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Original Research Article

Impact on Clinical Decision-Making in Patients with Ankle Pain by using Musculoskeletal Radiologist-Performed Ultrasound: A Prospective Study

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Abstract: ***Objectives:*** To evaluate the impact of musculoskeletal (MSK) radiologist-performed ultrasound on clinical decision-making in patients presenting with ankle pain. ***Methods:*** In this prospective observational study, 128 consecutive patients with ankle pain underwent standardized MSK ultrasound. Referring clinicians documented provisional diagnoses and management plans before ultrasound and final decisions after imaging. Changes in diagnosis, management strategy, additional imaging utilization, and interventions were recorded. Statistical analysis included McNemar testing and descriptivestatistics. ***Results:*** Ultrasound altered the primary diagnosis in 38% of patients and modified management plans in 45%. MRI utilization decreased by 41%, and surgical referrals declined by 22%. Ultrasound-guided procedures were performed in 12% of cases. ***Conclusion:*** MSK radiologist-performed ultrasound significantly influences diagnostic accuracy and clinical management in ankle pain, supporting its use as a first-line imaging modality.

Keywords: Ankle pain; Musculoskeletal ultrasound; Clinical decision-making; Imaging pathway; MRI utilization.

INTRODUCTION

Ankle pain, both traumatic and nontraumatic, is a frequent reason for emergency and outpatient presentation, and lateral ankle sprain is among the most common musculoskeletal injuries encountered in routine clinical practice. (1)(2) Acute ankle injuries require timely differentiation between ligamentous injury, tendon injury, occult fracture, osteochondral injury, and infection or inflammatory disease, because management strategies range from reassurance and functional rehabilitation to immobilisation and surgery. (2)(3)

The standard imaging pathway in most centres begins with plain radiography, primarily to exclude fracture. (1)(2) However, radiographs may be normal in many patients who have clinically significant soft tissue injuries (for example, ATFL or CFL tears, syndesmotic injury, peroneal tendon pathology) or occult osteochondral injury. (2)(4) In such situations, patients frequently enter an MRI waiting pathway, which can delay definitive diagnosis and treatment decisions. (2)(3) This delay may be clinically relevant, particularly in patients with high functional demands, suspected complete ligament rupture, suspected syndesmotic instability, tendon rupture, or persistent disabling symptoms. (2)(3)(5)

Musculoskeletal ultrasound (MSK US) is increasingly used as an early diagnostic test for ankle soft tissue pathology due to several practical advantages: rapid availability, portability, lack of ionising radiation, lower cost than MRI, ability to perform dynamic stress manoeuvres, and the opportunity for immediate comparison with the contralateral side. [6][7][8] The European Society of Musculoskeletal Radiology (ESSR) has published technical guidelines standardising ankle ultrasound scanning, including the approach to the lateral ligaments and the use of stress techniques when partial versus complete tear is uncertain. [6]

The lateral collateral ligament complex comprises the anterior talofibular ligament (ATFL), calcaneofibular ligament (CFL), and posterior talofibular ligament (PTFL). ATFL is most commonly injured in inversion mechanisms; CFL and syndesmotic ligaments may be involved in higher grade injuries. [6][9] Correct classification of severity (sprain vs partial tear vs complete tear) is clinically important because it guides immobilisation duration, rehabilitation intensity, orthopaedic referral urgency, and in selected cases, operative planning. [2][6]

Multiple systematic reviews and meta analyses have demonstrated high diagnostic performance of ultrasound for ATFL injury, including studies showing ultrasound sensitivity comparable to or greater than MRI for ATFL tear detection. [9][10] Recent meta analytic evidence also supports ultrasound accuracy for acute lateral ankle ligament injury compared with MRI, with particularly high sensitivity and specificity for ATFL and good specificity for CFL. [11] These findings provide a strong rationale for considering ultrasound as an early test where the primary question is ligament integrity and grade.

