CHAPTER **4**

HALLUX INTERPHALANGEAL JOINT ARTHRODESIS BY CROSSED SCREW TECHNIQUE

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INTRODUCTION

Hallux interphalangeal joint (HIPJ) arthrodesis is a frequently performed surgery for the treatment of pain, deformity, arthritis, hallux malleus, and a variety of other conditions affecting the HIPJ. The most common surgical techniques for fusion of this joint include intramedullary screw fixation and Kirschner wires (K-wires). Other less popular fixation techniques have included a single crossed screw, staples, intramedullary devices, and an external fixator. There are no reports detailing a double crossed screw technique for fusion of the HIPJ. The use of crossed K-wires is an effective means for HIPJ arthrodesis because they are easy to remove, prevent rotation, may be used in osteoporotic bone, and are minimally invasive. Disadvantages of the crossed K-wire technique include the lack of compression across the fusion site, and the fact that the exposed K-wires are external, making return to work difficult for some patients. Pins also carry a risk of pin tract infection or migration, and therefore may have a lower patient acceptance.

A single intramedullary screw has become popular for this procedure because the fixation remains internal and therefore may be more accepted by the patient and because it provides compression across the fusion site. However, this technique has its own known disadvantages, which include possible loss of fixation or adequate screw purchase and the possibility for frontal plane rotation. Screw head prominence at the tip of the hallux can also be problematic, which has led some authors to use headless screws in the area. Headless screws however rely on the screw design for its compression and may be difficult to remove should this be necessary. Intramedullary screws may not work well in osteoporotic bone, may require removal, and the authors feel that they are overall more invasive as they occupy a significant portion of the intramedullary canal. If the intramedullary screw does rotate, it is possible for the screw to back out causing ulceration or pain at the tip of the toe due to the screw head, or the screw threads may hold open the fusion site.

The authors have used the crossed K-wire technique popularized by Gerard Yu, DPM in the Podiatry Institute 1998 Update Textbook with good success. However the technique is limited in that it does not provide compression across the fusion site and leaves exposed K-wires that may be problematic or be an unattractive option for some patients. In this article, the authors will introduce a crossed screw technique utilizing cannulated screws that parallels in many parts the crossed K-wire technique as described by Dr. Yu (1,2). The authors feel that the crossed screw fixation of the HIPJ combine the advantages of the two most popular fixation techniques, the intrameduallary screw and crossed K-wires, while limiting the disadvantages. Crossed screw fixation allows compression of the fusion site, provides internal fixation, which has a higher patient acceptance and avoids pin tract infection, prevents axial rotation, provides bicortical fixation, which is strong, is a relatively simple technique, and overall is felt to be less invasive than an intramedullary screw. Where the screw heads are placed there is little prominence felt by the patient and therefore there is less chance of fixation pain requiring removal. The crossed screw technique as described by the authors does have some disadvantages, these include the use of cannulated screws, which may be cost prohibitive for some patients or not available, works best in conjunction with C-arm fluoroscopy, and is a partially blind technique. It also may not be sufficient in osteoporotic bone in which the crossed K-wire technique may be superior.

SURGICAL TECHNIQUE

The incisional approach to the HIPJ is surgeon dependent and not critical to the performance of the procedure. While a dorsal linear incision can be used, the proximity to the nail bed becomes a concern. As such, the authors prefer either a double semi-elliptical transverse incision over the joint or lazy S/double L-type incision (Figure 1A). After the incision, a transverse extensor tenotomy and capsular incision is performed gaining exposure to the HIPJ articular surfaces. The cartilage and subchondral

bone is removed by hand instrumentation or saw resection (Figure 1B). Saw resection is typically used when angular correction is necessary with the correction performed mostly through the proximal phalanx bone resection with minimal resection of the distal phalangeal base. Otherwise, the authors prefer hand instrumentation for bone removal to provide a rougher surface of cancellous bleeding bone for fusion.

Once the bone is prepared for fusion and good position and bone apposition is noted, the joint is ready for fixation. At this point, Dr. Yu described retrograding two 0.062 K-wires in a crossing fashion driven from the base of the hallux distal phalanx distally to the medial and lateral curvatures of the proximal phalanx base with one wire driven more superior than the other wire to avoid collision of the wires and therefore the screws. In the crossed cannulated screw technique, instead you substitute the guide pins for the screws for the K-wires, but they are driven in a similar fashion (Figures 1C-1D).

