

The Misuse of the Lapidus Procedure: Re-evaluation of the Preoperative Criteria

Fusion of the metatarsocuneiform joint has been documented in the literature for a number of conditions affecting the first ray. The fixation techniques have advanced greatly since Lapidus advocated the procedure, but the indications need to remain rigid and narrow. The review of the literature illustrates numerous complications, and this case presentation specifically depicts the long convalescence of the failed fusion of the first metatarsocuneiform joint. The Lapidus procedure ultimately should be used as a last resort to eliminate painful arthrosis from the metatarsocuneiform joint, reduce severe deformity, or give medial column stability to a paralytic or a spastic foot. If no pathology exists within the metatarsocuneiform joint, then surgeons should use other procedures to correct pathology of the first ray in elective foot surgery. (The Journal of Foot and Ankle Surgery 35(4):355-361, 1996)

Key words: hallux valgus; arthrodesis, metatarsocuneiform joint

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Arthrodesis of the first metatarsocuneiform joint has been documented in the literature since 1910, when Albrecht described the fusion to correct hallux valgus with metatarsus primus adductus (1). In 1925, Truslow described the use of a medial-based wedge from the medial cuneiform to correct metatarsus primus adductus (2). Kleinberg also advocated the use of a wedge from the medial cuneiform, but included resection of the lateral first metatarsal base to aid in correction of the metatarsus primus adductus and hallux abducto valgus (3). In 1934, Lapidus popularized metatarsocuneiform joint fusion to correct a nonreducible metatarsus primus adductus with hallux abducto valgus, which he concluded was congenital in nature and secondary to a medially angulated metatarsocuneiform joint. While Lapidus believed that correction at the metatarsocuneiform joint solved the problem, he admitted that the procedure required 3 months for healing. He also stated that elevation of the first metatarsal was possible (4, 5).

Fixation Techniques

Recent literature has documented various modifications to the procedure that have facilitated a more

favorable outcome. In 1974, Rutherford introduced the use of screw fixation to stabilize the fusion of the metatarsocuneiform joint (6). Giannestras and Butson used the medial eminence as a bone graft to be incorporated in the fusion site, thereby maintaining the length of the first metatarsal (7, 8). Sangeorzen and Hansen, who introduced two-screw fixation for fusion, disputed the use of the medial eminence as a bone graft. They contended that the medial eminence did not supply enough bone for grafting (9). Saffo *et al.*, in 1989, contended that plantarflexion of the first metatarsal was imperative to the success of the Lapidus procedure (10). In 1994, Chang and Ruch reported the use of a medial-placed five-hole 1/3 tubular plate with an obliquely lagged cancellous screw to maintain stabilization and compression (11). While all of these modifications have improved the outcome of this procedure, the indications, contraindications, and postoperative course must rigorously be addressed prior to its use.

Indications

Indications for the Lapidus procedure have been documented in the literature. The original indications of metatarsus primus adductus with severe hallux abducto-valgus by Lapidus are much less applicable today, but more indications have been documented. Authors have cited hypermobility of the first ray (9, 10, 12, 13), medial angulation of the metatarsocuneiform joint of 30° or greater (14), medial column instability (11), subluxation and degenerative changes of the metatarsocuneiform joint, and failed hallux abducto valgus surgery as indica-

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tions for the Lapidus procedure (9, 10, 13). Sangeorzen and Hansen emphasized that the evaluation and confirmation of hypermobility of the first ray is highly subjective between clinicians (9). Wu strongly emphasized that the Lapidus should only be used in a subluxed or severely arthrosed metatarsocuneiform joint (15). Chang and Ruch recently advocated fusion of the metatarsocuneiform joint in conjunction with other midfoot procedures to correct major deformities of the foot. They stated that the Lapidus "procedure is not usually performed as an isolated procedure, but the fusion is performed with other stabilizing procedures of the midfoot" (11). Although these indications have been documented, a strict adherence to these criteria has not been illustrated to qualify the use of the Lapidus procedure in elective foot surgery. Other procedures need to be considered before the fusion of the metatarsocuneiform joint, which would allow for normal biomechanics of the first ray and reduce the sequelae of complications associated with this procedure.

