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The Diagnostic Value of High-Resolution Ultrasound in Evaluation of Ankle Sports Injuries: A Comparative Study with MRI

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ABSTRACT

Background: Usually, the ankle joint's lesions are due to trauma, inflammatory disorders, or overuse syndrome. Different imaging modalities are used to evaluate the ankle joint including plain radiography, CT, US, and MRI.

Objective: The aim of the current study had to assess the value of high-resolution ultrasonography in sports injuries compared to high field MRI.

Patients and methods: High-frequency (7–15 MHz) ultrasound and MRI were performed in 30 patients with an acute ankle injury (traumatic ankle pain) in the age range between 18 and 55 years, complaining of unilateral ankle sports injuries.

Results: Sensitivity of US in the detection of sprain comparing to MRI as the gold standard was 75%, specificity was 100% and accuracy was 92.2% and there was statistical significance agreement between two tests. Regarding, the sensitivity of the US in the detection of tears comparing to MRI as gold slandered was 90%, specificity was 100% and accuracy was 96.7% and there was statistical significance agreement between two tests (P-value < 0.001). The sensitivity of the US in the detection of joint effusion comparing to MRI as gold slandered was 75%, specificity was 95.5% and accuracy was 90% and there was statistical significance agreement between the two tests.

Conclusion: Ultrasonography and MRI are two complementary tools of investigation with formers being used as a primary tool of investigation and the latter is done to confirm the diagnosis and the extent of the lesion especially when surgical interference is planned.

Keywords: Ankle Sports Injuries, CT, US, MRI.

INTRODUCTION

The ankle joint is the most frequently injured major joint in the body, where ankle sprains are frequently encountered in individuals playing sports, in addition to occurring in the general population [(1)].

Ankle pain is often due to an ankle sprain but can also be caused by ankle instability, arthritis, gout, tendonitis, fracture, nerve compression (tarsal tunnel syndrome), infection, and poor structural alignment of the leg or foot. Ankle pain can be associated with swelling, stiffness, redness, and warmth in the involved zone [(2)].

Ankle joint injury could result in critical short term morbidity, recurrent injuries, functional instability; appropriate initial evaluation, and treatment could decrease the occurrence of these complications [(1)].

Imaging plays a crucial role in the evaluation of ankle ligaments. The ankle joint's lesions are due to trauma, inflammatory disorders, or overuse syndrome. Different imaging modalities are used to evaluate the ankle joint including plain radiography, Computed Tomography (CT), Ultrasound (US), and Magnetic Resonance Imaging (MRI) [(3)].

The US is a rapid, available, safe, and noninvasive tool. It has a lowcost in comparison to CT and MRI. It doesn't have the risk of ionization radiation as in CT and plain radiography or the contraindications of cardiac pacemakers and metallic implants as in MRI.

Colour and power Doppler (PD) add essential data about the related vascular structures [(4)].

The musculoskeletal US could be a helpful imaging modality for the evaluation of joint lesions. It is a fact that MRI is more critically performed for joint lesions than the US, yet both of them could be considered as complementary to each other. As for the US, there has been a marked improvement in its capability to detect multiple joint lesions with increased resolution [(3)].

Ligaments on each side of the ankle also provide stability by tightly strapping the outside of the ankle (lateral malleolus) with the lateral collateral ligaments and the inner portion of the ankle (medial malleolus) with the medial collateral ligaments. The ankle joint is surrounded by a fibrous joint capsule. The tendons that attach the large muscles of the leg to the foot, wrap around the ankle both from the front and behind [(5)].

The advantage of sonography over MRI is the ability to focus the examination precisely in the region of symptoms. Ultrasound examination is also valuable in assessing ankle disorders when metallic artifacts would limit imaging with MRI or CT [(6)].

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The US performed with high-resolution linear-array probes have become increasingly important in the assessment of ligaments and tendons around the ankle because it is a low cost, fast, readily available, and free of ionizing radiation. The US can provide a detailed depiction of normal anatomic structures and is effective for evaluating ligament integrity [(3)].

