

9

Arthrodesis of the Interphalangeal Joint

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Arthrodesis of the hallux interphalangeal joint is itself a simple procedure. The difficulty originates over misconceptions involving the interpretations and applications of similar original articles. The major problems appear to center around the flexor hallucis longus, the extensor hallucis longus, and exactly what to do with both, as well as whether fusion of the interphalangeal joint is warranted.

REVIEW OF THE LITERATURE

In 1938, Forrester-Brown¹ described a procedure in which half the flexor hallucis longus was transferred to a new insertion in the extensor hallucis longus during the late stages of poliomyelitis, as well as of other paralytic conditions. The deformity arose because of faulty balance among the muscles, that is, the weakness of the tibialis anterior and compensation for the resulting weak dorsiflexion by the extensor hallucis longus. He also stated that the polio patient used the flexor hallucis longus to compensate for this weak dorsiflexion. When there was subluxation of the interphalangeal joint, he recommended arthrodesis of the joint and transfer of the whole tendon. The flexor hallucis longus was freed from a medial approach and sutured into the extensor hallucis longus on the dorsum of the proximal phalanx. If the metatarsophalangeal could not be plantar-flexed, he recommended a dorsal capsulotomy and extensor tendon lengthening. A dorsal wedge was removed from the interphalangeal joint and the opposing bone surfaces sutured. This procedure was theoretically based on the work of Sir

Harold Stiles,² who believed that part of the flexor digitorum sublimis in the hand, if transferred to the extensor tendon at the proximal phalanx, would function as an artificial lumbricales and flex the knuckle and extend the interphalangeal joint.

In 1926, Dickson and Dively³ reported on 56 cases of fusion of the hallux interphalangeal joint with extensor hallucis longus transfer into the flexor hallucis longus tendon just proximal to the first metatarsal head (Fig. 9-1). The authors thought that procedures that used an extensor hallucis longus transfer to remove the deforming force of the clawed hallux and at the same time dorsiflex the foot were not mechanically correct. They based their theory on the supposition that the paralyzed tendon that was causing the deformity was the flexor hallucis longus. They made no mention of a weak tibialis anterior. It is interesting to review the discussion that followed the presentation of the technique in the same article. Willis Campbell (Memphis, TN) and Henry Meyerding (Rochester, MN) stated that the transference of the extensor hallucis longus through the first metatarsal had not given uniformly satisfactory results. C.L. Lowman (Los Angeles), however, identified the weak tibialis anterior, the strong peroneus longus, and the common extensors used to dorsiflex the foot as the cause of claw foot as opposed to merely claw toe. He mentioned that only when the deformity is first corrected more proximally will correction of the claw toe succeed. The claw toe can then be corrected using the Jones procedure. Arthur Steindler (Iowa City) thought that this procedure, in conjunction with the stripping of the os calcis (Steindler stripping) seemed to be

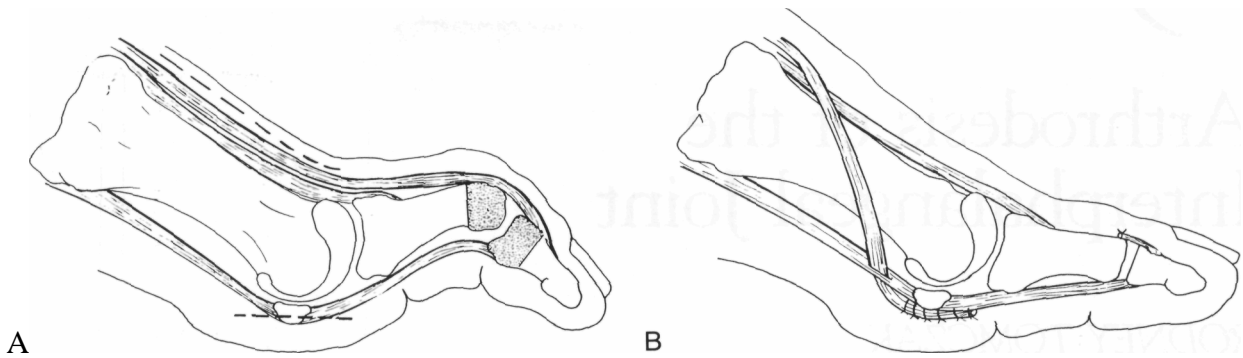


Fig. 9-1. (A & B) Dickson-Diveley operation for clawing of great toe. The extensor hallucis longus tendon is transferred to flexor hallucis longus tendon and the interphalangeal joint is arthrodesed after enough bone has been removed to correct deformity. (Adapted from Dickson and Diveley.³)

eminently sound mechanically; the sling constituted by the long flexor of the toes and the extensor of the big toe had the leverage to pull up the sunken head of the first metatarsal.

