The Journal of Foot & Ankle Surgery 50 (2011) 272–275

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Original Research

Results of Modified Lapidus Arthrodesis Procedure Using Medial Eminence as an Interpositional Autograft

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ARTICLE INFO

Level of Clinical Evidence: 4
Keywords:
bone graft
bunionectomy
hallux valgus
metatarsal
surgery

ABSTRACT

The Lapidus procedure has received wide acceptance as a valuable operation for correcting moderate to severe hallux valgus, especially in the presence of hypermobility. However, shortening of the first ray inherently occurs as the first metatarsocuneiform joint cartilage and subchondral bone are resected in preparation for arthrodesis. The purpose of this study was to radiographically compare the degree of shortening of the first ray with and without the use of the first metatarsal medial eminence as an interpositional autograft at the site of metatarsocuneiform fusion. Preoperative and postoperative radiographs were measured in 35 consecutive patients who underwent 37 modified Lapidus procedures for hallux valgus repair. In group A, 20 surgeries were performed without use of the interpositional autograft, and served as the control. In group B, 14 surgeries were performed using the medial eminence as an interpositional autograft. The mean amount of first ray shortening was 5.3 ± 1.66 mm in group A and 2.69 ± 1.56 mm in group B, and this difference was statistically significant ($P < .001$). All patients progressed to complete union, and the median follow-up was 6 months (range, 4–60). Based on these results, the use of the medial eminence as an interpositional autograft in conjunction with Lapidus arthrodesis resulted in a 49.2% reduction in the amount of shortening of the first ray and proved to be a useful source of readily available bone graft.

In 1934, Lapidus described first metatarsocuneiform (MC) arthrodesis for correction of hallux valgus (1). Resection of the metatarsocuneiform joint (MCJ) allowed for dramatic correction in the sagittal, frontal, and transverse planes. Inherently, however, resection of the MCJ led to shortening of the first ray, often with resultant overload of the second ray, development of intractable plantar keratosis, lesser metatarsal stress fracture, and predislocation syndrome of the second metatarsophalangeal joint (MTPJ), all of which have come to be known as potential complications of the Lapidus procedure.

In an effort to counteract these complications, Butson (2) described use of the medial eminence from the first metatarsal head exostectomy as a bone autograft to be used during MC fusion, the graft being positioned between the first metatarsal base and medial cuneiform and stabilized with Kirschner wire fixation. Butson reported good to excellent results in 110 (92.44%) of 119 feet with no cases of non-union; however, no mention was made as to the amount of first ray shortening when the autograft was used (2).

The aim of the investigation that we describe in this report was to quantify the amount of shortening of the first ray after Lapidus arthrodesis with and without use of the first metatarsal head medial eminence as an interpositional autograft at the site of the first MC arthrodesis. We hypothesized that the use of autologous medial eminence with the Lapidus procedure would result in significantly less shortening and would be adequate without compromising healing of the fusion site.

Patients and Methods

The authors undertook a review of the medical records of consecutive patients who underwent Lapidus arthrodesis over 87 months, from January 2001 to March 2008. To be included in the cohort, a patient had to have undergone a Lapidus arthrodesis, with or without use of the resected first metatarsal medial eminence as an interpositional autograft at the site of the MC fusion, during the observation period. Consecutive patients who had undergone Lapidus arthrodesis were identified from the records of the senior author (T.S.), using the Current Procedure Terminology code 28297 as the search term. The authors procured the identified records and abstracted information from the charts. Exclusion criteria included patients who necessitated any additional

Financial Disclosure: None reported.
Conflict of Interest: None reported.
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doi:10.1053/j.jfas.2011.02.012

bony procedure on the first or second metatarsal that would effect the measurement of the metatarsal protrusion distance. In addition, 3 of 49 radiographs were damaged during prolonged storage. Incomplete drying prior to filing or moisture during storage caused films to stick together, and they were damaged while trying to separate them. Thus, we were unable to obtain accurate pre and/or post surgical measurements from these few damaged films. These patients also were excluded from our study data. Union of the arthrodesis was defined as radiographic consolidation across the fusion site with an asymptomatic foot, as determined by the authors. First and second metatarsal protrusion distances were measured on the immediate preoperative and late-term postoperative weight-bearing anteroposterior radiographs. With regard to the assessment of the shortening of the first ray, an arbitrary point of reference was chosen at the distal navicular cartilage where the medial and intermediate cuneiform joints coincide (Figure 1). A line was then measured from this point to the most distal aspect of the first and second metatarsal heads and recorded in millimeters. The difference between the lengths of the first metatarsal and second metatarsal was compared preoperatively and postoperatively (Figures 2 and 3).

