

Carbon Fiber-Reinforced PEEK versus Titanium Tibial Intramedullary Nailing: A Preliminary Analysis and Results

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Purpose: This study compares a longitudinal cohort of patients with tibial fractures treated with intramedullary nailing, over 2 time periods, using a titanium nail followed by a carbon fiber-reinforced polyetheretherketone (PEEK) nail.

Methods: Tibial fractures treated with intramedullary nailing were reviewed over a 5-year period. In the initial period, titanium nails (TN) were used, while in the later period carbon fiber nails (CFN) were used. All patients were treated by a single surgeon with the same semi-extended, peri-articular technique of nail insertion and followed the same postoperative protocol. Follow-up intervals were 2, 8, and 12 weeks followed by 4-week intervals until fracture healing was verified radiographically. Outcome variables were interval healing rates, knee pain, infection, hardware removal, or barometric pain. Exclusion criteria were skeletal immaturity, neoplasm or an associated peri-articular fracture (pilon, plateau), prior surgery, infection, or nonunion. Cumulative healing rates at each interval were evaluated and analyzed using a Wilcoxon rank sum test while additional variables (ankle/knee pain, removal of hardware, barometric pain) were evaluated and analyzed with χ^2 test.

Results: All patients included were available for follow-up. Out of 56 patients, 26 received CFN and 30 received TN. Healing rates were reported at each time interval. At 8 weeks: TN was 0% and CFN 19%; 12 weeks, TN 17% and CFN 69%; 16 weeks, TN 57% and CFN 92%; 20 weeks, TN 87% and CFN 96%; and 24 weeks, TN 97% and CFN 96% ($P < 0.0001$ for every interval period except 24 weeks). Each group had 1 infected nonunion in an open fracture that went on to heal with subsequent treatment. There was a trend toward less barometric pain with CFN that did not reach statistical significance ($P = 0.065$). There were no significant differences with knee/ankle pain ($P = 0.109$), or removal of hardware ($P = 0.269$) potentially due to low power of the pilot study.

Conclusion: Tibial fractures treated with a carbon fiber-reinforced (CFR)-PEEK intramedullary nail had a higher rate of early healing compared with a titanium nail with statistically significant improvements between CFN and TN at time periods of 8, 12, 16, and 20 weeks. We believe that this effect is most likely due to the lower modulus of elasticity (which is closer to that of bone) while maintaining structure strength requirements and higher fatigue characteristics found in the CFR-PEEK implants. This unique material and structural technology provides an attractive alternative to current titanium nails. Furthermore, there was a trend toward less barometric pain with CFR-PEEK, which is a commonly noted anecdotal finding with metallic implants. Further study comparing the performance of CFR-PEEK would be beneficial.