In 1951, Taylor⁴ reported on 68 patients who underwent a procedure developed by G.R. Girdelstone that was then named the Girdelstone procedure. Of these 68 patients, 38 had associated pes cavus, 23 had planovagus deformity, and 7 had no apparent abnormality. Taylor reported that examination of all 68 patients failed to reveal any evidence of paralysis, and no evidence of abnormality of the intrinsic muscles was found at the time of surgery. He further stated that these findings in three different structural foot types make it difficult to account for the deformity, with the exception of ineffective use of the intrinsic muscles.

The technique of the Girdelstone procedure con-

sisted of merely tenotomizing the long and short flexors, transferring them to the lateral side of the extensor expansion through a buttonhole, and suturing them in place (Fig. 9-2). The interphalangeal joints were then arthrodesed. For the hallux, however, Taylor wrote that Girdelstone advocated excision of the interphalangeal joint and transplantation of the extensor hallucis longus into the neck of the first metatarsal so as to form a supporting sling for the head of the first metatarsal.

The Jones procedure⁵ itself seems to have its origin in the procedures described by Sherman⁶ and Forbes.⁷ These procedures advocated the transplantation of the extensor hallucis longus and extensor digitorum longus to the heads of the metatarsals to remove the deforming actions of these tendons on the digits. Jones recommended a Steindler stripping and

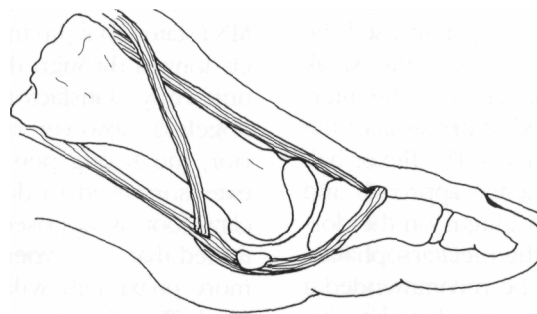


Fig. 9-2. Girdelstone-Taylor tendon transfer for clawing of toes. Deformity before surgery. Tendons of long and short toe flexors have been transferred to extensor expansions. The corrected position of each toe is maintained by a suture placed around both the proximal phalanx and the Lambrinudi splint. (From Taylor.⁴)

transfer of the extensor hallucis longus through the first metatarsal head as surgical treatment for an anterior-flexible claw foot. He did not mention fusion of the interphalangeal joint of the hallux as part of the procedure nor did he mention suturing the attached stub of the extensor hallucis longus tendon to the extensor hallucis brevis tendon.

Ingram, in *Campbell's Operative Orthopaedics*⁸ describes a technique of suturing the remaining portion of the extensor hallucis longus tendon to the soft tissues on the dorsum of the proximal phalanx (Fig. 9-3). He states that the interphalangeal joint may or may not be fused, depending on the age of the patient. Arthro-

desis is preferable, but fusion is difficult to obtain in a child because the epiphysis is largely cartilage. This technique of tenodesis was advocated in almost identical fashion in a 1973 article by McGlamry and Kitting.⁹ Rather than suturing the stub of the extensor hallucis longus to the proximal phalanx, O'Donoghue and Stauffer¹⁰ recommended Kirschner wire (K-wire) fixation to prevent a painful flexion contracture of the joint that may develop secondary to nonunion. Before K-wire fixation, these authors reported that 80 percent of the patients did not progress to bony fusion; with K-wire fixation, however, the rate of bony fusion was 85 percent.

