

# THE KELLER BUNIONECTOMY REVISITED

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William Keller produced two articles, the first appearing in 1904 and the second in 1912, describing a bunionectomy which essentially resected the medial eminence of the first metatarsal head and the base of the proximal phalanx for treatment of hallux valgus deformity. Due to the ensuing popularity, this procedure became known as the Keller procedure. Reidel as early as 1886 and Davies-Colley in 1887 had previously described similar procedures.

Keller's original technique utilized a 2 inch incision. The medial exostosis was removed by the use of a rongeur. The base of the proximal phalanx was freed dorsally, medially, laterally, and plantarly, preserving the periosteum and was then removed using a Gigley saw. The preserved periosteum/capsular tissue was used to cover the exposed surface of bone.

The Keller procedure has retained a great deal of its original popularity over the last 80 years. Accordingly, there are strong proponents and strong critics of this technique. It is primarily used today in the United States as a joint destructive type procedure for the correction of a painful, dislocated, or arthritic joint. In 1959, DuVries indicated that patients "with disability (following the Keller) represent a larger group than from any other operation employed for alleviation of this deformity." However, Wrighton indicated that "those who perform the Keller operation do not need to report their results, because they know them to be good."

The major complications associated with the Keller procedure fall into two distinct categories. The first is associated with disruption of the intrinsic muscular function. With resection of the proximal phalangeal base, the insertion of the four intrinsic foot muscles (abductor hallucis, adductor hallucis, flexor hallucis brevis, and the extensor hallucis brevis) is generally eliminated, resulting in proximal retraction of the sesamoids. This can ultimately lead to loss of plantar purchase of the hallux, an unstable or floppy flail hallux, recurrence of the abduction deformity of the hallux, dorsal dislocation of the hallux and/or increased lateral weight transference leading to metatarsalgia, keratosis, or stress fractures of the lesser metatarsals.

The second set of complications is due to the amount of bone resected from the base of the proximal phalanx. Excessive osseous resection at this level leads to a significantly shortened hallux which will be cosmetically unacceptable. There will always be some shortening of the hallux, but Hardie and Clapman, and Ganley have indicated that many patients inherently have a great toe that is longer than the second. Conversely, inadequate resection of the proximal phalangeal base can lead to painful pseudarthrosis especially if no interposition of soft tissue is utilized to cover the head of the metatarsal or the base of the proximal phalangeal stump.

Another potential problem of the Keller bunionectomy is retraction of the proximal pha-

lanx upon the first metatarsal head. This retraction phenomenon can be prevented by interposing soft tissue within the first MPJ space or by maintaining the joint space with a K-wire. The K-wire also stabilizes the hallux and preserves the correction of the deformity while the tissues are healing. The K-wire is usually removed 2-4 weeks following surgery. The disadvantage of interposing capsule within the joint is that this technique often leaves exposed bone or cartilage which cannot always be adequately covered with soft tissue. The disadvantage of relying on the K-wire to maintain the joint space is that the proximal phalanx may still migrate proximally along the wire. This proximal migration may be better prevented by a cross K-wire technique or the use of a single threaded K-wire.

However, with all these possible complications, Ganley reports the failure rate to be only 5%. The advantages of the procedure advocated by its proponents include a patient group that is generally happy with the overall results of the surgery. The painful first MPJ symptoms essentially resolve. The loss of the intrinsic and decreased purchase power of the hallux has not been a significant problem in a patient population that was in many instances a propulsive preoperatively. Metatarsalgia of the lesser MPJ's is a complication that can occur in almost any bunion procedure and needs to be controlled by biomechanical means. According to Ganley, the flail toe, or loss of intrinsic muscle function, may not lead to dorsal dislocation or recurrence if the extensor hallucis longus is lengthened. McGlamry feels that reattachment of the flexor hallucis brevis or longus tendon to the base of the proximal phalanx will also prevent this phenomenon. There have been a number of modifications of the traditional Keller operation in an attempt to avoid some of the potential complications. Postoperative splinting of the deformity is utilized for an adequate period of time (a minimum of 6 weeks) to help maintain the correction.

In the early 1970s, silastic implant replacements were introduced in an attempt to eliminate some of the complications of the Keller procedure. The prostheses included hemi-implants, angulated hemi-implants, and total implants. The implants were utilized in an attempt to maintain length and preserve some degree of purchase power and function of the hallux. Initially, they

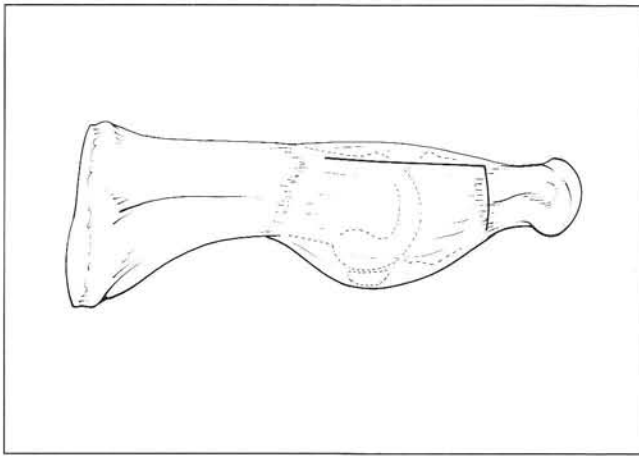
were thought to be able to resist deformity or re-deforming forces. It quickly became apparent that the silastic implants were primarily spacers and could not really resist deforming forces for any length of time. In addition, the implants themselves created an additional set of complications.

## SURGICAL TECHNIQUE

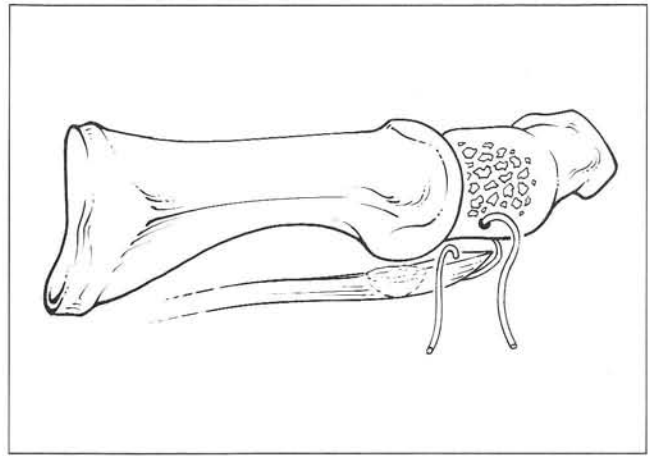
Another seldom discussed issue concerning the Keller bunionectomy, is a lateral release of the first MPJ. Even though the adductor tendon has been detached with resection of the base of the proximal phalanx, the fibular sesamoid may still lie in an abnormal position postoperatively. The flexor hallucis longus tendon which runs between the tibial and fibular sesamoids will continue to function in a laterally deviated position. This may ultimately lead to a recurrence of the deformity. This recurrence can be prevented by releasing both the adductor tendon and the fibular sesamoid ligament, allowing the sesamoids to be relocated beneath the metatarsal head. Relocation of the sesamoids will in turn re-establish the normal alignment of the FHL beneath the first metatarsal. In a severe hallux valgus deformity with significant lateral deviation of the fibular sesamoid, an adductor tendon transfer is often required to anatomically relocate the sesamoids.

