

Functional and Radiographic Results of Hemiarthroplasty in the Treatment of Hallux Rigidus of the First Metatarsophalangeal Joint

Birinci Metatarsofalangeal Eklemde Halluks Rigidus Hastalığının Tedavisinde Hemiartroplastinin Fonksiyonel ve Radyografik Sonuçları

Gökçer UZER , Fatih YILDIZ , Joryar ALI 

Department of Orthopedics and Traumatology, Bezmalem Vakıf University School of Medicine, İstanbul, Turkey

ABSTRACT

Objective: The purpose of this study was to evaluate changes in the radiological, clinical, and functional results following the application of hemiarthroplasty in patients with grade 3 or 4 first metatarsophalangeal joint osteoarthritis.

Methods: Twenty-one feet of nineteen patients who were who were diagnosed as grade 3 or 4 hallux rigidus and treated with hemiarthroplasty, between January 2013 and December 2015, were retrospectively evaluated. Functional results [visual analog scale (VAS) and American Orthopedic Foot and Ankle Society (AOFAS) scores, Short Form-12 (SF12) physical and mental scores], clinical results (ranges of dorsiflexion and plantar flexion), and radiological results (osteolysis, loosening, hallux valgus angles (HVA), and intermetatarsal angles (IMA)) were evaluated at their follow-up.

Results: The mean follow-up period was 24 (range: 12-66) months. The mean ranges of flexion was increased from 6° (range: 0°-20°) to 8° (range: 0°-20°) and ranges of extension from 4° (range: 0°-10°) to 7° (range: 0°-30°), postoperatively. Preoperative and postoperative values of the mean IMA (9° vs. 11°) and HVA (18° vs. 13°) did not change significantly. The mean AOFAS scores increased from 72 to 96 (p=0.003). The mean VAS, SF12-MCS, and SF12-PCS scores were 7.8 (range: 4-10), 42.7 (range: 33.8-55.7), and 51.1 (range, 36.7-61.2), postoperatively and comparisons to their preoperative values were not significant. Radiographic follow-up did not show findings of osteolysis around the prosthesis or loosening in any patient.

Conclusion: In the treatment of hallux rigidus with hemiarthroplasty, although postoperative range of movement was found to be limited, patient satisfaction and pain levels were improved in all patients.

Keywords: First metatarsophalangeal joint osteoarthritis, hallux rigidus, hemiarthroplasty

ÖZ

Amaç: Bu çalışmanın amacı birinci metatarsofalangeal eklem evre 3 veya 4 osteoartritinin tedavisinde uygulanan hemiarthroplastinin radyolojik, klinik ve fonksiyonel sonuçlarını değerlendirmektir.

Yöntemler: 2013 Ocak ile 2015 Aralık tarihleri arasında evre 3 veya 4 halluks rigidus tanısı almış ve hemiarthroplasti ile tedavi edilmiş 19 hastanın 21 ayağı geriye dönük olarak değerlendirildi. Fonksiyonel sonuçlar (VAS ve AOFAS skorları, SF12 fiziksel ve mental skorları), klinik sonuçlar (dorsifleksiyon ve plantar fleksiyon eklem hareket açıklıkları) ve radyolojik sonuçlar (osteoliz, gevşeme, HVA ve IMA açıları) takiplerde araştırıldı.

Bulgular: Ortalama takip süresi 24 (12-66) ay idi. Takiplerde ortalama fleksiyon 6° (0°-20°) den 8° (0°-20°) ye ve ekstansiyon 4° (0°-10°) den 7° (0°-30°) ye yükseldi. Preoperatif ve postoperatif IMA (9° ve 11°) ve HVA (18° ve 13°) dereceleri arasında istatistiksel fark yoktu. Ortalama AOFAS skoru 72'den 96'a yükseldi (p=0,003). takiplerde ortalama VAS, SF12-mental ve SF12-fiziksel skorları sırası ile 7,8 (4-10), 42,7 (33,8-55,7) ve 51,1 (36,7-61,2) idi ve ameliyat öncesi değerler ile karşılaştırıldığında anlamlı fark bulunmadı. Radyolojik takiplerde protez çevresi osteoliz veya gevşemeye rastlanmadı.

Sonuç: Halluks rijidusun hemiarthroplastisi ile tedavisinde her ne kadar ameliyat sonrası eklem hareket açıklığı kısıtlı kalsa da tüm hastalarımızda ağrı seviyesinde azalma ve hasta memnuniyetinde artış görülmüştür.

Anahtar kelimeler: Birinci metatarsofalangeal eklem osteoartriti, halluks rijidus, hemiarthroplasti

Introduction

Hallux rigidus is a clinical situation manifesting as restricted range of motion and inflammation associated with advanced arthrosis. It is characterized by the formation of osteophytes, loss of cartilage, and degeneration of the first metatarsophalangeal (1st MTP) joint with pain and restricted movement (1, 2). While the joint range of movement (ROM) is generally preserved in plantar flexion, a loss of dorsiflexion develops with the mechanical block effect of osteophytes.

