

A Novel Method to Quantify Ankle Soft-Tissue Envelope and its Association with Surgical Site Infections After Open Reduction and Internal Fixation of Unstable Ankle Fractures

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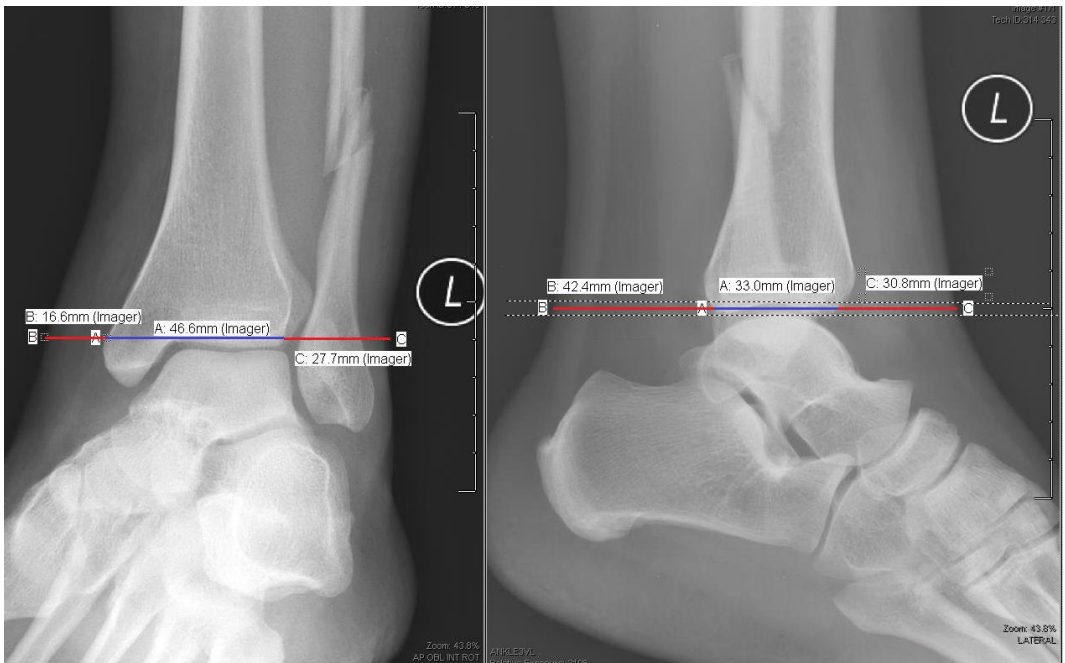
Background/Purpose: Unstable ankle fractures are common injuries seen in adults. The orthopaedic standard of care often involves open reduction and internal fixation (ORIF); however, unintended complications can arise, specifically surgical site infections (SSI). SSI can have a significant impact on patient quality of life, functional outcomes, and overall health-care costs and resource utilization. The soft-tissue envelope (STE) size may alter the patient's risk for SSI and ability to heal. To date, the associate between STE or body mass index (BMI) and ankle SSI after ORIF has not been extensively studied. In addition, a patient's weight/BMI may not be indicative of the size or quality of the STE surrounding the injured ankle. The aim of our study was to examine the association between STE and/or BMI and SSI following ORIF of unstable ankle fractures, as well as identify other potential patient-specific risk factors.

Methods: After IRB approval, we conducted a retrospective review of 499 patients who underwent ankle ORIF for unstable ankle fractures by multiple surgeons at a single institution. Radiographic measurements were performed at the time of injury, 3 months, and 6 months postoperatively. Coronal, sagittal, and cumulative STE measurements were recorded as shown in Figure 1. Relative ratios of the STE to the tibial plafond cortical diameter (TCD) served as an internal control to magnification variability. BMI to TCD ratio was also calculated. Age, gender, mechanism of injury, fracture classification, smoking status, medical comorbidities, type of fixation used, operating room metrics, infection management, and ultimate patient outcome were recorded. Descriptive statistics were undertaken to characterize patient cohorts. Univariate logistic regression was utilized to produce crude odds ratios and 95% confidence intervals, and all possible predictors with a univariate P value of <0.2 were considered for inclusion in a multivariable model to obtain adjusted odds ratios. Statistical significance was set at $P < 0.05$.

Results: STE size (total STE) was significantly larger in the infected cohort of patients. At the time of injury, the only significant difference was shown in the coronal measurements: 49.1 versus 45.1 mm (infected vs non-infected) ($P = 0.022$). At 3 and 6 months, coronal, sagittal, and cumulative STE (sum of sagittal and coronal measurements) were all significantly greater in the infected cohort. For example, cumulative STE showed a difference of 47.4 versus 40.9 mm at 3 months ($P = 0.003$) and 49.7 versus 40.0 mm at 6 months ($P < 0.001$). Similarly, the infection group demonstrated significant STE to TCD ratios, with 1.1 versus 1.0 ($P = 0.027$) on mortise view, 1.4 versus 1.3 ($P = 0.045$) total STE:TCD, and 1.5 versus 1.3 ($P = 0.003$) total STE:TCD at all 3 intervals, respectively. Patients who developed an infection after ankle ORIF showed a statistically significantly higher incidence of diabetes mellitus (DM), hypertension (HTN), coronary artery disease (CAD), and peripheral vascular disease

(PVD). Infection was also correlated with longer mean surgical time, 117.5 versus 106.7 minutes ($P = 0.046$). Of note, BMI did not show statistical significance.

Conclusion: In this study, we describe a novel measurement tool for evaluating the ankle soft-tissue envelope. Our findings suggest that STE size is a significant risk factor for developing surgical site infection, with significance at 3 and 6 months with all measurements. In examining preoperative radiographs, only the coronal (mortise view) measurements showed statistical significance. This may be due to wide variability in radiographs seen from emergency departments, urgent care facilities, and outside clinics. With more consistent technique at follow-up in a single-site clinic, the 3 and 6-month radiographs showed much less variability. Prospective studies would help to confirm this association and to further quantify the risk associated with increasing STE. In addition, our study has shown strong associations between SSI and immunocompromised and vasculopathic states, including DM, HTN, CAD, and PVD. This study helps to further support the value of a healthy ankle STE when considering fracture surgery. This novel tool allows surgeons to better counsel patients on their risk of developing an SSI.



The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.