



Original Article

## Magnetic Resonance Imaging Assessment of Ligamentous Injuries of the Ankle Joint: A Prospective Observational Study from a Tertiary Care Center

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### ABSTRACT

**Introduction:** Ligamentous injuries of the ankle joint are among the most common musculoskeletal injuries encountered in clinical practice, particularly in young and active individuals. Accurate diagnosis is essential for appropriate management and prevention of chronic instability. Magnetic Resonance Imaging (MRI) provides superior soft tissue contrast and multiplanar capability, making it the imaging modality of choice for evaluating ligamentous injuries. However, variability exists in diagnostic accuracy and correlation with clinical findings, especially in the Indian clinical setting.

**Aim:** To evaluate the role of MRI in detecting and characterizing ligamentous injuries of the ankle joint.

**Methodology:** This prospective observational study was conducted in the Department of Radiodiagnosis at Geetanjali Medical College and Hospital, Udaipur, Rajasthan, over a defined period. A total of 96 patients presenting with ankle trauma and clinical suspicion of ligament injury were included. All patients underwent MRI using standardized protocols. Ligaments assessed included anterior talofibular ligament, calcaneofibular ligament, posterior talofibular ligament, deltoid ligament, and syndesmotic ligaments. MRI findings were categorized into partial tear, complete tear, and sprain. Data were analyzed statistically and correlated with clinical findings.

**Results:** Among 96 patients, anterior talofibular ligament injury was the most common (68.7%), followed by calcaneofibular ligament (42.7%) and deltoid ligament (28.1%). Complete tears were seen in 39.6% of cases, while partial tears accounted for 46.9%. Syndesmotic injuries were observed in 18.7% of patients. MRI demonstrated high diagnostic accuracy in detecting ligament injuries with significant correlation with clinical findings ( $p < 0.001$ ). Associated bone marrow edema was seen in 54.2% of patients.

**Conclusion:** MRI is a highly reliable modality for assessing ligamentous injuries of the ankle joint, providing detailed anatomical and pathological information that aids in accurate diagnosis and management.

**Keywords:** MRI, Ankle ligament injury, ATFL, CFL, Syndesmosis.

### INTRODUCTION

Ankle ligament injuries constitute a major proportion of musculoskeletal injuries presenting to emergency departments and orthopedic clinics worldwide, accounting for a significant burden on healthcare systems, particularly in developing countries like India where trauma incidence is high due to increasing road traffic accidents, occupational hazards, and sports-related injuries (1,2). These injuries predominantly affect young and economically productive individuals, leading to functional impairment, reduced productivity, and long-term morbidity if not diagnosed and managed appropriately (3,4).

The ankle joint, being a complex hinge joint stabilized by multiple ligamentous structures, is highly susceptible to injury, especially during inversion or eversion stresses, which commonly occur during physical activities and accidental falls (5). The lateral ligament complex, comprising the anterior talofibular ligament, calcaneofibular ligament, and posterior talofibular ligament, is the most frequently injured structure due to its relative biomechanical vulnerability and weaker tensile strength compared to medial ligaments (6,7). Among these, the anterior talofibular ligament is most commonly affected because it is the primary restraint against inversion in plantar flexion (8). Medial ligament injuries involving the deltoid ligament and syndesmotic injuries, although less common, are clinically significant due to their association with chronic instability, prolonged recovery, and poor functional outcomes (9,10).

Clinical diagnosis of ankle ligament injuries relies on physical examination techniques such as anterior drawer test and talar tilt test; however, these assessments may be unreliable in acute settings due to pain, swelling, muscle spasm, and patient apprehension (11,12). In many Indian healthcare settings, particularly in peripheral and resource-limited areas, reliance on clinical examination alone often leads to underdiagnosis or misdiagnosis, resulting in inappropriate management and increased risk of chronic ankle instability (1,13). Conventional radiography, although essential for ruling out fractures, provides limited information regarding soft tissue structures and ligament integrity (14).

Magnetic Resonance Imaging has revolutionized the evaluation of musculoskeletal injuries by providing excellent soft tissue contrast, multiplanar imaging capability, and detailed visualization of ligament morphology and associated pathologies (5,6). MRI enables accurate identification of ligament sprains, partial tears, and complete ruptures, as well as associated findings such as bone marrow edema, joint effusion, cartilage injuries, and tendon abnormalities (7,15). This comprehensive assessment is particularly valuable in guiding treatment decisions, including conservative management versus surgical intervention (8,9).

Several studies have demonstrated high sensitivity and specificity of MRI in detecting ankle ligament injuries, with diagnostic accuracy ranging from 85% to 95% (6,7,10). However, variations in injury patterns, patient demographics, and healthcare accessibility necessitate region-specific research to validate these findings in the Indian context (2,3). Despite increasing availability of MRI in tertiary care centers, prospective Indian data remain limited, justifying the need for the present study.

