



# 1st metatarsophalangeal joint fusion: A comparison of non-union and gender differences between locking and non-locking plating systems



Edward James Bass\*, Siva Prasad Sirikonda

Royal Liverpool and Broadgreen University Hospital Trust, Prescot Street, Liverpool L7 8XP, Merseyside, United Kingdom

## HIGHLIGHTS

- The authors present a case series of 172 consecutive 1st MTP joint Fusions.
- The fusion rates of three different plating systems are compared.
- There was no significant difference between the groups.
- The difference in fusion rates between males and females was significant.

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## ABSTRACT

**Background:** Fusion of the first metatarsophalangeal joint (1st MTPJ) is a common surgical procedure used to treat a variety of diseases and deformities of the forefoot. Fixation methods vary and typically fusion rates are good.

**Objectives:** The objectives of the study are to demonstrate whether there is any advantage to using locking as opposed to non-locking plates for 1st MTPJ fusion. Additionally the study aims to determine whether there is any difference in non-union rates according to gender.

**Methods:** One hundred and seventy two consecutive 1st MTPJ fusions were performed for 153 patients. 40 patients (23%) were male and 132 (77%) female. Twenty patients received *Hallu-fix*<sup>TM</sup> plates, 76 *Charlotte*<sup>TM</sup> plates and 76 *Anchorage*<sup>TM</sup> plates. Postoperative radiographs were reviewed for non-union. Failure rates were compared using Fisher's exact tests ( $p = 0.05$ ).

**Results:** Twelve (6.9%) non-unions were identified. The difference in failure rates between all systems was not statistically significant. However, the difference in fusion rates between males (17.5%) and females (3.8%) was significant.

**Conclusion:** This study finds that 1st MTPJ fusion is an effective method to treat diseases of the 1st MTPJ. Locking plates may offer better fusion rates than their non-locking counterparts. This is especially evident in male patients.

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## 1. Introduction

Fusion of the first metatarsophalangeal joint (1st MTPJ) is a common surgical procedure used to treat a variety of diseases and deformities of the forefoot [1–4]. The more common indications include dorsal deformities such as hallux rigidus secondary to primary or post-traumatic osteoarthritis [4] and medial deformities such as hallux valgus [3] sometimes in the presence of

rheumatoid arthritis or other inflammatory arthropathies [5]. Less common indications include salvaging failed osteotomies or recurrent deformities and correction of iatrogenic deformities such as hallux varus [6].

Generally, surgical intervention is considered in patients with symptoms, where conservative management is no longer achieving acceptable relief. Conservative measures include stiff soled shoes, insoles and other footwear accommodations, lifestyle modifications and simple pharmacological analgesic interventions. Surgical intervention in the 1st MTPJ need not proceed initially with arthrodesis. Options for milder disease include open [7] or percutaneous cheilectomy [8] and debridement of the dorsal joint.

\* Corresponding author. Tel.: +44 0 7969 460 594.  
E-mail address: [E.bass@hotmail.co.uk](mailto:E.bass@hotmail.co.uk) (E.J. Bass).

Implant hemiarthroplasties have been described and may have use in a select group of patients [9]. Fusion of the 1st MTPJ is the gold standard for joints with severe symptomatic disease, severe deformity of the joint, or both [1]. Postoperative symptomatic relief is reliable, there is long-lasting correction of deformity and there is often a successful return to previously limited activities of daily living [1].

The critical aspect of the 1st MTPJ fusion is a stable and well-fixed joint and this can be achieved by a variety of methods. The approach may vary, however typically, joint surfaces are reamed in the manner of a hemispherical ball and cup. Occasionally, flat surfaces are preferred. There is general agreement that the hallux should end in neutral rotation with 15 to 20 degrees of 1st MTPJ dorsiflexion and 5 to 10 degrees of valgus [1]. Fixation methods vary by surgeon and by centre and include the use of K-wires [10], single [10] or crossed lag screws [11], staples [12], plate and screw systems sometimes with an added lag screw [1]. Regardless of methodology, reported rates of fusion are typically good—commonly greater than 90%. However, published data demonstrates a wide range of fusion rates between differing techniques and there are observable differences of fusion rates between different brands of systems based on similar mechanical principles.

