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Exploring the Impact of MRI on Bones and Joints Evaluation

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Abstract: Background: The most popular kind of musculoskeletal injury, trauma, accounts for around 12% of all visits. Ankle and rear foot injuries are placed at the top of the list.

Aim: This current study aimed to assess and enroll clinical outcomes of the MRI's accuracy in identifying ankle and foot pathologies.

Methods: This cross-sectional study was conducted on 78 patients with ankle and foot injuries. All patients were referred to the Diagnostic and Radiological Imaging Department Basra – Iraq hospitals during the follow-up period between February 2023 and February 2024. Patients' ages ranged from 20 to 60 years. All patients underwent magnetic resonance imaging (MRI). All patients consented to the diagnostic procedure. Clinical outcomes were evaluated after the MRI procedure, as well as quality of life, to determine the impact of MRI on the assessment of ankle and foot joints during the follow-up period.

Results: In the present study, a total of 61 patients were included in the analysis, of whom 51 (83.6%) were male and 27 (44.3%) were female, thereby indicating a predominance of males in the study population. The prevalence of acute pain was reported by 57.69% of the subjects, while chronic pain was noted by 42.31%. The observed injuries were categorized as follows: ligament injury (38.46%), tendon injury (15.38%), bone injury (20.51%), and joint effusion (25.64%). The most prevalent pathology types were trauma and infection, accounting for 51.28% and 21.79% of the patients, respectively. The diagnostic accuracy of magnetic resonance imaging (MRI) was determined to be highly sensitive (91.12%), highly specific (89.64%), and highly accurate (96.40%).

Conclusion: Our study revealed that magnetic resonance imaging used improves evaluation of the ankle and the foot joint, particularly when it comes to diagnosing and managing musculoskeletal conditions.

Keywords: Ankle joint and foot pathology, MRI Technique, Symptoms, A questionnaire health quality of life.

INTRODUCTION

Ankle joint and foot are anatomically complex structures vital for weight-bearing, mobility, and overall biomechanical function [1,2]. These regions are susceptible to a wide variety of pathologies, such as trauma, degenerative conditions, inflammatory conditions, and congenital anomalies, owing to their complex architecture and constant exposure to stress and injury. [3,4,5]

Thus, it contains clearly high-definition imaging modalities which would enable adequate imaging of soft tissues, including bones and articular surfaces, for accurate diagnosis and management of such conditions. [6]

The medical modality of Magnetic Resonance Imaging has gained paramount importance in ankle and foot evaluation because of its unmatched capability to generate high-resolution multislice images that do not exploit ionizing radiation [7,8]. It provides almost unparalleled anatomical contrast resolution, which is of great significance in detecting subtle abnormalities of the ligament, tendon, cartilage, synovium, and an intervening bone marrow space that might not be appreciated on standard radiographs or CT [9,10,11,12]. Therefore, MRI becomes very important in diagnosing ligamentous injuries, tears of tendons, osteochondral lesions, stress fractures, and soft tissue masses.

Also, MRI not only gives structural information but also functional information about the ankle and foot [13,14]. In addition, MRI will help to treat, follow, and judge postoperative management. Being non-invasive and flexible, MRI has made itself the chosen imaging modality for the thorough evaluation of these body parts [15]. The present paper stresses the importance of MRI in the assessment of the ankle joint and foot, focusing on its diagnostic possibilities, clinical applications, and influence on patients' lives in general. [16]

PATIENTS AND METHODS

I. Study Design

A cross-sectional study was conducted on patients with ankle and foot diseases who underwent magnetic resonance imaging (MRI) at the Radiology Department Basra – Iraq hospitals within the follow-up period between February 2023 and February 2024. Clinical data and demographic parameters were collected for affected patients, aged 20–60 years, who underwent clinical suspicion for ankle and foot evaluation.

II. Inclusion and Exclusion Criteria

- **Inclusion Criteria**

1. Patients aged 20–60 years.
2. Obese patients.
3. Only patients with pain and swelling in the ankle and foot.
4. Patients with ankle and foot instability.
5. Smokers and non-smokers.
6. Patients who underwent MRI.

- **Exclusion Criteria**

1. Patients aged 60 years and younger than 20 years.
2. Patients with severe anemia and cardiac disease.
3. Patients with iron magnetic implants and aneurysm clips.
4. Patients who have undergone previous foot and ankle surgeries.
5. Patients diagnosed with congenital foot deformities.
6. Patients diagnosed with other imaging techniques.

