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Comparative assessment with Ultrasound and magnetic resonance Imaging in the evaluation of chronic Ankle pathologies

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Abstract

Background: Chronic musculoskeletal conditions constitute a global health problem that is likely to increase as the average life span increases. Chronic ankle conditions may be linked to the high incidence of ankle injuries such as ankle sprain and fracture, injuries that are often thought to fully recover. Also, the incidence of degenerative, inflammatory, and infective pathologies is not much less either. Thus, imaging plays a crucial role in the evaluation of the ankle. However, clinical examinations may often be difficult to perform in the acute stage, and ligamentous pathologies may not be properly evaluated in routine radiographs. With time, advanced modalities like high-resolution ultrasound, computed tomography, and magnetic resonance imaging have become available. The superficial location [1] of most structures and the possibility of performing dynamic maneuvers during the examination means that ultrasound plays an important role in the management of patients with pathological conditions of the ankle.[2] MRI is a valuable non-invasive study to delineate those pathologies. Therefore, this study is being performed to determine the usefulness of USG to assess its accuracy, sensitivity, specificity in our setting and rule out any

other existing disease of the affected ankle, and to correlate it with MRI findings.This study was carried out in the Department of Radio Diagnosis where we studied 75 consecutive patients who were referred from the Orthopedics Out-Patient Department (OPD) having symptoms pertaining to chronic ankle pathologies. The patients were evaluated sonologically and those with positive findings (among tendinopathy, synovial thickening, synovial collection, calcification/substance deposition, synovial cysts, and cortical erosions) were subjected to magnetic resonance imaging (MRI).

in this study, we had a study population of 75 patients.Traumatic pathologies were by far the predominant, followed by degenerative, inflammatory, infective, and tumor and tumor-like conditions. In our study, the correlation between the ability of USG and MRI in the detection of chronic ankle pathologies mostly showed good total agreement. Tendinopathy, synovial thickening, joint effusion/bursitis, and substance deposition at the ankle joint showed 100% agreement. Synovial cyst (sensitivity 80%, κ value 0.854) showed almost perfect agreement and so did cortical erosion (sensitivity 95% κ value 0.946, almost perfect agreement). HRUSG can accurately detect the involved tendons, ligaments,synovium, and bursae around the ankle joint and associated tendinopathy, synovial thickening, joint effusion/bursitis, substance deposition, synovial cysts, and cortical erosions. MRI is a better modality to evaluate synovial cysts, cortical erosions, and marrow changes (especially in the case of osteomyelitis). MRI can readily pick up soft tissue or osseous abnormalities that may be missed on other conventional imaging, and sometimes even on arthroscopy.Overall, there was a good agreement between HRUSG and MRI in the assessment of chronic pathologies of the ankle joint.

Keywords: Chronic ankle pathologies, USG, MRI

Background

Chronic musculoskeletal conditions constitute a global health problem that is likely to increase as the average life span increases. Chronic ankle conditions may be linked to the high incidence of ankle injuries such as ankle sprain and fracture, injuries that are often thought to fully recover.

Also, the incidence of degenerative, inflammatory, and infective pathologies is not much less either. Thus, imaging plays a crucial role in the evaluation of the ankle. However, clinical examinations may often be difficult to perform in the acute stage, and ligamentous pathologies may not be properly evaluated in routine radiographs. With time, advanced modalities like high-resolution ultrasound, computed tomography, and magnetic resonance imaging have become available. The superficial location [1] of most structures and the possibility of performing dynamic maneuvers during the examination means that ultrasound plays an important role in the management of patients with pathological conditions of the ankle.[2]

MRI is a valuable non-invasive study to delineate those pathologies. Therefore, this study is being performed to determine the usefulness of USG to assess its accuracy, sensitivity, specificity in our setting and rule out any other existing disease of the affected ankle, and correlate it with MRI findings.

Material &Methods

A total of 75 consecutive patients who were referred from the Orthopaedics Out-Patient Department (OPD) having symptoms pertaining to chronic ankle pathologies were evaluated sonologically and those with

positive findings (among tendinopathy, synovial thickening, synovial collection, calcification/substance deposition, synovial cysts, and cortical erosions) were subjected to magnetic resonance imaging (MRI).

