Use of 3D Weight-Bearing CT Syndesmotic Assessment in Surgical Decision Making

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INTRODUCTION:

A variety of imaging modalities have been employed to assess syndesmotic instability. Plain radiographs are commonly used to assess syndesmotic instability due to their accessibility. In contrast, weight-bearing computed tomography (WBCT) has emerged as a valuable diagnostic tool, allowing for 3D assessment across multiple planes, incorporating physiologic loading conditions, and allowing direct comparison with the contralateral ankle, enhancing its ability to detect subtle instabilities. By capturing the ankle under physiological loads, 3D WBCT allows for more representative assessment of subsequent syndesmotic alignment and rotational or translational abnormalities not readily apparent in non-weight bearing conditions.

Although 3D WBCT offers diagnostic advantages, there is limited literature comparing its diagnostic performance with other imaging modalities in the context of ankle syndesmosis injuries. This study uses the surgeon's treatment decision as the reference standard to assess the diagnostic accuracy of various imaging techniques. By doing so, it aims to determine whether 3D WBCT provides superior diagnostic information that aligns more closely with the final clinical management. Understanding this potential diagnostic value of 3D WBCT may provide valuable insights into its clinical utility for guiding treatment decision-making.

METHODS: This prospective study included 32 consecutive patients with suspected syndesmotic instability following ankle trauma. All patients had prior plain radiographs as part of their initial workup. Furthermore, they underwent bilateral WBCT scans at the request of a foot and ankle surgeon as part of standard clinical care, prompted by diagnostic uncertainty. Syndesmotic assessments were independently conducted by expert musculoskeletal radiologists, and their interpretations served as the diagnostic reference for both the 2D WBCT and plain radiograph findings. In addition, a novel 3D volumetric syndesmotic measurement, previously described by Ashkani Esfahani et al., was performed using the semi-automated Ankle Insight 3D platform, allowing for bilateral comparison. Patients were prospectively followed to determine whether they ultimately underwent surgical intervention. Final clinical decisions were then compared against the imaging interpretations and the 3D WBCT analysis.

Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for each imaging modality in predicting surgical intervention to compare the diagnostic performance of 3D WBCT with conventional imaging interpretations in guiding operative decision-making for syndesmotic injuries.

RESULTS:

Demographics for the patients included in this study are summarized in Table 1**.** The performance for each imaging modality (3D WBCT, 2D WBCT, and plain radiographs) was compared in predicting operative decision-making. When comparing the diagnostic performance, 3D WBCT had the highest precision, NPV, and sensitivity compared to 2D WBCT and plain radiographs. Table 2 and Figure 1 summarize modality performance. Specifically, 3D WBCT showed a sensitivity of 56% and a specificity of 87%, with a positive predictive value (PPV) of 63% and a negative predictive value (NPV) of 83%. In contrast, 2D WBCT demonstrated lower sensitivity at 25% but slightly higher specificity at 92%. The PPV and NPV for 2D WBCT were 50% and 79%, respectively. Plain radiographs exhibited the highest specificity at 96% but had a sensitivity of 0%, indicating they failed to identify any patients who ultimately required surgery. The PPV for plain radiographs was 0%, and the NPV was 71%, highlighting limited utility in guiding treatment decisions.

DISCUSSION AND CONCLUSION:

In conclusion, this prospective study demonstrates that 3D weight-bearing CT outperforms 2D WBCT and plain radiographs in predicting surgical intervention for ankle syndesmosis injuries, offering a favorable balance of diagnostic accuracy, sensitivity, and clinical utility. Given these findings, 3D WBCT may serve as a valuable tool in optimizing preoperative assessment and surgical planning, particularly in cases where syndesmotic instability is equivocal. While this analysis relied on the interpretation documented in the imaging reports, future studies may incorporate expert surgeon review of 2D WBCT or radiographs to provide additional context to decision-making. Follow up studies may include larger patient cohorts, expand to other anatomic regions such as Lisfranc injuries—where 3D WBCT is increasingly applied—and be conducted across multiple centers to improve generalizability and validate findings across diverse clinical environments.

Figure 1. Diagnostic Performance of Imaging Modalities in Predicting Surgical Repair of Ankle Syndesmosis

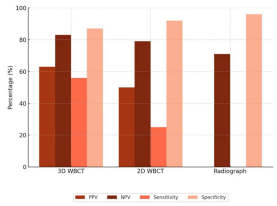

Table 1. Demographic characteristics of study patients

	Demographic characteristics	n=32
	Mean Age (± SD)	37.5 ± 14.3 years
Sex	Male (%)	59.4% (19/32)
	Female (%)	40.6% (13/32)
Race	White (%)	43.8% (14/32)
	Non-White (%)	56.2% (18/32)
	Surgery (%)	37.5% (12/32)
	No Surgery (%)	62.5% (20/32)

Table 2. Comparative Performance of 3D WBCT, 2D WBCT, and Radiographs in Predicting Surgical Intervention for Ankle Syndesmosis Injuries

	PPV	NPV	Sensitivity	Specificity
3D WBCT	63%	83%	56%	87%
2D WBCT	50%	79%	25%	92%
Radiograph	0%	71%	0	96%