Nail-Plate Combination Fixation for Treatment of Periprosthetic Distal Femur Fractures Allows for Early Weight-bearing with Low Reoperation and Revision Rates

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INTRODUCTION: Combination retrograde femoral intramedullary nail (IMN) and locking plate for periprosthetic distal femur fractures (PDFF) may offer improved construct strength and early weightbearing versus locked plating constructs or intramedullary nail (IMN) fixation. This study compared clinical and radiographic outcomes in PDFF treatment with nail-plate combination (NPC), locked plating, or IMN.

METHODS: Patients aged ≥ 18 undergoing PDFF surgery between January 1, 2015, and April 1, 2024, at three institutions were retrospectively identified. Patients were included with NPC, locked plate only (single-plate, dual-plate, or triple-plate), or isolated IMN.

RESULTS:

There were 78 patients with 79 PDFFs (OTA/AO 33A-C) (Su types I = 38, II = 27, III = 14) (Table 1). Median age was 79 years (41 to 95; standard deviation [SD] = 11.3) and 77% were women. Constructs included 42 locking plates (53%), 24 NPCs (30%), and 13 isolated IMNs (17%) (Figure 1). The locking plate cohort included 21 single-plates (50%), 17 dual-plates (40%), and four triple-plates (10%). Mean follow-up was 18 months (0.2 to 104.3; [SD] = 21). Postoperatively, 79% of NPC patients were immediately weightbearing as tolerated versus 40% of all other constructs (P < 0.001).

All-cause reoperation occurred in 12 cases (15%); 10 (24%) locked plate constructs and two (8%) NPC constructs (Figure 2). There were eight cases (10%) of nonunion or hardware failure requiring revision osteosynthesis (one NPC, seven other constructs, P = 0.42) (Table 2). Infection requiring surgical intervention occurred in 7 (9%) (one NPC and six locking plates, P = 0.67). Additionally, six cases underwent revision arthroplasty following fracture fixation for infection, instability, or conversion to distal femoral replacement for nonunion (one NPC, five locking plate constructs, P = 0.66).

DISCUSSION AND CONCLUSION: Nail-plate combination for PDFFs was associated with low reoperation and revision rates. These constructs may provide an advantage of earlier weightbearing in PDFF patients versus other constructs without compromising union.

Figure 1: Initial fracture films demonstrating a Su Type II periprosthetic distal femur fracture as seen on anteroposterior (A), oblique (B), and lateral (C) radiographs. This patient underwent fixation with a nail-plate construct as seen on postoperative radiographs including anteroposterior femur (D), anteroposterior knee (E), and lateral femur (F).

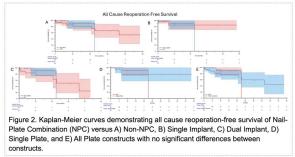

Figure 2. Kaplan-Meier curves demonstrating all cause reoperation-free survival of Nail-Plate Combination (NPC) versus A) Non-NPC, B) Single Implant, C) Dual Implant, D) Single Plate, and E) All Plate constructs with no significant differences between constructs.

Table 1: Patient Demographics and Characteristics

Variable	Single Plate (n = 21)	Dual Plate (n = 17)	Triple Plate (n = 4)	Nail Only (n = 13)	NPC (n = 24)	Total (n = 79)
Age (years), median (IQR)	80 (73-91)	79 (66-85)	83 (79-90)	78 (64-92)	77.2 (75-82)	79.2 (70-87)
Women, n (%)	19 (90)	14 (82)	4 (100)	7 (54)	17 (71)	61 (77)
BMI (Kg/m²), median (IQR)	26.3 (24-29)	28.8 (23-32)	31.2 (21-38)	34.0 (25-40)	26.2 (25-33)	28.8 (24-33)
Su Classification, n (%)						
I	10 (48)	6 (35)	3 (75)	8 (62)	11 (46)	38 (48)
II	5 (24)	7 (41)	1 (25)	3 (23)	11 (46)	27 (34)
III	6 (29)	4 (24)	0 (0)	2 (15)	2 (8)	14 (18)
Smoker, n (%)						
Current or Former	7 (33)	3 (18)	1 (25)	5 (38)	10 (42)	26 (33)
Never	14 (66)	13 (76)	3 (75)	8 (62)	14 (58)	52 (66)
Unknown	0 (0)	1 (6)	0 (0)	0 (0)	0 (0)	1 (1)
ASA, n (%)						
I	0 (0)	0 (0)	0 (0)	1 (8)	0 (0)	1 (1)
II	5 (24)	3 (18)	1 (25)	3 (23)	7 (29)	19 (24)
III	8 (38)	10 (58)	2 (50)	6 (46)	16 (67)	42 (53)
IV	1 (5)	1 (6)	1 (25)	3 (23)	0 (0)	6 (8)
V	0 (0)	0 (0)	0 (0)	0 (0)	1 (4)	1 (1)
Unknown	7 (33)	3 (18)	0 (0)	0 (0)	0 (0)	10 (13)
Race, n (%)						
White	16 (75)	16 (94)	4 (100)	10 (77)	20 (83)	66 (84)
Black or African American	1 (5)	0 (0)	0 (0)	1 (8)	3 (13)	5 (6)
Other	2 (10)	0 (0)	0 (0)	2 (15)	0 (0)	4 (5)
Unknown	2 (10)	1 (6)	0 (0)	0 (0)	1 (4)	4 (5)
Ethnicity, n (%)						
Hispanic or Latino	1 (5)	0 (0)	0 (0)	12 (92)	22 (92)	35 (44)
Non-Hispanic or Latino	17 (81)	16 (94)	4 (100)	1 (8)	0 (0)	38 (48)
Unknown	3 (14)	1 (6)	0 (0)	0 (0)	2 (8)	6 (8)
Osteoporosis Diagnosis*, n (%)	9 (43)	8 (50)	3 (75)	1(8)	5 (21)	26 (33)

Table 2: Clinical Outcomes.

Fixation Type	Patients (n)	All-Cause Reoperation (n,%)	Infection* (n,%)	Revision Osteosynthesis (n,%)	Revision Arthroplasty (n,%)
Single Plate[1,2]	21	3 (14)	2 (10)	3 (14)	1 (5)
Dual Plate[1,3]	17	5 (29)	3 (18)	2 (12)	3 (18)
Triple Plate[1,4]	4	2 (50)	1 (25)	2 (50)	1 (25)
Nail Only[1,5]	13	0 (0)	0 (0)	0 (0)	0 (0)
Nail-Plate Combination[6]	24	2 (8)	1 (4)	1 (4)	1 (4)
Total	79	12 (15)	7 (9)	8 (10)	6 (8)
P value		0.33	0.67	0.42	0.66

NPC = nail-plate combination. [1]data construct, [2]intramedullary nail involved construct, [3]single implant construct, [4]dual implant construct. *Includes superficial, deep (all fracture sites), and periprosthetic (arthroplasty sites) joint infection. [6]Comparing NPC constructs to non-NPC constructs.