CHAPTER **6**

"Problematic" Implant or Complications of First Metatarsophalangeal Joint Implant Arthroplasty – 2.0

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INTRODUCTION

Joint implant arthroplasty is now a routine procedure in orthopedics that mainly evolved from Charnley's concept of low-friction hip arthroplasty. Arthroplasty may involve total replacement or implantation limited to only one side of the joint. Total joint arthroplasty (TJA) can be described as very satisfying when good and a challenging nightmare when bad. This can be said about the most successful areas of hip, knee and shoulder replacement yet with a little more trepidation in other areas such as the ankle or foot.

TJA has been described as not only clinically efficacious but also a cost-effective therapeutic strategy. "Analyses of current and projected utilization for joint arthroplasty continue to predict a massive anticipated demand for these procedures in the coming decades" (1). "Despite the fact that total joint replacement is an effective operation for relieving pain and improving function, there are still issues related to implant wear and the adverse effects of particulate debris, including periprosthetic osteolysis and implant loosening"(2). The crux of the problem: "Because the cost, complications, and outcomes of revision joint replacement are generally worse than in primary surgery, there is great incentive to increase the longevity of joint replacements and to reduce the incidence of revisions"(1). Comprehensive care for joint replacement will be affected by the value based payment programs developed by the Centers for Medicare and Medicaid services (3).

Our objective in reviewing large joint orthopedics (LJO) is that similar complications exist across the general field of joint replacement surgery. As foot and ankle surgeons, most of us have utilized some type of joint implant; generally each of us may have somewhat polarized views of being pro or con joint replacement arthroplasty. First metatarsophalangeal (MTP) joint implants have been utilized for more than 40 years. Joint arthroplasty regardless of design or surgeon will have a certain frequency of complications that may be difficult to revise or deal with. This discussion will examine joint implant surgery specifically at the first MTP joint.

First MTP joint implants have been popular since the 1970s and the introduction of the Swanson Silastic great toe implant (4). Over the years, many designs including a double-stem interpositional implant and two-component systems have been introduced but long-term multicenter studies have been limited. We can say that a large number of patients are walking around with first MTP joint implants. Initially, silicone implants were popular with surgeons, particularly podiatrists (5-7). Implant arthroplasty was probably over utilized and placed in patients too young and too active (8). Literature with case reports of complications appeared particularly going back to the height of utilization of silicone implants (9-15).

Alternatives were introduced including hemi-arthroplasty utilizing metal implants. Two component implants were then reintroduced although by now surgeons displayed more caution and utilization was limited (16-18). Silicone hemi-arthroplasty gave way to the hemi-metallic great toe as a more durable alternative (19).

Surgeons have generally observed more severe arthritic change of the metatarsal side of the first MTP joint and new implant designs were offered that addressed this finding (20-22). Implant systems are now available that allow replacement arthroplasty of the phalangeal base, metatarsal head or total replacement of both surfaces (23).

Total joint replacement (TJR) typically involves a cobalt chromium metatarsal component and a polyethylene (MoP) articulating surface on a phalangeal titanium tray and stem (16,24). Ceramic two-component first MTP joint TJR systems have been utilized in Europe (25-27) but limited in the US with transient use of carbon devices in the late 1970s and early 1980s (28).

Implant arthroplasty has been a passion our entire professional life and we have represented views on both sides of the issue. Initially, our chosen area of investigation was complications of silicone arthroplasty (8,29). Biomaterials have certainly been at the center of controversy in joint replacement surgery. Our choice of a biomaterial involves knowledge of engineering/mechanics developing an implant that will provide good durability and longevity yet function in the intended role necessary for a particular joint (Figure 1).

