

**Open Tibia Fractures Requiring Flap Coverage: Is Machine Learning Helpful?***Paul Tornetta, III, MD, PhD, FIOTA; Pramod Kamalpathy, MD;**Job Nicolaas Doornberg, MD; CJ J. Foote, MD*

**Purpose:** Open tibial shaft fractures requiring flap coverage are prone to deep infection. Risk stratification of individual patients allows for close monitoring, appropriate counseling, and possibly early intervention. The purpose of this study was to evaluate the use of machine learning (ML)-derived algorithms to estimate the probability of deep infection following surgical management of open tibial shaft fractures requiring flap coverage for the individual patient.

**Methods:** We included 410 adult patients (72% M; average age 42 years) who sustained an open tibia shaft fracture requiring flap coverage treated at 15 trauma centers. Patients were followed until radiographic and clinical union or deep infection. A training (N = 329) and testing set (N = 81) were used. Multiple imputation using multivariate imputation by chained equations was performed to replace missing values. Backward stepwise regression was used to identify significant predictors of infection and 6 ML models were trained to evaluate patterns associated with infection. The models were evaluated based on (1) area under the curve (AUC), (2) Brier score, and (3) calibration intercept and slope.

**Results:** Of the 410 patients, 21% (N = 86) developed deep infection. The 5 variables for the model were: (1) ISS, (2) contamination of wound at presentation, (3) definitive fixation method, (4) time from injury to fixation, and (5) time from fixation to flap coverage. The AUCs for the 6 ML models ranged from 0.59-0.74 and the Brier score for the models tested were 0.15-0.16. The Elastic-net Penalized Logistic Regression had the best performance (AUC 0.74, Brier score 0.15, calibration slope = 0.89, calibration intercept 0.08). Time from definitive fixation to flap coverage and degree of wound contamination were the most important variables in all 6 models.

**Conclusion:** Machine learning algorithms accurately estimated the probability of deep infection for the individual patient. As opposed to other methods of analysis that result in identification of population-based risk factors, this tool can be useful in counseling individual patients.