VARIATIONS OF THE PEG-IN-HOLE ARTHRODESIS

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HISTORY

Peg-in-Hole proximal interphalangeal joint arthrodesis was first described by Soule[1] in 1910 and Jones[2] in 1917. Taylor[3] in 1940 and Selig[4] in 1941 advocated the use of a K-wire for end on end type arthrodeses. Later in 1980, Alvine and Garvin[5] advocated their peg and dowel fusion avoiding pin fixation. Schlefman, Fenton & McGlamry[6], in 1983, reported successful results following peg-in-hole arthrodesis in a study of 125 digits.

Digital arthrodesis is performed for the correction of flexible and rigid hammer toes where arthroplasty type procedures are not appropriate. If there is excessive flexor substitution, extensor substitution or loss of intrinsic muscle stability digital arthrodesis is recommended. Digital arthrodesis is also performed in the treatment of metatarsalgia where metatarsal osteotomy is to be avoided. peg-in-hole arthrodesis can provide additional intrinsic stability to the fusion site when compared to an end on end arthrodesis. Pseudarthroses following end on end or peg-in-hole arthrodesis can occur, although they are usually clinically asymptomatic.

THE PROCEDURE

A 3 cm linear incision is made over the proximal interphalangeal joint. In cases where redundant skin is expected, two transverse semi-elliptical incisions can be made over the proximal interphalangeal joint. This incision however, will not provide adequate exposure, if an extensor hood recession or metatarsophalangeal joint capsulotomy is needed. The transverse incision may then be used in conjunction with a proximal linear incision. The incision is deepened through the subcutaneous tissues and hemostasis is acquired as needed. The extensor apparatus is freed from the underlying bone. A z-plasty type incision is made into the tendon and the wings are reflected both proximally and distally with hemostats. The distal arm is used to aid dissection of the proximal interphalangeal joint. The capsule and collateral ligaments are severed and the head of the proximal phalanx is delivered into the wound.

The medial, lateral and plantar condyles are resected from the head of the proximal phalanx. The distal tip of cartilage is also resected. If additional shortening is desired, more distal resection is performed. The edges of the peg are smoothed with a rotary burr. An unloaded K-wire is used to find the medullary canal of the proximal phalanx. Attention is then directed to the base of the middle phalanx where a hole is created using drill bits and varying sized ball burrs. Trial seating is performed. K-wire fixation is performed by drilling the K-wire out the end of the toe and then retrograding it back into the proximal phalanx. The wire should not extend beyond the subchondral bone of the base of the proximal phalanx. (Fig. 1) Where desired, the K-wire may be driven through the metatarsophalangeal joint and into the shaft of the metatarsal. (Fig. 2)

The extensor tendon is reapproximated under physiologic tension. The tendon tips, previously held by hemostats, are resected. An absorbable continuous horizontal mattress suture is used to coapt the skin.*

* The continuous horizontal mattress technique utilizing an absorbable suture is not the standard skin closure used by most of the Institute Faculty.

Fig. 1. Correct K-wire placement in peg in hole arthrodeses of the second, third and fourth digits. An arthroplasty with K-wire stabilization was performed on the fifth toe.

Fig. 2. Correct K-wire placement through the metatarsophalangeal joint.

THE VARIATIONS

Tendon Reflection

A seldom used technique involves reflection of the extensor tendon without transection. The rationale for this maneuver is minimization of trauma to the extensor tendon. In the typical z-plasty type procedure, hemostats are clamped to the ends of the tendon. The ends are often not resected because of the need of extra tendon for lengthening. Reflection of the tendon negates the need for cutting the tendon, applying hemostats to the tendon or the need for blunt suturing through the tendon. With all arthrodesis type procedures there is shortening of the bone and an inherent lengthening of the soft tissue structures. Tendon reflection usually leaves the tendon at an appropriate length following arthrodesis.

Following the initial incision through the skin and subcutaneous tissue, the middle and distal phalanges are plantarflexed on the proximal phalanx. The collateral ligaments are then severed by cutting in line with the proximal phalanx at the level of the proximal interphalangeal joint. (Fig. 3) The extensor tendon is then underscored. (Fig. 4) A hemostat is slipped under the tendon and around the bone. (Fig. 5) As the hemostat is lifted, an incision is made along the length of the tendon. This will release the tendon from the joint and allow dislocation of the joint. Any remaining slips of tendon or collateral ligament should be severed. (Fig. 6) The head of the proximal phalanx can then be delivered into the wound for resection. (Fig. 7, 8, 9) The tendon can be reflected medially or laterally.