Contraindications for the Lapidus procedure include open epiphyses, gross osteoporosis, and a short first metatarsal (12). Butson (8) stated that the metatarsocuneiform joint fusion in the presence of hallux limitus is contraindicated, but this can be overcome with a prosthetic joint or a distal osteotomy to correct the limited motion of the first metatarsophalangeal joint as stated by Butson (8) and Bacardi and Boysen (12). When a short first metatarsal is noted, a tricortical bone graft must be used to maintain length and gain weightbearing status of the first metatarsal head. Saffo *et al.* avoided the use of a bone graft but strongly emphasized the importance of plantarflexion of the metatarsal to gain weightbearing status of the first metatarsal (10). Saffo *et al.* also reported that a shortening osteotomy of the second metatarsal was used on some of the patients, which accounted for nonshortening of length of the first metatarsal (10).

Case Presentation

A 27-year-old female presented to the authors, complaining of a painful left bunion of over 2 years. The patient related that she had prior surgery in an attempt to correct her painful bunion, which was still symptomatic. Review of systems and past medical history were unremarkable with the exception of a penicillin allergy.

Physical examination revealed bilateral hallux abductovalgus deformities with pain on palpation of the shaft of the left first metatarsal. Range of motion of the first metatarsophalangeal joint of the left foot was limited, and range of motion of the metatarsocuneiform joint of the left foot demonstrated moderate to severe pain with limitation of motion. Gait analysis revealed an altered

antalgic gait with the left foot inverted and bearing weight on the lateral aspect. The neurological and vascular examinations were unremarkable.

Radiographs taken of the left foot revealed a pseudoarthrosis of the metatarsocuneiform joint of the left foot. Two screws crossed the joint space with a recurrent hallux abductovalgus deformity and moderate hallux interphalangeus. The first metatarsal was elevated (Fig. 1).

Previous medical records were reviewed. These noted bilateral hallux abductovalgus deformities with hypermobile first rays. Initial preoperative radiographs demonstrated an intermetatarsal angle of 14° with 15° of hallux interphalangeus and a metatarsus adductus angle of 20°. The previous operative report described that a Lapidus procedure with bone graft was used at the arthrodesis site.

Intraoperative radiographs of the first surgery revealed a Reverdin osteotomy that appeared to transect the sesamoids and temporary fixation of the metatarsocuneiform joint fusion with bone graft. The patient was allowed to bear weight 3 weeks postoperatively and cast immobilization was discontinued at an additional 4 weeks.

Upon presentation to the authors, the patient complained of continued pain in the operative site. She complained of persistent pain in the metatarsocuneiform joint of the left foot and a progressive hallux abductovalgus deformity. The patient also complained of pain in the head and shaft of the left second metatarsal, which were suspicious of a stress fracture. Five months of consultation and conservative treatments that included soft casting, accommodative padding, functional orthoses, and nonsteroidal anti-inflammatory medications provided little relief. The patient was scheduled for revisional surgery to resect the non-union of the affected joint and to correct the original hallux abductovalgus deformity. The patient was informed that the previous fixation would need to be removed and the pseudoarthrosis would need to be resected and replaced with a bone graft. The patient understood the benefits of the procedure as well as the possible risks and complications, and was willing to proceed.

The patient was transported to the operating room and placed on the operating room table in the supine position. In anticipation of the use of internal fixation, the patient was prophylaxed with 600 mg. of Clindamycin. Under general anesthesia, hemostasis was maintained with a mid-thigh tourniquet at 350 mm. Hg. The initial procedure was a bunionectomy with a modified Hohmann osteotomy of the neck of the left first metatarsal. The osteotomy was made perpendicular to the long axis of the second metatarsal in the transverse plane and slightly oblique to the long axis of the first metatarsal in the sagittal plane. The capital fragment was

