

Revision arthroplasty for failed first metatarsophalangeal joint arthroplasties with ceramic arthroplasty and impaction bone grafting

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Abstract

Metatarsophalangeal (MTP) replacement arthroplasty has been an accepted form of treatment for hallux rigidus. Failure of such arthroplasties has led to complications including silicone synovitis, granulomatous bone destruction, loss of first metatarsal length and eventual transfer metatarsalgia. These failed arthroplasties pose a challenge in revision surgery.

We present our early results of six patients (7 ft) who had failed primary MTP joint arthroplasties, treated with impaction bone grafting, and a customised ceramic on ceramic MTP joint (MOJE) replacement. The mean follow up was 16.8 months. Patients were examined clinically and radiographically. The American Orthopaedic Foot and Ankle Society (AOFAS) score improved from 26 points (range 10–59) to a mean of 67 points (range 59–87). All patients reported relief from transfer metatarsalgia, improvement in their activity status and satisfaction with the final outcome of treatment. We conclude that ceramic implant revision, with impaction bone grafting into areas of granulomatous destruction, appears to be a viable, versatile, and safe alternative in the treatment of failed arthroplasty of the first MTP joint. © 2004 European Foot and Ankle Society. Published by Elsevier Ltd. All rights reserved.

Keywords: Salvage; Failed arthroplasties; Hallux rigidus; Impaction bone grafting; Transfer metatarsalgia

1. Introduction

Treatment of hallux rigidus with MTP replacement arthroplasty has been an accepted form of treatment for many years. It has been available as membrane, block, single stemmed, double stemmed, flexible hinge, cemented and uncemented options [1]. However, failure of such arthroplasties have led to complications including metatarsal shortening, silicone synovitis, bone loss and granulomatous reaction to silicone debris with the creation of a destructive avascular giant cell response [2,3]. Often the first MTP joint is rendered non functional, as a consequence of which transfer of load bearing to the lesser metatarsals leads to metatarsalgia [4]. Indeed stress fractures of the lesser metatarsals following double-stemmed silicone arthroplasty of the first MTP joint have been observed and reported [5]. Various methods have been advocated for the treatment of such difficult conditions including extraction

of implants and synovectomy [5], distraction arthrodesis to recreate metatarsal length, and shortening osteotomies of the lesser metatarsal [4,6].

This study reports our early results of treatment of such failed arthroplasties. Bone loss in the distal metatarsal and proximal phalanx was addressed by autologous impaction grafting and the MTP articulation was restored by the use of a new ceramic on ceramic modular implant system (MOJE joint) with customisation if required.

2. Materials and methods

Since May 2000, six patients (7 ft) who presented with symptomatic failed arthroplasty and lesser metatarsalgia underwent grafting and revision using a formalized protocol. The primary procedure, in all cases had been performed for painful hallux rigidus. The failed arthroplasties included: silastic hemiarthroplasty (2), twin stems (2), cemented metallic hemiarthroplasty (1) and cemented GTS arthroplasty (2). The common symptoms were painful deformities of the first MTP joint (40%), transfer metatarsalgia (100%)

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Fig. 1. Radiograph showing destruction of first MTP joint following primary silastic MTP joint arthroplasty.

and problems with footwear (100%). One patient had an increasing mass over the dorsum of the medial forefoot. No patients showed any clinical signs of superficial or deep infection. Full blood count, Erythrocyte Sedimentation Rate and C-Reactive Protein blood investigations were performed in the outpatient clinic to help exclude the possibility of a deep infection as a cause for failure of the primary implant. Weight bearing anterior–posterior, lateral and medial oblique radiographs were performed pre-operatively (Fig. 1). Pre-operative radiographs were sent off to the manufacturers for appropriate customisation of the implant. After extensive pre-operative counselling, special informed consent was obtained. Surgery was undertaken by a single surgeon.

3. Surgical technique

The operation was performed under general anaesthesia with the patient in the supine position, and a sand bag on the affected side to neutralise the hind foot. All patients received prophylactic antibiotics and post-operative thrombo–prophylaxis. An above knee tourniquet inflated

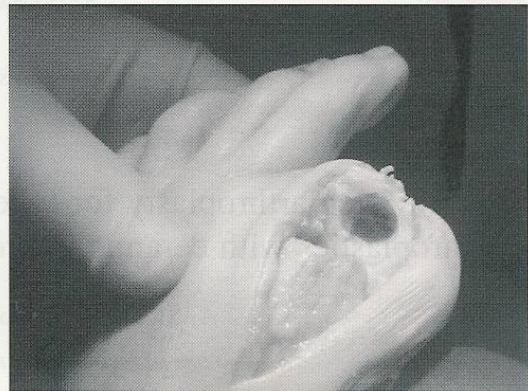


Fig. 2. Proximal phalanx showing defect following debridement of granulomatous material.

