FOLLOW-UP AND UPDATE: FIFTH METATARSAL OSTEOTOMY FOR TAILOR'S BUNION DEFORMITY

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Oblique Osteotomy of the Fifth Metatarsal

During the 1983 Doctors Hospital Surgical Seminar, Drs. Yu, Smith, and Ruch presented an oblique osteotomy at the neck of the fifth metatarsal for structural correction of the Tailor's bunion deformity. The technique utilized an intra-medullary 0.062 inch Kirschner wire (K-wire) for fixation. Compression across the osteotomy surfaces was created by elastic recoil of the K-wire which was bowed as it was introduced (Figs. 1, 2). The technique employed a form of compression via the pre-stressed fixation pin and resistance to bending forces through the concept of intra-medullary nailing. Compression was dependent upon an intact lateral cortical hinge which would function as a tension band and convert medially directed pressure into compressive forces across the osteotomy surface. The combined effects of compression and the intra-medullary splint to resist bending forces were intended to produce a more stable form of fixation and allow weightbearing. The buried K-wire also allowed early removal of the surgical dressing.

Accumulated experience over the last four years has been acceptable, however the intended result of stable fixation, primary bone healing, and uncomplicated postoperative weightbearing has not been a consistent postoperative finding. Postoperative findings often include: fracture of the lateral cortical hinge, shift, shortening, and angular displacement, delayed union, and potential nonunion (Figs. 3-5). While these events are not unique to the oblique fifth metatarsal osteotomy, and are commonly seen in other types of fifth metatarsal osteotomy, they were disappointing in light of an attempt to produce a "better mouse trap".

Analysis

The failure to produce consistent primary bone healing is directly related to the inability of the mechanics of the osteotomy and fixation to withstand the disruptive forces of weightbearing. Secondary bone healing or callus formation does not imply failure of the procedure or even a significant postoperative implication. However, it does imply movement between the apposed bone fragments and the potential for less than the desired surgical result (Fig. 6).

Points of Concern

Oblique Osteotomy

The oblique osteotomy has been used successfully in the first metatarsal osteotomy because it has not been subjected to the forces of weightbearing (Fig. 7).

The inherent weakness of the long oblique osteotomy (or fracture) has been clearly presented by Charnley. The long oblique fracture surfaces provide little intrinsic stability to resist shift or displacement. The long oblique nature of the opposing surfaces readily allows shortening of the segment or telescoping and results in loss of bone-to-bone stability and tension band effects of related soft tissues (Fig. 8). The long oblique fracture will readily shorten and produce an angular deformity with application of bending forces.

In the case of a pre-planned osteotomy or ORIF of a long oblique fracture, once the fixation has failed, there is little intrinsic mechanical stability afforded by the opposing surfaces of the fragments themselves. A mechanically unstable fracture or osteotomy is then less able to withstand the disruptive forces that would prove to be detrimental to the total end result.

Lateral Cortical Hinge

As long as the lateral cortical hinge remains intact in the oblique fifth metatarsal osteotomy with intra-medullary fixation, the osteotomy will remain relatively stable and undisplaced (Fig. 9).

Should the lateral cortical hinge fracture, the oblique osteotomy is then easily displaced with proximal shift of the distal fragment, shortening, rotation, and even angular displacement (Fig. 10).

Weightbearing has proven to be a significant force that can lead to fracture of the lateral cortical hinge. Preliminary strain studies have demonstrated consistent fracture of the lateral cortical hinge with load forces that

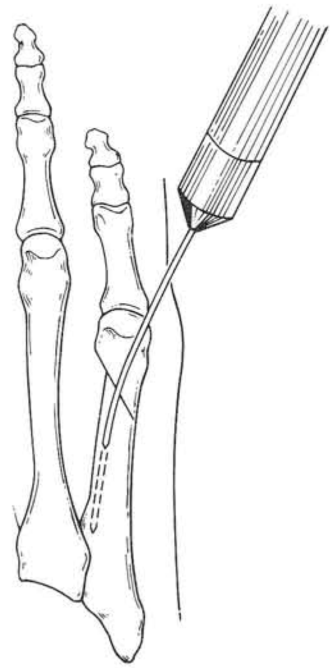

Fig. 1. The 0.062 in Kirschner wire is introduced to cross the oblique osteotomy and bow down the internal cortex of the medullary canal.

