The Journal of Foot & Ankle Surgery xxx (2017) 1–5

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Original Research

Comparison of the Outcomes Between Headless Cannulated Screw Fixation and Fixation Using a Locking Compression Distal Ulna Hook Plate in Fracture of Fifth Metatarsal Base

Jun-Beom Kim, MD, In-Soo Song, MD, Byeong-Seop Park, MD, Chi-Hoon Ahn, MD, Cheol-U Kim, MD

Orthopedist, Department of Orthopaedic Surgery, Sun General Hospital, Daejeon, Republic of Korea

A R T I C L E I N F O

Level of Clinical Evidence: 3

Keywords:
fifth metatarsal
fixation
locking compression distal ulna hook plate
metatarsal base fracture
screw fixation

A B S T R A C T

The aim of the present study was to evaluate and compare the clinical and radiologic results of internal fixation with a headless cannulated screw versus a locking compression distal ulna hook plate for fractures at the base of the fifth metatarsal bone, zone 1. From April 2012 to April 2015, 30 cases (29 patients) were retrospectively evaluated. The mean follow-up period was 13 months. The patients were divided into 2 groups stratified by the fixation method: screw (group A, n = 15) or plate (group B, n = 15). We measured the displacement to diastasis of the fracture on the foot oblique radiographs taken pre- and postoperatively in each group, recorded the time to bony union, and measured the difference in the reduction distance in each group. The clinical results were evaluated using the American Orthopaedic Foot and Ankle Society midfoot score at 12 months postoperatively. In group A, the mean interval to union was 54.2 ± 9.3 days, the mean displacement to diastasis had improved to 0.3 ± 0.4 mm postoperatively ($p < .001$), and the mean reduction distance was 2.9 ± 1.0 mm postoperatively. In group B, the mean interval to union was 41.5 ± 7.0 days, the mean displacement to diastasis had improved to 0.06 ± 0.2 mm postoperatively ($p < .001$), and the mean reduction distance was 4.1 ± 1.6 mm. The American Orthopaedic Foot and Ankle Society midfoot scale score was 97.7 ± 3.4 in group A and 98.2 ± 3.2 in group B. The interval to union was significantly different between the 2 groups ($p = .01$). No complications were recorded. Our findings have shown that the plate is a reasonable and alternative method for the surgical treatment of fifth metatarsal base fractures.

Fifth metatarsal base fracture is the most common of the metatarsal fractures and classified according to 3 anatomic zones (1). Zone 1 is the most proximal part of the tuberosity of the fifth metatarsal and includes insertion of the peroneus brevis tendon, the peroneus tertius (which inserts on the dorsal region of the metaphysic), the lateral band of the plantar aponeurosis, and articulation with the cuboid. Zone 2 includes the articulation with the fourth metatarsal in the border between the metaphysic and diaphysis. Zone 3 is the site of proximal diaphyseal stress fractures. Zone 1 and 2 fractures result from acute injury; however, zone 3 fractures are usually pathologic stress fractures (2).

Undisplaced zone 1 and 2 fractures usually respond well to nonoperative treatment, such as a walking cast and controlled weightbearing (3,4). Nonoperative treatment, however, has serious risks of delayed union, nonunion, and a long period of rehabilitation (5,6). Many investigators have suggested and described the use of open reduction and internal fixation in the treatment of displaced fractures or fractures that involve >30% of the fifth tarsometatarsal joint (5–10). Until recently, internal fixation with a screw was the most common surgical treatment for these fractures. However, no consensus has been reached regarding which technique will achieve the best functional outcomes. Surgical management has been described using several methods, including tension band wiring, compression screw, Kirschner wires, and plating, such as a locking compression distal ulna hook plate (8–10).

To the best of our knowledge, no clinical study has compared the outcomes of each technique for these fractures. We were interested in determining the difference in the results using a headless cannulated screw (Osteomed, Addison, TX) versus a locking compression distal ulna hook plate (Depuy Synthes, Oberdorf, Switzerland) for fixation. We hypothesized that the outcomes would not be significantly different between the 2 fixation methods at the final follow-up examination. Our primary aim was to measure the time to bony union, functional outcomes, and complications. Our secondary aim was to

Financial Disclosure: None reported.
Conflict of Interest: None reported.
Address correspondence to: Jun-Beom Kim, MD, Department of Orthopaedic Surgery, Sun Medical Center, Mok-dong, Jung-gu, Daejeon 10-7, Republic of Korea.
E-mail address: kjb9290@gmail.com (J.-B. Kim).

1067-2516/$ - see front matter © 2017 by the American College of Foot and Ankle Surgeons. All rights reserved.
http://dx.doi.org/10.1053/j.jfas.2017.01.048

measure the reduction distance before and after surgery with each fixation method. We undertook a retrospective case-control study to compare the outcomes of patients who had undergone screw fixation with those who had undergone plate fixation to treat displaced intra-articular zone 1 fractures of the proximal fifth metatarsal.