Also, the US allows the performance of dynamic maneuvers, which may contribute to increased visibility of normal ligaments and improved detection of tears. It can facilitate accurate identification, localization, and differentiation between synovial, tendinous, and entheseal inflammation, as well as, joint, bursal, and soft tissue fluid collection [(5)].

The aim of the current study had to assess the value of high-resolution ultrasonography in sports injuries compared to high field MRI.

PATIENTS AND METHODS

High-frequency (7–15 MHz) ultrasound and MRI were performed in 30 patients with an acute ankle injury (traumatic ankle pain) in the age range between 18 and 55 years, complaining of unilateral ankle sports injuries.

All ultrasound examinations were always done by only one radiologist We analyzed 17 male and 13 female patients, with the average age of 33 years (18–55) without visible bone fracture on standard radiograms at initial examination. A week after we performed an ultrasound investigation on a Philips using a 7–15 MHz linear probe. A stand-off pad was not necessary because the variable focus-depth was easily adapted to the thickness of the soft tissue overlying the bone.

Ethical approval:

This cross-sectional study had been approved by Zagazig University Hospital, Research, and Ethical Committee.

Consent was obtained from all patients before doing this study. All patients were referred to the Radiology Department from the Outpatient Clinic of the Orthopedics Department during the year 2018.

Inclusion criteria: Patients who had a history of acute ankle sprain injury. Patients who had residual symptoms of pain, swelling, or instability after conservative treatment including rest, analgesia, ankle guard, and physiotherapy for at least 6 weeks. Patients who had positive clinical findings suggestive of ligamentous injury such as positive anterior drawer test and/or talar tilt test.

Exclusion criteria: Patients with previous ankle surgery, interventional intra-articular procedures (previous arthroscope, injections), systemic inflammatory disorders (collagen diseases), diagnosed osseous lesions. Patients with recent or old rheumatologic, orthopedic ankle disorder, arthritis, gout, tendonitis or infections; and any contraindications for MRI.

All patients were subjected to:

History taking: All patients were subjected to full history taking, smoking and dietary habits s well as drugs, related risk factors such as systemic diseases, trauma, and familial diseases, patients complaints such as ankle pain, swelling, instability, previous surgeries, previous treatment, and ankle sports pain duration and clinical provisional diagnosis.

Clinical examination:

(i) Inspection: Skin for scar or sinuses, swellings, shape and symmetry and position, and movement of the ankle. (ii) Palpation: Determination of the point of maximum tenderness, tendon defect, and assessment of movements (Active, and passive) and power.

They underwent plain X-ray (to rule out osseous lesions to exclude these patients), real-time high-resolution ultrasonography, and MRI for the affected ankle joint.

Imaging studies:

(i) Plain radiograph: All patients were subjected to plain X-ray in AP and lateral views to exclude any osseous lesions.

(ii) High-resolution US examination: All patients had standardized ultrasonography of the injured ankle joint and excess gel was used. Ultrasound examinations were performed using Philips HD11 and Esaote my lab60 US machines were used with a superficial 7–10 MHz transducer.

(iii) Gold standard Test (MRI examination): After the US examination, the patient was scheduled to do an MRI of the ankle joint within a maximum of 2 days. There is no special patient preparation. Ankle MRI was performed using a 1.5-T Signa scanner (General Electric Milwaukee, Wisconsin, USA) on all patients who enrolled in the study.

Scanning protocol:

- The imaging planes, sequences, and even the selection of which coil to use varied depending on the clinical circumstances. The lower extremity was externally rotated and the planes of imaging were oriented to the anatomy of the foot, rather than to the magnet. Only the extremity with a suspected abnormality was imaged to employ a small field of view to increase the detail and resolution of the images.
- Ankle MRI protocol took 45 to 60 minutes.
- The FOV included the distal tibia and fibula, all of the tarsal bones, and the bases of the metatarsals.

