CHAPTER **8**

REVISION OF THE FAILED IMPLANT ARTHROPLASTY

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First metatarsophalangeal (MTP) joint implant arthroplasty has been practiced by foot surgeons for now more than 30 years.[1-14] Implants and surgical techniques have evolved but as with any surgical procedure complications may occur. Implant arthroplasty involves the implantation of non-biologic materials into human hosts with the expectation of mechanical joint properties with a minimum of wear. This ideal situation certainly can be expected to have difficulties and at times failure of the procedure may occur.

The orthopedic and podiatric literature is replete with case reports of first MTP joint implant complications.[13,15-24] As in any problematic surgery, the surgeon should give considerable thought as to why the original arthroplasty failed, what is the present problem both from the patient's point of view and his own perception and what is most likely to provide the patient with a painfree and durable revision. Revision and surgeon's choices of repair will certainly vary both with his experience and willingness of the patient to comply with surgical procedures and postoperative morbidity and disability. There is a wide range of surgical alternatives from simple implant removal, re-implantation, revisionary arthrodesis with bone grafting, bone graft substitutes, bone plates, and external fixation that may be considered. Occasionally, amputation may be the most expeditious treatment alternative. When performing revisionary surgery, there is an increased likelihood of subsequent complications. For this reason, surgeons may perform "simple" procedures or the patient may not want to undergo more aggressive or risky procedures. Each action has its own group of complications and these must be considered by both surgeon and patient during discussions of the problematic implant.

TREATMENT PROTOCOL FOR THE FAILED FIRST MTP JOINT IMPLANT

As with any clinical problem, evaluation and assessment of the pathology must precede treatment (Figure 1). A comprehensive history and physical examination is the initial course of the treating physician. The history (Node 1) should include documentation of the prior surgical interventions including dates of occurrence and postoperative course. The patient may have had an uneventful postoperative course and not suffered any untoward effects until years later. Symptoms may be quite striking or mild and limited. The patient may present with or without complaints of pain and swelling in and around the first MTP joint. The patient may complain of generalized forefoot pain or a functional inability, such as inability to wear regular shoes comfortably. The patient may no longer be able to perform the same work duties as prior to surgery. Many implant procedures were performed for deformities including hallux valgus and recurrence of deformity certainly may be a presenting concern on the part of the patient.

Physical examination of the patient (Node 2) includes identification of the pathology as well as the normal findings. Patients may present with chronic joint swelling, tenderness, pain on range of motion, limitation of joint motion, deformity of the first ray or remainder of the foot, subcutaneous bony prominences, soft tissue masses, or lesser metatarsalgia. Patients may also present with symptoms that are totally unrelated to the prior implant arthroplasty yet at times the subsequent treating physician may initiate patient dissatisfaction with discussion of the appropriateness or quality of the implant arthroplasty.

As with most musculoskeletal problems, the initial evaluation of the patient generally includes radiographic examination (Node 3). Radiographs document the type of arthroplasty and generally the type of implant utilized, the resulting deformity and any concomitant bone or soft tissue reactions. Obviously, radiographs must be correctly interpreted and the observed images evaluated by those familiar with the pathology of implant arthroplasty.

Radiolucency is generally indicative of loosening be it a mechanical phenomenon or osteolysis secondary to implant debris or infection. Osteolysis can be a very troublesome problem leading to chronic pain and instability of the implant within bony confines. Cystic erosions have occurred and may be the result of bone resorption to particular debris.