Attention is then directed to the middle phalanx for formation of the hole. (Fig. 10) Extra care in retraction is now needed. Following the completion of the procedure, the extensor tendon is replaced dorsally over the proximal interphalangeal joint. (Fig. 11) It may be loosely tagged to prevent dislocation of the tendon. Tendon reflection can also be performed with arthroplasty procedures and anchoring of the tendon is advised. The skin is closed with an absorbable suture in a continuous horizontal mattress fashion.* (Fig. 12)

Tendon Transection

The extensor tendon may also be transected in a transverse manner, similar to that performed in an arthroplasty. Tendon reapproximation via an end on end fashion is needed. If inadequate tendon length remains the proximal portion of the extensor tendon may be attached via drill holes into the shaft of the proximal phalanx. This is comparable to a Jones procedure which is commonly performed on the hallux.

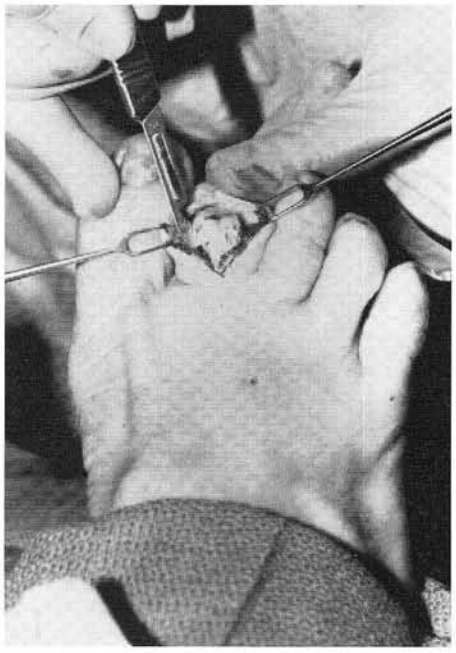

Fig. 3A. The middle and distal phalanges are plantarflexed and the collateral ligaments are severed medially and laterally.

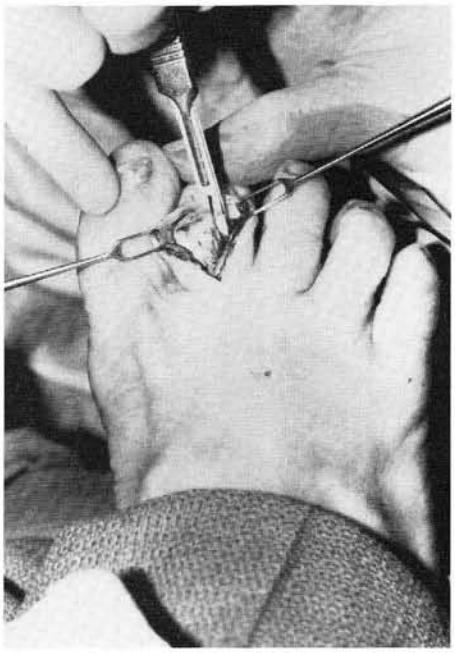

Fig. 3B.

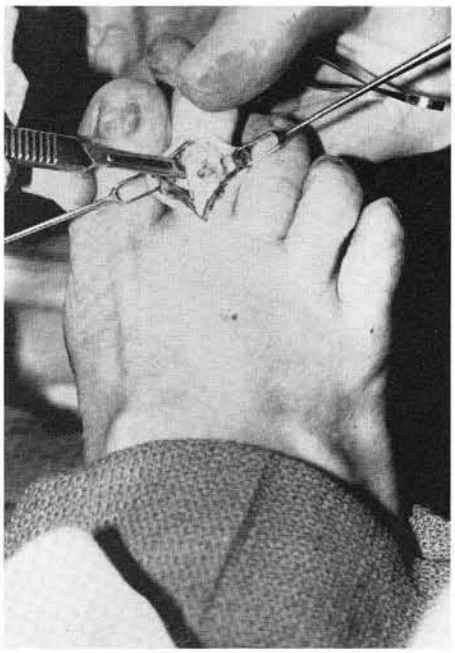

Fig. 4. The extensor tendon is underscored.