- Slice thickness ranged from 3-5 mm with a gap of 1 mm.
- Matrix 256/192.
- Results obtained from the ultrasonographic examination were compared to those obtained from the MRI examination for each patient.

Statistical analysis

All images were interpreted on the computer workstation by two expert radiologists blinded to the patient's history and the diagnosis was established, then statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 22.0 (SPSS Inc., Chicago, IL, USA). Patient characteristics were analyzed descriptively. The Mean and standard deviation were reported for numerical variables, whereas the number of patients and percentages were reported for categorical variables. Performance of US and MRI were assessed using descriptive statistics to generate sensitivity, specificity, and positive predictive and negative predictive values with 95% confidence intervals. P-value < 0.05 was considered significant. P-value < 0.001 was considered as highly significant. P-value > 0.05 was considered insignificant.

RESULTS

Table 1: Sociodemographic characteristics of the studied patients

Variables	(n = 30)
Age (years)	
Mean ± SD	32.87± 18.45
Gender (%)	
Males	17 (56.7%)
Females	13 (43.3%)
BMI (Kg/m^2)	
Mean ± SD	26.21± 3.31

This table presented 30 patients (17 males and 13 females) ranged in age between 18 and 55 years with a mean age (Mean± SD: 32.78±18.45 years), the mean BMI 26.21± 3.31 (ranged from 25-35 Kg/m^2) (**Table 1**).

Table 2: Validity of US in the diagnosis of ligaments sprain in comparison to MRI as the gold standard:

US	MRI		Total	Kappa	P-value
	+ve	–ve			
+ve	6	0	**6**	**0.82**	**<0.001****
-ve	2	22	**24**		
Total	**8**	**22**	**30**		
Validity	**Sensitivity:75%** **PVP: 100%**		**Specificity: 100%** **PVN: 91.7%**		
Accuracy	**93.3%**				

This table shows the sensitivity of the US in the detection of sprain comparing to MRI as gold slandered was 75%, specificity was 100% and accuracy was 92.2% and there was statistical significance agreement between two tests by Kappa test (**Table 2**).

Table 3: Validity of US in the diagnosis of ligaments tear in comparison to MRI as the gold standard:

US	MRI		Total	Kappa	P-value
	+ve	–ve			
+ve	9	0	**9**	**0.92**	**<0.001****
-ve	1	20	**21**		
Total	**10**	**20**	**30**		
Validity	**Sensitivity:90%** **PVP: 100%**		**Specificity: 100%** **PVN: 95.2%**		
Accuracy	**96.7%**				

This table shows the sensitivity of the US in the detection of tears comparing to MRI as the gold slandered was 90%, specificity was 100% and accuracy was 96.7% and there was statistical significance agreement between two tests by Kappa test (**Table 3**).

Table 4: Affected tendon among the studied cases by MRI and US:

Variable	MRI (*n*=30)	US (n=30)	Kappa	P-value
Achilles				
Tendonitis	2 (6.7%)	2 (6.7%)	**1**	**<0.001****
Partial tear	1 (3.3%)	1 (3.3%)		
Complete tear	3 (10%)	3 (10%)		
TP				
Tendonitis	1 (3.3%)	1 (3.3%)	**1**	**<0.001****
Partial tear	1 (3.3%)	1 (3.3%)		
Complete tear	1 (3.3%)	1 (3.3%)		
FDL				
Tendonitis	0 (0.0%)	0 (0.0%)	**1**	**<0.001****
Partial tear	1 (3.3%)	1 (3.3%)		
Complete tear	0 (0.0%)	0 (0.0%)		
FHL				
Tendonitis	1 (3.3%)	0 (0.0%)	**0.85**	**<0.001****
Partial tear	0 (0.0%)	0 (0.0%)		
Complete tear	0 (0.0%)	0 (0.0%)		
TA				
Tendonitis	1 (3.3%)	1 (3.3%)	**1**	**<0.001****
Partial tear	1 (3.3%)	1 (3.3%)		
Complete tear	0 (0.0%)	0 (0.0%)		
EDL				
Tendonitis	0 (0.0%)	0 (0.0%)	**---**	**----**
Partial tear	0 (0.0%)	0 (0.0%)		
Complete tear	0 (0.0%)	0 (0.0%)		
Peroneal				
Tendonitis	1 (3.3%)	1 (3.3%)	**0.79**	**0.009****
Partial tear	1 (3.3%)	0 (0.0%)		
Complete tear	0 (0.0%)	0 (0.0%)		

