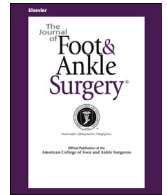


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Original Research

Fusion of the First Metatarsophalangeal Joint and Second to Fifth Metatarsal Head Resection for Rheumatoid Forefoot Deformity

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ABSTRACT

The goals of the present study were to evaluate the mid-term results of first metatarsophalangeal joint fusion combined with second to fifth metatarsal head resection in rheumatoid forefoot deformity and identify the prognostic factors. The inclusion criteria were 2010 American College of Rheumatology and/or European League Against Rheumatism criteria for rheumatoid arthritis; symptomatic forefoot deformity; first metatarsophalangeal joint fusion and second to fifth metatarsal head resection; and a minimum of 4 years of follow-up data available. The patients were evaluated using the Disease Activity Score 28 for rheumatoid arthritis, Health Assessment Questionnaire for Rheumatoid Arthritis, Foot Function Index, forefoot American Orthopaedic Foot and Ankle Society scale, and weightbearing radiographs. Different pre-, intra-, and post-operative variables were investigated to identify the prognostic factors. Sixty-two patients (89 feet) with a mean age of 60.8 ± 9.4 years and 85.5 ± 22.4 months of follow-up data were included. The preoperative American Orthopaedic Foot and Ankle Society scale score was 33.4 ± 16 points and improved significantly ($p < .001$) after surgery (mean 82.9 ± 11.7 points). The mean Foot Function Index improved significantly ($p < .001$) from 131.6 ± 37.4 to 77.4 ± 46.3 points at the last follow-up visit. Only the revision surgery variable was significantly ($p = .02$) related to poor outcomes. Revision was necessary in 8 feet (9%). This procedure produced satisfactory results. Poor outcomes were significantly related to the necessity for revision surgery for nonunion, malunion, inadequate metatarsal resection, and painful hardware.

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Foot involvement in patients affected by rheumatoid arthritis (RA) ranges from 80% to 90%, and 25% to 40% of the surgeries are performed on the forefoot (1). The pathomechanical features of RA foot deformities include distension of capsules and ligaments, erosion of the metatarsal heads, and dislocation of the metatarsophalangeal (MTP) joints. The hallux will commonly show a valgus deviation with pronation. The plantar plate and fat pad will be stretched dorsally and will have lost their shock absorption function. In the end stages, the lesser toes show a clawing deformity (Fig. 1). The loss of weightbearing capacity of the first ray results in metatarsalgia and callus formation (2–4).

When conservative treatment fails and the RA is well controlled, surgery could be indicated. Hoffmann (5) described resection

arthroplasty of all MTP joints. Other types of resection arthroplasty were described by Mayo (6) and Keller (7) and others (8,9). Joint preserving procedures include subcapital metatarsal osteotomies (2,10–12). Although some investigators still use panmetatarsal resection and joint preserving procedures (2,10–12), some reports have described high recurrence rates (1,13). Therefore, currently one of the most common procedures for hallux valgus with second to fifth MTP joint dislocation in RA patients is first MTP joint fusion combined with second to fifth metatarsal head resection (3,14–17). The goals of the present study were to evaluate the mid-term results of first MTP joint fusion combined with second to fifth metatarsal head resection with a plantar approach in rheumatoid forefoot deformity and to identify the prognostic factors (pre-, intra-, and postoperative) related to the outcomes.

Patients and Methods

All procedures were in accordance with the ethical standards of the institutional research committee and with the Declaration of Helsinki. According to our state laws, no institutional review board approval is required for observational studies.

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Conflict of Interest: None reported.

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Fig. 1. Preoperative clinical (A, B) and radiographic weightbearing anteroposterior (C) views of rheumatoid forefoot deformity.

Patients meeting the inclusion criteria were prospectively followed up. The inclusion criteria were patients meeting the 2010 American College of Rheumatology and European League Against Rheumatism criteria for RA (18); (2) symptomatic hallux valgus with dislocation of the lesser MTP joints with or without claw deformity of the lesser toes; (3) first MTP joint fusion and second to fifth metatarsal head resection with or without interphalangeal (IP) resection arthroplasty of the lesser toes; and (4) a minimum of 4 years of follow-up data available. The exclusion criteria were the presence of other forefoot deformities or other rheumatic conditions and/or the use of associated mid- or hindfoot procedures. From 2001 to 2009, 72 patients (101 feet) were included.

