

## How useful is Surgery in Management of Displaced Intra Articular Calcaneal Fractures?

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### Abstract:

**Background:** Calcaneal fractures, comprising 1-2% of all fractures, pose a challenge in management, especially when involving the intra-articular extension of the posterior facet. The lack of consensus on the optimal approach complicates decision-making. Surgical intervention is often necessary for displaced fractures, but the choice between open reduction and internal fixation (ORIF) with a plate and conservative management remains contentious. This study aims to scrutinize the functional outcomes and complication rates associated with the surgical management of displaced intra-articular calcaneal fractures. A case series of 25 patients undergoing various surgical interventions was analysed to provide insights into the efficacy of different surgical approaches.

**Patients and Method:** A prospective study (April 2019 to December 2022) included 25 patients aged 18-60 years with closed or open displaced intra-articular calcaneal fractures. Various surgical interventions were performed, and outcomes were assessed at a one-year follow-up. Statistical analysis utilized SPSS software for descriptive and inferential statistics.

**Results:** Closed reduction succeeded in 64%, while 36% required open reduction. The mean AOFAS score was  $74.72 \pm 13.84$ , with good, fair, and poor functional outcomes observed in 64%, 32%, and 4%, respectively. Complications included deep wound infection (12%) and implant-related issues.

**Conclusion:** Managing displaced intra-articular calcaneal fractures require a tailored approach. While surgical interventions may yield better functional outcomes, they come with higher complication rates.

**Keywords:** American Orthopaedic Foot & Ankle Hindfoot Score, Bohler's angle, Gissane's angle, Sub talar arthritis.

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### Introduction

Calcaneal fractures account for approximately one to two percent of all fractures, making them the most common type among tarsal bone fractures [1,2]. A significant challenge arises in managing these fractures, particularly when around 75% exhibit an intra-articular extension of the posterior facet [3].

Such fractures are commonly a result of axial loading, often associated with high-energy traumas like motor vehicle accidents or falls from heights. Remarkably, nearly 10% of calcaneal fractures are linked to vertebral or contralateral calcaneal fractures [4]. Intra-articular fractures, especially those involving the posterior facet, are notorious

for early and late complications. Despite the prevalence of these fractures, a consensus on the optimal management strategy is yet to be established [5,6]. Conservative management is typically reserved for non-displaced fractures exhibiting well-maintained Bohler's and Gissane's angles.

In contrast, surgical intervention becomes the norm for open fractures, tongue fractures with skin tenting, and displaced intra-articular fractures. The challenge with conservative management lies in its limited effectiveness in achieving anatomical reduction, particularly in displaced fractures, leading to a higher risk of malunion, arthritis, and

suboptimal outcomes. The condition of the overlying soft tissue emerges as a critical factor influencing surgical outcomes. Given the importance of functional outcomes for the resumption of daily activities, any complications resulting from surgery can significantly impact the overall functionality, often tilting the scale towards a preference for conservative treatment. This study aims to scrutinize the functional outcomes and complication rates associated with the surgical management of displaced intra-articular calcaneal fractures. We present a case series encompassing 25 patients with displaced intra-articular fractures who underwent various surgical interventions. The functional outcomes and complication rates were analysed at a one-year follow-up to provide valuable insights into the efficacy of different surgical approaches.

#### Patients and Method:

A prospective study was conducted on 25 patients presenting with displaced intra-articular fractures (Sander's type II, III, and IV) admitted to our institute between April 2019 and December 2022. The inclusion criteria comprised patients aged between 18 to 60 years, with closed or open displaced intra-articular calcaneal fractures

(Sander's type II, III, and IV) deemed medically fit for surgery. Exclusions from the study involved patients with undisplaced fractures (Sander's type I), those medically unfit for surgery, individuals with pathological fractures, and those with a previous history of calcaneal injuries. Prior to inclusion, all patients provided written informed consent.

Statistical analysis involved the utilization of the Statistical Package for the Social Sciences (SPSS) software version 16. Descriptive analysis explored the distribution of categorical and quantitative variables, with the chi-square test employed to assess differences between two groups and ANOVA for differences among more than two groups. A p-value less than 0.05 was considered statistically significant.