The aim of this study is to investigate the clinical results of three different dorsal plating systems used at a single University teaching hospital. There is a particular emphasis on the differences in non-union rate between locking and non-locking systems, and also between genders.

## 2. Patients and methods

One hundred and seventy two consecutive 1st MTPJ fusions were performed between 01/2009 and 07/2012 at a University hospital trust. Regardless of indication, all the procedures were performed with the same operative technique as described in the next section. It was anticipated that a greater degree of stability would be desirable for presentations other than hallux rigidus. By not altering the technique between cases, the confounding impact of the operative technique to the series was minimised. No patients underwent bilateral procedures at the same time. We included all the patients coded correctly, with pre and postoperative radiographs available for viewing and paper or electronic medical records, available for interrogation.

The mean age of the patient group was 62 with a range of 41 (42–83). In the group there were 132 (77%) women and 40 (23%) men. The diagnoses included hallux rigidus (116), hallux valgus (77, including 23 with inflammatory arthropathies), revision fusion (6), recurrence of valgus deformity after SCARF/Chevron osteotomies (3), hallux varus after SCARF (1) and a failed Keller's osteotomy (1). A Fisher's exact test demonstrated no significant difference in the make-up of each group in terms of the indication for surgery. Fig. 1 shows a patient typically presenting to the clinic with symptomatic deformity prior to any operative intervention (Fig. 1). Three plating systems were assessed in the study. These were the Integra *Hallu-fix*<sup>TM</sup> (20), Wright Medical *Charlotte*<sup>TM</sup> (76) and Stryker Memometal *Anchorage*<sup>TM</sup> (76) plating constructs. Each of these groups was then separated by gender (Table 1). Medical records were reviewed for each patient and radiographs were assessed for signs of non-union. Despite radiographic evidence of fusion being difficult to define we assessed for the following four features; incomplete bridging of bone, increased radiolucency around screws, fractures and breakage of metalwork. Figs. 2 and 3 demonstrate some of these signs. The statistical significance of the differences in non-union rates between patients with different plating systems and between genders was assessed with Fisher's exact tests ( $p < 0.05$ ).



Fig. 1. A photograph demonstrating a typical appearance of a patient presenting to clinic with hallux valgus deformity.

Table 1

A table demonstrating the number of 1st MTPJ fusions performed, separated by plating type and patient gender.

	Males	Females
<i>Hallu-fix</i> <sup>TM</sup>	3	17
<i>Charlotte</i> <sup>TM</sup>	17	59
<i>Anchorage</i> <sup>TM</sup>	20	56
Total	40	132

### 2.1. Operative technique

All procedures were performed in a bloodless field achieved by ankle tourniquet. A single dose of the broad-spectrum antibiotic cefuroxime was applied intravenously at induction of anaesthetic. A dorsal approach with soft tissue dissection to the joint capsule was used to access the 1st MTPJ. Neurovascular structures were identified and protected, with particular care given to the dorsal medial sensory nerve. Exposure of the joint was achieved by longitudinal capsulotomy and osteophytes were then removed with bone nibblers. Both joint surfaces were reamed mechanically to form a hemispherical ball and cup shaped surface pairing. Prior to fusion, a 1.6 mm K-wire driver was used to drill holes in both surfaces to aid postoperative bone healing.

The hallux was placed in neutral rotation with 15 to 20 degrees of 1st MTPJ dorsiflexion and 5 to 10 degrees of valgus. A temporary K-wire was driven across the joint surface to hold this position (Fig. 4). This positioning is a critical part of the procedure and as such great care was taken to ensure correct positioning. The lid from the theatre instrument set can be used for this purpose. When the sole of the foot is placed on the lid the distal hallux should lie no higher off the surface than can be reduced by minimal flexion of the interphalangeal joint. The degree of valgus is appreciated by visual comparison with the second toe. Regardless of the brand of plate, the dorsal plate is then applied with a single non-locking screw in the proximal phalanx to seat the plate on the bone. A compression screw is inserted into the metatarsal head in a dorsoplantar direction. Likewise in all cases, a 3.0 mm headless dual thread compression screw was inserted from the disto-medial aspect, in a proximo-lateral direction independent of the plate with the aim of adding additional compression. Once the degree of compression, and positions of the toes were satisfactory, the rest of the screws were inserted. This aspect of the operative technique differed between plate types and is discussed below.

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