

Outcomes of Periprosthetic Distal Femur Fractures by Fixation Construct: A Retrospective Cohort Study

Robin M. Litten, MS¹, Jared R. Halstrom, MD¹, Doriann M. Alcaide, MD², Ryan N. McIlwain, BS¹, Clay A. Spittler, MD¹, Joey P. Johnson, MD¹

¹Department of Orthopaedic Surgery, University of Alabama at Birmingham; Birmingham, AL.

²Department of Orthopaedic Surgery, University of Missouri-Kansas City; Kansas City, MO.

rlitten@uthsc.edu

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INTRODUCTION: Periprosthetic distal femur fractures (PDFF) are increasingly encountered as arthroplasty volume rises and pose significant challenges in elderly, comorbid patients. These injuries require fixation strategies that minimize reoperation risk while enabling early mobilization to reduce medical complications. While intramedullary nails (IMN) and single lateral locking plates (sLLP) have been used historically, both are associated with high complication rates. More recently, dual constructs such as nail-plate constructs (NPC) have been adopted to improve stability and permit earlier weight-bearing, yet comparative outcome data remain limited. This study evaluated clinical outcomes of IMN, sLLP, and dual constructs (NPC and dual plating) in PDFF, with particular attention to reoperation risk, progression to weight-bearing, and fracture morphology factors including medial comminution and medial translation. We hypothesized that sLLP fixation may be associated with a higher rate of unplanned reoperation, and that dual constructs may be associated with earlier postoperative weightbearing.

METHODS: A retrospective review was conducted of adult patients with PDFF managed operatively at a single Level I trauma center between 2012 and 2024. Patients treated with IMN, sLLP, or dual constructs (dual plating or NPC) were included, while those undergoing revision arthroplasty or distal femoral replacement were excluded. All patients were analyzed for postoperative weight-bearing status, and those with at least six months of follow-up or an early documented complication were included in outcomes analyses. Data collected included demographic variables, comorbidities, fracture classification, fixation method, and operative characteristics. Outcomes of interest were unplanned reoperation, reoperation to promote bone healing, implant failure, fracture-related infection (FRI), malunion, hardware removal, wound dehiscence, and time to weight-bearing as tolerated (WBAT). Medial comminution and postoperative medial translation were measured using criteria previously described by Lee et al. [1]. Multivariable logistic regression was used to evaluate associations between fixation construct and unplanned reoperation, adjusting for age, sex, and body mass index.

RESULTS: Ninety-nine patients were identified, of whom 64 met criteria for outcomes analysis, including 20 treated with IMN, 19 with sLLP, and 25 with dual constructs. The mean age was 69 years, and the mean BMI was 33.8 kg/m²; three-quarters of the cohort were female and 59% were Black. Preoperative medial comminution was present in 34.4% of patients overall, with the highest prevalence in dual constructs (53.8%) compared with IMN (30.0%) and sLLP (10.5%) ($p = 0.010$). Mean postoperative medial translation was 3.2 mm across the cohort and differed significantly between fixation constructs, measuring 4.3 mm in IMN, 1.3 mm in sLLP, and 3.8 mm in dual constructs ($p = 0.032$). Immediate WBAT was permitted in 70.7% of dual construct patients and 52.8% of IMN patients, compared with only 9.1% of those treated with sLLP ($p < 0.001$). Time to WBAT was shortest with dual constructs at a mean of 13.8 days, compared with 26.0 days for IMN and 42.8 days for sLLP ($p = 0.020$). Unplanned reoperation occurred in 35.9% of the cohort, including 20.0% of IMN, 57.9% of sLLP, and 32.0% of dual construct patients ($p = 0.042$). On multivariable regression, sLLP fixation was associated with increased odds of unplanned reoperation (OR 5.57, 95% CI 1.51–20.56, $p = 0.010$), while IMN (OR 0.12, $p = 0.013$) and dual constructs (OR 0.23, $p = 0.040$) were associated with a lower risk of unplanned reoperation. Infection occurred in 15.6% of patients and did not differ significantly by fixation group. Furthermore, rates of hardware removal, wound dehiscence, reoperation to promote bone healing, and malunion also did not differ significantly when stratified by fixation construct.

DISCUSSION: In this retrospective study of patients with PDFFs, single lateral locking plate fixation was associated with a higher rate of unplanned reoperation compared to IMNs and dual implant constructs. After adjusting for age, sex, and BMI, single lateral locking plate fixation remained significantly associated with increased odds of reoperation, while both IMN and dual constructs were associated with decreased odds. Dual constructs permitted the most rapid progression to weight-bearing, an important advantage in elderly and frail populations where immobility carries substantial medical risks. The observed differences in medial comminution and medial translation by fixation type are clinically relevant, as both have been previously identified as predictors of reoperation in distal femur fractures [1]. Their distribution in this cohort highlights the importance of accounting for fracture morphology when selecting implants, as construct choice may interact with these variables to influence outcomes.

SIGNIFICANCE/CLINICAL RELEVANCE: Implant selection plays a critical role in the management of periprosthetic distal femur fractures. Single lateral locking plates were associated with increased reoperation risk, while intramedullary nails and dual constructs were associated with a lower risk. Dual constructs provided the greatest opportunity for immediate and early weight-bearing, which could translate to improved recovery and fewer systemic complications. Consideration of medial comminution and medial translation, in addition to construct type, may further guide implant selection and help optimize outcomes in this high-risk population.

REFERENCES:

1. Lee, C., et al., Risk factors for reoperation to promote union in 1111 distal femur fractures. *Journal of orthopaedic trauma*, 2023. 37(4): p. 168-174.