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## Introduction

Arthroplasty (joint replacement) of the first metatarsophalangeal joint (first MTPJ) is employed to address both deformity and arthritic conditions. Over the last 30 years, techniques and implants have evolved. Unfortunately there is a paucity of well-designed studies with adequate numbers and external validity from which to glean guidance on whether arthroplasty really is as valuable as one would like to believe [1, 2]. In fact, a recent review of the literature suggests the highest level of evidence for the treatment of hallux rigidus is around first MTPJ arthrodesis [3]. Gibson et al. present the only randomized controlled study of arthroplasty vs. arthrodesis. At 2 years follow-up, there was an overall 82% improvement with arthrodesis vs. 45% improvement with arthroplasty [1]. Nonetheless, certain trends can be appreciated and form the basis of this chapter.

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## Indications and Types of Implants

The goals of arthroplasty are to achieve pain relief, restore joint stability, and improve function. Further, the results should be durable and long lasting. Generally reserved for patients with lower functional demands, problems may arise when joint replacement is used in younger patients, those with greater functional expectations or demands and those with pronounced deformity. The quality of the surrounding soft tissues and bone also play a crucial role in the success or failure of these procedures [4]. Arthroplasty is a joint destructive procedure from which there is no going back and the implants themselves will have a finite life span.

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The type of implant and the salvage upon failure should be taken into preoperative consideration. The implant should be convertible to a different implant or an arthrodesis. Because of the amount of the bone removed at the initial surgery, bipolar or total joint replacements will result in the greatest bone deficit and thus are more difficult to reconstruct.

Unipolar or hemi-arthroplasties have become more popular. Several case reports document the salvage of a failed phalangeal hemi-arthroplasty [5, 6]. Over the last 10 years, metatarsal head hemi-arthroplasties have been more widely used. Both of these options supposedly limit the amount of bone resection and thus the amount of bone loss to be replaced should failure occur, making salvage technically easier and potentially more successful.

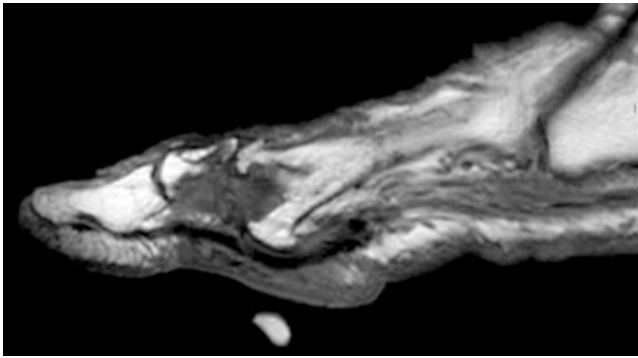
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## Modes of Failure

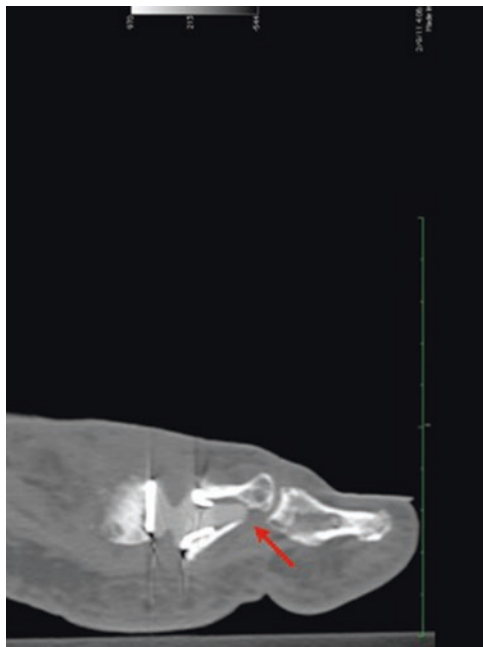
Failure is defined by a loss of function due to pain, joint instability, or disturbance of the metatarsal weight-bearing parabola. There are times when surgeon bias or the impressive nature of radiographic changes may prompt the patient to believe there is a failure, although the three criteria above have not been met. This is an important point. Salvage of a failed first MTPJ arthroplasty is a challenging procedure and should be approached with sound judgement, advanced surgical skill, and realistic expectations [7].

The type of implant material plays a crucial role in the mode of failure. Silicone of the past presented with varying degrees of detritic synovitis and cystic changes in the bone due to shards of silicone breaking loose over time [8, 9] (Fig. 14.1). Contemporary silicone implants hold up better and reports of such failure have diminished. In addition, the introduction of titanium grommets also improved the situation [10, 11]. There can still be bone erosion secondary to the movement of the implant within the bone (Fig. 14.2).

