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BEITRAG ZUM THEMENSCHWERPUNKT

Is total replacement of the first MTP-joint for arthrosis an option? An overview

Ist der endoprothetische Ersatz des Großzehengrundgelenks bei Arthrose eine Option? Eine Übersicht

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Abstract

Total replacement of the first metatarsophalangeal joint has been in use for about 30 years. It has never reached a standard where it could compete with other treatments like osteotomy, cheilectomy, arthroplasty, or arthrodesis. This paper will describe the evolution, and a suggestion of a new concept.

The Roto-Glide® (Implants International, UK) is a non-cemented TiCaP surfaced three-component device. It allows for normal mobility in the joint. The metatarsal implant has a rather long intramedullary stem. The upper part of the metatarsal head has an anatomical flange. In the middle it has a crest which corresponds to the natural crest in the lower part of the head. The phalangeal implant also has a stem. We have used this prosthesis for more than 10 years. At present about 130 cases have been treated. A prospective review of the series is currently being undertaken. Currently, we know that there has been no aseptic loosening of the prosthesis, that it gives excellent pain relief and sufficient mobility for normal daily activities. We do not recommend running and jumping (for any prosthesis for that matter), but all daily life activities can otherwise be performed.

In conclusion, the Roto-Glide prosthesis has given hope for the future use of total MTP-1 prosthesis.

Zusammenfassung

Der endoprothetische Ersatz des Großzehengrundgelenks ist seit 30 Jahren möglich. Diese Versorgung hat jedoch bisher nicht den Standard wie z.B. Osteotomie, Cheilektomie, Arthroplastie oder Arthrodese erreicht. Diese Arbeit beschreibt die Entwicklungsgeschichte des endoprothetischen Ersatzes und stellt ein neues Konzept vor.

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Die Roto-Glide® (Implants International, UK) ist eine nichtzementierte TiCaP beschichtete Drei-Komponenten-Prothese. Sie erlaubt einen normalen Bewegungsumfang. Die metatarsale Komponente hat proximal einen langen intramedullären Schaft und distal eine anatomisch geformte Gelenkfläche. In der Mitte der Gelenkfläche befindet sich einen finnenartige Vorwölbung, die mit der weiter kaudal gelegenen anatomischen Vorwölbung korrespondiert. Die phalangeale Komponente beinhaltet ebenfalls einen intramedullären Schaft.

Wir haben diese Prothese seit mehr als zehn Jahren im Einsatz. Bisher wurden mehr als 130 Prothesen eingesetzt. Eine prospektive Nachuntersuchung läuft noch. Bisher ist keine aseptische Lockerung aufgetreten und wir konnten eine exzellente Schmerzreduktion und suffiziente Mobilität für normale tägliche Aktivitäten feststellen. Laufen und Springen wurden wie bei anderen Prothesen üblich nicht empfohlen.

Zusammenfassend gibt die Rotoglide-Prothese Hoffnung für den zukünftigen endoprothetischen Ersatz des Großzehengrundglenks.

Introduction

Total replacement of the first metatarsophalangeal (MTP) joint has been in use for about 30 years. It has never reached a standard where it could compete with other treatments like osteotomy, cheilectomy, arthroplasty, or arthrodesis [3]. This paper will describe the evolution, and a suggestion of a new concept. Before going into the different prosthetic designs that have been tried one should consider the facts about the anatomy, the function, the mobility and the forces applied to the MTP-1 joint during loading.

Anatomy. The MTP-1 joint is a true synovial joint. It has a capsule and stabilizing elements like collateral ligaments and tendons. Involved in the articulation is also the two sesamoids.

Functions are extension/flexion, abduction/adduction and rotation.

Mobility is foremost extension/ flexion (80/30), but in combination with slight abduction/adduction and free rotation that secures an adaption of the great toe to the ground no matter the position of the foot.

Forces during motion are increasing the more dorsiflexion the joint is loaded in and the forces are applied to the upper half of the metatarsal head and the phalangeal counterpart.

Symptoms in arthrosis of the MTP-1 joint. Patients are complaining about pain in the joint, especially at the dorsal aspect. This gives pressure problems in shoe wear. The other trouble is diminished mobility, especially in dorsiflexion.