Kappa; Chon's kappa test **Highly significant (P<0.01)

Achilles: Achilles tendon, **TP**: Tibialis posterior tendon, **FDL**: Flexor digitorum longus tendon, **FHL**: Flexor hallucis longs tendon, **TA**: Tibialis anterior tendon, **EDL**: Extensor digitorum longus tendon, **Peroneal**: Peroneal tendon

This table shows that there was a statistically significant agreement between MRI and US in the affected tendon (**Table 4**).

Table 5: Validity of US in the diagnosis of tendonitis in comparison to MRI as the gold standard:

US	MRI		Total	Kappa	P-value
	+ve	–ve			
+ve	5	0	**5**	**0.91**	**<0.001****
-ve	1	24	**25**		
Total	**6**	**24**	**30**		
Validity	**Sensitivity:83.3%** **PVP: 100%**			**Specificity: 100%** **PVN: 96%**	
Accuracy	**96.7%**				

Kappa; Chon's kappa test **:Highly significant (P<0.01)

This table shows that sensitivity of the US in the detection of tendonitis comparing to MRI as gold slandered was 83.3%, specificity was 100% and accuracy was 96.7% and there was statistical significance agreement between two tests by Kappa test (**Table 5**).

Table 6: Validity of US in the diagnosis of tendon tears in comparison to MRI as the gold standard:

US:	MRI		Total	Kappa	P-value
	+ve	–ve			
+ve	8	0	**8**	**0.93**	**<0.001****
-ve	1	21	**22**		
Total	**9**	**21**	**30**		
Validity	**Sensitivity:88.9%** **PVP: 100%**			**Specificity: 100%** **PVN: 95.5%**	
Accuracy	**96.7%**				

Kappa; Chon's kappa test **:Highly significant (P<0.01)

This table shows that the sensitivity of the US in the detection of tears comparing to MRI as gold slandered was 88.9%, specificity was 100% and accuracy was 96.7% and there was statistical significance agreement between two tests by Kappa test (**Table 6**).

Table 7: Validity of US in the diagnosis of bone lesions in comparison to MRI as the gold standard:

US	MRI		Total	Kappa	P-value
	+ve	–ve			
+ve	14	0	**14**	**1**	**<0.001****
-ve	0	16	**16**		
Total	**14**	**16**	**30**		
Validity	**Sensitivity:100%** **PVP: 100%**			**Specificity: 100%** **PVN: 100%**	
Accuracy	**100%**				

Kappa; Chon's kappa test **:Highly significant (P<0.01)

This table shows that sensitivity of the US in the detection of bone lesions comparing to MRI as gold slandered was 100%, specificity was 100% and accuracy was 100% and there was statistical significance agreement between two tests by Kappa test (**Table 7**).

Table 8: Validity of US in the diagnosis of joint effusion in comparison to MRI as the gold standard:

US	MRI		Total	Kappa	P-value
	+ve	–ve			
+ve	6	1	**7**	**0.73**	**<0.001****
-ve	2	21	**23**		
Total	**8**	**22**	**30**		
Validity	**Sensitivity:75%** **PVP: 85.7%**			**Specificity: 95.5%** **PVN: 91.3%**	
Accuracy	**90%**				

Kappa; Chon's kappa test **:Highly significant (P<0.01)

This table shows that the sensitivity of the US in the detection of joint effusion comparing to MRI as gold slandered was 75%, specificity was 95.5% and accuracy was 90% and there was statistical significance agreement between two tests by Kappa test (**Table 8**).

