CHAPTER **18**

Functional Repair In Lesser Metatarsophalangeal Joint Arthrosis

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(In memory of Dr. Jim Ganley. His untimely death in 1992 is not only a tragic loss to his family and friends, but a monumental loss to his profession.)

Arthrosis of a lesser metatarsophalangeal joint is a difficult problem to resolve. When conservative therapy fails, and radiographic evidence of joint space narrowing and irregularity has led to painful motion across this joint, some form of joint invasive procedure is required to alleviate pain and restore motion.

ETIOLOGY

The etiology of arthrosis in a lesser metatarsophalangeal joint can be varied. Frieberg's avascular necrosis represents a joint destructive, vascularly compromised section of bone, usually located in the distal portion of a metatarsal head (Fig. 1A).

Figure 1A. Frieberg's avascular necrosis of the third metatarsal head.

The etiology is often indeterminant, but may be associated with some form of trauma. Degenerative joint disease can be caused by abnormal biomechanical forces acting over a period of time to erode the cartilage surface, or lead to subluxation of the joint (Fig.1B). Intra-articular trauma can lead to painful degeneration of a joint surface. Even non-intra-articular trauma, if malpositioned healing occurs, can lead to abnormal biomechanical pressure and degenerative joint disease or digital limitus (Fig. 1C). Digital limitus, where there is a limitation of dorsiflexion at the lesser metatarsophalangeal joint (similar to hallux limitus), is much less common. However, when present it can lead to similar painful degeneration. Iatrogenic and traumatic conditions are most commonly associated with this relatively rare phenomenon (Fig. 1D). Dislocation, either acutely traumatic, or gradually progressive resulting from biomechanical subluxations, can be similarly painful and lead to degeneration of the articular surface (Fig. 1E). Finally, tumors involving the base of the proximal phalanx or metatarsal head area can lead to painful joint motion (Fig. 1F).

Figure 1B. Degenerative arthrosis of the second metatarsophalangeal joint.

CONSERVATIVE THERAPY

Early on, painful motion of a lesser metatarsophalangeal joint can often be treated conservatively to relieve symptoms. Range of motion exercises, and frequent warm or contrast soaks, can help to reduce the symptoms. These treatments may need

Figure 1C. Intra-articular fracture of the base of the proximal phalanx.

to be supplemented with forefoot nerve blocks in the adjacent interspaces. Functional orthotics can also be used to help neutralize abnormal pathomechanical forces. This will lead to gradual resolution of subluxations and help to reverse these trends.

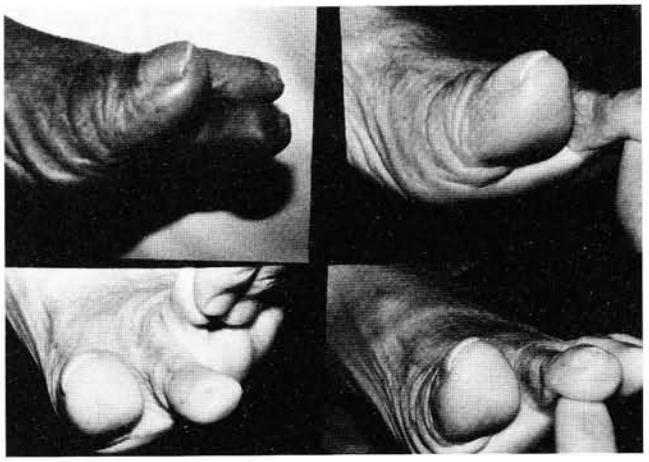

Figure 1D. Iatrogenic digital limitus of the second toe.

SURGICAL INTERVENTION

Surgery for a painful metatarsophalangeal joint generally falls into one of two categories, joint preservation or joint destructive procedures. With regards to joint preservation procedures, release- and relocation of the metatarsophalangeal joint may be necessary. Arthroplasty of the proximal interphalangeal joint may be necessary in conjunction with this release to allow for realignment of the digit. Another alternative is arthrodesis of the proximal interphalangeal joint, along with an associated relocation of the metatarsophalangeal joint. This often requires K-wire fixation across the metatarsophalangeal joint for four to six weeks.