Clinical examination. The contour of the metatarsal head is square. Osteopytes can be palpated from lateral, over the dorsal aspect and to the medial side of the metatarsal head. There is a painful collision phenomenon in dorsiflexion. The toe is in an anatomical position and the joint is stable. There may also be distinct pain when moving the sesamoids, especially the tibial one.

Radiography. art Arthrosis in MTP-1 is graded into four stages (Fig. 1).

Current treatments

Treatment is depending on the loss of cartilage. In stage one and stage 2 there is no indication for total joint replacement, as cheilectomy is a sufficient surgical treatment. The stability is not lost, and sufficient dorsiflexion can be obtained with pain reduction. The arthritic process, however, goes on, and later on it may progress to stage 3 and 4, needing further surgical treatment.

Arthroplasty as in Keller's arthroplasty was previously used frequently, but it lacks stabilization due to cutting of the plantar stabilizing structures, does not change the lateralization of the load of the foot and may give rise to a cock-up toe, or a very short hallux and thereby metatarsalgia. This is true whether or not capsular structures are inserted into the joint space.

Osteotomy. Several types of osteotomy have been described. Moberg's is a dorsal wedge reduction osteomy of the proximal phalanx that allows better dorsiflexion. Metatarsal head osteotomies intend to reduce the pressure in the joint by shortening (Malerba) or a dorsal wedge that turns up less degenerated cartilage (Waterman(Fig. 2a and Fig. 2b). While they may give better mobility they do not address the arthritic process, and further treatments can be expected in the future.

Arthrodesis is an excellent treatment for pain, and especially in cases with excellent mobility of the IP joint, it is a good solution. There is a tendency for loading the foot on the lateral side which in turn may give problems of its own. Women