Most materials chosen for joint implantation were considered because of expected inertness. Metals have been the dominant material component of joint replacement systems due to their material properties; a combination of strength for load bearing, biocompatibility allowing long-term human implantation, formability, and ease of

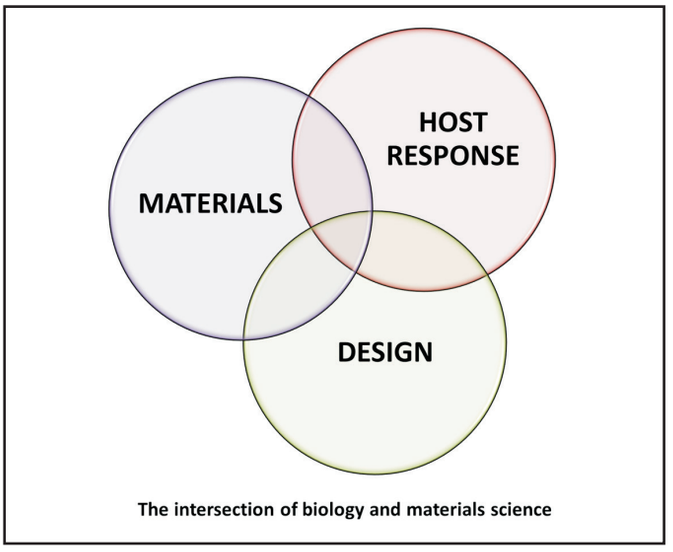

Figure 1. Biomaterials of joint arthroplasty (adapted from ref. 29).

manufacturing allowing high quality and efficient implant production. Biomaterials are selected for specific functions and generally matched with a group that culminates as the joint replacement system.

Metals have been at the forefront of hemi-arthroplasty and are often combined with a low-friction bearing surface for total joint systems. So too in the foot, Swanson began with a pressed-fit stainless steel prosthesis to replace the first metatarsal head and then after unsatisfactory results, designed flexible arthroplasties of the hand and feet utilizing silicone elastomers (30,31). For more than a decade, silicone was the biomaterial of choice for hemi-great toe arthroplasty before being replaced by stainless steel (Swanson), cobalt chrome, and also titanium implants.

Total joint systems are a composite system of components of various materials generally incorporating a metallic, cobalt chrome convex component articulating with a UHMW polyethylene concave one. The polyethylene surface is mounted on a titanium tray and stem design. Many different concepts regarding bonding or adherence of implant materials to bone have evolved (32). Initial implants for the hip, toe, and other areas were not cemented but simply impacted or press fit. Failures were encountered as a result of resorption and loosening. Acrylic bone cement, PMMA acting as a grouting agent was used, which stabilizes the implant by means of mechanical interlock. The phenomenon of biologic ingrowth of bone then heralded the next generation of implants with surface coatings to enhance biointegration. Today, major joint replacement systems are combinations of components manufactured for biologic ingrowth, mechanical interlock, press fit, screw fixation, or cementing. In each area of the intended arthroplasty, the most beneficial interface between implant and biologic material is assessed and implemented for each particular component.

Metallic and nonmetallic materials are utilized in joint implant systems (Table1).

Patient safety is paramount yet there are many questions that the entire industry has difficulty answering. The body's corrosive environment along with its poor tolerance or toxicity to even trace amounts of many elements make only a few metals potentially useful (33) (Table 2).

Wear of joint replacement systems is not only detrimental to joint function but plays a greater role in complications. Wear is generally a component of the coefficient of friction and hence "low friction arthroplasty." Couples are the bearing surfaces coming in contact with each other and include metal on polymer (MoP), metal on metal (MoM), ceramic on polymer (CoP) and ceramic on ceramic (CoC) (32). Debris and host reactions must be

Table 1. Joint Arthroplasty Biomaterials

Biomaterial	Advantages	Disadvantages	Uses
Metals			
Stainless Steel	High tensile strength	Poor bearing surface	Fixation implants
Cobalt Chromium Alloys	High compressive strength	Ionic, particulate debris	Bearing surface joint implants
Titanium	High tensile strength low elastic modulus	Soft, generates wear debris	Joint implant stems, fixation implants
Polymers			
UWMW Polyethylene	Low coefficient of friction	Wear debris	Bearing surface joint implants
Polymethylmethacrylate	Grouting agent	Wear debris	Bone cement
Silicone	Low elastic modulus	Fragmentation, Wear	Joint arthroplasty, Soft tissue implants
Ceramics	Low coefficient of friction	Brittle	Total joint arthroplasty
Carbon	Low elastic modulus	Fracture	Interpositional arthroplasty