Transfer of the flexor digitorum longus tendon to restore dynamic balance is another alternative in

Figure 1E. Dislocation of the third metatarsophalangeal joint with dorsal subluxation of the second metatarsophalangeal joint.

Figure 1F. Pseudo tumor of the second metatarsal head.

association with the metatarsophalangeal joint release, and arthroplasty of the proximal interphalangeal joint. Occasionally, a flexor tendon transfer can be successful without the need of arthroplasty of the proximal interphalangeal joint. Another option is a shortening osteotomy of the corresponding metatarsal. However, all of these joint preservation procedures require adequate cartilaginous surfaces on the base of the proximal phalanx and the head of the metatarsal. An acute or chronic dislocation of a lesser metatarsophalangeal joint may be relocated with closed reduction, or open reduction and internal fixation, without the need for osseous repair of the metatarsal or the digit.

Joint Destructive Procedures

With more advanced arthrosis of a lesser metatarsophalangeal joint (cartilage erosion), joint destructive procedures will be required. The options include metatarsal head resection, partial metatarsal head resection, phalangeal base resection, metatarsophalangeal joint arthrodesis, and implant arthroplasty.

Metatarsal head resection as an isolated procedure is not recommended (Fig. 2A). This will generally lead to transfer lesions from increased weight bearing of the adjacent metatarsal heads. It will also lead to shortening of the ray, and consequently, shortening of the digit. The toe also becomes non-functional and floating. The one exception to this is that the fifth metatarsal head, on occasion, can be resected without an associated transfer lesion or significant metatarsalgia.

Figure 2A. X-ray of a fifth metatarsal head resection.

Partial metatarsal head resection will also lead to some loss of weight bearing and can lead to a transfer lesion, although generally not quite as significant (Fig. 2B). The patient may also have some shortening and floating of the toe, or lack of purchase. Although it generally does not occur to the same degree as a total head resection, it can be significant. Another possible complication can be continued arthrosis or pain at the metatarsophalangeal joint, if enough of the metatarsal head is not resected. Furthermore, with a partial metatarsal head resection, it is important to also remove part of the plantar condyle.

Figure 2B. X-ray of a partial metatarsal head resection including plantar condylectomy.

Phalangeal base resection has traditionally led to a floating or dorsally dislocated toe, due to loss of the insertion of the intrinsics musculature (Fig. 2C). This is due to loss of the muscle tendon balance across the metatarsophalangeal joint. Similar dislocation deformities frequently occurred with the Keller procedure for the first metatarsophalangeal joint, prior to implementing muscle-tendon balance techniques.

Arthrodesis of a lesser metatarsophalangeal joint is not a procedure that has been widely utilized (Fig. 2D). The complications with this procedure may be non-union and/or continued pain. However, assuming stable arthrodesis or fusion has been achieved across this joint, the position of fusion can lead to potential problems. If the toe is fixed in too much of a dorsiflexed position, this can lead to shoe irritation, especially in women's shoes. The position of the toe will furthermore

Figure 2C. X-ray of a proximal phalanx base resection with subsequent digital dislocation.

Figure 2D. X-ray of a partial metatarsal head and proximal phalangeal base resection, in conjunction with a double-stemmed implant.

limit the heel-height capabilities in women's shoes. If the position is not dorsiflexed adequately, painful ambulation can occur as the patient lifts the heel to propel.

