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Original Research

First Metatarsophalangeal Joint Arthrodesis: Does the Addition of a Lag Screw to a Dorsal Locking Plate Influence Union Rate and/or Final Alignment after Fusion

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ABSTRACT

First metatarsophalangeal (MTP-1) joint fusion is a reliable method for the correction of various deformities, including hallux valgus and hallux rigidus. Ideal constructs provide high rates of fusion in the desired alignment. The present study examined the union rates and the change in dorsiflexion angle during the follow-up period in patients who had undergone MTP-1 fusion with a dorsal locking plate and a lag screw compared with patients who had undergone fusion with a dorsal locking plate alone. We performed a retrospective review of 99 feet undergoing MTP-1 fusion. The joints were fused using either a dorsal locking plate alone or a lag screw plus a dorsal locking plate. Union was determined radiographically during the follow-up period. Suspected nonunions were confirmed by computed tomography. The dorsiflexion angles were radiographically measured at the first postoperative visit and at the final follow-up visit. Of the 99 feet, 36 (36.4%) were in the lag screw plus dorsal plate group and 63 (63.6%) in the dorsal plate group. The mean follow-up period was 12.9 (range 12 to 33.5) months. The dorsal plate plus lag screw group had a significantly lower change in the mean dorsiflexion angle (0.57° ± 5.01°) during the postoperative period compared with the dorsal plate group (6.73° ± 7.07°). The addition of a lag screw to a dorsal locking plate for MTP-1 arthrodesis might offer improved stability of the joint in the sagittal plane over time compared with a dorsal plate alone.

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First metatarsophalangeal (MTP-1) joint arthrodesis is commonly performed for treatment of hallux valgus, severe hallux rigidus, and other deformities involving the first metatarsal joint (1–4). No consensus has yet been reached regarding the best method for fusion, because success has been demonstrated with the use of plates, screws in parallel or crossed fashion, Kirschner wires, and memory staples; however, plate and screw fixation have been the most common methods and have demonstrated success rates of ~90% (2,5–9). However, it has been demonstrated that patients with severe hallux valgus might have fusion rates that are less than optimal, necessitating a stiffer construct (10). Various biomechanical studies have determined that adding a lag screw to a dorsal plate offers the stiffest construct for MTP-1 fusion. However, few studies have explored this concept clinically (7,11,12). Dening and van Erve (6) retrospectively reviewed the union rates of patients who had undergone MTP-1 fusion with various constructs, including the use of a dorsal plate and lag screw and a dorsal plate alone.

Although achieving union after arthrodesis is the main goal, it is also important to maintain the alignment during the postoperative period. The dorsiflexion angle evaluates the position of the MTP-1 joint in the sagittal plane; the optimal angle after fusion is 20° to 25° (13–15). The hallux valgus angle (HVA) evaluates the relative position between the first metatarsal and the proximal phalanx, with a preferred angle after fusion of 15° to 20°, although this can vary depending on the degree of hallux valgus before fusion (13–18). A dorsiflexion angle less than this range increases pressure beneath the hallux and can lead to the development of interphalangeal joint arthritis (13,19). In contrast, a dorsiflexion angle greater than this range can lead to hallux dorsal impingement, increased dorsal pressure, sesamoid overload,

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Fig. 1. Preoperative lateral and anteroposterior radiographs of a patient with severe hallux valgus.

clawing of the interphalangeal joint, and footwear difficulties (13–15,20).

The present study evaluated the union rates and the change in the dorsiflexion angle during the postoperative period between patients who had undergone MTP-1 fusion with a lag screw in addition to a dorsal plate and those who had undergone fusion with a dorsal plate only. We hypothesized that the dorsal plate and lag screw construct would result in greater rates of union and a lower change in the dorsiflexion angle during the postoperative period.

Patients and Methods

The institutional review board approved the study and provided a waiver for informed consent. The data from patients who had undergone MTP fusion of the first digit performed by a single fellowship-trained foot and ankle surgeon from January 2011 to August 2015 were reviewed retrospectively. The inclusion criteria were patient age ≥18 years, moderate to severe hallux valgus (HVA >30°) or hallux rigidus, and treatment specifically with MTP-1 arthrodesis (Figs. 1 and 2). Patients with an insufficient follow-up duration (<12 weeks), previous failed MTP-1 fusion, and active infection of the ipsilateral foot were excluded. A total of 99 feet (91 patients) met the inclusion criteria. Of the 99 feet, 32 had hallux valgus and 67 had hallux rigidus as the primary diagnosis (Table 1).

