

LOCKING PIN TECHNIQUE REVISITED

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INTRODUCTION

Various forms of fixation have been advocated for stabilization of traditional Austin or Chevron type osteotomies. The use of Kirschner-wire (K-wire) is still considered an efficient, effective, predictable, and cost-effective method of fixation.¹ Kencht and Vanpelt, in 1982 reported the use of 0.045-inch K-wire for fixation of an Austin procedure in an attempt to increase stability.² The K-wire was inserted from dorsal-lateral to plantar-medial and was left in position for 6 to 10 days and immobilized for 4 weeks.² Problems such as pin migration or retraction justified the need for locking K-wire in a predictable position. The locking pin technique for fixation of Austin osteotomy was popularized by Dr. Yu in 1999. Using the principles of flexure, this technique effectively eliminates the tendency of pin migration with increased stability.¹ This is a time-honored technique still in use by those who appreciate the art and the science of the locking pin technique.

SCIENCE OF THE TECHNIQUE

The locking pin technique is based on 3-point bending or beam flexure principle. The spring-like material properties of a K-wire creates tension and compression across an osteotomy site. The K-wire is driven from dorsal-proximal to plantar-distal into the capital fragment. The distal end of the wire is implanted in the subchondral bone plate just beneath the articular cartilage. The proximal segment of the wire is bent near 90 degrees outside the bone and twisted or “locked” against the external cortical surface creating a load (Figure 1). This load applied to the K-wire by the dorsal external cortex causes both proximal and distal segments of the K-wire to flex. The flexed K-wire loads the surrounding bone and provides compression between the capital fragment and the proximal fragment. Hence, compressive load increases friction between the bone fragments and therefore enhances osteotomy stability and “prevents rotation or inward/outward migration.”¹

SURGICAL TECHNIQUE

Anatomic dissection of the soft tissue is carefully performed.³ An axis guide is used to create an osteotomy. For successful stable fixation, the design of the osteotomy is crucial.⁴ For an Austin osteotomy, the plantar arm of the osteotomy is more critical than the dorsal cut. The more parallel the plantar cut to the weightbearing surface, the more stable the osteotomy. Once the capital fragment is impacted on the shaft of the metatarsal, a single 0.062-inch (1.6-mm) K-wire with a trocar or a diamond tip is inserted 1 to 1.5-cm proximal to the osteotomy on the dorsal medial aspect of the first metatarsal diaphysis medial to the extensor tendon. The K-wire is driven from dorsal-proximal to plantar-distal. The wire is oriented perpendicular to the plantar arm of osteotomy. The tip of the pin should be visualized exiting the capital fragment in the plantar half of the metatarsal head centrally. The K-wire is then withdrawn until the tip of the wire is just beneath the articular cartilage.¹

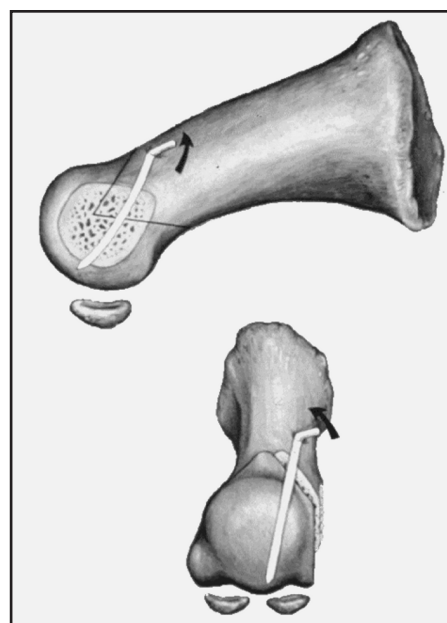


Figure 1. Application of the principle of beam flexure or 3-point bending for traditional Austin bunionectomy.¹

There are two methods of creating the locking effect: outside the bone lock pin technique, and the *in situ* lock pin technique.⁴

Outside the bone lock pin technique (Figure 2)

The steps for this technique are as follows:

1. Leave the initial wire in the bone (A)
2. Use same length K-wire to determine how much K-wire is in the bone (B)
3. Mark the point of bend

4. Bend the K-wire approximately 30 degrees (C)
5. Cut the K-wire so that sharp point (underside of the pin) will engage cortex of bone
6. Remove the initial wire
7. Insert the bent K-wire from proximal to distal (D)
8. Rotate the K-wire 180 degrees with heavy duty pliers for the lock effect (E,F)