A variety of surgical techniques are proposed for the Keller bunionectomy. A technique popularized by McGlamry utilizes an inverted L-shaped capsulotomy with the medial capsular flap being detached distally at the midshaft level of the proximal phalanx. (Fig. 1, 2) Dissection of this medial capsular flap provides exposure to the head of the first metatarsal and the base and shaft of the proximal phalanx. A power saw is used to resect the base of the proximal phalanx as well as the medial eminence of the first metatarsal head. A drill hole is made in the plantar, plantar-medial, and dorsomedial cortex of the stump of the proximal phalanx. The flexor hallucis brevis or longus tendon is re-attached to the proximal phalanx via the plantar drill hole with a 2-0 non-absorbable suture in an effort to maintain the purchase power of the hallux postoperatively.

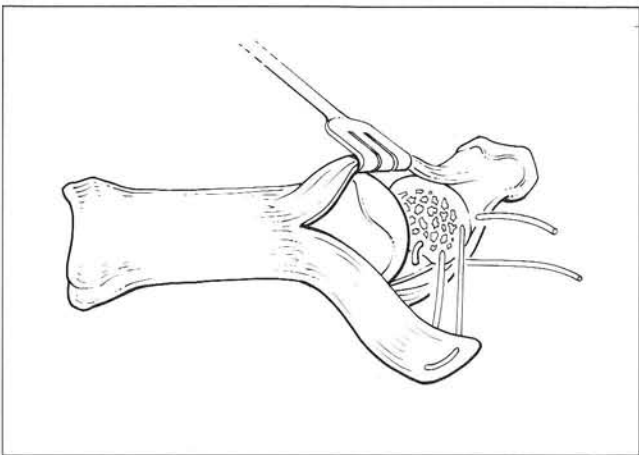
A 0.062-inch K-wire is delivered through the hallux and across the first MPJ. The medial capsular flap is then re-attached to the proximal phalanx stump via a 2-0 non-absorbable suture



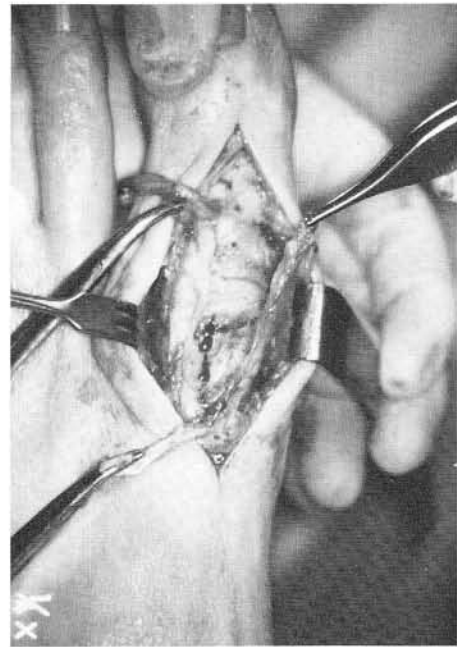
**Fig. 1A.** Inverted L capsular flap



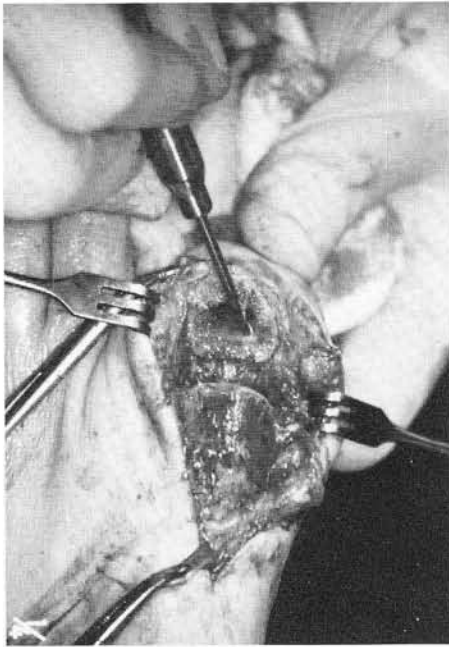
**Fig. 1B.** Re-attachment of FHB to proximal phalanx



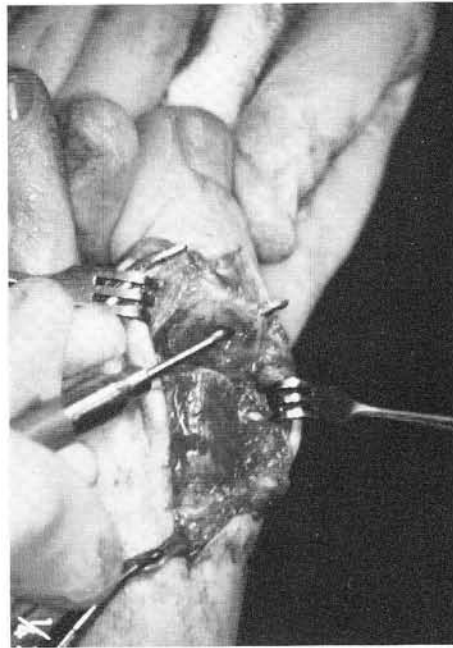
**Fig. 1C.** Re-attachment of medial capsular flap to proximal phalanx.



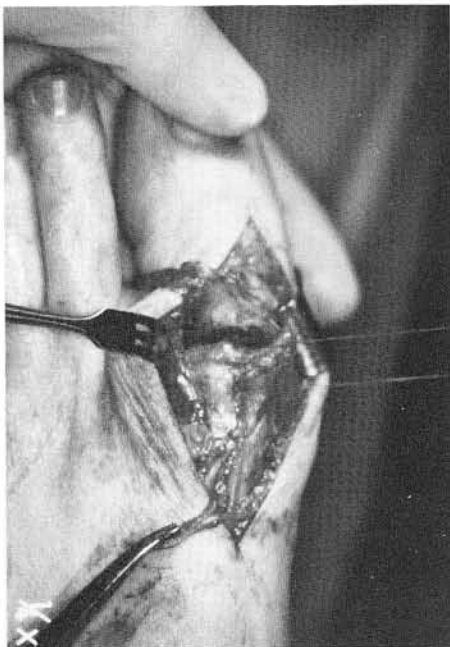
**Fig. 2A.** Exposure of inverted L medial capsular flap. Note A Z lengthening of EHL was also performed.



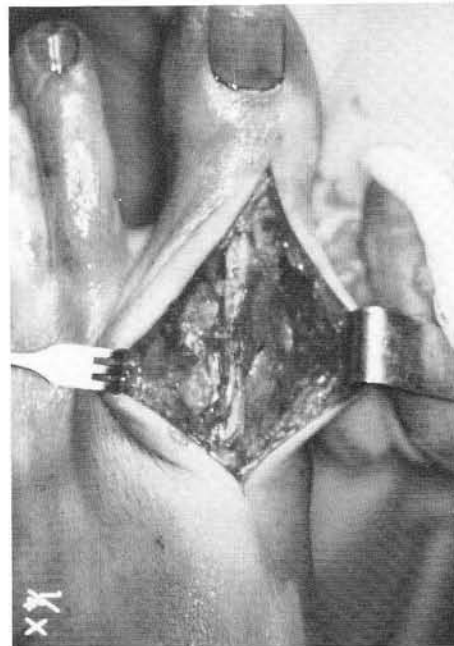
**Fig. 2B.** Creating a plantar drill hole in the proximal phalangeal stump for re-attachment of FHL following resection of the base of the proximal phalanx.