Implant arthroplasty of a lesser metatarsophalangeal joint is another alternative (Fig. 2E). The implant serves only as a spacer and cannot be expected to resist any significant deforming force. Placement of the implant requires resection of bone. This necessitates resection of the head of the metatarsal or the base of the proximal phalanx, or a partial resection of both. Consequently, this has the inherent problem of loss of weight-bearing of the metatarsal head with transfer lesions, and/or problems with dislocation of the toe. Additionally, foreign body reactions and general implant complications can occur. Similar to the problems with the first metatarsophalangeal joint if the head of the metatarsal is removed, ground reactive forces oblique to the shaft of the metatarsal will promote dislocation of the implant.

Unfortunately, there is no single procedure to sufficiently solve the problem of the painfully eroded and arthritic lesser metatarsophalangeal joint. However, muscle-tendon balancing arthroplasty with proximal phalangeal base resection may prove beneficial. In 1979, Dr. Jim Ganley indicated that resection of the base of the proximal phalanx worked well in digital surgery. Ganley received excellent results from this procedure. Ganley did not have the complication of the dislocated toe, in spite of loss of intrinsic stability. This is due to the fact that the extensor digitorum longus was transferred to the corresponding metatarsal. This technique utilized the principle of tendon balance, similar to that seen in the Keller arthroplasty for the first metatarsophalangeal joint.

From Ganley's observations and from experience with the Keller bunionectomy, a muscle-tendon balance technique was developed for joint destructive procedures for the lesser metatarsophalangeal joint. This technique consists of: 1. base resection of the proximal phalanx,

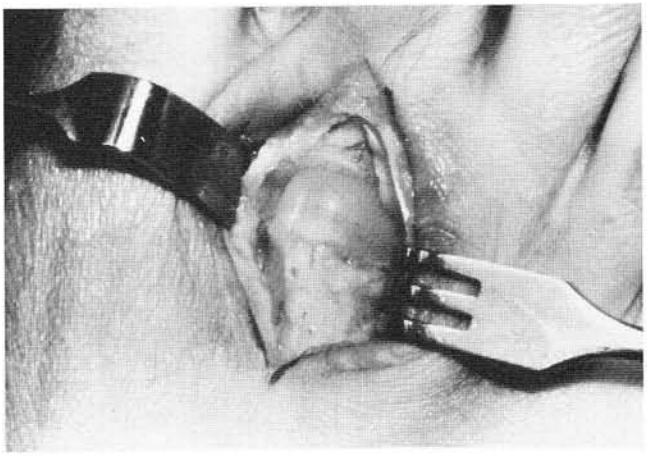

Figure 2E. Implant arthroplasty of a lesser MPJ.

2. flexor digitorum longus transfer to the proximal phalangeal stump, 3. extensor digitorum longus transfer to the metatarsal, 4. capsulorrhaphy.

This procedure preserves the weight-bearing metatarsal head, neutralizes the dynamic forces across the metatarsophalangeal joint, and stabilizes the digit. Like most other joint destructive procedures of the lesser metatarsophalangeal joint, it also eliminates the painful motion of this joint.

SURGICAL PROCEDURE

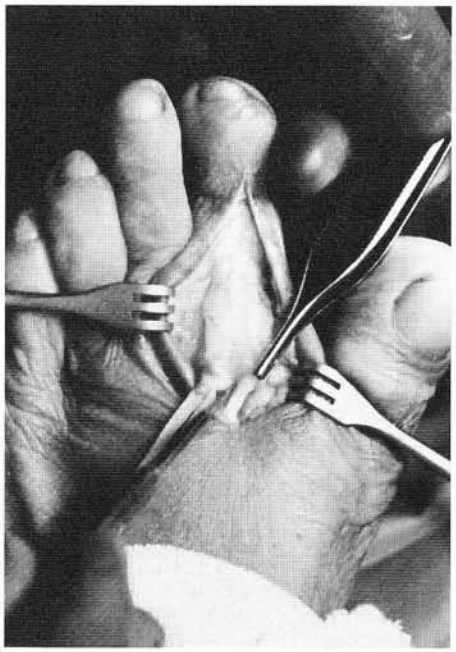

Figure 3A. A 4-5 cm curved incision is made over the lesser metatarsophalangeal joint, extending onto the toe. The extensor digitorum longus and the extensor digitorum brevis tendons are identified, the extensor hood is incised, and the extensor apparatus is reflected. The extensor digitorum longus is sectioned at the neck of the metatarsal and reflected proximally.