Study Design

Institutional Cross-sectional observational study.

Inclusion Criteria

- Patients with a history of chronic ankle pain (>6 weeks) referred from the Orthopedics Department for suspected internal derangement of the ankle joint, due to chronic degenerative conditions, chronic inflammatory and auto-immune conditions, chronic infection, and chronic trauma
- Patients > 10 and < 60years of age
- Patients of both sexes will be considered for the study.
- Patients with unilateral ankle pain

Exclusion Criteria

- Patients with history of acute trauma (< 48 hours) around the ankle.
- Any electrically, magnetically or mechanically activated implants
- Age <10 yrs.&>70 yrs.
- Patients with bilateral ankle pain.
- Patients who had surgeries to the ankle joint
- Patients with comorbidities (Diabetes Mellitus, Hypertension, Chronic Renal Disease), hemodynamically unstable and have respiratory distress, not suitable for MRI examination.
- Patients who do not give valid and informed consent

Study Design

Institutional Cross-sectional observational study

Period of Study

From 1st MAY 2020 to 31st JULY 2021

Study Tools

1. 1.5 Tesla MRI machine made by GE HEALTH CARE [MODEL NUMBER – BRIVO MR355] with other required accessories.
2. Philips HD7 Ultrasound Scanner with High-Resolution transducer of frequency L12-3 Mhz.

Statistical Analysis

Statistical analysis was performed using SPSS statistical software version 19.0. Interobserver agreement was determined by calculating a weighted kappa (Kw) statistic. This kappa statistical value considers the degree of agreement into account and also considers differences in the importance of disagreement. The K statistic (Kw) reflects that the agreement is beyond chance. Landis and Koch proposed that a kappa in the range of 0.21-0.40 be considered a 'fair' agreement, kappa=0.41-0.60 be considered a 'moderate' agreement, kappa=0.61-0.80 be considered a 'substantial' agreement, and kappa >0.81 be considered 'almost perfect' agreement.

Results

- Regarding the type of pathologies; traumatic pathologies (34%) were most common followed by degenerative pathologies (27%)

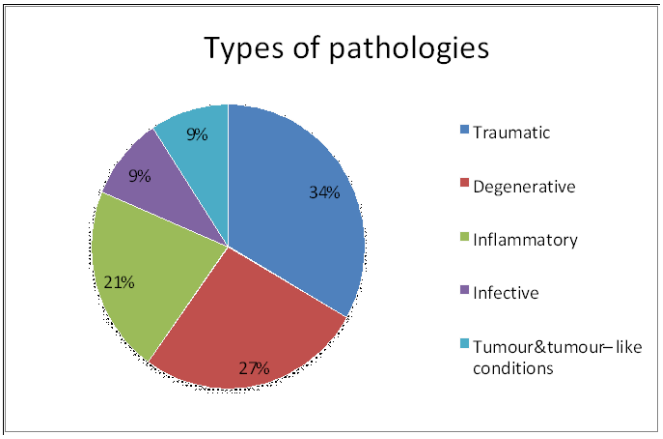

Figure 1: distribution of the study according to the types of pathologies.

Regarding the age of involvement Traumatic pathologies were most common in the age group of 30-39 (36%), degenerative in the age group of 40-49 and 50-59 (35% each), inflammatory in 20-29 (44%), infective in 10-19 (57%), and maximum number of cases of tumour and tumour like conditions was in the age group of 20-29 and 30-39 (28% each).

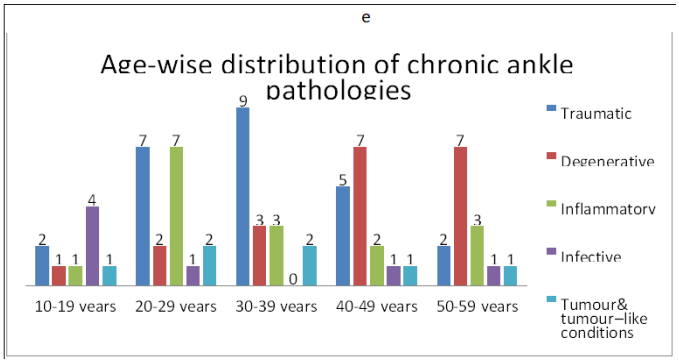

Figure 2: age-wise distribution of chronic ankle pathologies.

