COMPLICATIONS OF THE KALISH BUNIONECTOMY

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INTRODUCTION

Criteria for the structural correction of hallux abducto valgus with associated metatarsus primus adductus has included procedures performed in either the distal or proximal metaphysis of the first metatarsal. Logically, surgeons have preferred these areas as they provide greater amounts of cancellous bone with associated increased vascularity and healing potential. Generally, the distal metaphyseal or capital osteotomies are chosen for deformities with a mild to moderate intermetatarsal angle, while proximal metaphyseal or basal osteotomies are selected in deformities with a moderate to severe intermetatarsal angle. The distal osteotomies are popular due to their ease of performance, relative stability, and earlier postoperative mobilization and weightbearing. Disadvantages of the distal osteotomies include limited and/or only relative reduction of the intermetatarsal angle, and the potential for osteotomy displacement and malunion if not adequately stabilized or fixated.

The primary advantage of proximal osteotomies is an increased ability to affect intermetatarsal angle correction. However, basal osteotomies have numerous sequelae, including potential malunion or elevatus of the first metatarsal, which to be avoided necessitates a period of non-weightbearing and the use of rigid fixation. Thus for many years, the pendulum of the level of osteotomy correction has swung back-and-forth from proximal to distal depending on the techniques preferred in a particular region or training program.

Recently, several shaft osteotomies have been introduced which attempt to glean the advantages of both the proximal and distal metaphyseal osteotomies (i.e., greater intermetatarsal angle correction with earlier postoperative rehabilitation and weightbearing). These "compromise" osteotomies, to varying degrees, are performed between the proximal and distal metaphyses. These osteotomies include the Mau, the Ludloff, the Scarf-Meyer Z-osteotomy, the Vogler Offset V-osteotomy, and the Kalish osteotomy. Advantages and disadvantages are inherent to each of these osteotomies.

The Kalish osteotomy, first performed by Stanley R. Kalish in 1983, was first described in the literature in 1986.[1,2] Concisely stated, the osteotomy involves a sagittal plane through-and-through "V" osteotomy offset so that the dorsal arm is longer than the plantar arm. As with the traditional Austin osteotomy, the apex of the Kalish osteotomy remains in the center of the metatarsal head and the plantar cut exits the first metatarsal just proximal to the joint and plantar articular cartilage. The dorsal arm is elongated and extends into the diaphysis of the first metatarsal creating a more acute angle than the traditional Austin osteotomy. The distal, capital fragment is then transposed laterally and fixated with screws.

In 1987, Kalish and Bernbach[3] reported the results of an early retrospective study of 64 patients followed for greater than one year. Their data showed an average preoperative intermetatarsal angle of 14 degrees and an average postoperative intermetatarsal angle of 3 degrees.[4] They briefly discussed their complications, but stated further follow-up and review was in progress. In 1989, Kalish[4] reported on 264 osteotomies, which included the initial 64 patients. He stated hallux varus was the most common complication, occurring in 8 (3%) of the patients.

In their description of the Kalish modification of the Austin bunionectomy, Downey, Malay and Ruch[1] stated "The modified osteotomy necessitates increased soft tissue dissection and a higher level of technical expertise." This statement continues to be true. Most complications associated with the Kalish technique can be attributed to a failure in the surgeon's adherence to the indications for the procedure, failure in the performance of the procedure, or inadequate postoperative management.

The purpose of this paper is not to condemn the Kalish osteotomy, but to look at the technical aspects of the Kalish osteotomy and its potential complications. By providing such a critical review, it is hoped that the surgeon performing the Kalish osteotomy might reconsider the indications, technical limitations, and postoperative course of the procedure thus avoiding the complications identified.

FAILURE TO OBSERVE INDICATIONS

Potential Complications:

1. Recurrent hallux valgus deformity
2. Hallux varus deformity
3. Hallux limitus/rigidus

Kalish and Bernbach[3] stated "the indications for the Kalish modification are similar to those originally described by Austin." Initially, they identified the following criteria for the Kalish procedure:

1. Hallux abductus angle greater than 15 degrees,
2. Metatarsus primus adductus angle less than or equal to 15 degrees,
3. Pain-free first metatarsophalangeal joint range of motion,
4. Absence of degenerative joint disease.

