

## **Tibial Malalignment Is an Independent Predictor of Nonunion following Intramedullary Nailing of Tibial Shaft Fractures**

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### **INTRODUCTION:**

Tibial shaft fractures are often treated with intramedullary nailing. Much effort is devoted to ensuring "acceptable" intraoperative alignment, however it is not known if malalignment is related to nonunion. This study assessed the relationship between postoperative alignment and nonunion in patients with tibial shaft fractures treated with intramedullary nailing. We hypothesized that malalignment after tibial nailing would be associated with an increased odds of nonunion.

### **METHODS:**

This retrospective case-cohort study included the creation of a study group of 192 patients (51 with nonunion, 141 without nonunion, randomly sampled over the same time period) with a tibial shaft fracture treated with intramedullary nailing at a single academic trauma center. The primary outcome was an unplanned reoperation for nonunion. Alignment was measured on immediate postoperative x-rays in the coronal and sagittal plane by two independent reviewers. Malalignment less than 2 degrees in both planes was observed in 14 patients with nonunion (15%). Malalignment in one plane greater than or equal to 2 degrees was observed in 19 patients with nonunion (29%). Malalignment in two planes greater than or equal to 2 degrees was observed in 21 patients with nonunion (42%).

We used logistic regression to evaluate the crude association between malalignment and nonunion and an adjusted model to account for variation in sex, diabetes, open fracture, location of fracture (distal third vs. not), compartment syndrome, coronal translation, and cortical continuity.

### **RESULTS:**

Of the 192 patients included in the study, the median age was 38 years (IQR, 25 – 50) and 76% (n=146) were male. Patients who required a reoperation to promote union were more likely to have open fractures (76% vs. 50%,  $p<0.001$ ), had less cortical continuity at the index fixation ( $p=0.003$ ), and were more likely to have coronal translation (61% vs. 41%,  $p=0.02$ ).

There was a strong association between postoperative tibial malalignment in one plane and nonunion (OR, 3.0, CI 1.1-8.3,  $P=0.03$ ). This association was greater for malalignment in both coronal and sagittal planes (OR, 5.7, CI 2.1-16.1,  $P<0.001$ ).

### **DISCUSSION AND CONCLUSION:**

To our knowledge, this study is the first to identify a strong relationship between postoperative tibial malalignment and developing a nonunion. After controlling for confounders and utilizing rigorous statistical techniques aimed at causal inference, postoperative malalignment of even a few degrees in the coronal or sagittal plane appears to be associated with tibial shaft nonunion. Clinicians should be aware that even relatively small amounts of malalignment during tibial shaft nailing may increase the risk of nonunion.