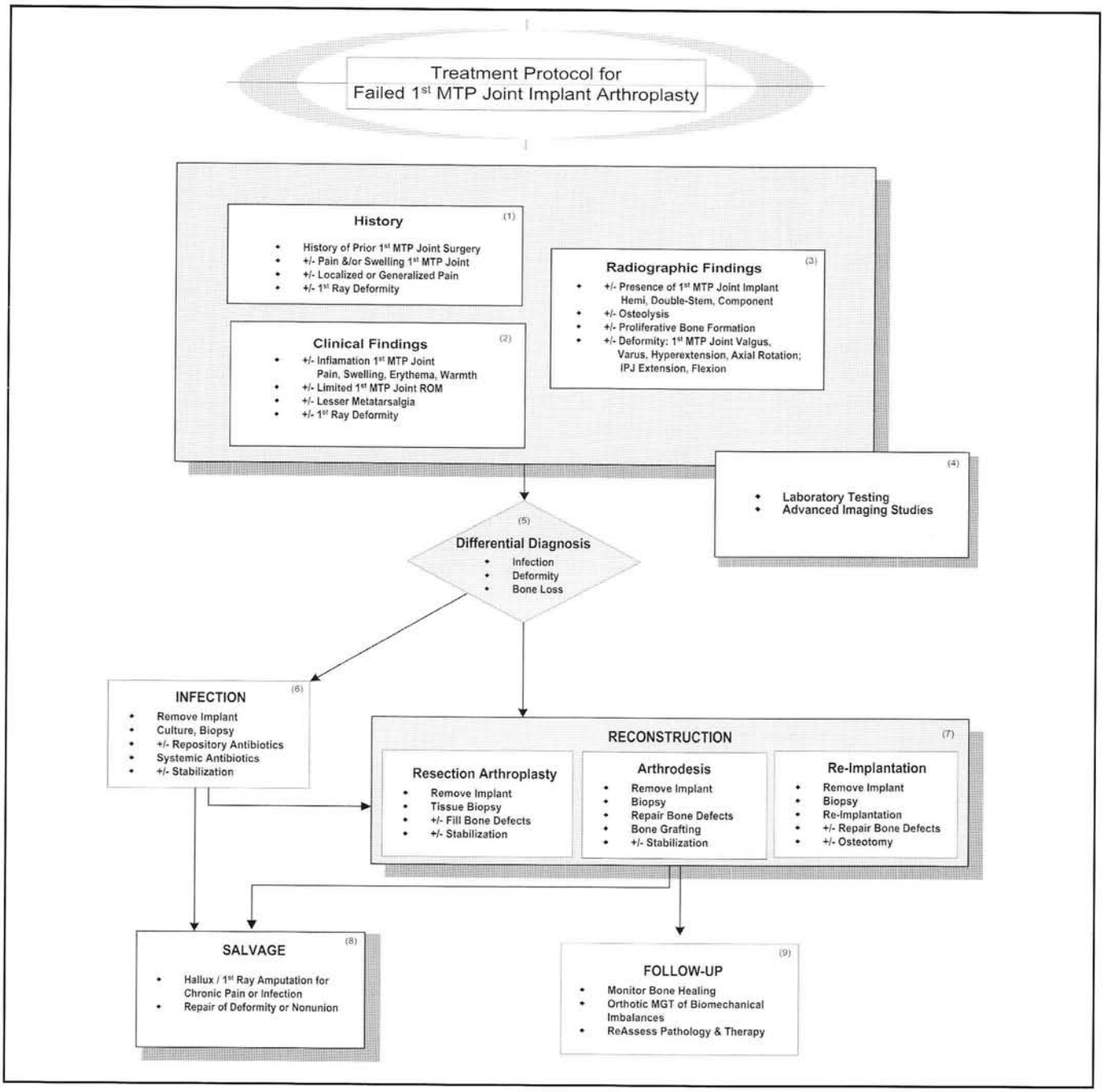

Table 1. Algorithm.

Soft tissue margins and contours also provide indicators of local or regional swelling and inflammation. The soft tissues are a reflection of both soft tissue and bone pathology. Chronic swelling of the soft tissues may be consistent with detritic synovitis, infection or simply instability of the implant. Abnormal soft tissue contours may reflect abnormal implant position or dislocation. If malalignment of the implant or joint segments are noted initially, surgical judgment or technique are probably to blame. Malalignment of the implant may be reflective of surgical technique although even an initially well aligned implant arthroplasty may go on to show poor alignment after years of mechanical stress. Malalignment of a total joint system may lead to wear of the softer component, generally titanium or polyethelene, leading to detritus in the tissues and possible tissue reactions.

