

Outcomes of Minimally Invasive Approach to Intra-Articular Calcaneal Fractures with Percutaneous Screw versus Plate Fixation

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INTRODUCTION: Calcaneal fractures are the most common type of tarsal injury. Displaced intra-articular fractures account for about 75% of all calcaneal fractures. These types of fractures typically result from high energy trauma and are associated with significant soft-tissue swelling, morbidity, and long-term disability. Surgical fixation of intra-articular fractures with plates and screws is generally recommended, but can be complicated by infection, nonunion, wound dehiscence, and healing complications. In an effort to mitigate risks associated with larger surgical incisions, minimally invasive techniques have been developed. The purpose of this study is to investigate the outcomes of intra-articular calcaneus fractures treated with open reduction and internal fixation with percutaneous screw versus calcaneal plate fixation via a minimally invasive sinus tarsi approach.

METHODS: A retrospective chart review was conducted to identify all patients with an intra-articular calcaneus fracture who underwent open reduction and internal fixation through a minimally invasive approach. Inclusion criteria included patients >18 years of age with a Sanders Type 2b, 2c, or 3 intra-articular calcaneal fracture. Exclusion criteria included patients under 18 years of age, multiple injuries to the same extremity, polytrauma that precludes the planned postoperative rehabilitation for calcaneal fractures, and patients lost to follow up. Charts were reviewed for demographic, comorbidity, and radiographic measurements of calcaneal displacement including Gissane angle, Bohler's angle, calcaneal height, and calcaneal width. Radiographic measurements were followed through the postoperative period for reduction assessment. In addition, intraoperative time of procedure, tourniquet time, and cost were assessed to evaluate value based measures associated with each group. Postoperative complications and revision were also noted. Patients were followed for up to two years, with a minimum of 6 weeks, given the high rate of trauma patients lost to follow up. Univariate analysis was performed to assess differences between plate versus screw fixation groups. Statistical significance was determined based on a p-value of <0.05, with a 95% confidence interval.

RESULTS: Overall, 77 patients, 82 feet were identified. A total of 55 patients (34.5% female, 65.5% male) were included in the cohort with a mean age of 41.47 years and BMI of 27.52. The cohort was grouped based on type of surgical fixation with 38 patients who underwent plate fixation and 15 patients with screw fixation (cannulated and solid screws). Comparing the two groups via univariate analysis, there were no significant differences in medical comorbidities or patient demographics between cohorts in terms of age, gender, MOI, HTN, BMI, obesity, or Sanders classification. The screw fixation group contained a higher incidence of diabetes mellitus ($P = .04$). With regard to operative measurements, the average time to surgery was significantly shorter in the screw fixation group ($P < .001$) with surgery taking place on average 7.172 days earlier, 95% CI (3.321-11.023). There were no statistically significant differences in incision to closure time, tourniquet time, pre/postoperative Visual Analogue Scale (VAS) scores, or pre/postoperative pain scores. There were no statistically significant differences in Δ Gissane Angle ($P = .663$), Δ Bohler's angle ($P = .645$), Δ Calcaneal height ($P = .963$), or Δ Calcaneal width ($P = .258$) between groups. There was a statistically significant higher incidence of wound dehiscence ($P = .041$) and unplanned return to the operating room (UROR) ($P = 0.021$) in the plate fixation cohort requiring an increased in clinic visits and total cost of care. Cost comparison of both cohorts showed the cost of fracture fixation with a pericalcaneal plate to be \$1,300, whereas percutaneous screw fixation cost \$1,000 for cannulated screws or \$700 for solid screws.

DISCUSSION AND CONCLUSION: Open reduction and internal fixation is often recommended as surgical treatment for intra-articular calcaneal fractures. However, there remains controversy over the optimal surgical fixation given the high rate of complications. Minimally invasive procedures have continued to advance options for treatment of intra-articular calcaneal fractures. Our study demonstrates that a minimally invasive approach to Sanders type IIb, IIc and III calcaneal fractures with screw fixation provides satisfactory radiographic reduction and clinical outcomes with a lower incidence of complications and cost, improving value-based care. Longer term studies with a larger sample size and randomized controlled trials are required to define the superiority of our minimally invasive technique compared with conventional surgical treatment of calcaneal fractures, including MIS approaches with plate fixation.