All the patients underwent a consistent procedural method. The surgeon used a dorsal approach to access the MTP-1 joint. Conical MTP joint preparation was performed using cup-shaped power reamers to create congruous cancellous surfaces. The hallux valgus deformity was then corrected, and 1 Kirschner wire was placed to temporarily fix the MTP-1 joint. At that point, 1 of 2 different fixation constructs was used: a titanium dorsal locking plate pressed into compression mode or a lag screw to provide compression, followed by placement of a titanium dorsal locking plate. The senior surgeon (A.S.) introduced the lag screw in addition to a dorsal locking plate for MTP-1 arthrodesis in his practice in 2014. Therefore, all patients who had undergone fusion before 2014 had been treated with a dorsal locking plate and all patients who had undergone fusion after 2014 were treated with a lag screw and dorsal locking plate.

Postoperatively, the patients were placed in a postoperative shoe and instructed to remain heel weightbearing, as tolerated. The sutures were removed at 2 weeks postoperatively, and the patients were transitioned to a supportive shoe with a carbon fiber plate at their 6-week follow-up appointment. All patients had weightbearing anteroposterior and lateral foot radiographs taken before surgery and postoperatively at 6 weeks, 3 months, 6 months, and the final follow-up appointment. Union was defined as 3 of 4 (medial to lateral on the anteroposterior view and superoinferior on the lateral view) bridging cortices on radiographic evaluation. A computed tomography scan was used to confirm all suspected nonunions.

The dorsiflexion angle was measured by 2 medical students (B.C., J.R.S.) after training by the lead surgeon (A.S.). The angle was measured using the intersection of the middiaphyseal line of the first metatarsus and the middiaphyseal line of the proximal phalanx on the lateral radiograph (13). Any discrepancies in angle measurements between the 2 assessors were reviewed by the lead surgeon. All measurements were made on digital radiographs using the hospital's standard radiology software system (IntelliSpace PACS Enterprise, Koninklijke Philips NV, Netherlands). The postoperative dorsiflexion angle was measured at the first and the final follow-up visit. The preoperative and postoperative measurements (at the final follow-up visit) of the HVA were also recorded.

The collected data were entered into Microsoft Excel (Microsoft Corp., Redmond, WA). The mean ± standard deviation are reported for all the data, except for the average

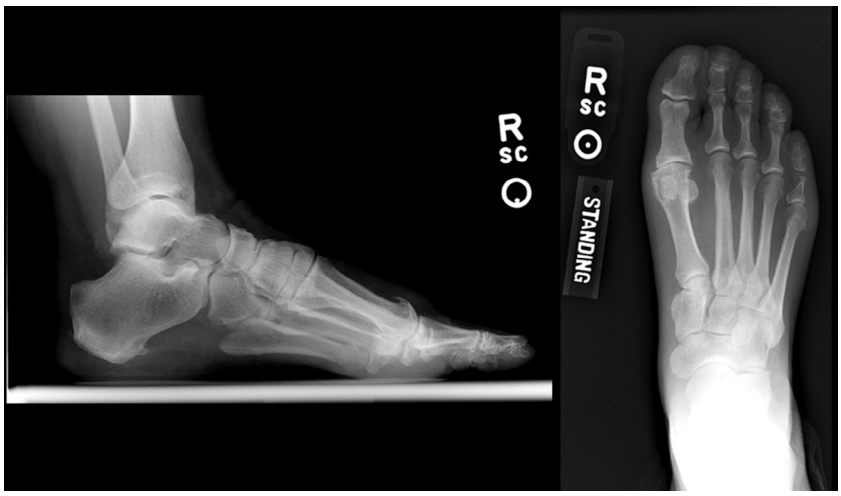

Fig. 2. Preoperative lateral and anteroposterior radiographs of a patient with hallux rigidus.

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