New bone formation at either side of the resected bone surfaces may occur, ectopic bone formation. Excessive bony proliferation is associated clinically with limitation of motion. Prior to three months postoperatively, an aseptic periosteal reaction may be noted predominantly along the metatarsal likely associated with periosteal bone formation as a result of the surgical dissection. Of course, in each case, infection must be excluded.

Most complications are chronic in nature although occasionally acute symptoms may be seen. Findings must be correlated and additional laboratory testing or advanced imaging studies performed. Basic testing may reveal lymphocytosis, or elevated sedimentation rates indicate infection or osteomyelitis. The patient may have a history of a draining wound, may be multiple wound cultures and treated with antibiotics. All information may be relevant and may indicate areas of further investigation. Advanced imaging studies such as bone scans and MR imaging may further elucidate pathology. The serotech bone scan utilizes (99m)Tc-labeled leukocytes and is the radionuclide procedure of choice for detecting most infections.

DIFFERENTIAL DIAGNOSIS

Pathology of the implant arthroplasty has been detailed with a variety of complications including infection, deformity, soft tissue and bone reactions, and biomechanical pathology (Node 5). The workup of the patient should allow the determination of the pathology at hand. The treatment plan is formulated with appropriate discussion and informed consent of the patient. Implant revision may be necessary or simple observation and periodic evaluation performed until symptoms flare or the patient willing to proceed with further treatment.

REVISION OF THE FAILED INTERPOSITIONAL IMPLANT

Revision of an interpositional implant may vary from the simple to the complex and this is an important determinant of patient morbidity and success. Implant revision may be necessary due to chronic pain, recurrent deformity, or various soft tissue or bony reactions, such as, detritic synovitis or osteolysis. The patient may experience chronic joint pain and swelling, deformity or lateral metatarsalgia.[16,25]

The diagnosis of infection, be it acute or chronic osteomyelitis or a foreign-body cenetered infection, is the most immediate factor that influences treatment decisions. Infection of an implant arthroplasty may be very subtle and not at all the typical red, hot swollen joint that might be expected. A chronic draining wound may aid diagnosis but usually not present. The patient may have had prior intermittent therapeutic courses of antibiotics with recurrent minor erythema or limited periarticular swelling. If the diagnostic work-up indicates a deep infection, the site requires culture and biopsy (Node 6). Generally, this is done as a surgical incision and drainage and sequestrectomy. The implant is best removed particularly in the presence of loosening and purulence. The treatment of a foreign-body centered infection requires the removal of the implant. Culture should include aerobic, anaerobic and fungus wound cultures. Tissue biopsy aids diagnosis particularly bone in osteomyelitis.

Wounds may be managed open for a period of time or the wound may be closed over repository antibiotic beads, be it polymethylmethacrylate or calcium sulfate. Systemic antibiotics are administered per usual standards and consultation with infectious disease may be considered. In the presence of significant bone resection and osseous instability, stabilization of the first ray with an external fixator may also be considered. Alternatives for reconstruction will be much like any other revisionary arthroplasty (Node 7). In the presence of chronic osteomyelitis or a flail toe, the patient's most expedient treatment may be that of amputation (Node 8)

Most implant problems are not infectious in nature but a combination of deformity with soft tissue or osseous reactions secondary to the implant. Surgical reconstruction (Node 7) may consist of conversion of the implant arthroplasty to a 1) resection arthroplasty, 2) arthrodesis, or 3) insertion of another implant. Bone loss and deformity are among the most important determinates of surgical decisions. Radiographically, the quality of the remaining bone, presence of osteolysis, or cystic erosions may influence the revising surgeons choice of procedure. In all cases, the implant generally requires removal. Tissues should be biopsied and cultures considered. The reconstruction must be tailored not only to the clinical findings but the patient must be willing to comply with the postoperative regime required for the

proposed procedure. The situation may arise when an amputation is selected. The patient may be quite elderly, sedentary or simply not willing to comply with the prospect of maybe multiple additional procedures and amputation may be considered.