to 300 mmHg was used. The first MTP joint was accessed through the old dorso-medial scar. A full thickness sub periosteal dissection, protecting the dorsal cutaneous nerve, was carried out to expose the joint and the adjacent bones. The sesamoid apparatus was exposed and an extensive release was carried out, excising all synovitis. Synovectomy of the MTP joint was also performed. All granulomatous tissue, silastic debris and implant were excised and the bony defect assessed (Fig. 2). Swabs from the synovial fluid were taken and sent for microscopy and culture. Biopsies of the granulomatous tissue were performed and sent for culture and histology. Membranous tissue from the medullary canal of both bones was carefully curetted and the presence of cloacae determined.

Bone graft was harvested from the iliac crest from four patients or from the distal tibia in two patients. Reamers included in the instrumentation, were used as tamps to impact the bone graft after initial restriction of the canal, using a small piece of cortical bone. Bone graft was impacted until the pre-determined (customised) peg diameter was reached (Fig. 3). A cloaca was plugged with cortical bone prior to impaction. All host bone was

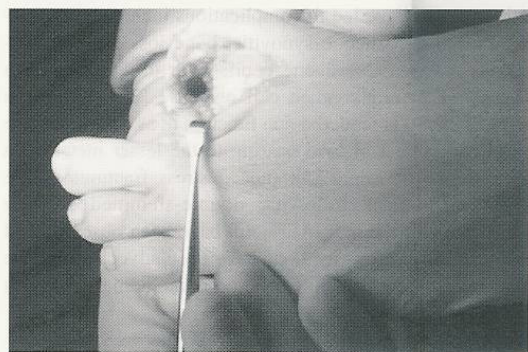


Fig. 3. Proximal phalanx following impaction bone grafting.

therefore coated with impacted autograft. The selected implant was then press fitted and assessed. If any movement was detected the implant was removed and impaction repeated until an absolutely tight fit was obtained. At this point the joint was screened and the mantle of bone graft assessed. Once satisfactory, the wound was irrigated and closed in layers.

Post-operatively patients were non-weight bearing in a plaster bootie for 6 weeks. This protocol was followed to help allow incorporation of the graft and early ingrowth of the implant. Following this initial period, patients were started on a physiotherapy protocol, which included passive movements for 2 weeks with partial weight bearing in a heel-bearing shoe followed, by active movement and full weight bearing over a period of 4 weeks.

Their average inpatient stay was three days. They were followed up at 2 weeks, 6 weeks, 3 months, 6 months 1 year and annually thereafter. Patients were evaluated using the AOFAS Hallux 100 point outcome scale [7]. A subjective outcome questionnaire was used to assess the patient satisfaction. All patients underwent weight-bearing analysis using the podotrack maps post-operatively as well as weight bearing antero–posterior, lateral and medial oblique radiographs.

The average time period following their first procedure was 6.1 years (range 3–10). The radiographs revealed osteolysis, implant fracture, loosening, and loss of first metatarsal length. There was no evidence of deep bone infection in any of these patients. None of these patients had diabetes, ischemia, nor were immunocompromised from any other disease process.

4. Results

All patients were available for review. The average follow up was 16.8 months (range 4.5–35 months). All patients showed a significant improvement in their AOFAS scores. The mean pre-operative AOFAS score of 26 points (range 10–59) improved to a mean of 67 points (range 52–87) post-operatively (Figs. 4–7). Five patients reported satisfactory outcome in symptoms, function and foot wear. Two patients complained of an inadequate range of motion. All patients showed satisfactory graft incorporation at 3 months. Podotrack analysis revealed that all patients were weight bearing on the first metatarsal during the 'toe off phase' of the gait cycle. All patients reported relief of transfer metatarsalgia, although two patients had asymptomatic mild callosities. All patients improved on their pre-operative activity status at 3 months. All patients reported a satisfactory outcome following the operation and were happy to recommend the procedure to a friend.