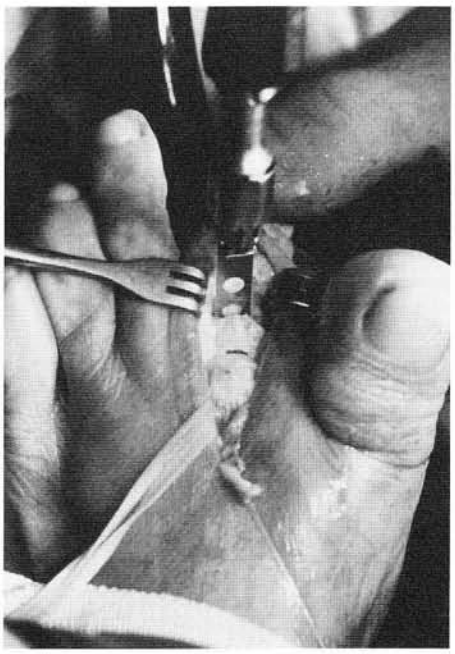

Figure 3B. A linear periosteal-capsular incision is used to identify the metatarsophalangeal joint, extending from the neck of the metatarsal to the shaft of the proximal phalanx. The base of the proximal phalanx is identified and freed of its soft tissue attachments, transected, and excised.

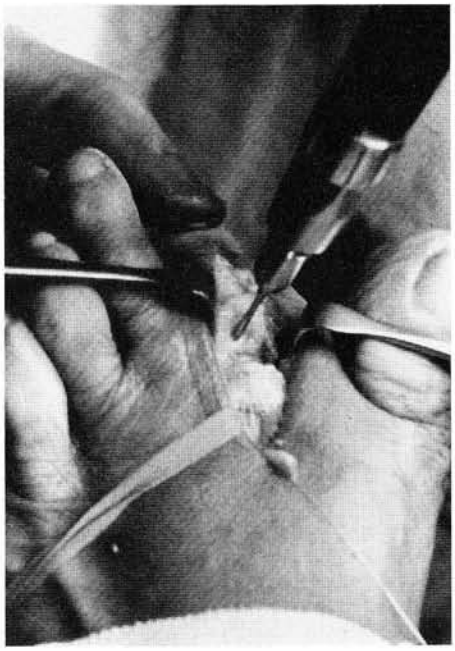

Figure 3C. A drill hole is placed centrally through the plantar cortex of the stump of the proximal phalanx.

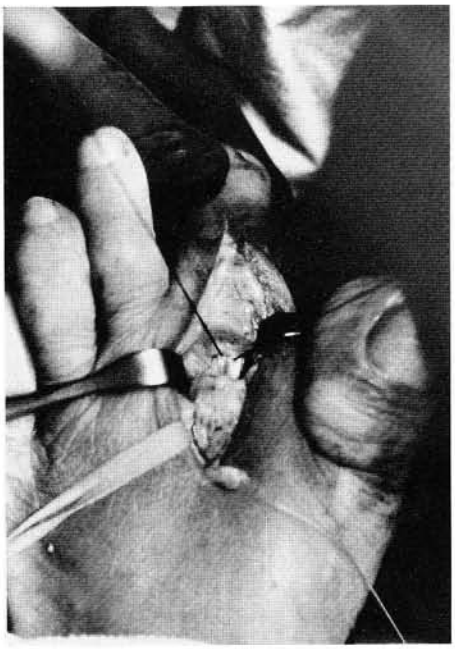

Figure 3D. The metatarsal head is freed of any restrictive soft tissue attachments with the aid of a McGlamry metatarsal elevator. A linear incision is made through the plantar capsular plate and the flexor digitorum longus and the flexor digitorum brevis tendons are identified. The flexor digitorum longus tendon is isolated, and with the toe held in a corrected position, the tendon is secured with a 2-0 Ethibond suture via the drill hole in the plantar stump of the proximal phalanx.