Reconstruction with resection arthroplasty would involve removal of the implant, filling of any bone defects and osseous stabilization. Stabilization for a period postoperatively helps to maintain hallucal position and may be accomplished by a variety of techniques from simply intramedullary Kirschner wire to use of external fixation.

Reconstruction with revisionary arthrodesis is probably the most viable alternative for patients with a failed first MTP joint implant arthroplasty. Arthrodesis allows for a durable reconstruction but has definite requirements of bone grafting, stabilization and long-term disability to allow non-weightbearing and successful bone union. The postoperative course may be quite extended with the use of bone grafts, various forms of fixation and the potential for subsequent complications.

Reconstruction with replacement of a new implant may be relatively straight forward or quite heroic. Revision to another joint implant should probably be reserved for the patient without significant host reaction to any of the prior implanted biomaterials. A situation encountered in the past was that of the failed silicone hemi. The length of the proximal phalanx, integrity of the flexor apparatus, and quality of bone stock often determine the most appropriate reconstruction. Revision with a double stem hinged silicone implant may provide a satisfactory reconstruction. Revision to a component total joint replacement has also been attempted but this may be more difficult and past success really does not indicate this as a viable option. Hemi metallic implants are also in clinical use and potential revision is aided with the relatively limited bone resection required at the initial surgery.

As with any other surgical procedure, revisions of implant arthroplasty have requirements to monitor clinical course and symptoms post-operatively, (Node 9). In the case of bone grafting and or arthrodesis, the patient should be followed with periodic radiographs until consolidation is complete. Biomechanical disturbances occur and management with orthotic devices may be necessary. In the presence of complications, such as: nonunion of a revisionary arthrodesis, flail toes or deformity, additional surgery may be necessary.

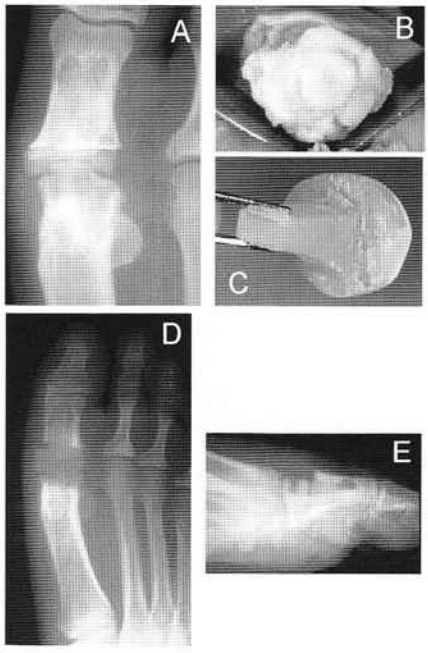

Figure 1. Patient described in Case 1 with chronic joint pain and stiffness. A) Radiograph 5 years postoperative hemi silicone implant reveals metatarsal head erosions and cystic changes. B) Intraoperative appearance of metatarsal head articular surface showing osteophytosis and degenerative changes. C) Removed hemi implant reveals deformation and fatigue fracture. D) and E) Reconstruction involved revision with a double-stem hinge implant.