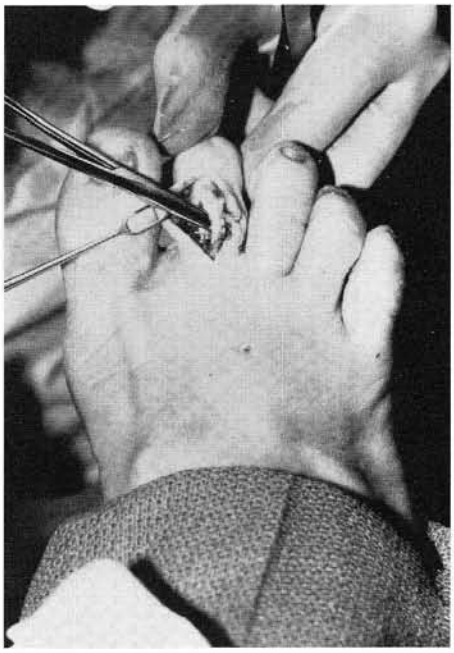

Fig. 5. The extensor tendon is reflected using a hemostat.

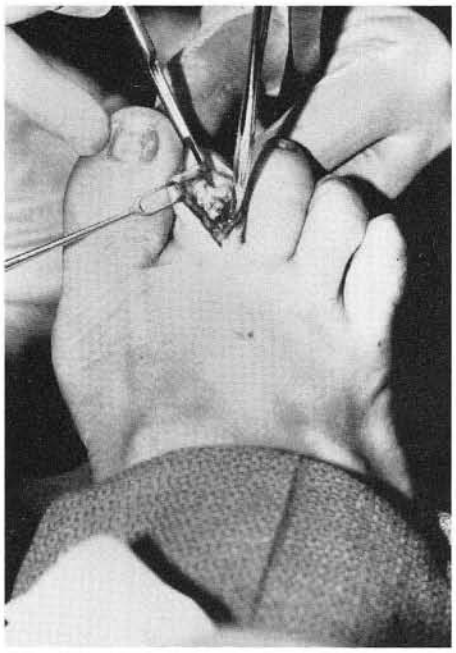

Fig. 6. Any remaining soft tissue is removed from the head of the proximal phalanx.

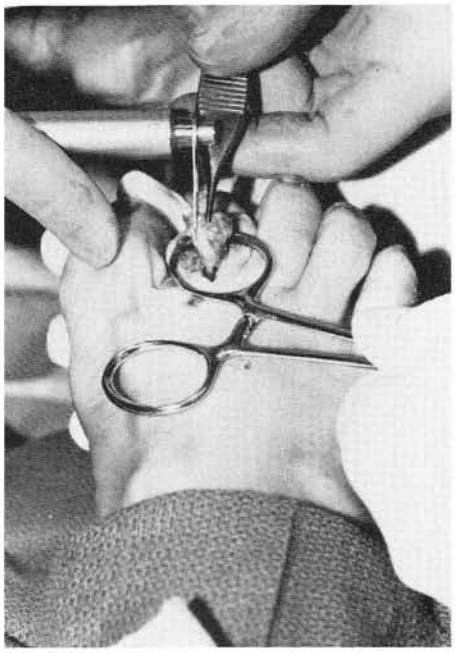

Fig. 7A. Resection of the medial, lateral, and plantar condyles as well as the distal cartilaginous tip.

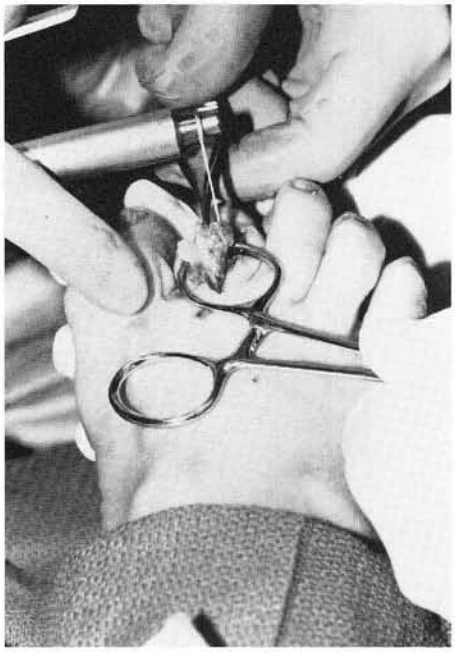

Fig. 7B.