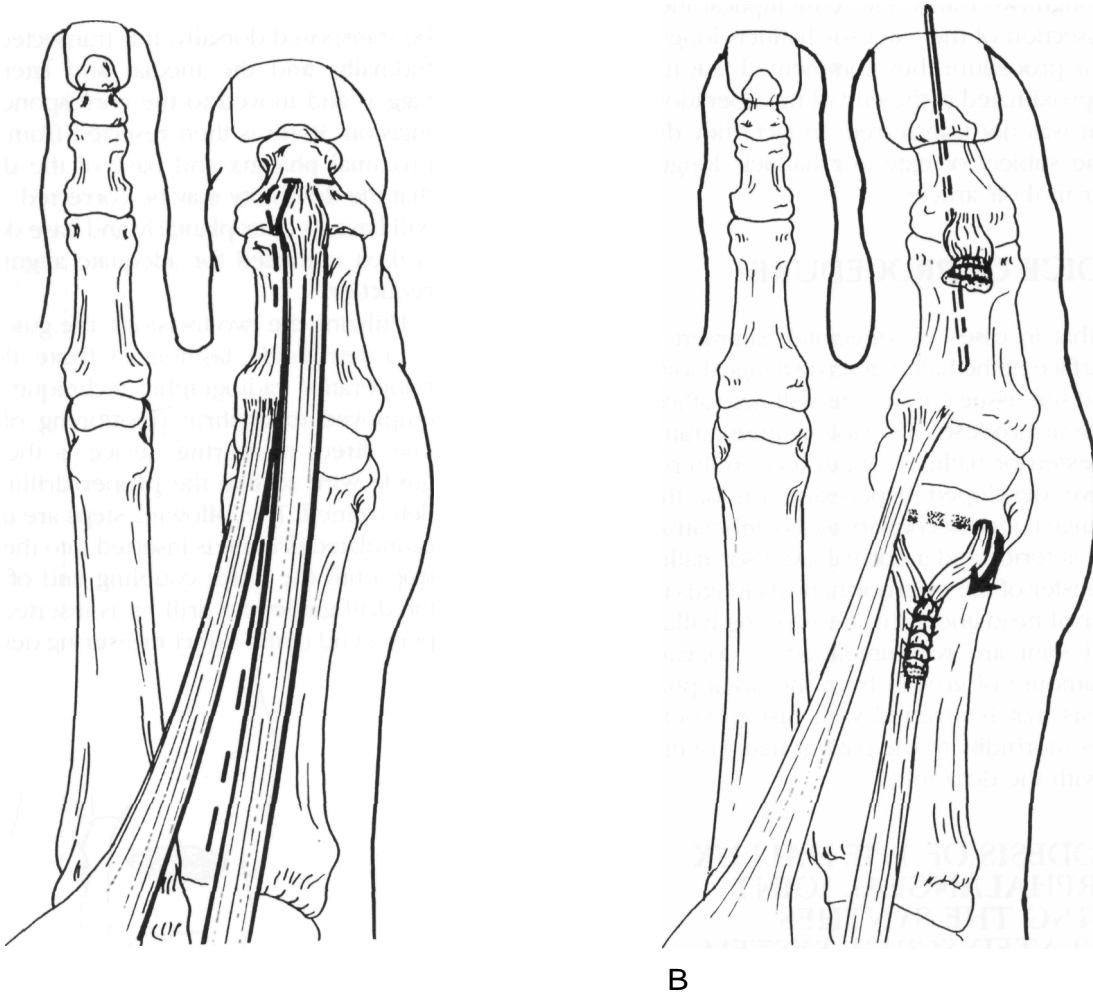


Fig. 9-3. Modified Jones operation for clawing of great toe. Extensor hallucis longus tendon is attached to the neck of the first metatarsal; the interphalangeal joint is arthrodesed and fixed by medullary wire and by suturing the distal end of the extensor hallucis longus tendon to soft tissues over the proximal phalanx.

Shives and Johnson¹¹ from Mayo Clinic reported on the use of a 4.0-mm. cancellous bone screw across the denuded interphalangeal joint to achieve rigid internal fixation and compression. This was done through an L-shaped incision parallel with the joint and extending proximally on the medial aspect of the hallux. The extensor hallucis longus tendon was not transected unless it was being transferred. Shives and Johnson implied that extensor hallucis longus transfer did not accompany every interphalangeal joint fusion. A case of hallux hammer toe secondary to an old flexor tendon laceration was treated with joint fusion alone.

