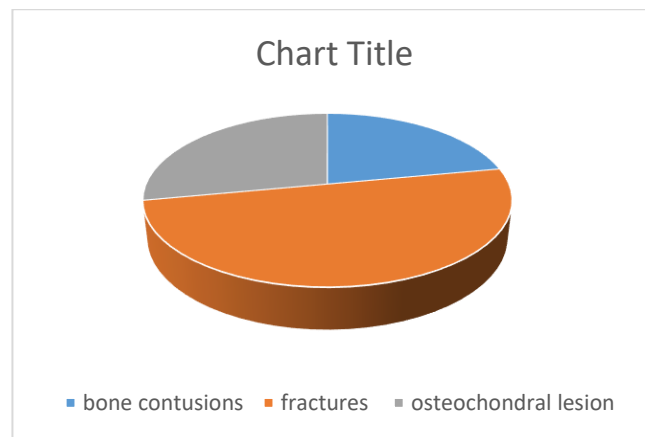


Figure 3: MRI findings of various osseous injuries

Deltoid ligament injury is significantly associated with the age of the respondents (P.value = .005) since those 35 years old or less 15 (44%) are more frequently prone to have deltoid ligament injury than those more than 35 years old 2 (9%). Osteochondral Lesion differ among males and females, more females (16%) tend to have Osteochondral Lesion than males (3%), but this difference comes to be statistically not significant (P.value = .096). all other ligamentous findings in MRI are not significantly related to age or gender (P.value more than .05).

Table 3: Shows the association between age, gender, and MRI results.

MRI Findings	Age (years)		P value (x ² test)	Gender		P value (x ² test)
	≤ 35 (n=34)	> 35 (n=22)		Male (n=31)	Female (n=25)	
	N (%)	N (%)		N (%)	N (%)	
ATFL	25 (73%)	12 (54%)	0.143	21 (68%)	16 (64%)	0.769
Ach	4 (12 %)	5 (23%)	0.275	6 (19%)	3 (12%)	0.456
Del	15 (44%)	2 (9%)	0.005	11 (35%)	6 (24%)	0.353
CFL	1 (3%)	2 (9%)	0.318	1 (3%)	2 (8%)	0.430
FR	5 (15%)	4 (18%)	0.729	5 (16%)	4 (16%)	0.990
JE	28 (82%)	16 (73%)	0.391	26 (84%)	18 (72%)	0.282
OL	3 (9%)	2 (9%)	0.973	1 (3%)	4 (16%)	0.096
BC	3 (9%)	1 (4%)	0.544	2 (6%)	2 (8%)	0.823

* Chi-square test (x²) was used.

Joint effusion is associated with 34 (74%) of the acute onset and found in all participants with chronic onset ankle pain (100%) but this difference is not statistically significant (P- value = .068). other MRI findings is not related to the onset of ankle pain (P- value more than .05).

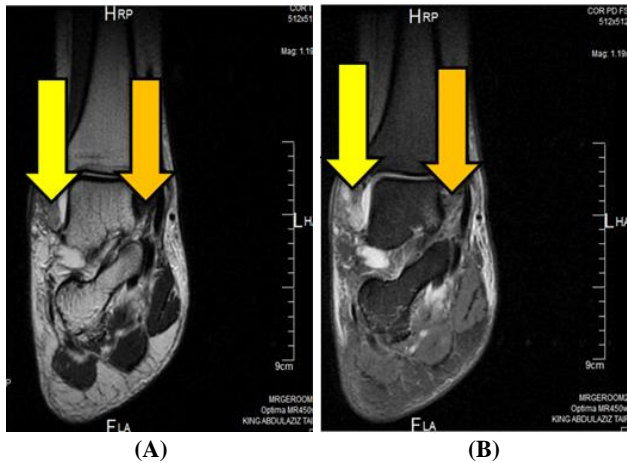
Table 4: Relation between onset of ankle pain and MRI findings

MRI Findings	Onset of ankle pain		P value
	Acute (n=46)	Chronic (n=10)	
	N (%)	N (%)	
ATFL	30 (65%)	7 (70%)	0.772
Ach	9 (20%)	0 (0%)	0.127
Del	16 (35%)	1 (10%)	0.122
CFL	3 (6%)	0 (0%)	0.406
FR	9 (100%)	0 (0%)	0.186
JE	34 (74%)	10 (100%)	0.068
OL	0 (0%)	5 (50%)	0.275
BC	4 (9%)	0 (0%)	0.333

* Chi-square test (x²) was used.