CASE STUDIES

Case 1: Detritic Synovitis with Silicone Hemi Implant Treated with Revision Implant

During the 1970s through the early 1980s, the hemi silicone implant was the dominant first MTP joint implant. These were no longer in common use much after the later 1980s due to its history of complications, specifically detritic synovitis, associated primarily in cases of hallux rigidus. The patient in Figure 2 was a 34-year-old female who probably should have never been implanted due to her age and limited degenerative changes preoperatively. Five years postoperatively, she complained of periarticular pain with chronic swelling and joint stiffness. Symptoms were chronic in nature. Interestingly, she had prior removal of the implant on the opposite foot within the first postoperative year for dislocation. In 1981, she underwent revision of the hemi silicone implant on the right side. Intraoperative findings included degenerative

changes of the first metatarsal head with implant deformation and fracture but limited inflammatory response to particulate silicone. Revisionary arthroplasty to a double-stem hinged silicone implant was performed. Her immediate postoperative course was unremarkable but long-term, she developed limitation of first metatarsophalangeal joint motion and lesser metatarsalgia that required orthotic devices for relief. She also sustained permanent limitation of activities and work capabilities.

Actually, many patients with these implants did have good results with excellent range of motion but the problems of detritic synovitis lead to a backlash with medicolegal implications. There were problems with this implant as many of these implants were used in a broad range of patients and pathology. Patients with hallux valgus seemed to fair the best while those with hallux rigidus and hallux varus often encountered complications.

Case 2: Ankylosis with Double-Stem Hinged Implant Treated with Explantation

Ankylosis following implant arthroplasty is not an uncommon situation. Case 2, (Figure 3), follows the course of a middle-aged female with diabetes. The preoperative radiograph, shows a hallux valgus rigidus that was treated surgically with a McBride type procedure. She presented several years afterward with difficulties with plantar ulceration of the great toe associated with limited first MTP joint motion. Radiographs showed recurrent deformity with degenerative changes. A double-stem silicone hinge implant arthroplasty was performed. Although she initially did well, she later developed an ulcer associated with a plantar exostosis that apparently developed along the plantar distal surface of the first metatarsal. She was treated with exostectomy and removal of the first MTP joint implant. The medulary canals of the first metatarsal and proximal phalanx were packed with calcium hydroxyapitate. The revision was stabilized with a axial kirschner wire and interesting she subsequently went on to complete bony union between the first metatarsal and proximal phalanx.

Some of the most satisfied patients with an implant arthroplasty had very limited motion at the first metatarsophalangeal joint, be it a double-stem hinged implant or component implant. Due to the joint ankylosis, these patient actually had a very stable reconstruction and rarely had problems with recurrent deformity.

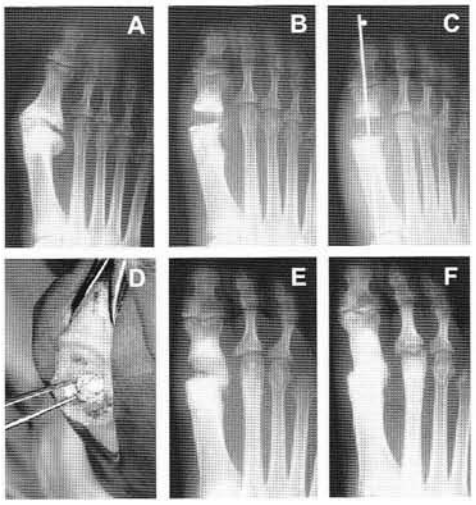

Figure 2. Patient with failed McBride bunionectomy A) described in Case 2 underwent a silicone hinge arthroplasty. B) She developed an ulceration beneath the distal first metatarsal and joint stiffness. C) Radiograph postoperative explantation with kirschner wire stabilization and D) intraoperative insertion of bone graft substitute within medullary canals. Although the phalanx and metatarsal remained distracted, radiographs at 3 months E) and 9 months F) postoperatively showed progressive bony union.

Figure 3. This patient described in Case 3 complained of chronic pain and low grade swelling. No erythema was evident yet intraoperative photo A) shows purulence and Staphylococcus epidermis grew on culture. B) The preoperative radiograph at the time of revision surgery shows resorption around the metatarsal stem. C) The implant was removed and this radiograph shows the presence of antibiotic beads. D) The patient underwent reconstruction with autogenous bone graft fusion and internal plate fixation which she later fractured. E) Subsequent revision and grafting was performed with use of an external fixator. F) This AP radiograph shows consolidation and final satisfactory alignment.