Preoperative Evaluation

Preoperatively, weightbearing anteroposterior and lateral radiographs were taken, together with oblique views of the feet. Dislocation of the MTP joints and claw toe deformities were assessed (Fig. 1C). In addition, the first to second intermetatarsal angle and first MTP angle were measured.

The Disease Activity Score 28 and Health Assessment Questionnaire were calculated to assess the activity of RA and the effect of the disease on daily living. Whether the RA presented in an aggressive form or not was recorded. RA was considered aggressive in the case of involvement of multiple joints with severe deformity, bony erosions, high rheumatoid factor, and anticitrullinated protein antibody (>3 times the upper limit), as previously described (18). The patients completed the Foot Function Index (FFI) and forefoot American Orthopaedic Foot and Ankle Society (AOFAS) scale (19). Similar to other studies using the AOFAS scale (3,15,16), the whole forefoot (including hallux and lesser toes) was evaluated for the following items: IP motion, alignment, and callus formation (Table 1).

Surgical Technique

A dorsomedial approach to the first MTP joint was used (Fig. 2). The residual cartilage was removed from the first MTP joint (Fig. 2). Arthrodesis was performed with 30° of dorsiflexion in relation to the first metatarsal shaft or 10° in relation to the plantar aspect of the foot, with 10° to 15° of valgus. The choice of fixation device depended on bone quality. In >90% of cases, compression staples were used (Fig. 2). Other fixation devices included headless compression screws (3%), Kirschner wires (2%), plate and screws (2%), and staples combined with Kirschner wires (2%).

All the patients received a plantar incision for circumferential release of the metatarsal heads (20) (Fig. 3). The heads were resected at the level of the metaphysis with an oscillating saw directed 45° from proximally to distally and plantarly to

dorsally, with a 1 = 2 > 3 > 4 > 5 metatarsal formula (Fig. 3). Only in the case of a severe deformity of the second to fifth MTP joints or combined IP resection arthroplasty, was Kirschner wire fixation used (197 lesser toes; 55.3%). When necessary, additional procedures on the lesser toe IP joints were performed (Fig. 3).

Postoperatively, weightbearing on the hindfoot was allowed 24 to 48 hours after surgery with a forefoot offloading shoe. The Kirschner wires were removed 3 weeks after surgery. The forefoot offloading shoe was discontinued 40 days after surgery.

Clinical Evaluation

The patients were prospectively followed up clinically and radiographically at 40 days, 3 months, and 1 year postoperatively and annually thereafter. The forefoot AOFAS scale and FFI (21) were administered 1 year after surgery and at the last follow-up visit. At the last follow-up examination, the patients were asked to express their satisfaction regarding the surgery as very satisfied, satisfied, dissatisfied, and very dissatisfied.

Radiographic Evaluation

Radiographs (weightbearing anteroposterior, lateral, and oblique views of the feet, just as preoperatively) were obtained 40 days, 3 months, and 1 year postoperatively and annually thereafter. Maintenance of the postoperative correction was evaluated. The 1-2 intermetatarsal angle, first MTP angle, and dorsiflexion angle of fusion (between the first metatarsal longitudinal axis and proximal phalanx longitudinal axis on the sagittal plane) were measured (Fig. 4) (15).

Different variables were investigated to find an association with the outcomes. The preoperative variables included age, sex, follow-up period, interval from RA diagnosis, bilaterality, aggressiveness of RA, preoperative first MTP angle, preoperative 1-2 intermetatarsal angle, Disease Activity Score 28 score, and Health Assessment Questionnaire score. The intraoperative factor was the use of associated procedures. The postoperative factors included revision, first and second intermetatarsal angle, first MTP angle, and dorsiflexion fusion angle.

Statistical Analysis

A paired *t* test was used to compare the AOFAS scale and FFI scores before and after surgery (normality tested using the D'Agostino-Pearson test). The correlation between the outcome measures was tested with Spearman's rho. A simple logistic regression analysis was performed. All statistically significant ($p < .05$) or close to significance

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