

Original Article**Minimally invasive calcaneal fracture fixation by using two-point distractor - A Prospective Observational Cohort Study**

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Abstract:

Introduction: A displaced fracture of calcaneum is serious and disabling injury. Treatment options have evolved from conservative to open surgical alternatives and include a variety of minimally invasive techniques also. We hypothesise that minimally invasive surgery of calcaneal fractures by using a distractor achieves a good clinical and functional outcome with minimum wound complications.

Aims and objectives: The aim of our study was to assess the functional outcome of minimally invasive surgery in the management of calcaneal fractures and the subsequent complication rate in the management of displaced intra-articular fractures.

Methods: Between April 2018 and March 2021, patients with unilateral or bilateral closed calcaneal fractures, treated operatively with minimally invasive technique using distractor were included in the study. 64 patients with 60 calcaneal fractures were included in the study. Pre operatively CT scan evaluation was done and fractures were classified as per Sander's classification. Only type II and type III were included in the study. Pre operatively both Bohler's and Gissane's angles were measured. **Maryland foot and ankle score** was used for evaluation and effectiveness of intervention.

Results: The average operative time in our study was 45± 11.2 minutes. No major wound complications were reported in our study. Screw prominence was seen in three patients. Complex regional pain syndrome was seen in seven of our patients. Both Gissane and Bohlers angles were restored in 94% of our patients. Maryland foot and ankle score was excellent in 20 % (11) of patients, Good in 60% (33), Fair in 15% and Poor in 5%.

Conclusion: We concluded that management of calcaneal fractures with the use of distractor helps to restore the articular congruity of subtalar joint with minimum soft tissue complications.

JK-Practitioner2023;28(3-4):16-19**Introduction:**

Calcaneal fractures are the most common among tarsal bone fractures and constitute around 65% of all tarsal bone fractures.[1] Treatment options vary from conservative treatment to operative extensile approach and minimally invasive techniques of fixation. Although the ideal treatment is still controversial, but operative treatment has been found to have superior results in terms of pain and disability in the long run. [2,3]. The advanced minimally invasive techniques fair better in terms of wound complications, skin necrosis and early rehabilitation.[4]. Moreover, early surgical intervention is possible by means of minimally invasive techniques which in turn decrease the overall morbidity and rehabilitation time. The primary aim of our study was to assess the functional outcome of minimally invasive calcaneal surgery by using two-point distractor.

Methods

This was a prospective observational study undertaken from April 2018 to March 2021 at our hospital. The study was approved by the institutional ethical committee and was laid down in accordance with the declaration of Helsinki.

The mean age of our patients was 45 years. 64 calcaneal fractures in 60 patients were operated by using two-point distractor during this period

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Keywords

Distractor, Calcaneal fractures;
 Screw fixation.

and were included in the study. Four patients had bilateral fractures. Out of 64 calcaneal fractures, 45 were male and 19 were female. Pre-operatively fractures were evaluated by axial view, lateral view, Broden's views and a CT scan. Fractures were classified based on CT scan classification by Sander's. [5] Only patients with displaced type II and III Sander's were included in our study. Patients with open calcaneal fractures and type IV Sander's were excluded from the study. The average time from injury to surgery was 5.5 days. The average preoperative Bohler's angle was $12 \pm 5.6^\circ$ and the average preoperative Gissane's angle was $75.0 \pm 10.3^\circ$. Mechanism of injury is given in Chart 1. **Maryland foot and ankle score** was used for evaluation and effectiveness of intervention.

Surgical technique

Patients were positioned in a lateral position with the side to be operated up. Two trans fixation collinear 2.5 to 3mm pins were placed in talus and calcaneal tuberosity for attachment to distractor. Two-point calcaneal distractor was placed in a manner so that it does not come in the field of vision [Fig. 1]. The placement of pins was confirmed under fluoroscopy. The initial lateral view, axial view and

Broadens view were done at this point to check for varus/valgus alignment, posterior facet depression and articular malalignment. The pins are distracted on either side by means of a distractor to correct corresponding malalignment and confirmation is done under fluoroscopy [Fig. 2]

Once reduction was found to be satisfactory one or two cannulated 4mm sustentacular screws were placed under fluoroscopy followed by 6.5mm screws along the axial length of the calcaneum [Fig. 3]. The distractor was removed at this point of time and final fluoroscopic picture is taken followed by application of short leg slab [Fig.4 and 5].