**Fig. 2C.** Creating a dorsomedial and plantar medial drill hole in the proximal phalanx for re-attachment of the medial capsular flap.



**Fig. 2D.** Re-attachment of medial capsular flap to proximal phalangeal stump with a 2.0 non-absorbable suture.



**Fig. 2E.** Final closure of 1st MPJ capsule and re-approximation of EHL.

through the dorsomedial and plantar medial drill holes. The dorsal arm of the capsulotomy is reapproximated with a 3-0 absorbable suture in a running interlocking fashion, leaving no areas of exposed bone. This technique may also be used when a first MPJ implant arthroplasty is desired.

A variety of techniques involving soft tissue

interposition are also used for the Keller bunionectomy. One such technique utilizes a proximally based U-shaped capsulotomy overlying the medial aspect of the first MPJ. (Fig 3, 4) The capsule is detached distally from the base of the proximal phalanx, and interposed within the joint space and sutured into the lateral capsule of

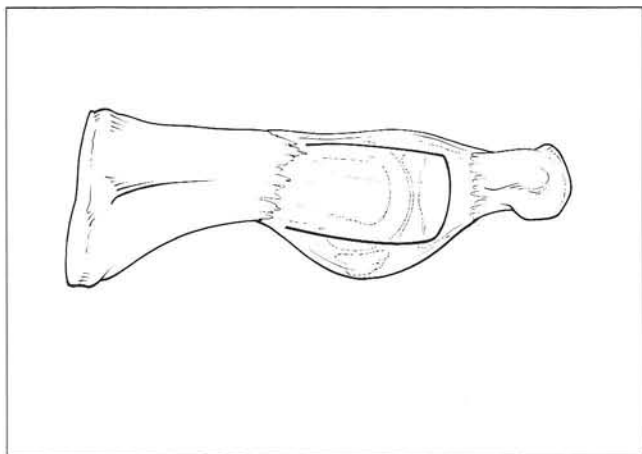


Fig. 3A. Proximally based U-shaped capsulotomy

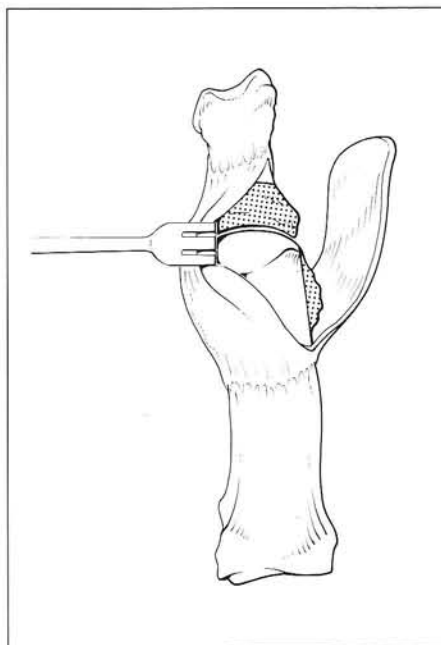


Fig. 3B.

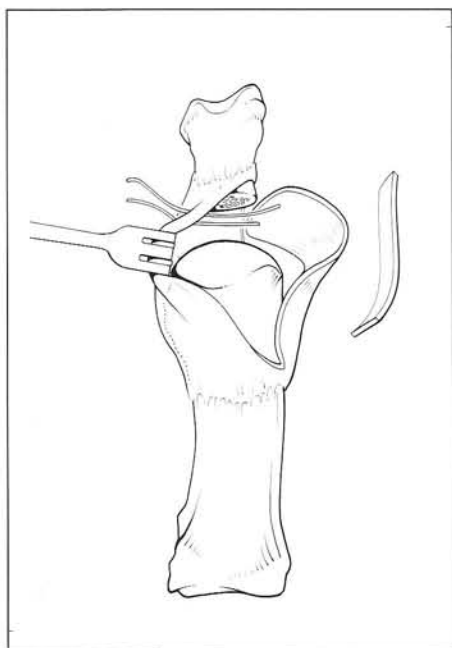


Fig. 3C. Capsule interposed within the 1st MPJ and sutured into soft-tissue.

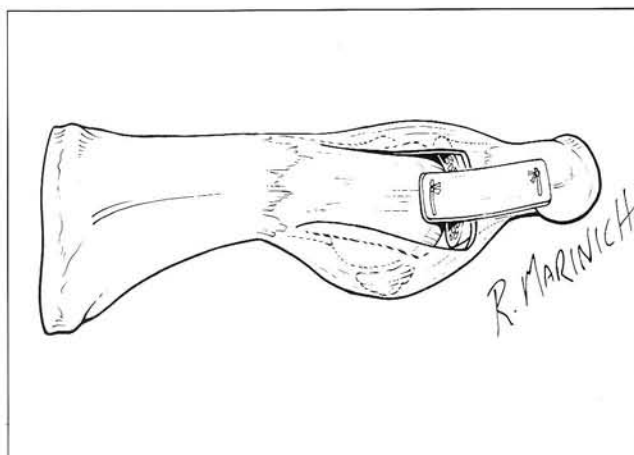
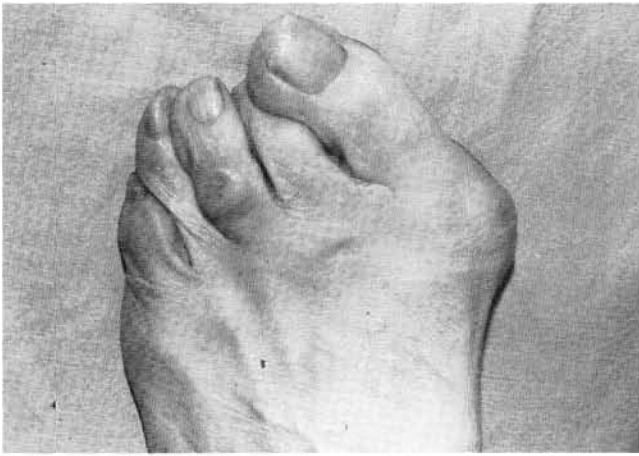
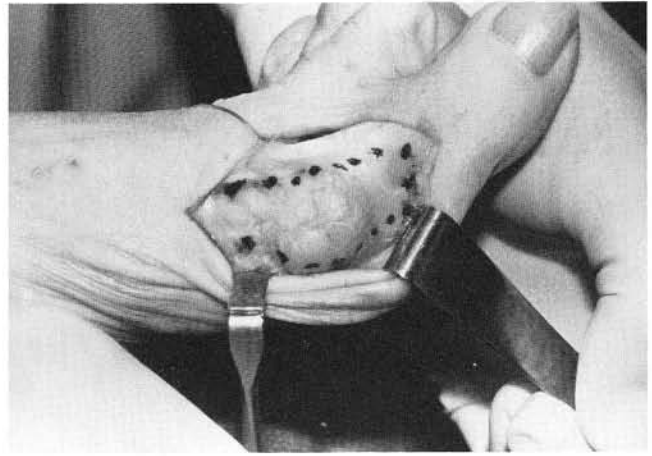


