Risk Factors for Nonunion Following Locked Plating of Distal Femur Fractures

***Ryan M. Graf, MD**; Natasha Simske, BS; Jordan T. Shaw, MD; Patricia Nicole Siy, BS; Alexander Siy, BS; Stephanie Kliethermes, PhD; Paul S. Whiting, MD*
University of Wisconsin - Madison, Madison, WI, United States

Purpose: Nonunion is common following locked plating of distal femur fractures. The purposes of this study were to investigate risk factors for nonunion following locked plating of distal femur fractures and to compare clinical and radiographic union using the Radiographic Union Scale for Tibial Fractures (RUST) and modified RUST scores, which have previously been validated in metadiaphyseal fractures.

Methods: We performed a 10-year retrospective review of all distal femur fractures treated with locked platingat an academic Level I trauma center. Fisher's exact test was used to assess the impact of variables including weight-bearing status and rigidity score on rates of nonunion. RUST and modified RUST scores were calculated at final follow-up or non-union diagnosis. Associations between nonunion and RUST/modified RUST scores were investigated using two-sample t tests.

Results: 78 of 90 patients (87%) achieved clinical union, for an overall nonunion rate of 13%. Rigidity score wassignificantly associated with risk of nonunion ($P = 0.002$, Table 1). No significant association was detected between nonunion and postoperative weight-bearing status ($P = 0.76$) or other previously identified risk factors. Patients who achieved fracture union had significantly higher mean RUST (10.67 vs 6.53, $P<0.001$) and modified RUST (13.47 vs 6.94, $P<0.001$) scores than patients who developed nonunion. Classification analyses identified a RUST score threshold of 9 for diagnosing clinical union (sensitivity [Sn] 93.6% and specificity [Sp] 91.7%) and a modified RUST score threshold of 8 (Sn 93.6%, Sp 91.7%).

Table 1: Impact of postoperative weight bearing, implant rigidity score, and other risk factors on nonunion rates

	Healed (n=85)	Non-Union (n=12)	p-value¥
Post-op Weight bearing			
WBAT	7 (100%)	0	0.76
50%	4 (100%)	0	
TDWB or NWB	74 (86%)	12 (14%)	
Obese			
Yes	48 (86%)	8 (14%)	0.76
No	33 (89%)	4 (11%)	
Fracture Type			
Open	5 (71%)	2 (29%)	0.21
Closed	80 (89%)	10 (11%)	
Infection			
Yes	2 (100%)	0	0.99
No	83 (87%)	12 (13%)	
Plate Type			
Stainless Steel	66 (87%)	10 (13%)	0.69
Titanium	17 (94%)	1 (6%)	
Mean Rigidity Score (SD)	2.62 (1.27)	2.83 (0.94)	0.58
Median Rigidity Score (IQR)	3 [1,4]	3 [2, 3.5]	0.89
Rigidity Score			
0	1 (100%)	0	0.002
1	28 (97%)	1 (3%)	
2	0 (0%)	3 (100%)	
3	29 (85%)	5 (15%)	
4	27 (90%)	3 (10%)	
5	0	0	

¥: Fisher Exact Test used for all categorical analyses due to small expected cell-counts. WBAT: weightbearing as tolerated; TDWB: touch-down weightbearing; NWB: non-weightbearing; SD: standard deviation; IQR: interquartile range

Conclusion: Immediate postoperative weight-bearing status did not appear to impact nonunion rates in our cohort of distal femur fractures treated with lateral locked plating. We observed a statistically significant association between rigidity score and nonunion. This study supports the utility of the RUST and modified RUST scores for determining clinically relevant union in patients with distal femur fractures treated with locked plating.