THE SURGICAL MANAGEMENT OF THE RHEUMATOID ARTHRITIC FOREFOOT

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INTRODUCTION

The patient with rheumatoid arthritis presents as a particular challenge to the surgeon dedicated to the reconstruction of severe foot deformities. While the indications for surgical reconstruction of forefoot deformities are well known, it must be emphasized that rheumatoid arthritis is a progressive, systemic inflammatory disease of mesenchymal tissue which ultimately affects many organ systems of the body. Its effects on the entire musculoskeletal system can be crippling and disabling, depending on the nature, severity, and rate of progression of the disease process.

A basic understanding of the disease process, its various clinical forms and prognosis, are prerequisites for successful surgical reconstruction of the rheumatoid arthritic foot. The success of surgery will depend upon a "team approach". Failure to integrate and incorporate internal medicine, physical therapy, and rheumatology, in the comprehensive management of the patient, is to invite complications throughout the perioperative period. Certain medications may require cessation or adjustments prior to surgery because of their ill effects. Cervical spine x-rays should be obtained if the patient is undergoing general endotracheal anesthesia. Only after a comprehensive evaluation has been completed can an accurate assessment of the patient, as a surgical candidate, be made.

INDICATIONS AND CONSIDERATIONS

The indications for forefoot reconstructive surgery in a patient with rheumatoid arthritis include gross physical deformity with resultant pain and limitation of normal function. The primary deforming force in the rheumatoid arthritic foot is soft tissue contractures. Multiple joint effusion and intense synovitis result in instability of the metatarsophalangeal joints, with the long-term effects being severe digital contractures and deformities. This may include both dorsal and transverse plane dislocation of the digits. Anterior migration of the plantar fat pad is predictable in such cases and will contribute further to severe metatarsalgia, diffuse plantar tylomas, intractable plantar keratomas, as well as ulcerative and preulcerative lesions. Ultimately, normal function is restricted, with the end result being severe pain and disability to the point that many patients will be able to walk and stand only minimally during the course of a typical day.

Instability of the first metatarsophalangeal joint typically results in the formation of a severe hallux abducto valgus deformity, with or without degenerative changes of the joint. This is commonly secondary to the inflammatory disease process itself. It soon becomes more difficult to tolerate conventional shoes due to a physical incompatibility. Ambulation then becomes increasingly more painful and limited.

The goals and objectives of surgical reconstruction should be to relieve pain, prevent further destruction, improve function, and provide long-term stability to the forefoot. While significant improvement in the cosmetic appearance of the foot is almost always inevitable, it should be thought of as a by-product and not as the primary objective of the surgery. Furthermore, the surgeon must maintain realistic goals. At all times, treatment should be geared towards providing an optimal functional capacity with minimal pain, maximum duration of the improved state, while maximizing the safety of the surgical procedures undertaken. Perfection, in some cases, may not be a realistic or achievable goal, even in the most highly responsive patients and in the hands of the most skilled surgeon. In addition, effective communication between the patient and surgeon is critical to a successful outcome.

A symptomatic approach to surgery in the rheumatoid foot is to be discouraged. In reconstructing the forefoot deformities of the rheumatoid arthritic patient, the "all or none" law generally applies. In most cases, either the entire forefoot is reconstructed or nothing is done at all. Many times, attempts at partial corrective surgery (i.e., resection of one metatarsal head or isolated metatarsal osteotomy) simply results in early recurrence of the deformity alone, or in combination with more severe deformities of the adjacent rays. If one considers the forefoot as a functional unit and deals with it as such, the outcome of surgery is likely to be better than treatment of an "isolated broken part".

The timing of surgery is also an important consideration. There is no ideal time for surgical reconstruction to be undertaken. It is, however, generally agreed that active disease should be absent, and the patient should be in a period of quiescence or remission if not "burned out".

PAN-METATARSAL HEAD RESECTION THE BUILDING BLOCK

Numerous approaches have been described for reconstruction of the rheumatoid arthritic forefoot. The mainstay and basic foundation is the pan-metatarsal head resection. This should include resection of all of the metatarsal heads, including the first metatarsal head. All too often, the first metatarsal head is preserved and the second through fifth metatarsal heads resected. Such an approach is fraught with complications, the most common being the recurrence of a severe bunion deformity.

