Magnetic Resonance Imaging for Syndesmosis Injury: A Systematic Review of Diagnostic Criteria and Severity Assessment

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INTRODUCTION: High ankle sprains involving syndesmotic injury present a challenge for both diagnosis and severity assessment. Magnetic Resonance Imaging (MRI) is generally considered the gold-standard imaging modality in diagnosing and assessing syndesmosis injury, but a standardized set of diagnostic criteria remain undefined. The purpose of this study was to systematically review the literature surrounding the utilization of MRI in diagnosis and severity evaluation of syndesmotic injuries as well as any associated parameters that are most predictive of injury and severity grading.

METHODS: A comprehensive search of MEDLINE, Embase, CINAHL Complete, and Scopus was conducted up to February 12, 2025, following PRSIMA guidelines. Inclusion criteria comprised of peer-reviewed human and radiographic publications in English on MRI in the context of syndesmosis injuries. Excluded were review studies, case reports, abstract-only, biomechanical and cadaver studies.

RESULTS: There were 27 studies consisting of 1862 ankles included. There is high diagnostic accuracy on MRI for complete tears of the anterior inferior tibiofibular ligament (AITFL), interosseus ligament (IL), and posterior inferior tibiofibular ligament (PITFL). Ancillary signs such as the ring-of-fire edema sign, distal tibiofibular joint effusion, and distal joint space widening are less studied, but each have high specificities and variable sensitivities. MRI identification of chronic syndesmotic injuries is largely limited to detection of syndesmotic scarring, which has high specificity and variable sensitivity. There remains a gap of which of these parameters may be used to determine severity and indicate for earlier surgery in elite athletes.

DISCUSSION AND CONCLUSION: Condensing multiple MRI findings into a set of diagnostic criteria for syndesmotic injury improves diagnostic accuracy. Prompt diagnosis leads to better functional outcomes in both athletes and non-athletes that suffer an injury to the syndesmosis, including lower rates of osteoarthritis and chronic ankle instability. Based on the current review, we propose that disruption of the AITFL, accuracy 91%, and PITFL, accuracy 95%, be used for *diagnosis* as it has the most available research for usage for diagnosis. To measure *severity* of injury- we propose using 3 criteria. 1) The proximal migration of distal tibial joint edema of >8mm, 2) Ring of fire, circumferential assessment, 3) and distal tibiofibular joint space measurements of >2mm at 2cm above the tibial plafond and >3.45mm at 1cm above the tibial plafond. Future research should focus on establishing correlations with severity and clinical outcomes, particularly in elite athletes.

Sign on MRI	Sensitivity	Specificity	Other	Current studies reporting sensitivity & specificity
8-mm distal tibial joint effusion (DTJE)	73% [41]	83% [41]		1
"Ring-of-fire" sign (circumferential periosteal edema above ankle)	49% [5]	87% [5]	PPV: 88% [5] NPV: 98% [5]	1
AITFL partial tear	20% [33]	64% [33]	PPV: 4% [33] NPV: 92% [33]	1
AITFL total tear	36-100% [8,9,11,31,42,43]	80-100% [8,9,31,31,42,43]	PPV: 96-100% [9,33] NPV: 8-71% [9,33] Accuracy: 91% [9]	6
PITFL partial tear	23% [33]	33% [33]	PPV: 46% [33] NPV: 15% [33]	1
PITFL total tear	74-100% [31,31,42,43]	78-100% [8,31,31,42,43]	PPV: 54% [33] NPV: 90-100% [9,33] Accuracy: 95% [9]	4
IL partial tear	24% [33]	35% [33]	PPV: 50% [33] NPV: 15% [33]	1
IL total tear	65-67% [9,33]	76-87% [9,33]	PPV: 50-67% [9,33] NPV: 85-87% [9,33] Accuracy: 81% [9]	2
Syndesmotic scarring (low signal on T1-weighted & low to intermediate signal on T2-weighted)	21-89% [4,36]	100% [4,36]		2
Distal tibiofibular joint space >2mm on MRI (normal = 1mm)	90% [18]	94.8% [18]	93.4% [18]	1
Distance between the most anterior point of the incisura and the nearest most anterior point of the fibula Mean normal = 3.47mm Mean injured = 4.49mm	n/a	n/a	p-value: .000 [39]	0
RATIO: Distance between the most anterior point of the incisura and the nearest most anterior point of the fibula : Distance between the most posterior point of the incisura and the nearest most posterior point of the fibula Mean normal = 0.51 Mean injured = 0.64	n/a	n/a	p-value: .002 [39]	0
Distance between the tibia and the fibula in the middle of the incisura Mean normal = 2.56mm Mean injured = 3.45mm	n/a	n/a	p-value: .000 [39]	0

Table 2: Sensitivities and specificities of select MRI signs in syndesmosis injuries. All measurements found in >1 study are represented with a range of values that encompasses the findings of all of those studies. A value of 0 in "current studies reporting sensitivity and specificity" column indicates sensitivity and specificity were not directly reported – authors used alternate statistical methods to demonstrate differences.