Case 3: Chronic Pain Due to Foreign Body Centered Infection Treated with Revision Fusion

Case 3 (Figure 4) is an example of a failed total joint system due to a foreign body centered infection. This 52-year-old female presented 6 months after hallux rigidus repair with an Osteomed total joint arthroplasty with low grade periarticular pain and swelling. No erythema or acute inflammation was ever apparent and there was no significant increase in sedimentation rate or white count. Radiographs showed a radiolucency around the stem of the phalangeal component. The patient did experience lesser metatarsalgia. Loosening of implant components may be a mechanical phenomenon, occur secondary to failure of the cement mantle, osteolysis due to foreign body reaction, or of course, infection.

Implant removal and fusion was recommended but upon opening the joint capsule, a seropurulent exudate was evident. The implant was removed, and cultures obtained. Wound closure over gentamicin impregnated PMM beads was performed and the patient begun on IV antibiotics. Cultures grew Staphococcus epidermis. She developed allergies to the vancomycin and completed a six week course of clindamycin.

The patient subsequently underwent removal of the antibiotic beads and reconstruction of the defect with an autogenous bone graft fusion. An iliac crest bone graft was inserted with maxillofacial straight plate fixation (7 hole - 2.4 mm). The patient was kept non-weight bearing for 8 weeks and went on to good wound healing without evidence of infection or resorption of the graft. At 16 weeks postoperative, she suffered a fracture of the plate and fusion during a molestation incident.

The patient then underwent revision of the fusion with autogenous bone graft from the calcaneus and fixation with an external fixator. There was no evidence that infection played a role in failure of the initial attempt at fusion. The frame was left in place for 12 weeks and then removed. Sometime during the postoperative course, the patient developed a chronic pain syndrome, CRPS type II. Fortunately, this was diagnosed with initial presentation of symptoms and the patient referred to a pain clinic for management.

This case illustrates appropriate management of an infected implant arthroplasty. The implant must be removed in order for the infection to resolve. The most appropriate reconstruction of the remaining defect is with autogenous bone graft fusion. Unfortunately, even when all things are done right, complications can occur and a chronic pain syndrome made this a very difficult for the patient.

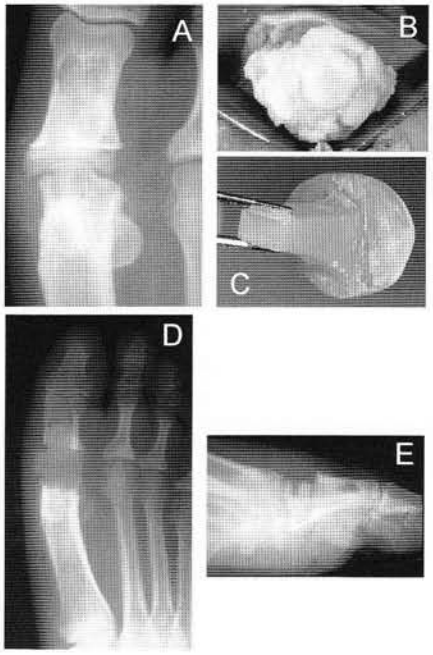

Figure 4. Case 4 involved a patient with complete dislocation of a TJR system with bone loss secondary to osteolysis, preoperative AP A) and lateral B) radiographs. Bone grafting and internal fixation reconstructed the proximal phalanx while the first MTP joint was left as an arthroplasty with transfer of the remaining proximal phalangeal head and articular surface to the first metatarsal, C) AP radiograph and D) clinical appearance. Although this reconstruction was quite complicated, the patient did progress nicely to full resumption of activities of daily living and only required orthotic management of lesser metatarsalgia that was vastly improved from that experienced preoperatively.

