Using Portable Ultrasound to Measure the Effect of Lateral Ankle Ligament Injury on Syndesmotic Stability: A Cadaveric Study

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Introduction/Purpose: About one-fifth of all patients diagnosed with an ankle sprain also suffer a ligamentous injury of the ankle syndesmosis. Despite the common concomitant injuries, it is still unclear whether there is a direct contribution of the lateral ligaments towards stabilizing the syndesmosis. Portable ultrasonography (PUS) has increasingly been used in the clinical setting, allowing dynamic and non-invasive evaluation at the point of care. The primary aim of this study was to assess to what extent lateral ankle ligaments contribute to syndesmotic stability in the sagittal and rotational plane using PUS. Secondary, we determine if PUS is a reliable tool for the assessment of syndesmotic instability. Our primary hypothesis was that lateral ankle ligaments contribute significantly to the stability of the ankle syndesmosis.

Methods: 16 fresh-frozen cadaveric specimens were equally divided into 2 groups that underwent PUS evaluation for syndesmotic stability. The assessment was done at the intact state and later with sequential ligament transection. In group 1, the anterior talofibular ligament (ATFL) was transected, followed by the calcaneofibular ligament (CFL), the posterior talofibular ligament (PTFL), the anteroinferior tibiofibular ligament (AITFL), the interosseous ligament (IOL), and the posteroinferior tibiofibular ligament (PITFL). In group 2, the transection started with the AITFL then followed by the ATFL, the CFL, the IOL, the PTFL, and the PITFL. PUS measurements were performed during anterior to posterior (AP), posterior to anterior (PA), and external rotated loading condition (Figure 1). One-way ANOVA and post hoc Dunnett test were used to compare the findings of each state to the intact. Besides, we assessed the inter-rater and intra-rater reliability using the intraclass correlation coefficient (ICC) through a two-way mixed-effects model.

Results: In group 1, showed that compared to the intact stage, fibular translation in the sagittal plane and the anterior tibiofibular clear space (TFCS) distance did not increase after transection of all three lateral ankle ligaments. However, the syndesmotic PUS measurements did increase after subsequent transection of the AITFL and IOL (p-values ranging from 0.047 to <0.001). In group 2, the AP translation of the fibula in sagittal plane, as well as the anterior TFCS distance, only increased significantly after transection of at least two syndesmotic ligaments (AITFL, IOL) together with two lateral ligaments (ATFL and CFL) (p-values ranging from 0.047 to <0.001). The ICCs Inter-rater and intra-rater reliability for syndesmotic PUS measurements ranged from 0.84-0.95, indicating excellent agreement.

Conclusion: PUS is a reliable tool for the assessment of syndesmotic instability. Using PUS we found that lateral ankle ligaments contribute marginally to the stability of the ankle syndesmosis. Syndesmotic sagittal and rotational plane instability occurred after injury to all three syndesmotic ligaments or after partial syndesmotic injury (AITFL+IOL) with concomitant two or more lateral ankle ligament injury. The intraclass correlation coefficient for the sagittal and rotational plane assessment of syndesmosis using PUS indicated excellent inter- and intraobserver agreement, and thus, can be a valuable diagnostic tool at the point of care.
Figure 1. PUS syndesmotic sagittal and rotational plane assessment.

- Sagittal plane assessment under AP and PA manual-loading conditions with 50N force (1a,1c) or AP and PA hook-loading conditions with 100N (1e,1f). One-headed arrows represent the direction of force applied. Two-headed arrows (red) represent the difference of the distances in the fibular position relative to the tibia position (mm) at before and after the force was applied (1b, 1d).
- Rotational plane assessment under ER loading conditions with 75N force. Two-headed arrow (green) is representing the anterior tibiofibular clear space at 10mm above the level of ankle joint line (mm) measured at before (1g) and after 75N ER force was applied (1h).