The Journal of Foot & Ankle Surgery 54 (2015) 848–851

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Short-Term Clinical Outcome of Hemiarthroplasty Versus Arthrodesis for End-Stage Hallux Rigidus

Karin H. Simons, MD [1], Pieter van der Woude, MD [2], Frank W.M. Faber, MD, PhD [3], Paulien M. van Kampen, PhD [4], Bregje J.W. Thomassen, PhD [5]

[1] Resident, Department of Orthopaedic Surgery, Medical Centre Haaglanden, The Hague, The Netherlands
[2] Orthopedic Surgeon, Department of Orthopaedic Surgery, Medical Centre Haaglanden, The Hague, The Netherlands
[3] Orthopedic Surgeon, Department of Orthopaedic Surgery, HAGA Hospital, The Hague, The Netherlands
[4] Research Coordinator, Department of Orthopaedic Surgery, HAGA Hospital, The Hague, The Netherlands
[5] Research Coordinator, Department of Orthopaedic Surgery, Medical Centre Haaglanden, The Hague, The Netherlands

ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
arthrodesis
first metatarsophalangeal joint
hallux rigidus
hemiarthroplasty

ABSTRACT

Few data are available to compare the outcomes of first metatarsophalangeal joint (MTPJ) hemiarthroplasty and arthrodesis. We included 46 patients who had undergone BioPro® first MTPJ hemiarthroplasty and 132 who had undergone arthrodesis, with a minimum follow-up duration of 12 months. The primary outcome was patient satisfaction, which was determined using binominal questions. The Foot and Ankle Outcome Score, Foot Function Index, and Numerical Rating Scale for pain and limitations questionnaires were also used. The secondary outcome was treatment failure. No differences were found in the satisfaction rate ($p = .54$) after a median period of 38.4 (range 12 to 96) months and 39.8 (range 12 to 96) months in the hemiarthroplasty and arthrodesis patients, respectively. Furthermore, no differences were found in the failure rates ($p = .93$) or the interval to failure ($p = .32$).The results of the present study showed no significant differences in the short-term clinical outcomes and failure rates for BioPro® first MTPJ hemiarthroplasty and arthrodesis. Prospective comparative studies are required to determine whether BioPro® first MTPJ hemiarthroplasty is a good alternative for first MTPJ arthrodesis in the long term.

Arthrodesis is still considered the reference standard for the treatment of severe hallux rigidus (1–3). However, arthrodesis has been criticized, because it eliminates all first metatarsophalangeal joint (MTPJ) motion and can be complicated by delayed union or nonunion and malposition of the phalanx and could increase stress on the adjacent joints (4). BioPro First MPJ Hemiarthroplasty® (BioPro, Port Huron, MI) partially replaces the articular surface of the proximal phalanx and seems to maintain joint function in the earlier postoperative period in contrast to arthrodesis. However, hemiarthroplasty survival is uncertain, and complications such as loosening of the implant, infections, arthrofibrosis, mechanical deformity, and persistent pain have been reported (3,5,6). Published studies have reported ambivalent results for first MTPJ hemiarthroplasty, with a limited number of studies reporting satisfying results (5–8). In contrast, arthrodesis is more predictable in its outcome. Only a few short-term comparative studies of first MTPJ hemiarthroplasty and arthrodesis have been published and included only small numbers of patients. None have been conclusive enough to define which procedure is superior (3,4). Therefore the most effective choice for treating end-stage hallux rigidus remains debatable. The aim of the present study was to evaluate and compare the satisfaction rate, failure rate, and other short-term results of patients with end-stage hallux rigidus who had undergone BioPro® first MTPJ hemiarthroplasty or first MTPJ arthrodesis.

Patients and Methods

A retrospective comparative cohort study was conducted. Patients with end-stage hallux rigidus who had undergone first MTPJ hemiarthroplasty (BioPro®) or first MTPJ arthrodesis from January 2005 to March 2012 were eligible. Patients were included if the follow-up period was >1 year. Deceased patients (n = 6) and patients who had undergone revision arthrodesis (n = 4) were excluded. The medical ethical review board decided that no approval was necessary (METCZWH, no.13-043).