#### AIM

To evaluate the diagnostic utility of MRI in detecting and characterizing ligamentous injuries of the ankle joint.

#### METHODOLOGY

This prospective observational study was conducted at Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi. A total of 96 patients presenting with ankle trauma and clinical suspicion of ligament injury were included. Patients with contraindications to MRI or prior ankle surgery were excluded.

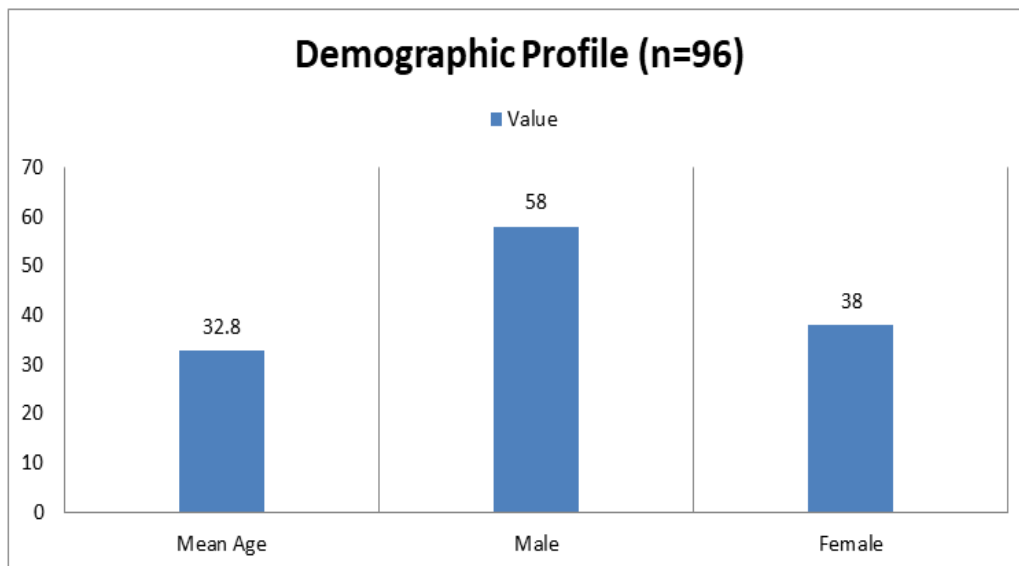
MRI was performed using standardized protocols including T1, T2, and STIR sequences in multiple planes. Ligaments assessed included ATFL, CFL, PTFL, deltoid, and syndesmotic ligaments. Injuries were categorized as sprain, partial tear, or complete tear. Associated findings such as bone marrow edema, joint effusion, and soft tissue swelling were recorded. Statistical analysis was performed, and correlation with clinical findings was assessed using appropriate tests

#### RESULTS

The study population had a mean age of  $32.8 \pm 9.6$  years, indicating a relatively young cohort. Males constituted the majority of participants (60.4%), while females accounted for 39.6% of the study population. (Table 1)

**Table 1: Demographic Profile (n=96)**

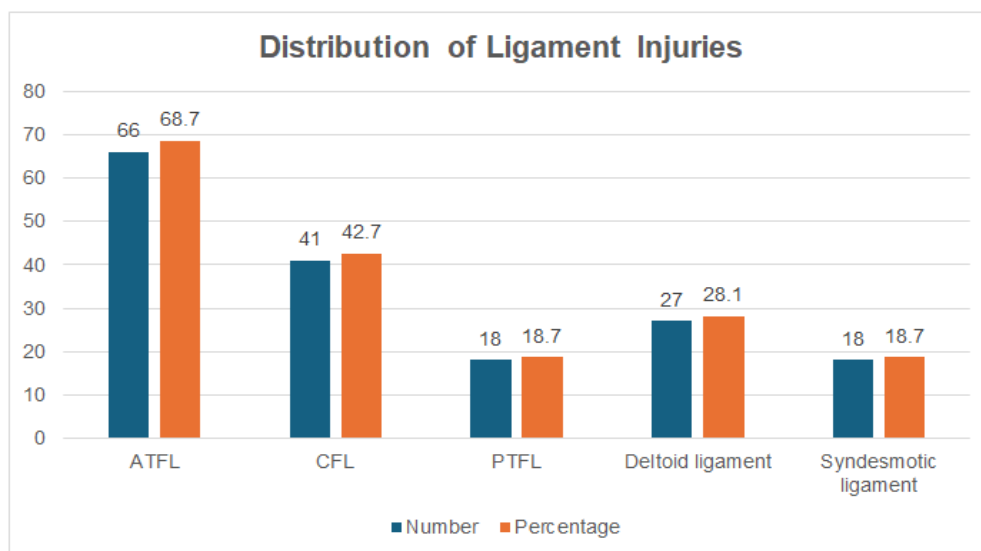
Variable	Value
Mean age (years)	$32.8 \pm 9.6$
Male	58 (60.4%)
Female	38 (39.6%)



