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# Plates, Screws, or Combination? Radiologic Outcomes After Lisfranc Fracture Dislocation

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ABSTRACT

Traditionally, Lisfranc fracture dislocations have been treated with transarticular screw fixation. A more recent development has been the use of dorsal bridging plates. The aim of the present study was to compare the radiologic outcomes for these 2 methods. Currently, no data comparing the outcomes of these 2 treatment options have been reported. A total of 62 patients were treated for Lisfranc fracture dislocations during a 6-year period. The inclusion criteria included ≥6 months of follow-up data available. Each fracture was classified using the Hardcastle classification system. Each fracture was also allocated into 1 of 4 groups: transarticular screw fixation, dorsal plating, a combination of plate and screw fixation, and nonoperative management. The outcome measures included the Kellgren-Lawrence grading of osteoarthritis and the Wilppula classification of anatomic reduction. In terms of results, radiologic osteoarthritis is not associated with the type of injury according to the Hardcastle classification nor with having an open or closed fracture. The Hardcastle classification is not associated with the type of fixation used. Fractures fixed with a combination of plates and screws had a 3.01 (95% confidence interval 1.036 to 8.74) increased risk of having stage 3 or 4 radiologic osteoarthritis compared with being fixed solely with bridging plates ($p = .009$). Multivariate analysis revealed that this increased risk of osteoarthritis was dependent on the quality of reduction, with good reductions having a 18.2 (95% confidence interval 15.9 to 21.8) times decreased risk of severe osteoarthritis compared with fair or poor reductions, independent of the type of fixation used ($p < .0001$). No radiologic benefits were found when comparing plate or screw fixation for Lisfranc fracture dislocations (although screw fixation might be associated with a less planus foot and fewer complications). Instead, a good anatomic reduction was the only predictor of the radiologic outcome, and the Hardcastle classification of fractures did not predict the surgery type or radiologic outcome. Finally, treatment with combination plates and screws resulted in worse radiologic outcomes, possibly owing to more complex fracture patterns.



Lisfranc fractures—or fracture/dislocations of the tarsometatarsal joint (TMTJ)—can leave patients with significant functional deficits. Mechanisms causing Lisfranc injuries range from low-energy twisting injuries to high-velocity trauma (1). The diagnosis of a Lisfranc fracture is usually by the radiologic findings, generally radiographs or computed tomography scans with tarsometatarsal joint displacement of ≥2 mm, typically necessitating surgery (2). Furthermore, good evidence is available to suggest that a significant factor in achieving superior radiologic and functional outcomes after surgery is the quality of the anatomic reduction (<2 mm) (3). If operative management is pursued, the aims of fixation include maintenance of appropriate medial and lateral column length, maintenance of an appropriately plantar flexed foot and stable internal fixation to retain anatomic reduction (4). Shortening of the medial column tends to produce a cavus foot, and shortening of the lateral column can result in a planus foot (3).

For many years, transarticular screw fixation was the recommended method of fixation for Lisfranc fracture dislocations (5,6). More recently, a trend has been seen for open reduction and internal

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**Fig. 1.** Radiograph of a foot from the screw-alone group.


**Fig. 2.** Radiograph of a foot from the plate-alone group.

fixation using dorsal bridging locking plates. Schildhauer et al (3) was the first to describe a temporary bridging plate of the medial column of the TMTJ in 2003. Dorsal bridging plates provide the advantage of overlying or straddling the fracture/dislocation and, unlike transarticular screws, do not need to be passed through the articular cartilage. The loss of fracture position can therefore be limited and the risk of developing post-traumatic osteoarthritis (OA) minimized. In addition, comminution and fracture fragmentation in the more severe fractures can make transarticular screw fixation technically difficult to achieve. Another advantage of bridge plating is the reduced footprint of the plate on bone, which, in turn, has been shown to protect the periosteal soft tissues and vascularity and encourage both bone union and soft tissue healing (7,8). Biomechanical studies have shown that dorsal plates demonstrate similar levels of resistance compared with transarticular screws on application of weightbearing force (9). More recently, Bayley et al (10) was able to show that locking plates in complex midfoot fractures were able to maintain adequate fixation in terms of length, alignment, and stability—that is, they were able to maintain quality anatomic reduction. However, the limitations of dorsal bridge plating include the limited space for screw placement—allowing room for loosening and loss of screw and fracture position. As far as we are aware, no studies have compared screw and plate fixation in terms of the radiologic or functional outcomes after a Lisfranc injury in the clinical setting.

### Patients and Methods

A cohort of 142 patients with Lisfranc fracture-dislocation were treated at our level 1 trauma center from January 1, 2006 to August 31, 2013. All cases with <6 months of radiologic follow-up data were excluded. We then retrospectively reviewed all cases to collect data such as the mechanism of injury, surgical treatment options, pre- and postoperative radiologic findings, and postoperative complications. Three patients were excluded because of incomplete data, leaving 62 eligible fracture/dislocations identified for inclusion. The institution's human research ethics committee provided ethical approval for the present study.

The preoperative radiologic imaging studies were reviewed to determine the fracture type, using the Hardcastle classification system (11). Whether the fracture was open or closed was also recorded. The postoperative imaging studies and operative reports were reviewed. Fractures were then grouped according to the type of surgery performed: (1) fixation of the TMTJ with transarticular screws only; (2) dorsal plate fixation only of the TMTJ; (3) fixation with a combination of dorsal plates and transarticular screws of the TMTJ; and (4) nonoperative management. Because the Lisfranc interval was only fixed with a transarticular screw, it was excluded when determining to which of the 4 groups the fixation belonged. Figs. 1 to 3 demonstrate the first 3 groups. Two major outcome measures were obtained by review of the most recent postoperative imaging study. Each film was classified using the Kellgren-Lawrence grading system (grade 1 to 4) of OA. The anatomic reduction (alignment, length, and Lisfranc interval diastasis) was also assessed on these images using the Wilppula classification of good, fair, or poor anatomic reduction. A good anatomic reduction was described as a good total shape of the foot, with the diastasis between the first and second metatarsal bases <5 mm and slight arthrosis only. Fair anatomic reduction was described as a first and second metatarsal base diastasis of 6 to 9 mm and slight or moderate arthrosis. Finally, poor anatomic reduction was defined as marked deformity (e.g., cavus, abduction or adduction, shortening, or first metatarsal dislocation), with a diastasis between the first and second metatarsal bases of ≥10 mm and moderate to severe arthrosis (12).

Meary's angle was used to measure dorsal and plantarflexion pre- and postoperatively. A blinded post-fellowship orthopedic surgeon reviewed the pre- and postoperative radiologic studies to ensure interobserver reliability for our Hardcastle classification and outcome measures. This yielded kappa coefficients with good agreement. Finally, the postoperative complications were assessed by a review of the outpatient clinic notes and divided into 4 groups:

1. Soft tissue complications, including infections and soft tissue deficits
2. Malfixation, including broken screws
3. Pain requiring more than standard investigations and treatment such as corticosteroid injections and computed tomography scans
4. Non- or malunion

Cases necessitating a return to the operating room were also noted, including those for removal of metalware, and these were incorporated as a part of the present analysis.

## Results

A total of 62 Lisfranc fracture dislocations (32 right and 30 left) were included in the present study. Of the 62 patients, 41 were male and 21 were female. The mean follow-up period was 1 year, 2 months (range 6 months to 4 years, 6 months), and the mean age was 38.77 (range 17 to 73) years. Motor vehicle accidents were the most common mechanism of injury, with 36 incidents (58%), followed by falls