Table 2. Elemental Composition TJA Metals

CoCrMo ASTM F75	
Chemical Composition	**% Composition (Wt)**
Cobalt (Co)	61-66%
Chromium (Cr)	27-30%
Molybdenum (Mo)	4.5-7%
Nickel (Ni)	<2%
Iron (Fe)	<1.5%
Carbon (C)	<0.35%
Silicone (Si)	<1%
Manganese (Mn)	<1%
Tungsten (W)	<0.2%
Phosphorus (P)	<0.02%
Sulphur (S)	<0.01%
Nitrogen (N)	<0.25%

Ti-6Al-4V ASTM F136	
Chemical Composition	**% Composition (Wt**
Titanium (Ti)	89-91%
Aluminium (Al)	5.5-6.5%
Vanadium (V)	3.5-4.5%
Carbon (C)	<0.08%

ASTM - American Society for Testing and Materials

appreciated. Initially, foreign body reactions to polymer particulate debris of UHMWPE and silicone were identified. Wear characteristics of UHMWPE has been improved with highly cross-linked polymers and radiation prior to implant fabrication (32).

Metals introduce the issue of ionic toxicity as well as reactions to particulate debris. Metallosis or staining of tissues with particulate metal debris has long been observed particularly with titanium. Now, MoM implants have provided a new issue with adverse local tissue reaction (ALTR) or adverse reaction to metal debris (ARMD) (34). Pseudotumor is now part of the literature describing a granulomatous mass or a destructive cystic lesion, which may mimic an infection or neoplastic process associated with wear (particulate debris) or ionic (soluble) particles (35-37).

Are there patients who display allergy to implanted biomaterials? Can allergy be responsible for aseptic loosening of devices or is this strictly a mechanical phenomenon or reactive process to particulate debris? There appears to be a debate between the allergists and orthopedists regarding tissue reactions and allergy (38,39). There has been a debate about the use of bone cement versus bone ingrowth type implants and design changes implemented. Joint implants may involve bone ongrowth or bone ingrowth as osteointegration and biologic fixation (32,40).

Figure 2 is the list of implant complications from a 1984 article (8) written specifically to address silicone

I. Implant failure
  A. Intrinsic
    1. Deformation
    2. Fatigue fracture
    3. Microfragmentation
  B. Extrinsic
II. Alignment abnormalities
  A. Transverse plane instability
    1. Medial subluxation
    2. Lateral subluxation
  B. Sagittal plane instability
    1. Dorsal subluxation
    2. Plantar subluxation
  C. Frontal plane instability - axial malrotation
III. Adjacent bone abnormalities
  A. Aseptic necrosis
    1. Proximal phalanx
    2. First metatarsal bone
  B. Ectopic bone formation
    1. Proximal phalanx
    2. First metatarsal
  C. Bone detritus
  D. Bone cysts
    1. Juxta-articular
    2. Periarticular
  E. Degenerative erosion - bone intolerance to the implant
IV. Soft tissue abnormalities
  A. Reactions to silicone
    1. Reactive synovitis
    2. Foreign body giant cell reaction
    3. Fibrous hyperplasia
  B. Inflammatory reactions extrinsic to silicone
  C. Infection
V. Biomechanical joint failure
  A. Technique error
    1. Excessive metatarsal head resection
    2. Arthrosis of metatarsal-sesamoidal complex
    3. Extensis and limitation of motion caused by inadequate bone resection
  B. Inherent to joint arthroplasty
    1. Loss of dynamic joint purchase
    2. Metatarsus primus elevatus
    3. Relative decrease of weight-bearing function of first metatarsal

Figure 2. Classification of first metatarsophalangeal joint implant arthroplasty, circa 1983.

I. Alignment Abnormalities
  -Deformity
  -Joint Malalignment
  -Dislocation arthroplasty &/or implant(s)
II. Soft Tissue Reactions
  -Ankylosis
  -Inflammatory
III. Infection
  -Soft Tissue (SSI) - superficial, deep
  -Osteomyelitis
  -Foreign-body Centered Infection
IV. Osseous Reactions
  -Hypertrophic Bone
  -Osteolysis
  -"Pseudotumor"
V. Chronic Pain
  -Biomechanical Faults
  -Chronic Pain Syndrome
  -Implant Loosening
  -Metal Allergy

Figure 3. Classification of first metatarsophalangeal joint implant arthroplasty, circa 2016.

arthroplasty in the days of predominant use of the silicone great toe hemi. Figure 3 is today's modified version, which is an attempt to incorporate a broader group of biomaterials and categorize the complications in a less specific manner.