DISCUSSION

Our study included **30** patients complaining of unilateral ankle pain; males represented 56.7% of all patients while females represented 43.3%, with their ages ranged from 18 to 55 years (mean age was 32.87 years). This agreed with the study of **Elgohary *et al.*** [7] which was performed on 40 patients (12 females and 28 males) ranged in age between 12 and 60 years with a mean age (Mean± SD: 28.98±12.44). Also, Similar findings were demonstrated by **Artul and Habib** [8] **and El-Liethy and Kamal** [9].

Regarding mean BMI was 26.21 kg/m^2 and ranged from 20 to 36 kg/m^2. A total of 60% of the studied cases were from an urban area. Regarding occupation 36.7% of the studied cases were student and 30% were specialists. The most common sports among the studied group were football 43.3%. These findings were in agreement with **Elgohary *et al.*** [7].

In our study, all patients were subjected to plain X-ray, real-time high-resolution ultrasonography (US), and MRI of the affected ankle. We found the left side was affected in 63.3% of all cases while the right side was affected in 36.7%. This agreed with the study of **El-Liethy and Kamal** [9] which was performed on 35 patients with the left side was affected in 54.3% and the right side was affected in 45.7%. Also, the study of **Sultan *et al.*** [10] which was performed on ninety patients with the left side was affected in 55.5% of all cases while the right side was affected in 44.5%.

The current study shows 60% of the studied cases had ligament lesions most frequent was sprain (26.7%) by MRI while by the US 46.7% had ligament lesion most frequent complete tear 20%. There was a statistically significant agreement between MRI and US in both frequency and type of ligament lesions. This agreed with the study of **Sultan *et al.*** [10]. Regarding, there was a statistically significant agreement between MRI and US in affected ligaments.

Our results also were nearly similar to the results achieved by **Cheng *et al.*** [4], who showed that sonography succeeded to diagnose 14 out of 15 ATFL tears with a sensitivity of 93%. Similarly, **Margetic *et al.*** [11] reported that US results agreed in 100% of the cases with operative findings for ATFL and 92% for CFL. However, **D'Erme** [12] indicated that MR imaging was superior to sonography in the diagnosis of ankle collateral ligament injuries. On the other hand, **Milz *et al.*** [13] yielded a promising improvement of sonographic accuracy by using high-frequency transducers (13 MHz); they concluded that sonography can identify normal ankle ligaments with high accuracy and it showed the greatest accuracy in evaluation of the ATFL and CFL (90% and 87%, respectively). This agreed with **Sconfienza *et al.*** [14] where they reported that the US has shown valuable results in the evaluation of the normal and pathological anatomic structures of the ankle and provides an imaging modality alternative to MR imaging. Use of a standardized imaging technique that allows dynamic imaging may play an important role in the assessment of the anatomic structure and main patterns of the ankle.

Thus, after inversion ankle injury, visualization of an intact ATFL virtually excludes the rupture of any of the lateral collateral ligaments [15]. In our study, ATFL injury was associated with two cases diagnosed as having a CFL injury. Similar results were also achieved by **Martinoli and Bianchi** [16].

The present study represented the sensitivity of the US in the detection of sprain comparing to MRI as the gold standard was 75%, specificity was 100% and accuracy was 92.2% and there was statistical significance agreement between two tests. Also, the sensitivity of the US in the detection of tears comparing to MRI as gold slandered was 90%, specificity was 100% and accuracy was 96.7% and there was statistical significance agreement between two tests (P-value < 0.001). These findings are similar to the ones found in studies by **Rockett *et al.*** [17]**, Doherty *et al.*** [18], and **Shalaby *et al.*** [19]. They concluded that US and MRI are two complementary tools of investigation with the former being used as a primary effective tool of investigation and the latter is done to confirm the diagnosis.

According to the frequency and type of tendon lesions, our study found 50% of the studied group had ligament lesions most frequent was tendonitis (20%) by MRI while US 43.3% had ligament lesion most frequent tendonitis 16.7%, (P-value < 0.001). There was a statistically significant agreement between MRI and US in both frequency and type of tendon lesions. This finding was consistent with the previous study performed by **Artul and Habib** [8].

