

Risk Factors Associated with Delayed and Aseptic Nonunion Following Tibial Diaphyseal Fractures Managed with Intramedullary Nailing

Navnit S. Makaram, MBChB; Jun Min Leow; William M. Oliver, MBBS; Zhan Herr Ng, MBChB; Cameron Simpson, MBChB; Nicholas D. Clement; John F. Keating FRCS (Ortho)
Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

Purpose: Tibial diaphyseal fractures are the most common long bone fractures in adults. The majority of these fractures are successfully managed with reamed intramedullary nailing. However, nonunion and delayed union are recognized complications that cause considerable patient morbidity and require significant resources to manage. There remains a paucity of evidence identifying factors that predict a patient's risk of progression to delayed union and nonunion following a tibial shaft fracture. The primary aim of this study was to identify independent predictors of nonunion and delayed union in tibial diaphyseal fractures treated with intramedullary nailing. The secondary aim was to assess the Radiographic Union Scale for Tibial fractures (RUST) score as an early predictor of tibial fracture nonunion.

Methods: A consecutive series of 647 patients who underwent intramedullary nailing for tibial diaphyseal fractures were identified from a trauma database. Demographic data, comorbidities, smoking status, alcohol consumption, use of nonsteroidal anti-inflammatory drugs (NSAIDs), steroid use, details regarding mechanism of injury, fracture classification, complications, and further surgery were recorded. Nonunion was defined as the requirement for revision surgery to achieve union. Delayed union was defined as a RUST score <10 at 6 months postoperatively.

Results: There were 41 nonunions (6.3%), of which 13 were infected (31.7%), and 77 delayed unions (11.9%). There were 127 open fractures (19.6%). Adjusting for confounding variables, NSAID use (odds ratio [OR] 3.50, $P = 0.042$), superficial infection (OR 3.00, $P = 0.026$), open fractures (OR 5.44, $P < 0.00001$), and high-energy mechanism (OR 2.51, $P = 0.040$) were independently associated with nonunion. Smoking was associated with nonunion on unadjusted analysis ($P = 0.021$). Smoking (OR 1.76, $P = 0.034$), open fracture (OR 2.82, $P = 0.001$), and high-energy mechanism (OR 1.81, $P = 0.030$) were independently associated with delayed union. The RUST score at 6-week follow-up was reliably predictive of nonunion (sensitivity and specificity of 75%).

Conclusion: NSAID use, high-energy mechanisms, open fractures, and superficial infection were independently associated with nonunion in patients with tibial diaphyseal fractures treated with intramedullary nailing. The 6-week RUST score may be a useful tool to identify patients at risk of nonunion.