CHAPTER **24**

LAPIDUS ARTHRODESIS: Patient Selection and Surgical Technique

David J. Caldarella, D.P.M.

In the early 1930s, Paul Lapidus first described surgical correction for hallux abducto valgus deformity through an arthrodesis of the first metatarsocuneiform joint. Since his first description, the Lapidus procedure has endured much controversy in terms of its viability in hallux valgus surgery, from both an orthopaedic and podiatric perspective. Furthermore, continued debate exists regarding appropriate patient selection, surgical technique, and overall usefulness of the Lapidus arthrodesis technique.

The author has utilized the Lapidus arthrodesis as both a primary and a salvage procedure for advanced hallux abducto valgus deformity with gratifying clinical outcomes. The Lapidus procedure, when properly selected, executed, and managed in the appropriate patient can be effective, and at times, may be an ideal surgical option for specific hallux abducto valgus deformities.

PATIENT SELECTION

While the characteristics of HAV deformity are often generalized, specific considerations regarding key elements involved in advanced hallux abducto valgus deserve a thorough review and level of appreciation. Most modern-day surgeons appreciate the dynamic nature and interplay of structural and functional influences, however, the selection of a surgical procedure is often not directed at the primary level or apex of deformity. This reality often results in under correction and/or recurrence of the deformity over time. A complete review of the dynamics of structural and functional influences on surgical decision making in HAV deformity is beyond the scope of this paper, however, several meaningful components are recognized as contributory to the author's selection criteria when consideration to Lapidus arthrodesis is made.

Divergence of the first metatarsal from the second metatarsal is one of the most significant structural relationships in the etiology and progression of HAV deformity. The orientation and characteristics of the first metatarsocuneiform joint are often contributory to the development of progressive deformity, as well as directly correlating to an increased and/or pathologic intermetatarsal angle.

Table 1 outlines specific characteristics which are evaluated when considering Lapidus arthrodesis as a viable surgical method to attain correction. Dynamic soft tissue rebalancing around the first metatarsophalangeal joint (MTPJ) is routinely performed in combination with a Lapidus arthrodesis, as with other methods of structurally correcting a HAV deformity.

The decision to perform a Lapidus arthrodesis is based on criteria which includes a significant increase in structural intermetatarsal angle, combined with a variable degree of pathologic hypermobility at the first metatarsal-cuneiform articulation. This clinical scenario is appreciated through careful clinical and radiographic evaluation.

Table 1

GENERAL CONSIDERATIONS/ RATIONALE FOR THE LAPIDUS ARTHRODESIS

Significantly increased first intermetatarsal angle
Significant hypermobility at metatarsocuneiform joint
Evaluation of secondary metatarsalgia
Evaluation of secondary submetatarsal plantar lesions
First metatarsal length pattern
Second metatarsal cortical hypertrophy
Metatarsocuneiform joint architecture
Lesser digit / Lesser MTPJ pathologic changes

CLINICAL EXAMINATION

A thorough clinical examination of a hallux valgus deformity is of paramount importance in the selection of necessary and appropriate surgical procedures. Critical evaluation of this deformity has led the author to develop inclusion criteria which is based upon the physical examination and confirmed through radiographic evaluation.

A significant increase in the first intermetatarsal angle and its relation to pathologic motion at the metatarsocuneiform joint is assessed. This combination of moderate to severe hallux abducto valgus deformity and hypermobility at the metatarsocuneiform joint is regarded as the author's baseline "primary" inclusion criteria for Lapidus arthrodesis in a select adult population. Further examination often reveals "secondary" or more subtle, yet often significant evidence of pathologic function of the first ray which further supports the selection of Lapidus arthrodesis as a viable surgical option. These include evidence of a second digital deformity or second or lesser submetatarsal pathology directly related to the abnormal mechanics of the hypermobile metatarsocuneiform joint. The scenario as presented in Figures 1A-1E will serve as a representation of the thought process of inclusion criteria whereby Lapidus arthrodesis is considered.