The present study presented the affected tendons diagnosed by the US compared to MRI as a gold standard. Achilles was represented in 6 cases (20%), followed by 10.9% TP, 3.3% FDL, 3.3% FHL, 6.6% TA. On the other hand, peroneal diagnosed by the US represented in one case (3.3%) compared to MRI as gold standard represented in 2 cases (6.6%), (P-value < 0.001). Statistically, significant was an agreement between MRI and US in affected tendons. This is matched with **Klauser *et al.*** [20] **and Liffen** [21] who reported that Achilles tendon ruptures are commonly affecting middle-aged individuals and abnormal tendons. The result of Achilles tendon injuries in our study was presented with tendinosis, partial tear, and complete tears representing 6.7%, 3.3%, and 10% of the Achilles tendon injuries, respectively. Achilles tendon, too much force on the tendon can cause it to tear partially or rupture completely [22].

Although it is the strongest tendon in the human body, **Liffen** [21] agreed that the Achilles tendon is the most commonly injured ankle tendon; with the site of pathological findings is typically a zone of relative avascularity 2–6 cm from the calcaneal insertion. Our results coincide with this hypothesis as Achilles tendon injuries represented 52.4% of all diagnosed ankle tendons' injuries and ranged in severity from tendinosis, partial tear to complete tear. In our study, ultrasound was capable of detecting all Achilles tendon injuries identified at MRI (100% sensitivity).

This study shows that sensitivity of the US in the detection of tendonitis comparing to MRI as gold slandered was 83.3%, specificity was 100% and accuracy was 96.7% and there was statistical significance agreement between the two tests (P-value < 0.001). Regarding, the sensitivity of the US in the detection of tears comparing to MRI as gold slandered was 88.9%, specificity was 100% and accuracy was 96.7% and there was statistical significance agreement between two tests (P-value < 0.001). These findings are similar to the ones found in studies by **Liffen** [21], **Sconfienza *et al.*** [14]**,** and **El-Liethy and Kamal** [9].

The study result **Kumar *et al.*** [23] which was performed on 130 patients revealed high sensitivity (81.65%) and high specificity (89%) in diagnosing ligament injury. The positive predictive value of the test was 97.8%, and the negative predictive value was 44%. The P-value of the difference of translation as 0.0001 was also statistically significant. The authors can safely conclude from their study that the functional US can be used as a primary tool to diagnose ligament tears. US ubiquitous availability and simple technique of the procedure can bring a revolution in the future for diagnosing and managing ligament injury.

In our study bone lesions were diagnosed by the US and confirmed with MRI as a gold standard. Bone lesions were represented in 16 cases (53.3%). Types of bone lesions most frequent with bone contusions in 5 cases (20%), followed by ostechondrial lesion in 5 cases (16.7%), Bone fractures lesions in 3 cases (10%), and OS trigonum in 2 cases (6.7%). Statistically, there was significant agreement between MRI and US in both frequency and type of tendon lesions (P-value < 0.001); which is in line with **Chan *et al.*** [24] who assumed that almost 75% of sports-related ankle injuries affect the lateral ligamentous complex. Our findings also are similar to **Subhawong *et al.*** [25] and **Sadineni *et al.*** [26].

The current study represented sensitivity of the US in the detection of bone lesions comparing to MRI as gold slandered was 100%, specificity was 100% and accuracy was 100%. Statistically, there was significant agreement between the two tests (p < 0.001). These findings are similar to **El-Liethy and Kamal** [9].

Recently, **Shalaby *et al.*** [19] reported that the US can be used as a first step diagnostic tool in cases of ankle pain. MRI should be spared to cases with negative or equivocal US findings. The US was capable to detect various lesions. It had a sensitivity of 95.4%, a specificity of 83.3% and an overall accuracy of 92.8%. US had a limited value in the detection of avascular necrosis (AVN), bone marrow edema, and fractures.