3. MRI Diagnosis

All patients were subjected to the method of ankle and foot MRI on the state of the high field-strength magnetic resonance imaging scanner. The patient is then undertaken with preparation in a supine position with the ankle and foot in a neutral position with plantar flexion of 20-30 degrees in order to diminish the "magic angle" artifact. No movement is allowed during examination through supporting the ankle with pads. Ankle coil was used in all cases for study in our department.

RESULTS

Table 1: Frequency distribution of demographic features over patients.

Characteristics	Frequency, {n = 78}	Percentage, %
Age		
20 – 30	13	16.67%
31 – 40	18	23.08%
41 – 50	22	28.21%
51 – 60	25	32.05%
Sex		
Male	51	65.38%
Female	27	34.62%
Body mass index, {kg/m2}		
Underweight	7	8.97%
Normal weight	12	15.38%
Overweight	25	32.05%
Obesity	34	43.59%
Smoking status		
Present	29	37.18%
Absent	49	62.82%
No. of other illnesses	50	64.10%
Hypertension	41	52.56%
Diabetes	25	32.05%
Skin diseases	14	17.95%
Asthma	4	5.13%
Heart diseases	3	3.85%
Others	3	3.85%
Alcohol consumers		
Present	14	17.95%
Absent	64	82.05%
Marital status		
Single	14	17.95%
Married	55	70.51%
Divorced	5	6.41%
Widow	4	5.13%
Education status		
Primary school	9	11.54%
Secondary school	17	21.79%
Postgraduate university	52	66.67%

Table 2: Frequency distribution of symptoms on patients in this study.

Symptoms	Frequency, {n = 78}	Percentage, %
Pain	75	96.15%
Tenderness	53	67.95%
Swelling	46	58.97%
Fever	17	21.79%
Pedal Edema	44	56.41%
Stiffness of Joint	12	15.38%
Restricted Movement	66	84.62%
Difficulty in Weight Walking	54	69.23%

Table 3: Detecting the main causes of ankle and foot injuries.

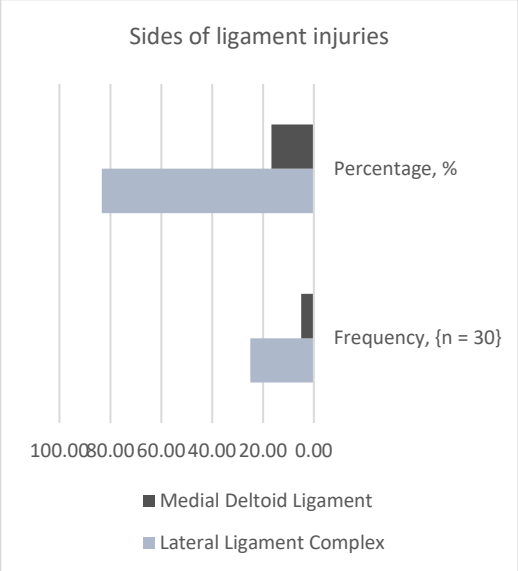
Causes	Frequency, {n = 78}	Percentage, %
Sprains and Fractures	47	60.26%
Soft Tissue Injuries	35	44.87%
Rheumatoid Arthritis (RA)	22	28.21%
Reduced physical activity	30	38.46%
Increased stiffness	25	32.05%
Flexibility loss	20	25.64%

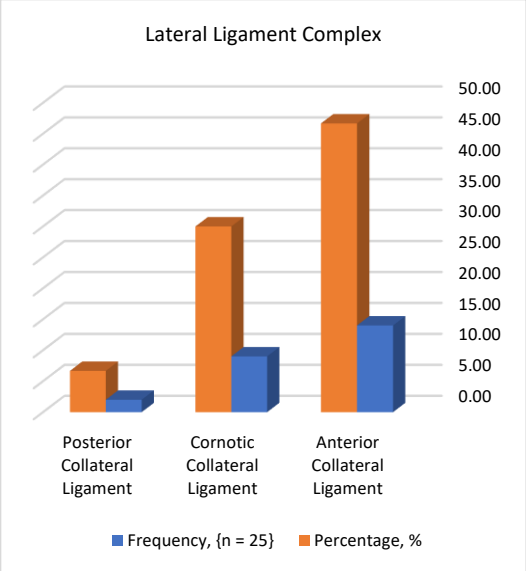
Table 4: Frequency distribution of ankle and foot pain detected by MRI in this study.