Stab incisions are sutured and dressed and short leg slab is applied for three weeks. At three weeks sutures were removed and patient is encouraged for ankle and foot range of motion exercises. Patient is followed at 6 weeks, 10 weeks and 12 weeks. Patient is allowed partial weight bearing after 8 weeks and full weight bearing only after 3 months. Evaluation at the final follow up was done using Maryland foot and ankle score. Any complication arising during the course of treatment was noted down and managed appropriately.

■ Fall from height ■ Road traffic accident ■ others

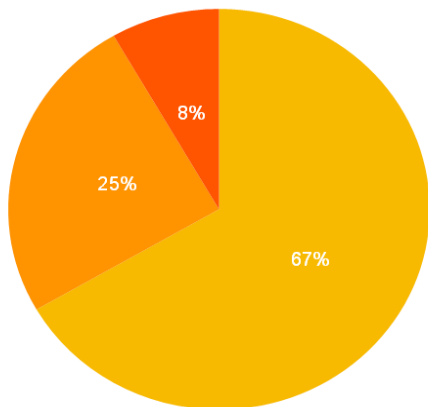


Chart 1: Mechanism of injury

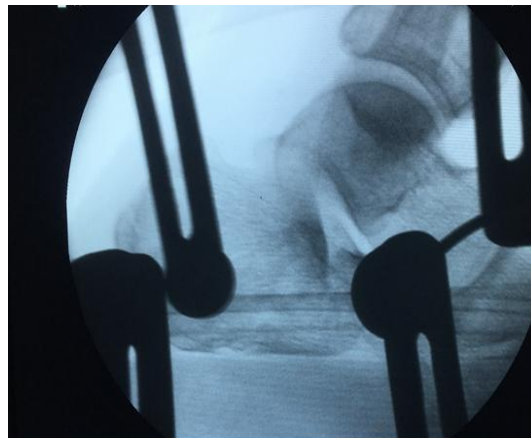


Fig 1: Placement of pins in talus and calcaneum with application of distractor

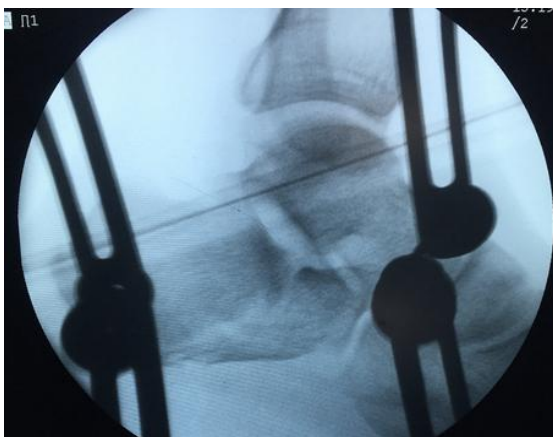


Fig 2: Articular step correction by use of two point distractor

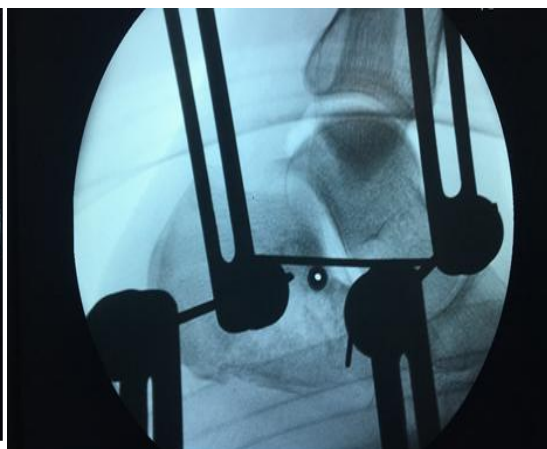


Fig 3: Placement of Sustentacular screw



Fig 4: Final fluoroscopic picture



Fig 5: Final AP view

Results

The study was conducted for a period of 3 years with a mean follow up around 22 months (16 -36 months). At final follow up 55 calcaneal fractures were reviewed with a follow up rate of 85%. The average operative time in our study was around 45 ± 11.2 minutes. No major wound complication or deep infection was reported in our study. Three of our patients had minor superficial wound infections which resolved with antibiotics and dressings. Screw prominence at tuberosity was seen in three of our patients which were removed after the fractures united. Complex regional pain syndrome was reported in 7 patients which was managed conservatively.

The average length of hospital stay in our patients was 5.3 ± 3.2 days. We did not report any sural nerve involvement or peroneal tendon dislocation in our patients. Reduction of posterior facet has been restored in 96% of patients. The average postoperative Bohler's angle was $28.5 \pm 3.6^\circ$ and the average postoperative Gissane's angle was $125.0 \pm 10.3^\circ$. Both Bohlers and Gissane angles were restored in 94 % of the patients. Varus was corrected in all patients. Calcaneal height and length were restored in 92%. Loss of reduction was seen in five of our patients in view of lateral wall comminution. Maryland foot and ankle score was excellent in 20 % (11) of patients, Good in 60% (33), Fair in 14% and Poor in 6%. We achieved anatomically satisfactory reduction in majority of our patients.

Discussion

Displaced calcaneal fractures are very serious injuries and the optimal management of these fractures is still controversial. There are many studies which have been published regarding the optimal management of intra articular calcaneal fractures [6-8], but most of them lacked representative number of patients to develop a valid consensus. [6,7, 9-13]. We employed technique of minimally invasive fixation of intra-