Metallic implants may still present with a similar detritic reaction, but more often peri-implant lysis and secondary loosening of the implant. Subsidence of the implant can occur



**Fig. 14.1** Detritic synovitis from a silicone implant



**Fig. 14.2** Erosion of the plantar aspect of the proximal phalanx (*red arrow*)

in hemi- and total implants. This will often have significant bony destruction. Even in the case of a hemi-arthroplasty, bone loss can be significant enough that revision requires the use of a structural bone graft to restore normal metatarsal weight-bearing parabola [5, 12, 13] (Figs. 14.3 and 14.4).

As with any arthroplasty, the dreaded complication is infection. The literature specifically on the incidence of infection with first MTPJ arthroplasty is scant, but the percentages in the available case reports suggest it is quite low [14]. Furthermore, there is no evidence-based algorithmic approach to addressing infection, and protocols have been extrapolated from the hip and knee literature.

## Workup

A thorough history will often guide the surgeon as to why the implant may have failed. Most patients will present with pain. This may be in the first MTPJ or elsewhere, for exam-



**Fig. 14.3** Loosening and subsidence of a hemi-implant



**Fig. 14.4** Loosening of the implant in the head of the metatarsal and subsidence of the implant into the base of the proximal phalanx

ple, with sub-second metatarsal pain. A thorough understanding of the subjective issues must be complimented with an appreciation of the patient's expectations.

Signs and symptoms of infection (local and systemic) should be noted and addressed appropriately. History of a draining sinus tract over the joint is ominous and should heighten concerns that an infection, either fulminant or occult, is present.

## Clinical Evaluation

The first step is to evaluate for signs of infection. The cardinal signs of inflammation may represent infection but may

also be due simply to implant loosening or reactive synovitis or inflammation from the implant material. Any evidence of an open wound or draining sinus tract should be fully inspected and in and of itself is an indication for surgical exploration [15].

Once the likelihood of infection has been addressed, the next step is to assess for contributing proximal pathology. Ankle equinus and clinically significant hindfoot or midfoot deformity or instability may both contribute to the implant's failure. These should be fully evaluated and addressed at the time of revision [16].

Deformity and functional derangement of the first ray must be evaluated. First ray hypermobility should be taken into consideration and addressed. Deformity in the first MTPJ may present as hallux valgus and/or hallux malleus. Flexibility of these deformities will determine the optimal procedure(s).

Lesser MTPJ pain may be the chief complaint. Evaluation for MTPJ instability (plantar plate and/or collateral ligaments) and the existence of digital deformities should be considered and addressed appropriately.

## Imaging

Weight-bearing plain films are evaluated for the presence of peri-implant lucency (Fig. 14.4). This likely suggests instability but should also be considered as a sign of infection if coupled with other clinical evidence. An inventory of bone loss and disturbance of the weight-bearing parabola is taken and severity determined. This is an essential component of the evaluation as this will have a profound impact on the reconstructive plan. With defects of >1 cm, serious consideration should be given for a staged reconstruction. Acute correction of defects of this size or larger may result in vascular and/or neural injury.

In the case of hallux valgus, standard radiographic evaluation is undertaken noting severity and apex of deformity. As first MTPJ arthrodesis is the most common salvage procedure, one can anticipate between 5 and 8° of IM correction [17]. The hallux interphalangeal joint (HIPJ) is evaluated for deformity in all three planes as well as for arthritis.

## Laboratory Data

If an infection is suspected, an aspiration of the joint is recommended. The presence of purulence is not diagnostic of infection. In the case of metal on metal (MoM) implants, it may be indicative of a foreign body reaction. Fluid is evaluated for cultures (aerobic, anaerobic, fungal, AFB) and sensitivities. WBC and differential is evaluated as well. A synovial WBC >3000/mL and polymorphonuclear cells (PMNs) >80% have the highest accuracy and sensitivity for infection [18].

Evaluation of the erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are also in order. ESR of >30 mm/h and CRP > 10 mg/dL are highly suggestive of infection. Taken together, the sensitivity for infection is estimated to be 93% and warrants further investigation [15]. In this instance, surgery is usually indicated to get synovial culture and biopsy. A negative culture doesn't rule out infection. In addition, an elevated synovial CRP has been reported to have an accuracy of 91% [15]. In addition to a positive culture, this can be the impetus to start an infected implant treatment protocol.