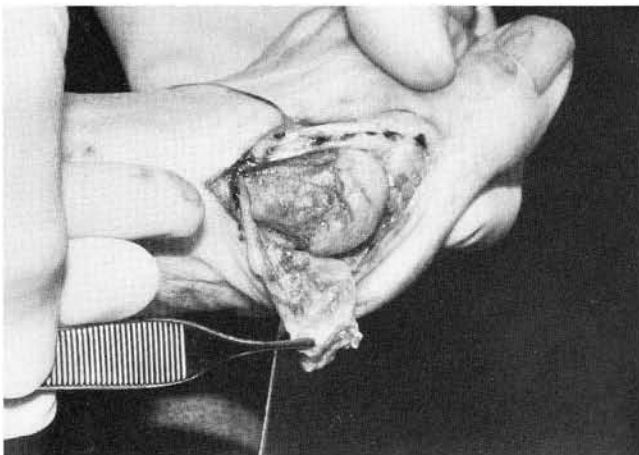
Fig. 3D. Capsular defect of proximal phalanx covered by an only graft.



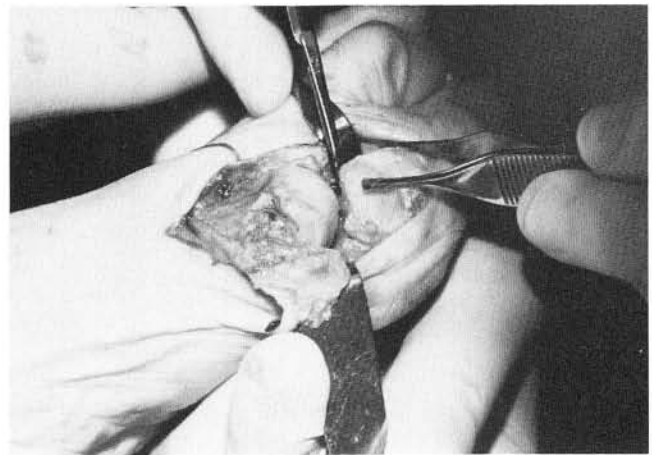
**Fig. 4A.** Preoperative severe hallux valgus deformity with longstanding degenerative joint disease of the 1st MPJ.



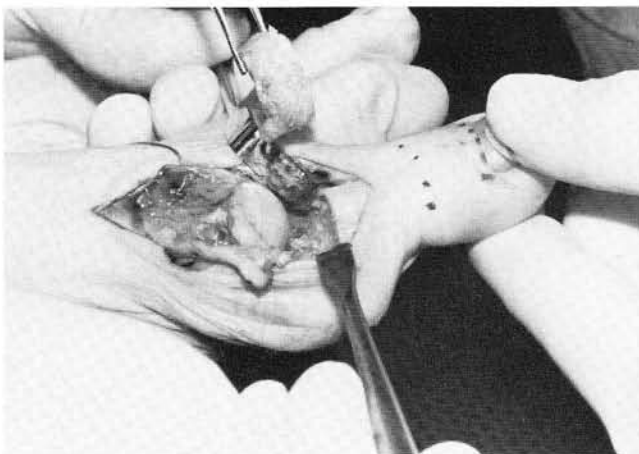
**Fig. 4B.** Proximally based U-shape capsulotomy



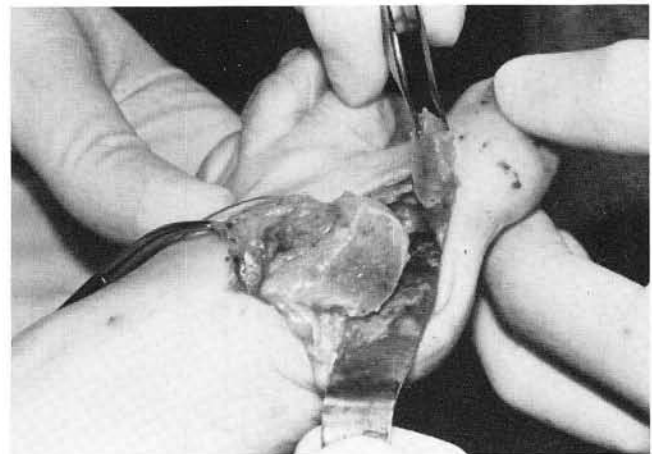
**Fig. 4C.** Reflecting U-shaped capsule plantarly to expose the head of the 1st metatarsal and the base of the proximal phalanx.



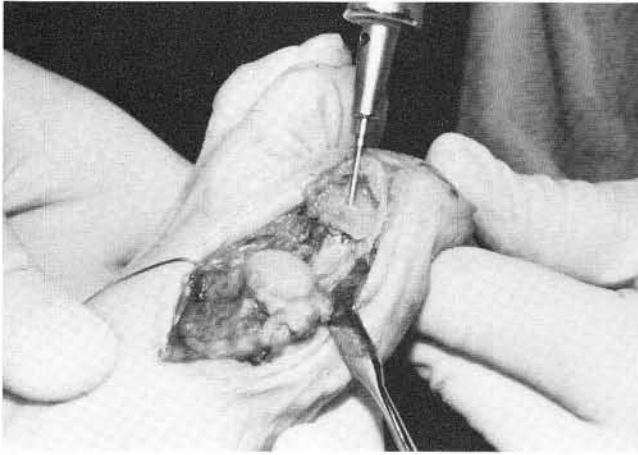
**Fig. 4D.** Further exposure of the proximal phalangeal base.



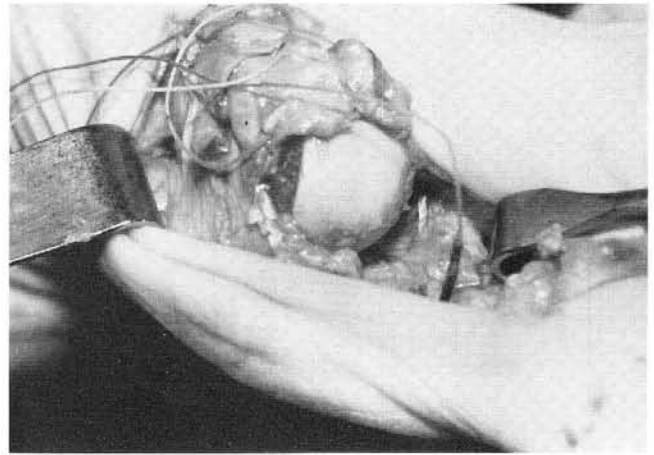
**Fig. 4E.** Resection of the base of the proximal phalanx and the medial eminence of the 1st metatarsal.