articular calcaneal fractures using the two point distractor. We believe that this mode of fixation has less number of wound complications as compared to the open reduction internal fixation [10 to 20 %]. In conventional plating, chances of main blood supply disruption which comes through lateral aspect are high and wound complications are severe as compared to minimally invasive technique. [14,15] De wall et al reported a deep wound infection and superficial wound infection of 14.3% and 21.4% respectively in open reduction and internal fixation of calcaneal fractures. [16] Buckley et al reported a 25 % rate of wound complications after open reduction and internal fixation. [17] It also allows early return to activities as patients can be operated as early as possible without waiting for the soft tissues to consolidate. We did not report any major wound complication in our study. In a meta-analysis by Fan et al the clinical results of minimally invasive technique were compared with that of ORIF. The lower incidence of soft tissue wound complications and reduced duration of surgical procedure was noted.[18] Moreover, arthrodesis becomes technically easier after minimally invasive technique of fixation.

The incidence of sural nerve injuries in minimally invasive calcaneal fracture fixation is negligible. The incidence of sural nerve injuries in extended approach can go up to 10% as there is a risk of injury to nerve at both proximal and distal part of the incision. Approximately 7.7% of sural nerve injuries have been reported by Weber et

al in extended approach.[19] No injuries to sural nerve were reported in our series as only stab incisions at anatomically safe points were given.

Our study had several limitations. First, the exact power analysis was not possible and the sample size was not that large to draw a meaningful conclusion. We had a midterm follow up only, as longer follow up is need to comment on arthritis which is the most common complication. Therefore, further studies are

needed with larger sample size and longer follow up to ascertain a more precise and meaningful understanding of the clinical efficacy of distractor and minimally invasive technique in calcaneal fractures.

Conclusion

We believe that minimally invasive technique with two-point distractor is ideal for treatment of joint depression and comminuted calcaneal fractures. It helps us to achieve length, width, joint congruity and varus-valgus alignment with rapid recovery and minimal wound complications.

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