

A Deep Surgical Site Infection Risk Score for Patients with Open Tibial Shaft Fractures

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INTRODUCTION:

Despite the high rate of deep surgical site infections in patients with open tibia shaft fractures, surgeons have few tools to estimate a patient's infection risk prior to intramedullary nailing. This study aimed to identify infection risk factors in patients with open tibia shaft fractures and develop a scoring algorithm to predict the baseline infection risk in this patient population.

METHODS:

This retrospective cohort study included all patients with an open tibia shaft fracture treated with an intramedullary nail at a single academic trauma center in the United States from December 2006 to October 2020. The primary outcome was a deep surgical site infection requiring surgical debridement. Seventeen factors hypothesized to predict postoperative infection were included in an initial multivariable logistic regression model. This model was reduced using stepwise elimination to derive a final 4-factor prognostic model that was internally validated using bootstrapping and 10-fold cross-validation. The final model's coefficients were used to develop an infection risk score for this population.

RESULTS:

Of the 769 patients in the cohort, a deep surgical site infection occurred in 97 (13%) patients. The model identified 4 factors that predicted surgical site infection in the sample population. A Gustilo-Anderson type IIIB or IIIC (vs. type I or II) was the strongest predictor, associated with an 11-fold increase in the odds of infection (OR, 11.8, $p < 0.01$). Additional factors included age > 40 years (OR, 1.7, $p = 0.03$), ASA score ≥ 3 (OR, 1.9, $p < 0.01$), Gustilo-Anderson type IIIA vs. type I or II (OR, 2.8, $p < 0.01$), and gunshot wounds (OR, 2.9, $p = 0.02$). The risk scoring model discriminated patients who would develop an infection from those who would not with an acceptable level of accuracy (AUC 0.79). The risk score created 5 strata of 10-point increments to categorize patients from a low probability of infection 2% - 6% with < 10 points to high risk (58% - 69%) with > 40 points.

DISCUSSION AND CONCLUSION:

The purpose of the current study is to identify independent risk factors specific for postoperative infection in open tibial shaft fractures treated with an intramedullary nail, and subsequently to create a model to predict percent risk of postoperative infection at the time of initial presentation. Our primary endpoint was postoperative infection requiring surgical debridement. We considered 17 candidate predictors, of which 4 factors were incorporated in our final model: age, ASA score, Gustilo-Anderson classification, and gunshot wound. These 4 predictors were subsequently used to create a risk score with the ability to stratify patients based on infection risk and estimate percent risk of infection. The scoring system was developed and internally validated using rigorous bootstrapping and 10-fold cross-validation. We have developed a risk score that predicts postoperative infection in patients with open tibia shaft fractures treated with intramedullary nails. The model's prognostic performance exceeds generally accepted levels of clinical utility. The ability to accurately estimate infection risk at the time of presentation aids patient expectation management and focuses additive infection prevention strategies on the high-risk subset of this population.