

Evaluation of First Metatarsal Phalangeal Fusion With Immediate Weight-Bearing

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Background

Arthrodesis of the first metatarsal phalangeal joint is performed as a salvage operation for a variety of painful conditions ranging from hallux rigidus, primary osteoarthritis, rheumatoid arthritis, severe hallux valgus or varus (acquired or iatrogenic), and failed 1st metatarsophalangeal joint replacement. A number of techniques have been described to facilitate fixation of the fusion site with a range of post operative protocols to maximize union¹⁻⁵. The timing of weight-bearing after surgery has been variable and dependent on the type of fixation used. In the literature it varies from a minimum of two weeks non-weight-bearing, with restricted weight-bearing for 4 more weeks, to casted heel (or non) weight-bearing for 1-2 months. Many of these patients are elderly, and limited weight-bearing makes activities of daily living difficult. As such, restrictive weight-bearing procedures are a challenge and may not be followed. Newer fixation methods with a more robust construct appear to allow patients the freedom of immediate weight-bearing without an increase in complications such as nonunion or early implant failure.

A Plating System with Novel “X-Post” Technology

The OMNI MTP Plating System is among these newer, more robust constructs, as

it has been shown to provide mechanical benefits over other plating constructs in the market. The unique element of this construct is a post integrated into a screw hole within the plate (X-Post Technology). This post allows a lag screw to integrate into the plate, and act as a metal opposite cortex for the lag screw. The compression provided using this construct is thus independent of bone quality, which may be poor in patients with osteoporosis or comminuted fracture patterns. Thus, the post combined with the lag screw provides increased compressive power across a fusion or fracture site versus an independently placed lag screw, and reduces rates of screw strip-out. In addition, given the lag screw is placed in the plantar portion of the fusion/fracture site, it now provides consistent plantar-side compression, avoiding plantar gapping (and the potential for nonunion due to lack of bone contact)*.



This paper discusses the benefits of the OMNI MTP Plating System, and the potential for earlier weight-bearing compared to traditional plating and lag screw approaches.

Patients Were Being Treated for Severe Untreated Hallux Valgus

The medical records of a single surgeon practice were retrospectively evaluated for patients with a first metatarsophalangeal fusion using Extremity Medical's OMNI MTP Plating System. Of those patients, all who were not able to participate in the immediate weight-bearing protocol were excluded. This left 46 patients who qualified to be in this analysis. The leading diagnosis for the surgery was severe untreated hallux valgus (with or without prior surgery). This cohort was relatively healthy, as the demographics and medical history of the group is described in tables 1 and 2.

Surgical Technique

All surgeries were done in a hospital setting on an outpatient basis under general anesthesia with the patient supine. The incision was dorsal longitudinal just medial to the extensor hallucis longus tendon. Enough tissue medial to the EHL was retained to allow suture realignment when closing. The medial and lateral collateral ligaments were detached at the metatarsophalangeal joint, and a McGlamery elevator was used to detach the plantar plate from its metatarsal origin.

This soft tissue stripping allowed for rotational correction of the toe such that the dislocated sesamoids could be repositioned in their respective grooves, and the plantar pad would be in full contact with the ground following great toe arthrodesis.

The joint was prepared for fusion manually with a double action rongeur to shape the head of the metatarsal to fit with the base of the proximal phalanx in the desired alignment for fixation. All residual cartilage was then removed from the base

Demographic	Result	
	Range	Average
Age	41 to 85	69.5
BMI	19.1 to 36.0	28.31
Sex	35 females, 11 males	

Table 1. Summary of study demographics.

Medical Condition History	# Pts
Significant Arthritis in MTP	11
Arthritis without deformity	10
Hallux Rigidus with arthritis	6
Failed Hallux Valgus reconstruction	7
Failed MTP fusion	1
Osteoarthritis affecting the joints	30
Non-insulin dependent diabetic	2
Smoking history	35
Rheumatoid arthritis	2
Previous Hammertoe surgery	23

Table 2. Summary of the medical history of the patient cohort.

of the proximal phalanx, and a 2.0mm drill bit was used to fenestrate the remaining subchondral bone, emphasizing the center and lateral surfaces. The morselized bone created by the drilling was left in the joint as bone graft for the fusion.

With the joint surfaces prepared, the toe was placed in the preferred position for fusion (with the assistance of a flat plate to simulate plantigrade weight-bearing stance) and fixed with a 2.0mm Kirschner

wire, placed from the medial base of the proximal phalanx into the lateral cortex of the first metatarsal. In all cases, the toe was positioned so that the head of the proximal phalanx did not come into contact with the flat-plate surface. The flexion of the IP joint allowed the plantar tuft of the toe to touch the flat-plate surface when flexed. The position of the joint fusion was adjusted until this desired position was obtained.

