

# Arthrodesis of the First Metatarsophalangeal Joint

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## Abstract

Arthrodesis has emerged as the primary salvage procedure for severe osteoarthritis of the first metatarsophalangeal (MTP) joint. Forty-three patients underwent arthrodesis of the first MTP joint with stabilization provided by either 2 crossed lag-screws or a dorsal plate and screws. First MTP joint arthrodesis was the primary procedure for 46 of the 54 treated feet. Joint surfaces were shaped into a ball-and-socket configuration to augment joint surface contact and facilitate alignment for arthrodesis. Postoperative care involved using a compressive bandage, a surgical shoe, and a cane, crutches, or a walker. Partial weight-bearing was allowed immediately after surgery. Few casts were used postoperatively.

At a mean of 21.7 months (median, 13.5 months), 34 of the 43 patients completed a brief telephone survey about surgical outcomes. Radiographic measurements of intermetatarsal, hallux valgus, inclination, and dorsiflexion angles were made preoperatively and postoperatively. Mean time to fusion was 7.3 weeks; arthrodesis was successful for 50 of 52 feet (radiographs were missing for 2 of the 54 feet treated). Internal fixation devices were removed from 5 feet. Thirty (88.2%) of the 34 patients rated their result as excellent or good; the other 4 (11.8%) rated their result as poor.

Arthrodesis of the first metatarsophalangeal (MTP) joint was first described, by Clutton<sup>1</sup> in 1894, as a salvage procedure for end-stage arthritis. Recently, this technique has gained attention as a primary reconstructive operation because of the high failure rate and morbidity associated with silicone implantation and resection arthroplasty.<sup>2,3</sup> Current indications for arthrodesis of the first MTP joint include severe osteoarthritis, end-stage hallux rigidus, severe hallux valgus, hallux varus, rheumatoid arthritis, failed implantation arthroplasty, symptomatic resection arthroplasty, and recurrent hallux valgus.<sup>4-8</sup>

It is now generally accepted that arthrodesis of the first MTP joint provides improved outcomes as compared with resection arthroplasty with or without implantation.<sup>6,9-12</sup>

The goal of this retrospective review is to determine results and subjective outcomes in a diverse patient population undergoing arthrodesis of the first MTP joint. In what was initiated as a quality review, we hoped to determine whether our results mirror the reports from the current literature.

## Methods

Over 6 years, arthrodesis of the first MTP joint was performed on 55 patients (66 feet) by 4 surgeons at the Loyola University Medical Center and the Edward R. Hines, Jr. Veterans Administration Hospital. There were 33 male patients and 22 female patients. Ages ranged from 24 to 87 years (mean, 61.0 years). Follow-up ranged from 6 to 58 months (mean, 21.7 months; median, 13.5 months). Of the 55 patients, 37 had surgery for end-stage osteoarthritis of the first MTP joint (4 of these had previous surgery to correct hallux valgus, and 4 had previous Silastic<sup>®</sup> implantation), 27 had surgery for rheumatoid arthritis, and 2 had surgery for psoriatic arthritis. To be included in the study group, patients had to have preoperative and postoperative weight-bearing dorsoplantar and lateral radiographs (Table I).

Ten patients were lost to follow-up or had incomplete radiographs, and 2 patients had structural iliac crest bone graft placed for loss of metatarsal bone length—leaving 43 patients (54 feet) in the study population.

Surgery was performed in an ambulatory surgical center. Regional nerve block anesthesia was used. Joint surfaces were prepared with cup and cone reamers.<sup>7</sup> The goal for joint positioning was 15° of hallux valgus and 15° of dorsiflexion of the proximal phalanx. Provisional fixation was done with a 0.062-inch Kirschner wire (K-wire). In 6 of 51 feet, the K-wire was left in place; in the other 45 feet, it was replaced with a cancellous bone screw applied using a compression technique. Dorsally applied contoured titanium plates were used for stabilization in 40 (73%) of 55 feet. A 6-hole plate was used for 17 feet, and a 4-hole plate was used for 23 feet. One-third tubular

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TABLE I. RADIOGRAPHIC VALUES

Measured Angle	Preoperative		Postoperative	
	Mean	Range	Mean	Range
Intermetatarsal	12.4	3 to 28	9.4	0 to 18
Hallux valgus	39.1	0 to 74	16.7	0 to 64
Dorsiflexion	28.0	18 to 60	26.8	0 to 50
Inclination	6.9	16 to 38	8.7	0 to 23

stainless steel plates were used for 11 feet. Three procedures were performed with a crossed lag-screw technique. Postoperative management involved immediate weight-bearing with a commercial rigid postoperative shoe; this lasted until the patient was able to wear a loose-fitting athletic shoe (4-6 weeks). Five patients wore a short-leg walking cast for associated hindfoot surgery. Occasionally, a patient uncomfortable wearing the postoperative shoe was switched to a commercial fracture boot.

