

### Can We Predict When Exchange Nailing Will Fail?

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**Purpose:** Exchange nailing for long bone nonunion has reported success rates ranging from 54% to 100%. Given the disease burden and variability in failure rates, identifying patient and injury factors that are associated with failure is critical in order to help guide surgeons. The purpose of this study was to identify factors associated with failure of exchange nailing. We hypothesized that cortical contact less than 100% (but greater than 50%), and a foot type appearance (elephant or horse) would be associated with higher rates of failure.

**Methods:** We performed an IRB-approved, retrospective review of all femur and tibia nonunions treated with exchange nailing at two Level I trauma centers from 2006 to 2019. Septic nonunions and patients whose primary mode of treatment was not exchange nailing were excluded from the analysis. Failure of exchange nailing was defined as either (1) absence of bridging bone on 3 or more cortices on radiographs obtained at least 1 year following exchange nailing, or (2) patient required an additional surgery during the follow-up period to promote union. Treatment method and return to the operating room for secondary procedure was at the treating surgeon's discretion. Demographic data, body mass index (BMI), smoking status, comorbid conditions, injury data, fracture location and characteristics, supplemental fixation, cortical contact, and graft use were recorded. Fisher's exact test and forward logistic regression were utilized to assess confounders.

**Results:** A total of 138 patients met inclusion criteria, 83% (115) having a minimum of 1-year follow-up or meeting primary outcome, with 63% being femurs and 37% tibias. Average age at exchange nailing was 39 years (95% confidence interval [CI] 37.00-42.50) with 68% being male. Overall union rate was 77%, with 20% (21 of 105) requiring at least one secondary surgery to promote union. Proportion of healed fractures at 6 weeks, 3 months, and 6 months was 9.6%, 36%, and 66.7%, respectively. Foot type was not associated with increased risk of treatment failure (odds ratio [OR]: 1.131, 95% CI 0.335-3.817,  $P = 0.843$ ). Factors associated with success of treatment included oligotrophic type (OR: 3.12, 95% CI 1.15- 8.43). Factors associated with failure included use of graft (auto- or allograft) (OR: 0.262, 95% CI 0.087-0.780,  $P = 0.016$ ) and less than 100% cortical contact (OR: 0.275, 95% CI 0.074-1.023,  $P = 0.054$ ). Age, gender, BMI, smoking status, history of diabetes, open / closed fracture, foot type, presence of comminution, and nondiaphyseal location were not associated with failure.

**Conclusion:** In our series, we demonstrated a 33% failure rate of exchange nailing, which is higher than previously reported in some studies. Bone graft use and lack of 100% cortical contact appear to increase the risk of failure. Morphological features do not appear to increase the risk of failure. Surgeons should utilize caution when considering bone grafting if the primary treatment is exchange nailing. Alternative treatment options may be more successful.