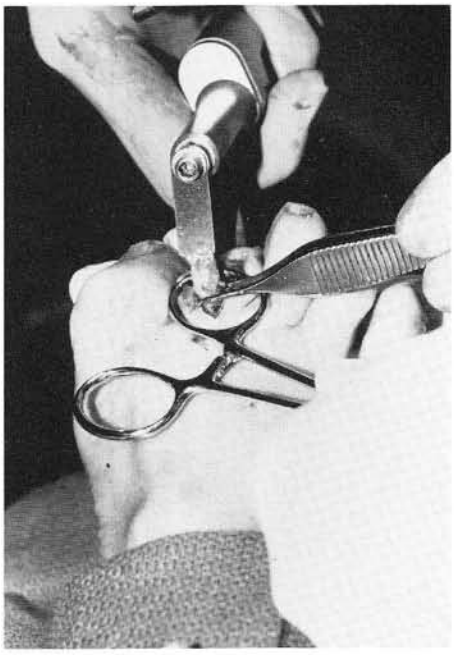

Fig. 7C.

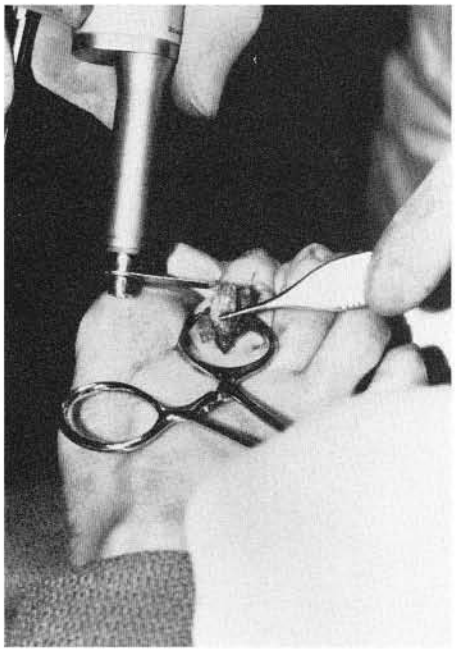

Fig. 7D.

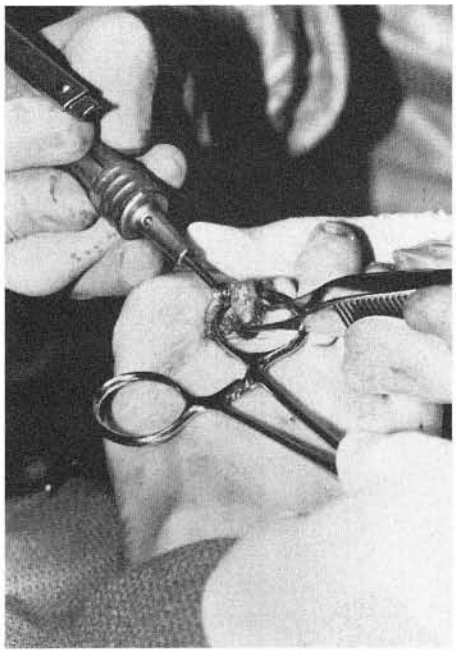

Fig. 8. The peg is smoothed with a rotary burr.

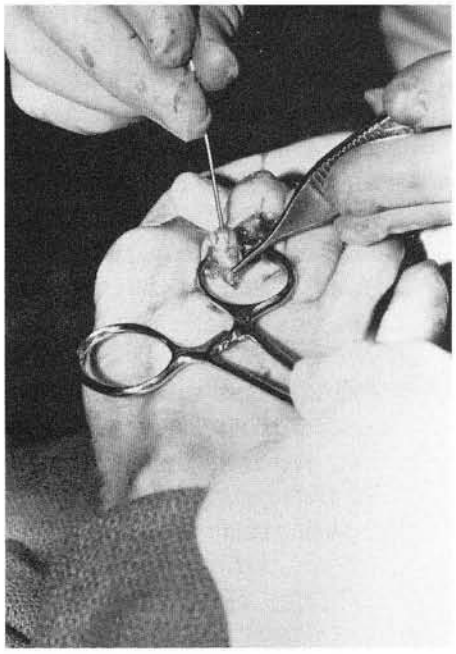

Fig. 9. The medullary canal is reamed with an unloaded 0.045 K-wire.