However, based upon empiric evidence, these criteria have been expanded. As Kalish and Bernbach[3] alluded, "in our experience a larger metatarsus primus adductus angle may be corrected than with the traditional procedure." They attributed this to the increased stability provided by internal fixation of the osteotomy allowing greater lateral displacement of the capital fragment. In 1989, Kalish[4] redefined the indications broadening the potential intermetatarsal angle correction to 15 to 18 degrees if combined with an adductor hallucis tendon transfer:

1. Hallux abductus angle greater than 15 degrees,
2. Metatarsus primus adductus angle 15 degrees or less,
   A. Without adductor transfer,
   B. Metatarsus primus adductus angle 15-18 with adductor transfer,
3. Pain-free range of motion with no significant osteophytes,
4. Absence of severe degenerative joint disease.

One year later, Cain[5] advocated the use of the osteotomy along with the apical axis guide to not only laterally transpose the capital fragment but to concomitantly plantarflex and shorten the first metatarsal. In this fashion, he stated the Kalish modification was applicable for hallux limitus and stated that with resultant relaxation of the periarticular soft tissues "intermetatarsal angles greater than twenty degrees are capable of satisfactory reduction." Cain provided several cases demonstrating such correction. Thus, the criteria for the Kalish osteotomy, as with other shaft osteotomies, has rapidly broadened as surgeons attempt to avoid more proximal basilar osteotomies.

The natural result of any procedure stretched to its limits, and potentially beyond, is an increase in complications. An increase in recurrent hallux abducto valgus with residual metatarsus primus adductus can be expected if the indications for the Kalish osteotomy are increased significantly from the 15 to 16 degree intermetatarsal angle traditionally considered acceptable (Fig. 1A, 1B). Obviously, other factors may allow an additional few degrees of structural correction. These factors include the flexibility of the deformity and first ray segment, the width of the first metatarsal head, the quality of the bone, and the absence of other structural deformities (e.g., increased PASA). As Kalish[4] cautioned, "care must be taken to avoid the troughing effect common to those osteotomies greater than 18 degrees. Complications from this effect include fracture of the metatarsal, rotary instability (as the lateral cortex rotates in the plantar medullary canal), and inability to correct high proximal articular set angles with a single cut."

Second, overcorrection may result if aggressive structural correction is combined with aggressive soft tissue correction. As previously

Fig. 1A. Preoperative dorsoplantar view of severe hallux abducto valgus deformity with associated metatarsus primus adductus. The intermetatarsal angle was 17 degrees.

Fig. 1B. Postoperative view of same patient 1-year following Kalish osteotomy with adductor hallucis tendon transfer. Note recurrent hallux abducto valgus deformity.

Fig. 2A. Hallux varus following a Kalish osteotomy with adductor hallucis tendon transfer. Radiographs are 3 months postoperative. Dorsoplantar view. Note the negative relative intermetatarsal angle.

Fig. 2B. Sesamoid axial view. Note the tibial sesamoid is medial to the medial sagittal groove and the fibular sesamoid is medial to the central crista. Thus, the hallux is in an adductovarus position relative to the first metatarsal.

mentioned, hallux varus is the most common reported complication of the Kalish osteotomy (Fig. 2A, 2B). Kalish[4] stated that 5 of the initial 64 cases (8%) developed hallux varus, while 3 of the more recent 200 cases (1.5%) developed hallux varus. He attributed the higher initial rate of hallux varus to the standard use of the adductor hallucis tendon transfer in the early cases. As noted in his revised criteria, Kalish now advocates the mobilization and transection of the adductor tendon without transfer in cases with a metatarsus primus adductus angle of less than 15 degrees. He continues to espouse full adductor mobilization and transfer in situations with greater than 15 degree intermetatarsal angles.

Certainly, one must be cautious when utilizing a sequential release and reconstruction of the pathologic soft tissue anatomy of the first metatarsophalangeal joint. Surgical complications are imminent if one considers the osteotomy to be the key and relegates the soft tissue correction to a position of secondary importance. After performing the Kalish osteotomy, one must carefully assess and close the soft tissues. This involves a critical evaluation of the tibial sesamoid position. This is most readily accomplished by evaluating the position of the medial aspect of the base of the proximal hallucial phalanx. The medial rim of the phalangeal base should course in the medial sagittal groove (or just lateral to it) with the first metatarsal loaded and the joint taken through a full range of motion. If during this passive range of motion maneuver, the rim of the phalangeal base shifts medially from the sagittal groove, one can assume the tibial sesamoid is dislocating from the sagittal groove medially. If not addressed, hallux varus may be anticipated. If medial luxation is identified, revision of the structural correction should be performed. This typically necessitates removal of the fixation screws with reduction of the amount of lateral capital fragment transposition and revisional fixation.