An aggressive resection of the metatarsal heads is recommended. Transection of each of the metatarsal heads in the distal diaphyseal portion of the bone is strongly recommended. Transection in the more distal metaphyseal area is prone to osseous proliferation, and commonly necessitates a revisional metatarsal head resection in the future.

There has been much discussion about the most appropriate metatarsal parabola. Typically, a parabola favoring the second metatarsal bone as being the longest has been advocated. The author prefers a parabola in which the first and second metatarsals are generally about equal in length, with gradual sloping or tapering of the second, third, fourth, and fifth metatarsal bones. It is not necessary to leave the second metatarsal bone as the maximum protrusion point, because the foot will not function with normal biomechanics.

The angle of transection of the metatarsal has also been a topic of debate. The author's preference is to transect each of the bones with a power oscillating saw, perpendicular to the long axis of the bone or with a very slight bevel from dorsal distal to plantar proximal. In either case, the periphery of the distal end of the metatarsal head should be contoured with a power burr. A sharp angle from dorsal distal to plantar proximal is not necessary, because once a metatarsal head has been resected, the remaining bone is minimally or entirely non-weight bearing. Transection of a metatarsal bone from dorsal proximal to plantar distal, however, should be avoided. This would result in a spike which could potentially cause problems, even with minimal weight bearing.

Power instrumentation is generally recommended for transection of the bone. Although not scientifically or conclusively proven, it stands to reason that the use of power instrumentation will avoid excessive splintering of the end of the metatarsal bone. These "micro-fractures" encourage osseous proliferation and bone callus formation. When a pan-metatarsal head resection is performed from a plantar approach, hand instrumentation, although not preferred, may be necessary for resection of the metatarsal heads.

The use of power instrumentation for pan-metatarsal head resections from a plantar approach can prove difficult and challenging.

Several historical articles have recommended resection of the proximal phalangeal bases along with metatarsal head resection (i.e., Hoffman-Clayton procedure). This approach is strongly discouraged and has no functional basis to support its use. The primary purpose for resection of the base of a proximal phalanx is to gain exposure to each of the metatarsal heads for resection. Resection of the phalangeal bases only, further decreases the stability of the digit following the metatarsal head resection, as any potential stability imparted by the intrinsic musculature is now lost. In addition, raw surfaces of bone are left adjacent to one another, creating an undesirable situation. In such cases, performing pan-metatarsal head resections from a plantar approach precludes the necessity of resecting the phalangeal bases.

In some cases, it may be desirable to achieve additional stability of the first metatarsophalangeal joint by either primary arthrodesis or total implant arthroplasty. There are obvious advantages and disadvantages to each procedure, and each deserves careful consideration. The author's preference is to avoid implant arthroplasty altogether and, thus, avoid the potential complications of this procedure, especially in the rheumatoid arthritic patient who is already known to be an immunocompromised host. Total implant arthroplasty is used only in those patients where additional stability is desirable, with preservation of range of motion to the joint, and in whom there is no significant deformity of the first metatarsal which would necessitate an osteotomy or a fusion more proximally (i.e., metatarsus primus varus). It should be emphasized that the use of a total implant to correct transverse plane deformities (hallux varus or hallux valgus) is inappropriate. Significant mechanical stress and strain can be expected to cause failure of the implant.

Additional stability to the first metatarsophalangeal joint is readily achieved by arthrodesis. This procedure has been found to produce long-term, favorable results in many cases. Because osteoporosis is typical in such patients, the method of fixation should be adjusted accordingly. The author typically favors less rigid forms of fixation such as multiple crossing Kirschner wires or Steinmann pins, in lieu of traditional screws or plates, because of the osteoporosis. The surgeon should be aware that a somewhat greater than normal delayed union or nonunion rate, when performing fusion of this joint, has been reported, and thus, careful monitoring postoperatively is in order to ensure consolidation.

The author discourages the use of any type of implant in the lesser metatarsophalangeal joints. Metatarsal caps and implants have not been found to provide better long-term results than the conventional pan-metatarsal head resection. The indiscriminate use of foreign materials in immunocompromised hosts is likely to encourage postoperative complications.

