



Original Articles

Early results of Roto-glide joint arthroplasty for treatment of hallux rigidus

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ABSTRACT

Background: Traditionally severe hallux rigidus is treated with arthrodesis. Recently arthroplasty has been used in order to retain motion at the metatarsophalangeal joint.

Aim: To assess the early to mid-term functional and radiological outcomes in patients undergoing first metatarsophalangeal arthroplasty using the Rotoglide implant.

Materials and methods: A prospective review was undertaken to assess functional and radiological outcomes of all patients undergoing an un-cemented three-component first metatarsophalangeal arthroplasty for hallux rigidus. Thirty four implants were performed in 28 patients over a 2-year period. Mean age was 60.5 years (range 45–77 years). Mean follow-up was 27.7 months (range 7–44 months).

Results: Mean AOFAS score improved from 41.2 pre-operatively to 89.1 at final follow-up (47.9; 95% CI = 43.6–54.3; $p < 0.0001$). The mean metatarsophalangeal (MTP) range of motion improved from 29.5° pre-operatively to 68.2° post-operatively (38.7; 95% CI = 35.1–42.2; $p < 0.0001$). The mean AOFAS pain scores improved from 8.8 preoperatively to 35.0 postoperatively (26.2; 95% CI = 22.4–29.9; $p < 0.0001$).

Three patients required revision surgery. No radiological complications were observed in any other patients. **Conclusions:** This un-cemented prosthesis provides pain relief, while maintaining range of motion of the joint. The authors have observed clinically and statistically significant improvement in functional outcomes, with a low early complication rate and high patient satisfaction levels.

1. Introduction

Hallux rigidus is a degenerative condition of the first metatarsophalangeal (MTP) joint of the great toe, characterised by progressive loss of motion, particularly dorsiflexion. This combined with the formation of dorsal osteophytes, results in pain and stiffness of the joint.

An estimated 2% to 10% of the general population has varying degrees of hallux rigidus [1–3] and it is the second most common forefoot presentation after hallux valgus.

Coughlin and Shurnas developed a classification system for hallux rigidus, using a combination of clinical and radiological findings [1]. This is a commonly used tool for grading severity of disease (Table 1). In addition, the presence and extent of any associated deformity, patients' age and activity level should also be considered when deciding on surgical treatment.

Traditionally, mild to moderate disease has been treated with cheilectomy or osteotomy, with more severe cases being treated with arthrodesis [3]. Arthrodesis is the accepted surgical options for advanced arthritis providing long-term pain relief [1]. However, all patients do not accept this option due to concerns about loss of motion.

There are concerns about potential limitations to involvement in physical activity and alteration of gait. More recently, arthroplasty of the MTP joint is becoming an increasingly used surgical treatment for patients with advanced disease. This gives the option of providing pain relief, while maintaining range of motion [1,4,5].

There are numerous implants available for use in hallux rigidus of varying designs, including hemiarthroplasty and total joint arthroplasty, each with their own benefits and limitations. However, long term outcomes and large series evaluating the use of such implants is lacking in the literature.

Roto-Glide™ (Implants International, UK) is an uncemented three part, non-constrained titanium-on-ultra-high molecular weight polyethylene implant which incorporates a rotating meniscus and was first introduced into the UK in 2002.

The aim of the present study was to assess the early to mid-term functional and radiological outcomes in patients undergoing first metatarsophalangeal arthroplasty using this implant for the treatment of severe hallux rigidus.

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Table 1
Grading of hallux rigidus, by Coughlin and Shurnas [1].

Grade	Clinical findings	Range of motion	Radiographic findings
0	No significant pain Stiffness, loss of passive motion	Dorsiflexion: 40–60° ± 10–20% loss compared to normal side	Normal or minimal changes
1	Mild or occasional pain and stiffness Pain at extremes of motion	Dorsiflexion: 30–40° ± 20–50% loss compared to normal side	Dorsal osteophyte main finding
2	Moderate to severe pain, constant stiffness Pain before maximal dorsi- or plantar-flexion	Dorsiflexion: 10–30° ± 50–70% loss compared to normal side	Dorsal, lateral ± medial osteophytes Flattened appearance of metatarsal head Mild-moderate joint space narrowing ≤ 1/4 dorsal joint space involvement on lateral radiograph
3	Constant pain, significant stiffness Pain throughout motion, except for mid-range	Dorsiflexion: ≤ 10° ± 75–100% loss compared to normal Notable loss of plantar-flexion (usually ≤ 10°)	As grade 2, and: Substantial joint space narrowing Periarticular cystic changes ≥ 1/4 of dorsal joint surface involved on lateral view Sesamoids enlarged, cystic or irregular
4	As for grade 3, with additional pain at mid-range of motion	As for grade 3	As for grade 3

2. Materials and methods

Thirty four toes in 28 patients (6 patients were bilateral) were included in a prospective review of all patients undergoing first MTP joint arthroplasty for the primary treatment of hallux rigidus under the care of the senior author between February 2013 and July 2015. All patients were operated using the same 3 component total arthroplasty system (Roto-glide™ Implants International, UK) and surgical technique.

