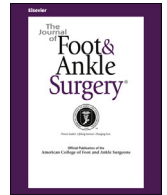




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Original Research

A Consecutive Case Series of 166 First Metatarsophalangeal Joint Fusions Using a Combination of Cup and Cone Reamers and Crossed Cannulated Screws

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ABSTRACT

Fusion of the first metatarsophalangeal joint (MTPJ) is the reference standard surgery for significant hallux rigidus. A number of different techniques for first MTPJ fusion have been reported. We describe our technique of first MTPJ fusion using cup and cone reamers for joint surface preparation and 2 crossed cannulated screws for fixation. To the best of our knowledge, this is the single largest series using this technique. The present study reports on a single-surgeon, consecutive series of 166 consecutive cases in 147 patients who had undergone first MTPJ fusion. The demographic data and comorbidities of the patients were collected from the digital medical records, and the radiographs were evaluated by 2 of us (S.Q., M.A.) independently to document fusion status. Radiologic nonunion was seen in 11 of 166 cases (6.6%). The mean duration of follow up was 60 ± 29.5 (minimum 26, maximum 183) days. However, only 4 of the 11 cases (36%) of nonunion were clinically symptomatic and underwent revision using a bone graft and locking plate. A statistically significant difference was found in union rates among males and females ($p = .01$). Other factors, such as diabetes ($p = .2$), inflammatory arthritis ($p = .5$), steroids ($p = .6$), smoking ($p = .5$), hallux valgus deformity ($p = .5$), and concomitant forefoot surgery, did not have a statistically significant ($p = .3$) effect on union in our study. The union rate of first MTPJ fusion with our technique was comparable to that of others, with the advantage of being simple and less expensive compared with the use of a plate.

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Hallux rigidus was first reported by Davies-Colley (1) in 1887. This is the second most common condition to affect the first ray after hallux valgus (2), with an incidence of 2.5% in patients >50 years (3). Various nonoperative (4) and operative options are available to treat symptomatic hallux rigidus. Operative treatment is offered when conservative options have been exhausted or the disease is at an advanced stage. The various surgical options include cheilectomy (5), osteotomy (6), soft tissue arthroplasty (7), implant arthroplasty (8), and arthrodesis. However, arthrodesis remains the reference standard procedure for advanced hallux rigidus (9).

Although several studies have reported on metatarsophalangeal joint (MTPJ) fusion, to the best of our knowledge, the present study is the

single largest study of a combination of cup and cone reamers and cannulated screws.

Patients and Methods

This retrospective cohort study was performed at Leicester General Hospital using data from the lead surgeon's (M.B.) electronic log book (available at: www.elogbook.org). We filtered the surgery using the dates February 1, 2009 to December 31, 2015 and the procedure name "first MTPJ arthrodesis" and Office of Population Censuses and Survey Classification of Interventions and Procedures, version 4 (OPCS4), code W593. OPCS-4 is used in National Health Service coding.

We collected the clinical and radiologic data for 166 consecutive procedures in 147 patients from February 2009 to December 2015 (71 months). All the operations had been performed by the senior author (M.B.) or under his direct supervision. Basic demographic data were collected from the digital patient records by 2 of us (M.A., S.Q.). Data were also recorded by 1 of us (S.K.) on patient comorbidities, including diabetes, hallux valgus, inflammatory arthritis, smoking, and medications, such as steroids, immunosuppressants, and anticoagulants (Table 1).

We included all adult patients who had undergone first MTPJ fusion using cup and cone reamers and fixation using 2 crossed 3.5-mm cannulated screws. The exclusion

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Table 1
Comorbidities, medications, and forefoot surgery (N = 166 procedures in 147 patients)

Condition	Union [n (%)]	Nonunion [n (%)]	Total [n (%)]	p Value
Immunocompromised/steroid use	9 (5.4)	0	9 (5.4)	.59
Anticoagulant use	1 (0.6)	1 (0.6)	2 (1.2)	.50
Diabetes mellitus	4 (2.4)	1 (0.6)	5 (3)	.22
Current smokers	6 (3.6)	0	6 (3.6)	.50
Inflammatory arthritis	18 (10.8)	0	18 (10.8)	.53
Hallux valgus	98 (59)	6 (3.6)	104 (62.7)	.54
Concomitant forefoot surgery	40 (24.1)	1 (0.6)	41 (24.7)	.31
Metal work removal	15 (9.04)	4 (2.4)	19 (11.5)	.29

Data showing complexity of cases with union rates and p value (Mann-Whitney U test).

criteria were incomplete follow-up data, revision procedures, age <18 years, and any variation in the technique.

