The Comparison of Femur Fracture Internal Fixation (COFFIN) Study: A Preliminary Report among Locked Lateral Plating, Retrograde Nailing, Nail Plate Combination, and Dual Plating for Distal Femur Fractures

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INTRODUCTION: The treatment of distal femur fractures is controversial with regard to the optimal construct. Locked lateral plating (LLP), retrograde intramedullary nailing (RIMN), nail plate combination (NPC), and dual plating (DP) have all been described as techniques to accomplish successful open reduction internal fixation (ORIF). However, each technique carries significant advantages and disadvantages, making construct selection a more complex decision for these fractures. The purpose of this paper is to compare the outcomes of distal femur fracture fixation among these four constructs.

METHODS:

All patients over the age of 18 undergoing ORIF of the distal femur at a single institution were included for analysis from January 1, 2015 to January 1, 2020. Patients undergoing ORIF for pathologic fracture were excluded. A propensity-score matched based analysis was used to create two groups (LLP vs. RIMN), adjusting for subject characteristics. Negative binomial and logistic regressions were performed on this adjusted cohort. A value $p < 0.05$ was used to determine statistical significance.

RESULTS:

Two-hundred-thirty-eight patients with distal femur fractures were included in the final analysis. Of these, 160 (67%) were native distal femur fractures and 78 (33%) were periprosthetic fractures with a prior total knee arthroplasty. The most common mechanisms of injury were falls from standing height (53%) and gunshot wounds (14%). Thirty-five patients (14%) had adverse outcomes, categorized as a return to the operating room (OR), surgical site infection, or hardware failure.

In the cohort of native distal femur fractures, a plurality were treated with a RIMN (49%), followed by LLP (45%), NPC (6%), and DP (1%). In this cohort of patients, LLP (10%), RIMN (12%), and NPC (11%) all had low rates of returning to the OR in the study period. DP was only utilized to treat one patient who did not return to the OR.

Of the periprosthetic fracture group, only four patients were treated with DP, of whom three returned to the OR. Patients in this cohort managed with LLPs had the highest return to OR rate (24%), followed by patients with RIMNs (14%). Zero NPC patients returned to the OR.

Overall, LLPs had higher rates of infection (7%) than RIMNs (2%), and DP constructs were infected in two out of five patients (40%). All but one infection required return to the OR for treatment. Hardware failure was more common in the LLP group (6%) than in the RIMN group (3%), as well. All patients with hardware failure required return to the OR.

Logistic regression was utilized to compare LLP and RIMN adverse outcomes. Analysis found a shorter hospital length of stay of 0.7 days associated with RIMNs compared to LLPs ($p=0.008$). Surgical construct had no significant association with the rate of hardware failure ($p=0.47$), return to the OR ($p=0.82$), infection ($p=0.21$), or mortality ($p=0.80$).

Lateral plate and retrograde intramedullary nailing were compared through propensity-score matching. Patients treated with RIMNs (53.7%) were substantially more likely to be made weight bearing as tolerated ($p<0.001$) compared to those treated with LLPs (11.6%). While not found to be statistically significant, there was a difference between discharge to facility. Patients who underwent LLP (49.6%) were more likely to be discharged to a skilled nursing facility compared to those who underwent RIMN (35.4%).

DISCUSSION AND CONCLUSION: A majority of patients with distal femur fractures in this study were treated with locking lateral plate or retrograde intramedullary nailing. Of these constructs, patients treated with RIMN had shorter hospital stays. Importantly, patients treated with retrograde intramedullary nail were more likely to bear weight as tolerated postop and also were less likely to be discharged to a facility. This highlights that in a geriatric patient population with distal femur fractures, the status of weight bearing as tolerated postoperatively may influence patient discharge disposition. There was no significant difference in return to the OR, infection, or hardware failure between constructs; however, these findings may be due to the low number of adverse outcomes in the study. Future directions will be aimed at compiling a larger data set from multiple institutions to look for similar findings.