

## Original Research Article

# Management of fractures of calcaneus by open reduction internal fixation using lateral extensile approach and calcaneus plate

Amandeep Singh Bakshi<sup>1</sup>, Jaspreet Singh<sup>2</sup>, Sanjeev Arora<sup>3</sup>, Gurleen Kaur<sup>4\*</sup>

<sup>1</sup>Associate Professor, Department of Orthopaedics , Govt. Medical College & Hospital, Patiala

<sup>2</sup>Assistant Professor, Department of Orthopaedics , Govt. Medical College & Hospital, Patiala

<sup>3</sup>Senior Resident, Department of Orthopaedics , Govt. Medical College & Hospital, Patiala

<sup>4</sup>Associate Professor, Department of Pharmacology, Adesh Medical College & Hospital, Haryana

\* Corresponding author :\_Dr Gurleen Kaur\_ Associate Professor, Department of Pharmacology, Adesh Medical College & Hospital, Shahabad (M), Kurukshetra, Haryana , Email id: drgurleen04@gmail.com



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## Abstract

**Introduction:** Calcaneal fractures are a common fracture in the hind foot caused by a high energy trauma, such as a fall or motorcycle accident. For ideal functional results, anatomical reconstruction and restoration of the joint should be achieved with the restoration of articular congruity of the subtalar joint.

**Methods:** We retrospectively evaluated 12 patients of calcaneus fracture who were treated at Department of Orthopaedics, Govt. Medical College & Hospital, Patiala, between January 2017 to December 2019.

**Results:** 8.3% patients had wound edge necrosis and required debridement which healed with dressings. 1(8.3%) patient had a serious wound dehiscence. Excellent result was achieved in 7 (58.3%) patients. Good results were seen in 3 (25%) patients. 1 patient (8.3%) had a fair result. 1 patient (8.3%) had a poor result.

**Conclusion:** The treatment of calcaneus fracture by open reduction and locking plate is a satisfactory method. There is good outcome and better patient satisfaction.

**Key-words:** calcaneus, plating, surgical wound dehiscence

## Introduction

Calcaneal fractures are a common fracture in the hind foot caused by a high energy trauma, such as a fall or motorcycle accident.<sup>1</sup> Ninety percent of these fractures are caused in age group of 20 to 40 years.<sup>1</sup> Intra-articular fractures account for approximately 75% of calcaneal fractures and historically have been associated with poor functional outcomes.<sup>2</sup> For ideal functional results, anatomical reconstruction and restoration of the joint should be achieved with the restoration of articular congruity of the subtalar joint.<sup>3</sup> Calcaneal fractures can be complicated by subtalar arthritis and malunion.<sup>4</sup> Pain associated with mal-union can be variable in origin, such as peroneal tendon or lateral malleolus impingement due to widening of the calcaneus, anterior tibio-talar impingement due to a loss of height leading to a decrease in the talar inclination angle, and varus or valgus alignment causing pain during ambulation.<sup>5</sup> Since it is difficult to obtain an excellent anatomical reduction by nonoperative treatment the open reduction and

stable internal fixation (ORIF) for displaced intra-articular calcaneus has been considered to be the gold standard protocol for intra-articular calcaneus fracture.<sup>6</sup> Open reduction and internal fixation is performed by various approaches which may be broadly divided into the extensile lateral approach and mini incision approach which includes the sinus tarsi approach. The extensile lateral L-shaped approach has been traditionally used for fixation of calcaneus and it is very popular among the surgeons.<sup>2</sup> However, this approach has some limitations. The foot should be free of swelling and oedema when the surgery has to take place. Hence, it is recommended to do this surgery in the first 12 to 24 hours. Otherwise, it should be postponed to after 10 to 14 days, when the wrinkling sign has appeared.<sup>2</sup> The advantages of this approach include a very wide exposure of the lateral wall which allows adequate inspection of the fracture geometry including the subtalar joint and calcaneo-cuboid joint. This also permits easy placement of the plate on the calcaneus. The disadvantage of this approach is that there is no exposure of medial wall and patients may present with post-operative wound problems. Lim et al saw 30% of patients experience some incision complications including edge necrosis, dehiscence, hematoma, or deep infection.<sup>7</sup> The soft tissue problems have caused surgeons to look at mini-incision techniques in the hope of reducing wound complications. There is the problem of an inadequate exposure of the lateral wall, difficulty in getting a good reduction and difficulty in putting calcaneus plate through mini-incision technique. Hence, various tips and tricks are being used to minimize soft tissue complications of extensile lateral approach and simultaneously get a good reduction.