	Ankle		Foot	
Items	N	%	N	%
Acute	45	57.69%	43	55.13%
Chronic	33	42.31%	35	44.87%

Table 5: Define different types of injuries detected by MRI in this study.

Injuries	Frequency, {n = 78}	Percentage, %
Ligament Injury	30	38.46%
Tendon Injury	12	15.38%
Bone Injury	16	20.51%
Joint effusion	20	25.64%





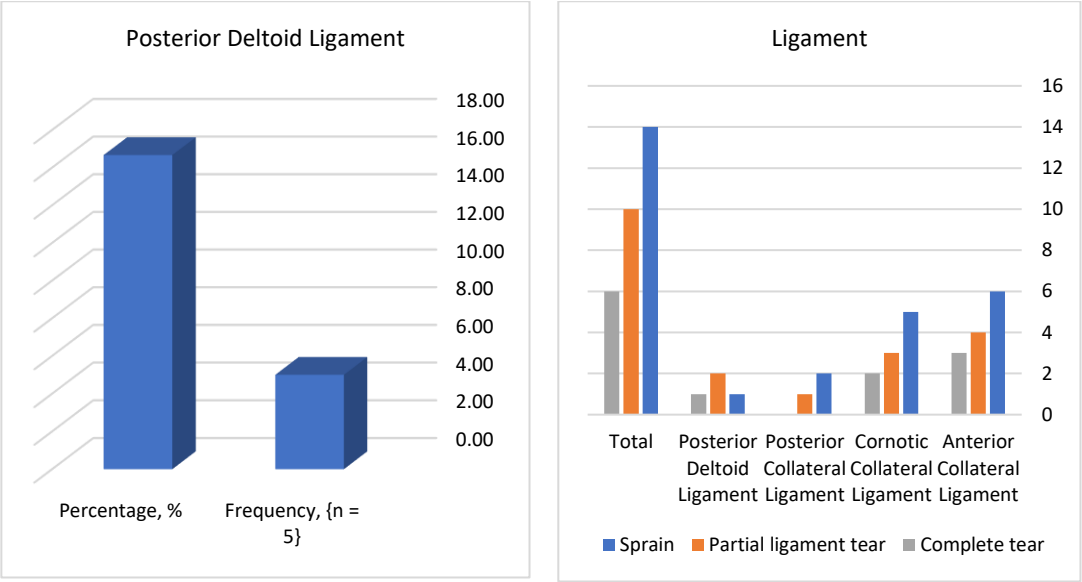


Figure 1: Detecting of ligament injuries by MRI in our study.