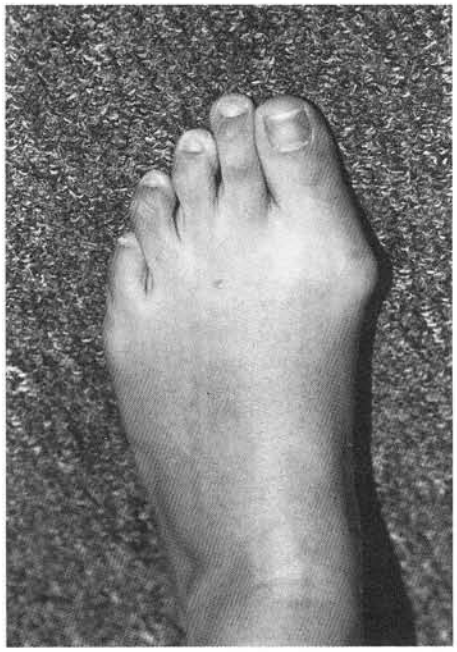

Figure 1A. Significant hallux abducto valgus deformity in an adult patient.

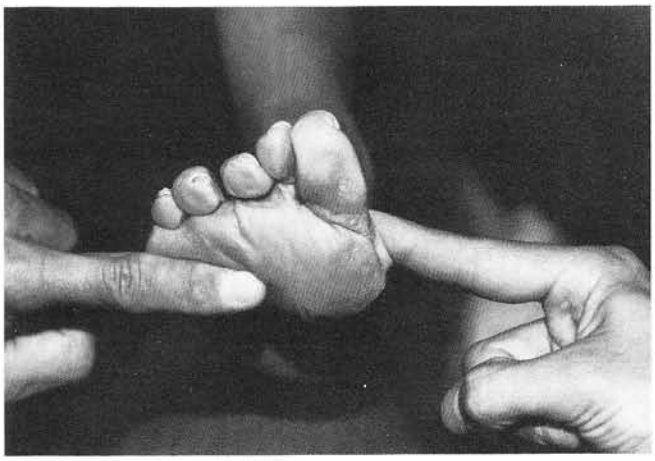

Figure 1B. Clinical examination reveals significant and pathologic motion at the first metatarsocuneiform joint. The navicular-cuneiform region is stabilized and manual manipulation of the first metatarsal-cuneiform articulation is performed.

Figure 1C. Note the significant motion at the first metatarsocuneiform joint.

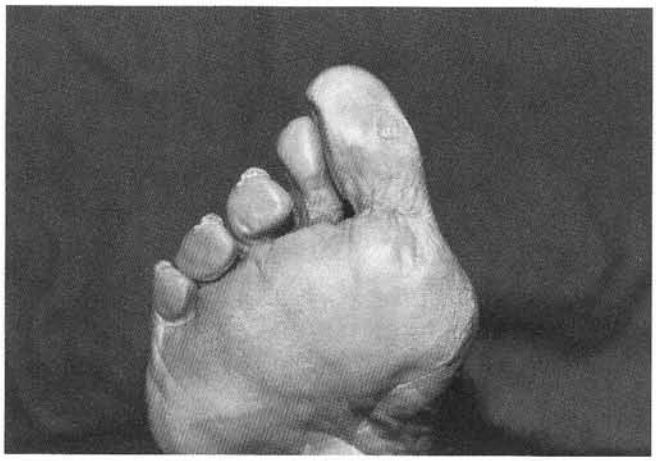

Figure 1D. Plantar aspect of the foot with evidence of a plantar lesion and second submetatarsal symptomatology secondary to a hypermobile first ray, and pathologic "lesser metatarsal overload."