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Address for Correspondence/Yazışma Adresi: Fatih YILDIZ, Bezmalem Vakıf Üniversitesi Tıp Fakültesi, Ortopedi ve Travmatoloji Anabilim Dalı, İstanbul, Türkiye E-mail: yildizfatih@hotmail.com

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Several classifications are used in the grading of hallux rigidus. In 1988, Hatstrup and Johnson (3) separated hallux rigidus into three grades based on radiological findings. Then, Coughlin and Shurnas (4) recommended grading using both radiographic and clinical evaluations, and this system is the most widely accepted for assisting in the selection of surgical treatment (Table 1). According to this classification, grades 0-2 can be followed up with non-surgical treatment options such as non-steroid anti-inflammatory drugs (NSAID) and shoe modifications (5). For advanced grades, surgical treatments may include cheilectomy, which yields successful results in the early stages as it prevents constriction of osteophytes in the dorsal part (6); and for grade 3 and 4s, Keller resection arthroplasty (7), phalangeal and metatarsal osteotomy (8), joint distraction, arthrodesis (9, 10), and total or partial arthroplasty are the preferred methods (11-13).

The aim of this study was to evaluate the changes in radiological, clinical, and functional results following the application of hemiarthroplasty in patients with grade 3 or 4 1st MTP joint osteoarthritis.

Methods

This retrospective study was performed according to the Declaration of Helsinki and received Institutional Review Board approval. We evaluated patients who were diagnosed with grade 3-4 hallux rigidus and treated with hemiarthroplasty, between January 2013 and December 2015 (Figure 1. a, b). Patients were excluded from the study if they had not attended regular outpatient clinic follow-up, if different implants had been used, or if total joint arthroplasty had been applied. In total, 19 patients were included in this study, comprising 4

males and 15 females, with a mean age of 56 (range: 47-73) years. Hemiarthroplasty procedures (HemiCAP®, Arthrosur-face, Franklin, MA, USA) were applied to 21 1st MTP joints of the 19 patients; 12 to the right foot and 9 to the left foot. All the operations were performed in the same hospital by two different surgeons. All the patients signed informed consent forms before surgery and were operated under spinal anesthesia. On postoperative day one, active and passive 1st MTP joint ROM exercises were initiated and from the end of the first week, walking was recommended with full weight-bearing and two crutches and special wedge shoe modifications.

In the subsequent period, exercises to increase ROM were recommended. Patients were called for outpatient clinic follow-up examinations at 1, 3, and 6 weeks, then at 3, 6, and 12 months for evaluating ROM, wound site problems, and pain. Standing anteroposterior and lateral radiographs were acquired at the 6-week, 3-month, and 12-month examinations (Figure 2. a, b). All the patients were evaluated clinically with respect to plantar flexion and dorsiflexion ROM, and radiologically on the radiographs taken with respect to osteolysis, loosening, and change in the hallux valgus angles (HVA) and the intermetatarsal angles (IMA) (Figure 3). A visual analog scale (VAS) was used to evaluate pain status, and functional results were assessed using the American Orthopedic Foot and Ankle Society, (AOFAS) scoring system. Patient satisfaction was evaluated using the Short Form-12 (SF-12) in face-to-face interviews to evaluate the physical (SF12-PCS) and mental (SF12-MCS) status. Patients were also questioned whether they had experienced difficulties in shoe selection in the postoperative period.

Table 1. Clinical and radiological staging in Hallux valgus

Stage	Dorsiflexion	Radiological findings	Clinical findings
0	~40°-60° or 10%-20% lower than normal side	Normal	No pain, only restriction in ROM
1	~30°-40° or 20%-50% lower than normal side	Dorsal osteophyte is the main finding, mild narrowing of the joint space, mild sclerosis and mild flattening of the metatarsal head	Rarely painful, especially during the end-levels of the dorsiflexion and plantar flexion
2	~10°-30° or 50%-75% lower than normal side	Dorsal, lateral or medial osteophytes show flattening of the metatarsal head. In the lateral X-ray, 3/4 of the articular cartilage is preserved. Mild or moderate narrowing of the joint space. Sesamoids are usually affected.	Moderate or severe continuous pain, which occurs with the hyperextension and hyperflexion.
3	≤10° or 75%-100% lower than normal side. Usually severe restriction in plantar flexion of the MTF joint.	Similar to stage 2 but severe narrowing in the joint space, cyst formation around the joint and more than 1/4 of the dorsal cartilage is narrowed on the lateral X-ray. Widening of the sesamoids with cysts and roughness.	Continuous pain and severe restriction of the ROM. Pain is more apparent with the hyperextension and hyperflexion. No pain in the mid-ranges of the motion.
4	Similar to Stage 3	Similar to Stage 3	Similar to grade 3 but pain becomes even in the mid-ranges of the motion.

ROM: range of movement

Statistical analysis

Statistical analysis of the preoperative and postoperative scores and changes in angles were applied using the Wilcoxon signed-rank test.

