Post-Operative Cortical Continuity as a Predictor for Nonunion in Open Tibia Fractures

***Amy Ford, MD**; Madeline Lyons, MD; Elizabeth Harkin, MD; Hobie D. Summers, MD; Garin Hecht, MD; William Dean Lack, MD; Joseph Bowman Cohen, MD*
Loyola University Medical Center, Maywood, IL, United States

Purpose: Open tibia fractures maintain an all-comer nonunion rate of 2%-48%. Patient-specific factors such as smoking and NSAID (nonsteroidal anti-inflammatory drug) use, as well as fracture pattern characteristics, such as transverse pattern and postoperative fracture gap, have been reported widely in the literature with varying effects on nonunion rate. We analyzed all open extra-articular tibia fractures at our institution over a decade to determine which factors predict nonunion in our patient population.

Methods: 107 patients with 115 AO/OTA Type 41A2-3, 42A-C, 43A open tibial shaft fractures treated surgically at a Level-I academic trauma center from 2007-2017 were retrospectively reviewed. 27 patient, injury, and surgeon-related prognostic factors were analyzed for predictors of nonunion. Nonunion was defined as failure of progression of fracture healing for 6 months or at least 2 consecutive months with lack of cortical continuity on 2 of 4 cortices on anteroposterior and lateral radiographs. Hazard ratio estimates were performed to identify statistically significant associations.

Results: The nonunion rate was 22.6% with 26 instances of nonunion. The median follow-up was 13.9 months. Postoperative cortical fracture gap ($P = 0.04$) and deep infection ($P < 0.01$) were significant predictors of nonunion. Postoperative cortical continuity of 0%-25% resulted in a hazard ratio for tibial nonunion of 5.20. Deep infection resulted in a hazard ratio of 6.95. The overall deep infection rate was 11% with 13 occurrences; 10/13 deep infections were in the setting of Gustilo-Anderson type 3 fractures. The patients (5/6) who had an infection but achieved bony union had cortical continuity >75%. No other characteristics of the injury, including mechanism of injury, fracture pattern, fasciotomies, and the need for soft-tissue coverage were predictive of nonunion. No patient-specific factors predicted fracture union, including diabetes, smoking, steroid, and NSAID use.

Conclusion: This study found that postoperative cortical continuity and deep infection were significant predictors of nonunion in open extra-articular tibia fractures treated with operative fixation. Our data indicated that the presence of a fracture gap or only 1 cortex in continuity is a strong radiographic predictor of nonunion, and cortical continuity may be protective against nonunion in the setting of infection. When reporting on the risk of nonunion, fractures should be subcategorized by fracture gap given that fractures with limited or no cortical contact following fixation predictably go on to nonunion and warrant a staged approach.