

# Functional and Radiological Outcome of Displaced Intra-Articular Calcaneal Fractures

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## Abstract

**Introduction:** Calcaneal fractures account for 1-2% of all the fractures and may be associated with increased disability in young and middle age group. The management of these fractures are challenging and this study assesses the clinical and radiological outcomes of displaced intra articular calcaneal fractures treated by open and closed reduction techniques.

**Aim:** To analyse the functional and radiological outcomes of displaced intra-articular calcaneal fractures.

**Methods:** A total of 26 study patients were and followed during the time period June 2018 to July 2019 in Department of Orthopaedics, Thanjavur Medical College, Thanjavur. Patients between the age group 18-65 years and those with B/L and unilateral calcaneal fracture sander's fracture classification type -2, 3 & 4 and injury less than 3 weeks were included in the study. Institutional ethics committee clearance was obtained and informed consent was taken from all the study patients before the study.

**Results:** The mean age was 46.28 years and males were more commonly affected. The results were best in the ORIF group with a mean AOFAS score of 81.24 and inferior in the CRIF with k wire group with a mean AOFAS score of 68.75. The cancellation screw group showed better results than the k-wire group but worse than the ORIF group.

**Conclusion:** The functional outcomes were best in the ORIF group and the minimally invasive techniques achieved a fair outcome and ankle functionality clinically and radiographically.

**Key words:** Calcaneus, ORIF, CRIF, AOFAS, Subtalar joint, Böhler's angle

## INTRODUCTION

The most frequent injuries of the tarsal bone are Calcaneal fractures, and account for 1–2 % of all fractures in the human body. Their annual incidence is 11.5 fractures per 100,000 people<sup>[1,2]</sup>. Males between 20-29 years are the most commonly affected population. The sequelae of DIACFs (displaced intra-articular calcaneal fractures) are disabling conditions and this poses a significant socioeconomic burden, as the affected population are mostly youth and middle-aged male workers<sup>[3]</sup>. Diabetes, osteoporosis, autoimmune disorders and injury are all the associated risk factors. Fall from a height with the heel hitting the ground

causes 70% of the intra-articular calcaneal fractures that involves the subtalar joint.

The management of Calcaneal fractures poses a challenge to the orthopaedic surgeon due to low level of evidence. Fracture reconstruction and improvising the fracture healing with the surrounding tissues is a major problem. The goal of a valuable surgical treatment is achieving a 3-dimensional anatomy of the calcaneum and many techniques have been identified in the recent years to accomplish this goal. Sanders computerized tomography (CT) classification and the Böhler angle measurement are the available useful diagnostic tools<sup>[4,5]</sup>. Studies have been done about the conservative management of these fractures but the results were not satisfactory. The most widely accepted surgical technique is open anatomic reduction and internal fixation through the extended lateral approach which permits good and wide visualization of the subtalar joint<sup>[6]</sup>. Minimally invasive procedures may be associated with incomplete reduction and fixation in cases of complex fractures. Studies report the loss of reduction

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**Month of Submission :** 11-2019  
**Month of Peer Review :** 12-2019  
**Month of Acceptance :** 12-2019  
**Month of Publishing :** 01-2020

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and inadequate restoration with cancellous bone screws and K-wires<sup>[7]</sup>.

This may arise the need for additional open surgery leading to wound necrosis, increased hospitalization and delayed rehabilitation. This study analyses the functional and radiological outcomes of DIACF with open and closed reduction techniques.

### Aim

To analyse the functional and radiological outcomes of displaced intra-articular calcaneal fractures.

## MATERIALS AND METHODS

An observational study was conducted among 26 study patients in Department of Orthopaedics, Thanjavur Medical College, Thanjavur during the study period June 2018 to July 2019. Parameters like sex distribution, age distribution, mode and type of injury (based on sander classification), site of involvement, timing of surgery, radiological analysis, ankle-foot alignment, range of movements, bone grafting and type of surgery to analyze the functional and radiological outcome of intra-articular calcaneal fractures treated by open/closed reduction method were studied. Patients between the age group 18-65 years and those with B/L and unilateral calcaneal fracture sander's fracture classification type -2, 3 & 4 and injury less than 3 weeks were included in the study. Patients not willing to participate in the study, age >65 years, sander's classification type-1 fracture, medical contraindications and injury greater than 3 weeks were excluded. The study began after obtaining informed consent from the study patients after ethical clearance from the Institutional Ethics Committee. Proper and timely follow up was done and the observations were documented. The pre-operative and post-operative radiographic images were analysed and fractures were classified. Data were statistically analysed and the results were discussed.