Results

The mean follow-up period of the 21 feet of 19 patients was 24 (range: 12-66) months. Preoperatively, the mean ranges of flexion of the 1st MTP joint was 6° (range: 0°-20°) and exten-

sion was 4° (range: 0°-10°). At the final follow-up, they were measured as 8° (range: 0°-20°), and extension as 7° (range: 0°-30°).

The mean IMA was 9° (range: 4°-15°) preoperatively and 11° (range: 6°-16°) postoperatively. The mean HVA was 18° (range: 7°-30°) preoperatively and 13° (range: 7°-22°) postoperatively. The mean AOFAS scores increased from 72 (range: 82-92) to 96 (range: 79-100), postoperatively. The mean VAS, SF12-MCS, and SF12-PCS scores were 7.8 (range: 4-10), 42.7 (range: 33.8-55.7), and 51.1 (range: 36.7-61.2) postoperatively.

The increase in the mean AOFAS scores from the preoperative to postoperative period was statistically significant (p=0.003), whereas changes in ROM, IMA, and HVA were not statistically significant (p=0.478, p=0.106). Although 53.8% of the patients reported problems of shoe selection and the need to wear special shoes, the mean VAS score was found to be 7.8 (range: 4-10), and 72% of the patients stated that they were satisfied with the operation.

A statistically significant correlation was determined between the preoperative AOFAS and preoperative HVA, the change in postoperative HVA, and the postoperative AOFAS (p=0.001, p=0.013, p=0.011, respectively). No statistically significant correlation was found between preoperative values of body mass index, age, IMA, HVA, and the postoperative AOFAS and VAS scores.

Radiographic follow-ups did not indicate osteolysis around the prosthesis or loosening in any patient. Two patients complained of persistent pain and joint stiffness, postoperatively. They were treated with plate arthrodesis of the 1st MTP joint at the third and seventh months after their initial surgeries, and their complaints resolved.

Discussion

In the treatment of advanced stage osteoarthritis of the 1st MTP joint, surgical options should be considered if conservative treatment fails. Although good results have been reported in the literature from arthrodesis, which is applied as the preferred choice in patients with a high functional demand, kinematic studies have shown arthrodesis to cause a shortening in step length and loss of ankle plantar flexion in the toe-off phase (14). Complications have also been reported such as malalignment, non-union, and degeneration of the adjacent joints (9, 10).

High failure rates have been reported of 1st MTP joint arthroplasty applied in the early stages of the disease (15), but with recent developments of implants compatible with foot biomechanics, higher success rates have been reported. Implants have now been developed as 4th generation. The 1st and 2nd generation were produced from silicone, but many complications were reported to be associated with these implants such as wear, early breakage of the implant, synovitis, and osteolysis (16, 17). The 3rd generation were developed as metallic



Figure 1. a, b. Anteroposterior (a) and lateral (b) radiographs of a patient with the hallux rigidus of the first metatarsophalangeal joint



Figure 2. a, b. Postoperative anteroposterior (a) and lateral (b) radiographs of the same patient after implantation of the hemiarthroplasty



Figure 3. Dorsiflexion and plantar flexion of the metatarsophalangeal joint with the hemiarthroplasty

press-fit implants, and the 4th generation are metallic implants combined with a stem (18, 19).

As hemiarthroplasty is applied to a single surface; although minimal bone defect and minimal toe length are provided, it facilitates the transfer to arthrodesis when necessary (20). Very few studies have been published related to the mid-term results of hemiarthroplasty. In a study by Aslan et al. (11) of hemiCAP applied to patients, after a 37-month follow-up period, the mean AOFAS score was reported as 85.1 and the ROM had increased to 40° in the postoperative period.

In the current study with a mean 24-month of follow-up (range: 12-66 months), the mean postoperative AOFAS score was 97 (range: 79-100). This difference in the AOFAS scoring can be considered to be due to most of the patients in the current study having advanced arthritis and not having a high level of activity. The mean postoperative VAS score was 7.8 (range: 4-10), and the SF-12 scores were 42.7 (range: 33.8-55.7) for MCS and 51.1 (range: 36.7-61.2) for PCS, which reflected recovery and patient satisfaction and supported reduction in postoperative pain. However, despite improvement in AOFAS scores, the mean ROM was 15° (range: 0°-30°), which is not similar to that reported in the literature. This can be considered to be related to insufficient rehabilitation during the postoperative period.

Conclusion

In the treatment of hallux rigidus with hemiarthroplasty, although postoperative ROM was found to be limited, almost half of the patients changed their choice of footwear and there was a high level of patient satisfaction with reduction in pain. As a result of implant developments, the rates of loosening and osteolysis have reduced, and hemiarthroplasty can be considered to be a good alternative for the treatment of hallux rigidus in patients with low activity levels.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki “Ethical Principles for Medical Research Involving Human Subjects”, (amended in October 2013).

Informed Consent: Written informed consent was obtained from all patients who participated in this study.

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Hasta Onamı: Yazılı hasta onamı bu çalışmaya katılan tüm hastalardan alınmıştır.

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