Stabilization of the lesser digits is strongly recommended. This generally consists of an end-to-end arthrodesis of the proximal interphalangeal joint with K-wire stabilization across the metatarsophalangeal joint. The K-wire should extend down the shaft of the metatarsal bone and, if necessary, cross the corresponding tarsometatarsal joint. K-wires which are inserted only a portion of the way down the metatarsal shaft (i.e., one-third or one-half) generally have inadequate stability and are unlikely to maintain their position for the recommended 6 to 8 weeks postoperatively. Kirschner wires driven to the base of the metatarsal or across the tarsometatarsal joints provide excellent stability for a prolonged period of time. After the K-wire has been properly seated, distraction is maintained at the metatarsophalangeal joint level. This space can be expected to fill with fibrous tissue during the postoperative period. Smooth Kirschner wires are effective and it is not necessary to use threaded Kirschner wires to maintain distraction.

In some cases, the author simply manipulates the digits into a rectus alignment, and then performs Kirschner wire stabilization without direct surgical fusion of the interphalangeal joints. Based on a limited number of cases, the long-term results do not seem to be significantly different. The digits are clinically rigid, and the rigid beam effect is maintained, similar to digital fusions. In cases of significant sagittal or transverse plane deformity at the proximal or distal interphalangeal joint level, bone resection will be necessary to accomplish realignment and fusion.

Intraoperative x-rays are commonly employed to confirm establishment of an appropriate

metatarsal parabola and proper placement of the Kirschner wires. An unacceptable metatarsal parabola is further adjusted by appropriate resection of bone. Improperly located Kirschner wires are removed and replaced and additional x-rays taken to confirm proper placement, position, and overall alignment.

SKIN INCISION APPROACHES

A discussion of surgical procedures for reconstruction of the rheumatoid forefoot would be incomplete without a consideration of the most appropriate skin incision approach. A variety of approaches have been recommended over the years. The proposed skin incision should be based upon the type and severity of the digital and metatarsophalangeal joint deformities. Each incisional approach has inherent advantages and disadvantages. It is the author's belief that no "standard" approach should be routinely employed. The surgeon should consider the nature and severity of the deformity, weigh the potential advantages and disadvantages of each particular incisional approach, and select an approach which will permit adequate correction of the deformity, with minimal risk of wound complications. Personal experience and training alone should not be the deciding factors for the incisional approach when performing pan-metatarsal head resections in a rheumatoid foot.

Dorsal Longitudinal Approaches

Both the three and five dorsal longitudinal incisional approaches have received considerable attention over the years. The five incisional approach provides exposure to each of the metatarsophalangeal joints and corresponding digits. The three incisional approach provides exposure to the first ray through one incision, the second and third rays through an incision placed between the second and third metatarsal heads and shafts, and the third incision provides exposure to the fourth and fifth metatarsal heads. The three incisional approach, although seemingly less traumatic, may in fact require increased dissection in order to gain exposure to the adjacent metatarsal heads. It typically involves more manipulation of the neurovascular bundles, and is generally not preferred by the author. Furthermore, it requires additional incisions on each of the toes if arthroplasty or arthrodesis of a digit is to be performed.

The five incisional approach has been found to be valuable in those cases in which there is minimal to no dorsal subluxation of the metatarsophalangeal joints. The five incisional approach can be used successfully in patients with significant transverse plane deformity. It provides exposure to the metatarsophalangeal joint, with easy access for resection of the metatarsal head. It also exposes the interphalangeal joints for fusion and stabilization of the digits. Because of the close proximity of each of the adjacent incisions, it is recommended that the incisions first be marked with a skin scribe prior to surgery. This avoids creating excessively narrow islands of tissue which may be prone to an increased rate of wound complications postoperatively. First metatarsal head resection, implant arthroplasty, or arthrodesis, is routinely performed through a standard dorsomedial incisions.

It should be emphasized that dorsal incisions are reserved for those patients undergoing lesser metatarsal head resections in which there is no significant dorsal or sagittal dislocation of the digit or metatarsophalangeal joint. In cases where significant dorsal subluxation or dislocation is present, a plantar transverse approach is preferred and recommended. Stabilization of the interphalangeal joint of a lesser digit is routinely performed through a short dorsal longitudinal incision placed centrally over the interphalangeal joint.