Surgical Intervention

After standard prepping, draping, and application of an ankle tourniquet, a single longitudinal incision was created medial and parallel to the extensor hallucis longus tendon from the medial cuneiform to the midshaft of the hallux proximal phalanx. The incision was carried through the subcutaneous layer with care to cauterize and/or retract all vascular structures and to retract any nerves. Next, the capsular and periosteal incision was performed to expose the first MTPJ and first MCJ. A sagittal saw was then used to remove the cartilage and ligamentous attachments from the medial aspect of the medial eminence of the first metatarsal head. The thickness of the removed bone was typically 1 to 2 mm. Next, a parallel cut with the saw was made to remove the remaining medial eminence with care taken to preserve the sagittal groove plantarly for articulation with the base of the proximal phalanx and the tibial sesamoid. After removing any remaining cartilage and soft tissue from the autograft with a rongeur, the bone was then placed on the back table in saline solution to await placement into the first MC fusion site, in those cases wherein the interpositional autograft was to be used; otherwise, the eminence was discarded. Next, the lateral release and first MCJ preparation were performed in a standard fashion. In every case, the sagittal saw was used for cartilage and subchondral plate removal, keeping the amount of bone resection to a minimum. The opposing surfaces of the first metatarsal base and medial cuneiform were then fenestrated, and, in those cases wherein the interpositional autograft was used, the graft bone was positioned at the site of the MC fusion and checked with intraoperative fluoroscopy. Using standard principles of osteosynthesis, the MC fusion was then stabilized with two 4-mm diameter, partially threaded, cannulated cancellous screws inserted in a lag fashion from distal to proximal. The wound was then closed in layers and dressed in standard fashion. The postoperative recovery entailed 6 to 8 weeks of non-weight bearing in a below-the-knee cast with crutches to assist ambulation.

Fig. 1. Ridge on distal surface of navicular at the intersection of the medial and intermediate cuneiforms used as a point of reference to measure metatarsal lengths (circled area).

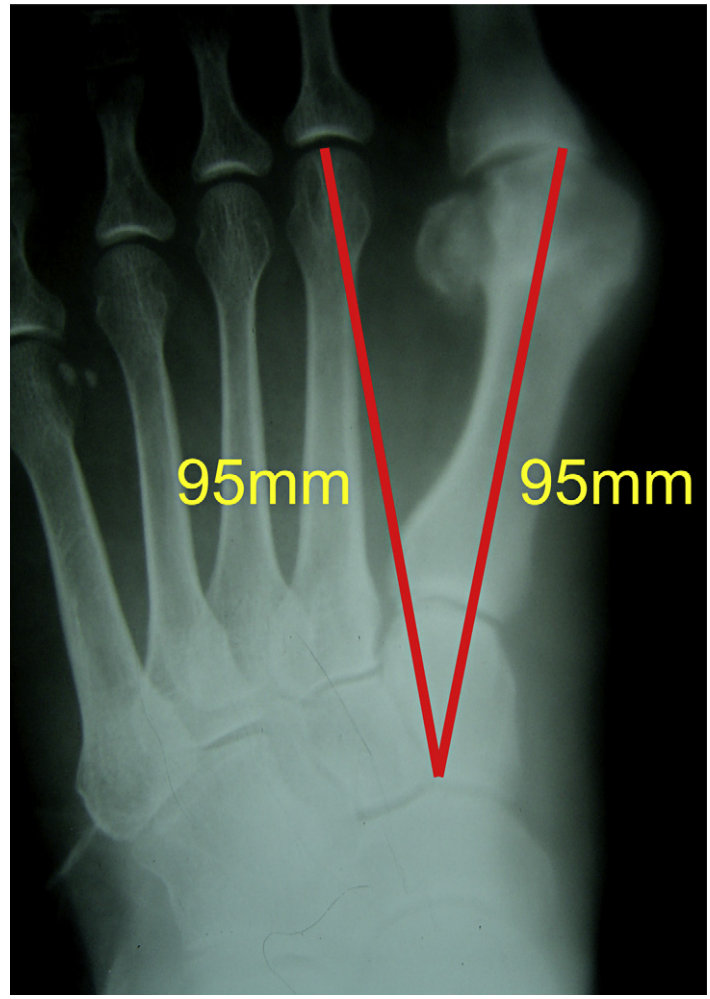

Fig. 2. Preoperative measurements of relative lengths of the first and second metatarsals.

Results

Thirty-nine consecutive patients were identified as eligible for inclusion in the retrospective cohort. One surgeon (senior author, T.S.) performed all of the operations. One patient, who underwent a concomitant Reverdin osteotomy of the first metatarsal at the time of the Lapidus procedure, was excluded based on the aforementioned criterion. Three patients with missing or damaged radiographs were also excluded. Therefore, 46 procedures (35 patients) were included in the analyses. Nine patients underwent a second (bilateral) procedure at a separate surgical encounter. A comparison of the demographic and outcome variables, based on whether the interpositional autograft was used, is depicted in Table 1. Overall, 46 Lapidus procedures were performed in 37 (80.4%) women and 9 (19.6%) men. Overall, the mean age of the cohort was 42.4 years (range, 13–74 years). A total of 20 (43.5%) procedures were performed without use of the interpositional medial eminence autograft, whereas 26 (56.5%) procedures were undertaken with use of the autograft. Group A (MC fusion without autograft) had 20 Lapidus procedures performed on 13 (65%) women and 7 (35%) men with a mean age of 40.4 years (range, 14–74 years). Group B (MC fusion with autograft) had 26 Lapidus procedures performed on 25 (96.2%) women and 1 (3.8%) man with a mean age of 43.9 years (range, 13–72 years). The mean shortening was 5.3 ± 1.66 mm for group A (MC fusion without autograft), and 2.69 ± 1.56 mm for group B (MC fusion with autograft), and this difference was statistically significant ($P < .001$). There was 1 delayed union (6 months), 1 malunion (Hallux varus