Revisions of TJR are challenging and often fraught with difficulty for both patient and surgeon (41). The object of this article is to revise our initial 1984 classification scheme of first MTP joint implant complications making it more generalized and able to assess the spectrum of pathologies as currently understood and encountered.

IMPLANT COMPLICATIONS

Alignment Abnormalities

One of the objectives in joint replacement surgery is restoration of relatively normal anatomic alignment of the osseous segments. This sounds rather basic but it is not always optimally achieved. Great toe joint replacement procedures may be performed for conditions with limited deformities but significant arthrosis such as hallux rigidus or performed in situations of significant deformities such as metatarsus primus varus or elevatus. In cases of hallux rigidus, joint arthroplasty is generally sufficient for reduction of most MTP joint deformities. In cases of hallux valgus, arthroplasty must generally be supplemented with some type of osteotomy for correction of osseous deformity.

There are generally two permutations of alignment abnormalities, osseous deformity and joint malalignment

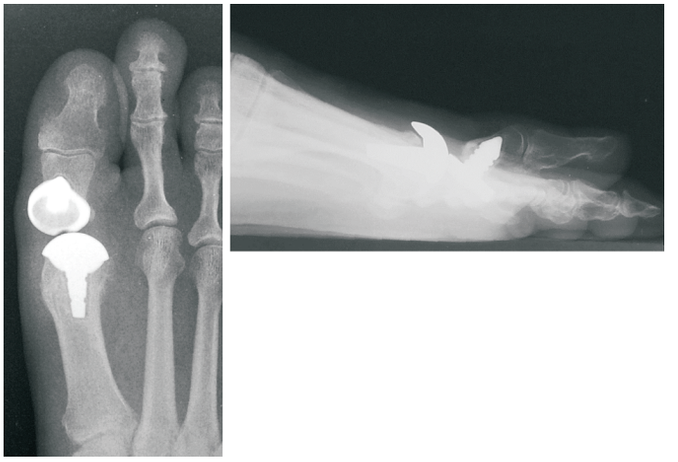

Figure 4. Radiographs illustrating alignment abnormality. There is rotation and displacement of the implant within bone as well as poor alignment of the articulation between the implant components with joint dislocation.

both of which are not mutually exclusive and often seen in combination (Figure 4). Failure to address preoperative deformities often leads to unsatisfactory postoperative alignment of the arthroplasty. Joint instability or malalignment, varus, valgus, or malleus are often associated with progression of deformity but also lead to other complications including generation of implant wear debris. Wear particles of almost any biomaterial will generally lead to a subsequent soft tissue or bone reaction (42,43).

The end-stage outcome of an alignment abnormality is joint dislocation. Joint dislocation is often associated with a wide range of problems including functional limitations with activity, difficulty with shoe fitting and chronic pain or even ulceration and infection.

Biomaterial Failure

Implant deformation and fracture were described in our prior publication and involved cases of silicone arthroplasty. Both deformation and fracture often lead to development of other pathology in the soft tissues or bone and are mainly associated with reactions to particulate debris. Ceramics are known to be a brittle biomaterial and implants in vivo have also been reported to fracture, Moje endoprosthesis (26). UHMW polyethylene will deform under load and displays plastic deformation with a time variable of applied load or "creep." The poly bearing surface may thin as well as generate wear debris. The PMMA mantle may be implicated in loosening as well as a potential allergen (44). Thermal and chemical insult from PMMA polymerization must also be considered and a problem in LJO.

Metals generally possess an oxide coating but may leach soluble ions in the adjacent tissues. Metal implants may possess smooth, etched, or rough surfaces that may affect generation of wear particles. Metals wear, and generate particulate debris increasing the likelihood of host reactions including osteolysis, loosening, and chronic pain. Components may

also fracture; fracture of stem prostheses have occured in LJO. Deformation and fracture is also a potential feature of polymers such as polyethylene and silicone.

Soft Tissue Reactions

Soft tissue reactions encompass a wide range of problems from simple fibrous ankyloses to local inflammatory reactions. Arthrofibrosis is often described as joint stiffness following arthroplasty and generally is associated with low grade inflammation or simply the scaring and contracture of the healing process. This may result in a severely restricted range of motion or ankylosis.