Once satisfactory structural alignment of the joint is achieved (i.e., the medial rim of the proximal phalanx remains in the sagittal groove or just lateral to the groove throughout passive range of joint motion), soft tissue closure including muscle tendon balancing procedures may be completed. For this closure, the hallux should be held in a rectus position with the relationship of the medial phalangeal base and sagittal groove maintained while adductor transfer and/or medial capsulorrhaphy is performed. After capsular closure, the joint should again be taken through a full range of motion to assure no medial luxation of the tibial sesamoid is occurring. As Martin, Phillips, and Ruch[6] have stated, "The final capsular closure is as critical as any other part of the surgical procedure. Great care must be taken to properly align the metatarsophalangeal joint in its congruous position for this final phase of the repair of the hallux valgus deformity."

Third, the procedure has recently been espoused for the management of hallux limitus. Cain[5] discussed the use of the osteotomy in patients with mild hallux limitus and either metatarsus primus elevatus or a long first metatarsal. However, in such cases the osteotomy must be combined with appropriate arthroplasty techniques of the first metatarsophalangeal joint. Cases with advanced degenerative joint disease are less amenable to such joint preservation approaches, and if attempted are likely to result in recurrent hallux limitus or hallux rigidus.

TECHNICAL FAILURES

Potential Complications:

1. Osteotomy fracture/displacement
2. Malunion
3. Delayed Union/Nonunion
4. Fixation failure/displacement

The Kalish osteotomy necessitates a greater level of technical expertise than a traditional Austin osteotomy. The procedure requires a knowledge of screw fixation and proper instrumentation, and prior to performing the Kalish osteotomy one should be well versed in AO technique. Failure in any step of the technique may occur even in the hands of the most skilled surgeon. Therefore, the surgeon must also have the ability to deal with these technical problems and have alternative forms of fixation available.[7]

The osteotomy itself involves a long dorsal arm, modified to allow fixation with two 2.7mm cortical screws inserted in lag fashion. If the osteotomy is excessively short, fixation with two screws may be difficult. Indeed, many surgeons have attempted to fixate the osteotomy with a single 2.7mm or 3.5mm screw. Although in some cases this will be satisfactory, the lack of two points of fixation may allow shifting of the capital fragment. Excessive bone callous, loosening of the fixation screw, fragment displacement and/or malunion may result. If at anytime the capital fragment is felt to be unstable, the affected foot should be placed in protective weightbearing or preferably a non-weightbearing attitude. If the dorsal arm of the osteotomy is too long, one may create a more acute osteotomy angle with potential intra-articular fracture from the apex of the osteotomy or fracture of the distal spike of the metatarsal. Additionally, the incision will need to be extended proximally to avoid damage to dorsal soft tissue structures (e.g., the EHL tendon) where the osteotomy exits bone. Ideally, if one has started cutting the osteotomy and recognizes

it may be too long, the saw should be adjusted in line with the apical axis to exit the metatarsal at the appropriate level. This may be accomplished by always cutting the proximal "free end" of the osteotomy first and then progressing back distally to the axis wire.

Problems may also occur if the osteotomy is improperly oriented. Use of the apical axis guide is a critical part of the procedure. If the osteotomy is improperly oriented, malunion may result. Kalish[4] reported postoperative stress fractures of the second metatarsal in 2 of 264 cases (1%). He felt the cause may have been secondary to inappropriate dorsal displacement of the capital fragment. Whether this displacement was due to an improper osteotomy orientation or early weightbearing is unclear.

Problems more frequently occur with fixation of the osteotomy. Kalish[4] reported that fracture of the dorsal arm of the osteotomy was the second most frequent complication occurring in 7 of 264 osteotomies (3%). He stated that "careful planning of the osteotomy length and proper countersinking of the screw heads will avoid this complication." Indeed, countersinking seems to be the critical step in the dual screw fixation of the osteotomy. Countersinking is performed to properly disperse the compressive forces of the screw head when inserted in lag fashion and thus prevent a stress rizor or fracture of the fragment. Additionally, the countersinking process recesses the head of the screw to prevent it from being prominent. If excessive pressure is applied while countersinking, the dorsal arm of the osteotomy may fracture (Fig. 3A-C). If excessive countersinking is performed, the screw head may sink into the medullary canal necessitating a washer or larger screw to properly fixate the osteotomy. Too little countersinking may result in a stress rizor when the screw is tightened. This fracture may occur between the screw hole and the osteotomy or between the two screw holes. Many surgeons now advocate the use of one 2.7mm screw and one 2.0mm screw, as the smaller screw necessitates less countersinking and decreases the likelihood of a fracture. If an intraoperative fracture occurs, alternative fixation should be employed if needed (Fig. 4). Further, postoperatively the patient should be kept nonweightbearing on the surgical foot for at least four weeks.