Of note, many cannulated screw systems do not have double pointed guide pins, in these cases it is helpful to drive the guide wire or similar sized K-wire all the way out through the distal phalanx, remove the pin than pass the blunt-sided portion of the guide pin out distally so that when the guide pin is driven proximally the pointed end can penetrate the proximal cortex medially and laterally, thus stabilizing the guide pin prior to screw placement. Once the blunt side of the 2 guide pins are passed distally such that the pointed surface no longer sticks out of the base fusion site, the distal phalanx base is positioned in rectus alignment against the proximal phalanx distal fusion surface. The guide pins are than passed proximally into the proximal phalanx ideally exiting the medial and lateral cortices of the proximal phalanx diaphysis (Figure 1E). Alternatively, the guide pins can capture the subchondral bone plate at the base of the proximal phalanx, but this is not as ideal. Guide wire placement and fusion apposition can be confirmed using intraoperative fluoroscopy.

Once the fusion site apposition and guide pin placement is deemed appropriate, a small incision is created at the guide pin exit sites distally and widened slightly to allow passing of the cannulated screws. The cannulated screws, typically 2.4 to 3.0 partially threaded screws, may than be placed in standard fashion (Figures 1F-1G). Again, screw placement and length may be checked by C-arm. Since this is a partially blind technique as far as screw placement, there are a few pearls to avoiding problems. The authors recommend utilizing intra-operative fluoroscopy as these smaller screws can sometimes be difficult to tell when full contact of the screw head to bone has occurred. Additionally, take care not to lose engagement of the screwdriver to the screw head as again these small cannulated screws often have cruciate heads

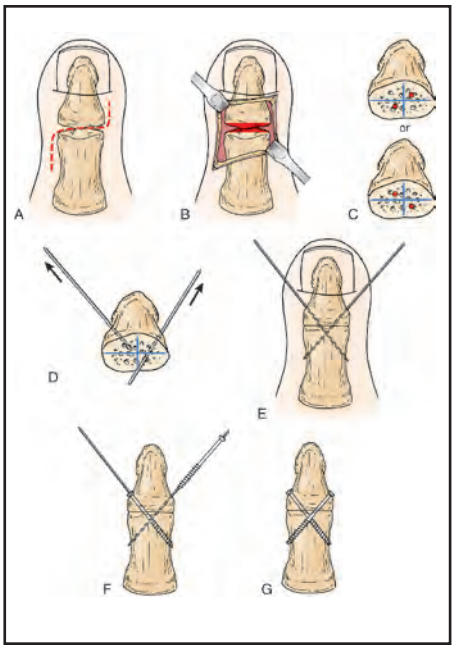

Figure 1. Illustration demonstrating the overall crossed screw technique for HIPJ fusion. Of note, the authors prefer to slightly stagger the insertion of the guide wires as depicted in 1C in both the dorsal to plantar and medial to lateral planes in attempt to avoid collision of the screws.

and it may be difficult to re-engage the screwdriver to the head of the screw blindly when only partially driven into the bone, it is also important to avoid stripping the screw head which will be more likely each time the surgeon attempts to re-engage the screw. Once compression of the fusion site is achieved and the screw placement is completed, the guide pins may be removed and closure of the wound in layers may commence at the HIPJ. This will include reapproximating the extensor tendon, prior to closure of the subcutaneous and skin layers per surgeon preference. Often just one simple interrupted suture is required to close the distal screw insertion sites. A dressing is applied and typically the patient is weightbearing to tolerance in a surgical shoe.

POSTOPERATIVE CARE

The dressing is changed within the first week and inspected for complications or infection. A new dry sterile dressing is then applied and the patient may be followed per surgeon preference with serial radiographs.

RATIONALE

Crossing screws to achieve fusion is not a new concept and has been utilized by the authors and other surgeons for many sites in the foot and ankle, including the first metatarsophalangeal joint. The authors are simply applying

Figure 2. Case sequence of the HIPJ fusion crossed screw technique, patient A.

Figure 3.

Figure 4.

Figure 5.

Figure 6.

Figure 7.

this concept to the HIPJ. The crossed screw technique has the advantage of avoiding potential rotation of the distal phalanx on the proximal phalanx with the single axial compression screw technique, but affords the compression that the crossed K-wire technique does not. The authors have presented a comprehensive technique in applying cross screw fixation to fuse the HIPJ.

Figure 8.