There were no serious complications. One patient had a superficial wound infection, which was treated successfully

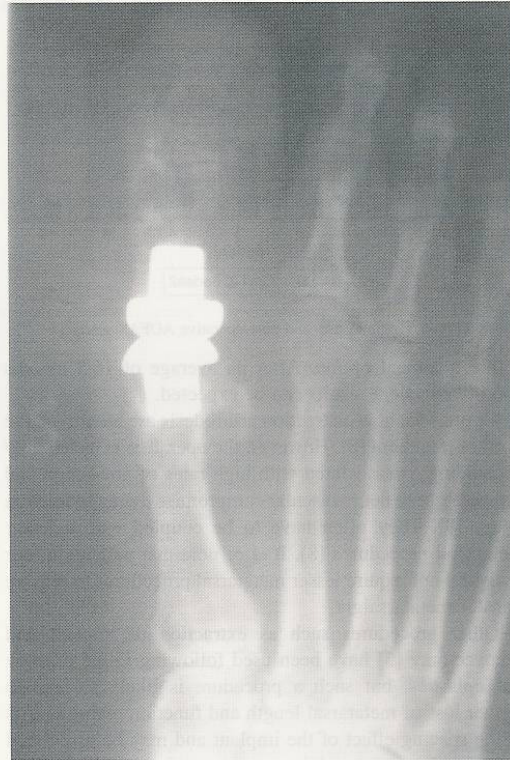


Fig. 4. Radiograph demonstrating MOJE joint replacement and incorporation of bone graft 6 months following surgery.

with antibiotics. One patient had proximal phalangeal cortical breach and was asymptomatic.

5. Discussion

The results of the current study appear to suggest that revision of failed first MTP joint arthroplasties using MOJE ceramic implant augmented with impaction bone grafting is

Summary of results

Patient	Age	Pre op AOFAS score	Post op AOFAS score	Function	Footwear	Symptoms
1	45	27	87	Good	Fair	Excellent
2a	63	13	52	Fair	Poor	Fair
2b		10	62	Fair	Fair	Fair
3	58	39	59	Poor	Fair	Fair
4	43	29	62	Fair	Good	Good
5	57	57	85	Good	Excellent	Excellent
6	57	10	62	Good	Fair	Excellent

Fig. 5. Summary of results.

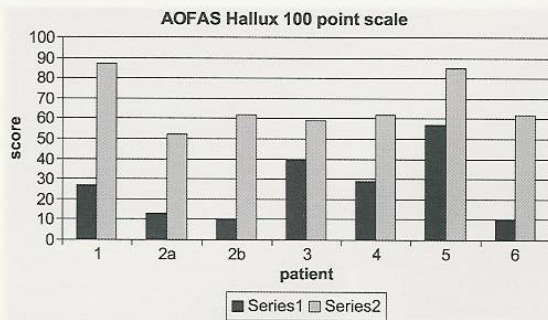


Fig. 6. Graph of pre- and post-operative AOFAS scores.

viable treatment option. After an average of 16.8 months good to excellent results can be expected.

Options such as distraction arthrodesis are an alternative form of treatment [8]. However, the operation is technically demanding, is associated with high rates of non-union and can give rise to neurovascular compromise owing to traction injury [8]. They often have to be coupled with a lesser metatarsal procedures [8]. It is of note that patients in our study did not require lesser metatarsal procedures to resolve transfer metatarsalgia.

Other procedures such as extraction of implant and synovectomy [5] have been used following failed primary arthroplasties, but such a procedure is likely to lead to further loss of metatarsal length and function owing to loss of the spacing effect of the implant and may be associated with transfer metatarsalgia.

Impaction bone grafting has been used to restore bone stock in patients with failed hip and knee arthroplasties. Impaction of the bone graft appears to act as a stimulus and may well be osteo inductive. Incorporated bone graft demonstrates adequate structural integrity and strength, and has been very useful in reconstructing large losses of bone stock in hip arthroplasty [9–11]. In our experience impaction bone grafting was successful in resolving the problems of bone loss in the metatarsal and proximal



Fig. 7. Post-operative assessment showing a well-healed scar and an excellent range of motion at the first MTP joint during the "toe off" phase.

phalanx, and allowed successful implantation of the MOJE implant system.

The MOJE ceramic toe implant is made of zirconium oxide (ZrO_2) and was developed in 1994 by Werner and Moje [12,13]. The original implant design was screw fit, but complications were noted including screw loosening and metallosis type reactions to the titanium screws [13]. This screw fit has been replaced by the current press fit design. This newer implant relies on an interference fit. It is also coated with the bioactive glass ceramic Bioverite that allows osteointegration, and therefore a more stable fixation of the implant in the long term [13,14].

The MOJE joint has been used by the senior author in the treatment of hallux rigidus with satisfactory results. Early results of this implant have been published by West and Moir and show a satisfactory outcome [13]. For revision surgery the customisation of the implant is required to gain a satisfactory peg diameter for stable implantation in an area of impaction bone grafting. It is also useful in restoring the first metatarsal length, often to its original length prior to the procedure.

An early assessment of a small number of patients in our study appears to suggest that the use of the ceramic on ceramic implant MOJE coupled with the use of impaction bone grafting is a satisfactory and safe procedure and achieves both restoration of bone stock and metatarsal length thereby restoring function to the first MTP joint and relieving metatarsalgia.

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