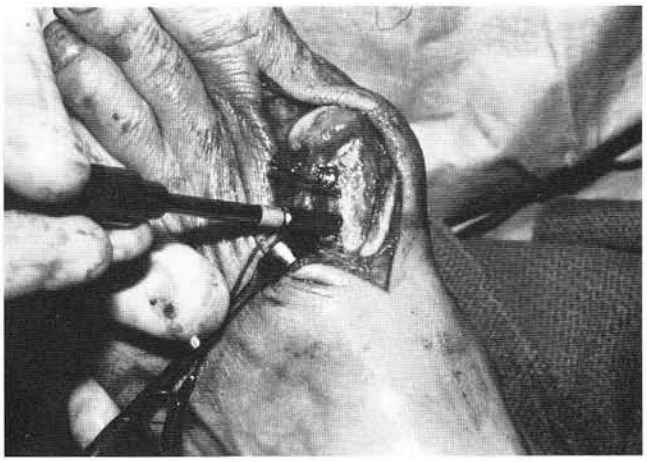

Fig. 3A. Countersinking is the most critical step in the fixation process as most fixation problems result from improperly performing this maneuver. Countersinking for the second or proximal screw.

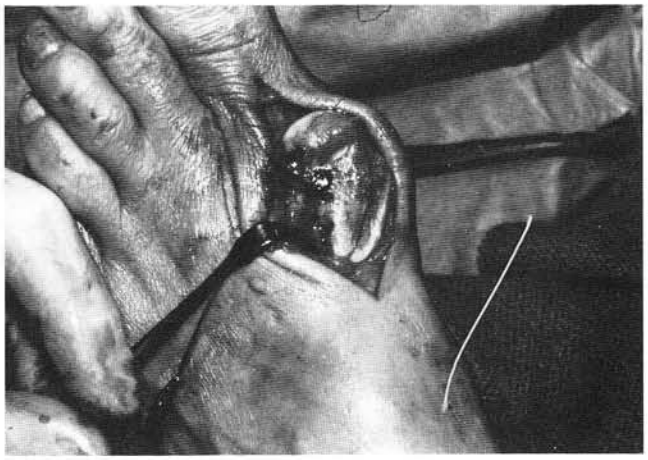

Fig. 3B. Aggressive countersinking has resulted in a fracture between the screw hole and lateral portion of the osteotomy.

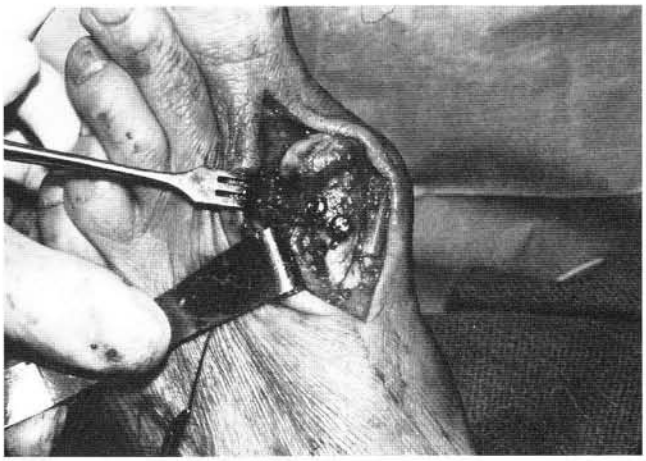

Fig. 3C. In this case, the surgeon repositions the second screw and inserts it through a new hole created more medially. Note the previous fractured hole is seen proximal-lateral to this second screw.