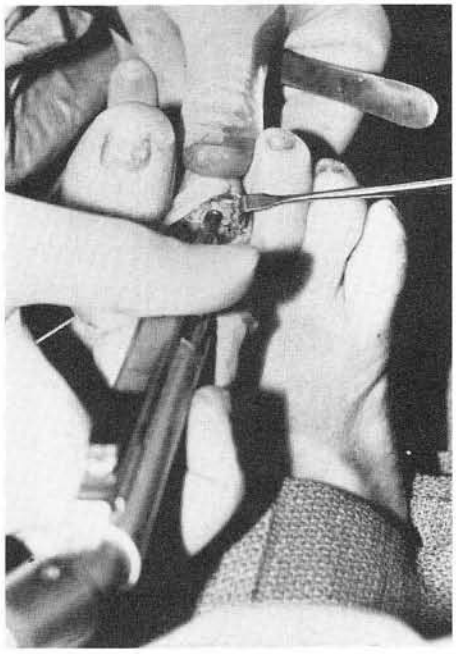

Fig. 10. The hole is created with the use of a ball burr.

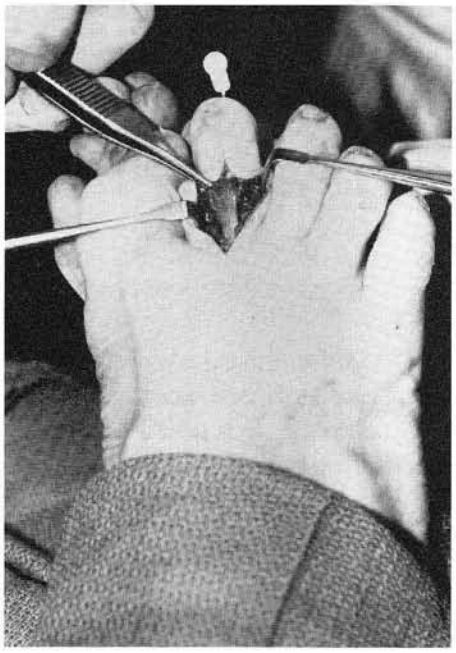

Fig. 11. Following K-wire fixation and seating of the peg in the hole, the extensor tendon is reapproximated over the operative site.

Fig. 12. The skin is closed in a continuous horizontal mattress fashion using an absorbable suture.

Absorbable Pin Fixation

Alvine and Garvin[5] advocated the peg-in-hole arthrodesis due to its inherent stability. They felt that k-wires should be avoided due to the potential of pin breakage, pins backing out and pin tract infections. Pin problems can be minimized by preventing bending forces on the toes with the use of toe plates, padded surgical shoes, or below knee cast.

The Orthosorb® Absorbable Pin (Johnson & Johnson, New Brunswick, NJ) may be used for peg and hole arthrodesis. The procedure is similar to the above until fixation. The 1.3mm k-wire in the kit is used to ream the medullary canal in the proximal phalanx as well as the middle and distal phalanges. Care should be taken NOT to penetrate through the distal tip of the distal phalanx or the skin of the toe. The length of both canals are measured. The amount of seating of the peg in the hole is also measured. This amount is subtracted from the total length to obtain the length necessary for the absorbable pin. The pin is cut to the proper length. Using the gauging probe, the distal end of the pin is inserted first. The gauging probe is removed and the pin is then manually placed in the proximal end and the peg is seated in the hole simultaneous. The pin is radiolucent on x-ray (Fig. 13).

Fig. 13. A postoperative DP projection of a peg in hole arthrodesis using an Orthosorb® absorbable pin.

Use of an absorbable pin eliminates the problems mentioned earlier that are associated with the use of pins, while still providing support to the arthrodesis site. Patients are allowed to bath once the skin incision is healed. This is well before the time when using a K-wire (5-6 weeks). One major drawback of the absorbable pin is that it cannot be used when realignment and stabilization of the MPJ is needed.

The peg-in-hole procedure is recommended by the author for digital arthrodesis. Tendon reflection minimizes trauma to the tendon. The use of absorbable pins minimizes problems typically associated with K-wires.

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