Plantar Transverse Approaches

Plantar transverse approaches are extremely valuable in many cases, especially where there is dorsal subluxation or luxation of the metatarsophalangeal joint, with gross prominence of the metatarsal heads plantarly. In such cases, the base of the proximal phalanx is found dorsal to the metatarsal head, making the dorsal approach extremely difficult. In contrast, the metatarsal head is plantarly prominent directly beneath the skin. Each metatarsal head is readily palpated plantarly. The fat pad is typically displaced distally. Two semi-elliptical incisions with a resultant resection of a wedge of skin is recommended. The wedge of skin removed directly overlies the metatarsal head. Following resection of the metatarsal head, the scar will then be in a non-

weight-bearing area. Resection of a wedge of skin will also assist in the relocation of the plantar fat pad, and provide additional stability to the lesser digits in a plantar direction. This decreases the chance of dorsal subluxation of a digit postoperatively. While there is a general fear among surgeons to perform such incisions, they provide the easiest approach to resection of the metatarsal head. In addition, such incisions follow the principles of relaxed skin tension lines, and are less prone to the formation of a hypertrophic scar, keloid or other wound complication.

CLINICALLY ILLUSTRATED TECHNIQUE

Figure 1. Patient with rheumatoid arthritis. Note the moderate hallux abducto valgus deformity, multiple transverse plane digital deformities, and dorsal subluxation of the lesser metatarsophalangeal joints on the left foot.

Figure 2. Dorsoplantar x-ray of the same patient in Figure 1. Note the splaying between the first and second metatarsal bones, with osseous adaptation at the base of the first metatarsal. Metatarsophalangeal joint luxation/subluxation with transverse plane deviation is evident.

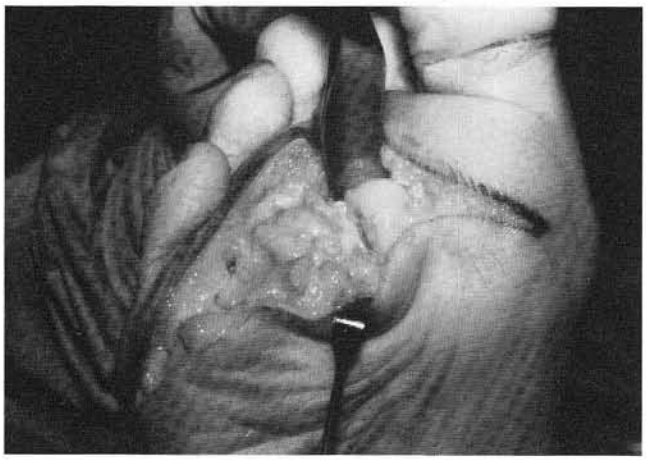

Figure 3. A plantar incisional approach was used for the pan-metatarsal head resection. The incision is placed centrally over the lesser metatarsal heads. The flexor tendons are retracted medial or lateral to the metatarsal heads.

Figure 4. Postoperative dorsoplantar x-ray. First MPJ arthrodesis was performed in conjunction with resection of the second through fifth metatarsal heads. Note the position of the K-wires crossing the tarsometatarsal joints, to provide stability for 6-8 weeks. Additional bone resection from the first metatarsal head to shorten the first ray segment would be recommended.

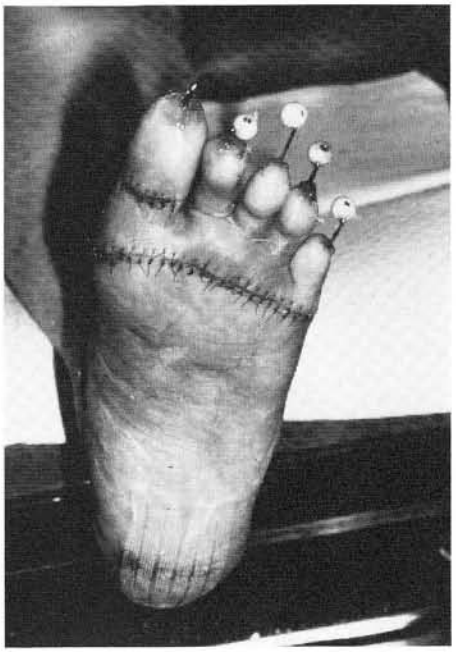

Figure 5. At six weeks postoperative, note the minimal amount of edema on the plantar aspect of the foot. Additional transverse incisions were utilized at the interphalangeal joint of the great toe, and the plantar aspect of the heel, for excision of rheumatoid nodules.