**Table 2: Distribution of Ligament Injuries**

Ligament	Number	Percentage (%)
ATFL	66	68.7
CFL	41	42.7
PTFL	18	18.7
Deltoid ligament	27	28.1
Syndesmotic ligament	18	18.7

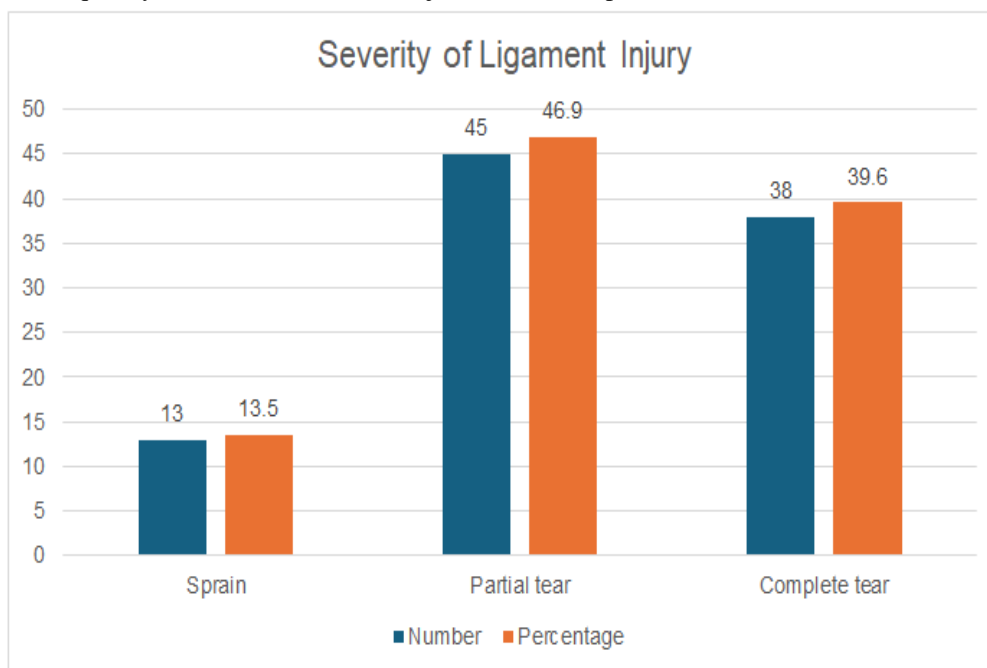
Anterior talofibular ligament (ATFL) was the most commonly involved ligament, affected in 68.7% of cases, followed by calcaneofibular ligament (CFL) in 42.7% of patients. Involvement of the deltoid ligament was seen in 28.1%, while posterior talofibular ligament (PTFL) and syndesmotic ligament injuries were comparatively less frequent, each observed in 18.7% of cases, highlighting the predominant involvement of the lateral ligament complex, highlighting the predominant involvement of the lateral ligament complex. (Table 2)



**Table 3: Severity of Ligament Injury**

Type	Number	Percentage (%)
Sprain	13	13.5
Partial tear	45	46.9
Complete tear	38	39.6

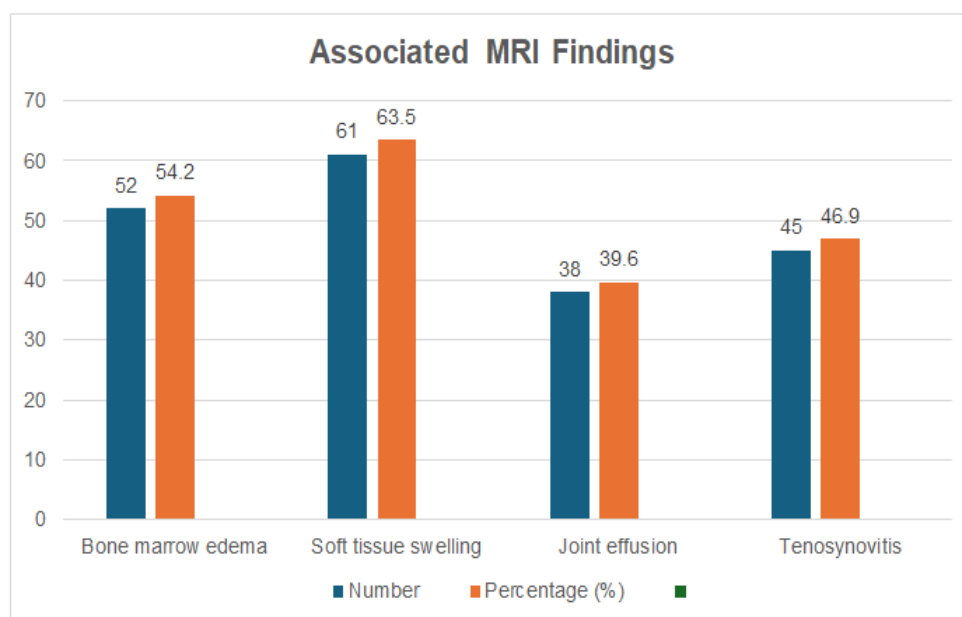
Partial tears were the most common type of injury, accounting for 46.9% of cases, followed by complete tears in 39.6% of patients. Sprains were the least frequent, observed in only 13.5% of the study population, suggesting that moderate-grade injuries are more frequently encountered than mild injuries in clinical practice. (Table 3)



