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Immediate Weightbearing after Lapidus Arthrodesis with External Fixation

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ABSTRACT

A common surgical treatment of severe hallux abductovalgus deformity with coincident first ray hypermobility is metatarsal-cuneiform fusion or Lapidus procedure. The aim of the present study was to illustrate a reliable and novel method of fixation for Lapidus fusion using an external fixation device through a retrospective cohort investigation of consecutive patients. Twenty Lapidus fusions were performed in 19 patients, including 17 females (89.47%) and 2 males (10.53%). The mean age at surgery was 41 (range 20 to 64) years. The patients were evaluated clinically and radiographically pre- and postoperatively. The mean duration in the fixator was 12 (range 3 to 34) weeks. The mean interval to radiographic union was 9.2 (range 4.7 to 30.7) weeks in 18 of 20 feet (90%) and 2 (10%) were designated as nonunion. The mean follow-up period was 37 (range 5.6 to 211.1) weeks. The most common complication was pin tract infection in 5 patients (6 feet) and was treated with oral antibiotics; only 1 foot required early hardware removal. According to the visual analog scale, the mean patient pain score decreased significantly from 8.2 ± 2.7 to 0.83 ± 0.98 postoperatively ($p < .001$). Our results highlight that immediate weightbearing after Lapidus fusion with external fixation is a viable treatment option for the correction of severe hallux abductovalgus with associated hypermobility.

Hypermobility or instability of the medial column tarsometatarsal joint often leads to an increased clinical and radiographic intermetatarsal angle (IMA) with associated hallux abductovalgus (HAV) deformity (1,2). Procedure selection for surgical correction of HAV can be quite variable for mild to moderate deformity; however, HAV in the setting of hypermobility of the first ray has been shown to respond well to first tarsometatarsal joint arthrodesis (3,4). A wide variety of fixation methods have been used over the years with the goals of adhering to the core Arbeitsgemeinschaft fuer Osteosynthesisfragen principles of anatomic reduction, atraumatic technique, rigid internal fixation, and early range of motion, which also pertain to external fixation (5).

First ray hypermobility has been described as excessive sagittal plane excursion due to instability at the tarsometatarsal joint, naviculocuneiform joint, or talonavicular joint (6–9). The medial tarsal synovial cavity of the Lisfranc joint is complex and consists of numerous articulations, including intermetatarsal, tarsometatarsal, and intercuneiform surfaces, all of which can contribute to the hypermobility (10). Both tarsometatarsal fracture or dislocation and hypermobility can lead to increased joint pain and degenerative arthritis.

The treatment options for increased mobility at the first metatarsocuneiform joint with associated bunion deformity historically have consisted of open reduction with internal fixation, originally described by Albrecht in 1911 and popularized by Paul W. Lapidus in 1934 (11). Because of early complications with respect to achieving consistent union rates, modifications of the early techniques have been reported, with excellent results (12). Recently, medial plating, combined with screw fixation, has been shown to be superior to crossed screws in load-to-failure models (13). Many investigators have also migrated toward early weightbearing, within as early as 2 weeks after this procedure, with radiographic union and good patient satisfaction achieved by incorporation of crossed screws, plate and screw fixation, and Kirschner wire fixation through the transverse axis to prevent sagittal plane excursion (14–16).

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External fixation provides great strength for fixation and allows early weightbearing, with rates of fusion comparable to analogous internal fixation constructs (17). To our knowledge, only 1 study has evaluated external fixation for Lapidus arthrodesis (18). Distinct patient advantages exist with external fixation, including the ability to undergo bilateral foot surgery, immediate weightbearing, participation in showering or pool rehabilitation, the option of returning to work earlier, caring for family, and no retained internal fixation after treatment completion.

In keeping with the present trend for early weightbearing, we aimed to critically investigate our method of external fixation for Lapidus/metatarsal–cuneiform arthrodesis and present a unique technique for its application. In the present study, we report the short-term results of patients who had undergone the Lapidus procedure with external fixation and immediate postoperative weightbearing.