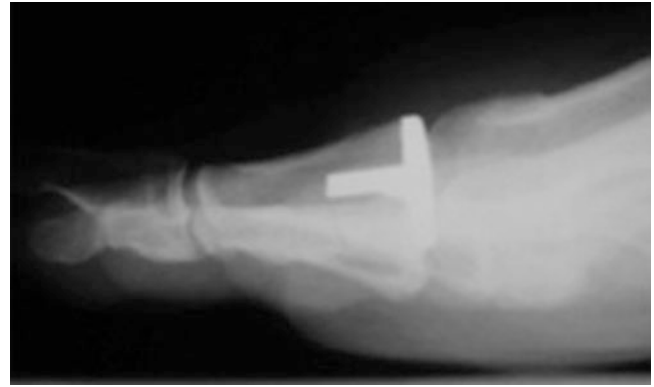
## Procedures

There are four options for treatment for failed implants of the first metatarsal phalangeal joint: maintain the implant, removal of the implant and reimplantation at a later date, removal of implant, or arthrodesis. The decision of which option to choose will be determined by the diagnosis, quality of the soft tissues and bone, and whether there is an infection. An arthrodesis is the most definitive of these procedures but can be a challenging surgery. Hecht et al. [19] showed that arthrodesis of a failed silicone implant improved patient's average walking tolerance, ability to wear shoes, and overall level of satisfaction. Garras et al. [5] followed 18 patients that were converted from a failed hemi-arthroplasty to a fusion. They showed that the VAS pain score went from 0.75 to 7.8 out of 10.

The surgeon should attain adequate intraoperative range of motion during implant surgery of the first metatarsal phalangeal joint. It is essential to make sure that enough bone has been removed, the implant is well placed, and the sesamoids are gliding. There are times when the postoperative motion is significantly reduced even when good surgical technique has been followed. Patients should be educated on range of motion exercises preoperatively and instructed to do range of motion exercises in the immediate postoperative period to prevent arthrofibrosis and limitation of joint range of motion. Conservative measures should be attempted as soon as loss of motion becomes evident. Physical therapy for range of motion exercises combined with ultrasound may be used in conjunction with cortisone injections. When cortisone injections are used, injectables that do not contain crystals are recommended; crystals can be destructive to the implant. When there is no improvement in the range of motion or continued loss of motion, closed manipulation of the joint under anesthesia can be attempted. Doing a local block and attempting this in the office are not advised as this can be painful and the patient will guard preventing the motion from being attained. An open arthrotomy with debridement of the fibrosis can be used, but the authors have not found this to be very successful. There are times when inadequate bone resection is preventing motion (Fig. 14.5).



**Fig. 14.5** Arrows demonstrating inadequate bone resection, preventing range of motion



**Fig. 14.7** Loss of joint space after insertion of hemi-implant



**Fig. 14.6** There is no joint space after insertion of hemi-implant

These cases will require revision surgery with adequate debridement to allow for improved range of motion. If there is continued loss of motion, but no pain, the patient may opt to live with the implant and limited range of motion. For those patients that have pain along with the loss of motion, arthrodesis is usually the best option. Patients that have had a hemi-implant can be converted to a total implant. The authors have found that there is often a significant loss of joint space in failed hemi-implants (Figs. 14.6 and 14.7). This may prevent successful conversion to a total implant and necessitate an arthrodesis.

Postoperative hematoma can occur in implant surgery and should be addressed sooner than later. The hematoma can lead



**Fig. 14.8** Postoperative hematoma

to dehiscence, fibrosis with limited range of motion, and infection. It is advisable to perform an incision and drainage if the hematoma does not resolve quickly. During the procedure a thorough lavage along with a culture and sensitivity should be performed (Fig. 14.8). If there is no infection, the implant can be left in place. In cases where there is a postoperative infection, the implant should be removed.

Postoperative infection is another complication that can occur and will need to be treated by thorough debridement and lavage along with appropriate antibiotic coverage. Consideration should be given to a prolonged course of antibiotics. The infection will need to be completely eliminated prior to doing the revision surgery. It is recommended to wait for several weeks before proceeding with the revision whether it is reimplantation or arthrodesis to ensure there is no recurrence of infection. A spacer made of antibiotic-loaded bone cement should be used to help maintain the position and joint space between the metatarsal head and the base of the proximal phalanx especially if reim-

**Fig. 14.9** Antibiotic cement spacer after removal of an infected total implant in the first metatarsal phalangeal joint



**Fig. 14.10** Antibiotic cement spacer after removal of an infected total implant in the first metatarsal phalangeal joint



plantation is being considered (Figs. 14.9 and 14.10). This will also provide increased local antibiotic delivery.