MRI remains the preferred modality when the clinical question extends beyond superficial ligament assessment, such as suspected osteochondral lesions, marrow oedema or occult fracture, syndesmotic injury with instability, deep deltoid or spring ligament complex injury, complex tendon tears, multifocal pathology, or when ultrasound is limited by patient body habitus, pain, or extensive soft tissue swelling. [2][5][12] For syndesmotic injury, MRI is widely used due to its ability to demonstrate ligament disruption, marrow oedema, osteochondral lesions, and secondary signs of instability. [13][14]

Given the frequent scenario of normal radiographs with ongoing ankle pain and suspected soft tissue injury, an imaging pathway where MSK radiologist performed ultrasound is used as the first line test may shorten time to diagnosis, accelerate clinically significant decision making, and reduce unnecessary MRI utilisation, while still identifying patients who require MRI for comprehensive assessment or operative planning. [2][6][9][11]

Clinical decision rules such as the Ottawa Ankle Rules were developed to reduce unnecessary ankle radiographs while maintaining high sensitivity for clinically significant fractures. [15][16] However, after radiographs are negative, further imaging is often required when pain persists or when clinical suspicion remains high for occult fracture, osteochondral injury, syndesmotic instability, or significant ligament or tendon disruption. [2][3]

The ACR Appropriateness Criteria (acute ankle trauma) emphasise radiography as initial imaging in appropriately selected patients and acknowledge a secondary role for cross sectional imaging in persistent symptoms and suspected occult injury. [2][3] In practice, MRI becomes the most commonly requested second line test due to its broad soft tissue and marrow assessment capabilities. [2][3]

The ESSR technical guideline for ankle ultrasound provides a structured approach for scanning the anterior, lateral, medial, and posterior compartments, including recommended positioning, transducer orientation, and stress manoeuvres for ligament assessment. [6] These standards are particularly relevant for reproducibility and for ensuring that ligament assessment (ATFL, CFL, PTFL and syndesmotic ligaments) is performed in a consistent manner. [6]

A large body of evidence supports ultrasound for ATFL evaluation. A systematic review and meta analysis comparing ultrasound and MRI for ATFL injury found ultrasound to have very high sensitivity for ATFL injuries and, in some analyses, higher sensitivity than MRI for detecting ATFL tears. [9] Another systematic review and meta analysis using operative findings as reference also reported high pooled accuracy estimates for ultrasound in detecting ATFL tears across acute and chronic settings, emphasising the importance of high frequency probes and operator expertise. [10]

These findings are clinically relevant because ATFL injury is a primary determinant of lateral ankle instability and is commonly implicated in recurrent sprains and chronic ankle instability. [6][9][10]

Peroneal tendon pathology commonly coexists with lateral ankle ligament injury and can present as the ankle sprain that does not improve. High resolution ultrasound allows direct tendon evaluation and dynamic assessment for subluxation, whereas MRI offers a more global view of the ankle and associated intra articular pathology. [20]

Recent evidence includes:

- A direct comparison study with intraoperative correlation reported high sensitivity and specificity for both ultrasound and MRI in peroneal tendinopathy; ultrasound showed strong performance for peroneal subluxation, while MRI was slightly more accurate for tendon tears in that cohort. [21]

- A 2025 systematic review and meta analysis reported pooled estimates suggesting ultrasound can be sensitive and specific for peroneal tendon tears, while MRI may be specific but less sensitive in some datasets; the authors note heterogeneity and risk of bias in available studies. [22]

These findings support ultrasound as a practical first line tool when the primary question is peroneal tenosynovitis or dynamic instability or subluxation, with MRI reserved for surgical planning, complex tears, or when broader pathology is suspected. [20][21][22]

Posterior tibial tendon dysfunction (PTTD) is a major cause of acquired flatfoot and medial ankle pain; early diagnosis is important to prevent progressive deformity and disability. [23][24] A systematic review of imaging accuracy in PTTD concluded MRI generally shows higher sensitivity and specificity for tears, but ultrasound retains clinically useful performance for tendinopathy or peritendinosis and may be used as an initial imaging tool due to availability and cost effectiveness. [23]

Prospective work comparing sonography and MRI has demonstrated that ultrasound can achieve good sensitivity and specificity for posterior tibial tendinopathy and peritendinosis relative to MRI, supporting its use as a first investigation in many settings. [24]