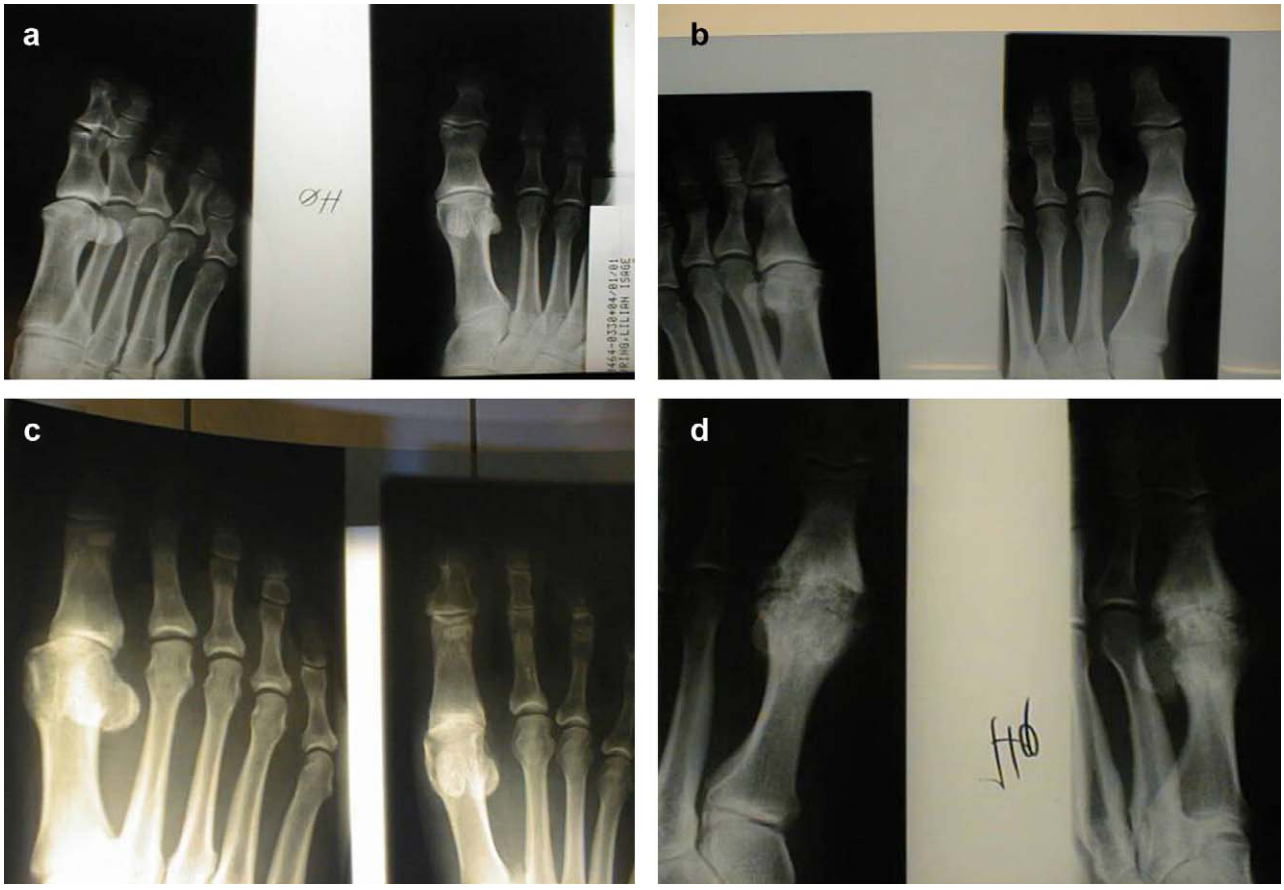

Figure 1. Grades of arthrosis in the MTP joint. Figure 1a, grade 1, dorsal osteophyte; Figure 1b, grade 2, dorsal arthrosis; Figure 1c, grade 3, obliterated joint; Figure 1d, grade 4, ankylosis.

however, would at occasions like to wear higher heels. This is not really an option with an arthrodesis. Also men working as electricians, carpetlayers, and plumbers would need a dorsiflexion when working on the floor. There should therefore be an option other than arthrodesis for grade 3 and 4 arthrosis where mobility can be retained.

The prostheses

While stemmed silicone prostheses have been rather successful in hand surgery, it led to a significant number of failures in the great toe replacement. (Fig. 3).The reasons were the greater forces in the MTP-1 joint and the inability for the device to rotate the joint. This gave rise to breakage of the implant at the joint space level, followed by severe synovitis and eventually removal of the implant leaving severe bone losses.

Metal implants have been and are still used either as hemi-prosthesis or total prosthesis. The total joints are all two piece devices. While uncemented hemi-prosthesis may be useful in grade 1 and 2 arthrosis, they have no place in grade 3 and 4 arthrosis. Originally the two piece metal devices were cemented. Those with short pegs in the medullary canal loosened (Fig. 4). The same has been reported about the uncemented device [6,1,8]. Modern two-piece devices have used metal on polyethylene (Fig. 5). At 3 years follow-up Fuhrmann et al. 2003 found radiographic loosening in 1/3 of their cases [5]. In a recent study, Bartak et al. found 16% failures after 24 months which confirms the results of Kundert and Zollinger-Kies [1,7]. Ceramics-ceramics (Fig. 6) have no real long-term results, but the results that have been published are not encouraging with short- term loosening between 12.5% and 18% after respectively 26 months and 3 years [4,2]. The only attempt of a randomized prospective study: arthrodesis versus total replacement of the first metatarso-phalangeal joint unfortunately had serious flaws [6]. There was change of the procedure in the replacement group from uncemented to cemented implantation because of loosening of the uncemented devices. The authors used the implant for arthrosis stage 1, 2 and 3, and there were bilateral cases, and cases