Regarding traumatictend Achillesinjuries total of 15 patients had trauma to the ten do Achilles of which 8 were partial tears and 7 were full thickness tears. Correlation between the ability of USG and MRI in detection of such tears yielded a sensitivity of 100%

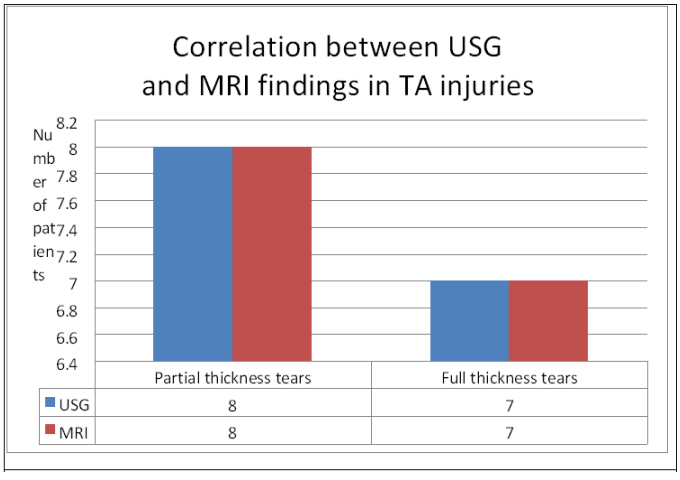

Figure 3: correlation between USG MRI findings in TA injuries.

In our study other than ten do Achilles, the tibialis posterior, tibialis anterior and peroneus brevis tendons were injured. On correlating USG with MRI, the sensitivity in picking up tendon tears and other associated findings was 100%.

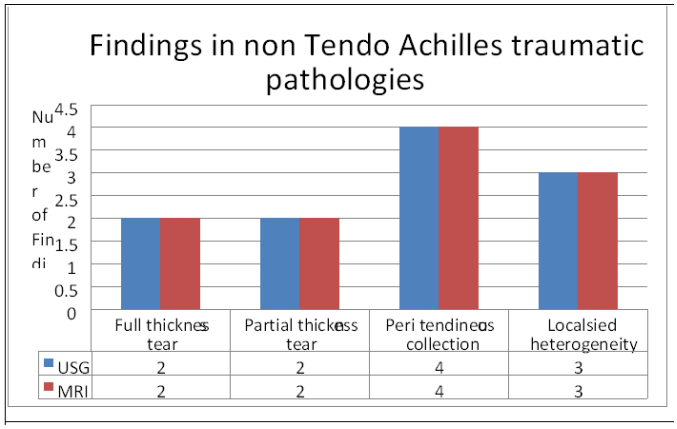

Figure 4: correlation between USG MRI findings in non a chilies traumatic pathologies.

In our study; Correlation between the ability of ultrasonography, against MRI in detection of ligamentous tears yielded a sensitivity of 100%.

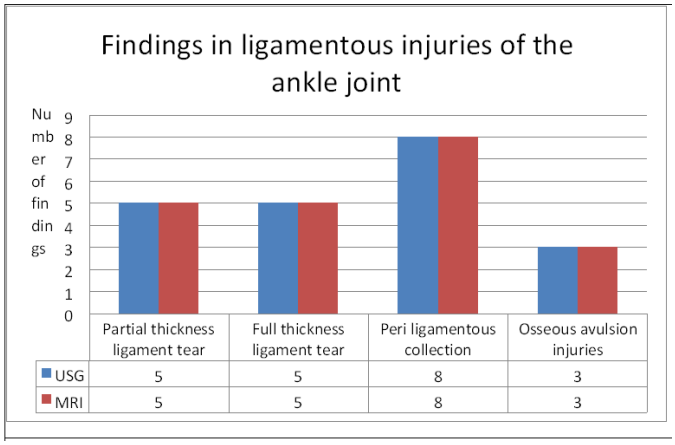

Figure 5: correlation between usg and MRI findings in ligamentous injuries of the ankle joint.