Radiographic measurements were made from standard weight-bearing dorsoplantar and lateral radiographs. Intermetatarsal angle was defined as the angle measured between the long axis of the first metatarsal and the long axis of the second metatarsal; hallux valgus angle was defined as the angle between the long axis of the first metatarsal and the proximal phalanx as measured on the dorsoplantar radiograph; dorsiflexion angle was defined as the angle between the long axis of the first metatarsal and the long axis of the proximal phalanx as measured on the lateral radiograph; and inclination angle was defined as the angle between the long axis of the proximal phalanx and the weight-bearing surface.

At least 1 year after surgery, 34 (79%) of 43 patients completed a brief telephone survey about surgical outcomes. (Of these 34 patients, 7 had had bilateral surgery.) Patients were asked 3 questions:

1. How would you rate the result of your big toe joint surgery?  
*Excellent*—without problems, very satisfied, no pain, walks without difficulty  
*Good*—a few problems, satisfied, mild pain, walks without difficulty, glad underwent surgery  
*Fair*—moderate pain, limited walking, reservations about success of surgery  
*Poor*—continued pain, little improvement in walking ability, regrets undergoing surgery
2. On a scale of 1 to 10, how would you rate overall improvement after your surgery?
3. Knowing what you now know, would you have the surgery?<sup>4,9</sup>

**Results**

Clinical union was defined as no pain at the MTP joint with application of manual stress, and no

TABLE II. RESPONSES TO PATIENT SURVEY QUESTIONS

Response	n	%
1. How would you rate the result of your big toe joint surgery?		
Excellent	22	64.7
Good	8	23.5
Fair	0	0
Poor	4	11.8
Mean		Range
	8.0	1-10
2. On a scale of 1 to 10, how would you rate overall improvement after your surgery?		
	8.0	1-10
3. Knowing what you now know, would you have the surgery?		
Yes	28	82.4
No	6	17.6

\*Thirty-four patients completed a brief telephone survey about surgical outcomes. Excellent indicates without problems, very satisfied, no pain, walks without difficulty; good, a few problems, satisfied, mild pain, walks without difficulty; fair, moderate pain, limited walking, reservations about success of surgery; poor, continued pain, little improvement in walking ability, regrets undergoing surgery.

motion, after a minimum of 4 weeks. Mean time to clinical union was 7.3 weeks (range, 5-20 weeks). Clinical union was confirmed with radiographs in 50 (96%) of 52 feet (radiographs were missing for 2 of the 54 feet treated). Radiographic values are listed in Table I.

At a mean of 21.7 months (median, 13.5 months), 34 of the 43 patients completed a brief telephone survey about surgical outcomes. On the outcomes survey, 22 (64.7%) of 34 patients rated their surgical result excellent, 8 (23.5%) rated it good, and 4 (11.8%) rated it poor; no one rated the result fair (Table II). Patients also rated symptom improvement on a scale ranging from 1 to 10; mean score was 8.0 (range, 1-10). Twenty-eight (82.4%) of the 34 patients said that they would have the procedure done again; the other 6 (17.6%) said they would not.

Regarding complications, 4 patients (all asymptomatic) had clinical and radiographic nonunion, 3 had delayed union (>10 weeks' delay in clinical and radiographic union), 1 had a deep infection requiring sur-

gical débridement and parenteral antibiotic therapy, 6 had a superficial infection that responded to local wound care and oral antibiotic therapy (4 of these patients had rheumatoid arthritis), 1 had a myocardial infarction after surgery, 4 had late-transfer metatarsalgia, and 5 had to have the internal fixation device removed (for various reasons).

### Discussion

As part of a quality initiative, we wished to retrospectively evaluate the clinical results of MTP joint arthrodesis of the first ray. We chiefly used this technique as a primary procedure for severe hallux rigidus and osteoarthritis of the first MTP joint when a more limited cheilectomy could not be performed. Simple resection arthroplasty has been replaced by this technique in treating all but the most limited ambulatory geriatric patients. We used this procedure as a salvage operation after failed hallux valgus and Silastic implantation surgery.<sup>11,13</sup> It was our procedure of choice for symptomatic rheumatoid forefoot deformity.