Patients and Methods

The institutional review board of Sun General Hospital (Daejeon, South Korea) approved the present study.

Study Design

From April 2012 to April 2015, 29 patients (30 cases) with zone 1 fractures of the fifth metatarsal base were treated surgically and evaluated retrospectively. The inclusion criterion was the diagnosis of a fifth metatarsal base fracture (zone 1) displaced >2 mm. The mean follow-up period was 13 (range 12 to 15) months. The exclusion criteria were pathologic fractures and zone 2 fractures.

All cases were divided into 2 groups according to the fixation method. Group A included 15 patients (6 males and 9 females; mean age 47, range 21 to 70 years), who underwent treatment with a headless cannulated screw for bicortical internal fixation (Fig. 1). Group B included 15 patients (5 males and 10 females; mean age 50, range 21 to 77 years), who underwent treatment with a locking compression distal ulna hook plate (Fig. 2).

The displacement of diastasis was defined as the distance between the fracture margins seen on a standard oblique radiographic view of the foot that showed the plantar lateral side of the fifth metatarsal bone (Fig. 3). Diastasis of the fracture margins was measured before and after surgery in each group. Preoperatively, the mean diastasis was 3.4 ± 0.8 mm in group A and 4.5 ± 1.6 mm in group B.

The reduction distance, defined as the change in the apposition in the fracture margins after reduction and fixation, was 2.9 ± 1.0 mm in group A and 4.1 ± 1.6 mm in group B.

No significant differences in gender, mean age, or displacement of diastasis were evident before surgery between the 2 groups (Table).

All procedures were performed by 1 surgeon, who used the same approach by way of the lateral border of the fifth metatarsal base. All patients underwent surgery within 5 days of the injury.

Surgical Technique

Under sciatic nerve block-guided ultrasonography, each patient was placed in the supine position on a radiolucent operating table with the knee flexed and the legs and hips padded appropriately. The surgery was aided by the use of an Esmarch tourniquet. A longitudinal skin incision of about 3 cm was made distally from the base of the fifth metatarsal bone. After the peroneus brevis and lateral band of the aponeurosis were identified, the periosteum was elevated gently to expose the fracture. The fracture was reduced using a reduction forceps. A headless cannulated screw (Fig. 4) or locking compression distal ulna hook plate (Fig. 5) application was attempted.

In group A, a 3.0-mm cannulated screw guide pin was inserted into the space between the lateral band of the plantar aponeurosis and the peroneus brevis tendon under fluoroscopic guidance. A cannulated drilling device was used to pierce a hole of the medial cortex in the fracture site. The 3.0-mm cannulated screw was inserted under fluoroscopic guidance over the guide pin to ensure bicortical placement of the screw for compression (Fig. 1*B*). The guide pin was removed after reduction with the screw. Smaller diameter, headless-type screws were used to eliminate metal irritation.

In group B, a distal skin incision was added to the distal incision, and the hook in a proximal portion of the plate covered the fifth metatarsal tuberosity (Fig. 2*B*). The plate was fixed by inserting a screw through the most distal plate hole, and the locking screws were placed into the diaphysis of the fifth metatarsal to secure the plate to the bone. If necessary, the locking screw was placed into the proximal fragment of the fracture. The wound was closed in layers, and a short leg splint was applied immediately after surgery.

The patients were allowed to start tolerable toe touch partial weightbearing during the postoperative period and advised to walk with crutches until 4 weeks postoperatively. After 4 weeks, gradual weightbearing was allowed, and full weightbearing was allowed at 6 weeks. All patients were allowed to return to full activity when they were clinically asymptomatic and radiographs had had demonstrated union.

Patient Assessments

The patients were evaluated clinically and radiographically, and the mean follow-up period was 13 months. The following factors were assessed: interval to union, functional outcome, and incidence of complications (i.e., infection, nonunion, failure of implants). All patients were followed up with radiographs, including 3 views of the foot (anteroposterior, oblique, and lateral), at 2, 4, and 6 weeks and monthly thereafter. Radiographic healing was defined as any evidence of a bridging callus across the fracture sites or obliteration of the fracture lines. We recorded the preoperative displacement and postoperative reduction and the immediately postoperative reduction distance in each group. The functional outcome was graded using the American Orthopaedic Foot and Ankle Society midfoot scoring system at 12 months after surgery.

Statistical Analysis

Statistical analyses were performed using SPSS, version 20 (IBM, Inc., New York, NY). The Student *t* test was used for the analyses of each group, and the Mann-Whitney *U* test was used to compare the 2 groups. The outcomes presented as categorical or dichotomous variables were analyzed using the Fisher exact test or multiple linear regression analysis, respectively. The Kolmogorov-Smirnov test was used to test for

Fig. 1. (*A*) Initial foot oblique view of Lawrence zone 1 area. (*B*) Immediate postoperative oblique view after open reduction and internal fixation with the compression screw. (*C*) Follow-up oblique view at 8 weeks postoperatively.