The radiographs were assessed independently by 2 of us (M.A., S.Q.), who were not involved in the surgery, for assessment of union, using the picture archiving and communication system of East Midlands Radiology Consortium. The electronic surgical records were also analyzed using the ORMIS Theatre Management (Computer Sciences Corporation; Tysons Corner, VA) to determine the implants used, date of surgery, additional procedures performed, metal work removal, and revisions. The primary outcome was radiologic union, defined as bridging callus in ≥ 3 of 4 cortices on 2 orthogonal views.

Surgical Technique and Postoperative Care

All the operations were performed with the patient under general anesthesia. A thigh tourniquet was applied. The surgery was performed using a medial approach to the joint. The joint surfaces were prepared using cup and cone reamers for surface preparation (HALLU1 ream; Integra Neurosciences Ltd., Hampshire, UK; proximal and distal reamers, DePuy Synthes, Raynham, MA; Figs. 1 and 2). Next, provisional fixation was performed using 2 crossed guidewires under radiographic guidance with the great toe in neutral position in the coronal plane and in 5° to 10° of dorsiflexion (Fig. 3). The foot was placed against a flat surface to confirm a satisfactory position before final fixation. After confirming the position, 2 partially threaded, 3.5-mm crossed cannulated screws were used for definitive fixation (Ortho Solutions Ltd., Maldon, UK; DePuy Synthes; Fig. 4).

The patients were permitted full weightbearing mobilization in postoperative shoes with off-loading (OrthoWedge; DARCO International, Huntington, WV). After discharge, all the patients were seen at 2 weeks postoperatively for a wound check and

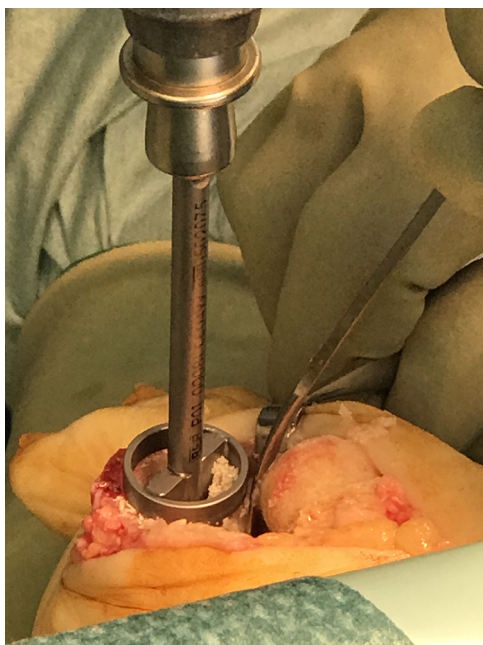


Fig. 1. Photograph of cone phalangeal reamer.

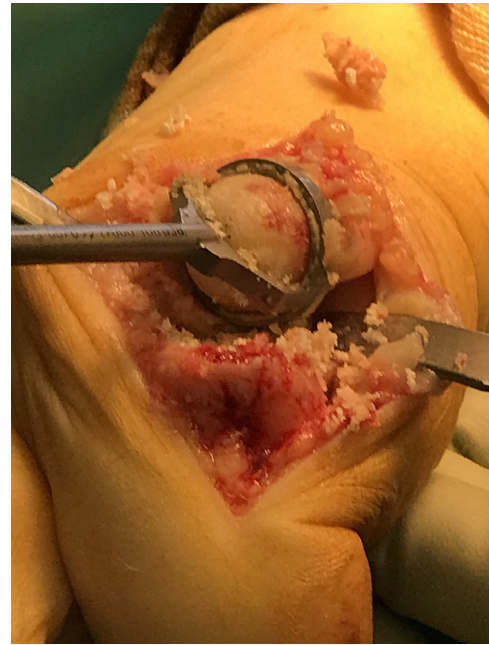


Fig. 2. Photograph of cup metatarsal reamer.

at 6 weeks for radiographs (Fig. 5). The postoperative shoe was removed once radiologic healing was complete, which was the case for most of the patients.

We collected data retrospectively using the electronic log book of the lead author (M.B.), digital hospital records, and East Midlands Radiology Consortium picture archiving and communication software. The data were compiled using an Excel Workbook (Microsoft, Redmond, WA).

Radiographic Signs

The criteria for union was bridging callus visible on ≥ 3 of 4 cortices (medial and lateral cortex on the anteroposterior view and the dorsal and planter cortex on the lateral view). Hallux valgus was defined as metatarsophalangeal angle of $>15^\circ$ (10).

Statistical Analysis

Statistical analysis was performed using SPSS, version 20 (IBM Corp., Armonk, NY). The Mann-Whitney U test was used to compare categorical variables. A p value $\leq .05$ was considered to indicate statistical significance to reject the null hypothesis.



Fig. 3. Intraoperative view of toe alignment.

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