Pre-operative assessment included clinical examination with documentation of range of motion at the first MTP joint using a goniometer, completion of American Orthopaedic Foot and Ankle Society Hallux Metatarsophalangeal Interphalangeal (AOFAS-HMI) scores [6] and standing AP and lateral radiographs of the foot to confirm the diagnosis.

Patients with advanced disease (Coughlin and Shurnas stage 3 or 4) with good bone stock and normal MTP joint alignment were eligible for inclusion. All patients had a trial of non-operative measures for at least 6 months prior to surgery.

Patients with inflammatory arthritis, associated hallux valgus (of more than 15°) and managed with arthrodesis. Those with neurovascular compromise, metal allergy or poor local tissue condition were also excluded from this study.

Informed consent for the procedure was gained from all participants during their pre-operative visit. In accordance with published guidelines on MTPJ arthroplasty from the National Institute for Health and Care Excellence (NICE) [7], all included patients were also given the option of arthrodesis, but declined as the loss of range of motion was unacceptable.

Radiological and clinical outcomes were assessed at 3, 6, 12, and 24 months post-operatively by an independent assessor. Patients were clinically assessed for the occurrence of any complications and range of motion at the first MTP joint. At each visit, AOFAS and visual analogue (VAS) pain questionnaires were completed. Patient satisfaction questionnaires were completed at 12 months post-operatively.

Radiographs were assessed for any evidence of subsidence, loosening or malalignment at each clinic visit. Loosening was defined as more than 2 mm of lucency around the bone-implant interface.

3. Experimental

All patients were operated on as a day-case procedure under a combination of general or spinal anaesthesia and ankle block; intravenous antibiotics were given at induction and a tourniquet was used in all patients. A dorsomedial approach was used to expose the joint.

A dorsal cheilectomy of the metatarsal was performed at 60° using the manufacturers jig and any osteophytes were excised from the proximal phalanx. The phalangeal jig is then used to resect 2–3 mm of

the joint surface perpendicular to the axis of the bone.

The medullary canals of the metatarsal and proximal phalanx are prepared with a drill and the trial implant components are inserted.

Further soft tissue release was performed as necessary, to include the sesamoid sleeve and flexor hallucis brevis tendon. A small periosteal elevator was inserted under the metatarsal head to relieve any contractures. Any osteophytes from the dorsal surface of sesamoids were excised

The definitive components were implanted and intra-operative range of motion was checked and deemed to be satisfactory if dorsiflexion was more than 70–80°. An image intensifier was used to ensure adequate placement of the prosthesis, and active radiological screening was performed during range of motion.

The wound was closed with non-absorbable sutures and patients were placed into a soft dressing.

On the operating table a rough assessment of the dorsiflexion was checked. At follow-up, a goniometer was used.

All patients undertook the same post-operative rehabilitation protocol. Patients were encouraged to fully weight bear and perform active range of motion of the first MTP joint immediately post-operatively.

A clinical review of the wound was undertaken at 2 weeks when the sutures were removed. Formal physiotherapy was commenced at this time.

4. Statistical analysis

Statistics were obtained using SPSS for Windows statistical program (SPSS Inc., Chicago, USA). Before applying parametric methods (paired student's t-test), the data was checked for normality. Statistical significance was designated at $p < 0.05$. All student's t-tests were two-tailed. Confidence intervals are reported at 95%. Bilateral patients ($n = 6$) were analysed as though the measurements on each foot were independent.

5. Results

The mean age of patients in this series was 60.5 years (range 45–77). Fourteen males and 15 females were included. One patient underwent a simultaneous hammer correction of the second toe at the time of MTP joint replacement. Mean follow-up was 27.7 months, (range 7–44 months).

5.1. Functional outcomes

There was a statistically significant improvement in mean AOFAS score from 41.2 preoperatively to 89.1 postoperatively (47.9; 95% CI = 43.6–54.3; $p < 0.0001$).

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