Patients and Methods

The present study was an institutional review board–approved, retrospective medical record and radiographic review of patients who had undergone Lapidus fusion from September 2006 to July 2012. Patient accrual was performed by one of us (J.W.), with the patients identified by their diagnosis (HAV, bunion, and hypermobility) and procedure (Lapidus, Lisfranc fusion, and tarsometatarsal fusion) using the institution's computer database. The inclusion criteria were patients who had undergone Lapidus arthrodesis with an external fixation device (Sidekick® Tomahawk, Wright Medical Technology, Inc, Arlington, TN, or M-100 MiniRail Fixator, Orthofix® Holdings, Inc, Lewisville TX) with or without adjunctive procedures. The exclusion criteria were patients not treated surgically with Lapidus arthrodesis and those for whom the retrospective medical record data did not include enough information, consistent with the study design. A total of 30 patients were eligible for the study, and 19 patients (20 feet) met the inclusion criteria.

At our institution, the senior author (B.M.L.) performed all the operations, either in isolation or combined with adjunctive procedures. For each patient, the preoperative and postoperative radiographic and clinical assessments were recorded and averaged. We recorded independent variables, including patient age, gender, height, weight, body mass index, smoking history, diabetes mellitus, preoperative diagnosis, previous surgery to the effected extremity, ancillary procedures, external fixator type, and date of external fixation application. The dependent variables, such as date of external fixation removal and total duration of external fixation, were predicated by the other data, such as the interval to radiographic union, outpatient follow-up duration, and complications. No assessor blinding with respect to perioperative management was implemented in the study design. Visual analog scale assessment was used to evaluate patient pain postoperatively at the last follow-up visit.

Before surgical intervention, a detailed physical examination was performed to assess first ray mobility. The senior author (B.M.L.) used a clinical technique that involves loading of the fourth and fifth metatarsal heads while placing the hallux in dorsiflexion, thereby mimicking the propulsive phase of gait. Manual pressure is then placed beneath the first metatarsal head for assessment of clinical hypermobility. This subjective physical examination is critical to evaluate preoperatively and postoperatively (Fig. 1 and Supplemental Video S1).

Standard weightbearing foot anteroposterior, medial–oblique, and lateral radiographs were elevated pre- and postoperatively for each subject. The following angles were measured and averaged on the anteroposterior view: first IMA, hallux abductus angle, metatarsus adductus angle. The metatarsal parabola and metatarsal protrusion distance were also evaluated. The following angles were measured and averaged on the lateral view: talar–first metatarsal angle (Meary's) and metatarsal pitch. All corresponding radiographic angles and distances to the nearest millimeter were measured using eFilm Workstation™, version 2.1.2 (Merge Healthcare, Inc, Hartland WI).

Fig. 1. Physical examination for assessing first ray hypermobility with simulation of the midstance followed by loading in simulated propulsion at 1 year after Lapidus arthrodesis and removal of the external fixator showing diminished medial column hypermobility.

Statistical Analysis

The Statistical Package for Social Sciences, version 17.0 (SPSS, Inc, Chicago, IL), was used to analyze all the data, in conjunction with Microsoft Excel for data collection (Microsoft, Redmond, WA). Descriptive statistics were used to calculate the mean and range. Statistically significant differences between the preoperative and postoperative assessments were evaluated using the Wilcoxon signed rank test for nonparametric data. We defined statistical significance at the 5% or $p \leq .05$ level.

Surgical Technique

To ensure an accurately placed external fixation device, we used a systematic approach. The patient was positioned supine on a radiolucent table with an ipsilateral bump under the hemisacrum to obtain foot-forward positioning for accurate intraoperative fluoroscopic interpretation. Preoperative planning with a 4-pin mini external fixator, Sidekick® Tomahawk (Wright Medical Technology, Inc, Arlington, TN) or M-100 MiniRail Fixator (Orthofix® Holdings, Inc, Lewisville TX) determined the initial spread and locations of the pins.

Typically, a dorsal medial 3-cm incision was made over the first metatarsocuneiform joint without periosteal dissection. After the joint capsule was released, the joint was removed by curettage, planar resection with a saw, or a combination to realign the first metatarsal. A separate, distal medial, 3-cm incision was used for bunion resection and capsule rebalancing. After reduction of the IMA under fluoroscopy, one or two 1.8-mm Ilizarov wires were inserted across the plantar aspect of the Lapidus fusion for provisional fixation. The skin was then closed after realignment had been confirmed on the anteroposterior and lateral fluoroscopic images before external fixation application. Under fluoroscopic guidance, the 4-half pin external fixator was applied by dorsal insertion into the shaft of the first