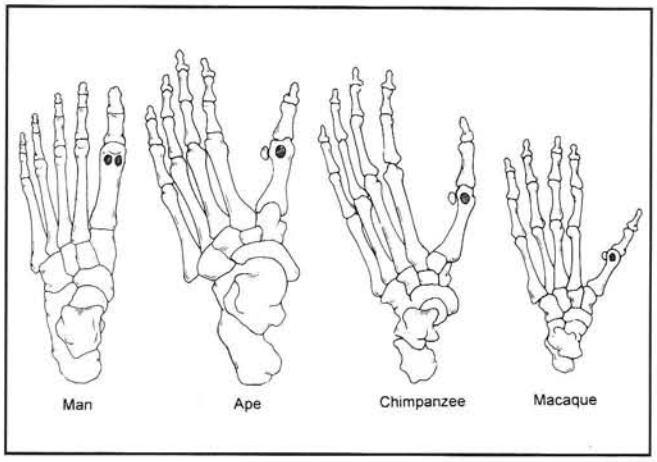

Figure 2. Comparison of first metatarsocuneiform joint to primates termed "atavistic."

RATIONALE FOR SELECTION OF LAPIDUS ARTHRODESIS

Many authors have described functional anatomy and theory regarding the structure and function of the first metatarsocuneiform joint, and a correlation to the selection of the Lapidus arthrodesis can be made. It is apparent through a review of evolutionary science that a distinct transition may have occurred in the context of the first metatarsocuneiform joint over time. The evolution and appearance of a flat-shaped and inherently stable first metatarsal cuneiform joint in man is contrasted to the anatomy of other primates (Fig. 2). Interestingly, the functional anatomy of the first ray has changed dramatically as bipedal gait has evolved, which certainly includes the first metatarsal cuneiform articulation. Hicks and Ebusui presented scientific data specific to the structure and function of the naviculo-cuneiform-metatarsal-hallux complex, and noted that a relative minority of motion occurs at the first metatarsocuneiform joint level relative to the entire range of motion throughout this axis (Fig. 3).

Figure 1E. Radiographic appearance of a significant increase in intermetatarsal angle and cortical hypertrophy of the second metatarsal radiographically correlated to lesser metatarsal overload. (Wolff's Law). Also note the degree of second MTPJ subluxation secondary to prolonged and increased stress at this level.

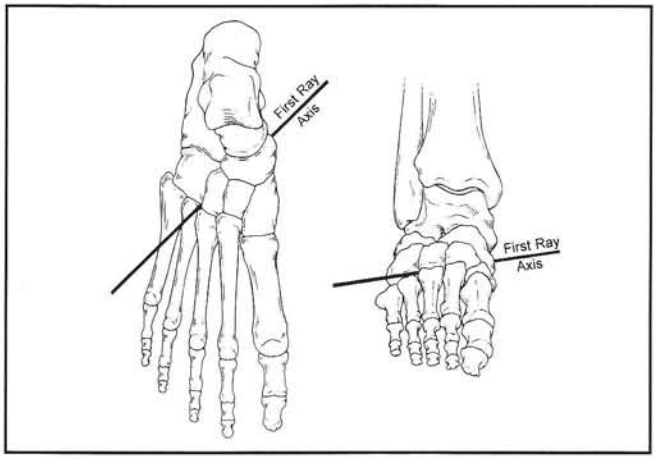

Figure 3. Dorsal and frontal views of the axis of rotation of the first ray.

"Structure dictates function" is a well-known basic tenet in functional anatomy, and appears to be meaningful in the context of the characteristics of normal and pathologic function of the metatarsocuneiform joint articulation. Pathologic motion often occurs at the first metatarsocuneiform joint, and is considered by the author and supported through scientific evidence, as a primary deforming influence on the etiology and more importantly the progression of select hallux abducto valgus deformities. Lapidus arthrodesis can effectively stabilize this pathologic influence and directly contribute to the neutralization of the structural intermetatarsal component in advanced hallux abducto valgus disorders.

SURGICAL TECHNIQUE

The author's modified surgical technique is presented through the following illustrations.