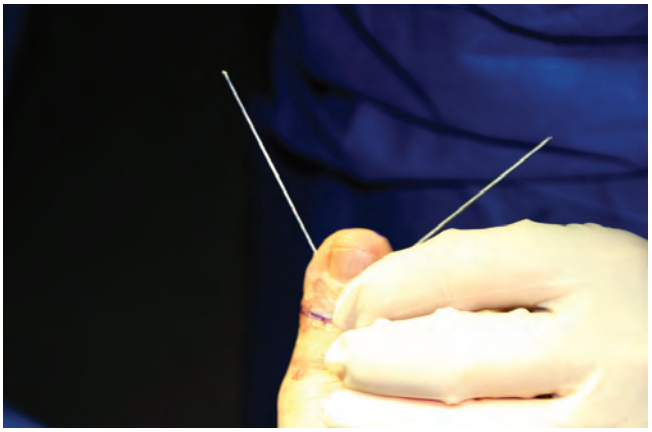

Figure 9.

Figure 10.

Figure 11.

Figure 12.

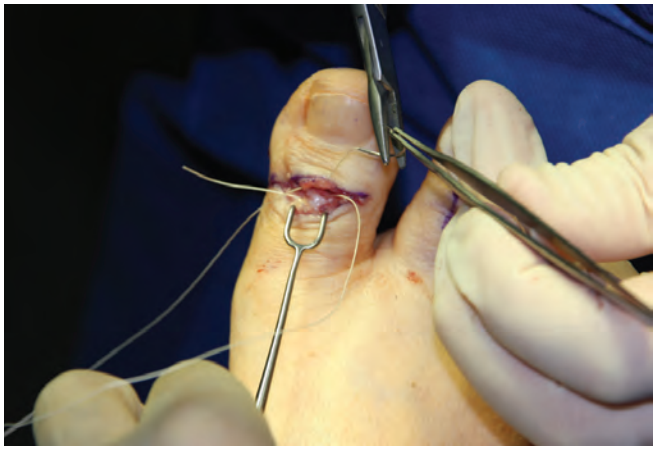

Figure 13.

Figure 14. Pre-operative radiograph for HIPJ fusion (patient B).

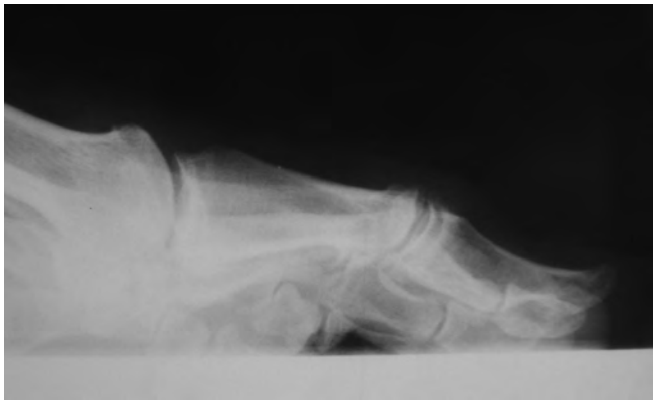

Figure15. Preoperative radiograph for HIPJ fusion (patient B), the patient has an old fracture fragment medially and painful HIPJ arthritis.

Figure 16. Intraoperative screw placement of patient B with good bone apposition noted.

Figures 17.

Figure 18. Full fusion and final long-term postoperative radiograph of patient B.

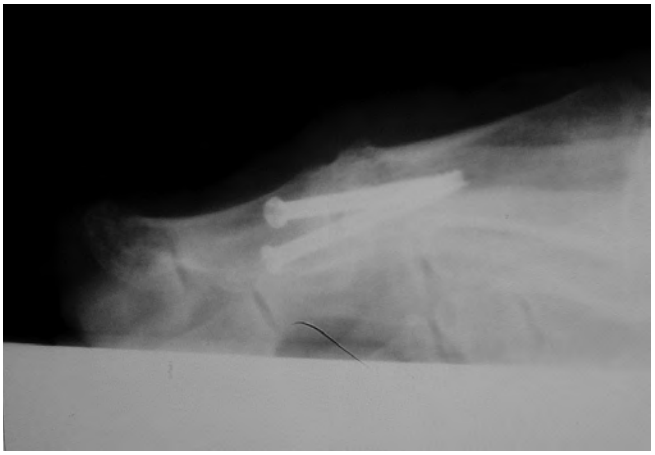

Figure 19. Post operative radiograph of patient B.

Figure 20. Preoperative radiograph, patient C.

Figure 21. Postoperative radiograph, patient C.

REFERENCES

1. Yu GV, Vargo FE, Brook JW. Arthrodesis of the interphalangeal joint of the hallux: a simple and effective technique. J Am Podiatric Med Assoc 2001;91:427-34.
2. Yu GV, Vargo FE. hallux interphalangeal arthrodesis: a simple technical pearl. The Podiatry Institute 1998 Update, (Tucker, GA): 1988. pp.129-34.