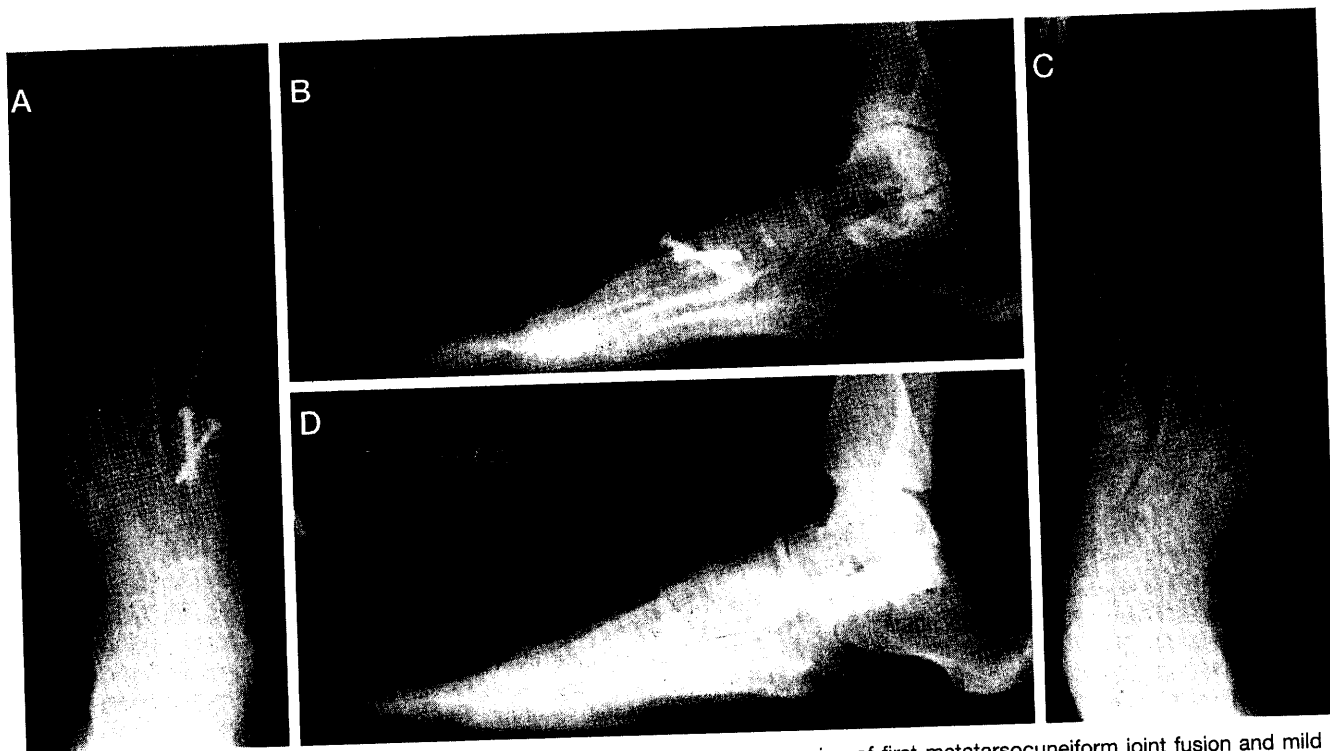


FIGURE 1 A, Anterior-posterior radiograph of left foot preoperatively. Note non-union of first metatarsocuneiform joint fusion and mild to moderate severity of hallux abducto valgus deformity. B, Lateral radiograph of left foot preoperatively. Elevation of first metatarsal appears to be moderate in severity. Note the lack of fusion of the first metatarsocuneiform joint. C, Anterior-posterior radiograph of right foot. Asymptomatic foot of patient with moderate increase in intermetatarsal angle and mild angulation between first metatarsal and medial cuneiform bones. D, Lateral radiograph of right foot. Note no elevated status of first metatarsal.

transposed 2 mm. laterally and plantarly and subsequently fixated a 2.7-mm. cortical screw using standard lag technique. On completion of the first procedure, the original fixation screws were removed. The arthrodesis site revealed absent bony union between the first metatarsal and medial cuneiform. Two-millimeter sections of bone were resected from the first metatarsal and medial cuneiform, and resected portions of bone were noted to have intact cartilage present on opposing joint surfaces.