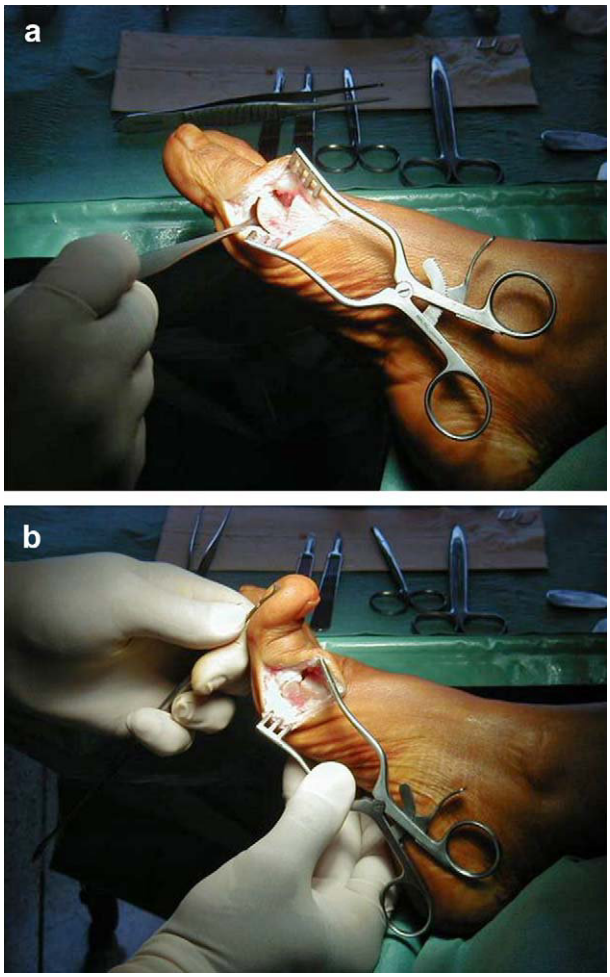

Figure 2. Waterman osteotomy. Figure 2a, dorsal wedge reduction osteotomy; Figure 2b, wedge closed.

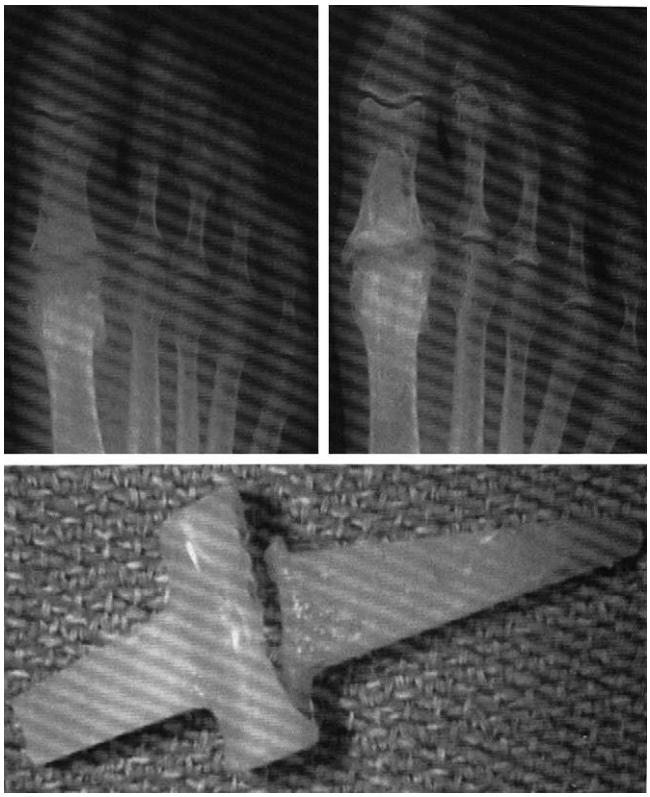

Figure 3. Broken silicone stem.

that got both arthrodesis on one side and replacement on the other side. Furthermore the authors claimed that the arthrodesis group got normal loading of the great toe. This is contradictory to what all others have found, and at the same time the replacement group did not get any loading on the great toe. Using the knowledge of the biomechanics of the different devices there would be room

Figure 4. Loosening of short stems.

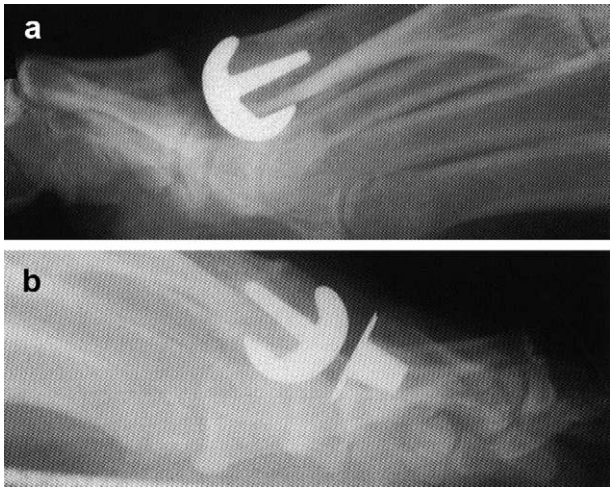

Figure 5. Koenig Total Toe Prosthesis. Figure 5a, uncemented metal-poly; Figure 5b, uncemented metal-polymetal.

for a new device which takes into consideration the failure modes of the current devises.