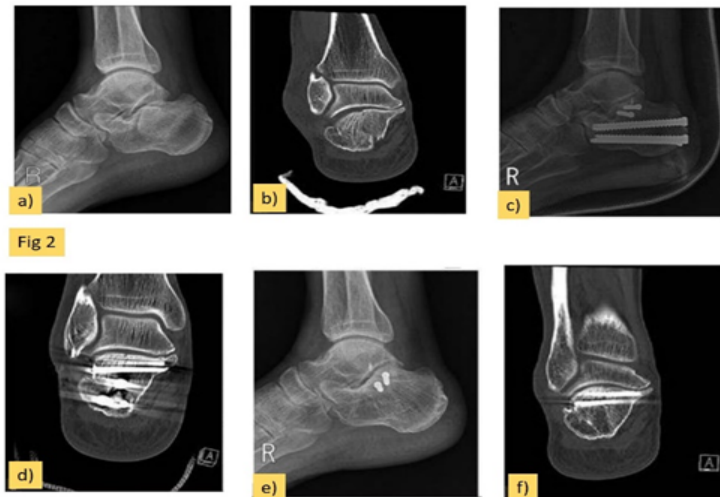
The initial evaluation included a detailed history, clinical examination, and an assessment to rule out associated injuries, coupled with the stabilization of the patient's general condition. Radiographic images, including heel lateral and axial views, along with CT scans, were obtained. A below-knee plaster of Paris slab was applied to support the ankle until surgery, which was deferred until the skin condition was favourable for incision (Fig 1).



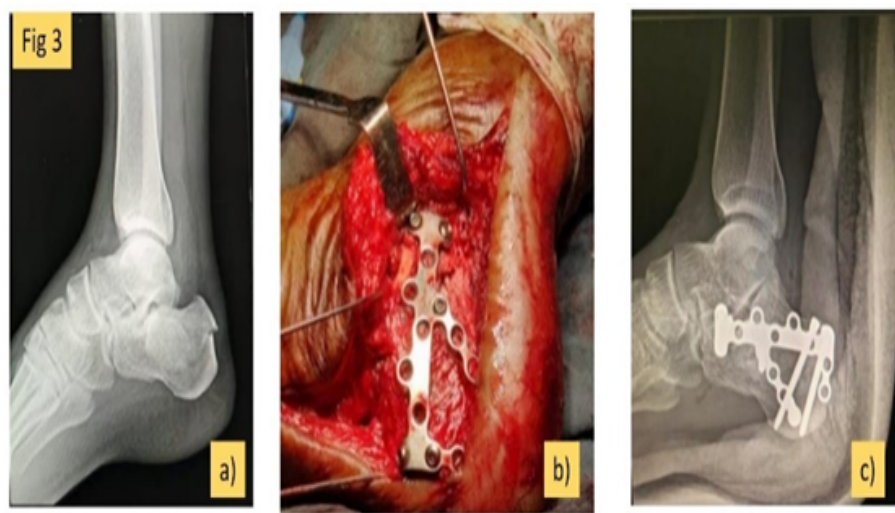
**Fig 1:** shows presence of blister over ankle and foot necessitating the need to defer surgery until the skin condition improves

Patients underwent surgery under spinal or epidural anaesthesia in the supine position with C-arm guidance. Surgical options included closed reduction and percutaneous screw or K-wire fixation, open reduction and internal fixation with plates and screws, and external fixator application. The extensile lateral approach was utilized when direct reduction was necessary, and the choice of implant depended on the reduction method, soft tissue condition, and wound status. Intravenous antibiotics were administered based on the chosen fixation modality, with the duration varying based on wound characteristics. Postoperatively, active toe movements and pain-permitted ankle

movements were allowed from day one. Immediate postoperative X-rays were taken to assess the quality of fracture reduction, and non-weight bearing was advised for at least six weeks. Protected weight bearing was permitted between six to eight weeks, gradually transitioning to full weight bearing at approximately three months after surgery. Follow-up included serial X-rays at two-week intervals up to three months, with scheduled follow-up appointments at three, six, and twelve months after surgery. The outcome of surgery was assessed at the one-year follow-up based on follow-up X-rays (Fig 2,3) and the American Orthopaedic Foot & Ankle Hindfoot Score (AOFAS).



**Fig 2 :** a) Radiographic image of right ankle of a patient showing calcaneal fracture b) CT image shows Sander's type II A fracture presentation c) d) Immediate post-operative x ray and CT images demonstrating well reduced fracture stabilized with cannulated screws e) f) One year follow up x ray and CT image of the same patient after implant removal



**Fig 3 :** a) Pre-operative x ray showing calcaneal fracture with altered Bohler's and Gissane's angle b) intra operative images demonstrating extensile lateral approach to calcaneum fixed with calcaneal plate and screws c) Immediate post-operative x ray showing restoration of anatomy and stabilization with calcaneal plate

## Results

The mean age of the study group was 38.12 years with the majority falling in the 21 to 40 years age group (64%). Males comprised 96% of the patients, while 28% had diabetes, and 12% had hypertension. The most common mode of injury was a fall from height (72%), followed by road traffic accidents (28%).