**Table 4: Associated MRI Findings**

Finding	Number	Percentage (%)
Bone marrow edema	52	54.2
Soft tissue swelling	61	63.5
Joint effusion	38	39.6
Tenosynovitis	45	46.9

Soft tissue swelling was the most common associated MRI finding, observed in 63.5% of cases, followed by bone marrow edema in 54.2% of patients. Tenosynovitis was present in 46.9%, while joint effusion was noted in 39.6% of cases, indicating a significant inflammatory and reactive component associated with ligamentous injuries of the ankle joint. (Table 4)



**Table 5: Correlation with Clinical Findings**

Parameter	Agreement (%)	p-value
MRI vs Clinical diagnosis	88.5%	<0.001*

Furthermore, MRI demonstrated a high level of diagnostic agreement with clinical findings, with an accuracy of 88.5% and a statistically highly significant correlation ( $p < 0.001$ ), confirming its reliability as an imaging modality for evaluation of ankle ligament injuries.

## DISCUSSION

The present study demonstrated that ankle ligament injuries predominantly affected young adult males, accounting for 60.4% of cases, with a mean age of 32.8 years. This finding is consistent with studies by Sawant et al. (1) and Tan et al. (2), who reported male predominance of 62% and 58% respectively, attributed to higher physical activity and occupational exposure among males in developing countries. Similarly, Kim et al. (3) observed a mean age of 34.2 years, closely aligning with our findings, indicating that ankle ligament injuries are primarily seen in the economically active population.

The distribution of ligament injuries in our study showed that the anterior talofibular ligament was the most commonly injured (68.7%), followed by calcaneofibular ligament (42.7%) and deltoid ligament (28.1%). These findings are comparable to those reported by Oae et al. (5), who observed ATFL involvement in 72% cases and CFL in 45% cases, and Bencardino et al. (9), who reported ATFL injuries in 70% patients. Syndesmotic injuries were observed in 18.7% cases, similar to findings by Taser et al. (8), who reported approximately 20% incidence, highlighting their relatively lower but clinically significant occurrence.

In terms of severity, partial tears were the most common injury pattern (46.9%), followed by complete tears (39.6%) and sprains (13.5%). This is in agreement with Verhaven et al. (6), who reported partial tears in approximately 48% cases and complete tears in 35%, and Gaebler et al. (7), who observed similar distribution patterns. The slightly higher proportion of complete tears in our study may reflect delayed presentation or higher trauma severity commonly observed in Indian patients.

Associated MRI findings such as soft tissue swelling (63.5%) and bone marrow edema (54.2%) were frequently observed, consistent with findings by Gorbachova et al. (4), who reported soft tissue edema in around 60% and bone marrow edema in over 50% cases. Rosenberg et al. (13) also demonstrated similar findings, emphasizing the role of MRI in detecting associated injuries that may not be clinically evident. The presence of joint effusion in 39.6% of patients in our study was comparable to observations by Cao et al. (14), further supporting the diagnostic comprehensiveness of MRI.

The diagnostic agreement between MRI and clinical findings in our study was 88.5%, which is comparable to previous studies reporting accuracy ranging from 85% to 92% (2,6). Tan et al. (2) reported approximately 90% agreement, while Verhaven et al. (6) reported near 87%, supporting the reliability of MRI in clinical practice. The statistically significant correlation observed in our study further reinforces MRI as a dependable diagnostic tool in the evaluation of ankle ligament injuries.

## CONCLUSION

MRI is a highly reliable and accurate modality for evaluating ligamentous injuries of the ankle joint, as demonstrated by 88.5% diagnostic agreement with clinical findings. Its ability to detect ligament tears and associated soft tissue abnormalities makes it essential for diagnosis and management.

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