

Failed First Metatarsophalangeal Arthroplasty Salvaged by Hamstring Interposition Arthroplasty: Metallic Debris From Grommets

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Implant arthroplasty of the first metatarsophalangeal joint (MTPJ) was first developed in 1967 to address inadequacies of Keller resection arthroplasty.¹ Implant arthroplasty, though still a joint ablative procedure, maintains length and alignment and preserves function. As with implant arthroplasty in other joints, the implants are subject to wear and therefore are usually advocated for older, less active patients.^{2,3}

Synovitis secondary to particulate silicone debris is well established.⁴⁻⁸ The inflammatory response initiated by silicone debris not only produces pain and swelling and compromises motion, but it also contributes to bone destruction and gross implant failure.⁴⁻⁸ To prevent or decrease production of silicone debris at the implant–bone interface, titanium grommets were introduced.

Use of circumferential titanium grommets in MTPJ arthroplasty began in 1985 in an attempt to reduce silicone wear by shielding the midsection of the flexible silicone hinge.¹ Reduction of silicone debris and synovitis through use of grommets has led to increased implant durability and fewer complications.^{1,9-11} Swanson and colleagues¹ reported an overall complication rate of 11% related to sharp bone edges, implant fracture, and reactive synovitis after flexible hinge arthroplasty without grommets and noted that grommets essentially eliminated these problems.

Production of particulate titanium debris with associated cellular response is a well-established entity in total hip arthroplasty,¹²⁻¹⁴ but up until now there have been no reports of titanium debris with respect to arthroplasty of the first MTPJ. Indeed, the literature suggests the opposite, that grommets themselves behave fairly inertly and signifi-

cantly reduce the amount of particulate silicone produced and its associated problems.^{1,9-11}

To our knowledge, this is the first published report of metallic debris secondary to use of grommets in first MTPJ implant arthroplasty. In addition, salvage of a failed prosthesis has historically consisted of arthrodesis or resection¹⁵⁻¹⁷ or revision to another implant system.¹⁸ To our knowledge, this is also the first reported case of interposition arthroplasty used as a salvage technique.

CASE REPORT

The patient was a healthy woman in her early 50s who underwent a right bunionectomy, medial sesamoidectomy, and first MTPJ implant arthroplasty using a Silastic (Dow Corning, Midland, Mich) implant with grommets. After recovery from the procedure, she experienced significant daily pain when walking. Of note, she had undergone implant arthroplasty (hemiresection with nonmetallic hemi-implant) of the left first MTPJ 5 years earlier, after which she had no problems. Orthotics were used without benefit, and an intra-articular corticosteroid injection 4 months after surgery failed to provide significant relief. The patient presented to the office of Dr. O'Malley 7 months after surgery with the chief complaint of pain and stiffness in the right great toe.

The initial physical examination was significant for right first interphalangeal joint (IPJ) tenderness with minimal swelling and a slight flexion contracture. The MTPJ was similarly tender, as was the region of the lateral sesamoid. The first MTPJ range of motion was limited to 25°. Ankle and subtalar motion were full.

Preoperative x-rays showed a well-seated implant with no evidence of osteolysis. Comparison of preimplant and postimplant x-rays demonstrated that the great toe was minimally lengthened (Figure 1). This overlengthening was clinically obvious, especially when compared with the contralateral hallux.

Approximately 7.5 months after surgery, the patient underwent removal of the symptomatic first MTPJ implant and then revision interposition arthroplasty using an ipsilateral semitendinosus tendon autograft.

Immediately obvious on entering the joint was mild wear on the dorsum of the silicone hinge, which had been placed upside down. More significantly, however, there was marked metallosis distributed throughout the

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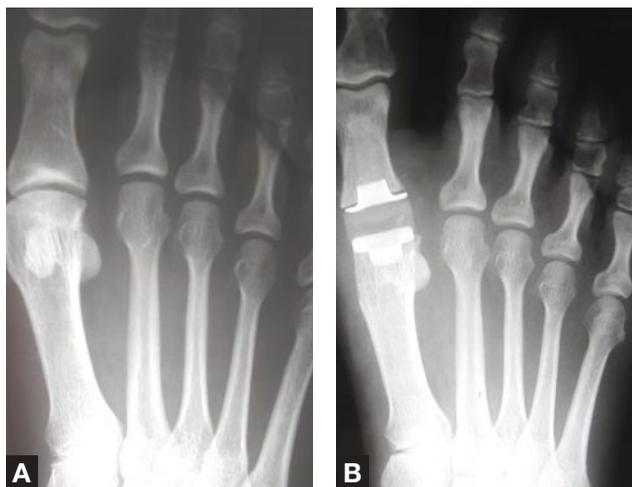


Figure 1. Preoperative (A) and postimplant arthroplasty (B) anteroposterior x-rays show well-seated components without gross evidence of osteolysis but with mild overlengthening of the hallux.