Inflammatory reactions may be associated with wear debris, or metal allergy, if it exists, or the local inflammation of bursitis or tendonitis associated with joint or implant alignment pathology. Polyethylene and silicone particulate debris is well known (33). "Poly disease" has been articulated with regard to tissue reactions to particulate polyethylene generated typically as a result of 2 body abrasive wear, for example the harder component (metal or ceramic) causes deformation of the softer material (polyethylene). Things become more complicated in situations of 3 body wear when particulate debris of metal, poly, PMMA, or even bone enter the articulation and become abrasive and create damage to the surfaces (34). Particle size does influence the type of tissue response with smaller, submicron particles eliciting osteolysis typical of MoM arthroplasty while larger particles are associated with foreign body giant cell reactions (45).

Chronic inflammatory reactions are often associated with macrophage engulfment, foreign-body giant cell formation and granulomatous reactions (Figure 5). Pathologists also recognize that debris from total joint prostheses (including clinically satisfactory implants) can migrate to distant lymph nodes and other organs and may be incidentally seen at the time of a lymph node dissection (46,47). With utilization of MoM joint systems, more attention has been placed upon the sequella of metal ions or debris. Metal ions can combine with host proteins becoming antigens and inducing hypersensitivity reactions (48,49).

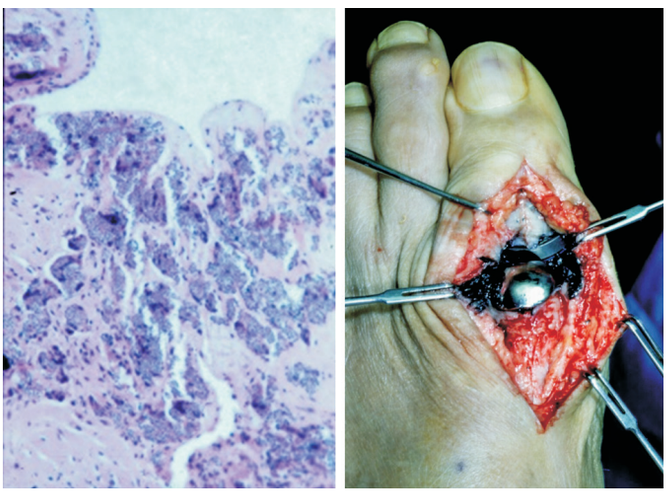

Figure 5. Soft tissue reactions. Microscopic section of foreign body reaction to particulate silicone **(left)**. Metallosis and metallic debris, titanium secondary from wear **(right)**.

ALTR or ARMD have been described in the orthopedic literature to give some clinical bearing to the effect of ionic molecules or particulate debris (34). A pseudotumor is an aggressive form of reaction that describes a granulomatous mass or a destructive cystic lesion, which may mimic an infection or neoplastic process, associated with wear or ionic particles. In our original discussion, "fibrous hyperplasia" was our description of this granulomatous tissue reaction occurring within bone as lytic and expansile radiographic changes. Granulomatous reactions within bone and soft tissue have also been seen with silicone particulate debris.

Metal allergy is a difficult subject and at times seems to be ignored in large joint orthopedics but is identified by allergists and pathologists. Patients may report skin reactions to metal jewelry or even oral braces. Cutaneous metal allergy occurs in 10-15% of the population but is not believed to correlate with orthopedic biomaterials (34,48,50). Metal allergy is believed to be a hypersensitivity reaction leading to localized swelling, erythema, and possible pain. Preoperative skin testing with metal allergen panels is available but not necessarily accepted as reliable by orthopedists. Interestingly, the probability of having a metal allergy was found to be almost 3 times higher in patients with a failed implant than in those with a stable implant (38). Metal allergies may involve nickel, cobalt, chromium, and titanium (39,51-54).

Infection

Infections may span a large gamut of pathology from a superficial or deep postoperative wound or surgical site infection, osteomyelitis, or a foreign-body centered infection. The term periprosthetic infection describes an infection of the arthroplasty site typically following complete healing of the surgical wound. Infection must be recognized and treated promptly. Infection is not common but must always be part of the differential diagnosis.