On comparing USG with MRI findings, there was excellent agreement Thus the sensitivity of USG was comparable to MRI (100%) in diagnosing cortical erosions, cartilage destruction, synovial hypertrophy, joint effusions and tendionopathies due to impingement syndrome.

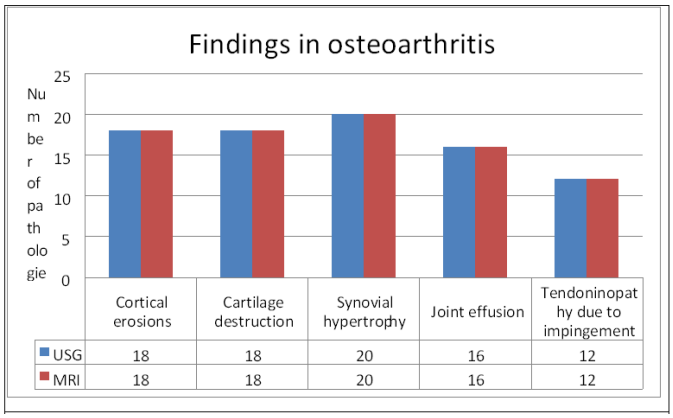

Figure 7: correlation between USG and MRI findings in osteoarthritis.

On comparing USG with MRI findings of inflammatory arthritis, there was excellent agreement, except in the case of cortical erosions where 8 were picked up on USG but MRI picked up 1 more. Thus the sensitivity of USG was comparable to MRI (100%) in diagnosing synovial hypertrophy, joint effusions, bursitis, tendionopathies, cartilage destructions and rheumatoid nodules.

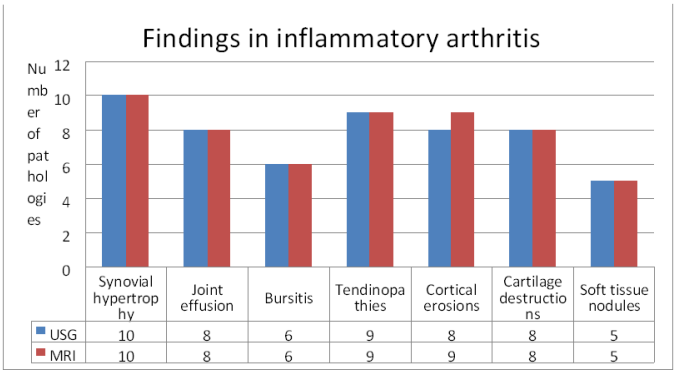

Figure 8: Correlation between USG and MRI findings in inflammatory arthritis.

On comparing USG with MRI findings of crystal deposition disorders, there was excellent agreement, except in the case of cortical erosions where 4 were picked up on USG but MRI picked up 1 more. Thus, the sensitivity of USG was comparable to MRI (100%) in diagnosing synovial hypertrophy, joint effusions, bursitis, tophi and tendionopathies. However, in the detection of cortical erosions it came down to 80% (κ value 0.571, moderate agreement).

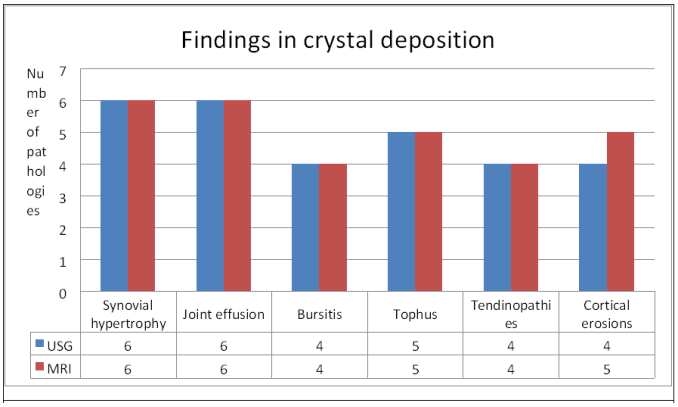

Figure 9: correlation between USG AND MRI findings in crystal deposition disorders.