Subsidence, bone over growth, or implant failure can occur over time. These can be handled by either excisional implant arthroplasty or conversion to an arthrodesis. Excisional implant arthroplasty will give the patient a short toe and will most likely not be a stable platform for propulsion (Figs. 14.11 and 14.12).

Arthrodesis can be a technically challenging procedure but will allow the surgeon to maintain length and provide stability to the hallux, which will aid in propulsion. Once the decision to remove the implant and convert to an arthrodesis has been made, the surgeon will need to decide whether the patient will need a bone block graft to maintain length or whether an end to end fusion is possible. Even if an end-to-end fusion is planned, it is advised to be prepared to have grafting material available to fill in the bone defects

from the implant removal. Garras et al. [5] required bone graft in all 18 fusions. Both Garras [5] and Gross [20] showed there was a longer time to fusion than a primary arthrodesis. Gross [20] also had a 58% reoperation rate in their study. Fusions, after implant failure, should follow the same basic surgical principles as any other fusion. The surgeon must debride to healthy bleeding bone and fixate the fusion. The debridement will often remove more bone than anticipated. In cases where a bone block graft is used, the fusion should be fixated with a plate (Figs. 14.13, 14.14, 14.15, 14.16, and 14.17).

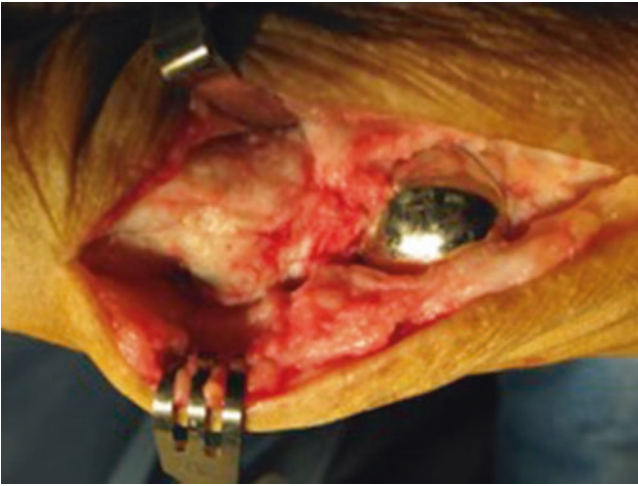
In conclusion complications of implants in the first metatarsal phalangeal joint can and do occur. It is important to get the appropriate testing to make the correct diagnoses and be sure the surgeon understands the extent of the bone damage. The surgeon will have several choices on what procedure to perform. Revision surgery of a failed first metatarsal phalan-

**Fig. 14.11** Failed implant of the first metatarsal phalangeal joint

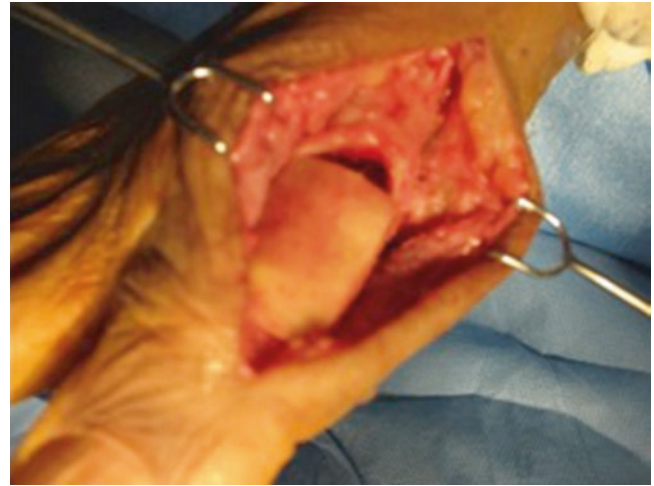


**Fig. 14.12** Resection implant arthroplasty





**Fig. 14.13** Subsidence of implant



**Fig. 14.16** Bone block in place, filling in the defect created by the implant removal



**Fig. 14.14** Removal of the proximal part of the implant. Notice the distal aspect is still in place



**Fig. 14.15** Debridement of the bone after the implant is totally removed



**Fig. 14.17** X-ray of final result

geal implant can be a challenging procedure; careful preoperative planning is essential to the outcome.

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