

# Diagnostic Accuracy of Weightbearing CT in Detecting Subtle Chronic Subtle Syndesmotic Instability: A Prospective Comparative Study

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**INTRODUCTION:** Improving the diagnosis of subtle syndesmotic instability (SSI) represents one of the most challenging missions in orthopedic surgery, since undiagnosed instability frequently leads to posttraumatic ankle arthritis. Stressed conventional radiographs, ultrasonography, bilateral comparative conventional CT and MRI serve as important diagnostic tools, however, the current diagnostic gold-standard is arthroscopic assessment, an invasive surgical method. The advent of weight-bearing computed tomography (WBCT) brought hope for improved non-invasive SSI diagnosis, particularly by utilizing distal tibiofibular syndesmotic (DTFS) area and volume measurements. However, to date, no studies assessed WBCT diagnostic accuracy for chronic SSI. The purpose of this study was to prospectively evaluate the diagnostic accuracy of WBCT area and volumetric measurements in patients with suspected chronic SSI, when compared to the gold standard arthroscopic assessment.

## **METHODS:**

In this IRB-approved prospective comparative study, 11 patients with suspected SSI were enrolled from July 2019 to December 2020. Patients were assessed preoperatively by bilateral standing WBCT. Raw 3D WBCT was automatically segmented by dedicated software. WBCT measurements performed: semi-automatic DTFS area (1cm proximally to tibial dome apex); DTFS volumes (1, 3 and 5cm proximally to tibial dome apex). Threshold values for WBCT abnormality were defined based on currently available data (area>105mm<sup>2</sup> and volumes>796mm<sup>3</sup>, >3062 mm<sup>3</sup>, and >6733 mm<sup>3</sup> for 1, 3 and 5cm, respectively). Subjects underwent surgical treatment including DTFS instability arthroscopic assessment, defined as positive when a 3mm diameter sphere could enter the syndesmotic incisura. Confirmed unstable cases were treated with open reduction/internal fixation. WBCT measurements sensitivity, specificity, positive and negative predictive values (PPV/NPV) and accuracy were calculated using confirmed arthroscopic instability as diagnostic gold standard. Paired t-tests/Wilcoxon analysis was used to compare measurements. P-values<0.05 were considered significant.

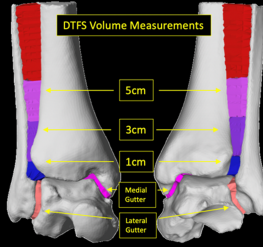
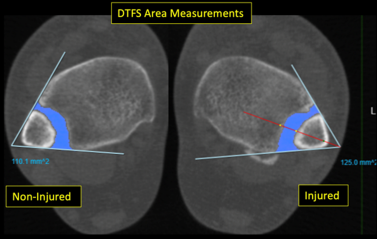
## **RESULTS:**

When compared to non-injured sides, DTFS area and volumes were significantly higher in injured ankles at 1cm (667 vs 554mm<sup>3</sup>) and 3cm (2331 vs 2038mm<sup>3</sup>). Medial gutter volumes were also increased in injured sides (398 vs 370 mm<sup>3</sup>). DTFS volumes at 5cm and lateral gutter volumes were not different. Nine of eleven patients had confirmed arthroscopic DTFS instability. Considering WBCT area measurements, 4/11 patients were found to be positive (>105mm<sup>2</sup>), including 3 true positives (+WBCT/+Arthroscopy), 1 false positive (+WBCT/-Arthroscopy), 6 false negatives (- WBCT/+Arthroscopy), and 1 true negative (-WBCT/-Arthroscopy), leading to a 33.3% sensitivity, 50%, specificity, 75% PPV 75%, 14.3% NPV and 36% accuracy. When analysing WBCT DTFS volumes (1cm), 3/11 patients were found positive (>796mm<sup>3</sup>), depicting 3 true positives, 0 false positives, 2 true negatives and 6 false negatives, with resultant diagnostic accuracy of: 33.3% sensitivity, 100% specificity, 100% PPV, 25% NPV 25%, and 45% accuracy.

## **DISCUSSION AND CONCLUSION:**

This is the first study to prospectively assess WBCT diagnostic accuracy of area and volume measurements in detecting chronic SSI, comparing it to arthroscopic diagnostic standard. When compared to uninjured side, DTFS area and volumetric measurements were significantly increased in injured sides of patients with suspected SSI, including medial gutter volumes, consistent with associated deltoid ligament instability. However, interestingly, we observed a diagnostic accuracy for WBCT area and volumetric measurements to be lower than initially expected. Further incorporation of additional patients, as well as introduction of an external rotational stress can potentially optimize the WBCT diagnostic accuracy for chronic SSI.

**DIAGNOSTIC ACCURACY OF WEIGHTBEARING CT IN DETECTING SUBTLE CHRONIC SYNDESMOTIC INSTABILITY: A PROSPECTIVE COMPARATIVE STUDY**



**Diagnostic Accuracy WBCT Syndesmotic Area Measurements**

Statistic	Value	95% CI
Sensitivity	33.33%	7.40% to 70.07%
Specificity	50.00%	1.26% to 98.74%
Positive Likelihood Ratio	0.67	0.13 to 3.53
Negative Likelihood Ratio	1.33	0.31 to 5.75
Disease prevalence (*)	81.82%	48.22% to 97.72%
Positive Predictive Value (*)	75.00%	36.19% to 94.07%
Negative Predictive Value (*)	14.29%	3.72% to 41.80%
Accuracy (*)	36.36%	10.93% to 69.21%

**Diagnostic Accuracy WBCT Syndesmotic Volume Measurements**

Statistic	Value	95% CI
Sensitivity	33.33%	7.40% to 70.07%
Specificity	100.00%	15.81% to 100.00%
Positive Likelihood Ratio	0.67	0.42 to 1.06
Negative Likelihood Ratio	0.67	0.42 to 1.06
Disease prevalence (*)	81.82%	48.22% to 97.72%
Positive Predictive Value (*)	100.00%	
Negative Predictive Value (*)	25.00%	17.36% to 34.60%
Accuracy (*)	45.45%	16.75% to 76.62%