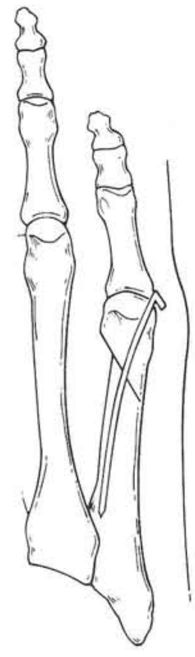

Fig. 2. The elastic recoil of the wire produces compression across the osteotomy as the bowed wire attempts to straighten itself.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. Some of the weight-bearing postoperative findings include lateral cortical hinge fracture, **Fig. 4.** shortening, **Fig. 5.** and delayed union.

resemble weightbearing (Fig 11).

Weightbearing

The load forces of weightbearing can produce significant bending, rotation, and shear. These primary disruptive forces pose a real threat to the stability of any osteosynthesis. The basic Swiss premise "No implant can be expected to withstand the unsupported stresses of weightbearing" again proves to be applicable to a primary podiatric procedure (osteotomy of the fifth metatarsal for the correction of the Tailor's bunion deformity).

The scenario becomes quite familiar:

1. beautiful, stable "on the table" result
2. ambulation in a surgical shoe (weightbearing)
3. fracture of the lateral cortical hinge
4. changes other than the beautiful "on the table" result...

Goals

One of the primary goals of the Doctors Hospital Podiatry Institute has always been to strive for a better understanding of the surgical skills and techniques that we all commonly employ.

Collective experience with the fifth metatarsal osteotomy prior to the introduction of the Swiss concepts has been inconsistent at best. While most osteotomies eventually heal, angular deformity (i.e., elevatus, over-correction) and other associated complications such as floating toes are not desired. In an effort to identify the cause of these less than favorable results, a common factor can be found in most all of the techniques and procedures and that is weightbearing.

The surgical intent of a structural osteotomy includes angular or positional change of the osseous segment into a specifically determined functional position. This position may be determined by preoperative planning or by intraoperative evaluation. The final position established at the completion of the procedure is the intended result of the structural procedure.

It is the intent of the surgeon that the osseous segment heal and function in the newly aligned position. Significant shift, displacement, rotation, or other change in the final surgically achieved position may be detrimental to the end result.

One of the primary anticipated effects of internal fixation is the maintenance of the new surgically created alignment. Our common experience has shown that weightbearing can introduce forces that can disrupt that new surgically created alignment and be the one common factor that may be detrimental to any technique or procedure involving osteotomy of the fifth metatarsal for correction of the Tailor's bunion deformity.

Realistic Observations

1. Osteotomy of the fifth metatarsal is a common procedure for correction of the Tailor's bunion deformity.

2. The procedure has been commonly performed with and without fixation.

3. Postoperative management has traditionally and continues to be weightbearing.

4. Recognized postoperative complications have commonly included: delayed union, non-union, and malalignment. These complications have not been considered as frequent. The above discussion is not intended to emphatically state that weightbearing is not an acceptable form of management for the fifth metatarsal osteotomy. It is intended however, to emphasize and make the reader aware of a logical explanation for problems that we all have or will encounter.

The point of the discussion is recognition of the significance of radiographically visible and clinically appreciated changes that may indicate that the perfect "on the table" result may have lost some of its primary stability and may be more susceptible to shift and displacement that lead to a less than ideal result. Radiographic changes that indicate a potential problem include cortical fracture, shift, displacement, bone resorption, callus formation, and loosening and shift of fixation devices.

Clinical observations that suggest problems include persistent and localized edema, erythema, and pain. This clinical syndrome is encompassed in the full understanding of the irritation callus (Fig. 12).

Should clinical and radiographic findings indicate decrease or loss of stability, the forces that could produce deformity must be controlled. If the cortical hinge fractures and there is minor shift and even callus formation, weightbearing should be reduced or eliminated to avoid additional shift or other complications. The clinician should closely monitor the postoperative course of the patient and be continually aware of those indicators that suggest complications.

Specifically, in osteotomy of the fifth metatarsal should the surgeon identify changes that indicate loss of stability, measures must be taken to control the deforming forces and avoid loss of surgical alignment and function.

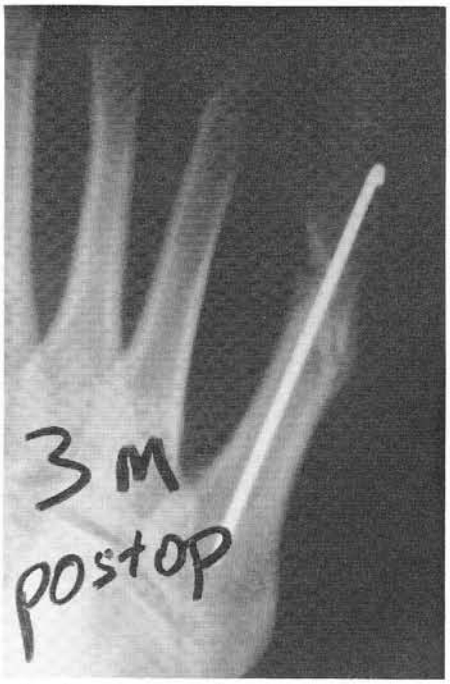

Fig. 6. Secondary bone healing indicates motion at the osteotomy site though not necessarily failure of the procedure.