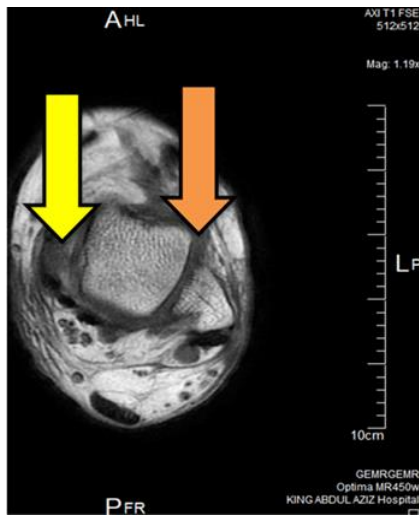
Table 5: Comparison of the current study's MRI results with previous studies

Imaging results	Our study (n=56)	Vijaykumar, Phaneendra,2020 (n= 50)	Mervat Mohamed et al (n=40)
Osseous injuries	32%	20%	35%
Tendon injuries	25%	20%	40%
Ligament injuries	66%	38%	42%
Joint effusion	79%	50%	57%



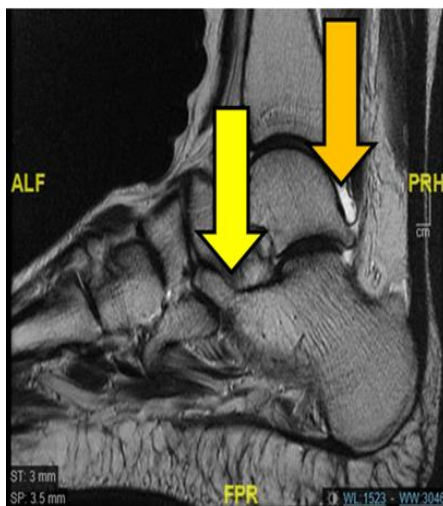
CASE 1: Male patient, age 27, with a sprained right ankle.

MRI manifestation: (A) coronal T2 ankle image displays anterior talofibular ligament partial tear (labelled with yellow arrow) and Intrasubstance injury to deltoid ligaments (labelled with orange arrow). (B) coronal PD image shows the same result with swelling with indistinct borders of the anterior talo-fibular ligament (labelled with yellow and orange arrow).



CASE 2: Female patient, age 35, with partial deltoid ligament injury

MRI finding: axial T1WI ankle MR image displays deltoid ligament partial injury, Anterior talo-fibular ligament tear (labelled with yellow arrow) and Tenosynovitis of the flexor tendons (labelled with orange arrow).



CASE 3: 50 years old Female patient, demonstrates a fracture of the calcaneus' anterior process.

MRI finding: sagittal T1WI ankle MR image demonstrates a fracture of the calcaneus' anterior process (labelled with yellow arrow) and Subcutaneous soft tissue edema at the medial aspect of the ankle (labelled with orange arrow).

Discussion

Magnetic resonance imaging regarded as one of the best modalities in evaluating soft tissue injuries, especially joints where it has been shown to be superior to other imaging modalities as it can show the degree of tear and cut if it is partial or complete cut, tendons and surrounds tissue inflammation, bones and their arrangement all those advantages are attributed to its high sensitivity and specificity in those types of injuries, so studying MRI and its role in the diagnosis of ankle injuries specifically will result in more understanding and even more evolution of this valuable imaging modality.

The aim of this study is to highlight the importance of MRI in the assessment of patients with Ankle pain as a result of a traumatic injury in Taif, Saudi Arabia also to determine the incidence of ankle injuries in Taif and to classify the types of ankle injuries. In the current study, slightly more than half of the respondents were males (55%) and the remaining were females (45%).

