The Journal of Foot & Ankle Surgery xxx (2017) 1–6

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Original Research

# Evaluation of Fixation Techniques for Metatarsocuneiform Arthrodesis

Eric A. Barp, DPM, FACFAS [1,2], John G. Erickson, DPM [3], Hayden L. Smith, PhD [4,5], Katrina Almeida, DPM [3], Kelsey Millonig, BA [6]

[1] *Program Director, Podiatric Medicine and Surgery Residency Program, UnityPoint Health-Des Moines, Des Moines, IA*
[2] *Attending Physician, The Iowa Clinic, West Des Moines, IA*
[3] *Resident, Podiatric Medicine and Surgery Residency Program, UnityPoint Health-Des Moines, Des Moines, IA*
[4] *Medical Researcher, UnityPoint Health-Des Moines, Des Moines, IA*
[5] *Adjunct Faculty, Carver College of Medicine, University of Iowa, Iowa City, IA*
[6] *Podiatric Medical Student, Des Moines University, Des Moines, IA*

ARTICLE INFO

*Level of Clinical Evidence:* 3

*Keywords:*
arthrodesis
bunionectomy
fixation
fusion
Lapidus
metatarsocuneiform arthrodesis
tarsometatarsal arthrodesis

ABSTRACT

First metatarsocuneiform joint arthrodesis has been used in foot and ankle surgery for the treatment of hallux abductovalgus deformity, among other pedal pathologic entities. The goal of the present retrospective study was to compare the fusion rates and complications of an intraplate compression screw fixation, crossing solid core screw fixation, and a single interfragmentary screw with a simple locking plate. All procedures were performed by a single surgeon, and all patients received an identical postoperative protocol. A medical record review was performed of 147 evenly distributed surgical methods. All patients were non-weightbearing by protocol for 4 weeks. The patient covariates included sex, age, nicotine status, osteoporosis, and diabetes. These variables were balanced among the treatment groups and were noncontributory, with the exception of sex. Male patients had a 6 times greater odds of experiencing nonunion. The overall nonunion rate was 6.7%, with 4% symptomatic and requiring revision. The individual nonunion rates for each method were 2% for intraplate compression screw fixation, 5% for single interfragmentary screw with locking plate fixation, and 9% for crossing solid core screw fixation. None of the differences reached statistical significance. The corresponding hardware removal rates were 12%, 11%, and 0%.



Metatarsocuneiform arthrodesis was first described by Albrecht (1) in 1911 for the treatment of hallux valgus. The procedure was further reported by Lapidus (2) in 1934 and in subsequent reports describing his use of the technique (3,4). The procedure has become a versatile option for the treatment of many pedal pathologic entities, including hallux abductovalgus (HAV), first ray hypermobility, arthritis, trauma, and pes planovalgus deformity. The metatarsocuneiform arthrodesis has been shown to be 1 of the most powerful tools for correcting HAV (5). The procedure is frequently performed for patients with instability or hypermobility of the metatarsocuneiform joint and moderate to severe intermetatarsal angle. It is also frequently performed in conjunction with a more distal procedure at the metatarsophalangeal joint. The technique is also frequently used for the treatment of recurrent HAV (6–8).

The goal of the present study was to retrospectively evaluate 3 fixation techniques for metatarsocuneiform arthrodesis for patients with HAV. It was hypothesized that procedures with increased fixation would result in increased fusion rates and fewer complications. It was also anticipated that a greater rate of hardware removal would be necessary secondary to the larger fixation constructs. To the best of our knowledge, the present study is the third largest review of metatarsocuneiform arthrodesis procedures in published studies and the largest performed by a single surgeon (9,10). In addition, multiple other studies have been performed to compare crossing screw fixation with locking plate fixation (11–14); however, to the best of our knowledge, the present study is the first retrospective analysis comparing an integrated compression locking plate with other established constructs.

