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Symptomatic Hardware Removal After First Tarsometatarsal Arthrodesis

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A R T I C L E I N F O

Level of Clinical Evidence: 3

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A B S T R A C T

Severe hallux valgus deformity with proximal instability creates pain and deformity in the forefoot. First tarsometatarsal joint arthrodesis is performed to reduce the intermetatarsal angle and stabilize the joint. Dorsomedial locking plate fixation with adjunctive lag screw fixation is used because of its superior construct strength and healing rate. Despite this, questions remain regarding whether this hardware is more prominent and more likely to need removal. The purpose of the present study was to determine the incidence of symptomatic hardware at the first tarsometatarsal joint and to determine the incidence of hardware removal resulting from prominence and/or discomfort. A review of 165 medical records of consecutive patients who had undergone first tarsometatarsal joint arthrodesis with plate fixation was conducted. The outcome of interest was the incidence of symptomatic hardware removal in patients with clinical union. The mean age was 55 (range 18.4 to 78.8) years. The mean follow-up duration was 65.9 ± 34.0 (range 7.0 to 369.0) weeks. In our cohort, 25 patients (15.2%) had undergone hardware removed because of pain and irritation. Of these patients, 18 (72.0%) had a locking plate and lag screw removed, and 7 (28.0%) had crossing lag screws removed. The fixation of a first tarsometatarsal joint fusion poses a difficult situation owing to minimal soft tissue coverage and the inherent need for robust fixation to promote fusion. Hardware can become prominent postoperatively and can become painful and/or induce cutaneous compromise. The results of the present observational investigation imply that surgeons can reasonably inform patients that the incidence of symptomatic hardware removal after first tarsometatarsal arthrodesis is approximately 15% within a median duration of 9.0 months after surgery.

Albrecht (1) and Lapidus (2) have been credited for describing arthrodesis of the first tarsometatarsal joint (TMTJ) for correction of moderate to severe hallux valgus deformity. The indications for the procedure include a large first intermetatarsal angle, hypermobility of the first ray, instability and/or arthrosis of the first TMTJ, recurrent hallux valgus, and pes planovalgus (3–5). The fixation constructs for first TMTJ arthrodesis have evolved over time and have ranged from Kirschner wires, staples, lag screws, nonlocking and locking plates, to external fixation.

Locking plate technology has increased in popularity for many foot and ankle procedures, including first TMTJ arthrodesis for hallux valgus (Fig. 1) (6–9). Although locking plate fixation has shown a trend toward early weightbearing and a decreased nonunion rate, complications still occur. Symptomatic hardware pain is one such complication that can be debilitating and costly. These plates are designed to be low profile and anatomically contoured; however, the thin dorsal skin on the foot and pressure from shoe gear can easily lead to irritation and prominent hardware pain, necessitating removal. To date, limited published data are available specifically evaluating the incidence of symptomatic hardware using lag screws alone or a locking plate and lag screw construct for first TMTJ arthrodesis.

The purpose of the present study was to determine the incidence of symptomatic hardware at the first TMTJ after arthrodesis for hallux valgus correction and then to determine the rate of hardware removal due to prominence and discomfort.

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Fig. 1. Locking plate for fixation of a first tarsometatarsal joint arthrodesis/Lapidus procedure. One drawback of locking plate fixation is the possible need for hardware removal owing to irritation and pain.

Patients and Methods

The OhioHealth institutional review board approved the present retrospective cohort study. Consecutive patients who had been treated from December 2004 to January 2013 and had been treated at a multisurgeon orthopedic foot and ankle surgical practice were eligible for inclusion in the present investigation. A computer-generated search of our surgical practice database was performed to identify patients who underwent tarsometatarsal arthrodesis or a Lapidus procedure for hallux valgus. The Current Procedural Terminology (American Medical Association, Chicago, IL) codes 28297 (Lapidus) and 28740 (single, tarsometatarsal arthrodesis) were used for the search.

Three authors (K.S.P., J.E.M., J.T.) abstracted the data from the medical records to select the patients for the investigation. One author (C.F.H.) and 4 surgeons not involved in the investigation performed the surgery and assessed the patients' outcomes. Our biostatistician for OhioHealth (Christy Collins, PhD) analyzed the data, and the report was written by 3 foot and ankle surgeons (J.E.M, K.S.P., C.F.H.).

Included in the cohort were patients who were $\geq$18 years old and who had undergone correction of hallux valgus by first TMTJ arthrodesis (Lapidus procedure) with the use of lag screws alone or lag screw fixation with a dorsomedial locking plate. Patients who had undergone first TMTJ arthrodesis revision surgery, those lost to follow-up for any reason, those treated with fixation other than lag screws with or without a plate, and those with Charcot neuroarthropathy of the first TMTJ were excluded from the present cohort.

Regarding the independent variables, the following demographic characteristics were recorded for each of the eligible patients: age, gender, extremity involved, follow-up duration, body mass index (BMI), tobacco use, diabetes status, the type of fixation used for the first TMTJ fusion, postoperative complications, and whether the hardware was painful. Our dependent variable of interest was whether the hardware was removed after the first TMTJ arthrodesis. Two foot and ankle surgery fellows (K.S.P., J.E.M.) and 1 podiatric medical student (J.T.), who were not involved with any of the surgical procedures, recorded all the data points in a secured electronic file.