Our results seem comparable to those of previously published series. The amount of perioperative morbidity and patient inconvenience was minimal. Deformity was easily correctable without additional metatarsal osteotomy. After fusion was solid, recurrence seemed unlikely. Conical reaming seems to reduce the likelihood of significant first metatarsal shortening by removing a minimal amount of bone, as evidenced by late-transfer metatarsalgia for only 4 patients. Another technical benefit is the large, stable surface area available for joint positioning and stabilization. The surgery was performed with regional nerve block anesthesia in the ambulatory setting.

Thirty-five of 55 patients did weight-bearing ambulation with a surgical shoe and crutches or a walker, 15 were initially placed in a removable cast boot for added protection and were then advanced to a surgical shoe, and 5 required below-knee casting because additional hindfoot reconstructive surgery was performed at the same time.<sup>11</sup>

### Morbidity Analysis

Complications included nonunion, delayed union, superficial and deep wound infection, need for hardware removal, suture reaction, interphalangeal arthritis, and metatarsalgia. The difference in frequency of complications between inflammatory arthritis and osteoarthritis was not statistically significant.

Analysis of morbidity and poor patient outcomes provided some insights. All 4 patients who rated their result poor had complications. One patient with bilateral procedures done at once had a postoperative myocardial infarction. Four of the 6 superficial infections occurred in patients with rheumatoid arthritis.

All the patients who rated their result poor indicated that they would not have the procedure done again. One patient with an excellent result and 1 with a good result indicated that they would not have the procedure again (both complained of late metatarsalgia). Three of the 4 patients with nonunions rated their result excellent and remained asymptomatic—in agreement with outcomes in previous reports.<sup>12,14-16</sup> Three of the 4 nonunions and 2 of the 3 delayed unions occurred with use of the 4-hole plate; the third delayed union occurred with the 6-hole plate. The numbers were too small to achieve statistical significance relative to the type of metal in the plate or to the length of the plate, but this trend was certainly striking.

The 11% infection rate may well be related to the high proportion of patients with rheumatoid arthritis (4 of 6 infections). One patient developed a wound infection in a surgical field separate from the first MTP joint arthrodesis site. Another patient developed a postoperative infection that required surgical débridement and parenteral antibiotic therapy. The rest of the postoperative infections were successfully treated with local wound care and oral antibiotic therapy.

### Metatarsalgia; Lesser Metatarsal Surgery

Half the patients in the study had lesser metatarsal surgery performed at the same time as the first MTP arthrodesis. Four patients complained of lesser metatarsalgia postoperatively. Three of the patients with rheumatoid arthritis had resection of the remaining metatarsal heads in addition to fusion of the first MTP joint. The patient who did not complain of metatarsalgia preoperatively had a second metatarsal head resected as part of a hammertoe correction. We did not observe a significant increase in morbidity among patients who underwent lesser toe or metatarsal surgery at the same time.

Shortening of the first metatarsal is a concern with fusion of the first MTP joint. A short first metatarsal may lead to lesser metatarsalgia, particularly when fusion of the first MTP joint is the only procedure performed. Conical reaming reduces the likelihood of significant first metatarsal shortening by removing a minimal amount of bone to achieve sound bone-on-bone contact and a desired position. We did not measure or compare the amount of first metatarsal shortening in this study because 50% of the patients had a pan or partial metatarsal head resection performed at the same time. Shortening is less of an issue when first MTP joint arthrodesis is performed with pan metatarsal head resection, as a new distal metatarsal parabola is established.

### Conclusions

The results of this retrospective review suggest that arthrodesis of the first MTP joint is a predictable treat-

ment option for the severely arthritic joint. This surgery has low surgical morbidity and can be performed with local anesthesia in the ambulatory setting. In addition, the procedure allows for immediate weight-bearing, and patients can remain independent. First MTP joint arthrodesis is an attractive alternative to resection and silicone implantation arthroplasty and is a good choice for a primary joint destructive procedure.

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### Correction

The following paragraph from the *Tips of the Trade* article written by E. P. Su and colleagues was published only in part in the previous issue of the journal. The following is the complete paragraph:

Here we describe a new method—using suture anchors to secure the clavicle to the coracoid process. We have found suture anchors technically easier to place than CC screws or wires. Furthermore, results of a recent cadaveric study showed that CC suture anchors provided strength similar to that of the CC ligament with respect to uniaxial loading.<sup>7</sup>

For a free copy of the complete and corrected article, please see our website at [www.amjorthopedics.com](http://www.amjorthopedics.com). Our apologies to the authors and our readers for this error.