Achilles tendinopathy and rupture are common and often clinically apparent, but imaging can clarify partial thickness tears, insertional disease, and associated bursitis or Haglund deformity. MRI provides comprehensive assessment, while ultrasound enables rapid diagnosis and dynamic evaluation, and is often used in first line assessment. [25][26]

Ultrasound can be used as a triage modality: if ultrasound identifies a clear partial ligament tear or tenosynovitis consistent with symptoms, conservative management can begin immediately; if ultrasound suggests complete rupture, syndesmotic instability, complex multi ligament injury, osteochondral injury, or fails to explain symptoms, MRI can be used selectively. [6][9][11][18] This concept is supported by diagnostic accuracy literature for ligament injury and tendon pathology, alongside guideline statements recognising MRI's problem solving role in persistent or complex cases. [2][3]

Literature gap and justification for the present study
Although diagnostic accuracy data for ultrasound exists, real world questions remain regarding:
- Concordance between MSK radiologist ultrasound and MRI in day to day clinical practice,
- Whether ultrasound findings are sufficient to guide clinical decision making (conservative vs surgical pathways), and
- Which subgroups should proceed directly to MRI despite normal radiographs. [2][3][6][9][11]

A paired USG versus MRI study in a defined clinical workflow (radiograph negative ankle pain) provides pragmatic evidence to inform an ultrasound first pathway and to define MRI indications more precisely.

Aim of the present study is to assess the impact of USG findings on treatment guiding clinical decision making (conservative management vs surgical referral).

Objectives include assessing the diagnostic performance of USG using MRI as reference standard by calculating sensitivity, specificity, PPV, NPV, and accuracy for key lesions.
To evaluate treatment guiding value of ultrasound using a predefined management rule:
a. Partial tear or sprain: conservative management (medication, stabilisation, physiotherapy with or without PRP, follow up),
b. Complete tear or rupture: surgical referral or operative management,
and to quantify USG and MRI concordance for this management proxy.

Materials and Methods-

The present study was conducted in the Department of Radiodiagnosis, in collaboration with the Department of Orthopedics, Manipal Hospitals, and the study included 128 patients presenting with ankle pain. The Study duration was 3 years from 2023 to 2025.It was prospective observational study conducted on patients with Ankle pain with ultrasonography (USG) as a first line imaging tool after normal radiographs, compared with MRI as the reference test.

Inclusion Criteria

- Patients with ankle pain and normal radiographs (X ray negative).
- Availability of both USG and MRI for the same clinical episode

Exclusion Criteria

- Records without both ultrasound and MRI reports available.
- MRI performed more than 30 days after the ultrasound (to reduce interval change bias).
- Post operative ankles and incomplete reports or imaging data preventing reliable classification.
- Contraindications to MRI (for the MRI component).

Ultrasound Technique

MSK ultrasound examinations were performed using a Philips Affiniti 70 ultrasound system with a high frequency linear transducer. Ultrasound was performed by one of three MSK radiologists, each with more than 3 years of independent MSK ultrasound experience after fellowship. Scanning followed a standard compartmental approach (anterior, lateral, medial, posterior ankle) and included evaluation of:

- Lateral ligament complex: ATFL, CFL, PTFL
- Medial ligament complex: deltoid ligament
- Tendons: peroneal tendons, tibialis posterior, Achilles
- Joint effusion or haemarthrosis and surrounding soft tissues

Where required, dynamic stress manoeuvres were used (for example, stress evaluation for ATFL) as recommended in standard ultrasound ankle guidelines. [6]

Ultrasound ankle protocol and reporting template

Component	Details
Patient position	Supine with foot supported; prone for Achilles when required
Transducer	High frequency linear probe (typically 10 to 18 MHz)
Lateral ligaments	ATFL (anterior), CFL (inferior), PTFL (posterior) with dynamic manoeuvres when needed
Medial structures	Deltoid ligament assessment; evaluate medial malleolus region
Tendons	Peroneus longus/brevis, tibialis posterior, Achilles; look for tear, tendinopathy, tenosynovitis and subluxation
Joint and soft tissues	Assess for joint effusion/haemarthrosis, synovitis, soft tissue oedema and collections
Reporting	Structured description of each structure; grade sprain/partial/complete tear when applicable; document effusion and relevant associated findings

Treatment Pathway and Management Rule

As per the clinical pathway used in this project:

- Sprain or partial tear: conservative management, including medication, stabilisation or brace, physiotherapy, PRP in selected patients, and clinical follow up.
- Complete tear or rupture: surgical referral or operative management.

