

Nitinol Staple Use Reduces Surgical Time and Effectively Achieves Union in Primary Arthrodesis of Lisfranc Fracture-Dislocations

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INTRODUCTION: Primary arthrodesis of Lisfranc fracture-dislocations is a reliable treatment option, yet concerns remain about nonunion. The use of a new generation of nitinol staples has proliferated in midfoot arthrodesis. The purpose of this study is to examine the use of nitinol staples, among other surgical and patient risk factors, in primary arthrodesis of acute Lisfranc fracture-dislocations, comparing outcomes to traditional plate and screw fixation.

METHODS: Midfoot fracture-dislocations treated with primary arthrodesis by seven foot and ankle orthopaedic surgeons were reviewed. Patients age 18 years or older with a fracture or dislocation of the first, second, or third tarsometatarsal joint, medial-middle cuneiform joint, or Lisfranc joint (2nd metatarsal-medial cuneiform joint) and a minimum of 4 month clinical and radiographic follow up were included. Patients with open fractures, fractures managed with external fixation, Charcot arthropathy, neuropathy, previous midfoot surgery, or concomitant hindfoot/ankle fractures were excluded. Of the 160 eligible patients, 121 patients met the required 4-month minimum radiographic follow up. Radiographic outcomes were analyzed at both a patient level and individual joint level. Patients and individual joints (305 total) were categorized as either staples alone (45 patients, 154 joints), staples plus plates and screws (hybrid) (45 patients, 40 joints), or plates and screws alone (31 patients, 111 joints). The primary outcome was the presence of arthrodesis union at each joint fused.

RESULTS: There was no difference in age, sex, body mass index, smoking status, end stage renal disease, or workers' compensation status between the groups. There was a higher rate of diabetes in the hybrid and plate and screw groups compared to the staple only group. Regarding the primary outcome, 93.4% of patients and 95.7% of individual joints demonstrated radiographic union at final follow up. On univariate analysis at the patient level, there was no difference in nonunion rate among the 3 fixation constructs ($P = 0.0649$). When assessed at the individual joint level, the nonunion rate was higher (9.0%, 10/111) among joints fixed with plate and screw constructs than with hybrid (2.5%, 1/40) or staple only constructs (1.3%, 2/154) ($P = 0.0085$). Multivariable regression analysis demonstrated that the use of an autograft was an independent risk factor for union, while no significant effect was detected for joint fixation type (Table 1). Median OR and tourniquet times were shorter for hybrid (92 & 83 minutes) and staple only (67 & 63 minutes) constructs compared to plate and screw only fixation (105 & 95 minutes) ($P = <0.0001$ & 0.0003). There was no difference in overall reoperation rate, malunion, or patient-reported outcome measures between fixation types. There was a higher rate of hardware removal in the plate and screw group (9.7%) and the hybrid group (11.1%) compared to the staple only group (2.2%) ($P=0.0127$).

DISCUSSION AND CONCLUSION: The use of nitinol compression staples should be considered for primary arthrodesis of Lisfranc and midfoot fracture-dislocations due to effectiveness in achieving osseous union and shorter tourniquet and surgical time compared to traditional plate and screw fixation.

Table 1. Multivariate Logistic Regression of Arthrodesis Union Odds Ratio Estimates

| Effect | Point Estimate | 95% Wald Confidence Limits | |
|------------------------------|----------------|----------------------------|-------|
| Plate/Screws vs Staples Only | 0.192 | 0.04 | 0.933 |
| Hybrid vs Staples Only | 0.449 | 0.039 | 5.195 |
| Autograft vs No Autograft | 5.964 | 1.798 | 19.77 |