Aggressive treatment with antibiotics resolves most infections. Organisms implicated in periprosthetic infections include *Staphylococcus aureus* (MSSA and MRSA) and *Staphylococcus coagulase* negative (55-57). Osteomyelitis often requires removal of the joint implant in conjunction with culture-based antibiotics. The published incidence of periprosthetic joint infection (PJI) in a large joint is varied from as low as 1% to almost 15%, although most studies segregate primary procedures from revisions and short-term (less than 1 year) from long-term, with a longer surveillance period. Comorbid risk factors certainly must also be considered. A recent meta-analysis identified significant risk factors for PJI: high body mass index, diabetes mellitus,

corticosteroid therapy, hypoalbuminaemia, history of rheumatoid arthritis, blood transfusion, coagulopathy, and malignancy (50). There is particular concern over diabetes in light of the large number of diabetic patients undergoing elective procedures. Recent studies show high incidence when diabetes is combined with other risk factors (58-60). Marchant and colleagues (59) reported that patients with moderately elevated hemoglobin A1c are 2 to 4 times more likely to develop PJI. However, other studies have suggested that the risk for PJI is more closely associated with the patient's current glycemic status rather than the patient's long-term glycemic control (58). Mraovic and colleagues (60) reported patients with blood glucose levels greater than 200 mg/dL on postoperative day 1 are twice as likely to have a PJI, compared with patients with well-controlled glucose levels.

Although not frequently encountered, a foreign-body centered infections (FBCI) may present clinically as a latent low-grade inflammatory, localized process often difficult to differentiate from several non-infectious reactions (Figure 6). Chronic pain and osteolysis with or without implant loosening may be apparent (48). The race for the surface of implanted biomaterials is often implicated in the development of FBCIs with sequestration of organisms within a biofilm. Mature biofilms are highly resistant to antimicrobial therapy and host defense mechanisms (55,61-63).

Total joint arthroplasty complications regarding infection are of particular concern because these devices unlike many others are intended to be permanent. Such infections may have devastating consequences including skeletal defects, functional impairment, and life-long physical disabilities.

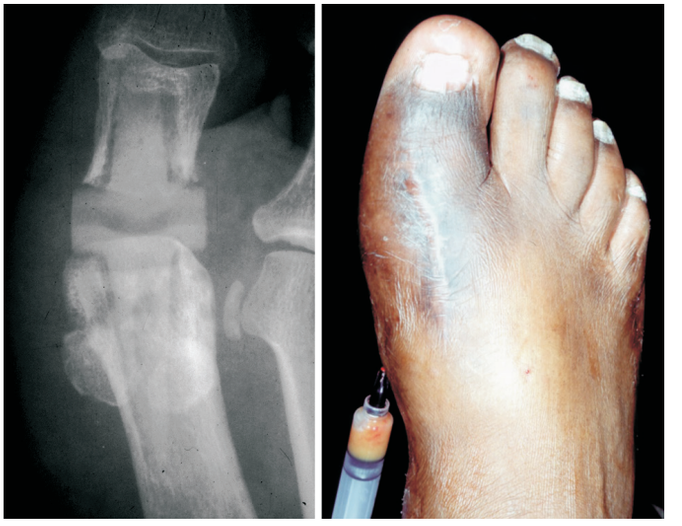

Figure 6. Infection. Radiograph showing radiolucency; osteolysis surrounding silicone implant associated with PPI. Pathologic fracture of medial distal first metatarsal is apparent **(left)**. Aspirate from same patient **(right)**.

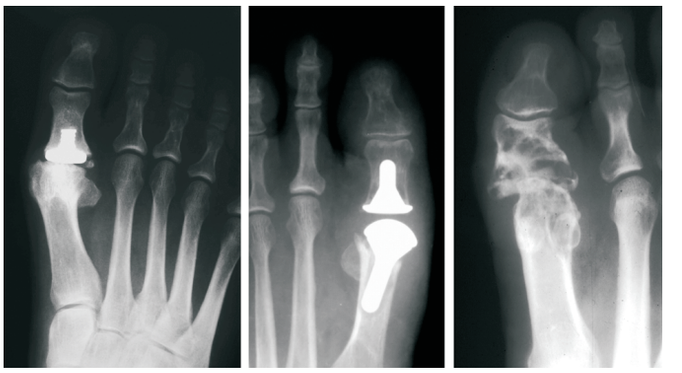

Figure 7. Radiographs illustrating a variety of osseous reaction: hypertrophic or ectopic bone **(left),** aseptic osteolysis **(middle)**, and expansile tumor-like granulomatous reaction **(right)**.