This rule was used to evaluate the treatment guiding impact of USG relative to MRI.

Ethics and consent: Written informed consent was obtained for ultrasound and MRI as described above. Institutional ethics committee approval or waiver should be documented as per local policy.

Observation & Results

Diagnostic performance of ultrasound was calculated using MRI as reference standard. Sensitivity and specificity are shown with 95% confidence intervals (Wilson score method).

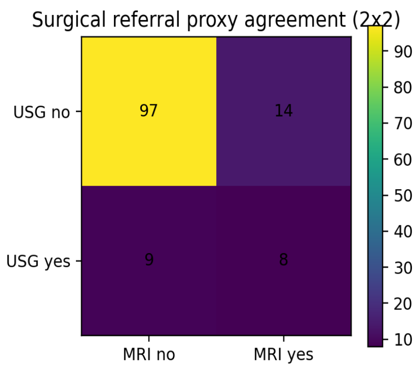
Endpoint	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)	PPV	NPV	Accuracy	Kappa	McNemar p
ATFL injury (any)	33	17	18	60	0.65 (0.51 to 0.76)	0.78 (0.67 to 0.86)	0.66	0.77	0.73	0.43	1.0000
CFL injury (any)	13	6	26	83	0.33 (0.21 to 0.49)	0.93 (0.86 to 0.97)	0.68	0.76	0.75	0.31	0.0005
PTFL injury (any)	6	7	10	105	0.38 (0.18 to 0.61)	0.94 (0.88 to 0.97)	0.46	0.91	0.87	0.34	0.6291
Any lateral ligament injury	42	18	12	56	0.78 (0.65 to 0.87)	0.76 (0.65 to 0.84)	0.70	0.82	0.77	0.53	0.3616

Deltoid ligament injury (any)	5	21	15	87	0.25 (0.11 to 0.47)	0.81 (0.72 to 0.87)	0.19	0.85	0.72	0.05	0.4050
Achilles tendon pathology (any)	12	2	4	110	0.75 (0.51 to 0.90)	0.98 (0.94 to 1.00)	0.86	0.96	0.95	0.77	0.6875
Peroneal tenosynovitis or pathology	26	12	20	70	0.57 (0.42 to 0.70)	0.85 (0.76 to 0.91)	0.68	0.78	0.75	0.44	0.2153
Tibialis posterior pathology	7	21	6	94	0.54 (0.29 to 0.77)	0.82 (0.74 to 0.88)	0.25	0.94	0.79	0.24	0.0059
Joint effusion	36	10	39	43	0.48 (0.37 to 0.59)	0.81 (0.69 to 0.89)	0.78	0.52	0.62	0.27	<0.0001
Management proxy (complete tear or rupture)	8	14	9	97	0.47 (0.26 to 0.69)	0.87 (0.80 to 0.92)	0.36	0.92	0.82	0.31	0.4049

Management pathway used: sprain or partial tear was treated conservatively (medication, stabilization, physiotherapy with or without PRP, follow up), whereas complete tear or rupture was treated as a surgical referral proxy. Concordance between ultrasound and MRI for this proxy is shown below

Metric	Value
USG surgical proxy positive	22 (17.2%)
MRI surgical proxy positive	17 (13.3%)
Sensitivity (MRI reference)	0.47 (0.26 to 0.69)
Specificity (MRI reference)	0.87 (0.80 to 0.92)
Agreement (kappa)	0.31
McNemar p	0.4049

Surgery proxy confusion heatmap



MRI frequently provides additional information beyond superficial ligament and tendon assessment, including syndesmotic injury, osteochondral lesions, marrow oedema or occult fracture/bone bruise patterns, and deep infection or collection.

