CHAPTER **50**

REPLACEMENT ARTHROPLASTY FOR HALLUX RIGIDUS

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Patients with early stages of hallux rigidus respond well to conservative treatment or joint preserving procedures.[1,2] In cases of end stage Hallux rigidus the treatment options are:

Keller – Brandes procedure and its modifications,[2-4] Fusion of the 1st MPJ,[2,5,6] Implant arthroplasty.[7-9] The implant arthroplasty of the 1st MPJ has been performed by the author in 81 cases since 1995. This paper presents the results of retrospective follow-up studies of 21 patients 2 years[10] and 6 years after the insertion of a two component implant for the 1st MPJ.

PATIENTS AND METHODS

Between May 1995 and March 2002, 81 patients underwent total 1st MPJ replacement (Table 1). In 21 patients the minimum follow-up time was 72 months. In 16 patients the implant was chosen as primary reconstruction of the end stage hallux rigidus, in 5 cases the implant was used after failed resection arthroplasty (n = 3 after Keller procedure, 2 after Mayo arthroplasty).

The study included both clinical and radiographic evaluation and a questionnaire to assess the patient`s evaluation of the procedure. The clinical assessment included symptoms, range of motion (ROM), swelling, toe purchase, and cosmetic evaluation. The patients were asked to describe the symptoms before and after surgery. Particular attention was paid to pain, ROM and level of activity; the patients were invited to express their opinion of the procedure.

All patients had pre- and postoperative weight bearing X-rays. The X-rays were compared to the images taken after two years and after 6 years after surgery.

The implant used (Bio- Action Great Toe Implant, Osteomed Corp., 3885 Arapaho Rd., Addison, TX 75001, U.S.A.) was introduced in 1991 and is a non-constrained two component system designed to replicate normal function of the first metatarsophalangeal joint. (Figure 1)

The "head" of the metatarsal component is spherical in shape, made out 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. The 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.

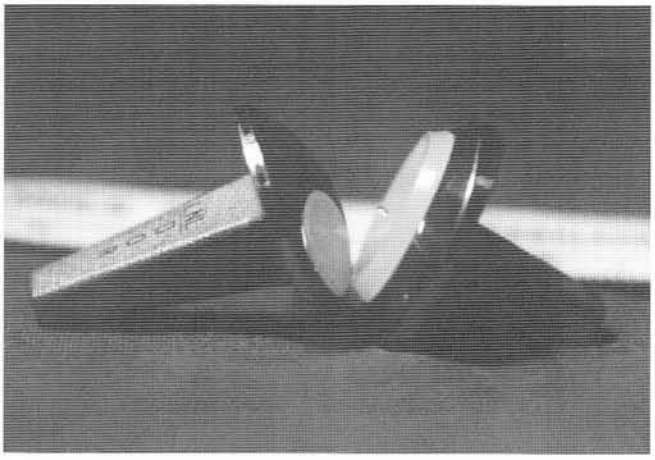


Fig.1. Bio Action Great Toe implant.

SURGICAL PROCEDURE

The procedure was carried out as described by the company. Few special instruments are needed. The components should not be inserted too tightly and dorsiflexion of at least 70° should be available. The implants are used as press-fit items without use of cement.

An increased intermetatarsal angle and an elevation of the first ray have to be corrected prior to the implantation or represent a contraindication for the procedure. The postoperative management includes immediate full weight-bearing and physical therapy after wound healing. After 6 weeks on average the patients were able to wear normal shoes. LMH was used for the period of one week on average.

RESULTS

Between May 1995 and March 2002 the 1st MPJ implant arthroplasty was performed in 81 cases. Twenty-one cases had a follow-up time of 72 months and were included into this study.

16 female and 5 male patients underwent the procedure. The average age of the patients at the time of surgery was 59 years (49-73). In 16 cases the implantation was the primary procedure, in 5 cases the implant was used in a revisional procedure after failed resection arthroplasty (Table 1).

