CHAPTER **20**

THE KELLER PROCEDURE: The Good, The Bad, and The Not So Ugly

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INTRODUCTION

The Keller arthroplasty, first described in 1904 by William L. Keller, was one of the most common procedures of hallux valgus surgery in the first half of this century.[1,2] Through the years, the indications for the procedure have not changed. These indications include end stage hallux limitus and hallux valgus in the senior patient.[3,4] Minimal patient age has long been considered 60-years-old. Patient selection is the most important factor in relative success of the procedure and patient outcomes. The patient's activity level is a matter of controversy in regards to this procedure. For years many have considered this procedure to be reserved for the relatively sedentary patient however, currently, many utilize the Keller procedure in relatively active patients. In these patients the deformity and pain are limiting their activities.[3] The Keller procedure provides correction and a reduction in pain to allow the patient to return to action. The recovery period is much shorter and less complicated when compared with the first metatarsophalangeal joint arthrodesis and implant arthroplasty.[5]

The Keller procedure has lost favor due to long-term complications, functional impairment of biomechanics of the great toe, and difficulties in salvaging failures. However, during the past century, modifications to the Keller procedure have been made. These modifications have included alterations in bone resection, interpositioning of the first metatarsophalangeal joint, use of Kirschner wire (K-wire) stabilization lengthening of the halluxis longus tendon, fibular sesamoidectomy, and attachment of the long flexor tendon to the remainder of the proximal phalanx. The use of these modifications has led to more predictable results and a significant decrease in complications associated with the procedure.[6-10] In fact, the literature has shown many of the previous complications associated with the Keller did not differ much from those associated with first metatarsal head osteotomies.[4] This article will discuss surgical techniques and the study analyzing the complications of this procedure.

TECHNIQUE

The first metatarsophalangeal joint is approached through a standard curvilinear dorsomedial skin incision. Dissection is then carried down to the level of the deep tissue and joint capsule. Next, a proximally based U capsulotomy is performed and carried out over to the central aspect of the phalangeal base. The capsule is reflected proximally exposing the base of the proximal phalanx and head of the first metatarsal. An aggressive resection of the medial eminence of the first metatarsal head is then performed. Preservation of the cristae is not important since we are not trying to maintain joint alignment.

In cases of hallux valgus, as opposed to hallux limitus, attention is directed into the first intermetatarsal space where the adductor tendon is identified and freed from its attachment into the sesamoid apparatus and base of the proximal phalanx. The fibular collateral ligament is then identified and released. At this time, an attempt is made to restore the sesamoid apparatus to a center position under the first metatarsal head. Positioning of the sesamoids is important in hallux valgus because of the path of the long flexor tendon. If the long flexor tendon is not centered back under the first metatarsal head it will continue to be a deforming force and hallux valgus is likely to reoccur. If the sesamoids are unable to be mobilized or osseous hypertrophy is present, the fibular sesamoid should be excised.

Attention is then turned to the base of the proximal phalanx where the proximal one third is identified at the notch on the hallux. Care is taken at this time to be sure that the resection of this base is perpendicular to the long axis of the shaft (Figure 1) Problems can arise when bone resection is made parallel to the articular surface of the proximal phalanx. The hallux is then held in proper alignment with approximately 1 cm gapping maintained between the proximal phalanx and the first metatarsal head. At this time, if there is significant pull or tension on the hallux an extensor hallucis brevis tenotomy can be performed. If sufficient tension continues causing either dorsal or abductory forces, the extensor hallucis longus tendon can then be lengthened using an open Z pattern.

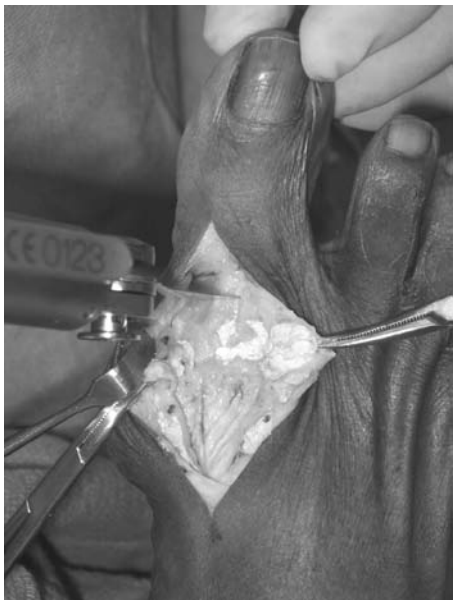

Figure1. Intraoperative photo showing the position of arthroplasty.

Figure 2. Immediate postoperative radiograph showing alignment.

Figure 3. Postoperative clinical view.

The flexor hallucis longus tendon is then identified and a small drill hole is made in the central plantar aspect of the shaft of the proximal phalanx. The toe is then distracted into position and a braided nonabsorbable suture is utilized to secure the tendon to the proximal phalanx though the drill hole. The first metatarsal head is remodeled both dorsally and medially in order to create a smooth rounded surface. Prior to placing a K-wire, the joint capsule is then interposed in the space from dorsal medial to plantar lateral. The capsule is then draped over the first metatarsal head and anchored to the deep fascial area at the plantar lateral aspect of the joint. The capsule will later be secured with the use of the K-wire.

