Ultrasound Demonstrates High Sensitivity for Detecting Ankle Syndesmosis Injuries

Ria Tilve[1], Dana Hazem[2], Daniel J.M. Rohde[3], Zodina A. Beiene[3], Jamieson M. O'Marr[3], Mark Xu[3], Meir T. Marmor[3]

[1]Case Western Reserve University School of Medicine, Cleveland, OH, [2]Geisel School of Medicine at Dartmouth, Hanover, NH, [3]University of California San Francisco, San Francisco, CA

Email of Presenting Author: ria.tilve@gmail.com

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INTRODUCTION: Ankle fractures are among the most common orthopedic injuries in the US, with about 600,000 cases annually. Nearly half are Weber B fractures, requiring syndesmotic stability evaluation. While radiography remains the gold standard, it has limitations, including radiation exposure and accessibility. Furthermore, intraoperative assessment of syndesmotic reduction remains challenging, with reported malreduction rates up to 50% despite fluoroscopic guidance. Ultrasound offers a portable, radiation-free alternative capable of visualizing soft tissue and ligament integrity in real time. This study evaluates the feasibility of using ultrasound to detect syndesmosis injury.

METHODS: Two cadaveric models were used to simulate syndesmotic injuries. For each specimen, two baseline radiographs (AP and Mortise) and three transverse ultrasound images (1 cm above palpated anterior joint line) of the intact ankle syndesmosis were obtained. Similar images were taken of each ankle after simulating a Weber B fracture with six types of fibular injuries: 0 mm displacement, 5 mm anterior translation, 5 mm posterior translation, 2 mm distraction, 15º internal rotation, or 15º external rotation. Each injury state was created using a standardized fixation frame to ensure reproducible displacements and rotations. Measurements of tibiofibular clear distance (TFD) were assessed on radiographs and ultrasound images using ImageJ by four scorers across all injury types. Inter-rater agreement and sensitivity for each imaging modality were calculated with 95% confidence intervals.

RESULTS: Inter-rater agreement was excellent for ultrasound TFD (ICC = 0.93 [95% CI: 0.89-0.96]) and radiograph TFD (ICC = 0.856 [95% CI: 0.70-0.93]). Among all six injury states for both specimens, mean TFD values were consistently greater than 6 mm on ultrasound compared with mortise radiographs. Ultrasound demonstrated higher sensitivity than measuring TFD on radiographs for detecting non-displaced injuries (0.89 [95% CI: 0.71-0.98] vs. 0.78 [95% CI: 0.40-0.97]), anterior translation injuries (0.96 [95% CI: 0.81-0.99] vs. 0.78 [95% CI: 0.40-0.97]) and external rotation injuries (0.82 [95% CI: 0.62-0.94] vs. 0.67 [95% CI: 0.30-0.93]).

DISCUSSION: Ultrasound TFD measurements demonstrated high sensitivity for detecting syndesmotic malreductions, suggesting that ultrasound could serve as a valuable adjunct for intraoperative assessment of syndesmotic alignment. Consistent detection of tibiofibular distances greater than 6 mm across multiple users and injury states supports ultrasound as a promising, high-fidelity method for identifying injuries to the ankle syndesmosis. Future work will validate these findings in larger cadaveric cohorts and translate them into clinical studies to evaluate feasibility, workflow integration, and patient outcomes.

SIGNIFICANCE/CLINICAL RELEVANCE: Successful implementation of ultrasound for assessing syndesmotic injury has the potential to improve surgical accuracy and reduce long-term morbidity from malreduction, especially in resource-limited settings.

TABLE 1: Sensitivity (95% CI) for Ultrasound and Radiograph across Injury States

	Ultrasound Sensitivity (95% CI)	**Radiograph Sensitivity (95% CI)**
0 mm Displacement	0.89 (0.71-0.98)	0.78 (0.40-0.97)
5 mm Anterior Translation	0.96 (0.81-0.99)	0.78 (0.40-0.97)
5 mm Posterior Translation	0.67 (0.46-0.84)	0.67 (0.30-0.93)
2 mm Distraction	0.82 (0.62-0.94)	0.89 (0.52-0.99)
15º Internal Rotation	0.52 (0.32-0.71)	0.67 (0.30-0.93)
15º External Rotation	0.82 (0.62-0.94)	0.67 (0.30-0.93)