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Kai Olms · Andreas Dietze

Replacement arthroplasty for hallux rigidus**21 patients with a 2-year follow-up**

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Abstract 21 patients underwent replacement arthroplasty of the metatarsophalangeal joint of the great toe. The indication for surgery was hallux rigidus in 16 patients and failed resection arthroplasty in 5 patients. The minimum follow-up period was 24 months. Clinical review showed an increased range of passive dorsiflexion from 10° to 50° postoperatively. 17 patients reported less pain or no pain and activity levels that were increased or maintained. Functional complications such as lack of toe purchase ($n=5$) or metatarsalgia ($n=4$) were successfully treated with orthotics.

Résumé. Cette étude rétrospective évalue les résultats cliniques et radiographiques obtenus par l'arthroplastie appliquée au traitement des stades avancés d'hallux rigidus et des reprises chirurgicales. Vingt et un implants placés chez 21 patients présentant un suivi de 24 mois sont inclus dans cette étude. Les plaintes provoquées par un stade terminal d'hallux rigidus représentent l'indication dans 16 cas et 5 cas étaient des échecs d'arthroplastie de résection. La revue clinique montre une augmentation de la mobilité post-opératoire en dorsi-flexion passive de 10° à 50°. Un questionnaire auquel ont répondu tous les patients révèle des résultats satisfaisants. Parmi les 21 patients, 17 n'ont plus ou ont moins de douleurs après l'intervention. Des complications fonctionnelles comme la perte d'appui du gros orteil ($n=5$) ou des métatarsalgies ($n=4$) peuvent être améliorées par des orthèses. L'activité est augmentée ou maintenue chez 17 patients.

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K. Olms
Department of Surgery, Agnes Karll Hospital,
D-23611 Bad Schwartau, Germany

A. Dietze (✉)
Senter for Rheumatiske Sykdommer, Rikshospitalet,
Akersbakken 27, N-0172 Oslo, Norway
Tel.: +47 2294 3817
Fax: +47 2211 4969

Introduction

Patients with early degenerative changes of the first metatarsophalangeal joint (MPJ) responde well to conservative treatment or to joint preserving procedures such as the Waterman-Green osteotomy [10, 11]. In severe cases, the options are : the Keller-Brandes procedure and its modifications [11, 15, 20], fusion of the first MPJ [4, 5, 11] or implant arthroplasty [1, 3, 16]. This paper presents the results 2 years after the insertion of a two component implant for the first metatarsophalangeal joint.

Patients and methods

Between May 1995 and November 1997, 69 patients underwent total first MPJ replacement. In 21 patients the follow-up period was more than 24 months (Table 1). 16 implants were inserted as primary reconstruction in patients with stage III and stage IV hallux rigidus. In 5 cases the implant was introduced as a revisional procedure. Three cases were performed after a failed Kellers arthroplasty and 2 after a failed Mayo arthroplasty.

The study included both clinical and radiographic evaluation and a questionnaire to assess the patients' evaluation of the procedure. Clinical assessment included symptoms, range of motion (ROM), swelling, toe purchase and cosmetic evaluation. As dorsiflexion is the major component of the movement, plantarflexion was not recorded.

The patients were asked to describe the symptoms before and after surgery. Particular attention was paid to pain, range of motion and level of activity; and the patients were invited to express their opinion of the procedure. All patients had pre- and post-operative weight bearing X-rays. The radiographs were compared with those taken at the time of final evaluation.

Table 1 Patients included in the follow-up study

Indication	<i>n</i>	Male	Female	Average age (years)
Primary surgery	16	13	3	60 (51–72)
Revisional surgery	5	2	3	57.6 (54–62)
Total	21	15	6	58.8

Fig. 1 The implant system. To the right the phalangeal component with the polyethylene articular surface. To the left the metatarsal component out of cobalt chrome with a spherical, ionated articular surface

The implant used (Bio-Action Great Toe Implant, MicroAire Surgical Instruments, Charlottesville, Virginia 22911, USA) was introduced in 1991, and is a non-constrained two component system designed to replicate normal function of the first metatarsophalangeal joint (Fig. 1). The “head” of the metatarsal component is spherical in shape, made of chrome-cobalt and has an ionated surface to reduce polyethylene wear. It is available in small and large sizes. In addition small right and small left sided implants are available with a 10° dorsal slant.

The phalangeal component is made of titanium with an Ultra High Molecular Weight Polyethylene (UHMWPE) spherical concavity as its articulating surface. This component is available in small and large sizes, in neutral or modified geometry. The modified component is designed to provide a flatter surface on the plantar aspect which seems to be more anatomical and does not interfere with the flexor tendons.

Surgical procedure

The joint is exposed through a dorso-medial incision. The medial capsule is incised in a t-shaped fashion. Areas of bony hypertrophy on the metatarsal and proximal phalanx are removed. An appropriate amount of bone is removed; more should be resected from the proximal phalanx than from the metatarsal in order to prevent further shortening of the first ray, which may be a cause of post operative metatarsalgia. When using a neutral metatarsal

Fig. 2 Radiographic result 29 month after operation. The arrows indicate the oval shaped radiolucency at the tip of the phalangeal component and the plantar shelf for preservation of the short flexor tendons

component the resection is made just proximal to the articular margin. About 5 mm of bone is removed when using right or left sided implants, and the cut is made from proximal/dorsal to distal/plantar with 10° angulation in the transverse plane. Resection through the proximal phalanx is made perpendicular to its long axis. The insertion of the short flexor tendons is preserved by leaving the plantar shelf of the phalanx intact (Fig. 2b). Usually a total of about 1–1.5 cm of bone needs to be resected.