The present study represented that 26.7% of patients had joint effusion by MRI while 23.3% were diagnosed by the US. There was a statistically significant agreement between MRI and US in both frequency and type of tendon lesions. These findings are similar to **Elgohary *et al.*** [7] who found joint effusion represented in 23 cases from 70 cases (32.8%) and **Shalaby *et al.*** [19] who demonstrated that post-traumatic ankle joint pain was encountered in 2 cases of our study. Ankle joint mild effusion was found in one case. The other case had AVN of the talar dome that was missed on US examination and only detected by MRI.

This study represented that the sensitivity of the US in the detection of joint effusion comparing to MRI as gold slandered was 75%, specificity was 95.5% and accuracy was 90% and there was statistical significance agreement between the two tests. These findings are similar to **Elgohary *et al.*** [7] and **Shalaby *et al.*** [19].

However, **Shalaby *et al.*** [19] study reported that the US could accurately diagnose a good number of cases with soft tissue abnormality. Their results showed that sensitivity of the US was (95.4%) which was higher than specificity or better positive than negative with an overall accuracy of (92.8%), (P < 0.001).

CONCLUSION

Imaging modality provides a non-invasive tool for the diagnosis of ankle sports injury, which is often difficult to diagnose with alternative modalities. MRI is the modality of choice for optimal detection of most trauma of the ankle sports injury includes tendons, ligaments, and soft tissue structures of ankle and when global evaluation of the osseous and soft tissue structures of the ankle is needed. The modality is also valuable in the early detection and assessment of the variety of osseous abnormalities seen in this anatomic location. MRI is particularly advantageous for assessing soft tissue structures around the ankle such as tendons, ligaments, nerves, and fascia, and for detecting occult bone injuries.

The ultrasound is an excellent cost-benefit widely available imaging modality that has high spatial resolution making it a helpful tool in diagnosing musculoskeletal ankle disorders mainly when evaluation soft tissue structures and extremely valuable when a focused evaluation is needed for a soft tissue structure or precisely examining the region of symptoms. Ultrasound examination is also valuable in assessing ankle sports injury when metallic artifacts would limit imaging with MRI or CT.

Ultrasonography and MRI are two complementary tools of investigation with formers being used as a primary tool of investigation and the latter is done to confirm the diagnosis and the extent of the lesion especially when surgical interference is planned.