Osseous Reactions

Osseous pathology may be varied from bony proliferative effects to simple osteolysis (Figure 7). Subsidence is a term from large joint orthopedics and identifies implant displacement generally the result of underlying bone compaction or microfracture. The implant may displace but does so within the substance of bone. The implant may "plow into" the bone or even become engulfed due to a combination of loosening, subsidence, and heterotrophic bone formation.

Periprosthetic fracture is potentially a catastrophic event that may lead to gross instability of the joint or implant system. Implant arthroplasty alters the stress through the bone segments and may result in excessive loading or diminished stress though segments of bone. Generally, this is associated with inadequate osseous integration or inadequate reduction of deformity and high local stress. The material and geometry of the implant system should be designed in accordance with physiologic mechanical loads. Certainly, pathologic fracture associated with pre-existing osteoporosis or inadequate implant fixation must be considered.

Bone may react with either resorptive or proliferative changes. Bony encroachment results from proliferative changes adjacent to the implant and often limits mobility and may yield chronic pain. Ankyosis may ensue with loss of joint motion with or without any other untoward effects. Bone cysts have been recognized and may be due to preexisting degenerative, gouty or rheumatoid arthritis, or arise as a result of intraosseous biomaterial wear debris. Aseptic necrosis has been identified at the level of the first metatarsal head as well as hallucal proximal phalanx, (64) but the term aseptic osteolysis is a prominent finding in failed joint arthroplasties.

Aseptic osteolysis is seen as erosive bone loss adjacent to the implant often involving the contiguous bone in cases of hemiarthroplasty. Radiolucency around the stem or undersurface of the implant may be a sign of loosening. Loosening of an implant or component may progress and

may or may not be symptomatic; local chronic pain may be a complaint. Osteolysis may result in worrisome radiographic changes but generally limited clinical problems unless further complicated by subsidence or migration of the implant. Osteolysis may also be a finding in the presence of infection and infection must also be considered. Osteolysis may also be a radiographic feature of "metal allergy" although difficult to determine with reasonable certainty (48).

Granulomatous reactions within bone may create more alarming radiographic changes with or without soft tissue involvement. The term "pseudotumor" is utilized in orthopedics for aggressive granulomatous reactions that lead to bone loss, implant migration, and chronic localized symptoms not necessarily limited to bone.

Arthroplasty Failure

Sometimes a procedure may just not work out well. The patient may experience chronic pain with or without alignment or functional limitations, for example chronic pain at the implanted joint. Healing of the surgical wound may have been unremarkable. Persistent local swelling with or without other signs of inflammation may be present. It is often more difficult to assess the surgical site that appears perfectly normal with a well healed wound. Chronic pain and osteolysis with or without implant loosening may be apparent. Sometimes, specific characterization of the pathology may be difficult. Osteolysis may be identified but the cause of it is elusive.

Was the initial surgical implantation successful with fixation or biointegration? Is there good alignment or has deformity or malalignment of the articulation become evident. Is metal allergy suspected? Do laboratory testing or imaging support one etiology versus another? These are often questions difficult to answer with conviction. Surgeons may debate allergists or radiologists or pathologists each with a unique prospective.