## RESULTS

Of the 26 patients, 18 patients were males and 8 patients were females. The mean age of the patients is 46.28 years. A total of 31 fractures was observed of which 18 cases were fixed with ORIF (open reduction & internal fixation) with PO, 5 with CRIF (closed reduction & internal fixation) with cancellous screw fixation and 8 cases with CRIF with k-wire fixation [Table 1]. The mean AOFAS score in patients who underwent surgery within 5 days following an injury was  $82 \pm 6.2$  and  $78 \pm 15.2$  in those who underwent surgery between days 6-10. The score was  $69 \pm 6.1$  in those who underwent surgery after 10 days of initial injury [Table 2]. There were 18 fracture fragments in the first group, those who underwent ORIF with PO and 5 fragments in the 2<sup>nd</sup>

group (CRIF with cancellous screw fixation) and 8 fragments in the 3<sup>rd</sup> group (CRIF with k-wire fixation) Table 3. The surgical outcomes were good in 27 fracture fragments and fair in 4 fragments Table 4. 4 cases reported with wound dehiscence 1 fracture site with wound infection. 26 cases did not have any post-surgical complications [Table 5].

## DISCUSSION

Fractures of the calcaneum are the commonest of the tarsal bone fractures and the prognosis for intra-articular fractures may vary. The management and choice of treatment of intra-articular calcaneal fractures still remains controversial. Hedge and his associates found in their study that the patient distribution was equal in the age groups 30-39, 40-49 & 50-59 years<sup>[8]</sup>. The mean age of fracture occurrence in our study was 46.28 years. Calcaneal fractures may vary depending on the age and mechanism of trauma. Mitchell *et al.* in his study said that most of

**Table 1: Cross-tabulation between fracture and surgical procedure**

S.No	Procedure	Number of fractures
1	ORIF with PO	18
2	CRIF with cancellous screw fixation	5
3	CRIF with k-wire fixation	8
	Total	31

**Table 2: Cross-tabulation between the timing of surgery and mean AOFAS**

S.NO	Timing of surgery	Mean aofas
1	<5 days	$82 \pm 6.2$
2	6-10 days	$78 \pm 15.2$
3	>10 days	$69 \pm 6.1$

**Table 3: Cross-tabulation between procedure and AOFAS**

S. No	Procedure	Number of fragments	Aofas score (mean)
1	ORIF with PO	18	81.24
2	CRIF with cancellous screw fixation	5	79.57
3	CRIF with k-wire fixation	8	68.75
	Total	31	

**Table 4: Cross-tabulation between no. of patients and outcome**

S.No	Outcomes	Number of patients
1	Good	27
2	Fair	4
3	Total	31

**Table 5: Cross-tabulation between patients and complications.**

S.No	Complications	Number of patients
1	No	26
2	Wound dehiscence	4
3	Wound infection	1

the fractures were due to fall from a height and males were at increased risk of injury<sup>[1]</sup>. In our study too, more number of males were affected than the females. Out of the 31 fracture fragments, 18 underwent ORIF with PO. The management of DIACF is challenging to the orthopaedician due to the complex anatomy of the tarsal bones and delicate surrounding soft tissue which can act as barriers to treatment<sup>[9]</sup>. Open reduction technique with an extended lateral approach and L-shaped incision provides better visualization of the fracture site and also protects the sural nerve and has been widely accepted for decades.

But there was a concern of post-surgical complication associated with this procedure. Bezes *et al.* in his study reported a 10% wound necrosis among 257 fractures using this approach<sup>[10]</sup>. Buckley *et al* and Folk *et al* also reported similar wound complications in their study. Biz and his team reported that no significant differences were found between populations treated with ORIF, screws, and K-wires but the best functional and radiological outcome was associated with ORIF group, which is considered as a gold standard for treatment of calcaneal fractures<sup>[11]</sup>. In our study too, the best AOFAS scores (81.24) were observed in the ORIF with PO group. The long-term pain and regaining of function was best achieved in this category but this technique is criticized for the complications associated. One out of 31 fractures presented with wound infection and 4 fractures with wound dehiscence. But the long-term results were good in 27 fractures.

We also observed in our study that the AOFAS score correlated with the timing of surgery. Better AOFAS score (82±6.2) was observed in cases treated within 5 days of the injury. This finding is concurrent with the study findings of McReynolds/Burdeaux who stated that prolonged wound exposure and delayed operating time may increase the chances of wound complications<sup>[12,13]</sup>. A normal range of Böhler's angle was observed in radiograph in most of the patients in ORIF group in our study. Optimal outcomes were achieved with CRIF with cancellous screw fixation with a mean AOFAS score of 79.57. In this study, the

least functional outcome was seen in the CRIF with k wire fixation group. The limitations of this study are the small sample size and the non-randomized structure.

## CONCLUSION

Our data showed that the ORIF group patients presented with superior radiographic and functional outcomes when compared to the two other groups. The timing of surgery also plays an important role in achieving a good functional outcome. The results were optimal in CRIF with cancellous bone screw fixation and least in CRIF with k-wire fixation. ORIF with PO may be associated increased with wound dehiscence and wound infections. Minimally invasive procedures can be used as an alternative to the conventional open reduction technique where there is a need to reduce post-operative complications.

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**How to cite this article:** Rajmohan GA, Chinnadurai MC. Functional and Radiological Outcome of Displaced Intra-Articular Calcaneal Fractures. *Int J Sci Stud* 2020;7(10):132-134.

**Source of Support:** Nil, **Conflicts of Interest:** None declared.