The Roto-Glide system

The Roto-Glide® (Implants International, UK) is a non-cemented TiCaP surfaced three-component device. It allows for normal mobility in the joint (Fig. 7). The metatarsal implant has a rather long intramedullary stem. The upper part of the metatarsal head has an anatomical flange. In the middle it has a crest which corresponds to the natural crest in the lower part of the head. The phalangeal implant also has a stem. This stem is hollow and has a flat surface toward the metatarsal head. Between the metal pieces a poly meniscus is inserted. This meniscus has a peg corresponding to

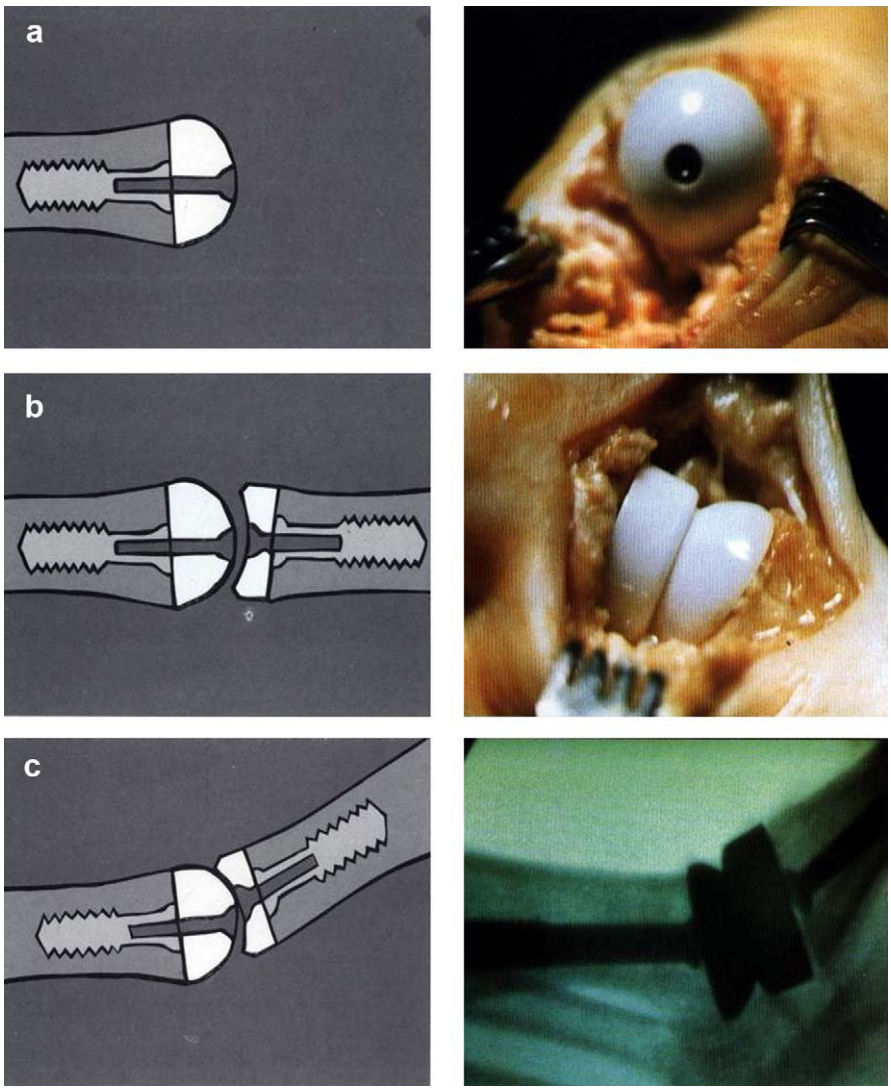

Figure 6. Ceramics-ceramics prosthesis with expander screw fixation. Figure 6a, proximal spect with the "screw in screw concept"; Figure 6b and c, complete joint in situ.