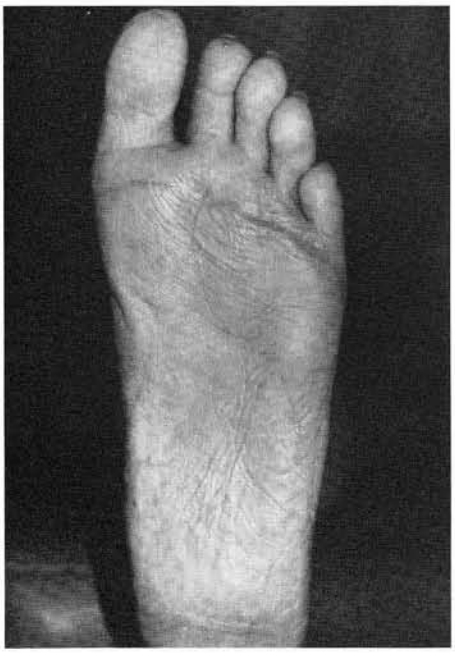

Figure 6. The plantar aspect of the foot five months postoperatively. The scars were very supple in the absence of wound complication.

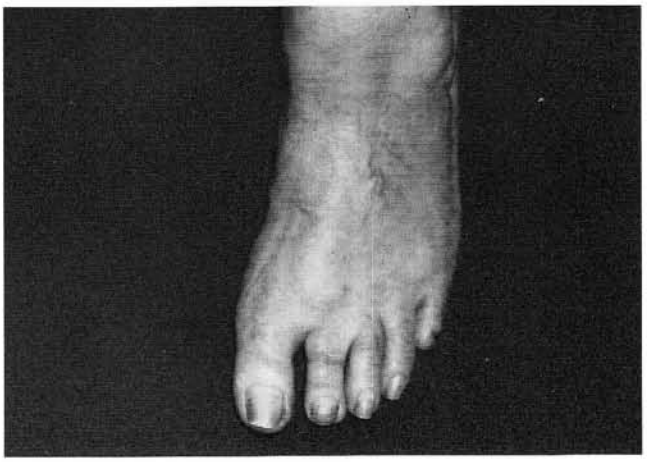

Figure 7. Weight-bearing appearance of the foot five months postoperatively. Excellent correction of the hallux valgus deformity with satisfactory alignment of the lesser toes is evident.

Figure 8. Medial oblique x-ray at five months postoperative demonstrating osseous consolidation at the first MPJ arthrodesis site.

SUMMARY

Pan-metatarsal head resection remains the basic building block procedure for surgical reconstruction of the rheumatoid arthritic forefoot. Stabilization arthrodesis of the lesser digits helps to maintain long-term corrective alignment and prevent and minimize recurrent dorsal subluxation. Additional stability to the first metatarsophalangeal joint can be achieved by first MPJ arthrodesis or total implant arthroplasty if desired. The plantar transverse incisional approach is recommended when sagittal plane dorsal subluxation of the lesser metatarsophalangeal joints is present. When the primary deformity exists in the transverse plane, dorsal incisional approaches are recommended. Appropriate orthotic devices should be fabricated in addition to digital retaining devices to maintain long-term corrective alignment. Proper patient selection, meticulous surgical technique, and appropriate postoperative care provide extremely gratifying results to both the patient and surgeon.

BIBLIOGRAPHY

Gerbert J, Dobbs B, McGlamry ED, Martin DE: The rheumatoid forefoot. In McGlamry ED, Banks AS, Downey, MS (eds) *Comprehensive Textbook of Foot Surgery, 2nd Ed* Baltimore, Williams & Wilkins, 1992, p. 948.

McGlamry ED, Martin DE: Pan-metatarsal head resection: Indications and uses in forefoot reconstruction. In DiNapoli DR (ed) *Reconstructive Surgery of the Foot and Ankle: Update '90* Tucker, GA, Podiatry Institute Publishing, 1990, p. 37.

McGlamry ED, Martin DE: Forefoot derangements Part I. In McGlamry ED, Banks AS, Downey, MS (eds) *Comprehensive Textbook of Foot Surgery, 2nd Ed* Baltimore, Williams & Wilkins, 1992, p. 931.