Background:

Procedures of the hallux are commonly performed for arthritis and/or deformity. When a hallux procedure leads to shortening of the first ray, alterations in the biomechanics of the forefoot are a concern. Transfer metatarsalgia leading to forefoot pain is a common complaint. However, a failed hallux procedure resulting in deformity, bone loss or nonunion can cause pain in the first metatarsophalangeal joint as well. Whether it is a failure of hallux valgus correction, failure of implant arthroplasty, trauma and arthrodesis procedures, if shortening is combined with severe arthritic changes in the first metatarsophalangeal joint and loss of bone, a salvage procedure with arthrodesis is often required.

A failed first MTP joint arthroplasty is one of the more common conditions leading to excessive shortening of the first ray requiring a salvage procedure. Restoration of hallux length and alignment often cannot be achieved with an in-situ fusion, and reconstruction with autograft or allograft bone is required. The goals of any salvage procedure are:

- Restore length and alignment
- Improve the mechanics of the first ray to restore the weightbearing properties of the medial column
- Reduce pain

Maintaining or improving motion at the first MTP joint is frequently a goal for the patient. However, frequently the length and alignment as well as improved mechanics are sacrificed in order to keep motion. Similarly, motion may be sacrificed to achieve these other goals.

Major challenges exist when salvaging the first MTP joint after a failed arthroplasty or hallux valgus procedure. These include:

- Bone loss
- Poor surrounding bone quality
- Deformity in multiple planes
- Shortening of the first ray
Preferred Technique

First metatarsophalangeal joint arthrodesis with interposition bone graft avoids further shortening of the first ray with joint preparation and allows correction of deformity in multiple planes.

An incision is made dorsally or dorsal medially over the first metatarsophalangeal joint, often using the prior incision. Occasionally lengthening of the extensor hallucis longus is required to distract and reposition the joint. The capsule is incised longitudinally and any osteophytes are removed from the phalanx and metatarsal head. Implants, if present, are removed from the joint space. Fibrous tissue is debrided as necessary and the bone surface at the base of the phalanx and distal metatarsal are prepared using the same reamers used for a primary arthrodesis. A Kirschner wire is used to appropriately align the reamer. On the metatarsal side of the joint, the cup-shaped reamer is used if the integrity of the distal metatarsal is maintained. If the distal metatarsal is flattened or significantly eroded, the opposite reamer is used to create a concave hemispherical depression in the distal metatarsal.

The proximal phalanx is reamed to produce a concave hemispherical depression, given the natural concavity of the surface. The reamer diameters used on the two joint surfaces are not required to be the same in this technique. The joint surfaces are irrigated to clear the wound of reamer debris. Further preparation with a small drill bit is preferred and cysts or other bone defects are appropriately debrided. The use of additional morselized bone graft is often considered for these types of defects.

By holding the toe in gentle traction, the gap is measured between the bony ends of the metatarsal and proximal phalanx. A tricortical iliac crest allograft graft can be shaped using the cannulated power reamer system over a guidewire placed down the length of the graft. The graft is prepared using a reamer of equivalent diameter so that a convex end would complement a concave joint surface or vice versa. Two bone graft and reaming configurations may be used.

The bone block is placed in the joint space and the toe is positioned in slight valgus, slight dorsiflexion, and neutral rotation. The toe position can be temporarily held with a 0.062 Kirschner wire and examined for appropriate position clinically, radiographically, and with a flat
surface applied to the plantar aspect of the foot. Most often a dorsal plate is used for fixation, and rarely a compression screw can be added.

**Similar Techniques**

Several reports describe salvage of failed surgery for the hallux with first metatarsophalangeal joint arthrodesis. Using the technique above, Luk, et al. report a union rate of 87% using allograft interposition bone graft with a spherical reaming technique. In this study, a low complication rate was seen in a group of 15 patients with high levels of patient satisfaction.

Hecht et al. were the first to present a case series of arthrodesis for salvage after failed implant arthroplasty. They reported an 80% union rate using flat cuts and a tricortical iliac crest autograft. Brodsky et al. reviewed their series of twelve patients who underwent salvage first MTP arthrodesis with tricortical iliac crest bone autograft. Joint surfaces were prepared in situ. The union rate was 92% (11/12 patients). There were two cases of skin necrosis, ultimately requiring a radial forearm flap for soft tissue coverage. Bhosale et al. reported a union rate of 90% in their case series of ten feet presenting with failed joint arthroplasty or Keller resection arthroplasty and treated with flat cuts, iliac crest tricortical autograft, and dorsal plating. These similarities to our union rate suggest that allograft is a reasonable alternative to autograft bone. Myerson et al. treated 24 patients with first metatarsophalangeal joint arthrodesis and interposition bone graft with a union rate of 79%. There was a combination of autograft and allograft bone blocks used, but the latter was favored as the study progressed, as its use in other procedures demonstrated excellent healing. A 5 mm bone burr was used to prepare the metatarsal and proximal phalanx joint surfaces, but it was stated that they were not contoured to fit the bone graft. Interestingly, none of the nonunions occurred in cases treated with structural allograft. Gross et al. identified twelve cases of first metatarsophalangeal joint fusion after failure of an implant arthroplasty. A variety of interpositional material was used, including iliac crest autograft (5/12), iliac crest allograft (1/12), calcaneal autograft and bone putty (1/12), bone graft from morselized metatarsal heads (4/12), and one without any supplementation. Two patients had nonunions (16.7%), and 41.7% of patients had a delayed union, requiring more than 6
months to fuse. One patient had a wound complication requiring a rotational flap. Historically, the rate of union for primary first metatarsophalangeal joint fusions has been 71% to 98%.

**Motion Sparing Options**

If patients desire an option that preserves motion at the first metatarsophalangeal joint, an interposition arthroplasty is considered. Coughlin and Shurnas described soft tissue arthroplasty for hallux rigidus using a bipolar reaming technique with insertion of a soft tissue tendon bundle to act as a spacer in the joint. Seven patients were followed for 42 months. Results were rated as good to excellent in all 7 patients and average range of motion improved. However, this procedure was performed as a primary treatment for hallux rigidus. In the salvage procedure, the results may differ due to loss of length of the first ray or inability to completely correct deformity.

Other interposition procedures have been described in the setting of primary surgical treatment of hallux rigidus. These are less applicable to the salvage scenario.

**References**