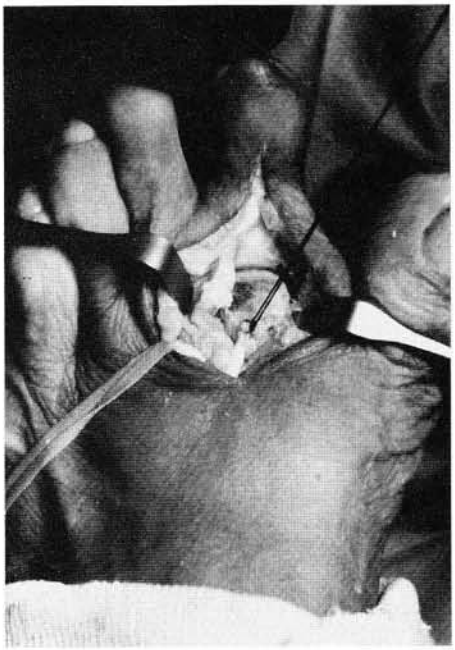

Figure 3E. The extensor digitorum longus is secured to the metatarsal neck with the foot held at a right angle to the leg. This is usually accomplished with the use of a Mitek anchor with 2-0 Ethibond suture.

Figure 3F. The periosteum is closed, incorporating the extensor digitorum longus tendon, and the capsular tissue is closed with a purse-string suture across the joint.

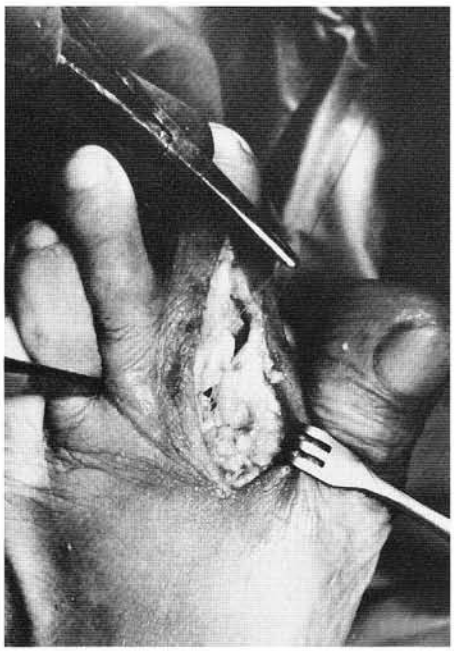

Figure 3G. The extensor hood apparatus is relocated and sutured if necessary.

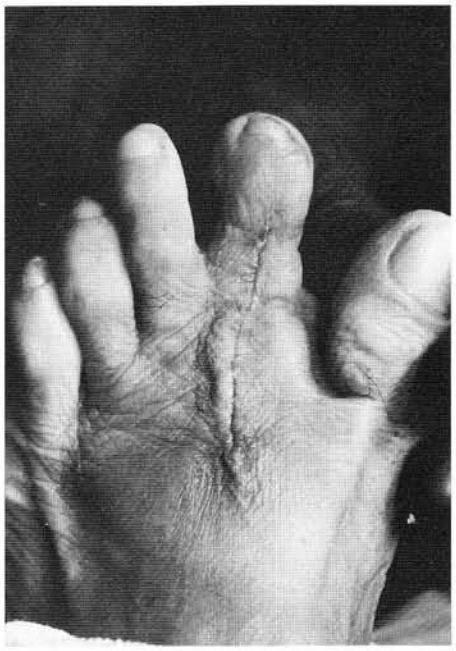

Figure 3H. The wound is closed in layers.