While evaluating infective pathologies of ankle joint ,USG showed similar results when compared to MRI (100% sensitivity) in the detection of synovial thickening, fluid collection, abscess formation, sinus tract or cortical erosions. The only short coming of USG was in the detection of the bone marrow changes where it picked up only 4 of the 6 pathologies, thus bringing down the sensitivity to 67% (κ value 0.364, fair agreement).

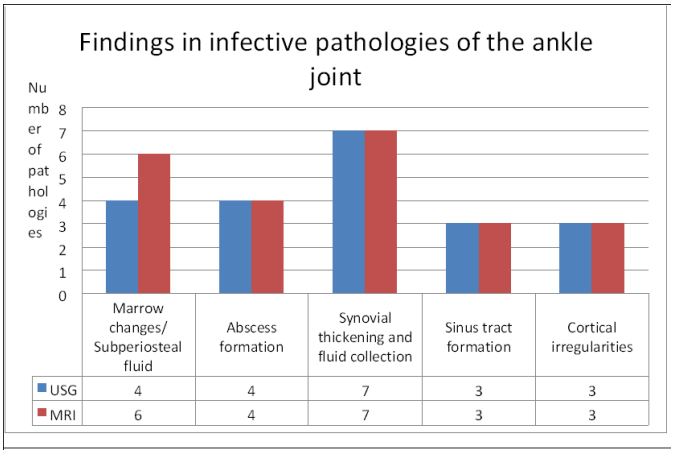

Figure 11: correlation between USG and MRI findings in infective pathologies of ankle joint.

Correlation between the ability of USG an MRI in the detection of tumour and tumour – like conditions of the ankle joint yielded a sensitivity of 100%.

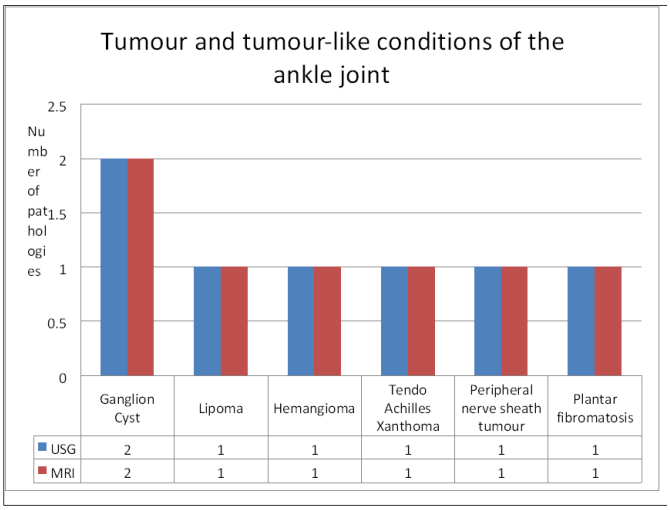

Figure 12: Correlation between USG and MRI findings in in tumour&tumour - like conditions of the ankle joint.

Correlation between the ability of USG an MRI in the detection of tendinopathy, synovial thickening, joint effusion / bursitis and substance deposition at the ankle joint yielded a sensitivity of 100%. However it reduced in the case of synovial cyst (sensitivity 80%, κ value 0.854, almost perfect agreement) and cortical erosion (sensitivity 95% κ value 0.946, almost perfect agreement).

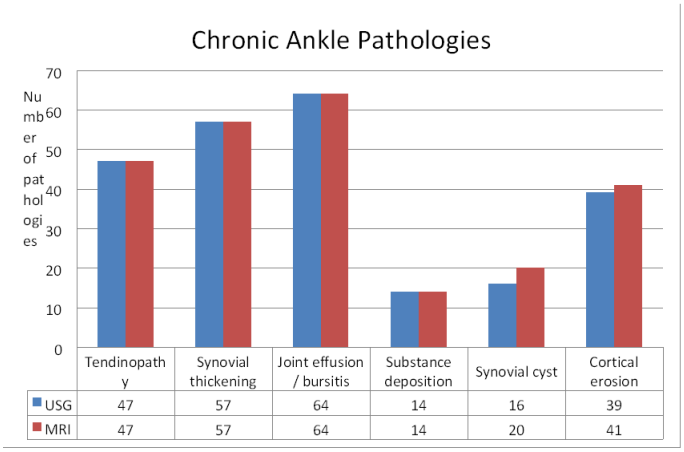

Figure 13: Correlation between USG and MRI findings in evaluation of chronic ankle pathologies.