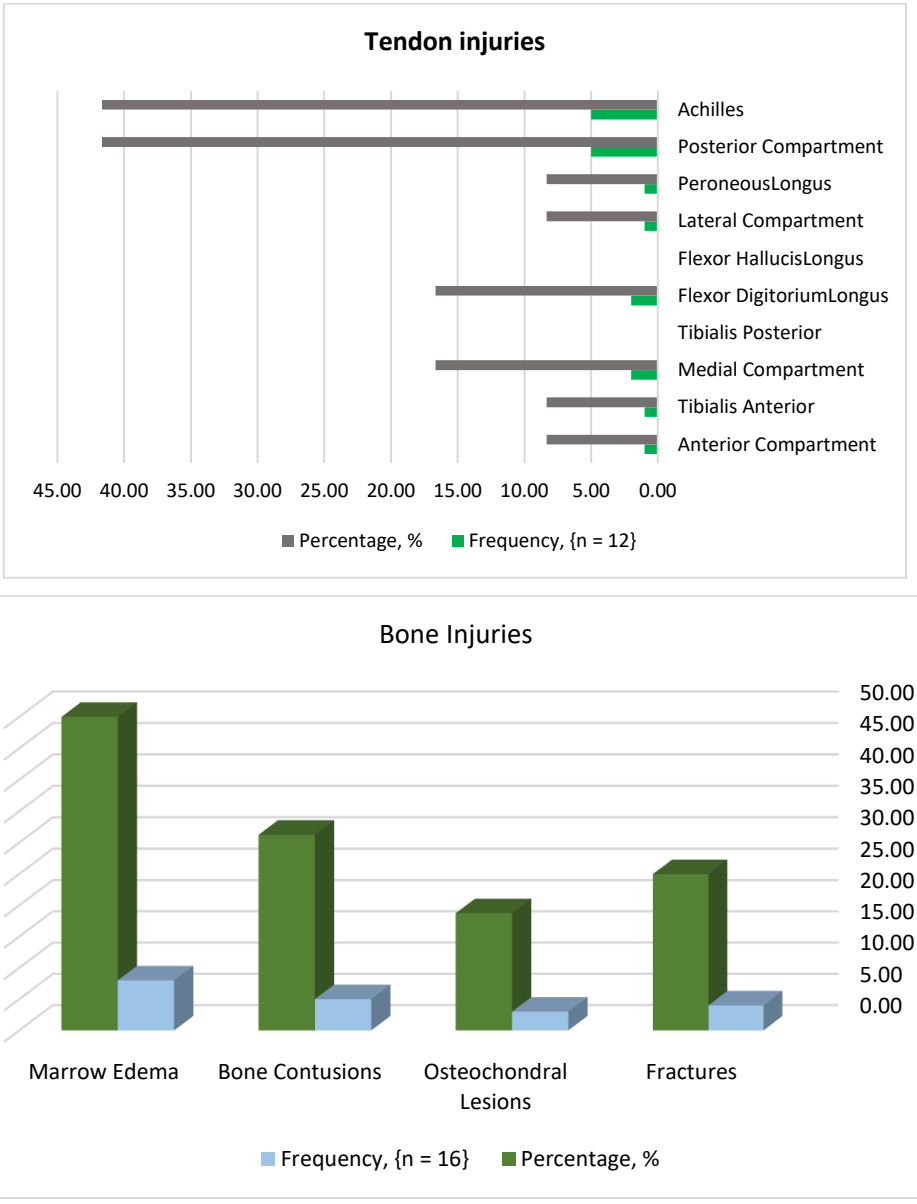


Figure 2: Frequency distribution each of bone and tendon injuries on patients in this study.

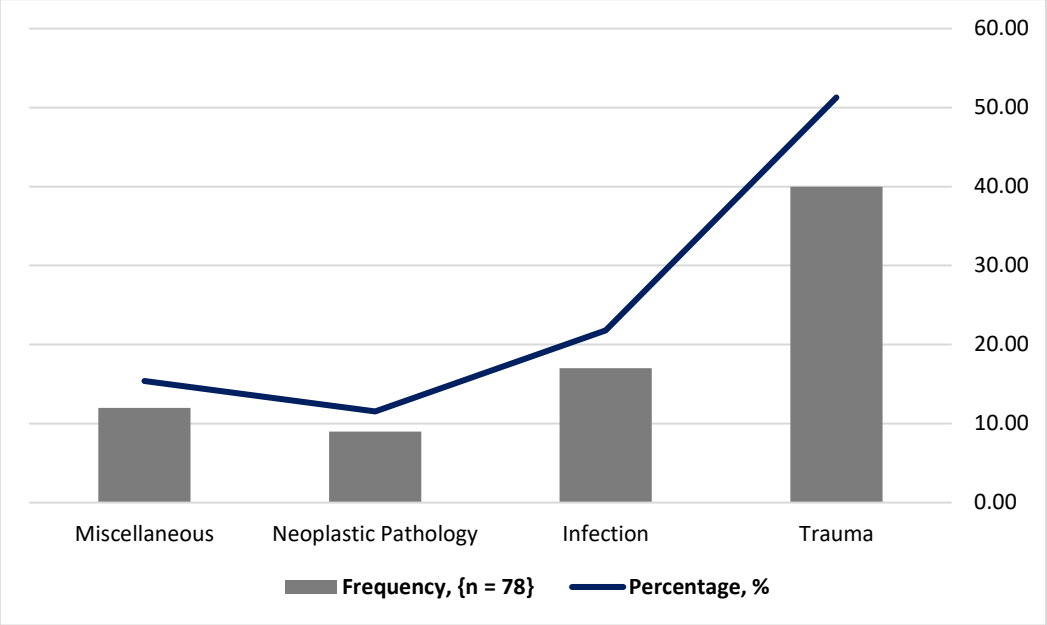


Figure 3: Identifying the main pathology detected by MRI in the patients in this study.

Table 6: A general health quality of life questionnaire in the patients.

Items	Scores
Physical function	45.37 ± 14.20
Social Function	40.43 ± 11.7
Worry	56.8 ± 8.46
Consequence of injury	38.55 ± 9.80
Emotional impact	44.66 ± 10.93
Treatment concerns	31.85 ± 6.48

Table 7: Assessment accuracy of magnetic resonance imaging (MRI) in diagnoses of patients.