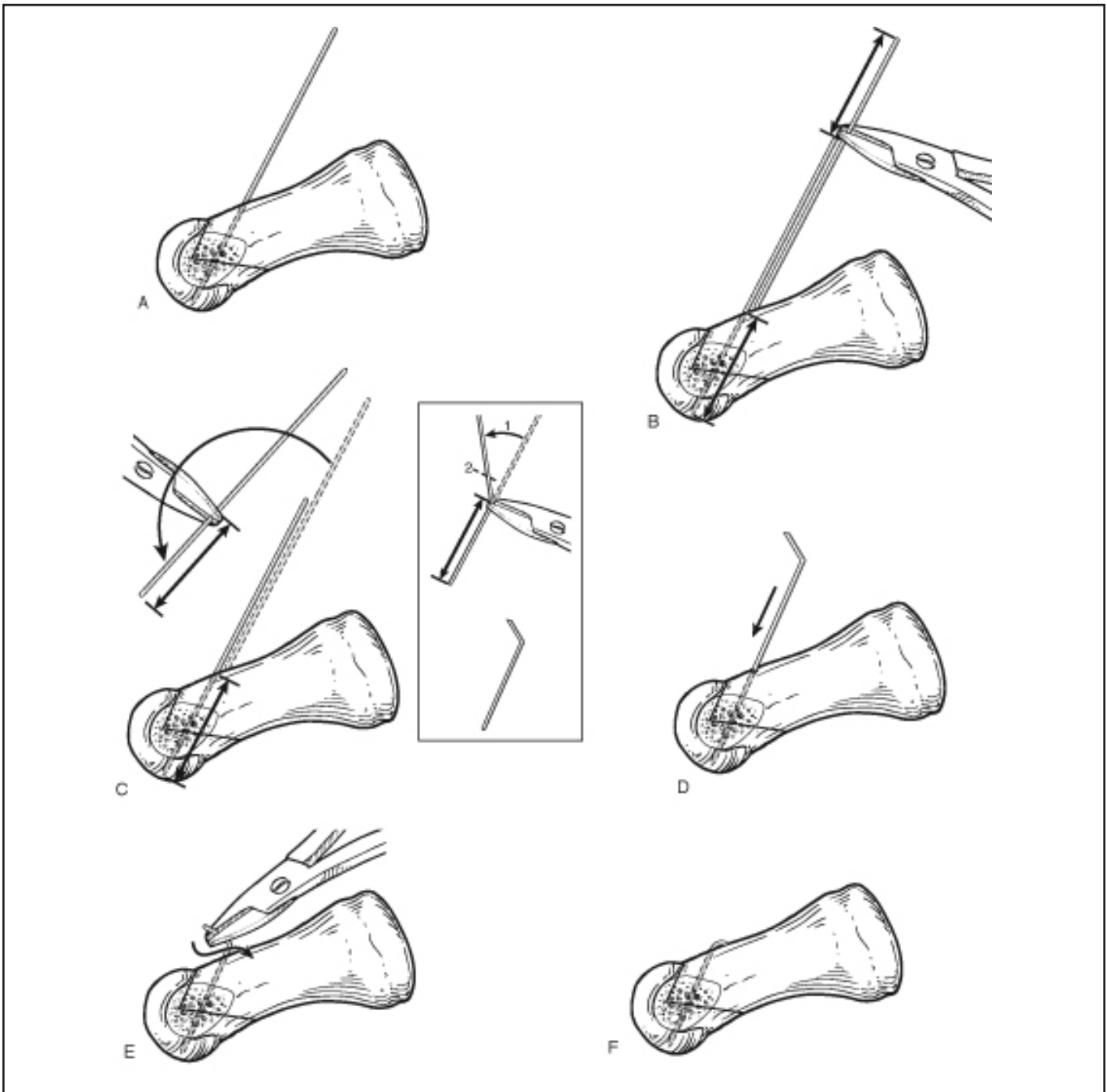


Figure 2. Outside the bone lock pin technique.⁴

The *in situ* lock pin technique (Figure 3)

The steps for this technique are as follows:

1. Leave the K-wire in the bone (A)
2. Secure the dorsal cortex distal to the K-wire with a rasp or small periosteal elevator and apply counter pressure with the thumb against plantar aspect of the metatarsal head (B)
3. Bend the K-wire approximately 30 degrees at the surface of the metatarsal proximally (C)
4. Cut the K-wire approximately one-quarter inch from the bend so that the sharp point (underside of the pin) will engage the cortex of bone
5. Rotate the K-wire 180 degrees for the lock effect with heavy duty pliers