The implant components are inserted with special instruments. The components should not be inserted too tightly and dorsiflexion of at least 70° should be available. The implants are press-fit without the use of cement. An increased metatarsal angle and elevated positioning of the first ray have to be corrected prior to implantation. The postoperative management includes immediate full weight-bearing and physical therapy after wound healing.

Results

The types of implant used in this study are shown in Table 2. The small metatarsal components were most frequently used (19 patients). After 6 (5–7) weeks the patients were able to use normal shoes. There were no

Table 2 Size and design of implants

Metatarsal component	Patients (n)	Phalangeal component	Patients (n)
Small neutral	16	Small neutral	2
Large neutral	2	Large modified	1
Small right/left	3	Small modified	18

Table 3 Results of the clinical examination. Range of motion (ROM) is listed as the average of all measurements

Indication	Infection/ removal	Lack of toe purchase	Meta- tarsalgia	ROM		
				pre- operatively	intra- operatively	post- operatively
Hallux rigidus	0	2	1	10	85	60
Revision	0	3	3	0	50	40
Total	0	5	4	10	75	50

Fig. 3 Periarticular ossification (marker) 26 months after surgery

cases of infection and no revision procedures were required. Clinical examination showed a good cosmetic result in all cases. There were no signs of synovitis or swelling at follow-up. With regard to function of the joint, there was lack of toe purchase in 5 cases. Metatarsalgia was present in four cases but resolved with orthotics. The pre-op range of dorsiflexion was between 0°–10°. The average intraoperative range of motion was 75° (50°–85°). At follow-up there was an average range of motion of 50° (40°–60°) (Table 3). A combination of stiffness and pain occurred in 13 patients pre-operatively and in three post-operatively. Post-operatively pain, when not wearing shoes was present in 4 patients and 6 patients mentioned pain in normal footwear. Post-operatively, 1 patient had pain when not wearing shoes and 4 still had pain in normal footwear. Constant pain was reported by 13 patients pre-operatively and 4 patients post-operatively (Table 4).

The patients were asked to quantitate the pain level pre-operatively and post-operatively. The same pain lev-

el was reported by 2 patients; more pain was reported by a further 2 patients. Thus of the 21 patients, 17 had less or no pain. 10 patients reported the same activity level as pre-operatively, whereas 7 patients recorded an increased activity level. A decreased activity was reported by 4 patients. 18 patients were satisfied with the procedure and 3 patients were dissatisfied.

At follow-up there was no change in the position of the implants. In 4 cases an oval shaped radiolucency could be seen at the tip of the implant stem (Fig. 2a). This was caused by drilling the central hole and is not a sign of loosening. Periarticular ossification was present in 3 cases. In some cases bone resorption was seen in relation to both components, and an area of radiolucency may be an early sign of loosening. (Fig. 3).

In one case the components were subluxed with too wide space between the metatarsal head and the proximal phalanx. This gap closed during the follow-up period without instability of the joint. The plantar shelf of the phalanx is preserved in order to maintain the insertion of the short flexor tendons (Fig. 2b).

Discussion

Arthroplasty of the MPJ was a logical consequence following the development of implants for other joints. Initially the most popular arthroplasty was the Swanson silicone implant with optional use of titanium grommets [8, 17]. However, after reported failures [2, 6], new biomaterials have been used and new biomechanical approaches made [1, 3, 7, 12, 18]. The two component non-constrained replacement system seems to be the most sophisticated approach to the restoration of a destroyed first MPJ [19].

The present study is based on clinical experience with such an implant. This study has shown that dorsiflexion changed significantly from 10° pre-operatively to an average of 50° at follow-up. This movement allows better function than after arthrodesis, with a recommended dorsiflexion of 20°. Large components are rarely needed. The small component with the 10° dorsal slant seems to allow greater range of dorsiflexion. The modified phalangeal component with a flat plantar aspect was most commonly used. This implant type seems most accurately to restore normal anatomy. The articulating surface between the ionated metatarsal head and the phalangeal component did not show any narrowing as an indication of polyethylene wear. Clinical signs of synovitis as seen with Silastic implants [14] were not seen. Review after 24 months did not show any complications, such as infection or the need to remove the implant. Lack of toe

Table 4 Results of the questionnaire. Patients ($n=21$), multiple choice possible

Clinical findings	Pain at any time	Pain with shoes	Pain and stiffness	Cosmetic complaint	Activity level same/better
Pre-operatively	13	6	13	2	–
Post-operatively	4	4	3	0	10/7 (17)

purchase in 5 cases and metatarsalgia in 4 cases could be effectively treated with orthotics.

In 3 cases periarticular ossification was seen (Fig. 3). This seems to be present in association with true bone apposition rather than with sinking of the implant within the bone. Radiolucency as a possible indication of loosening was not associated with clinical failure. The typical oval shaped radiolucency at the tip of the implant stem (Fig. 2) is caused by the use of an oval 4 mm bur for introducing the stem. This bur should be avoided when preparing the proximal phalanx as the bone is usually softer and no further preparation for the phalangeal component is required.

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