Regarding the onset of ankle pain, more than two-thirds of patients were of acute onset (82%) and in less than one fifth of them, ankle pain onset was chronic (18%) and gradually progressive. About more three quarters of patients (79%) had joint effusion with chronic and acute onset predominance. Our findings confirm the results of Jacobson et al. [10], who reported that ankle effusion was more accurately detected by MRI than by ultrasonography. MRI could only detect 1 ml of fluid, whereas ultrasonography reliably detected 2 ml. In this study, A total of 37 of the 56 patients had ligament injuries. The most often injured ligament was the anterior talofibular ligament, accounting for around (66%) of all ankle disorders, followed by deltoid ligament injury (30%). This finding was consistent with other studies examining ankle injuries [11]. Among the 37 patients with ligament injuries, the most reported injuries were complete tears which were reported by about less than half of the patients (43.2%) and about (32.5%) of them there was a partial tear and less than one-third (24.3%) of the ligamentous injuries were sprain. This is not always due to decreased incidence of partial tears or ligamentous sprain, but it is rather due to decreased number of patients presenting with those injuries as they considered a milder injury that could be treated conservatively from the patient's point of view. So, in this study, there is decreased prevalence of partial tears and ankle sprains, but this was in contradiction to another study which conducted in USA [12]. The percentage of Tenosynovitis was 14% and this could confirm the fact that tenosynovitis requires time to develop and most of the presenting cases were acute injuries, similar findings were found in a parallel study conducted in Korea showing ATFL injury in ninety percent of patients [13].

Less than five percent suffered from complete tendonous tears and only have experienced a partial tear, this reflects the decreased incidence of tendonous tears but also it needs to be lower. In this study, 14 tendon injuries were reported, accounting for around 25% of all ankle injuries. Despite being the human body's strongest tendon, the most often injured ankle tendon is the Achilles tendon, according to all current studies. Achilles tendon injuries were only detected in nine of the patients in our study. 66% were found in male. This outcome supported Tuite's [14] conclusion that males are more likely than females to sustain an Achilles tendon injury.

Considering the association between gender, age and MRI results; deltoid ligament injury has significantly associated the age of the respondents, those who are thirty-five years old or those who are less than fifteen years old are more frequently susceptible to have deltoid ligament injury than those more than thirty-five years.

Similar results were obtained in other studies showing an increase in incidence in teenage groups [13]. Joint effusion is associated with most acute onset injuries and is found in all patients with chronic onset ankle pain roughly all of them but this difference is not statistically significant, other MRI findings are not related to the onset of ankle pain. T2WI can easily detect effusion or edema but as stated before its finding is not found to be related to pain, as pain could be very severe with mild injury evidenced by mild effusion or edema as a part of the overall joint injury, and it could be mild with severe injuries as it mostly subjective in the first degree. So, pain must be considered but not reliable in demonstrating the severity of the injury accordingly.

Conclusion

MRI is a powerful diagnostic modality for identifying pathology and characterizing the different injuries that might result from ankle trauma. More than two-thirds of patients were of acute onset and in less than one-fifth of them, ankle pain onset was chronic and gradually progressive. More three-quarters of patients had Joint Effusion on MRI, nearly two-thirds of them have ATFL Anterior Talofibular Ligament injury and about one-third of them have deltoid ligament injury. The most reported ligamentous injuries were complete tears which was reported by about less than half of the patients and less than one-third of them there was a partial tear, and less than one-third of the ligamentous injuries were sprained. Deltoid ligament injury has significantly associated with the age of the respondents, those who are thirty-five years old or those who are less than fifteen years old are more frequently susceptible to deltoid ligament injury than those more than thirty-five years old. Joint effusion is associated with most acute onset injuries and is found in roughly all patients with chronic onset ankle pain.

Ethical approval

The study was approved by the Directorate of Health Affairs, Taif, Health committee no KACST, KSA: HAP-02-T-067, approved No: 509

Inform Consent Statement

Owing to the retrospective nature of the study, the need for written informed consent was waived.

Data Availability

The data of the study was is available upon request from the corresponding author.

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Conflict of Interest Statement

The author declares that there are no conflicts of interests

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