Small Residual Fracture Gaps Delay Time to Union in Length-Stable Femur Fractures Treated With Intramedullary Fixation

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Purpose: Intramedullary nailing of femoral shaft fractures is the gold standard treatment with union rates approaching 98% in previously published cohorts. Despite this success, delayed healing and nonunion are still encountered with significant physical, psychiatric, and social implications to the patient. The purpose of our study was to investigate whether fracture gapping or angulation at time of intramedullary nail fixation was associated with delayed healing.

Methods: Inherently stable (Winquist-Hansen 1 and 2) diaphyseal femur fractures treated with intramedullary nailing at a single Level-I trauma center from 2013 to 2019 were reviewed retrospectively. Patients were included in analysis if they had at least 90 days of radiographic and clinical follow-up. Fracture gap, translation, and angulation were evaluated on immediate postoperative radiographs as well as on routine follow-up radiographs. Radiographic healing was assessed using Radiographic Union Score in Tibias (RUST) scores at each follow-up. Radiographic union was defined as a RUST score of 8 or more. Analysis of variance (ANOVA) and Student's t test were used to evaluate correlation between radiographic parameters and time to union.

Results: Database review identified 183 patients undergoing intramedullary fixation during the study period. 35 were excluded for Winquist 3 or 4 fracture pattern, 3 were excluded due to being pathologic fractures, and 64 excluded due to insufficient radiographic follow-up. This left 81 patients who underwent intramedullary fixation with adequate follow-up during the study period. Antegrade nailing was performed in 55 cases and retrograde in 26. Average fracture gap was <1 mm in 23 cases, 1-3 mm in 26, and >3 mm in 32. Average time to radiographic union among healed fractures was 66.9 days, 94.2 days, and 100.4 days, respectively ($P = 0.02$). There were 2 fractures that never attained radiographic union in the 1-3 mm gap group and 8 that never attained union in the >3 mm gap group. All fractures with a gap of <1 mm attained radiographic union. Among fractures undergoing open reduction time to union was 84 days compared with 88.8 days among those managed closed ($P = 0.68$).

Conclusion: Residual gapping of diaphyseal femur fractures is an independent risk factor that has a significant negative effect on the time to fracture union. The orthopaedic trauma surgeon is confronted with numerous nonmodifiable risk factors for delayed bony healing; however, seemingly subtle malreductions and small fracture gaps at the time of intramedullary nailing can have real implications with regard to delayed healing and nonunion. Our data suggest that surgeons should carefully scrutinize their reductions and seek to optimize fracture alignment through open or closed means as these small changes can have a bona fide clinical impact.