The *in situ* technique is more frequently performed with ease and simplicity. The stability of the fixation is checked and redundant metatarsal is resected with a saw. Anatomic layered closure is performed. The periosteum and capsule are closed over the K-wire to decrease the likelihood of external migration, rotation and loosening.¹ The subcutaneous layer and subcuticular layer are closed with absorbable suture and the wound closure is reinforced with strips. Immediate weightbearing is allowed in a surgical shoe.³

ADVANTAGES

Locking pin fixation offers numerous advantages. According to Banks, the “pure simplicity of the fixation” is a good reason to use the locking pin technique for many different applications such as Austin osteotomy, first metatarsophalangeal joint arthrodesis, tailor’s bunionectomy, Lapidus arthrodesis, and triple arthrodesis.⁵

In 1909, Martin Kirschner introduced steel pins to be used as method of transfixation. Transfixation of bone is the use of a pin across a fracture or arthrodesis site to stabilize bone. This simple technique is in vogue even today to hold bone fragments together as an anchor for skeletal traction throughout the body. Besides being simple, K-wires are inexpensive and readily available in different variation such as smooth, threaded, diamond tip, or trocar tip. An array of sizes from 0.8- to 2.0-mm are easily accessible.

Excellent stable fixation with some limited compression are readily achieved using a single K-wire with the locking pin technique.¹ The length and the angular relationship of the plantar cut of the osteotomy to the long axis of the bone are known to provide inherent stability when subjected to the forces of weightbearing. Locking K-wire across the plantar arm enhances the overall stability of the distal fragment. The greater the stability, the more likely the