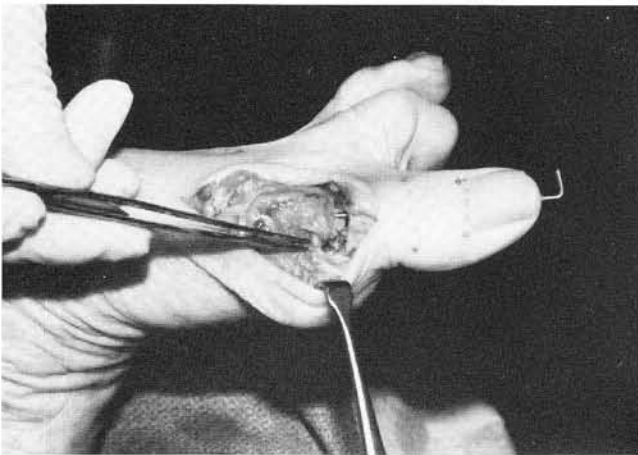
**Fig. 4F.**



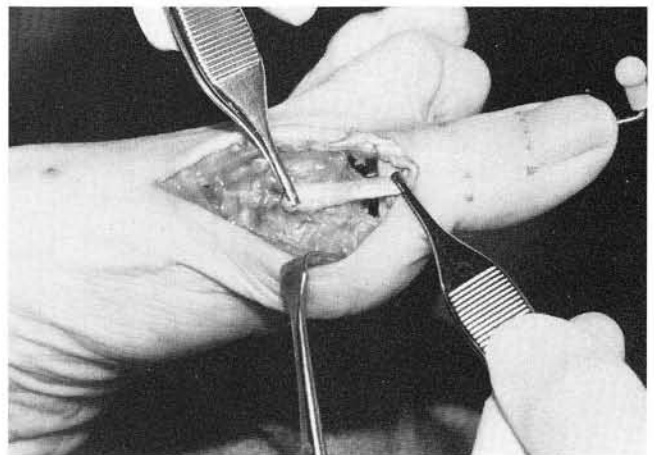
**Fig. 4G.** Creating a drill hole in the plantar cortex of the proximal phalanx for re-attachment of FHL.



**Fig. 4H.** Suturing the U-shaped capsule to the plantar-lateral soft tissue of the 1st MPJ



**Fig. 4I.** Placement of .062 threaded K-wire through the hallux and into the 1st metatarsal head. The K-wire serves to secure the interposed soft tissue in addition to stabilizing the hallux.



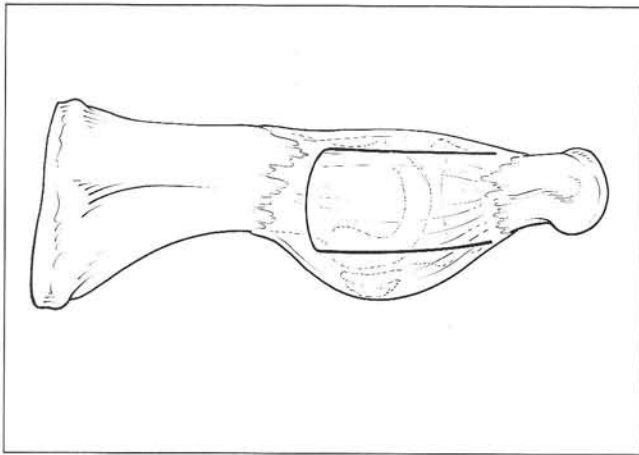
**Fig. 4J.** Re-enforcement of the medial capsular tissue with an onlay tendon graft obtained from the EHB tendon.



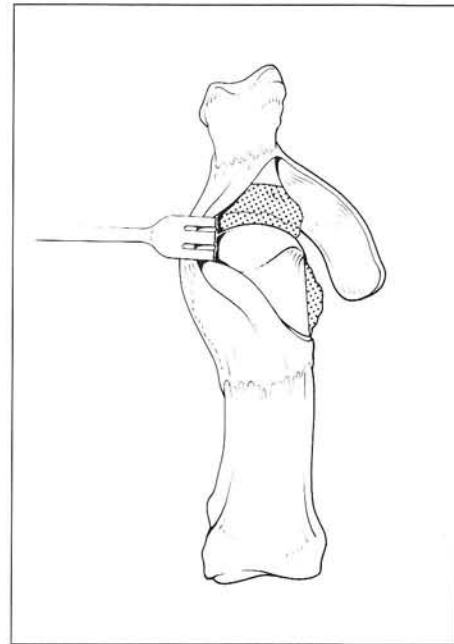
**Fig. 4K.** Final intraoperative.

the first MPJ. A 0.062-inch K-wire is usually driven across the MPJ to stabilize the digit and assist in securing the interposed soft tissue. An onlay graft of either tendon or fascia as described by Ganley is used to cover the exposed bone of the proximal phalanx and reinforce the medial capsular tissue.

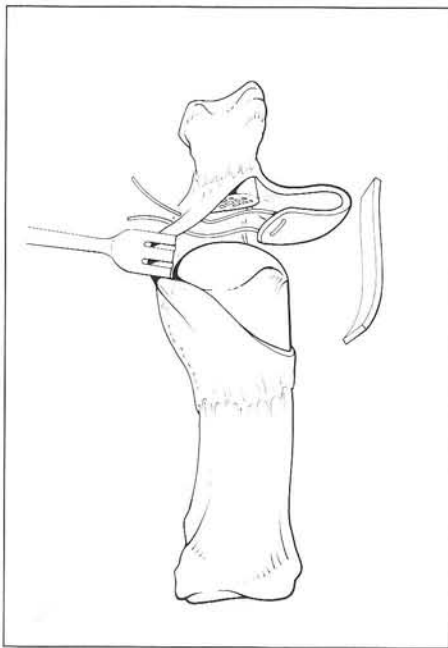
A similar technique involves a distally based U-shaped capsulotomy (Fig 5, 6). The capsule is again interposed within the joint and sutured into place. The onlay graft is then used to cover the exposed portion of the first metatarsal head.



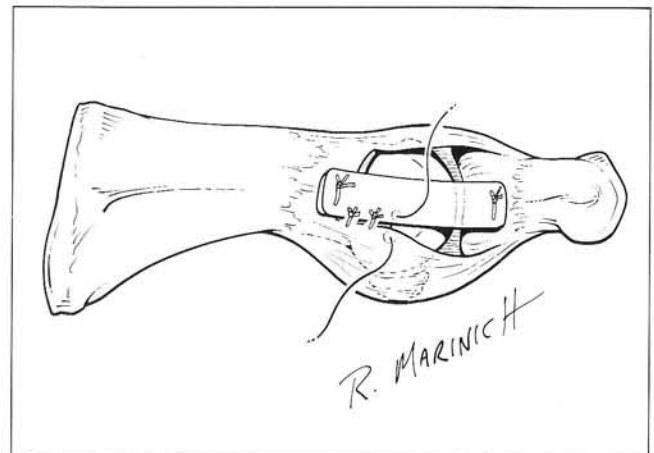
**Fig. 5A.** Distally based U-shaped capsulotomy



