

Risk Factors for Failure of Surgery to Promote Bone Healing for Tibia Nonunions and Acute Cortical Defects: A New Preoperative Risk Assessment Score

Michael A. Maceroli, MD; Daniel Connelly, BA, BS; Katherine Ordonio, BA¹; Renan C. Castillo, PhD; Molly P. Jarman, MPH; Jason W. Nascone; Robert V. O'Toole, MD; Marcus F. Sciadini, MD

¹University of Maryland, Baltimore, Maryland, USA

Purpose: The purpose of the present study is to develop a clinically useful prediction model of success at the time of surgery to promote bone healing for tibia nonunion or staged traumatic bone gaps.

Methods: The study group consisted of adult patients treated either for tibia fracture nonunion or staged bone grafting for traumatic bone defects at a single Level I trauma center from 2007-2016. A literature review yielded 27 potential independent variables thought to be associated with delayed healing of fractures and were therefore investigated. Patients were included if they had a minimum 12 months follow-up or were deemed healed via an evaluator blinded to outcome using the Radiographic Union Score for Tibia Fractures (RUST). The primary outcome measure was failure of the surgery to promote bone healing. Our cohort consisted of 203 patients who underwent surgery for nonunion (n = 143) or traumatic bone defects (n = 60). Chi-squared and Student t tests were used to examine bivariate relationships. Multivariate logistic models were developed using backward stepwise regression, removing covariates with P values >0.2.

Results: Multivariate logistic modeling identified 5 significant risk factors for failure of the surgery to promote bone healing: (1) mechanism of injury (MOI), (2) body mass index (BMI), (3) cortical defect size (mm), (4) flap size (cm²), and (5) insurance status. Using the 5 significantly associated risk factors a predication scoring model was created. Within this prediction model, MOI was afforded the highest point totals: 0 points for fall, 15 points for high-energy blunt trauma, 20 points for industrial/other, and 31 points for ballistic injuries. 1 point is given for every 10 cm² of flap size, 10 mm of mean cortical gap distance, and 10 units BMI, respectively. 3 points are awarded for Medicaid or no insurance and 2 points for Medicare. When risk score was regressed on the binary revision surgery measure, each 1-point increase in risk score was associated with a 6% increase in odds of having at least 1 revision surgery (P <0.001) with an area under the curve (AUC) of 0.77 indicating reasonable performance of the prediction model.

Conclusion: The present study presents a clinical score that predicts the likelihood of success following surgery for tibia fracture nonunions or traumatic bone defects. This score might be used in clinical practice to help guide surgical decisions and help set appropriate patient expectations.