Double Plating for Periprosthetic Distal Femur Fracture is Safe compared to Single Plating and Distal Femur Replacement: Analysis of 111 Cases

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INTRODUCTION:

Periprosthetic distal femur fractures (PDFF) are severe complications that can occur following total knee arthroplasty (TKA) and typically require surgical intervention. However, no clear consensus exists on the surgical strategy for their management and the patient and fracture characteristics that should inform this. The purpose of this study was to compare the failure and revision rates of double plating (DP), single locking plating (SP) using a lateral locking plate, or distal femur replacement (DFR) for the treatment of PDFF.

METHODS:

All patients with PDFF primarily treated with DP, SP, or DFR between 2008 and 2022 at one academic, tertiary referral center were included in this retrospective analysis of a prospectively followed trauma database. DP and DFR were performed through extensile medial or lateral parapatellar approaches +/- proximal screw targeting. No weightbearing restrictions were applied. The primary outcome was revision surgery for failure following DP, SP, or DFR. Secondary outcome measures included any reoperation, medical and surgical complications, length of hospital stay, and mortality. All basic demographic information (age, sex, ASA, osteoporosis, diabetes, bisphosphonate use, steroid use), primary implant details, and relevant injury related data were collected. The radiographic analysis included fracture classification (AO/OTS, Su, Falker) as well as evaluation of metaphyseal and medial comminution.

Data were analyzed using same software. Distribution was analyzed using the Kruskal-Wallis-Test and through visual analysis of the distribution after plotting. Parametric data were expressed as mean (SD) and non-parametric data as median (IQR). Continuous parametric data were compared using students t-test and non-parametric data using Mann–Whitney U test. Categorical data were compared using chi square or Fisher's exact test. Survival analysis was conducted using Kaplan-Meier survival curves and hazard ratios. A p-value of < 0.05 was considered significant.

RESULTS:

Across 111 PDFFs (Su 1 in 32 (29%); Su 2 in 37 (34%); Su 3 in 40 (37%)) in 111 patients, the median age was 82 years (IQR, 75 to 88) years, 96 PDFF (86%) occurred in female patients, and median follow up was 2.5 years (IQR, 1.2 to 5.0 years). The majority of fractures involved cruciate retaining femoral components (n = 99, 91%) but posterior stabilized components were present in 3 (2.8%) and more constrained implants with femoral stems in 7 (5%). Metaphyseal comminution was present in 31 cases (28%) and medial comminution in 19 cases (6.4%). Fixation involved SP in 66 (59%), DP in 15 (14%), and DFR in 30 cases (27%). Fixation involved additional cerclage cables in 25 (38%) of single plate constructs and 2 (13%) dual plate constructs ($p = 0.696$).

At a minimum follow up of 2 years, revision surgery for failure was performed in 11 (9.9%) cases at a median follow up of 5 months (IQR, 2 to 9 months) postoperative: 0 DP patients (0%), 9 SP (14%), and 2 DFR (6.7%) ($p=0.2$). Including reoperations to remove prominent metalwork at median follow up 7 months (IQR, 3 to 28 months), the reoperation rates were: 1 DP (7%), 12 SP (18%), and 2 DFR (7%) ($p=0.3$). Early medical and surgical complications (within 6 weeks) occurred in 62% and 5.4%, respectively. The mortality was 2.7% at 30 days and 18% at 1 year. The most common reason for reoperation was nonunion (9 cases, 8%) followed by infection (3 cases, 3%), prominent metalwork (2 cases, 2%), and loosening (1 case, 1%).

There were no significant differences in baseline patient characteristics (age, sex, ASA, osteoporosis, diabetes, bisphosphonate use, steroid use) between patients who underwent SP, DP, or DFR ($p>0.05$). Compared to SP, DP was more likely to have metaphyseal comminution (47% vs. 14%, $p=0.009$), to be low Su type 3 fractures (47% vs. 11%, $p=0.009$), and were more likely to be anatomically reduced (100% vs. 71%, $p=0.030$). Compared to DFR, DP cases were less likely to be low Su 3 fractures (47% vs 90%, $p=0.005$), but metaphyseal and medial comminution occurred with similar frequencies in both groups ($p>0.05$). Compared to SP, DFR cases were more likely to display metaphyseal comminution (52% vs. 14%, $p < 0.001$), and to be low Su 3 fractures (90% vs. 11%, $p < 0.001$). Though there was a tendency to increased early reoperation following SP (figure 1), there were no significant differences in revision for failure or any reoperation between DP, DFR, and SP groups.

DISCUSSION AND CONCLUSION:

The main finding of this study was that DP for PDFF did not require revision surgery for failure compared to 9.9% for SP and 6.7% for DFR. None of the basic demographic factors or comorbidities were able to predict treatment failure. However, radiographic analysis revealed that DP and DFR were successfully used for lower fractures with medial and metaphyseal comminution. Vice versa, SP was less frequently used for lower fractures with medial or metaphyseal comminution. This supports the use of DP and DFR for a specific subcategory of PDFF. The main advantage of DFR is a definitive treatment solution without the requirement to wait for fracture healing compared to DP and SP. However, DFR is

an in general larger procedure with high complication rates. The long-term complication of loosening is quite often underestimated because of the late occurrence. Given the usually high age and associated frailty of patients with PDFF, this complication might be not suitable for another revision surgery.

Double plating for distal femur fractures has gained some popularity in recent years, especially for the native bone. However, the literature on PDFF is very sparse and consists mainly of small case series. Nevertheless, previous studies suggested the benefit of this stronger construct for very low fractures and poor impaired bone quality. Fears that double plating creates a “dead bone sandwich” have not been borne out in this study.