Figure 2. Black metallic debris encountered within the first metatarsophalangeal joint.

entire joint, with blackish fluid in the joint. Removal of the grommets exposed bony surfaces blackened by metallic debris (Figure 2). Small curettes were used to débride the bony surfaces, and the joint was thoroughly irrigated with antibiotic solution after appropriate cultures were obtained.

Approximately 15 to 18 cm of ipsilateral semitendinosus tendon was harvested using a tendon stripper. A 2-0 Vicryl suture was used to create an “anchovy” from the tendon graft. After both bony defects were filled with Allomatrix (Wright Medical Technology, Arlington, Tenn), the dorsal capsule was elevated, and the semitendinosus graft was stabilized within the joint by suturing it to the plantar soft tissues. Next, the dorsal capsular tissue was sutured to the plantar capsule over the interposed tendon graft (Figure 3). Intraoperative dorsiflexion was approximately 50°.

The postoperative course was without complication. Final cultures were negative. Microscopically, the synovium was



Figure 3. Autogenous ipsilateral semitendinosus “anchovy” in place.

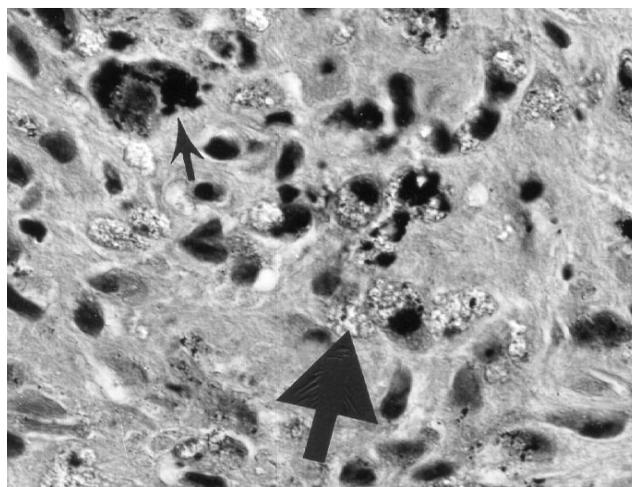


Figure 4. Histiocytic and foreign-body giant-cell reaction to silicone (large arrow) and metallic debris (small arrow). Hematoxylin-eosin, original magnification $\times 40$.

moderately hyperplastic and hypervascular. Numerous foci of marked histiocytic and foreign-body giant-cell reaction to metallic debris and nonrefractile silicone polymer were present (Figure 4).

At 1-year follow-up, the patient had no complaints and demonstrated 55° of dorsiflexion and 5° of plantarflexion at the first MTPJ. Postoperative standing x-rays showed good alignment of the hallux and restoration of the length of the first ray (Figure 5).

DISCUSSION

Implant MTPJ arthroplasty of the first ray is a technique used successfully to treat conditions such as hallux rigidus, inflammatory arthritis, and hallux valgus. The different implant types include double-stemmed hinged silicone implants, 2-component joint-mimicking implants, and hemi-implants.¹⁹ Clinical success is possible when strict selection criteria are used and surgical principles maintained.²



Figure 5. Follow-up standing anteroposterior x-ray shows good alignment of hallux and restoration of appropriate resting length.