Langford and Fenton¹² reported on a similar procedure done through two transverse semielliptical incisions with transection of the extensor hallucis longus tendon. In their procedure they commented that the tendon was approximated at the end of the operation, implying that it was not transferred. In fact, they did not address the subject of extensor hallucis longus tendon transfer in their article.

CHOICE OF PROCEDURE

Mann¹³ states that in cases of congenital hammertoe the articular surface of the hallux interphalangeal joint is abnormal and soft tissue corrections will not suffice. He recommends arthrodesis of the joint without transection of the extensor hallucis longus tendon. In patients who have developed hyperextension of the metatarsophalangeal joint secondary to a combination of weak tibialis anterior and a normal extensor hallucis longus, a transfer of the extensor hallucis longus to the first metatarsal head and arthrodesis of the hallux interphalangeal joint are recommended. It appears that the small amount of growth from the distal phalangeal epiphysis that is arrested with fusion would account for less morbidity to the patient than continued suffering with the deformity.

ARTHRODESIS OF THE HALLUX INTERPHALANGEAL JOINT USING THE SYNTHES CANNULATED SCREW SYSTEM

The introduction of the Cannulated Screw System (Synthes, Paoli, PA) has simplified the fusion of the hallux interphalangeal joint that was originally de-

scribed by the Association for the Study of Internal Fixation (ASIF) group.¹⁴ The basic principles of the Cannulated Screw System consist of a solid guide wire, a hollow drill bit that is placed over the guide wire to drill the hole through the phalanges, and a hollow screw which is inserted over the guide wire by means of a hollow screw driver.

Two semielliptical incisions are made over the hallux interphalangeal joint and a wedge of skin removed. A second fishmouth incision is made on the distal aspect of the hallux (Fig. 9-4) to allow for skin closure without redundant skin in the shortened toe. The extensor tendon is transected and tagged with suture for retraction. Soft tissues are incised and the interphalangeal joint is exposed. If the long flexor is to be transposed dorsally, it is transected and split longitudinally, and the medial and lateral portions are tagged and moved to the corresponding sides of the incision. Bone is then resected from the head of the proximal phalanx and base of the distal phalanx so that the deformity may be corrected. Thus, the wedge will have its apex plantarly and base dorsally. The joint is then evaluated for adequate alignment by manual reduction.

Utilizing the two incisions, the guide wire is passed in a retrograde fashion to fixate the joint. An intraoperative radiographic technique should now be employed to confirm positioning of the phalanges. The direct measuring device is then slid over the guide wire so that the proper drilling depth can be determined. The following steps are used: the 2.7-mm. cannulated drill bit is inserted into the drill guide with stop until the quick coupling end of the bit rests on the drill guide; the drill bit is inserted into the nontapered end of the direct measuring device; he knurled

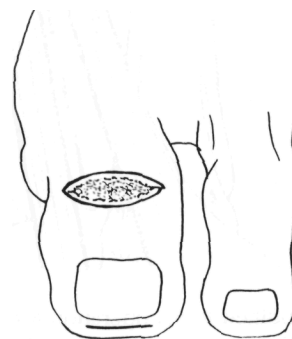


Fig. 9-4. Fishmouth incision on distal aspect of the hallux to allow for skin closure. (See text for details.)

nut on the drill guide is loosened; the threaded end of the drill guide is rotated until the drill bit corresponds to the drill depth; and the knurled nut is tightened.

The drill is then placed over the guide wire and the hole drilled. The drill bit will contact the drill guide when the appropriate length has been reached, and the drill should be removed at this point. The cannulated countersink is then placed over the guide wire and the distal aspect of the distal phalanx may be countersunk. The near cortex is tapped by means of the cannulated tap, which is inserted over the guide wire. A small cannulated screw, which is the same length as the depth previously drilled, is then selected and inserted over the guide wire. The guide wire is removed and discarded.

The long extensor tendon is reattached and the long flexor, if it is being transferred dorsally, is juxtaposed to the repaired capsule. Skin is closed in the normal fashion. Non-weight-bearing healing time is suggested if extensive tendon work has been performed.

The screw may be removed with a standard small hexagonal screwdriver if necessary after osseous healing has occurred. Langford and Fenton¹² reported a zero incidence of delayed or nonunions in 29 procedures performed with conventional screw fixation. There is no reason to doubt that similar results should be expected with the Cannulated Screw System.

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