This study was planned to assess the problem of wound complications and final outcome of fracture calcaneus. In this study, we have tried to correct the anatomy of calcaneus by restoring the length, width and height of calcaneus. Rigid fixation has been achieved by means of triangular fixation by calcaneal plate. Functional outcome was noted in clinical evaluation.

### **Material and Methods**

We retrospectively evaluated 12 patients of calcaneus fracture who were treated at Department of Orthopaedics, Govt. Medical College & Hospital, Patiala, between January 2017 to December 2019. These patients were treated by extensile lateral approach and calcaneus plate fixation. The inclusion criteria were intra-articular fractures of the calcaneus and the exclusion criteria were pathological fractures of calcaneus, severe destruction of subtalar joint.

Trauma type/ cause of trauma, any medical co-morbid conditions, pre-operative and post-operative x-rays were evaluated. The un-involved side was not x-rayed as it is normally seen under C-arm before surgery so as to assess the shape of calcaneus and hence, see the adequacy of reduction. Classification of fracture was done by Sander's classification. Bohler's angle, AOFAS Ankle and Hindfoot score, length, breadth and height of calcaneus were measured in the pre-operative x-rays. Time between the surgery and initial injury to the foot was noted. Course of the patients over the post-operative period was noted. Skin healing and wound complications were specially evaluated. In the post-operative period, functional results were evaluated using AOFAS hindfoot score. Post-operative x-rays were done at regular intervals to see Bohler' angle, length, breadth and height of calcaneus.

### **Surgical Procedure**

The surgery was performed under spinal or general anaesthesia. Tourniquet was used in all the cases.

The patient was kept in lateral decubitus position with affected limb lying on top. The extensile lateral approach was used and L-shaped incision was placed in a standard fashion. The vertical limb of the incision was made just anterior to the Achilles tendon to protect the sural nerve. Full thickness flap was raised with contained peroneal tendons. No-touch-technique was used on the flap raised and it was retracted by drilling k-wires into fibula, talus and cuboid. The anterior process was reduced and fixed to the constant piece by k-wire. Tuberosity was then reduced to constant fragment by manipulating it with a Steinmann pin. Varus/valgus correction and calcaneal height was restored now and then held by k-wires. Posterior facet was reduced into place. Reduction checked under C-arm. Calcaneal plate was applied. Wound closed over suction drain. Compression Elastic dressing was applied.

### **Post-operative Period**

Antibiotics and NSAID's were given in the post-operative period. Drain was removed after two days. The patients were encouraged to do active toe and ankle movements. If swelling persisted in the post-operative period, then RICE principle was used to reduce the swelling. Stitches were removed at the end of two weeks.

### **Follow up**

Partial weight-bearing was allowed at the end of 10 weeks and full weight-bearing at the end of 16 weeks. Clinical and radiological evaluation was done at 1 month, 2 ½ months, 4 months and 6 months post-operatively. The radiological evaluation included length, breadth and height of calcaneus. Bohler angle was measured. Clinical evaluation was done by AOFAS (American Orthopedic Foot and Ankle Society) ankle-hind foot score. Patients were followed-up for a period of 6 months to one year.