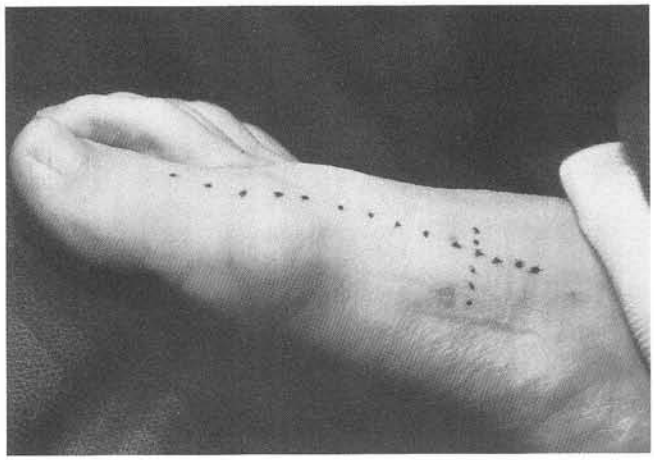

Figure 4A. Incision planning for access to the first metatarsophalangeal joint (MTPJ) and metatarsocuneiform joint (MTCJ).

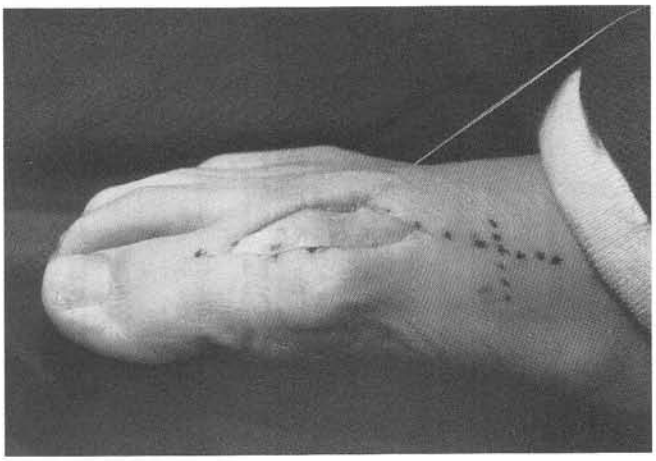

Figure 4B. Completed release at the first MTPJ and tagged adductor tendon for transfer as needed later in the procedure to complete rebalancing at the first MTPJ.

Figure 4C. Extension of the incision for access to the first MTCJ.

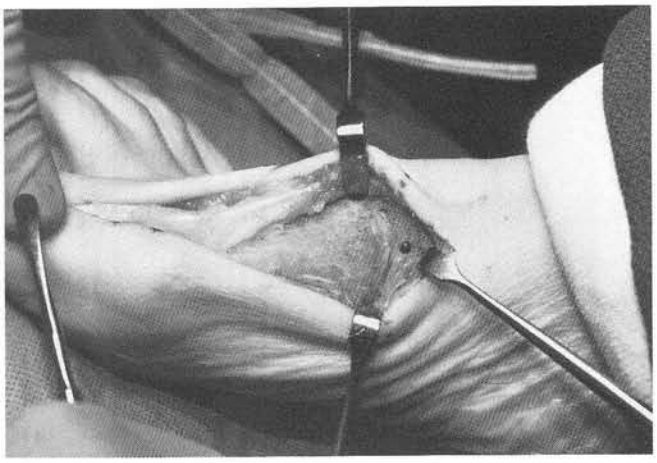

Figure 4D. Completed exposure at the level of the first MTCJ with complete dorsal/plantar visualization.

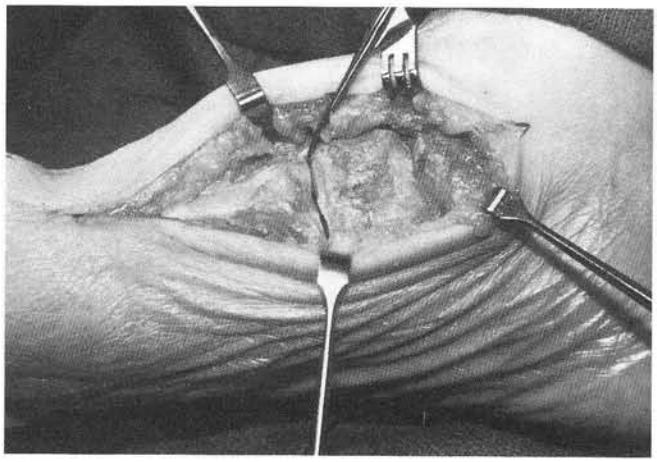

Figure 4E. Medial view of articular surface noted.