REFERENCES

1. **Mosher T, Kransdorf M, Adler R *et al.* (2015):** ACR Appropriateness Criteria acute trauma to the ankle. J Am Coll Radiol., 12(3):221-7.
2. **van den Bekerom M (2011):** Diagnosing syndesmotic instability in ankle fractures. World J Orthop., 2(7):51-6.
3. **Lee S, Jacobson J, Kim S *et al.* (2013):** Ultrasound and MRI of the peroneal tendons and associated pathology. Skeletal Radiol., 42:1191-1200.
4. **Cheng Y, Cai Y, Wang Y (2014):** Value of ultrasonography for detecting chronic injury of the lateral ligaments of the ankle joint compared with ultrasonography findings. Br J Radiol., 87:1–6.
5. **Jonckheer P, Willems T, De Ridder R *et al.* (2016):** Evaluating fracture risk in acute ankle sprains: Any news since the Ottawa Ankle Rules? A systematic review. Eur J Gen Pract., 22(1):31-41.
6. **Lee S, Yun S (2017):** The feasibility of point-of-care ankle ultrasound examination in patients with a recurrent ankle sprain and chronic ankle instability: Comparison with magnetic resonance imaging. Injury, 48(10):2323-2328.
7. **Elgohary M, Abdul Rahim S, Ibrahim T (2017):** Role of MRI in Evaluation of Traumatic Ankle Injuries. The Egyptian Journal of Hospital Medicine, 69 (3): 2016-2024.
8. **Artul S, Habib G (2014):** Ultrasound Findings of the Painful Ankle and Foot. J Clin Imaging Sci., 4: 25.
9. **El-Liethy N, Kamal H (2016):** High-resolution ultrasonography and magnetic resonance imaging in the evaluation of tendino-ligamentous injuries around the ankle joint. The Egyptian Journal of Radiology and Nuclear Medicine, 47: 543-55.
10. **Sultan E, Sherief M, Mashaly E (2018):** Role of Ultrasound and Magnetic Resonance Imaging in Diagnosis of the Etiology of Chronic Ankle Pain. Med J Cairo Univ., 86(1): 473-482.
11. **Margetic P, Salaj M, Lubina I (2009):** The value of ultrasound in acute ankle injury: comparison with MR. Eur J Trauma Emerg Surg., 35(2):141–6.
12. **D'Erme M (1996):** Lesions of the collateral ligaments of the ankle. Diagnosis and follow-up with magnetic resonance and ultrasonography. Radiol Med Torino., 91:705–12.
13. **Milz P, Milz S, Putz R *et al.* (1996):** 13-MHz high-frequency sonography of the lateral ankle joint ligaments and the tibiofibular syndesmosis in anatomic specimens. J Ultrasound Med., 15:277–284.
14. **Sconfienza L, Orlandi D, Lacelli F *et al.* (2015):** Dynamic high-resolution US of the ankle and midfoot ligaments: normal anatomic structure and imaging technique. Radio Graphics, 35:164–78.
15. **van den Bekerom M, Kerkhoffs G, McCollum G *et al.* (2013):** Management of acute lateral ankle ligament injury in the athlete. Knee Surg Sports Traumatol Arthrosc.,21:1390–5.
16. **Martinoli C, Bianchi S (2007):** Ankle: Ankle Pathology. In: Ultrasound of the musculoskeletal system. Springer-Verlag Berlin Heidelberg; Pp. 796 - 830.
17. **Rockett M, Waitches G, Sudakoff G *et al.* (1998):** Use of Ultrasonography versus Magnetic Resonance Imaging for tendon abnormalities around the ankle. Foot Ankle Intl., 19(9): 604-612.
18. **Doherty C, Delahunt E, Caulfield B *et al.* (2014):** The incidence and prevalence of ankle sprain injury: a systematic review and meta-analysis of prospective epidemiological studies. Sports Med., 44(1): 123-40.
19. **Shalaby M, Sharara S, Abdelbary M (2017):** High-resolution ultrasonography in ankle joint pain: Where does it stand? The Egyptian Journal of Radiology and Nuclear Medicine, 48: 645–652.
20. **Klauser AS, Miyamoto H, Tamegger M *et al.* (2013):** Achilles tendon assessed with sonoelastography: histologic agreement. Radiology, 267(3):837-42.
21. **Liffen N (2014):** Achilles tendon diagnostic ultrasound examination: a locally designed protocol and audit. Int Musculoskelet Med., 36(1):1–12.
22. **Trovinger A, Sonin A, Dunfee W *et al.* (2013):** Musculoskeletal MRI, part I: Ankle, Foot, Wrist, and Hand, Pp. 2-4. CE.websource.com.
23. **Kumar S, Kumar A, Kumar S *et al.* (2018):** Functional Ultrasonography in Diagnosing Anterior Cruciate Ligament Injury as Compared to Magnetic Resonance Imaging. Indian Journal of Orthopaedics, 52(6):638-42.
24. **Chan K, Ding B, Mroczek K (2011):** Acute and chronic lateral ankle instability in the athlete. Bull NYU Hosp Jt Dis., 69(1):17–26.
25. **Subhawong T, Jacobs M, Fayad L (2014):** Diffusion-weighted MR imaging for characterizing musculoskeletal lesions. Radiographics, 34 (5): 1163-1177.
26. **Sadineni R, Pasumarthy A, Bellapa N *et al.* (2015):** Imaging Patterns in MRI in Recent Bone Injuries Following Negative or Inconclusive Plain Radiographs. J Clin Diagn Res., 9(10): 10–13.