

Zone of Injury Determined by Free Air on Computed Tomography Scans of Open OTA 42A-C Tibial Fractures Correlates With Nonunion and Hardware Removal

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Purpose: Our objective was to evaluate a novel CT metric—the ratio of soft-tissue zone of injury (ZOISoft) to fracture zone of injury (ZOIFX)—as a predictor of clinical outcomes in open tibia fractures.

Methods: A retrospective review of patients in a tibia fracture registry from 2014 to 2024 at a single institution was performed. Inclusion criteria were age 18 years or older, open fracture, OTA 42A-C fracture, availability of preoperative CT imaging of the injured tibia, and a minimum follow up of 6 months. Demographic data, Charlson Comorbidity Index (CCI), injury characteristics, and clinical outcomes (fracture-related infection, amputation, nonunion, hardware removal, and total number of reoperations) were recorded. The ZOISoft was defined as the distance (mm) between the proximal and distal extents of soft-tissue air, while the ZOIFX represented the distance (mm) of the proximal and distal extent of the fracture. The ratio of ZOISoft/ZOIFX was calculated for each case, and patients were cohorted into two groups based on the ratio: ZOISoft/ZOIFX <3 (Group A) and ZOISoft/ZOIFX ≥3 (Group B). Univariate analyses were conducted using two-tailed Student's t-tests and χ^2 tests.

Results: In total, 55 patients (mean age: 39.2 ± 20.6 years; mean follow up: 16.9 ± 9.5 months) met the inclusion criteria and were divided into two groups: 33 patients (60.0%) in Group A and 22 patients (40.0%) in Group B. Demographic characteristics were similar between groups, except that Group A had a higher proportion of men (90.9% vs 68.2%, $p = 0.03$). Gustilo-Anderson classifications did not differ significantly between groups (Group A: 1 [n = 4], 2 [n = 9], 3 [n = 11]; Group B: 1 [n = 10], 2 [n = 12], 3 [n = 12]; $p = 0.51$). Group B experienced a higher incidence of nonunion (40.91% vs 18.18%; $p = 0.05$) and hardware removal (40.91% vs 18.18%; $p = 0.03$). Rates of other complications—including infection (22.73% vs 24.24%), amputation (4.55% vs 9.09%), and overall complication rates (50.00% vs 36.36%)—and the average number of reoperations (1.19 ± 1.95 vs 1.33 ± 2.95) did not differ between groups.

Conclusion: A ZOISoft/ZOIFX ratio of 3 or more was associated with an increased risk of nonunion and the need for hardware removal.