The intermetatarsal angle is then compressed and the hallux is held in a rectus position. Once adequate position is obtained, a 0.062-inch K-wire is retrograded out the distal aspect of the hallux and then back across the metatarsophalangeal joint into the first metatarsal head and shaft. Position at this point is very important and the phalanx should be placed in straight alignment with a slight dorsal position. Following observation of satisfactory position, the subcutaneous tissue and skin are subsequently closed (Figures 2 and 3).

Postoperatively, the patient is placed in a bandage and a surgical shoe with 0.5 inch felt ending in the digital sulcus to prevent pressure on plantar hallux pulp. The patient is also instructed to walk flatfooted. The K-wire is left in place for 3 weeks and subsequently pulled. Following the K-wire removal, the patient is kept in a bunion splint for 2 to 3 more weeks for continued splinting. Range of motion exercises are begun immediately after removal of the pin and continued throughout the entire postoperative course.

RELATIVE COMPLICATIONS

Complications associated with the Keller procedure can be placed into 2 distinct categories.[11] The first is related to the loss of intrinsic muscular attachment because of resection of the proximal phalangeal base. This group includes lesser metatarsalgia, lack of hallux purchase, cock up hallux, and flail hallux. The second is related to the amount of bone

resection. Complications such as cosmetically unacceptable shortening of the hallux and flail hallux can result from excessive bone resection. Inadequate bone resection can cause limited motion and reduced correction. This can also occur when the plantar aspect of the base of the proximal phalanx is preserved in an effort to maintain plantar intrinsic muscular attachments.

The next area of controversy associated with this procedure is the frequency and significance of these complications. As previously stated, the procedural modifications have reduced the relative rates of these complications. Analysis of these complications in the literature and our own work has led to a decrease in the significance of them.

Metatarsalgia is frequently recorded as one of the most common complications associated with the Keller procedure; however, when comparing metatarsalgia versus preoperative findings, this does not tend to be necessarily true. Most of these patients have some degree of metatarsalgia preoperatively due to the decreased weight-bearing aspect of the first ray present in the hallux valgus deformity.[11] Decreased plantar pressure of the first metatarsal is a result of an increased angular position and hypermobility of the entire first ray. Attachment of the flexor hallucis longus tendon and repositioning of the sesmoids results in increased weight bearing of the first ray. In addition, when comparing metatarsalgia to the other hallux valgus procedures, there is no discernable difference in the occurrence of metatarsalgia between the two. In fact, one comparison study found there to be a higher rate of occurrence in patients undergoing chevron osteotomies for the correction of hallux valgus.[4]

The deformity of a cocked-up hallux as well as lack of hallux purchase also appears to be a concerning complication following the procedure. Again, most of the patient candidates for this procedure have a decrease in plantar hallux purchase already. In cases of severe hallux valgus, the purchase power of the hallux is minimal.[9,11] Since the innovation of attachment of the long flexor tendon to the remainder of the proximal phalanx, these two problems do not appear to be as common. In fact, with plantar pressure evaluation utilizing a pressure strain gauge, the hallux propulsive force was found to increase following the procedure when compared with preoperative subjects.[11]

Shortening of the hallux has also been a concern in the past with this procedure. Although this does not usually result in a pathomechanical problem, it does leave some concern for cosmetic reasons. Since the use of the K-wire stabilization and capsular interposition, the occurrence of this problem does not appear to be as substantial with this procedure.[6-8,10]

Reoccurrence is another problem associated with the Keller procedure. Most state the cause of this problem to be a limit in the amount of correction obtained by this procedure. It has long been stated that this procedure resulted in very little correction of the intermetatarsal angle. However, there have been many papers that have shown good reduction of the first intermetatarsal angle and hallux abductus angle following the Keller procedure. We have found this to be true in all of our findings. In fact, again this appears to compare very nicely to distal head osteotomies. The amount of correction and sustainability are related to several factors.[4] The first and most important is the lateral soft tissue release and repositioning of the sesmoids. Utilizing the "Cerclage fibreux" technique, as described by LeLievre, good intermetatarsal angle correction has resulted.[3,4] Again, if realignment of the fibular sesmoid is not possible, fibular sesamoidectomy is advised.[5] In addition, closure of the intermetatarsal angle with rectus alignment of the hallux prior to pin insertion leads too more predictable correction.

In the end, patient selection is critical for this procedure. This procedure is intended to reduce deformity but most importantly, result in a reduction in pain. It does this very nicely without the concerns of healing an arthrodesis site. When compared to the use of implant arthroplasties, reaction to these materials as well as bone hypertrophy around them does not appear to outweigh the importance of this procedure. Utilizing the recommended modifications will lead to more successful results.

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