Discussion

In this study 25 patients (34%) had traumatic pathologies around the ankle joint including both tendinous and ligamentous pathologies. Tendon tears, ligament tears, bony avulsion injuries and surrounding collections accounted for a total of 47 pathologies.

The ten do Achilles was by far the commonest injured tendon in our study accounting for almost 79% (15 cases) of the total. 8 partial thickness tears and 7 full thickness tears were identified on USG which correlated perfectly on MRI, with a 100% agreement. The other injured tendons were tibialis posterior, tibialis anterior and peroneus brevis and these findings also had a 100% agreement on USG and MRI with results similar to studies by Lee SJ, Jacobson JA, Kim SM, et al..[3] and GM Watches et al [6]. However it superseded the results by Gerling MC et al which stated that Sensitivity, specificity, and accuracy of MR imaging in the diagnosis of PTT tears were 73%, 69%, and 72%, respectively. Dynamic US interpretation yielded values of 69% sensitivity, 81% specificity, and 72% accuracy.[10]

In our study the injured ligaments were the anterior talo fibular ligament, the calcaneo fibular ligament, the Antero inferior Tibio fibular ligament and the deltoid ligament (in decreasing order of involvement). They were associated with osseous avulsion injuries in 3 cases (50%). Correlation of these findings on USG and MRI had an agreement of 100%.[5][7][13] In concordance with studies by Chen JP, Allen AM tear of spring ligament is a rare entity and was no similar case was recorded in the study [4][14]

20 patients (27%) had degenerative (osteoarthritis) changes around the ankle joint. Synovial hypertrophy was the most common finding and was present in all cases. The next major findings were cortical erosions and cartilage destruction, seen in 18 (90%) cases. Joint effusion was seen in 16 (80%) cases and tendinopathy in 12 (60%) cases. Correlation of these findings in USG and MRI had a 100% agreement.

In our study, 16 patients (21%) had inflammatory pathologies [15], including inflammatory (both sero positive and sero negative)[12] arthritides and crystal deposition (gout) disorders[11]. As with degenerative pathologies, the predominant finding was that of synovial hypertrophy (seen in all cases). Joint effusion was seen in 14 cases (87.5%) and associated tendinopathies in 13 (81%). Bursitis was seen in 10 cases (62.5%). These findings showed 100% agreement on correlation with USG and MRI showing with the improvement of usg images limitation in USG diagnosis is reducing [8][9]. On the other hand, cortical erosions were shown by USG in 12 cases and MRI in 14 cases. The κ value was 0.6 (moderate agreement) and the percentage of agreement was 87.5.

7 patients (9%) showed infective changes around the ankle joint. Synovial thickening with fluid collection was seen in all cases. 4 cases (57%) showed evidence of abscess formation. 3 had cortical irregularities and 3 had sinus tract formation. On correlation with USG and MRI these findings had an agreement of 100%. The only short coming of USG was seen in the detection of marrow changes and sub periosteal fluid collections. USG detected only 4 out of 6 cases diagnosed by MRI. The κ value was 0.364 (fair agreement) and the percentage of agreement was 71.4%. This goes in favour with the study by Yuh WT et al which documented the superiority of MRI in diagnosis of osteomyelitis.[16]. The study showed acceptance with the study by Millet TT et al [17] that gadolinium should be reserved for clinically suspected infection in or around a joint, and in cases refractory to medical or surgical treatment due to possible abscess formation.

Our study showed 7 cases of tumorous conditions around the ankle joint. These were ganglion cysts, lipoma, hemangioma, ten do Achilles xanthoma, peripheral nerve sheath tumor and plantar fibromatosis. On correlation of USG and MRI, there was an agreement of 100%. The person with ten do Achilles xanthoma had also undergone a USG-guided Trucut biopsy at our department from the complaining swelling to further confirm the diagnosis, but that is beyond the scope of our study.

