



Outcomes and Complications of First Metatarsophalangeal Joint Arthrodesis: A Comparison of Two Fixation Techniques

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Statement of Purpose

The purpose of this study is to report the outcomes and complications of 274 first metatarsophalangeal joint fusions in our patient population using two different methods of fixation, specifically dorsal plating with an interfragmentary screw placed with or without the goal of compression.

Level of evidence: Level III

Literature Review

First metatarsophalangeal joint arthrodesis (MPJA) can be used for multiple problems including arthritis, hallux valgus, and salvage of prior surgeries. First MPJA has high patient satisfaction scores and excellent functional outcomes.¹⁻³ Complications include infection, delayed union, nonunion, malunion, hardware failure and painful hardware. Reported nonunion rates vary, but systematic reviews by Roukis and Korim show nonunion rates of 5.4% and 6.5% respectively.⁴⁻⁵

Techniques vary with saw resection, curettage, and reamers utilized for joint preparation. Fixation methods including k-wires, single screw, multiple screws, intramedullary nail, staples, plate alone, or plate with compression or neutralization screw have been used. Dorsal plating has been shown to be one of the strongest constructs biomechanically and clinically, with higher union rates observed in dorsal plate constructs compared to other constructs.⁶⁻⁸

Methods

- Approval was obtained from the University of Pittsburgh Institutional Review Board.
- Records of two surgeons (PRB and JMM) were reviewed to identify patients undergoing first MPJA from January 2006 to December 2016.
- Inclusion criteria: first MPJA using one of the two fixation techniques below (figure 1) and minimum follow up to include progression to unprotected weight bearing.
- Exclusion criteria: under the age of 18, over the age of 99 and those with incomplete follow up.
- Charts were reviewed to obtain demographics and outcomes.
- Data was then analyzed using chi-square or Fisher's exact test for categorical variables and the two sample t-test for continuous variables.



Figure 1. Fixation constructs for 1st MPJA. The two fixation methods utilized were as follows: dorsal locking plate followed by placement of a positional screw across the joint after the plate was fully secured (A) or placement of a compression screw followed by dorsal locking plate (B).

Results

Table 1. Patient demographics

Demographics	Whole Group (n = 274)	DP/PS (n = 239)	DP/CS (n = 35)	p Value
Gender				
Male	79 (29%)	70 (30%)	9 (26%)	0.66
Female	195 (71%)	169 (71%)	26 (74%)	
Age (years)	54.2 +/- 10.7	54.3 +/- 11.0	54.2 +/- 8.9	0.98
Follow-up time (days)	786.6 +/- 816.3	830.1 +/- 848.5	489.7 +/- 454.0	0.001*
BMI	29.4 +/- 6.5	29.1 +/- 6.3	31.5 +/- 7.1	0.05
Obese	110 (40%)	91 (38%)	19 (54%)	0.07
Diabetes	22 (8%)	21 (9%)	1 (3%)	0.33
NIDDM	12 (4%)	11 (5%)	1 (3%)	1.00
IDDM	10 (4%)	10 (4%)	0 (0%)	0.37
Neuropathy	20 (7%)	19 (8%)	1 (3%)	0.49
RA	19 (7%)	18 (8%)	1 (3%)	0.48
Hx of Gout	16 (6%)	13 (5%)	3 (9%)	0.44
Current tobacco	92 (34%)	82 (34%)	10 (29%)	0.50
Former Tobacco	37 (14%)	30 (13%)	7 (20%)	0.29
Prior 1 st Ray Surgery	59 (22%)	52 (22%)	7 (20%)	0.81
OR for HL	148 (54%)	126 (53%)	22 (63%)	0.26
OR for HAV	23 (8%)	21 (9%)	2 (6%)	0.75
OR for HL/HAV	80 (29%)	70 (29%)	10 (29%)	0.93
OR for trauma	2 (1%)	2 (1%)	0 (0%)	1.00
OR for nonunion	14 (5%)	13 (5%)	0 (0%)	0.38
OR for implant revision	3 (1%)	3 (1%)	0 (0%)	1.00
OR for HV	4 (1%)	3 (1%)	1 (3%)	0.42
OR for osteotomy nonunion	1 (0.4%)	1 (0.4%)	0 (0%)	1.00
Autograft	14 (5%)	14 (6%)	0 (0%)	0.23
Allograft	7 (3%)	6 (3%)	1 (3%)	1.00

Table 2. Patient outcomes utilizing 2 fixation techniques

Outcome	Whole Group (n = 274)	DP/PS (n = 239)	DP/CS (n = 35)	p Value
Any complication	64 (23%)	59 (25%)	5 (14%)	0.17
Nonunion	27 (10%)	26 (11%)	1 (3%)	0.22
Painful hardware	33 (12%)	29 (12%)	4 (11%)	1.00
Broken hardware	13 (5%)	13 (5%)	0 (0%)	0.38
Infection	8 (3%)	6 (3%)	2 (6%)	0.27
Revision surgery	16 (6%)	16 (7%)	0 (0%)	0.24
Hardware removal	29 (11%)	26 (11%)	3 (9%)	1.00
Wound complication	2 (1%)	1 (0.4%)	1 (3%)	0.24