**Fig. 5B.**



**Fig. 5C.** Capsule interposed within the 1st MPJ and sutured to soft tissue.

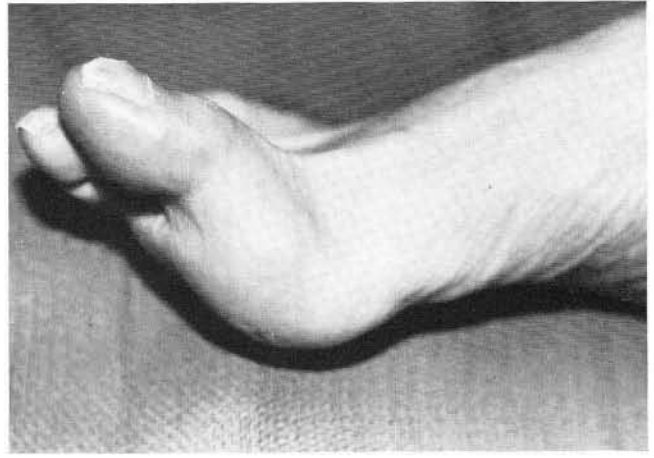


**Fig. 5D.** Capsular defect of 1st metatarsal head covered by onlay graft.

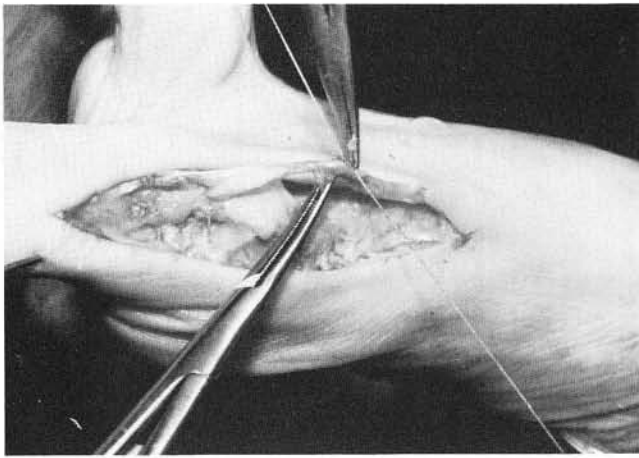




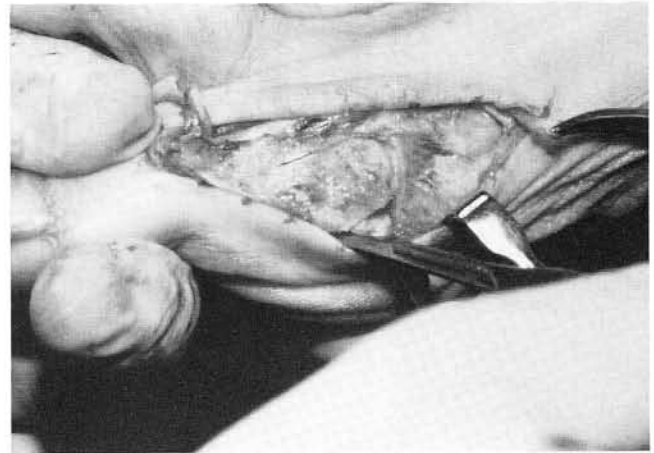
**Fig. 6A.** Preoperative clinical picture of a hallux limitus deformity with severe degenerative joint disease.



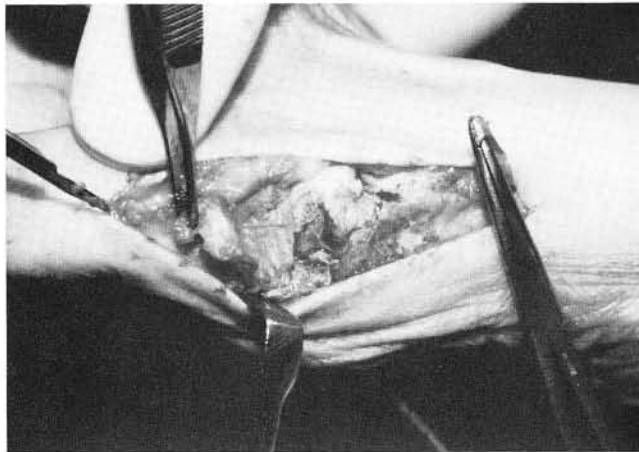
**Fig. 6B.**



**Fig. 6C.** Z-lengthening of EHL



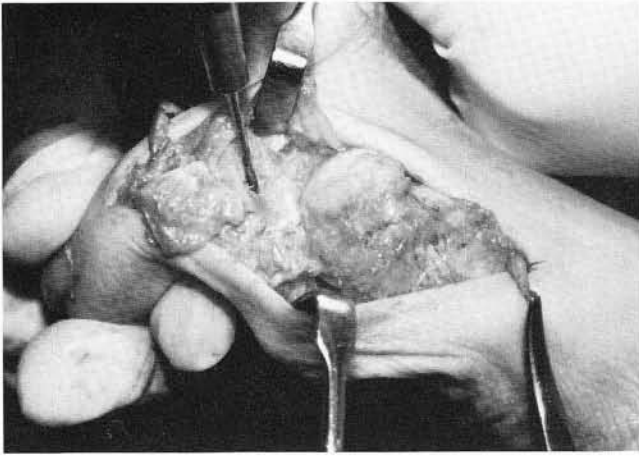
**Fig. 6D.** Distally based U-shaped capsulotomy



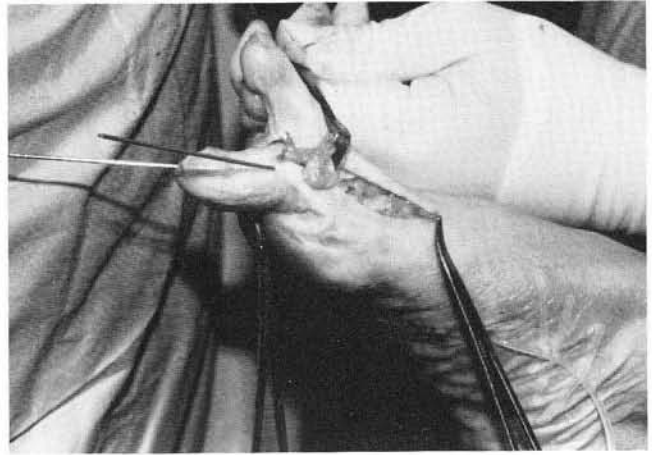
**Fig. 6E.** Reflecting U-shaped capsule distally to expose the head of the 1st metatarsal and base of the proximal phalanx.



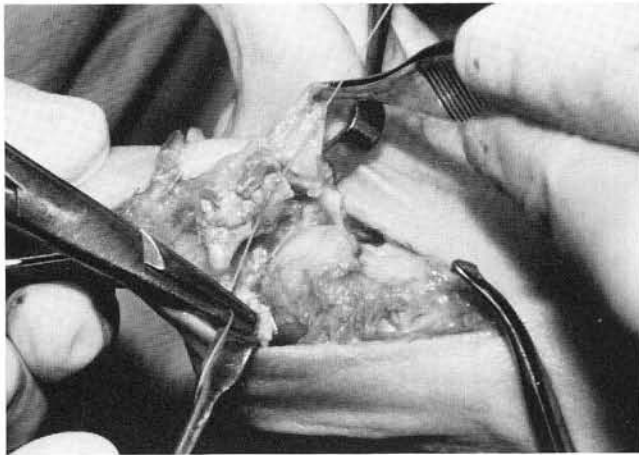
**Fig. 6F.** Resection of proximal phalangeal base.