Our follow-up protocol consisted solely of inspecting the electronic medical records at our practice and did not entail follow-up telephone interviews or letters to patients who had undergone first TMTJ fusion to query whether they had undergone hardware removal elsewhere.

The data were analyzed using frequencies and percentages for categorical data and the mean $\pm$ deviation or median and range for continuous data. The characteristics of the patients who required hardware removal and those who did not require hardware removal were compared using Fisher's exact chi-square tests for sex, tobacco use, and diabetes mellitus status owing to the small sample size. A chi-square test was used to compare the anatomic side of involvement. Patient age and BMI for the 2 groups were compared using Wilcoxon rank sum tests owing to the non-normal distribution. Statistical significance was defined at the 5% ($p \leq .05$) level. A biostatistician performed all the statistical analyses.

Surgical Technique

All procedures were performed with the patient under general anesthesia with a regional popliteal nerve block. A well-padded thigh tourniquet set to 300 mm Hg was also used for hemostasis. A standard 3-incision approach was used for the silver bunionectomy, distal soft tissue procedure, and first TMTJ arthrodesis. With adequate visualization of the first TMTJ using a Hintermann™ distractor (Integra LifeSciences, Plainsboro, NJ), the joint surfaces were prepared for arthrodesis (Fig. 2). In all cases, joint preparation included complete debridement of articular cartilage using curettage, a burr, and/or a sagittal saw. The subchondral bone plate was preserved during the resection of cartilage but was rigorously fenestrated with a solid drill to increase the surface area of bleeding cancellous bone. The surfaces were also "fish-scaled" using an osteotome. The surgeon's preferred bone graft substitute was then placed within the fusion site to enhance arthrodesis.

Next, a large bone tenaculum was used for first intermetatarsal angle reduction (Fig. 3). One end of the tenaculum was placed on the distal, dorsomedial aspect of the first metatarsal and the other around the neck of the second metatarsal. The windlass mechanism was then activated with dorsiflexion of the hallux on the first metatarsal, and the tenaculum was closed until adequate reduction of the first intermetatarsal angle was observed. Fixation was then achieved with either crossing lag screws traversing the first TMTJ arthrodesis interface or an interfragmentary lag screw combined with a dorsomedial locking plate (Fig. 4).

The medial first metatarsophalangeal joint capsule was sutured in a "pants-over-vest" fashion for closure with absorbable sutures after Silver exostectomy had been performed. If an Akin osteotomy was determined by the surgeon to be required for adequate correction, it was performed at this time. Standard layer closure was performed for each incision, and the final intraoperative radiographs were inspected to ensure satisfactory intermetatarsal and hallux valgus angle correction. Thereafter, a well-padded, non-weightbearing posterior splint was applied and remained in place until the first postoperative visit, which was scheduled for 7 to 10 days postoperatively. The patient was then placed in a non-weightbearing fiberglass cast or non-weightbearing high top boot walker (fixed immobilization) for approximately the next 3 weeks and then transitioned into a full-weightbearing, tall fracture boot for an additional 3 weeks. Serial radiographs were taken to monitor osseous healing and were interpreted by the treating foot and ankle surgeon. Radiographic fusion was determined by visible trabeculation and bridging with bone callus through >50% of the joint on 2 views, and clinical union was determined by a patient having no pain or tenderness with movement of the fusion site (Fig. 5).

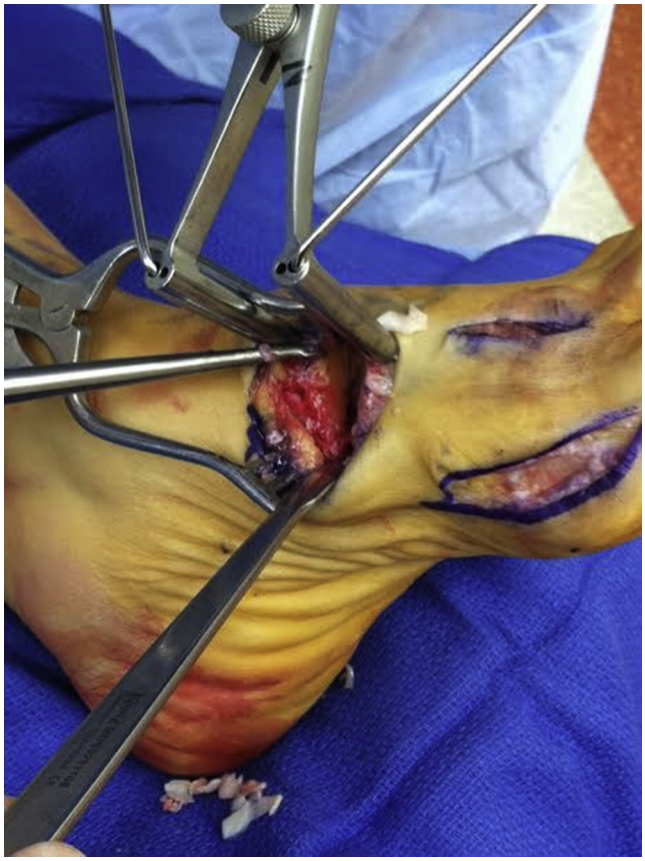

Fig. 2. Intraoperative visualization of the first tarsometatarsal joint using a pin-based distractor.