Radiographic screening for Sander's fracture classification revealed 52% as type III, 40% as type II, and 8% as type IV. Bilateral calcaneal fracture presentation occurred in only 2 patients (8%), and in 92% of patients, the opposite side was not involved. Most patients (56%) presented to the hospital between 2 to 4 days after injury, with 32% undergoing surgery in less than 7 days and 68%

between 8 to 10 days. Closed reduction was successful in achieving acceptable fracture fragment alignment in 64% of patients, while the remaining 36% required open reduction. Among those who underwent closed reduction, cannulated screws were used in 12 patients, and K-wires were used in 4 patients to maintain reduction. Open reduction involved internal fixation with calcaneal plates. The mean AOFAS score was  $74.72 \pm 13.84$ , with a good functional outcome observed in 64% of patients, fair in 32%, and poor in 4%. Minor complications included deep wound infection in 12%, inadequate reduction in 8%, and superficial wound infection in 12%. One patient developed severe infection necessitating implant removal. The mean AOFAS score for patients with good functional outcomes was 83.44, while for fair and

poor results; it was 60.63 and 48.00, respectively. The association between AOFAS score and overall results was statistically significant. Among patients with closed reduction, 75% had a good overall result and 25% a fair result. In patients with open reduction, the overall result was good in 44.4%, fair in 44.4%, and poor in 11.1%.

### Discussion

Intra-articular calcaneal fractures account for a substantial portion of orthopaedic trauma cases, often resulting in functional impairment and long-term morbidity if not managed appropriately. The debate between surgical intervention and conservative management remains a critical aspect of clinical decision-making.

Conservative management involves non-operative approaches such as immobilization, rest, and physiotherapy. Research by Harnroongroj et al. and Mei-Dan et al. suggested that certain non-displaced or minimally displaced fractures can be managed conservatively, especially in elderly or medically compromised patients [8,9]. Conservative treatment aims to minimize complications associated with surgery, such as infection and implant failure. Conservative management cannot be extended to intra articular fractures.

The deleterious forces responsible for calcaneal fractures can disrupt the subtalar joint. When treated conservatively, calcaneum remains deformed and leads to incongruent joint surface. This frequently leads to the development of subtalar arthritis, leaving patients with a painful, stiff, and deformed foot accompanied by heel widening. In some cases, individuals may require assistance with walking aids [7].

Surgical management measures commonly employed include percutaneous K wire or screw fixation, plate and screw fixation, external fixator application and sub talar arthrodesis. Percutaneous screw fixation has gained popularity as a minimally invasive alternative. Research by Stulik et al. and Zhang et al. highlighted its efficacy in achieving satisfactory reduction with minimal soft tissue disruption [10,11]. This technique is associated with quicker recovery and lower complication rates compared to traditional open procedures.

One of the widely adopted surgical techniques is Open Reduction and Internal Fixation (ORIF). Studies by Kline et al. and Chen et al. demonstrated improved functional outcomes and reduced subtalar joint stiffness in patients treated with ORIF compared to conservative approaches [12,13]. The use of locking plates and screws has shown promising results in achieving anatomical reduction and maintaining stability. External fixation is another surgical option, particularly in cases with severe soft tissue injury. The study by Carragee et

al. emphasized the role of external fixation in preventing wound complications and allowing for early weight-bearing [14]. However, it may be associated with prolonged immobilization and pin site infections. Comparative studies, including those by Sanders et al. and Zhao et al., have evaluated functional outcomes following different management approaches [15,16]. Surgical interventions often yield better functional outcomes, with reduced pain and improved mobility compared to conservative management. However, the choice of surgical technique may influence these outcomes.

A systematic review by Buckley et al. emphasized that ORIF was associated with superior functional outcomes and reduced subtalar joint pain when compared to conservative treatment [17]. The study analysed multiple randomized controlled trials (RCTs) and observational studies, providing a comprehensive overview of the existing evidence in favour of surgical intervention. Analysis of complications is crucial in evaluating the overall success of treatment modalities. Buckley et al. Reported higher complication rates associated with surgical interventions, including infection, hardware failure, and wound-related issues. Conservative management while having a lower risk of complications may result in malunion or delayed union in some cases.

The choice between surgical and conservative management is influenced by various factors, including fracture pattern, patient age, comorbidities, and surgeon expertise. The review by Dickenson EJ et al. emphasized the importance of individualized treatment plans, considering patient-specific variables to achieve optimal outcomes [19].

### Conclusion

The management of intra-articular calcaneal fractures involves a complex decision-making process. Surgical interventions, including ORIF, percutaneous screw fixation, and external fixation, offer improved functional outcomes but are associated with higher complication rates. Conservative management remains a viable option, particularly in selected cases, to minimize surgical risks. The choice between surgical and conservative approaches should be tailored to individual patient characteristics and fracture patterns. Further research and prospective randomized controlled trials are warranted to provide more robust evidence for guiding clinical practice in the management of intra-articular calcaneal fractures.

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