The small metatarsal implants were used most frequently (19/21 phalangeal component and 16/21 metatarsal component). There were no cases of infection and no revisional procedures were required. No implant had to be removed in the study group.

CLINICAL EVALUATION

Clinical examination revealed good cosmetic results in all cases. There were no signs of synovitis or swelling during the follow-up period of 6 years. With regard to function of the joint, there was a lack of toe purchase in 5 cases with subsequent metatarsalgia in 4 cases.

The average preoperative dorsiflexion was between 0°-10° and could be increased to 75°on average (50°-85°) intraoperatively. After 2 years the dorsiflexion decreased to an average of 50° and after 6 years to 40 ° (Table 2). No varus position was noted.

ANALYSIS OF THE QUESTIONNAIRE

The questionnaire revealed a dramatic decrease of the pain level. Preoperative constant pain was reported in 17 cases; 2 years post OP 3 patients had the same complaints

Table 1

MATERIAL

May 1995 - March 2002
–81 implant arthroplasties
–21 cases for the 2- and 6- year follow-up
–16 female/5 male
–Average patient age: 59 years
–16 primary procedures
–5 revisional procedures
- •3 after Keller resection arthroplasty
- • 2 after Mayo resection arthroplasty

Table 2

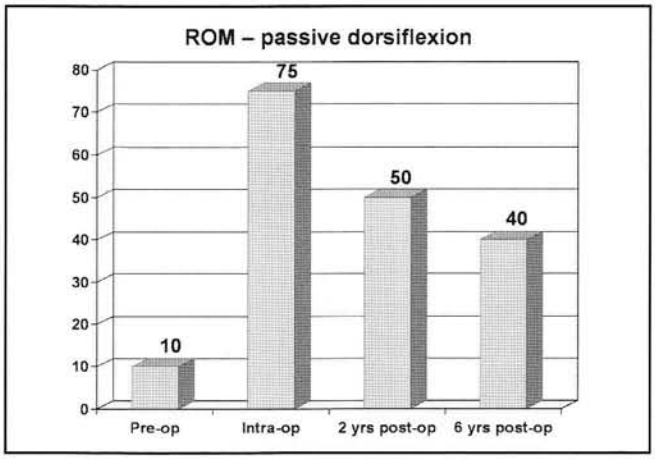
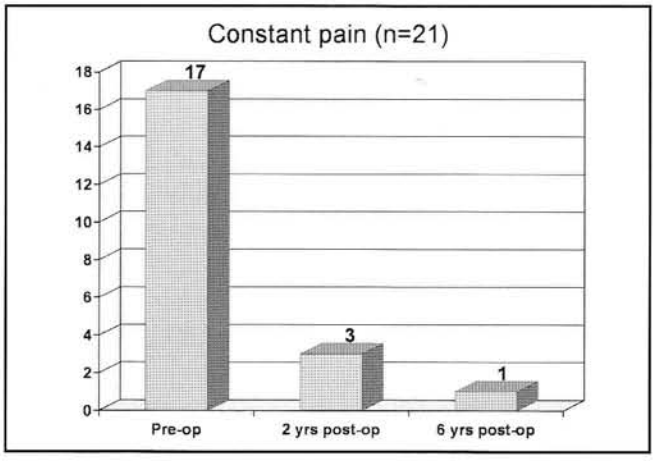


Table 3



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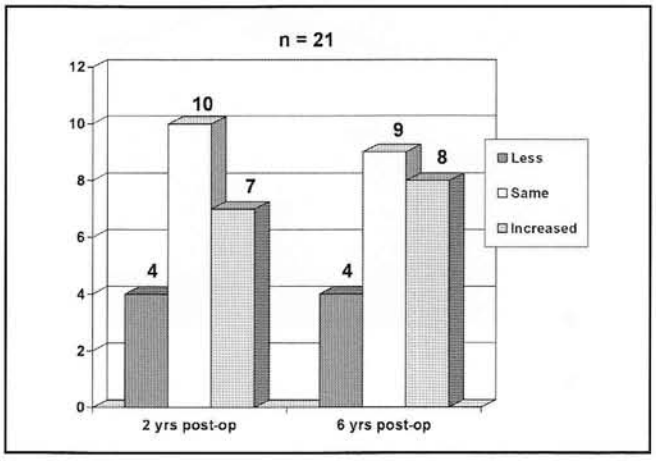


and after 6 years 1 patient stated to have constant pain after daily activities (Table 3).