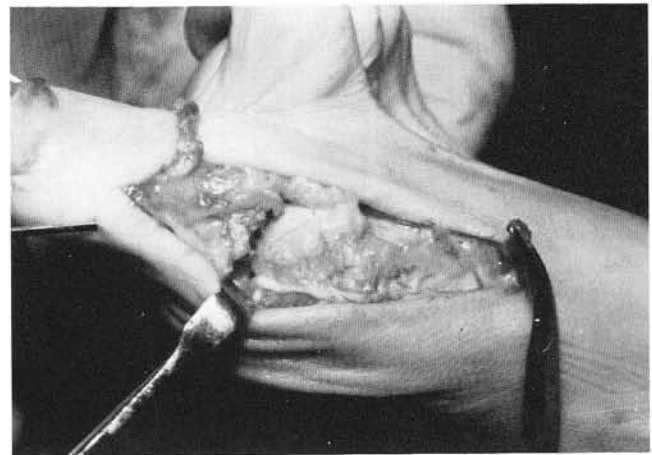
**Fig. 6G.** Creating a drill hole in the plantar cortex of the proximal phalangeal stump for re-attachment of FHL.



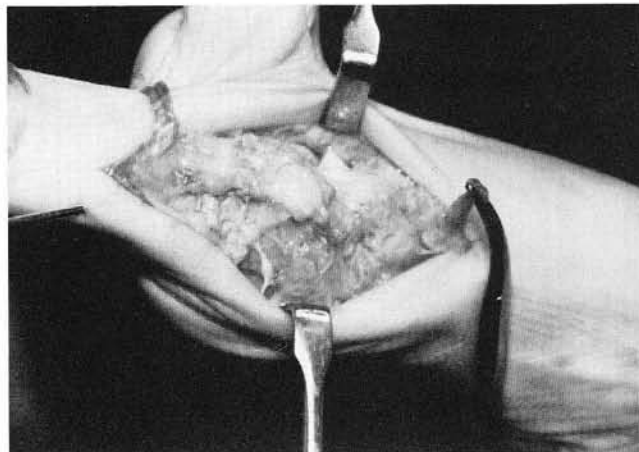
**Fig. 6H.** Placement of two .062 smooth K-wires through the proximal and distal phalanx in a crossed K-wire technique.



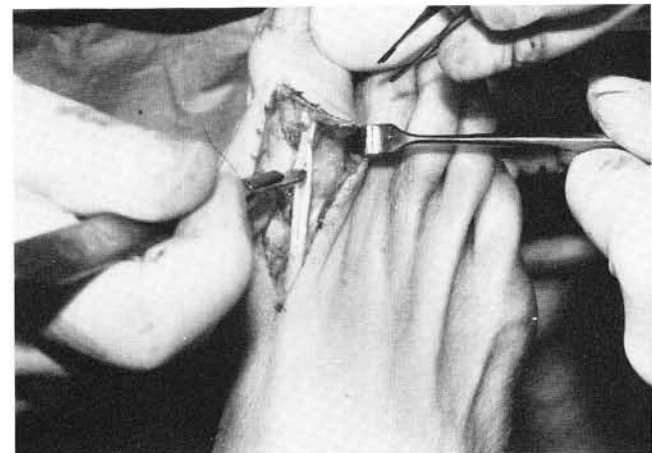
**Fig. 6I.** Interposition of U-shaped capsule into 1st MPJ. Capsule is sutured into soft tissue of lateral aspect of the joint.



**Fig. 6J.** Placement of crossed K-wires into the 1st metatarsal head.



**Fig. 6K.** Closure of soft tissue over exposed bone.



**Fig. 6L.** Re-approximation of EHL



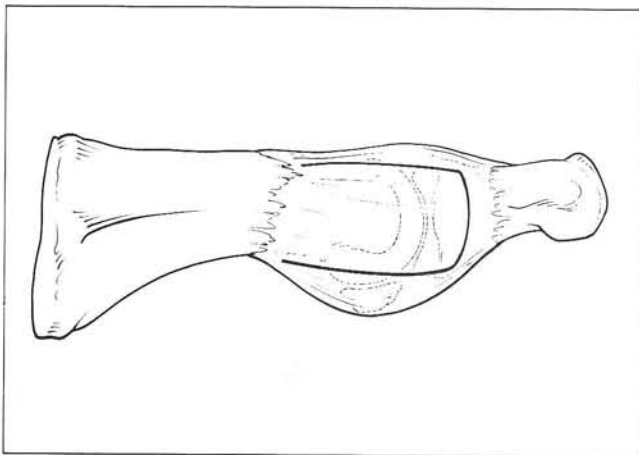
**Fig. 6M.** Final intraoperative pictures.



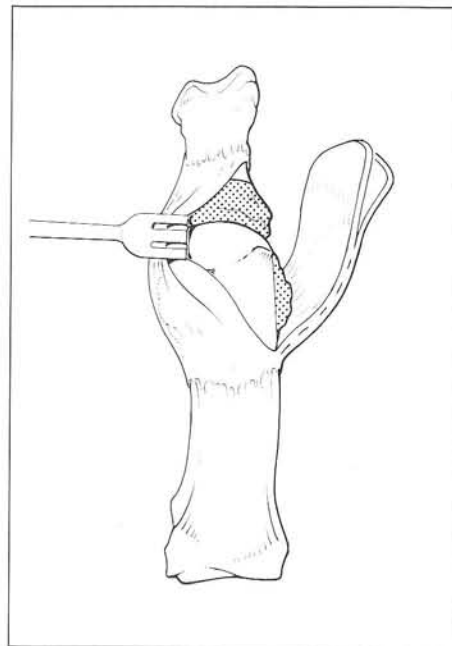
**Fig. 6N.**

If the joint capsule is hypertrophied medially, a sagittal plane capsule splitting technique can be performed as shown in Figure 7. The innermost portion of the capsule is interposed within the joint, while the outermost portion is secured to the proximal phalanx. The medial capsular flap can also be split into dorsal and plantar halves (Fig. 8). The dorsal arm of the capsule is interposed within the joint, and the plantar arm is secured to the proximal phalanx. An onlay graft is then used to cover the soft tissue defect created by the interposition of the dorsal arm of the capsule.

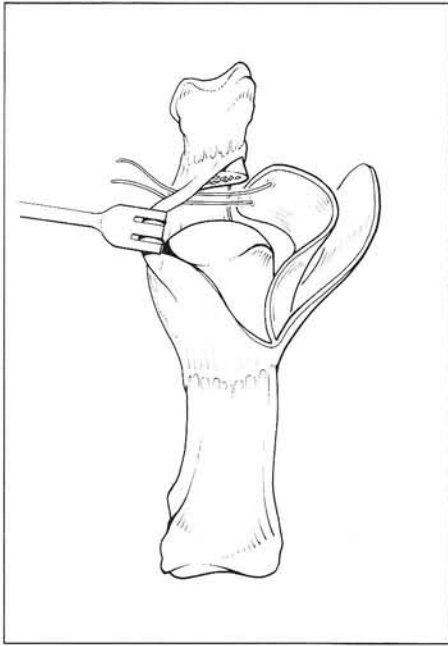
The hourglass technique is also used as a soft tissue interposition procedure for the Keller bunionectomy (Fig. 9). A linear capsular incision is made over the dorsal aspect of the first MPJ. Following resection of the base of the proximal phalanx, a through and through purse-string type closure of the joint capsule is performed. In order to prevent puckering of the skin upon closure of the capsule, the superficial fascia must be cleanly separated from the underlying joint capsule on both the medial and lateral aspect of the first MPJ.