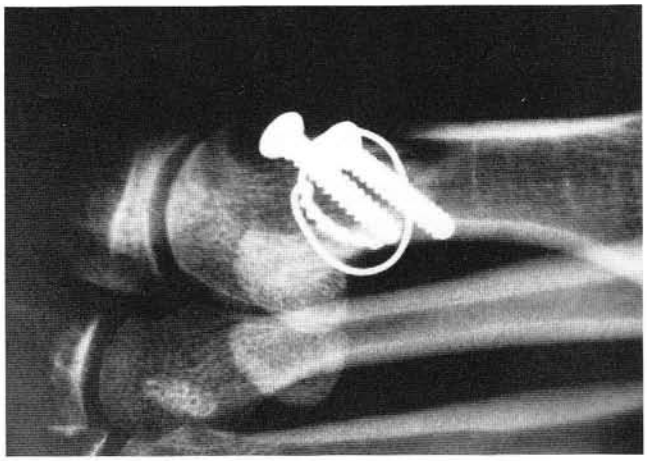

Fig. 4. Intraoperative fracture of the dorsal arm of the osteotomy occurred while tightening the second screw. The surgeon elected to reinforce the standard two screw fixation with a cerclage loop of stainless steel wire.

Other problems may occur with the fixation, but these are less frequent. Fracture of drill bits, improper screw lengths, and/or poor screw purchase and orientation all may be seen. These problems may be diminished by performing the technique in a standardized fashion as previously outlined in both film and text.[1,4]

POSTOPERATIVE COMPLICATIONS

Potential Complications:

1. Loss of rigid fixation/stability
2. Joint limitus
3. Infection
4. Hematoma
5. Wound dehiscence
6. Delayed union/Nonunion
7. Nerve damage
8. Other

As with any surgical procedure, the Kalish osteotomy may have postoperative complications. Delay in skin or bone healing, infection, hematoma, nerve damage, postoperative joint limitus, as well as the previously mentioned problems may occur. When rigidly fixated, many of these complications are reduced. Obviously, rigid internal fixation with early mobilization and return to weightbearing is a primary goal and advantage of the Kalish osteotomy.

Thus, it follows that most postoperative problems occur due to loss of the rigid fixation. Profound edema and/or pain may be the early signs of an unstable osteotomy. If instability is identified or suspected, the patient should be placed in guarded weightbearing or non-weightbearing on the surgical foot. If not treated appropriately, loosening and shift of the fixation screws and/or malunion, delayed union, or nonunion of the osteotomy may occur (Fig. 5A, 5B, 6).

Fig. 5A. Poor screw fixation may allow the osteotomy to shift or move. This motion may result in fixation loosening, osteotomy shift, and bone callous formation as seen in this example. Dorsoplantar view. Note the medial screw has migrated out of the first metatarsal. Bone resorption, which occurs with motion, is noted around the remaining screw. Extensive bone callous is also noted.

Fig. 5B. Lateral view of the same patient. Note displaced screw and bone callous around the screw remaining in the first metatarsal.

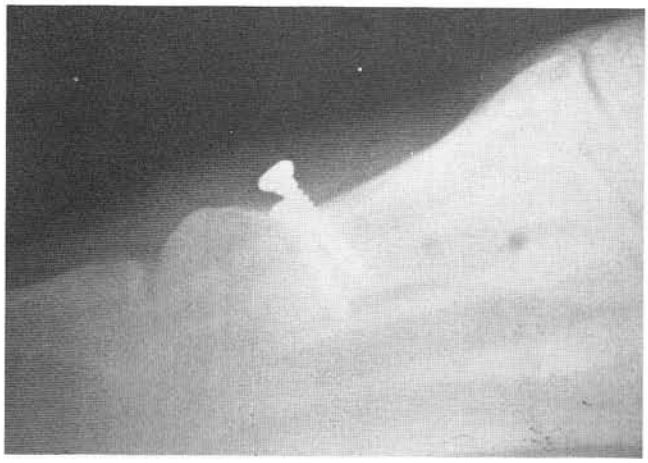

Fig. 6. Example of malunion secondary to fixation loosening and shift of the osteotomy. Note the proximal screw has loosened and the capital fragment has displaced dorsally. An iatrogenic metatarsus primus elevatus deformity with associated hallux limitus resulted.

SUMMARY

The Kalish osteotomy remains a popular procedure for the management of hallux abducto valgus with concomitant metatarsus primus adductus or mild hallux limitus associated with a long first metatarsal or metatarsus primus elevatus. Meticulous attention to the common problem areas identified with the procedure will allow the surgeon long-term gratifying results.

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