The patients were asked to describe the activity level pre and post OP. Out of 21 patients 4 described the level as being lowered both after 2 and 6 years, 10 patients had the same level as pre OP after 2 years and 9 after 6 years. A higher level of activity was confirmed by 7 patients after 2 years and 8 after 6 years (Table 4)

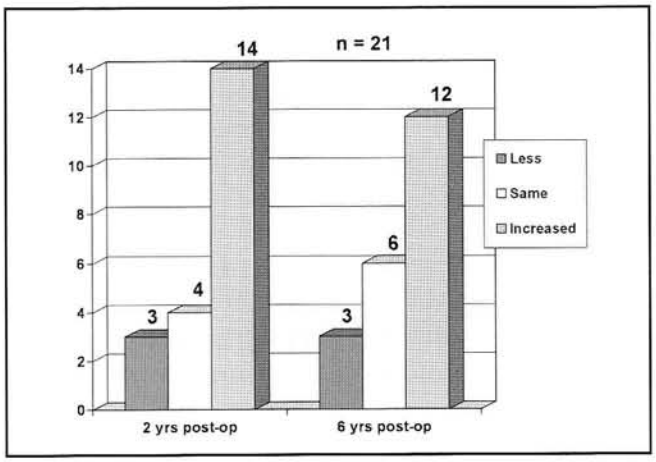
The ROM had to be described subjectively as being less, same or improved. After 2 and 6 years 3 patients felt to have less range of motion than preoperative, whereas 4 reported the same ROM after 2 years and 6 after 6 years. Fourteen patients stated to have an improved ROM after 2 years and 12 after 6 years (Table 5).

Being asked to define the over-all solution of the preoperative problems after 2 and 6 years, 4 patients had the same problems after 2 years and 2 after 6 years. An improvement was noted by 9 patients after 2 years and 8 after 6 years. A complete solution was reported by 8 patients after 2 years and 11 patients after 6 years (Table 6). Out of 21 patients 19 stated that they would like to have the same type of procedure again if necessary.

Radiographic Analysis

The X-ray images postoperative, 2 years and 6 years postoperative were evaluated. 10 out of 21 images showed no major signs of loosening or bone appositions after 2 and 6 years. Eleven images showed increasing signs of loosening, bone apposition or displacement of the implant without fracturing the cortex of the metatarsal. (Figures 2-5). The stems of the implants were seated in a hypersclerotic bone area both in the metatarsal and the phalanx (Figure 6). No fracture of the implant itself was noted.

Table 5



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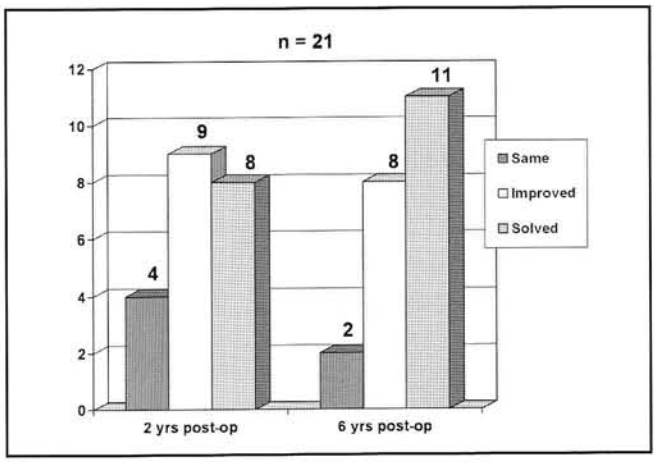