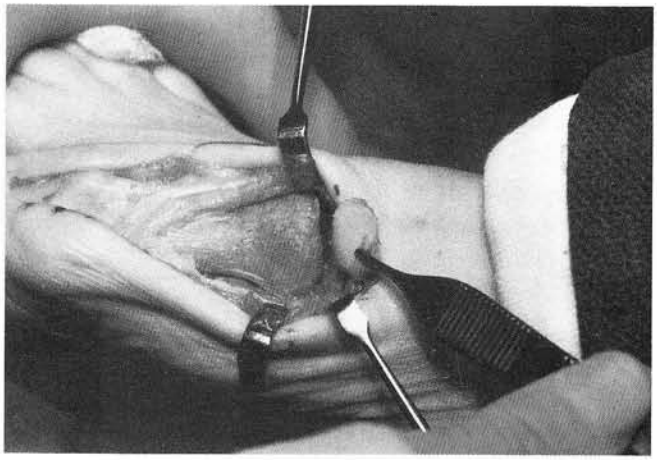

Figure 4F. Minimal resection of cartilaginous "cap" taken from the convex medial cuneiform.

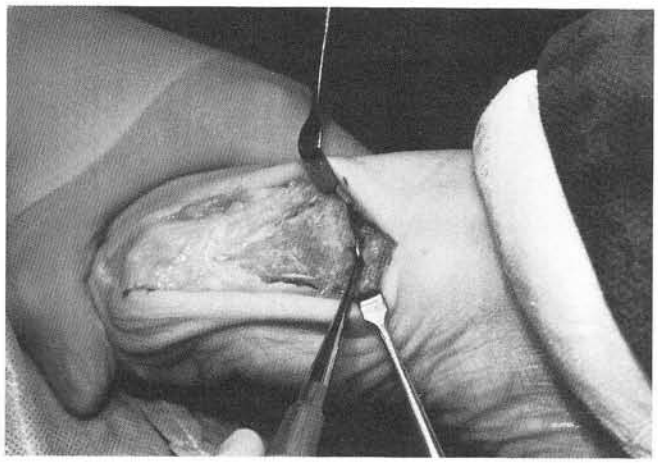

Figure 4G. Curettage technique to preserve length at the level of the concave first metatarsal base.

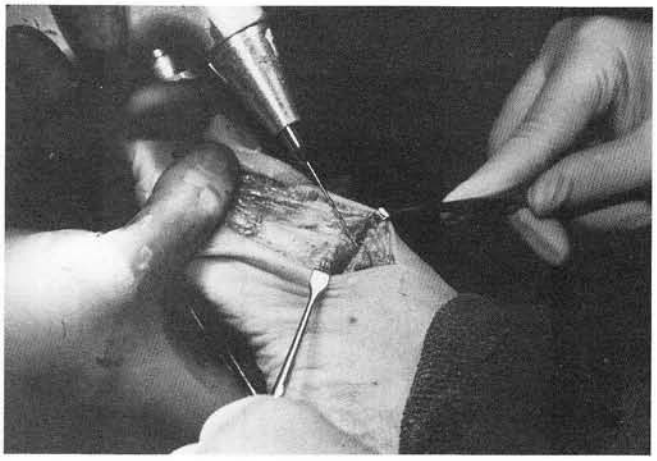

Figure 4H. Subchondral drilling to promote consolidation and primary bone healing at the arthrodesis site.