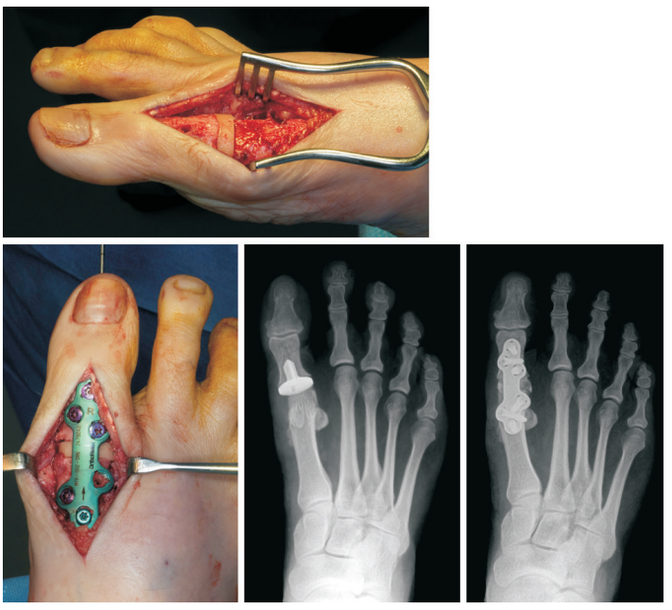

Figure 8A. Revision of failed arthroplasty. Intraoperative image of allograft prior to fixation **(top)**, post-fixation with locking plate **(bottom left)**, and preoperative radiograph **(middle)**,and postoperative radiograph **(right).**

Arthroplasty failure may be a broad inclusion term to describe many of the situations already discussed. Arthroplasty failure may simply be a "waste basket" term for the unidentified etiology of chronic pain or patient dissatisfaction. Problems may be experienced with limitations of activity, shoe fitting, and chronic pain. Mechanisms of arthroplasty failure may include the entire group of complications that we have addressed thus far as well as those that defy usual mechanisms.

DISCUSSION

Complications of joint implant surgery are quite significant and take on a variety of forms. Complications may be relatively limited biomechanical issues to quite debilitating joint dislocation, or host reactions. As surgeons, we hope to optimize our good outcomes and minimize the poor or unsatisfactory ones regardless of the cause. Surgical placement of a joint implant is a joint destructive procedure and generally requires significant bone resection particularly in the case of total joint replacement. This becomes important when faced with the need for revisionary surgery.

Treating a joint implant complication must involve careful assessment prior to knee jerk surgical recommendations. It has been our desire to bring attention to treating surgeons the myriad of complications that they may encounter and hopefully recognize. Both patient and doctor must work together to achieve a satisfactory goal. The doctor must appreciate the morbidity of his recommendations and give appropriate informed consent. Often the recommended course is difficult and some patients may not be willing to comply. Infection may not be obvious and there must always be an index of suspicion. Careful examination and work-up including labs, imaging studies, aspirates, and tissue biopsy may allow determination.

Generally, the best recommendation for revision of most first MTP joint complications is first MTP joint fusion. Arthrodesis or fusion often requires a bone graft to compensate for bone loss or deficits, costly fixation implants and a prolonged postoperative disability (Figure 8). The patient must be on board with and follow the entire treatment protocol often in the face of further impediments. The disability and impairment as a result of these complications are significant. Subsequent surgeries are generally more complicated, more expensive and fraught with more complications than the original surgery. Recommendations must be carefully formulated and patients need to be given appropriate informed consent.

First MTP joint implant arthroplasty is not perfect

but alternatives to fusion of the great toe exist and must be continued to be explored. First MTP joint implant arthroplasty is a viable procedure and surgeons do have options with regard to phalangeal, metatarsal or two component implant systems. We have come a long way since the Swanson hemi-arthroplasty and hopefully better understand the fundamentals of joint arthroplasty.

In conclusion, joint implant surgery has been performed for the past 4 decades and continues to evolve. The orthopedic literature has been explored and a good deal can be learned from LJO and materials science. Similar problems with regard to patient selection and comorbidities exist. Similar potential complications exist and present even greater challenges for the surgeon facing joint implant revision. Our objective is to continue to improve the good outcomes and minimize the untoward problems. Surgeons who perform implant procedures must be acutely aware of the potential complications and be ready to handle the myriad of complications. First MTP joint implant arthroplasty is a joint destructive procedure and must be considered as such. The pathology must warrant a joint destructive procedure. Surgeons must appraise their recommendations prior to implementation. Our modern health care system certainly monitors the cost of both the initial procedure as well as the financial burden of its complications.

Acknowledgment

This article is dedicated to the memory of our friend and colleague Irving Pikscher. Irv was one of the original coauthors who worked tirelessly in our investigation of the complications of silicone implants. Irv was a compassionate educator and was wonderful with students and residents. He disseminated his knowledge through several podiatric residency programs in the Chicago area. At one point, the three of us worked together at the Scholl College in the classroom, dissection labs, clinic, and with special projects. We dearly miss him.

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