Case 4: Chronic Pain of a TJR Treated with Explantation

This patient underwent a KMI total joint replacement and postoperatively had gradual hallux instability and deformity (Figure 5). She presented with significant osteolysis of the proximal phalanx with malleus deformity. The metatarsal component was prominent dorsally and caused pain. She also suffered with lesser metatarsalgia. Revisionary arthrodesis was recommended, but the patient was a 50-year-old woman who played golf and was very concerned about retaining movement. Due to the almost complete dissolution of the proximal

Figure 5. Osteolysis is a difficult problem and A) is the AP radiograph of a young patient who underwent silicone hinge implant arthroplasty. B) This photomicrograph of a granuloma shows extensive silicone in the tissues and chronic fibrous tissue. C) This radiograph demonstrates severe distortion of the hallucal proximal phalanx following a silicone hemi arthroplasty.

phalanx, revision with an autogenous bone graft from the distal tibia was performed to reconstruct the proximal phalanx with fusion of the interphalangeal joint and external fixation to stabilize the MTP joint reconstruction

This patient was very compliant and very cooperative with the postoperative regimen and went on to unremarkable healing. The external fixation frame was removed at 8 weeks postoperative and gradual return to activities was allowed. She did very nicely with resolution of preoperative symptoms including the metatarsalgia. She was maintained in orthotic devices for several years postoperatively but was able to maintain normal length and cosmesis of the great toe.

DISCUSSION

Implant arthroplasty of the first MTP joint has actually created a whole new milieu of pathologic situations. A good number of complications that were witnessed in the 1970's and 1980's were due to broad application of the various implants. The pathology must dictate a joint destructive arthroplasty and caution must used with placement in younger patients, those under 50, who are more likely to be active and place greater stress on the implant arthroplasty. This can lead to both biomechanical faults or wear of the implant with generation of particles and subsequent particulate disease.

Biomaterial and host response problems can be seen with any of the joint implants but in podiatry these were most frequent with the hemi silicone implant. The movement or pistoning of the silicone stem in the medullary canals also lead to detritic reactions within the bone, Figure 5. In large joint orthopedics, polymethylmethacrylate (PMMA) and polyethylene debris frequently lead to analogous osseous reactions of osteolysis and cystic erosions.

Biomechanical faults are most likely in younger patients who experience problems due to their functional demands. In nonsalvageable joints, particularly in younger patients, joint fusion must be considered. Arthrodesis is durable and provides a stable medial column and weight bearing through the hallux. It is a nice concept to try and provide motion in younger patients but there are no long term studies that show first MTP joint implant arthroplasty is a good alternative in this patient group. There was a period of time when manufacturer's detailed total joint replacement systems as being biomechanical superior to constrained designs of the hinge systems. On a theoretical basis this is true but in clinical usage, the component joint replacement systems as a whole show poor success.[4]

Implant arthroplasty is still a viable option for pathologies of the first MTP joint. The high level of patient satisfaction and rapid rehabilitation achieved with implant arthroplasty are testimony to the success of the procedure.[3,26-29] In cases of hallux valgus and hallux rigidus in older patients, the silicone hinge implant is a valuable option. Advances such as the titanium grommets may increase the life span of the implant arthroplasty and help limit complications.[9,10,25,29-31]

In cases of hallux rigidus, the metallic hemi implants have been valuable and have the option of being easily revised if necessary without the significant bone loss associated with the hinge implants or component systems. Although, joint replacement has been a very successful procedure in large joint orthopedics, its wide spread use in the foot has been limited as alternative procedures have provided good success. Our revision rates were probably never as high as those related to analogous total joint replacement of the hip or knee but somehow have suffered greater scrutiny.

Swanson proposed implant arthroplasty to

improve cosmesis, improve joint stability, and increase the likelihood of a reliable degree of joint motion. Implant arthroplasty as commonly performed today is not perfect, but it is a fairly reliable procedure particularly if the surgeon and patient have a clear understanding of the goals and objectives of the procedure.

Finally, if foot surgeons perform joint implant surgery, he(she) and the patient should be well aware of the potential complications and the surgeon capable of performing, at times, complicated revision surgery.

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