Table 3. Risk factors for developing any complication

Demographics	Any Complication (n = 64)	No Complication (n = 210)	p Value
Age (years)	51.5 +/- 9.2	55.1 +/- 11.0	0.02*
Follow-up time (days)	1352.3 +/- 876.9	614.2 +/- 714.7	<0.0001*
BMI	31.8 +/- 7.2	28.7 +/- 6.1	0.001*
Obese	36 (56%)	74 (35%)	0.003*
Current tobacco	33 (52%)	59 (28%)	0.001*
Prior 1 st Ray Surgery	26 (41%)	33 (16%)	<0.0001*
OR for HL	27 (42%)	121 (58%)	0.03*
OR for nonunion	7 (11%)	6 (3%)	0.01*
OR for implant revision	3 (5%)	0 (0%)	0.01*
Autograft	10 (16%)	4 (2%)	0.0001*

Data presented as n (%) or mean +/- STD

Abbreviations: DP/PS, dorsal plate/positional screw; DP/CS, dorsal plate/compression screw; NIDDM, non-insulin dependent diabetes mellitus; IDDM, insulin-dependent diabetes mellitus; HL, hallux limitus; HAV, hallux abductovalgus; HV, hallux varus

*statistical significance, p <0.05

Complications (n = 64)

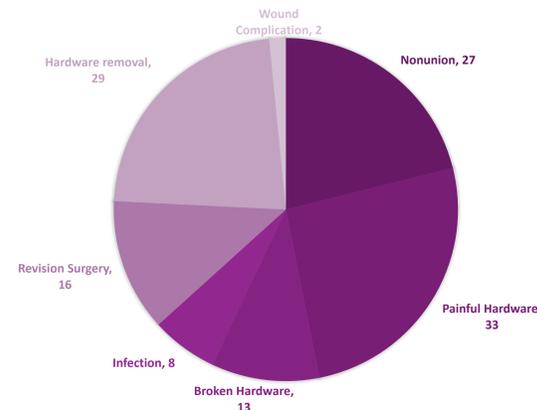


Figure 2. Breakdown of total complications

Table 4. Risk factors for developing nonunion

Demographics	Nonunion (n = 27)	Union (n = 247)	p Value
Age (years)	50.0 +/- 10.3	54.7 +/- 10.7	0.03*
Follow-up time (days)	1166.4 +/- 731.1	745.1 +/- 815.4	0.01*
Current tobacco	18 (67%)	74 (30%)	0.0001*
OR for HL	9 (33%)	139 (56%)	0.02*
Autograft	4 (15%)	10 (4%)	0.04*
Allograft	3 (11%)	4 (2%)	0.02*

Table 5. Risk factors for developing painful hardware

Demographics	Painful hardware (n = 33)	No painful hardware (n = 241)	p Value
Follow-up time (days)	1383.0 +/- 916.0	704.9 +/- 768.4	<0.0001*
BMI	31.9 +/- 7.1	29.1 +/- 6.3	0.02*
Obese	19 (58%)	91 (38%)	0.03*
Prior 1 st Ray Surgery	17 (52%)	42 (17%)	<0.0001*
OR for nonunion	6 (18%)	7 (3%)	0.002*
Autograft	7 (21%)	7 (3%)	0.0004*

Discussion

First MPJA is a versatile procedure with predictable outcomes. In our patient population there were 64 total complications. Patients who were obese, current smokers and those who had a longer follow-up time were significantly more likely to experience any complication. Patients with a history of prior first ray surgery in any form and those undergoing 1st MPJA for nonunion or implant revision were also more likely to experience any complication. The most common complications were nonunion and painful hardware.

Complications seen in patients with prior first ray surgery may be related to the development of scar tissue and adhesions, tissue damage from prior surgery, bone deficits requiring autograft or allograft, or the need for more substantial hardware for revision arthrodesis. These results have clinical implications for practitioners as first MPJA remains the gold standard for end-stage arthritis and deformity. Attempting joint salvage procedures such as cheilectomies and decompressive osteotomies or implant arthroplasties may not be without future implications should revision surgery and arthrodesis be needed later.

There were no statistically significant differences in outcomes among the two fixation groups. Prior studies comparing different plating fixation techniques have also shown no difference in overall outcome.⁹ Construct stability, rather than compression across the arthrodesis site, seems to be the important factor in avoiding nonunion and dorsal plating has been shown to provide more stability than other fixation techniques.⁶

Conclusion

To our knowledge this is the largest single-center study reporting outcomes of 1st MPJA. The results again confirm that it is a reliable, reproducible procedure. Dorsal plating with a positional screw results in similar outcomes as dorsal plating with a compression screw. A history of prior first ray surgery in any form leads to an increased rate of complications following fusion, particularly the occurrence of painful hardware.

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