The arthrodesis site was then prepared for introduction of an allogenic cortical and autogenic cancellous bone graft. The cortical graft was shaped to achieve plantarflexion and adduction of the first metatarsal as well as maintain length. The cortical strut was combined with an autogenic cancellous graft, which was harvested from the lateral aspect of the left calcaneus. With the cancellous autograph placed inside the allogenic cortical graft, these two components were used to maintain a stable site for length and optimal position and stimulate osteoinduction. The combination graft was placed into the fusion site and stabilized with a 0.062-inch Kirschner wire obliquely placed percutaneously across the fusion site from a distal medial plantar to proximal lateral dorsal direction. Additional fixation of a five-hole neutralization plate was used to stabilize the graft in its

proper position. The plate was maintained in position with a 3.5-mm. cancellous screw in the medial cuneiform and a 2.7-mm. cortical screw into the first metatarsal. The K-wire-neutralization plate fixation was found to be stable.

The proximal phalanx of the hallux was then addressed. An oblique Akin osteotomy was made. The first osteotomy was made from proximal lateral 1 cm. from the first metatarsophalangeal joint to distal lateral. A second osteotomy was made in the same direction and less oblique to create a resultant wedge 2 mm. wide on the medial aspect of the proximal phalanx. The bone fragment was removed. The osteotomy was reduced and fixated with two crossed 0.045-inch K-wires. The operative sites were closed, and drains were placed in medial and lateral surgical sites. The patient was placed into a posterior fiberglass splint and admitted to the hospital for 23 hr. Upon hospital discharge, the drains were removed, surgical sites were redressed, and the posterior splint was reapplied to the left lower extremity. The patient was instructed to ambulate with crutches and remain nonweightbearing on her affected foot. The patient was placed into a below-knee cast 7 days later and maintained nonweightbearing for 17 weeks until fusion of the first metatarsocuneiform joint was achieved and the bone graft site demonstrated radiographic in-

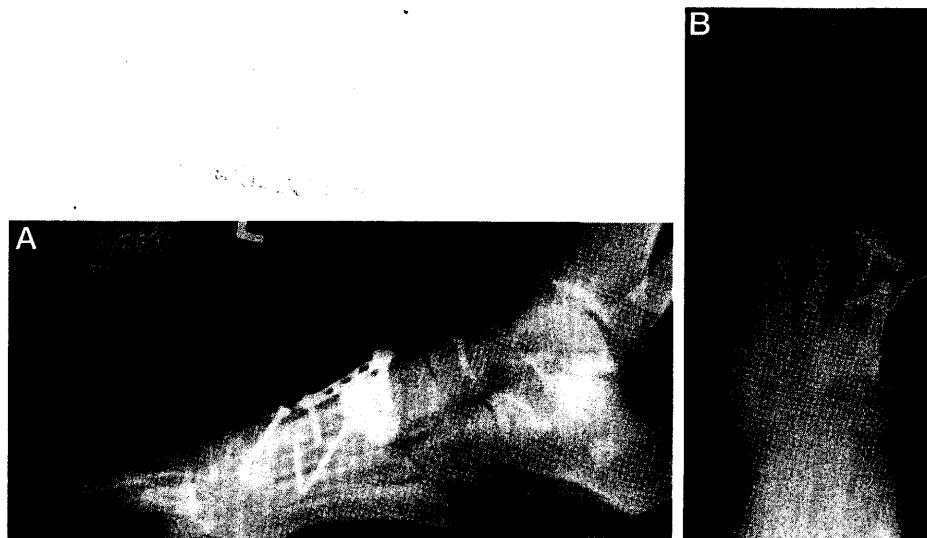


FIGURE 2 A, Lateral radiograph of left foot 11 weeks postoperative. Note placement of cortical allograft into fusion site and capital osteotomy, which is transposed plantarly to gain further correction. Also note the cortical window in calcaneus where cancellous autograft was retrieved. A 0.062-inch K-wire is placed obliquely to aid in stabilizing the graft in conjunction with the one-third tubular plate. B, Anterior-posterior radiograph of left foot 11 weeks postoperatively. Fixation with the one-third tubular plate is used to maintain position while graft is incorporated. 0.062-inch K-wire is placed obliquely to maintain the stability of the lateral aspect of fusion site.

corporation. The patient ultimately remained casted for 21 weeks.