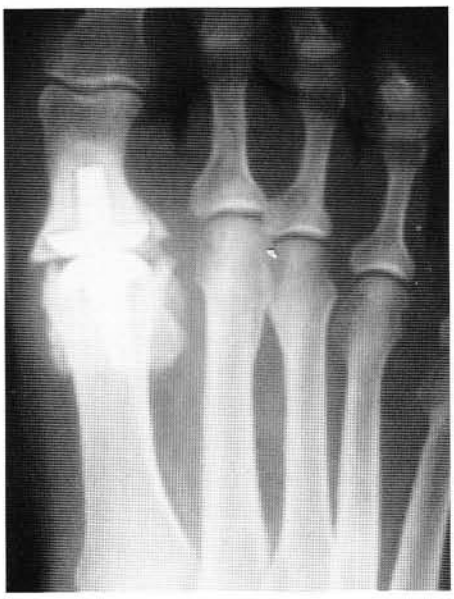

Figure 2. Bony apposition/sinking of the implant.

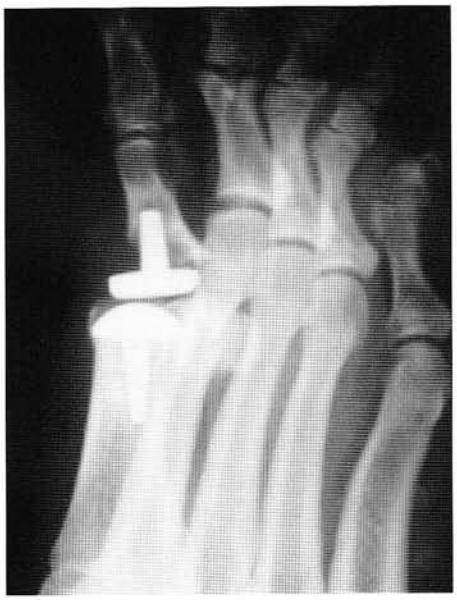

Figure 3. Signs of loosening at the phalangeal component.

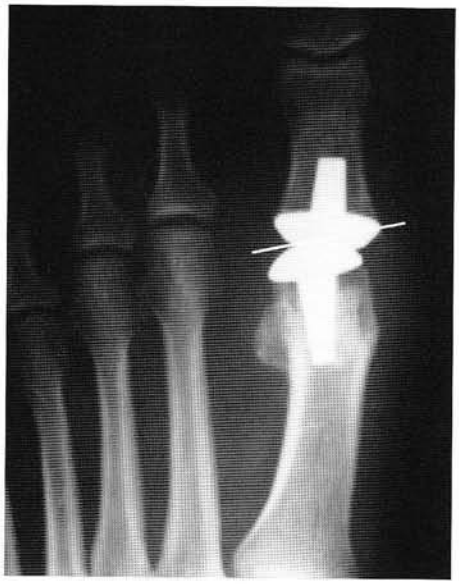

Figure 4. Dislocation of the implant due to incorrect implantation.

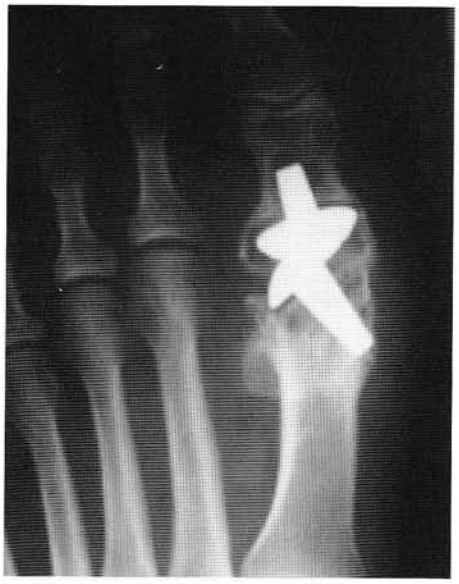

Figure 5.