Thus ultrasound is an efficient and inexpensive alternative to magnetic resonance (MR) imaging for evaluation of the ankle [.1][2]

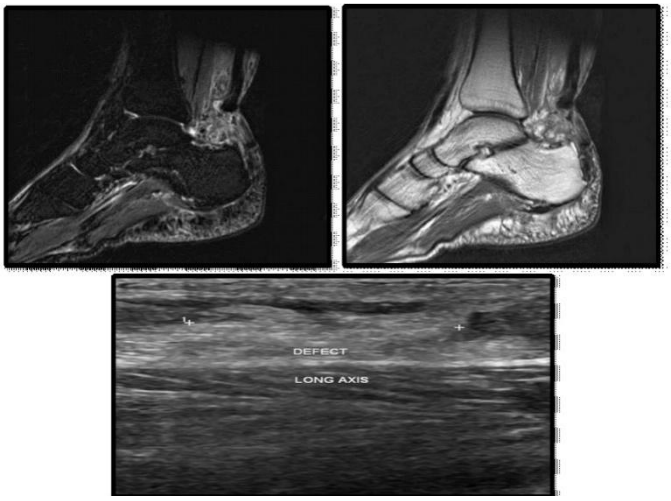

Figure 1: USG and MRI images showing a full thickness tear of the ten do Achilles with retraction of fibres

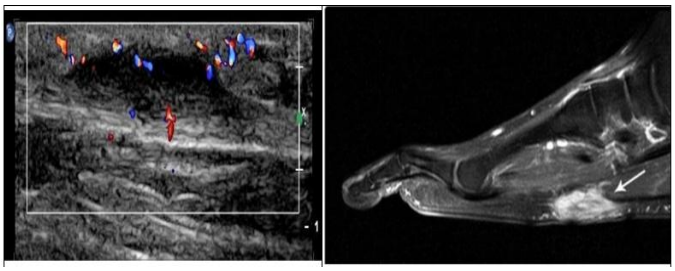

Figure 2: Ultrasound image showing a hypoechoic, fusiform lesion arising from the plantar fascia in the medial aspect of the arch of the right foot in keeping with a typicalplantar fibroma. Minor vascularity is also detected.

Sagittal T1 weighted images showing a hypointense soft tissue lesion on the plantar aspect of footwhich shows contrast enhancement.

Conclusion

Chronic ankle pathologies account for significant morbidity and reduction in the physical quality of life. Traumatic pathologies were by far the predominant, followed by degenerative, inflammatory, and infective and tumor and tumor-like conditions.

HRUSG can accurately detect the involved tendons, ligaments, synovium, bursae around the ankle joint and associated tendinopathy, synovial thickening, joint effusion/bursitis, substance deposition, synovial cysts, and cortical erosions.

The possibility of dynamic maneuvering in HRUSG helps in the diagnosis of impingement syndromes or any soft tissue pathology that may be otherwise obscured in other conventional imaging. Also, USG can be utilized in barbotage and guided administration of medication in cases of calcific tendinitis and other chronic inflammatory conditions.

HRUSG imaging is safe, cost-effective, repeatable, noninvasive procedure for investigating the periarticular soft tissues of the ankle joint. Thus, HRUSG should be the first line of investigation for chronic ankle pathologies and may be combined with other imaging modalities to obtain better diagnostic accuracy.

MRI is a better modality to evaluate synovial cysts, cortical erosions, and marrow changes (especially in the case of osteomyelitis). MRI can readily pick up soft tissue or osseous abnormalities that may be missed on other conventional imaging, and sometimes even on arthroscopy.

Overall, there was a good agreement between HRUSG and MRI in the assessment of chronic pathologies of the ankle joint.

Ethics approval and consent to participate

The above-mentioned research has been approved by Institutional Ethics Comitte of Burdwan Medical College, Burdwan in meeting held on 27/01/2020

List of abbreviations

HRUSG = High Resolution Ultrasonography

MRI = Magnetic Resonance Imaging

Data Availability

The data's used for the study have been provided in the master attached as the annexure

Author's contributions

IH collected; analysed the DATA. SSR Helped in collection of the data and preparation of manuscript.SD and Am contributed in the analysis of data; its interpretation and supervised the writing of manuscript. All authors read and approved the final manuscript."

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