Clinical and Radiographic Outcomes of Distal Radius Fractures Following Dorsal Bridge Fixation to the Second Versus Third Metacarpal

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INTRODUCTION:
Dorsal bridge plating (DBP) of distal radius fractures (DRFs) has been described to treat patients who sustain significantly comminuted and unstable fractures, as well as polytraumatized individuals. This technique has been described with fixation to either the second or third metacarpal. The purpose of our study was to compare range of motion, grip strength, patient-reported outcomes, radiographic parameters, and complication rates between patients who undergo DBP with fixation to the second versus third metacarpals for DRFs. Our primary hypothesis was that patients undergoing dorsal bridge plating (DBP) for distal radius fractures would demonstrate significantly higher rates of tendon rupture with worse radiographic outcomes when using the third metacarpal versus the second metacarpal. Our secondary hypothesis was that patients undergoing DBP to the third metacarpal would have similar patient-reported outcomes and reduced grip strength.
METHODS: In total, 432 patients with closed distal radius fractures were retrospectively analyzed. Wrist ROM and radiographic outcomes data were calculated at 6-month follow-up. PROMIS Upper Extremity (UE), Physical Function (PF), and Pain Interference (PI) were calculated at each follow-up visit. Injury characteristics, surgical complications, and patient demographic data were also analyzed. A combination of multivariate analysis, T-test, and Chi-Square tests were used to conduct the statistical analysis.
RESULTS: A total of 329 patients underwent DBP to the second metacarpal while 103 patients underwent DBP to the third metacarpal. Demographic variables, medical comorbidities and AO/OTA fracture classification was similar between the two groups ($p>0.05$)(Table 1). Tendon rupture was more common in the third metacarpal group (0.9% vs. 3.9%; $p<0.05$), while all other complication rates were similar between groups ($p>0.05$)(Table 2). The second metacarpal group demonstrated greater wrist flexion (57.8° vs. 56.2°; $p<0.05$), ulnar deviation (23.9° vs. 20.7°; $p<0.05$), and grip strength (62.3% vs. 57.8%; $p<0.05$). Wrist extension, forearm range of motion, and radial deviation were similar between the two groups ($p>0.05$). There was no difference in PROMIS UE, PF and PI scores were similar at 6-month follow-up. The second metacarpal group further demonstrated greater radial inclination (21.3° vs. 19.5°; $p<0.05$) and less volar tilt (6.8° vs. 7.1°; $p<0.05$) with similar radial height and articular step off ($p>0.05$)(Table 3).
DISCUSSION AND CONCLUSION: Dorsal bridge plating to the second metacarpal was associated with greater range of motion including wrist flexion, ulnar deviation, and grip strength at 6-months when compared to fixation to the third metacarpal. DBP to the third metacarpal was associated with a higher rate of extensor tendon rupture. Second metacarpal fixation demonstrated greater radial inclination with less volar tilt. Dorsal bridge fixation to the second metacarpal demonstrated overall improved range of motion and radiographic outcomes with similar PROMIS scores and lower overall incidence of extensor tendon rupture when compared fixation to the third metacarpal.

Table 1: Dorsal Bridge Plate Fixation to the Second Versus Third Metacarpal Cohort Characteristics.

Characteristic	Second Metacarpal (n=329)	Third Metacarpal (n=103)	*p* value
Demographics			
Age (mean; yr)	58.3	60.2	**0.017**
BMI >40 kg/m^2 (%)	20 (6)	6 (6)	0.98
Female (%)	204 (62)	69 (67)	0.36
Race (%)			
Black or African American	16 (5)	7 (7)	0.45
White	286 (87)	89 (86)	0.89
Other	27 (8)	7 (7)	0.65
Comorbidities (%)			
Tobacco Use	115 (35)	33 (32)	0.59
Diabetes	53 (16)	19 (18)	0.58
Rheumatoid Arthritis	20 (6)	5 (5)	0.65
Hypothyroidism	23 (7)	7 (7)	0.94
AO/OTA Classification (%)			
23-A	46 (14)	18 (17)	0.38
23-B	89 (27)	29 (28)	0.83
23-C	194 (59)	56 (55)	0.41

Table 3: Dorsal Bridge Plate Fixation to the Second Versus Third Metacarpal Outcomes at 6-Month Follow-Up

Outcome	Second Metacarpal (n=329)	Third Metacarpal (n=103)	*p* value
Range of Motion (degrees; SD)			
Wrist Flexion	57.8 (5.5)	56.2 (6.3)	**0.013**
Wrist Extension	63.9 (4.8)	64.0 (3.9)	0.85
Forearm Pronation	83.3 (1.6)	83.2 (1.2)	0.56
Forearm Supination	82.9 (0.9)	83.1 (1.1)	0.06
Wrist Radial Deviation	17.3 (2.1)	17.2 (2.2)	0.68
Wrist Ulnar Deviation	23.9 (2.6)	20.7 (2.5)	**0.0001**
Grip Strength (% uninjured)	62.3 (12.8)	57.8 (13.1)	**0.002**
Patient Reported Outcomes (SD)			
PROMIS UE	33.6 (4.1)	33.8 (3.7)	0.66
PROMIS PF	43.1 (3.3)	43.6 (3.4)	0.18
PROMIS PI	52.4 (4.2)	52.7 (4.0)	0.53
Radiographic Outcomes (SD)			
Radial Height (mm)	11.7 (1.7)	11.6 (2.0)	0.68
Radial Inclination (degrees)	21.3 (3.2)	19.7 (3.5)	**0.0001**
Volar Tilt (degrees)	6.8 (1.2)	7.1 (1.5)	**0.038**
Articular Step-Off (mm)	0.80 (0.2)	0.82 (0.2)	0.38

Table 2: Dorsal Bridge Plate Fixation to the Second Versus Third Metacarpal Complication Rates

Characteristic	Second Metacarpal (n=329)	Third Metacarpal (n=103)	*p* value
Complications			
Need for Revision Surgery	18 (6)	8 (8)	0.39
Malunion	9 (3)	5 (5)	0.29
Nonunion	15 (5)	5 (5)	0.90
Superficial Infection	9 (3)	3 (3)	0.92
Deep Infection	12 (4)	3 (3)	0.72
Tendon Rupture	3 (1)	4 (4)	**0.038**