## Patients and Methods

The institutional review board approved the present retrospective study to review data for patients undergoing metatarsocuneiform arthrodesis from 2011 to 2014. Patients were required to have a minimum of 12 months of follow-up after surgical intervention. The procedures were performed by a single board-certified reconstructive foot and ankle surgeon. The surgeon used a similar technique for all procedures, which typically only differed according to the type of fixation across the metatarsocuneiform

**Financial Disclosure:** None reported.
**Conflict of Interest:** E.A. Barp, DPM, serves as a consultant for Wright Medical and Zimmer Biomet.

Address correspondence to: Eric A. Barp, DPM, FACFAS, Podiatric Medicine and Surgery Residency Program, UnityPoint Health-Des Moines, 5950 University Avenue, West Des Moines, IA 50266.
*E-mail address:* ebarp@iowaclinic.com (E.A. Barp).

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.2017.01.012

joint. Most procedures used a demineralized bone matrix at the fusion site. The 3 fixation techniques evaluated were crossing solid core screws (CSF) (Figs. 1 and 2); a single interfragmentary screw with a simple locking plate (PSF) (Figs. 3 and 4); and a locking plate with an integrated compression screw (ISF) (Figs. 5 and 6). Selection of the fixation construct largely aligned with the surgeon's evolution of fixation preferences. The surgeon largely used CSF from March 8, 2010 to January 30, 2012; PSF from February 1, 2012 to January 28, 2013; and transitioned to ISF from February 20, 2013 through the conclusion of the study period on March 11, 2015. The postoperative treatment protocol remained identical for all patients in regard to the time to weightbearing.

## *Surgical Technique and Postoperative Protocol*

A standard surgical procedure was used for all patients, consisting of a 2-incision approach (Fig. 5). The primary incision was placed at the dorsomedial aspect of the first metatarsocuneiform joint (Fig. 7), and the secondary incision was over the medial aspect of the metatarsophalangeal joint. A modified McBride bunionectomy was performed through the medial incision, consisting of removal of the prominent medial eminence, and an intra-articular lateral release was performed.

The metatarsocuneiform arthrodesis was then performed through the primary incision (Fig. 8). A sagittal saw was used to remove the articular cartilage from the base of the first metatarsal perpendicular to the long axis of the first metatarsal. Next, the articular surface of the medial cuneiform was prepared in a similar fashion with an orientation perpendicular to the long axis of the second metatarsal (Fig. 6). Care was taken to not resect an excessive amount of bone, because this could lead to significant shortening of the first ray. A drill bit was used to fenestrate the fusion site. The first metatarsal was positioned slightly plantar against the medial cuneiform and engaging the windlass mechanism. A Kirschner wire was used for temporary fixation and permanent fixation was then applied in a standard fashion. The soft tissue was then closed in layers.

All patients returned to the clinic for a dressing change 1 week postoperatively, and the sutures were removed at the 2-week follow-up point. Protected weightbearing was then allowed at 4 weeks postoperatively. These events varied only for a few patients who experienced nonunion and for a few patients who admitted to early weightbearing against the medical advice of the surgeon.

## *Statistical Analysis*

Descriptive statistics were analyzed with continuous variables presented as the mean ± standard deviation and categorical variables as counts and percentages. Patients could have contributed >1 foot surgery in the study sample, which was the case for 21% of the eligible patients. Random between-patient effects were examined using multilevel level modeling, which revealed that controlling for between-patient level data did not explain a significant component of variability in the study. Therefore, the study observations were treated as independent and fixed effects were used. Patient covariates included sex, age, comorbidity status (i.e., smoking, diabetes, and osteoporosis) and a history of previous treatment on other foot. These variables were compared among fixation type using Fisher's exact tests or Monte Carlo exact median tests. The procedural outcomes included weightbearing within 30 days, nonunion, and hardware removal. These variables were evaluated by comparing ISF versus CSF and PSF using noninferiority tests based on the Farrington-Manning method. Noninferiority tests used a difference in risk of no more than 5% between the surgical constructs. Multiplicity was controlled for using Bonferroni's correction. If a construct had a risk

**Fig. 1.** Anteroposterior radiograph of crossing solid core screw fixation construct.

**Fig. 2.** Lateral radiograph of crossing solid core screw fixation construct.

**Fig. 3.** Anteroposterior radiograph of interfragmentary screw fixation with simple locking plate construct.