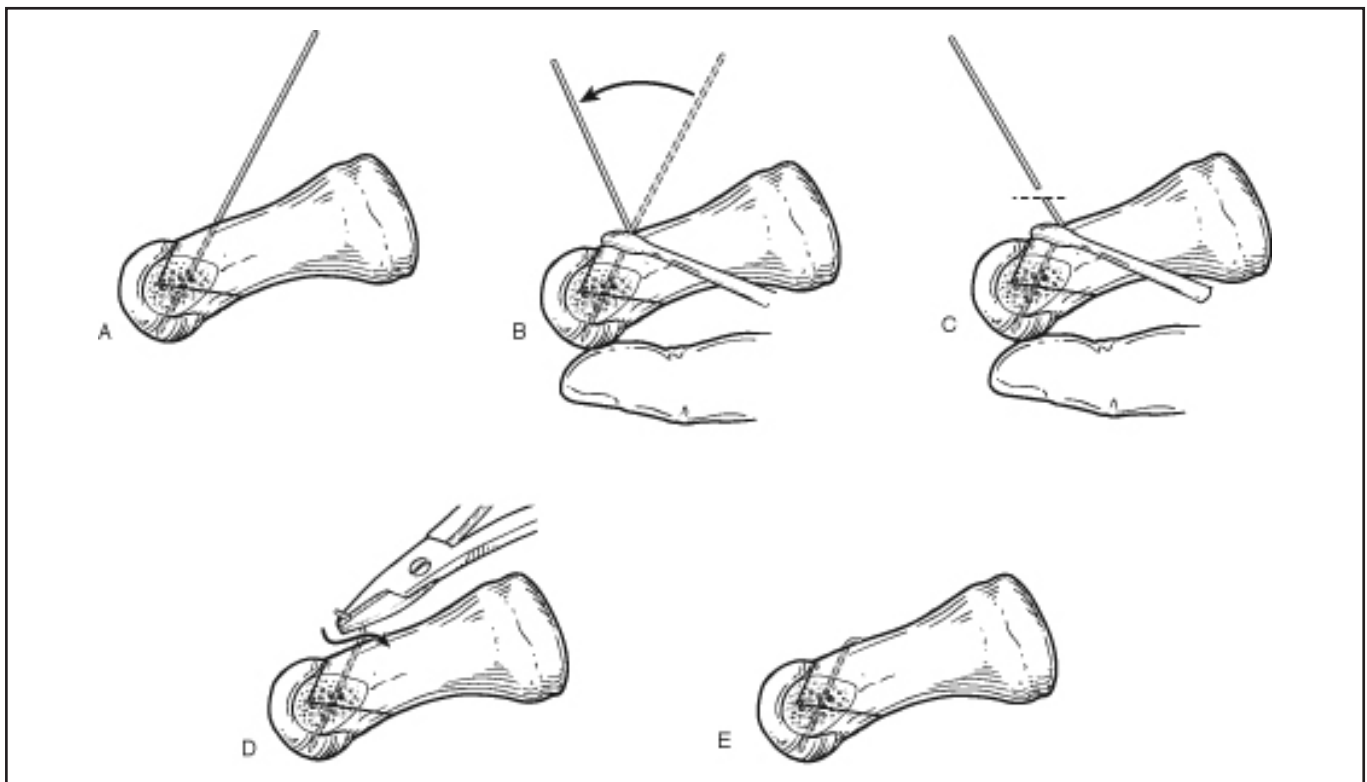


Figure 3. *In situ* lock pin technique.⁴

osteotomy is to heal by primary bone healing.³ The lock pin method ensures undisturbed primary bone healing. If the technique fails, it is readily salvaged by insertion of a second wire, or a cortical or cancellous screw.¹

A lesser degree of dissection is required for the insertion of the pin as opposed to using screws.⁵ Additionally, by driving the K-wire through the articular cartilage and then withdrawing until the tip of the K-wire is just beneath the articular cartilage allows unrestricted joint range on motion. The precise point of exit of the K-wire in the plantar quadrant is visually assessed.

DISADVANTAGES

Effective use of the lock pin technique requires good bone stock. If the bone quality is questionable with osteopenia or cysts, the metatarsal may not be able to withstand the stresses of bending with the locking of the pin.¹ It has been recommended to use 0.062-inch K-wire to effectively stabilize the osteotomy with the bending forces. Use of smaller diameter wire may alleviate the increased amount of tension in osteopenic bone. Hence using 0.054-inch K-wire rather than 0.062-inch K-wire reduces some bulk without any significant reduction in overall stability of the fixation.⁵

There is a possibility of shoe irritation after bending, cutting, and burying the wire in the dorsal cortex. Banks recommends inserting the K-wire more medially over the metatarsal shaft adjacent to the extensor hallucis longus. This reduces some of the bulk of the K-wire and as a result helps reduce the potential for later irritation.⁵

Fixation from the more stable fragment to less stable fragment is considered to be a taboo. In the case of an Austin osteotomy, the K-wire is inserted such that there is an increased chance that the capital fragment will be displaced. This is easily avoided by manually stabilizing the osteotomy as the wire is inserted. Insertion of the wire from dorsal to plantar stabilizes the plantar arm of the Austin osteotomy which is very important in achieving enhanced stability.¹



Figure 4: Postoperative AP and lateral views of the right foot using the in situ lock pin technique for fixation of Austin osteotomy with 0.062-inch Kirschner-wire.

CONCLUSION

Even though “no fixation” was intended for the original Austin osteotomy presented in 1962 attributed to the nature of the osteotomy.⁶ Numerous documented cases of dislocations leading to delayed union with cortical bone absorption or increased callous formation after Austin osteotomy called for stable internal fixation.⁷ The lock pin technique provides the benefits of using K-wires as the simplest and cheapest form of fixation with enhanced stabilization across an osteotomy site (Figure 4).¹

REFERENCES

1. Yu, GV, Malay SD. enhanced fixation of the traditional austin bunioneectomy. *Foot Ankle Quart* 1999;2:27-36.
2. Knecht, JG, Vanpelt WL. Austin bunioneectomy with Kirschner wire fixation. *J Am Podiatric Med Assoc* 1981;713:139.
3. Chang TJ. Distal metaphyseal osteotomies in hallux abducto valgus surgery. In: Banks AS, Downey MS, Martin DE, Miller SJ, editors. McGlamry's Comprehensive Textbook of Foot Surgery, 3rd ed. Baltimore (MD): Lippincott Williams and Wilkins; 2001. p.505 – 27.
4. Ruch, JA, Alder DC. Internal fixation of the foot and ankle: instructional course work book; Tucker (GA): The Podiatry Institute Publishing; 2007. p. 8-11.
5. Banks A. The Lock pin technique: it's not just for bunions. In: Update 2002. Tucker (GA); Podiatry Institute; 2002. p. 153-156.
6. Austin DW, Leventen ED. A new osteotomy for hallux valgus: a horizontally directed V: displacement osteotomy of the metatarsal head for hallux valgus and primus varus. *Clin Orthop* 1981;157:25.
7. Gerbert J. Complications of the Austin-type bunioneectomy. *J Foot Surg* 1978;17:1.