In the present study 178 patients were eligible, including 46 hemiarthroplasty patients and 132 arthrodesis patients. The patients who had undergone bilateral foot surgery were included in the study for both feet, including 4 hemiarthroplasty and 18 arthrodesis patients.

The basic demographic data, information on smoking status, surgery side, preoperative pain, previous minor surgery on the joint, postoperative complications, and

Financial Disclosure: None reported.
Conflict of Interest: None reported.

Address correspondence to: Bregje J.W. Thomassen, PhD, Department of Orthopaedic Surgery, Medical Center Haaglanden, P.O. Box 432, Den Haag 2501 CK, The Netherlands.

E-mail address: b.thomassen@mchaaglanden.nl (B.J.W. Thomassen).

1067-2516/$ - see front matter © 2015 by the American College of Foot and Ankle Surgeons. All rights reserved.
http://dx.doi.org/10.1053/j.jfas.2015.01.008

Table 1
Demographic factors in hemiarthroplasty and arthrodesis patients

Variable	Hemiarthroplasty (n = 46)	Arthrodesis (n = 132)	*p* Value (95% CI)
Age (y)	61.9 ± 8.4	59.6 ± 9.5	.18 (−5.42 to 0.68)
Sex			.00
Male	1 (2)	34 (25)	
Female	48 (98)	101 (75)	
Laterality			.62
Right	33 (67)	83 (61)	
Left	16 (33)	48 (39)	
Current smoker	8 (16)	7 (11)	.40
Postoperative time of data extraction (mo)			.96
Median	38.4	41.5	
Range	12 to 94	13 to 98	
Previous operations	9 (21)	21 (17)	.56

Abbreviations: CI, confidence interval; mo = months, y = years.
Data presented as mean ± standard deviation for continuous numeric data and n (%) for categorical data.
Current smoker included 78 of 132 arthrodesis patients.
Previous operations on the same foot included joint salvage operations, hallux valgus correction, bunionectomy, and combinations of several joint operations.

repeat operations were collected from the patients' medical records (Table 1). For 57 arthrodesis patients, the smoking status was not available.

The hallux rigidus grade, presence of a hallux valgus, and postoperative consolidation were evaluated from the radiographs. To grade hallux rigidus, the radiographic grading system of Giza et al (8), which was based on the clinical and radiographic system of Coughlin and Shurnas (9), was used. A radiographic examination was performed preoperatively to grade the hallux rigidus and 3 months postoperatively for the consolidation stage.

The patients were asked to participate in the study and complete the questionnaires. The participating patients received the questionnaires at their home. The patients who did not return the questionnaires within 6 weeks after sending were telephoned and request again to complete the questionnaires.

Outcome Measures

The primary outcome measure was patient satisfaction. Satisfaction was measured using 2 binominal anchor questions and repetitive choice for the received treatment. The secondary outcomes were treatment failure and the results of the patient-completed questionnaires. Treatment failure for the hemiarthroplasty patients was defined as removal of the prosthesis, which could be followed by reimplantation of a new implant or arthrodesis, and as revision arthrodesis for the arthrodesis patients. The questionnaires included the Foot and Ankle Outcome Score (FAOS) (10), Foot Function Index (FFI) (11), and Numerical Rating Scale (NRS) for pain and limitations. To the best of our knowledge, no validated questionnaires for arthrodesis patients are available.

Surgical Techniques

For hemiarthroplasty, the first MTPJ was exposed through a dorsomedial incision. A limited cheilectomy of the metatarsal head was performed, and the articular surface of the proximal phalanx was resected. The appropriate implant size was chosen by measuring the phalangeal surface. A central hole was made, and test prosthesis was inserted, after which the range of motion and overstuffing was checked. After positioning the final prosthesis, the joint range of motion was again tested, followed by closure of the wound in layers. In all operations, a BioPro® hemiarthroplasty device was used. All operations were performed by or under the direct supervision of 1 orthopedic surgeon (R.v.d.F.) in the Medical Center Haaglanden (The Hague, The Netherlands). Postoperatively, the patients were not allowed to bear weight on the operated foot for 2 weeks, followed by 4 weeks of protected mobilization. For arthrodesis, the first MTPJ was exposed through a dorsomedial incision. After exposing the articular surface, the osteophytes were removed. The articular surfaces of the metatarsal and proximal phalanx were then resected to created flat bone ends and aligned into proper position. The proper position consisted of 10° of dorsiflexion in relation to the ground surface and 15° to 20° of valgus and neutral rotation. Fixation with a Hallufix plate (Newdeal, Integra, Plainsboro, NJ) was then performed, and, if necessary, a positioning screw was placed. Eventually, all layers were closed. All arthrodesis operations were performed by or under the direct supervision of 1 orthopedic surgeon (F.W.M.F.) in the HAGA Hospital (The Hague, The Netherlands). The arthrodesis patients were immobilized by a cast postoperatively, with the first 2 weeks non-weightbearing followed by 4 weeks of protected weightbearing.