An OrthoPak³ bone stimulator was also used from the second postoperative week until the 20th week postoperatively from the first reconstructive surgery. K-wires of the proximal phalanx were removed 4 weeks postoperatively. The K-wire and neutralization plate at the fusion site remained in place for 16 weeks postoperatively, at which time the patient was returned to the operating room for the removal of the remaining internal fixation hardware because of superficial irritation. The patient was placed in a below-knee cast postoperatively for protection of loss of stress shielding of the fixation devices. The patient was allowed to begin weightbearing ambulation at 17 weeks. At 21 weeks, the cast was removed and the patient was allowed to begin ambulation with orthotics. The patient had no complaints of pain at the arthrodesis site and had no limitation of ambulation.

Postoperative radiographs were taken at immediate postoperative period, 6, 11, 15, 21, and 33 weeks, and 1.5 years (Figs. 2-4). The osteotomies and bone graft were analyzed serially to monitor for maintenance of correction, displacement, and graft incorporation. The cortical graft appeared to show steady incorporation and all osteotomies healed without complications. The patient did not relate any symptoms of pain at the fusion site or the distal aspect of the first ray and was able to participate in normal daily activity without any pain or limita-

tion. Nine-month, and 1.5-year follow-up revealed satisfactory reduction of the deformities with mild elevation of the left first metatarsal. The cortical graft also showed progressing incorporation between the first metatarsal and the medial cuneiform.

Discussion

The Lapidus procedure has long been proven to possess many complications and require a long postoperative period of convalescence. In his original and following presentations, Lapidus related no specific results of his patient outcomes, but he did emphasize an extensive immobilization period postoperatively for up to 3 months. He also warned that, despite the improved correction of the deformity, dorsal drift of the metatarsal is possible if not addressed (5). Richardson indicated that fusion of the metatarsocuneiform joint was technically difficult, and the postoperative period of morbidity was extensive. He ultimately recommended that the fusion of the metatarsocuneiform joint be limited to patients with recurrent metatarsus varus or spastic deformity (16). Butson made similar statements that the Lapidus procedure "is precise and there is little latitude for technical deviation" (8).

Sangeorzen and Hansen related that, when the Lapidus procedure was used as a primary corrective procedure for hallux abductovalgus, successful results were demonstrated in 75% of 33 cases reviewed despite the successful union of 90% of those cases. These authors also admitted that their failure rate based on radio-

³ Bioelectron, Inc., 200 Holt Street, Hackensack, New Jersey.

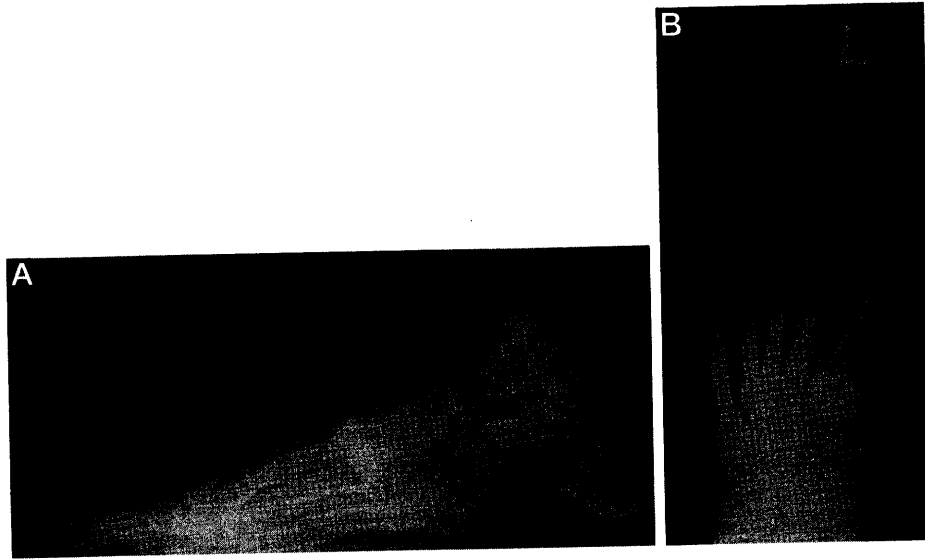


FIGURE 3 A, Lateral radiograph of left foot 33 weeks postoperatively. The first metatarsocuneiform joint appears fused, with graft site showing steady incorporation. B, Anterior-posterior radiograph of left foot 33 weeks postoperatively. Additional correction of intermetatarsal angle could have been achieved, but the main goal of joint fusion appears to be radiographically successful. While a step-off is evident at medial cuneiform, this has not affected the patient clinically.

