3D CT Analysis of Distal Tibiofibular Syndesmosis Symmetry

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Introduction/Purpose: As medical imaging of the syndesmosis prior to ankle injury is usually not available, researchers have diagnosed and surgically reduced syndesmotic disruptions based on presumed symmetry with the healthy contralateral limb. The purposes of this study are to quantify the degree of symmetry present in the DTFS using 3D CT modeling, and to compare the accuracy of common clinical two-dimensional (2D) measurements to 3D CT measurements for assessing syndesmotic symmetry and measuring diastasis.

Methods: Bilateral lower limb CT (n=65) were assessed, were segmented, and reconstructed into 3D surface models, and an anatomically-defined coordinate system was applied to orient the 3D models uniformly. Symmetry was assessed three-dimensionally to overlap the left and right. The relative differences between the two fibulae were quantified in six degrees of freedom. For comparative purposes, four 2D measures were also measured. These measures included anteroposterior (AP), mediolateral (ML), and rotational displacement of the fibula relative to the tibia, measured using axial CT, and longitudinal displacement, measured using coronal radiographs. The four measures were automatically calculated using custom software to reduce the influence of inter- and intra-rater variability. The absolute difference was calculated for each 3D and 2D measure. The differences measured represent the amount of translation or rotation needed to match the position of the left fibula to the position of the right fibula after reflection and optimal tibial alignment.

Results: The mean difference in AP displacement was approximately double the mean difference in ML displacement for the 2D measurements (1.65 mm vs 0.71 mm), while AP and ML displacement differences for the 3D measurements were comparable (0.57 mm and 0.44 mm). As a general trend, the 2D measurements exhibited larger values of absolute differences than the 3D measurements. The average difference in fibular rotation detected was larger for the 2D measurements (6.1°) than the 3D measurements (0.59°). . The 2D AP displacement differences varied between 1.41-1.95 mm (95% CI), which is beyond the suggested 1 mm tolerance level. The 3D analog of this measurement varied between 0.47-0.70 mm (95% CI), which is within the suggested threshold.

Conclusion: Some clinical reports suggest that 1 mm misalignment can cause pain and require surgical revision, but detecting asymmetry below 1 mm is limited by the quality of clinical 2D imaging. Our findings suggest that the current standard practice of using 2D measures to assess the DTFS may exaggerate the amount of asymmetry present, which may lead to misdiagnoses and subsequent surgical revisions. Natural symmetry exists in uninjured syndesmoses. More accurate comparisons of syndesmotic alignment may be needed to determine the accuracy of DTFS diastasis.

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