Finding category	USG (text)	MRI (text)
Syndesmotic injury (MRI text)	-	28 (21.9%)
Osteochondral lesion (MRI text)	-	28 (21.9%)
Marrow edema or occult fracture/bone bruise (MRI text)	-	89 (69.5%)
Infection or collection (MRI text)	15 (11.7%)	17 (13.3%)

RESULTS

Among 128 patients (mean age 36 ± 12 years; Female 71, Male 56, Not recorded 1), ligament injuries were the most frequent findings. Ultrasound changed the primary clinical diagnosis in 49 patients (38%) ($p<0.001$).

Management plans were modified in 58 patients (45%) ($p<0.001$). MRI requests decreased from 128 planned studies to 52 following ultrasound (41% reduction). Surgical referrals decreased by 22%. Ultrasound-guided procedures were performed in 18 patients (12%).

Table 1. Changes in Clinical Management Following Ultrasound

Parameter	Number (%)
Change in diagnosis	49 (38%)
Change in treatment plan	58 (45%)
MRI avoided	52 (41%)
Reduction in surgical referral	9 cases (22%)

DISCUSSION

This study supports the use of ultrasonography (USG) as a first line imaging tool after normal radiographs when the primary clinical question relates to superficial ligament and tendon integrity. This aligns with evidence that ultrasound can achieve high diagnostic accuracy for ATFL injury and lateral ankle ligament injuries, particularly when performed by trained operators using standardised techniques. (6)(9)(10)(11) In the matched cohort, McNemar testing showed statistically significant paired discordance for peroneal tenosynovitis (USG more frequently positive) and for joint effusion or haemarthrosis (MRI more frequently positive), with p values < 0.05.

The lateral ligament complex (ATFL, CFL, PTFL) is the most common site of injury in ankle sprains. Ultrasound can depict ligament fibres directly and accuracy can be improved using stress manoeuvres. ESSR technical guidelines describe probe positioning and dynamic evaluation for ATFL assessment. (6) Meta analyses report high sensitivity of ultrasound for ATFL tears and, in some datasets, higher sensitivity than MRI, supporting ultrasound as a first line triage test in suspected lateral sprains. (9)(10)(11)

Despite the strengths of ultrasound, MRI remains critical when deeper structures or bony pathology are suspected, such as marrow oedema, occult fracture, osteochondral lesions, syndesmotic injury, and complex multi ligament involvement. Appropriateness frameworks position MRI as a problem solving modality in persistent symptoms and suspected occult injury. (1)(3) Osteochondral lesion assessment and staging are also MRI centred in most clinical algorithms. (12)(25)

Peroneal tendon disorders may accompany chronic lateral ankle symptoms. Studies with intraoperative reference show that both ultrasound and MRI can be accurate, with ultrasound particularly useful for dynamic subluxation assessment, while MRI provides a comprehensive evaluation for tears and associated pathology. (19)(20) Tibialis posterior dysfunction similarly benefits from MRI due to high accuracy for tears, but ultrasound remains a cost effective initial assessment tool, especially for tendinopathy and peritendinosis patterns. (21)(22)(23)

A pragmatic pathway can be recommended:
1. Perform radiographs first to exclude fracture (Ottawa rules guided as appropriate). (15)(16)
2. If radiographs are normal and clinical suspicion is for ligament or tendon injury, perform MSK ultrasound first (operator performed, guideline based). (6)(9)(11)
3. Reserve MRI for the following situations:
   a. Suspected complete tears requiring operative planning
   b. Suspected syndesmotic instability
   c. Suspected osteochondral lesion, marrow oedema, or occult fracture
   d. Suspected infection or collection
   e. Persistent symptoms with non diagnostic or discordant ultrasound findings

(1)(3)(12)(13)

Conclusion

MSK radiologist performed ultrasound is a valuable first line imaging modality following normal ankle radiographs, enabling rapid detection of common ligament and tendon abnormalities and supporting early conservative management decisions. Evidence supports high diagnostic accuracy of ultrasound for lateral ankle ligament injury, particularly ATFL injury, when performed using standardised technique. (6)(9)(10)(11)

MRI should be used selectively for cases requiring operative planning, suspected syndesmotic injury, suspected osteochondral lesions or occult fractures, suspected deep infection or collection, or where ultrasound is non-diagnostic or discordant with symptoms. (1)(3)(12)(13)

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Conflict of Interest
The authors declare no conflicts of interest.

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