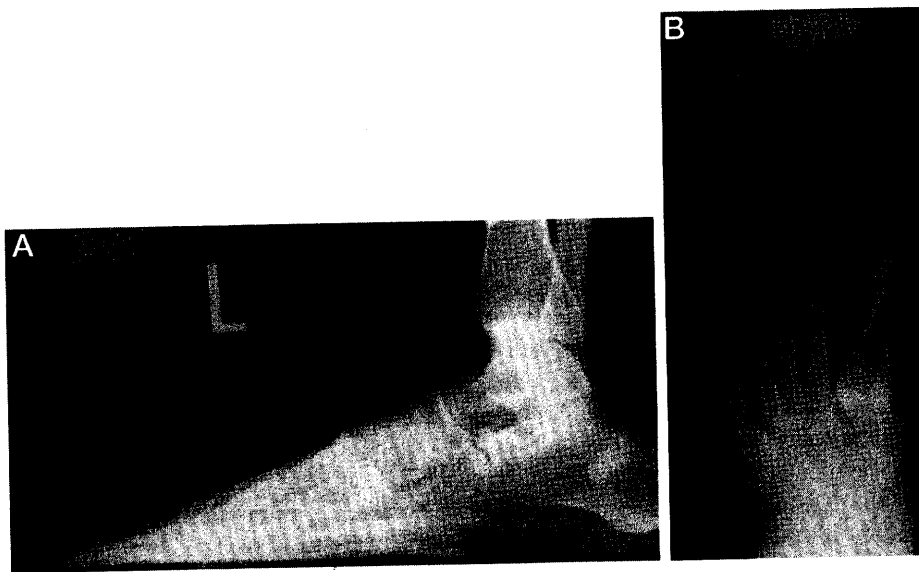


FIGURE 4 A, Lateral radiograph of left foot 1.5 years postoperatively. Incorporation of graft into fusion site shows further integration and reorganization. First metatarsal still shows mild to moderate elevation radiographically. B, Anterior-posterior radiograph of left foot 1.5 years postoperatively. Note the graft incorporation progression. The step-off of the medial cuneiform is still evident but this has not affected the patient clinically.

graphic and clinical parameters was 8 of 40 procedures, or 20% (9).

Saffo *et al.* demonstrated that, in 54 procedures performed on 44 patients, 12% resulted in non-union and pseudoarthrosis. Another 14% of their subjects developed transfer lesions of the lesser metatarsals secondary to elevation of the first metatarsal (10). Myerson, Allou, and McGarvey (17) also related that 12% of 62 procedures in patients who had undergone metatarsocuneiform joint arthrodesis developed a

pseudoarthrosis. They considered this outcome acceptable and not a complication when the patient demonstrated no symptoms (17).

Mauldin, Sanders, and Whitmer reported a 25% fusion rate in 51 feet with the use of an inlay bone graft to fuse the metatarsocuneiform joint. They also reported that stability of the joint was maintained without extensive dissection of the metatarsocuneiform joint, but their incidence of hallux varus was 15% or eight feet (18). Sangeorzen and Hansen stated that they had reservation

toward the findings of other authors who state that metatarsocuneiform joint non-unions were asymptomatic (9).

These studies clearly depict only some of the possible complications of the Lapidus procedure. These authors consider the above unacceptable rates for uncomplicated elective foot surgery. It is the opinion of these authors that, when the complication rate for any elective foot procedure rises above 3%, the procedure, technique, indications, and contraindications should be heavily scrutinized to evaluate the effectiveness of the particular procedure.

Fusion of the metatarsocuneiform joint also possesses a potentially costly biomechanical outcome. Butson advocated the use of a prosthetic joint implant for the first metatarsophalangeal joint to combat hallux limitus (8). Bacardi and Boysen stated that upon fusion of the metatarsocuneiform joint, hallux limitus will result, which they reduced by the use of an implant at the first metatarsophalangeal joint (12).