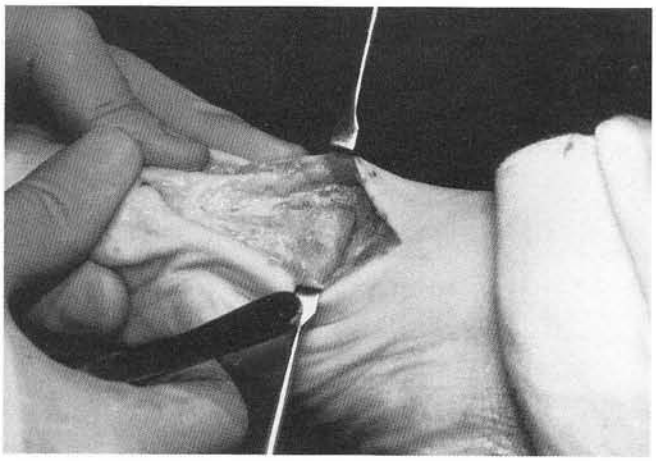

Figure 4I. Manipulation of the first MTCJ in sagittal and transverse plane to afford correction of deformity.

Figure 4J. Temporary fixation of the arthrodesis site.

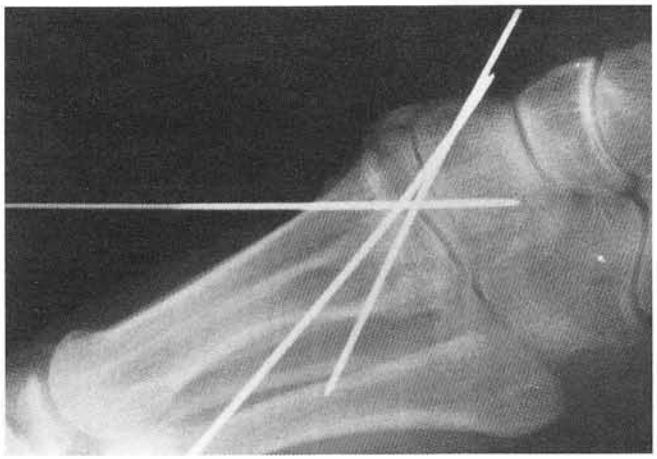

Figure 4K. Radiographic illustration of temporary fixation of arthrodesis site.

Figure 4L. Permanent fixation construct including three screw fixation technique.

Figure 4M. Permanent fixation construct including three screw fixation technique.

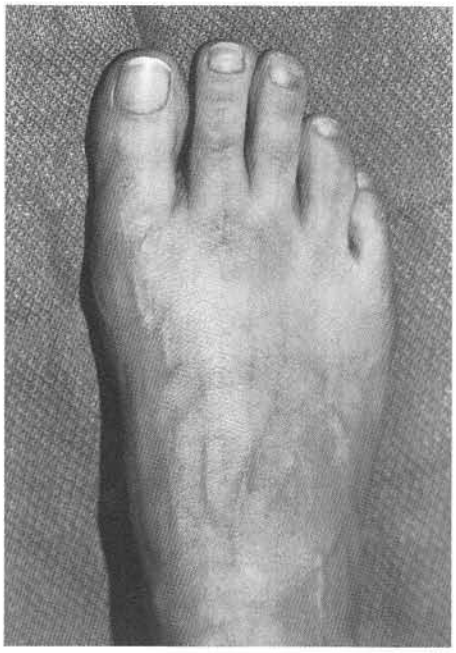

Figure 4N. Clinical photograph at approximately two years post Lapidus arthrodesis.

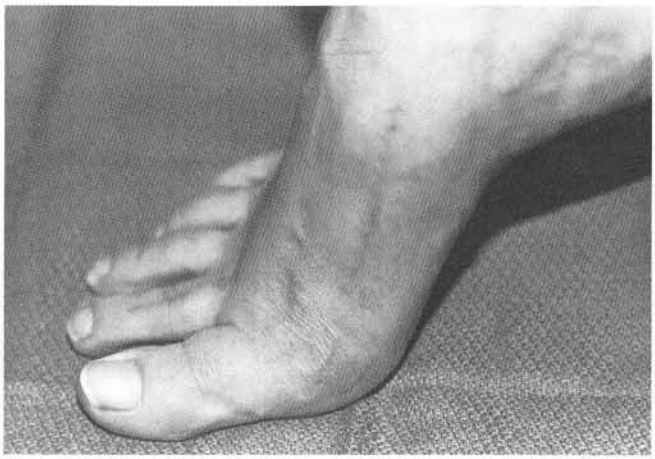

Figure 4O. Lateral view at 2 years postoperative.