Reasons for failure of implant arthroplasty include reactive synovitis, device failure, surgical error, deep infection, and transfer metatarsalgia.^{19,20} Young age has been identified as a risk factor for poor survival, with one study reporting an 82% 10-year survival rate in patients age 57 or younger and a 90% 10-year survival rate in patients older than 57,²⁰ making implant arthroplasty a procedure usually reserved for older, less active patients.^{2,3}

Synovitis secondary to silicone debris in MTPJ arthroplasty is well documented in the literature⁴⁻⁸ and is usually attributed to wear against sharp bone edges^{6,19} often in the setting of excessive activity on the part of the patient. It is not uncommon for reactive synovitis to occur in the early postoperative period.^{7,8} Thus, protecting the silicone implant from the shearing forces of sharp bone edges during joint motion is felt to be of particular importance, especially in patients with rheumatoid arthritis, in whom thin, sharp bone edges often exist.¹⁹

At least one study seems to provide evidence that grommets protect against silicone wear at the bone–stem interface as the silicone pistons in and out of the first metatarsal and proximal phalanx. Ishikawa and colleagues⁹ examined the bilateral silicone implants in a 66-year-old woman at autopsy; one side had been inserted with grommets, the other without. Using histology and scanning electron microscopy, the authors demonstrated decreased silicone

wear on the side with grommets. No micrographic evidence of titanium debris was encountered.

Up until now, there have been no reports of titanium debris in the setting of first MTPJ implant arthroplasty. Titanium wear and particulate debris have been well documented in total hip arthroplasty, however, and an early report from our institution details the histology of titanium particulate debris and its corresponding cellular response.¹² Many similar histologic findings are identified in this case, including a prominent histiocytic response with foreign-body giant cells and metallic debris within histiocytes. Although silicone particles are usually considered to be the primary cause of reactive synovitis, it seems likely that the metallic debris in this case was at least in part responsible for the pain and inflammation about the IPJ and the MTPJ.

This marked metallosis is likely caused in part by the relative lengthening of the hallux after the primary procedure. Increasing hallux length leads to increased tension in flexor and extensor tendons—not only decreasing joint motion but also increasing forces at the bone–grommet interface. In this case, though osteolysis was not clinically obvious 7 months after the implant arthroplasty, with more time it likely would have become apparent. We feel that adequate bone resection should be done to maintain adequate soft-tissue balance and motion. Kampner³ recognized overlengthening as a problem but was more concerned about the stress it places on bones—believing it leads to increased implant subsidence and shortening. In addition, the silicone hinge was inserted upside down, contrary to the original technique of Swanson and colleagues.¹ Gould²¹ described inserting a double-stemmed silicone implant with the hinge upside down in rheumatoid patients to increase power toward the floor. Doing this would seem only to increase the shear forces at the interfaces as the hallux is forced into dorsiflexion. In higher-demand patients without rheumatoid arthritis, positioning of the component in this fashion might adversely affect outcome.

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Salvage of failed first MTPJ implant arthroplasty includes resection of implant with synovectomy, arthrodesis, and revision to a different implant.¹⁵⁻¹⁸ In this revision setting, because of the excessive synovitis and metallic debris, we opted for thorough débridement and interposition arthroplasty. Although interposition arthroplasty is an established primary technique for hallux rigidus,²² it has never been used, to our knowledge, for salvage of failed implant arthroplasty. Various tissues have been advocated for implantation—including plantaris autograft²³ and portions

of the extensor hallucis longus or a piece of the gastrocnemius aponeurosis.²⁴ Because the plantaris tendon is absent in 10% to 60% of patients²⁵ or, when present, often quite thin, we have found that harvesting a hamstring tendon from the ipsilateral lower extremity to be more predictable and satisfying. It also allows creation of an “anchovy” of sufficient size to substitute for the relatively larger amount of resected bone for implant arthroplasty as compared with primary interposition arthroplasty. This is not unlike using the flexor carpi radialis tendon for basal joint arthritis.

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“Because the plantaris tendon [may be] absent...or... often quite thin, we have found harvesting a hamstring tendon from the ipsilateral lower extremity to be more predictable and satisfying.”

CONCLUSIONS

We have reported a case of short-term failure of a silicone hinge implant with titanium grommets in the first MTPJ. A significant amount of metallic debris differentiates this case from those previously reported. Generation of a relatively large quantity of metallic debris likely stems from increased shear forces at the bone–grommet interfaces secondary to overlengthening of the hallux and perhaps placement of the silicone hinge in the upside-down position. A salvage procedure using ipsilateral semitendinosis autograft for interposition arthroplasty is described.

AUTHORS’ DISCLOSURE STATEMENT

The authors report no actual or potential conflict of interest in relation to this article.

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