Domains	Scores
Sensitivity	91.12%
Specificity	89.64%
Accuracy	96.40%

DISCUSSION

Imaging is very important in the assessment of ankle tendons and ligaments. It has become the de facto standard for the evaluation of ligamentous injuries to the ankle, showing a variety of soft tissue and bony abnormalities [17]. MRI helps with local staging and surgical planning in cases where radiographs reveal no change or are equivocal for pathology; in such cases, the MRI will most often confirm the diagnosis-it is as sensitive as and more specific than any other radiological tool [18]. In short, owing to its high contrast resolution and accurate detection of bone edema, MRI is the most trusted imaging modality for the diagnosis of traumatic ankle injuries, especially with respect to ligamentous injuries.[19]

Out of 61 patients, 51 (65.38%) are males, and 27 (34.62%) are females, thus showing a predominance of males in our study. Some studies [20,21,22] had a similar distribution of gender. Their study included 33 (66%) males and 17 (34%) females. Dissimilar results have been reported in their study wherein males constituted only 39% of the whole population as opposed to females who formed 61%. However, [23,24] other studies included 40 patients out, where 12 were females, and 28 were males, which is also consistent with this study.

In this research, acute pain was reported by 57.69%, while chronic pain was noted by 42.31% of the subjects. [25] The American study just stated that 22 (55%) cute ankle pain and 18 (45%) cases of chronic ankle pain. In the same vein, in the [26] German study, 34% of subjects were reported as experiencing acute pain and 66% chronic pain.

Ankle-joint injury accounts for the highest category of sports-and-recreation-related injuries. Most ankle injuries occur in youth. Injury to ligaments of the ankle joint complex is called a low ankle sprain. Injury resulting in high ankle sprains includes damage to the tibiofibular ligament or syndesmosis. Inversion sprains resulting in injury to the lateral ligaments of the ankle joint complex are by far the most common. High ankle sprains usually occur from an eversion injury with a fracture or damage to the deltoid ligament complex. [27]

In this study, ligament injury was diagnosed in 38.46% of subjects. Among those with ligament injuries, lateral ligament involvement was observed in 25 subjects, while medial deltoid ligament injuries were documented only in 5 subjects. A total of 46.67% showed ATFL injuries, and 30.0% had CFL ligament injuries. Out of the total study subjects, 14 had sprains, 10 had partial ligament tears, and 6 exhibited complete ligament tears.

According to several studies [28,29,30], the anterio talofibular ligament (ATFL) is the most commonly injured ligament, accounting for 57.2% of all ligamentous injuries, with the posterior talofibular ligament (PTFL) at 19% and calcaneofibular ligament (CFL) at 14.3%. The least injured was the deltoid ligament at 9.5%. This finding correlates with various authors relating to ankle ligament evaluation. According to the Netherlands study, the anterior talofibular ligament is considered the most commonly torn ankle ligament; the calcaneofibular ligament is next, and in 70% of cases of ankle sprains, only the anterior talofibular ligament is torn, whereas the calcaneofibular ligament is torn in 20% of cases.

From our study, tendinopathy of the Achilles was listed among the most common types of tendon injuries and accounted for 41.67% of subjects. Although the Achilles tendon is the strongest tendon in the body, all the literature agrees that it is the ankle tendon most commonly injured. For the severe injury of the Achilles tendon, excessive force upon it may also cause its modification by partial tear or complete rupture. Another study agreed that the Achilles tendon is the most commonly injured ankle tendon, with the site of pathological findings typically being in a zone of relative avascularity 2 to 6 cm away from the calcaneal insertion. [31]

Among the subjects, sixteen had bone injuries. The bone injuries included contusion (31.25% of subjects) and fracture (25% of subjects) revealed, respectively. In this study, joint effusions occurred in 79.41% of the subjects. Our results were concordant with some studies concluding that MRI is more sensitive than ultrasonography in the detection of ankle effusion. MRI could detect intra-articular fluid of 1 ml, and sonography could reproducibly detect 2 ml; they have also agreed that evaluation of the ankle in plantar flexion would allow the greatest sensitivity for both imaging modalities.

SUMMARY

MRI is the most important modality in the examination of ankle and foot lesions, and it solves the comprehensive and accurate diagnostic setting. It helps early diagnosis and treatment planning and also improves patient outcomes. MRI should be the first-line imaging modality for suspected soft tissue injury or osteochondral lesion. Further studies are needed to understand the potential role of advanced MRI techniques in the imaging of the foot and ankle.

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