The author's preferred surgical technique for Lapidus arthrodesis specific to hallux abducto valgus repair is generally through a dorsomedial incision. Surgical manipulation and soft tissue re-balancing are almost exclusively performed in combination with fusion of the first metatarsocuneiform joint. A dorsomedial approach provides optimal exposure to the medial and lateral aspect of the first metatarsophalangeal joint, and a proximal extension of this incision provides adequate exposure to the first metatarsocuneiform articulation. Through this approach, adequate access to the joint surfaces is possible. Appropriate internal fixation is also achieved with minimal disruption to adjacent tissues. Anatomic dissection techniques are utilized as have been well-described previously.

Care is taken to evaluate and completely reduce the lateral deforming forces at the first MTPJ, and following a sequential release, attention is directed proximally to the first metatarsocuneiform joint. As noted, the architecture of the first metatarsocuneiform joint reveals a narrow and relatively deep joint with a concave first metatarsal base and convex anterior cuneiform.

Critical elements in the appropriate preparation for Lapidus arthrodesis include several surgical considerations, including minimal resection of cartilaginous surfaces to the level of the subchondral bone plate of both respective surfaces. This maintains the normal anatomical shape of the joint surfaces and minimizes shortening of the first metatarsal length pattern. Generally this is accomplished through a joint curettage technique. Should further resection of bone be required to produce satisfactory IM correction in the transverse plane, care is taken to minimally resect bone from the convex medial cuneiform, primarily resected through a technique of reciprocal planing at the lateral 50% of the cuneiform. Preservation of the concave shape of the first metatarsal head is maintained.

Subchondral drilling/abrasion arthroplasty can be utilized as a surgical adjunct to promote primary bone healing. Often, the first metatarsal is manipulated into adequate alignment, reciprocal planing is performed, and temporary K-wires are used to assess position in the transverse and sagittal plane. Dorsal and plantar ligamentous and capsular tissues are released to afford satisfactory mobility at the joint level.

Another key element to satisfactory alignment in the sagittal plane is plantar transposition of the first metatarsal. The maneuver to plantarly translocate the first metatarsal relative to the cuneiform has proven to be a satisfactory method to create a normal transverse plane relationship of the first and lesser metatarsals. This is far less technically difficult than triplanal correction attained through joint resection, and has been described elsewhere. As discussed, the hypermobility of many advanced hallux abducto valgus disorders is addressed

through this manipulation, and a satisfactory transverse plane relationship of metatarsals 1 through 5 is achieved. Bone grafting can be utilized in those cases where excessive shortening is anticipated to be clinically problematic.

Internal fixation generally consists of a two or three screw fixation construct as noted in the illustrated technique. Once satisfactory alignment and internal fixation is achieved, attention to the MTPJ is made, and completion of the first MTPJ rebalancing is performed.

Closure is performed in anatomical layers, and a modified Jones compression dressing is applied and bivalved. Recommendations include bivalved short-leg cast or short-leg Cam-type walker following the first dressing change at postoperative day 3 to 5. Range of motion exercises are initiated at the first MTPJ immediately, and a period of 4 weeks of non-weight bearing is uniformly prescribed by the author. Select patients are candidates to begin partial weight bearing at postoperative week 5 provided appropriate internal fixation construct is protected from untoward stress through off-loading of the area, and strict compliance can be anticipated.

SUMMARY

Utilization of the Lapidus arthrodesis in a select patient population with advanced hallux abducto valgus can be a useful and predictable procedure with successful outcomes. Attention to appropriate patient selection, surgical technique and postoperative management is critical to its success.

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