Statistical Analysis

The data were tested for normality using the Kolmogorov-Smirnoff test. When the data were not normally distributed, the median and range are presented, and, when normally distributed, the mean, standard deviation, and 95% confidence intervals are presented. The primary outcome, patient satisfaction, was determined using a chi-square test. The secondary outcome, treatment failure, was determined for both groups using a chi-square test, and a Kaplan-Meier curve was generated. To determine the correlations, the Spearman correlation test was used. The postoperative FAOS, FFI, and NRS scores were compared between the hemiarthroplasty and arthrodesis groups using the Mann-Whitney *U* test. Statistical significance was set at the 5% level ($p < .05$). The data were analyzed using SPSS, version 20.0, for Windows (SPSS, Chicago, IL).

Results

The cohort consisted of 178 patients, 46 hemiarthroplasty and 132 arthrodesis patients. The median follow-up duration was 38.4 (range 12 to 94) months for the hemiarthroplasty patients and 41.5 (range 13 to 98) months for the arthrodesis patients ($p = .96$). The baseline data are presented in Table 1; gender was the only factor with a statistically significant difference ($p < .001$) between the 2 groups.

Satisfaction

Satisfaction questionnaires were available for the hemiarthroplasty group at a median follow-up time of 38.4 (range 12 to 96) months and for the arthrodesis group at a median follow-up time of 39.8 (range 12 to 96) months. The satisfaction rate was not significantly different statistically ($p = .54$) between the 2 groups. All satisfied hemiarthroplasty patients (81.6%) would have chosen the same treatment again. Seven hemiarthroplasty patients (19.4%) were not satisfied; however, 2 patients would still have chosen to undergo the operation again. Fifty-two arthrodesis patients (64%) were satisfied with the outcome and would choose arthrodesis again. Also, 8 patients (13.3%) were not satisfied but would have chosen the same procedure again. However, 12 arthrodesis patients (16.0%) would not choose the arthrodesis operation again, although 4 were truly satisfied (Table 2). Dissatisfaction in the arthrodesis patients did not correlate with removal of the implant ($r_s = -0.021$, $p = .88$).

Treatment Failure

Two hemiarthroplasties (4.1%) failed at a median time of 42 (range 12 to 72) months. These were converted to arthrodesis because of persistent pain (not included in the arthrodesis group, in accordance with the intention to treat principle). In the arthrodesis group, 5 patients (3.7%) underwent revision arthrodesis at a median time of 19.5 (range 13 to 84) months. The reason for revision was nonunion in all 5 patients. The results showed no statistically significant difference for treatment failure ($p = .93$) or the interval to failure ($p = .32$) between the 2 groups. Apart from a second operation because of failure, 15 arthrodesis patients (11.1%) required a second operation to remove the implant because of pain complaints or infection.

Questionnaires

Of the patients, 78% of the hemiarthroplasty patients and 60% of the arthrodesis patients returned the questionnaires. The postoperative questionnaires were completed after a median period of 37.5 (range 12 to 96) months for the hemiarthroplasty patients and 39.5 (range 12 to 96) months for the arthrodesis patients; the difference was not statistically significant ($p = .91$). The postoperative FAOS, FFI, and NRS pain and limitation scores are listed in Table 2. No statistically significant differences were found between the hemiarthroplasty and arthrodesis groups in the FAOS ($p = .74$), total FFI score ($p = .73$), or NRS score for pain ($p = .14$) and limitation ($p = .42$). Also, the subscales of the FAOS and FFI showed no statistically