Placement of the appropriate OMNI plate was determined by the size of the proximal phalanx (width and length). Occasionally, plate contouring was required. More often, a rongeur was used to remodel the dorsal bone contour to fit the desired plate. After confirming the post would be within the lateral cortical wall of the metatarsal, 2.8mm locking screws were placed through the plate and into the proximal phalanx to secure the distal toe. A 3.5mm non-locking screw was used within the compression slot to secure to the metatarsal side of the construct. As the compression screw was tightened, the flat surface was used to simulate plantigrade foot. A second 3.5mm screw was then placed in the medial plate hole to secure the plate to the metatarsal. The temporary Kirschner wire was then removed. The position of the compression screw was then adjusted to ensure the screw head was flush with the plate, while not allowing further compression of the joint.

The Post Drill was then used to create the pilot hole for the OMNI post. Post depth was determined by assessing the vertical thickness of the metatarsal head prior to violating the plantar cortex. Following post placement, the Targeting Guide was aligned and left in place until the lag screw threads engaged the post hole. The guide was placed alongside the medial aspect of the proximal phalanx (against good cortical bone, and allowing

a sufficient bone bridge), and a solid drill was used to prepare the lag screw trajectory. A Wire Guide was inserted through the Drill Guide, and then a guide wire was placed through the post hole, purchasing the lateral metatarsal cortex. The lag screw was then placed, with the head abutting the medial phalangeal cortex, and the threads engaging the post and lateral metatarsal cortex. Imaging confirmed excellent compression and alignment, and manual testing confirmed stability of the construct.

Immediate Weight-bearing Post-Op Protocol

Postoperatively, all patients were placed into a short leg plaster cast with plantar toe plate extension, with the ankle in full dorsiflexion. The plate extension protected the great toe phalanges from contacting the ground. In the recovery room, each cast was split anteriorly, widened 5mm with gauze wedges, and over-wrapped with fiberglass. Each patient was placed in a cast shoe and allowed to weight bear to tolerance and without restriction. The cast was removed after two weeks (as were sutures), and the patient was placed into a short removeable walking boot. The patient could self-determine when they wished to use their own shoes - the only criterion was comfort.

Results

None of the patients in the cohort had problems with weight-bearing in a cast. None experienced deep vein thrombosis. There were two instances of wound dehiscence at follow-up. Both cases were treated with daily soap water washes, oral antibiotics, and dry dressing. Both patients healed without incident or sequelae. By 6 weeks, all patients were in standard shoes without mobility restrictions. By 3 months, 45 of 46



Figure 1. Comparison of pre-operative and post-operative X-Rays in AP (left) and lateral (right) views after fusion with the OMNI MTP implant.

patients confirmed no restrictions in desired activity with normal shoe wear. One patient experienced failure (nonunion). This patient had an ipsilateral peroneal nerve injury from a previous total knee replacement, affecting motor control of the foot. At 2.5 months she sustained a failure of fixation and required a revision of the fusion which healed without incident. Three patients requested removal of their implants due to irritation after successful fusion of their first metatarsophalangeal joint. Implant removal occurred within 10-12 months post surgical.

Discussion

Immediate weight-bearing after an isolated first metatarsophalangeal fusion is a goal of many surgical techniques described in the literature. A variety of fixation techniques aspire to safe immediate weight-bearing without increasing the complication rate. The major deterrent is the risk of nonunion due to micromotion at the fusion site.

Two recent systematic reviews in the literature looked at surgical fixation methods and the rates of nonunion. The first study analyzed seven papers with isolated first MTP fusion⁶.

The criteria were not specific for weight-bearing status; but did review fusion rates. The seven studies combined 277 feet, with an overall nonunion rate of 4.3%. Three papers within this review used a dorsal plate technique for fixation, allowing full early weight-bearing in a rigid shoe, with a nonunion rate of 4.8% (6/124).

The second review had a criterion of early weight-bearing (< 2 weeks) in its search for peer reviewed articles on first MTP fusion⁷. Included in early weight-bearing were protocols that did not allow full flat foot weight-bearing. This broader search found 17 studies that professed to early weight-bearing, again with a variety of fixation methods.

Of the 898 feet included, the nonunion rate was 6.35% (57/898). Seven of the studies included in this review used dorsal plate fixation. These seven studies consisted of a combined 331 feet undergoing arthrodesis with a nonunion rate of 6.94% (23/331). Only one of these studies allowed full unrestricted weight-bearing immediately after surgery. This present series allowed immediate weight-bearing after surgery protected by a weight-bearing cast to assist patients in plantigrade weight-bearing.

This series showed a failure rate of 1.0% which is significantly lower than that published in the literature.

Conclusions

The Omni MTP Plating System by Extremity Medical allows for successful immediate weight-bearing in patients with first metatarsal phalangeal fusion without restrictions based on this technique and post operative protocol.



* Data on file

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