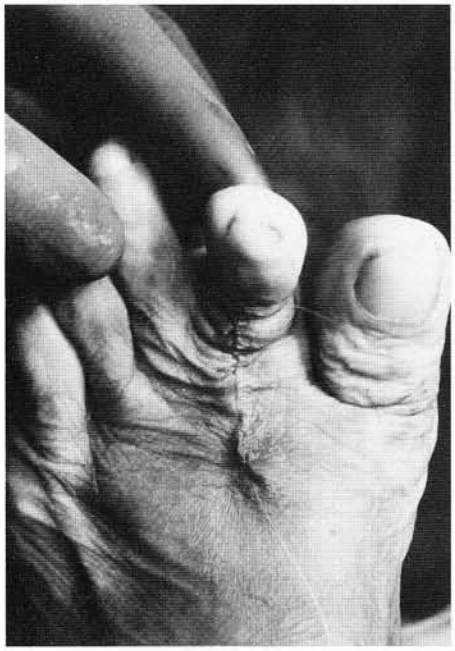

Figure 3I. Range of motion is evaluated intraoperatively to insure adequate motion.

Figure 3J. Preoperative (left) and postoperative (right) x-rays demonstrate the amount of correction obtained.

Implant arthroplasty can also be utilized with this procedure. Some authors feel that this more effectively maintains length and purchase power of the toe. Since the metatarsal head is preserved, the oblique dislocating reactive force of gravity is muted, and since the muscle tendon balance procedures are performed, dynamic stability is preserved. Adequate base resection must be accomplished to relieve tension across the implant. A total joint hinged implant is recommended for this procedure.

Arthrodesis of the proximal interphalangeal joint is not routinely necessary. However, if a fixed contracture is noted at the proximal interphalangeal joint, a minimal resection end-to-end arthrodesis can be performed. This is done to preserve length of and blood supply to the remaining proximal phalanx.

Neutralization of transverse plane forces is often not necessary since the interossei on both sides of the metatarsophalangeal joint have been released with resection of the base of the proximal phalanx. However, release of the extensor hood on the contracture side of the deformity, and tightening the hood on the opposite side, may prove helpful. Transfer of a capsular interosseous flap to the hood mechanism may occasionally be necessary. When transverse plane instability is significant, it remains a difficult force to neutralize.

K-wire fixation is often used to help maintain slight overcorrection of the toe for 6-8 weeks. The K-wire is usually driven proximally to at least the base of the metatarsal. When K-wires are not used, Betadine casting or other bandaging techniques are strongly recommended to maintain alignment for an extended period of time.

POST OPERATIVE CARE

K-wire fixation is maintained for 6-8 weeks. It is necessary to pad a surgical shoe with a 1/4" to 1/2" of Korex or felt, from the heel to the web of the toes. This will elevate the toes from the sole of the shoe, and prevent bending of the K-wire upon ambulation. If a K-wire is not used, a bandaging technique is recommended to maintain alignment. Sutures are removed in 10-12 days. Following removal of the K-wires, Bouton splints or toe comb foam splints are used for 3-6 months.

CONCLUSION

When conservative therapy and joint preservation procedures are inadequate, the tendon balance "mini-Keller" joint destructive procedure is another surgical option in the treatment of a painfully eroded and arthritic lesser metatarsophalangeal joint. Even when joint destructive procedures are employed such as a partial or complete metatarsal head resection, the muscle-tendon balancing portion of the procedure should be encouraged. Statistical analysis of long-term follow-up is not yet available. However, Dr. Ganley's extensive use of proximal phalangeal base resection, along with the author's long-term results following muscle-tendon balancing of the Keller bunionectomy, provides a logical method by which to surgically correct a painful arthritic lesser metatarsophalangeal joint.

BIBLIOGRAPHY

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