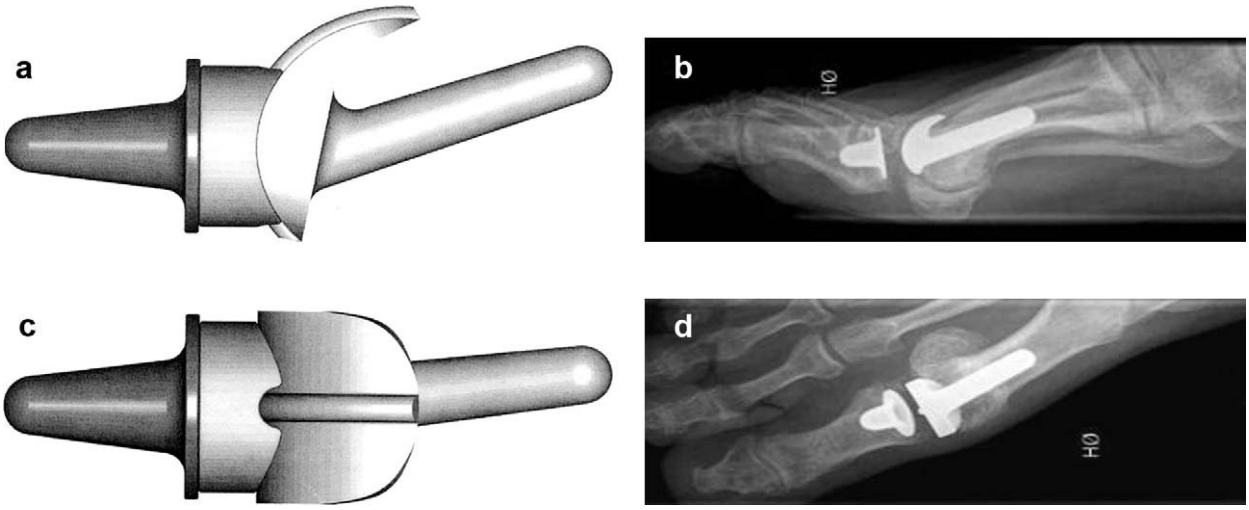

Figure 7. The principles of the Rotoglide. A three-component non-cemented device with a mobile bearing. Figure 7a and b, lateral view; Figure 7 c and d, dorsal view.

the hollow phalangeal implant. The cranial surface of the meniscus is congruent with the metatarsal's surface. It should correspond to the crest for sideboard stability. Thus, extension/flexion takes place between the meniscus and the metatarsal implant, whereas rotation takes place between the meniscus and the phalangeal implant. The prosthesis comes with different interchangeable sizes and a set of instruments for precise cutting and drilling.

The surgical procedure.

With the patient supine under spinal analgesia and using a tourniquiet, an extended dorso-medial incision is used. Osteophytes are removed from the metatarsal head and the phalanx. The metatarsal jig is applied taking care it is the normal rotation. The angulated cut removes the dorsal osteophyte and the upper half of the metatarsal head is sliced off at 60° similar to a cheilectomy. Another jig is applied for the cutting of the phalangeal joint surface. Care must be taken to secure the plantar structures (capsule and the short flexor tendon). About 2-3 mm of the upper phalanx is resected perpendicular to the phalanx's axis. Instruments for drill guides to the medullary canals are used. Make sure the holes are centralized and that the hole in the metatarsal head corresponds to the crest. Trial prostheses are inserted, and the best fitting meniscus is inserted. The joint should be a little slack, but not sideboard unstable. If the joint cannot move to 80° dorsiflexion, osteophytes are removed from the sesamoids and fasciotomy of the flexor muscles are performed. After inserting the final prosthesis, the wound is closed in anatomical layers.

The postoperative care includes direct toe standing exercises. The patient is also taught to load on the medial side of the foot over the hallux (the former habit of walking on the lateral side of the foot should be abandoned from day one. No special shoe wear is needed. Sutures are removed 14 days postoperatively, and the instructions on how to walk correctly are re-instructed. Radiographs are taken under image intensification.

Results

We have used this prosthesis for more than 10 years. At present about 130 cases have been treated. A prospective review of the series is currently being undertaken. Currently, we know that there has been no aseptic loosening of the prosthesis, that it gives excellent pain relief and sufficient mobility for normal daily activities. We do not recommend running and jumping (for any prosthesis for that matter), but all daily life activities can otherwise be performed.

In conclusion, the Roto-Glide prosthesis has given hope for the future use of total MTP-1 prosthesis.

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