DISCUSSION

The implant arthroplasty was the 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.[11,12] However, after reported failures,[13,14] new biomaterials have been used and new biomechanical approaches made.[7, 8, 15, 16, 17]

The two component non-constrained replacement system seemed to be the most sophisticated approach to the restoration of the first MPJ.[18] The synovitis due to the foreign body reaction as described in the use of silicone implants[19] did not occur anymore.

The presented study shows the results of a six years retrospective analysis of 21 patients out of a total of 81 patients that underwent the replacement arthroplasty with the Bio Action Great Toe implant since 1995. Follow-up studies after 2 and 6 years are compared.

The indication for the procedure is very rigid and should be reserved for semi-active patients. The patients should not be younger than 50 and after having performed the procedure for 8 years now, I would recommend the minimum age of the patient to be at least 60.

For younger patients the 1st MPF fusion should be considered as the best procedure.

It is critical to understand, that any changes of the IM angle should be corrected prior to the implantation of the implant.[2] This point is very scientific and I would simply recommend not to select a patient with an increased IM angle for an implant procedure.

A short first ray after a failed primary procedure should be a contraindication, as the implant does not compensate for the shortening (Figure 7). The procedure itself is very easy; a fact that should not lead the surgeon to extend the indication. Among the implants available, the Bio action is technically the easiest system, without any disadvantages to the competing systems.

In the postoperative period the patient is allowed for immediate full weight-bearing in a surgical shoe, which is very advantageous for the patient compared to the postoperative course after a 1st MPJ fusion with about 6-8 weeks non-weightbearing.

The radiographic analysis shows the typical osseous changes after 2 and after 6 years. Signs of loosening with radiolucencies both at the metatarsal and phalangeal component can be found in about 50% of the cases. The 1st MPJ implant is the only implant that is positioned perpendicular to the long axis of the body. The other weight-bearing joint replacement systems are parallel to that axis.As long as the 1st MPJ system moves, there will be very little shear forces, however once the joint becomes stiff, it will act as a single component system perpendicular to the main body axis. This system sticks in the shaft like a metal stem as has to come loose inevitably (Figure 8).

Bony appositions or a sinking of the implant can be observed in the same percentage and may be due to the implant size and the high pressure in the joint. (Figures 2, 3). The placement of the implant seems to be very easy; however it is critical to avoid a valgus or varus position of the stem. This will inevitably cause a dislocation of the implant over the time (Figures 4, 5). The

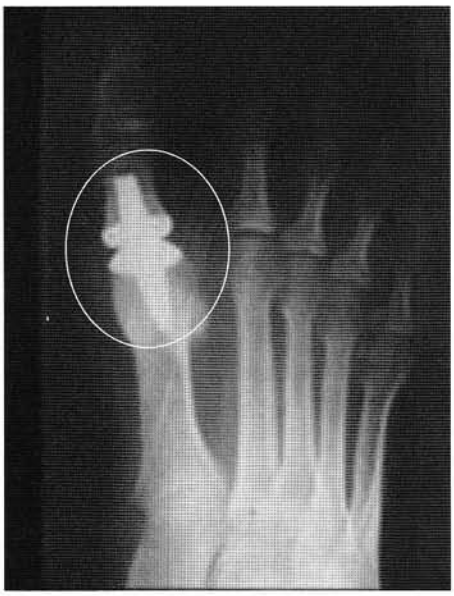

Figure 6. Sclerosis of the implant bed.

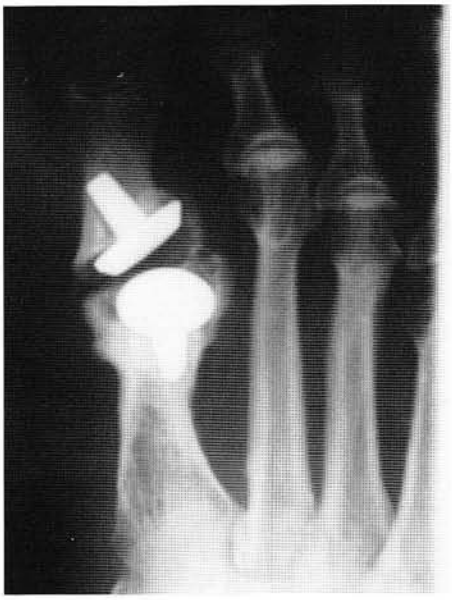

Figure 7. Implant does not compensate for short ray.

displacement occurred due to an incorrect seating of the metatarsal component. The reverse buckling effect on the metatarsal stem in a valgus position and the increase of the shear forces lead to the dislocation of the implant.