Christensen also states that a functional hallux limitus will occur in postoperative Lapidus procedure patients if the fusion includes the base of the second metatarsal (19). No studies have ultimately reviewed the biomechanical long-term effects of the Lapidus procedure, but the study of other joints of the body can provide insight to the possible outcome. First metatarsophalangeal joint fusions have been contraindicated when degenerative arthritis of the interphalangeal joint is present (20, 21). Some authors have indicated that excessive strain may be placed on the interphalangeal joint of the hallux when fusion of the first metatarsophalangeal joint is performed (22, 23). Patients who have undergone triple arthrodesis of the rearfoot have been shown to ultimately have modifications at their ankle joints and Lisfranc's joints secondary to the lack of rearfoot motion (24). Other studies of the motion of the foot, after ankle joint fusion, indicate that distal joints must accommodate and will ultimately show signs of arthrosis and degeneration (25, 26). These examples demonstrate that the outcome of joint fusion will have a strenuous effect on the remaining functioning joints of the lower extremity. If fusion of the metatarsocuneiform joint is attempted without proper review of the indications, the biomechanical outcome can have deleterious effects on the remaining joints of the first ray.

The case presented in this paper illustrates the severity of complications and the subsequent scenario endured by this particular patient because of the improper review of indications for the fusion of the first metatarsocuneiform joint. The initial clinical and radiological presentations were not severe enough to immediately consider the use of the Lapidus procedure. The predominant problem in the postoperative care of the original

procedure was that the patient was allowed to ambulate bearing weight on her left foot long before the graft had incorporated and the arthrodesis was completely healed.

Other procedures also needed to be considered to correct the patient's original deformity. Prior to the use of a joint-destructive procedure, a closing base wedge osteotomy with a distal neck osteotomy could have been utilized to correct the deformity. An opening wedge osteotomy of the medial cuneiform incorporating a bone graft as described by Cotton (27) and Fowler, Brooks, and Parrish (28) could also be used to decrease the intermetatarsal angle, and decrease the obliquity of the metatarsocuneiform joint in a patient with metatarsus primus adductus. These procedures would correct these and similar deformities without destroying the normal motion of a potentially functional first ray articulation. Utilization of these possible procedures and closer initial postoperative care monitoring could have saved this particular patient the prolonged convalescence due to the original attempt of metatarsocuneiform joint fusion. The presentation of this particular case emphasizes the need to establish a more objective and strict evaluation of criteria for the Lapidus procedure, or to ultimately restrict its use completely in elective surgery of the first ray if no symptomatic pathology exists within the metatarsocuneiform joint.

The Lapidus procedure should ultimately be used as a salvage procedure for failed hallux abductovalgus surgery and for the severely arthrosed, degenerated, and subluxed metatarsocuneiform joint with 30° of medial angulation. A recent study has shown that the measurement of the medial angulation of the metatarsocuneiform joint radiographically will change with positioning and technique (29). This fusion could also be considered when used in conjunction with other procedures to correct severely deformed feet as described by Chang and Ruch (11). Metatarsocuneiform fusion should also be considered in patients with spastic or paralytic feet to control first ray pathology which may occur in Charcot-Marie Tooth patients or post-polio patients. The use of the Lapidus procedure for first-time hallux abductovalgus correction should be avoided, to maintain the function of the metatarsocuneiform joint and first ray.

Summary

Use of the Lapidus procedure has been presented. Fusion of the metatarsocuneiform joint should not be used as a first line procedure for correction of hallux abductovalgus because of the prolonged convalescence and high rate of complications. The Lapidus procedure should only be used when symptomatic pathology exists within the first metatarsocuneiform joint and should follow guidelines for fusion of any joint. The goal of the

Lapidus should be to eliminate painful arthrosis of the metatarsocuneiform joint, to correct severe deformity, or provide stability across a joint in paralytic or spastic feet. If the metatarsocuneiform joint demonstrates no signs or symptoms of pain or limitation of function, surgeons should consider other procedures within their armamentarium to correct the underlying pathology of the first ray.

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