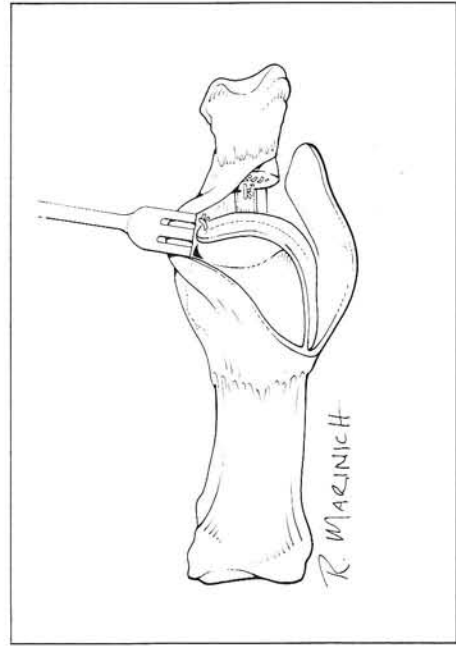
**Fig. 7A.** U-shaped capsulotomy



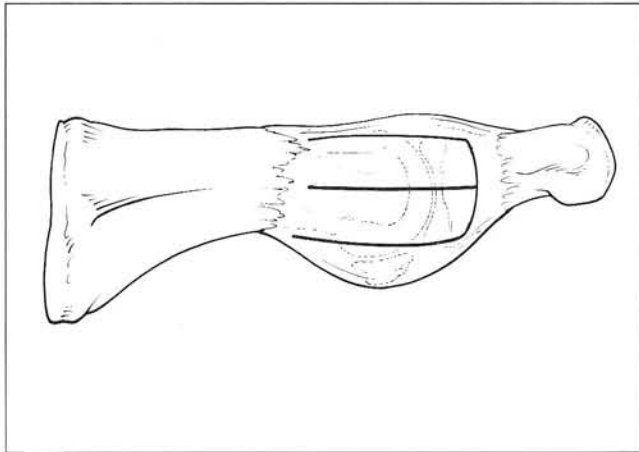
**Fig. 7B.** Capsule is split into inner and outer halves



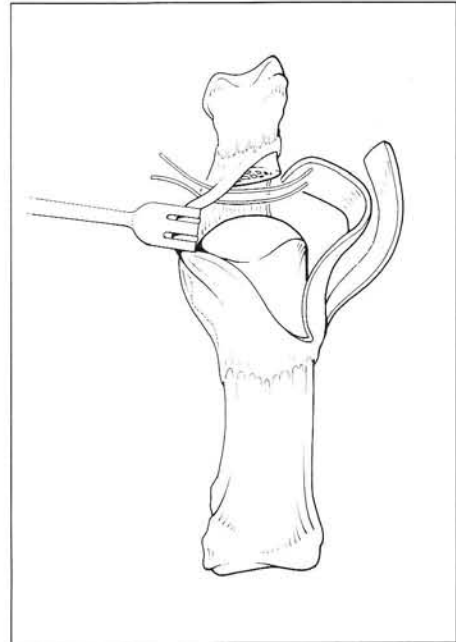
**Fig. 7C.** Inner portion is interposed within 1st MPJ



**Fig. 7D.** Outer portion is attached to the proximal phalanx.



**Fig. 8A.** U-shaped capsulotomy



**Fig. 8B.** Capsule is split into dorsal and plantar halves. The dorsal capsule is interposed within the 1st MPJ.

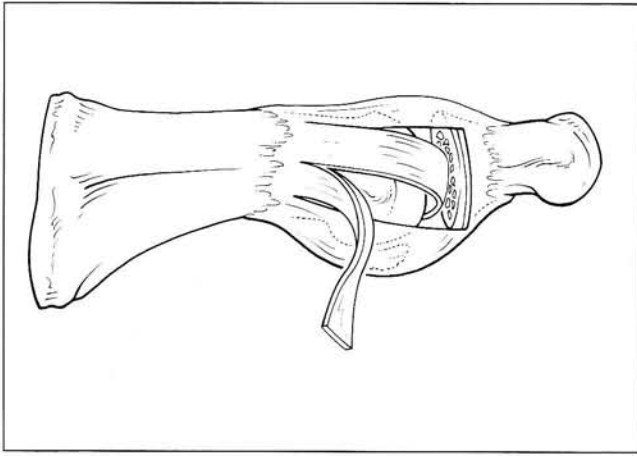


Fig. 8C.

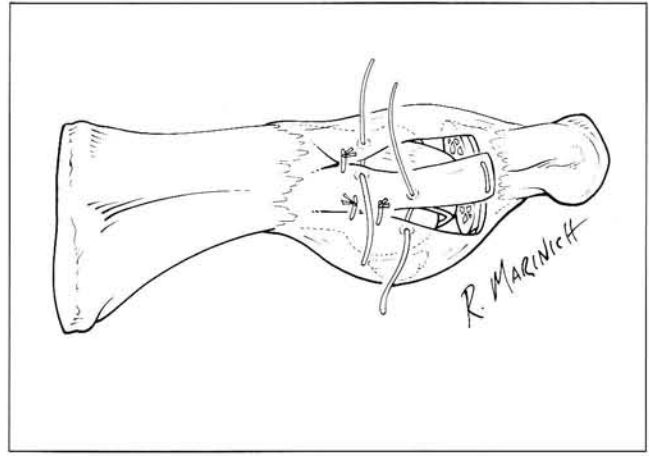


Fig. 8D. The plantar capsule is re-attached to the base of the proximal phalanx.

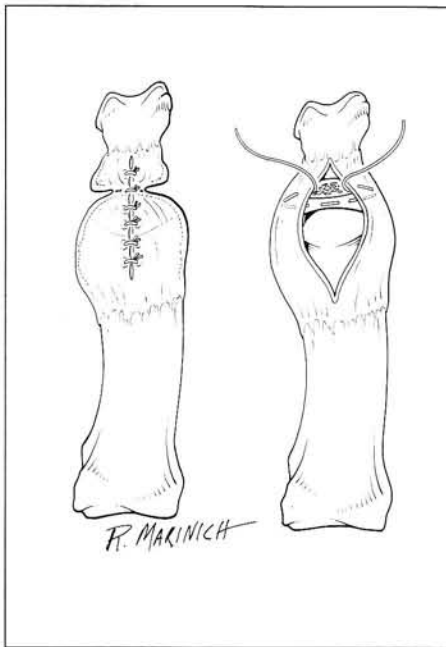


Fig. 9. Hour glass technique utilizing a purse string closure of the joint capsule.

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