For the surgeon it is very disappointing to observe to realize the decrease of the range of motion after the surgery. The loss of ROM is about 50% after six years, but it is in a steady state after that time. There are several reasons for that phenomenon. The fibrosis of the soft tissue is the reason that is mentioned most often and is well accepted.

The bony apposition is clearly a mechanism that may block the motion both on the metatarsal and phalangeal side. For me the most important fact is that none of the implants available cover the metatarsosesamoidal articulation. When opening up the joint in the procedure it is evident that there is no motion even after removal of the osteophytes. The motion occurs once the plantar release is performed with the McGlamry elevator. The function of the sesamoid apparatus is the one of the most important factors for the motion in the 1st MPJ.

As the sesamoids retract after the resection of the base of the proximal phalanx due to the detachment of the short flexors and attempt to cover the sesamoids will fail. The sesamoids sit far too proximal to the implant to be covered.[7] In the future it would be necessary to develop an implant as a hemi- head implant that covers the articulation between the 1st metatarsal head an the sesamoids in order to maintain the motion in the 1st MPJ.

The sesamoids will stay completely covered and will not retract as the FHB tendon will not be severed.

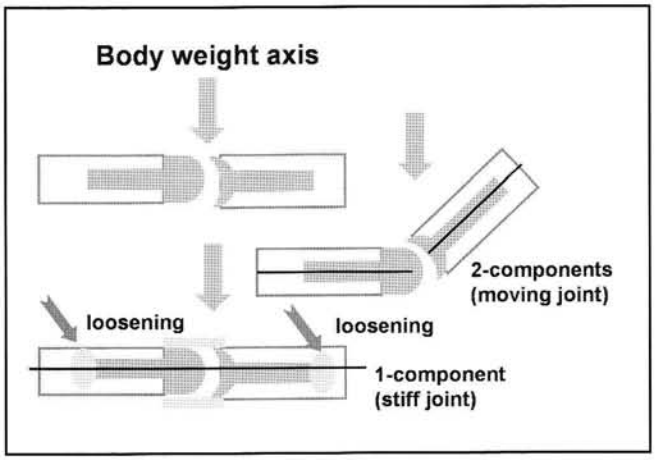

Figure 8. Stiff joint leads to loosening of the implant.

The acceptance of the procedure by the patients is well documented after 2 and 6 years without major changes. It is obvious that the objective findings both in the radiographic and the clinical evaluations do not correlate with the patients assessments. Although a decrease of the motion is documented, the patients still stated that the motion is sufficient and improved compared to the first follow-up after 2 years. The signs of loosening in the radiographs should implicate pain, swelling and crepitus. This does not occur according to the evaluation of the questionnaire.

CONCLUSION

The replacement arthroplasty of the first MPJ is a viable option for the treatment of the end stage hallux rigidus. The indication has to be very rigid and the procedure should be reserved for the elderly patient with an unchanged IM angle. The acceptance of the implant arthroplasty after 6 years is high, as documented in the analysis of a questionnaire.

Biomechanical problems of the system lead to loosening of the system and to the loss of range of motion after 6 years, without being a problem for the patient. The duration of the implant can be estimated to be about 8-10 years. The patients will then need a tricortical bone graft or will be left with a Keller-Mayo situation with a high risk of metatarsalgia. The aim for the future should be a hemi-head implant that covers the metatarso-sesamoidal articulation to restore full motion in the joint. Is case of a failure of that system a simple end to end fusion in the 1st MPJ should be sufficient.

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