Fig. 7. This oblique osteotomy of the first metatarsal healed with primary bone healing because the osteotomy was maintained non weightbearing.

Fig. 8. A long oblique fracture is vulnerable to the forces of displacement.

Fig. 9. An intact lateral cortical hinge will prevent displacement.

Fig. 10. A fractured lateral cortical hinge allows displacement to occur.

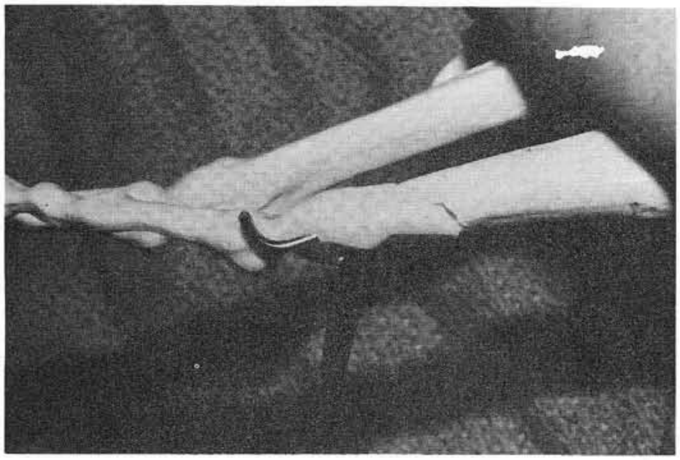

Fig. 11. Bone model studies have demonstrated the effects of load forces on the lateral cortical hinge.

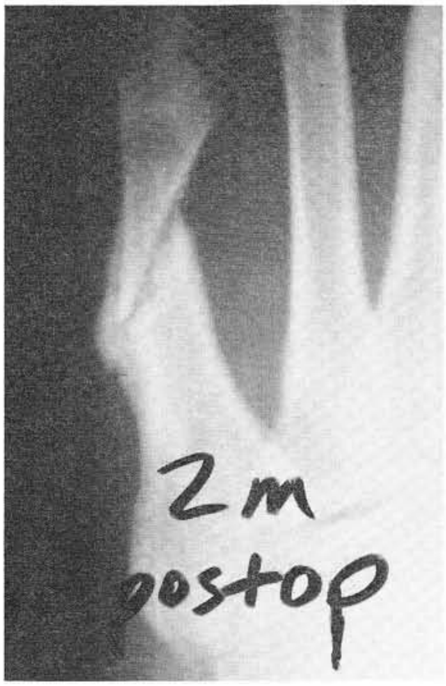

Fig. 12. The soft tissue swelling associated with the irritation callus can be seen.

Fig. 13. The lateral cortical hinge can be reinforced with a cerclage wire loop of the metatarsal at the osteotomy site.

Fig. 14. The modified Austin osteotomy can be applied to the fifth metatarsal and fixated with one or two 2.0 mm screws or 2.7 mm screws.

Fig. 15. The intrinsically stable transverse osteotomy is fixated with a cerclage wire loop in this young patient.

These measures might include devices such as cut-out surgical shoe, below knee cast, and even non weightbearing with ambulation on crutches.

Supplemental and Alternative Techniques

Continued interest and innovation in the technique of the fifth metatarsal osteotomy has produced several different approaches to the procedure. Dr. Tom Cain (1986) demonstrated reinforcement of the lateral cortical hinge with the use of a cerclage wire technique (Fig. 13).

Dr. Stanley Kalish (1986) applied the modified Austin concept to the fifth metatarsal osteotomy with a long dorsal cut and fixation via two 2.0 mm cortical bone screws (Fig. 14).

Return to the transverse wedge osteotomy with the incorporation of a transverse horizontal cerclage loop wire fixation technique has also been used (Fig. 15).

Summary

Obviously modifications on the theme are limited only by the imagination of the artist. As long as basic surgical and mechanical principles are followed, the surgeon is capable of producing a functional and pleasing result.

It is the consensus of opinion of the Doctors Hospital Podiatry Institute that the fifth metatarsal osteotomy for the correction of Tailor's bunion must follow the same fundamental guidelines of bone healing that we have come to adopt from the Swiss teachings. Combination of osteotomy design, stable fixation, and judicious postoperative management are the keys to a successful surgical procedure.

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