### **Results**

Out of the 12 patients, 10 were males and 2 were females. 11 patients sustained injury by fall from height and 1 patient had a road-traffic accident. The age range of patients was 27 to 65 years with a mean age of 45 years. All the patients were involved with manual hard work or were daily labourers. All the cases were closed fractures. Pre-operative classification of all fractures was done by Sander's classification. There were 7 cases of type IIA, 1 case of type IIB, 3 cases of type IIC and 1 case of type IIIAB. Fig 1 shows an illustrative pre-operative x-ray of calcaneal fracture. Out of 12 patients, 4 were chronic smokers or tobacco consumers. They were advised to stop tobacco consumption as it would interfere with bone healing. Average time for surgery was about 10.4 days after the initial injury. This was done usually late because most of the patients would present after 12 to 24 hours, and swelling would have set in by then. So, surgery was postponed till the wrinkle sign was positive. (Fig 2)

### **Wound Healing**

10 (83.3%) out 12 cases healed primarily. 1 (8.3%) patient had wound edge necrosis and required debridement which healed with dressings. 1(8.3%) patient had a serious wound dehiscence which necessitated removal of implant and debridement to allow for subsequent wound healing. None of the patients needed plastic surgery to cover the defects. There was no incidence of blister formation or compartment syndrome. In the patient where plate had to be removed due to wound dehiscence, there was no collapse of the fragments. So, there was adequate fracture reduction which later progressed to satisfactory bone healing.

### **Radiological Results**

All the cases were assessed repeatedly for pre and post-operative measurements of length, breadth and height of the calcaneus. These findings are summarized in Table 3. It is clearly evident that there is an improvement in the radiological indices. The differences in the pre and post-operative results was found to be statistically significant.

### **Functional Results**

AOFAS-Ankle Hindfoot score

Excellent result was achieved in 7 (58.3%) patients. Fig 4 and 5 demonstrate an excellent reduction which produced excellent AOFAS Ankle and Hindfoot Score. Good results were seen in 3 (25%) patients. 1 patient (8.3%) had a fair result. 1 patient (8.3%) had a poor result. AOFAS Ankle and Hindfoot Score assessed pre-operatively and at the last follow-up (Table 6).

There was no case of screw breakage, screw back out, implant impingement, nonunion or malunion. One patient had subtalar joint stiffness which improved with physiotherapy over a period. No case of subtalar arthritis was noted till last follow-up. No case of post-operative sural nerve injury was seen.

Fig 1: Pre-operative x-ray of calcaneal fracture



**Fig 2: Wrinkle sign present at the surgical site**



**Table 3: Radiological Results (pre & post-operative) of all the 12 cases**

S. no.	Bohler Angle		Calcaneal Width (mm)		Calcaneal Length (mm)		Calcaneal Height (mm)	
	Pre-op	Post-op	Pre-op	Post-op	Pre-op	Post-op	Pre-op	Post-op
1	9	32	39	33	81	89	70	76
2	5	33	44	41	86	88	78	88
3	3	24	40	34	85	83	72	81
4	4	32	48	39	88	91	82	88
5	2	30	42	35	88	91	77	85
6	19	30	43	37	86	92	93	97
7	-21	30	59	40	75	84	71	80
8	-22	27	46	45	74	86	71	89
9	5	28	47	35	92	94	85	92
10	-4	27	45	37	82	85	77	87
11	-13	30	51	35	76	81	71	81
12	-3	35	48	33	89	91	82	87
<b>Median</b>	2.5	30	45.5	36	85.5	88.5	77	87
<b>Mean</b>	-1.33	29.83	46.00	37.00	83.50	87.92	77.42	85.92
<b>SD</b>	11.61	2.88	5.15	3.49	5.66	3.90	6.78	5.50
<b>p-value (paired t-test)</b>	1.6132E-08		8.55358E-05		0.04466378		0.003845102	

Fig 4: A post-operative x-ray of fracture calcaneus



Fig 5: A post-operative x-ray of fracture calcaneus



**Table 6: Average AOFAS-Ankle Hindfoot score of patients (pre & post-operative)**

AOFAS score	Pre-op (Average)	Last Follow-up (Average)	p-value
<b>Pain</b>	23	31	<0.05
<b>Function</b>	35	40	<0.05
<b>Alignment</b>	7	9	<0.05
Total	67	81	<0.05

### Discussion

It has been repeatedly shown that open reduction and internal fixation of calcaneus fracture has long term benefits-both financial and physical. This produces better quality of life for the patient with a very low complication rate. Better implants are now available which allow earlier weight bearing and bone grafting is not required anymore.

Multiple studies have demonstrated cost-effectiveness of surgery when compared to conservative treatment for intra-articular calcaneus fractures. Most of the conservatively treated patients ended up with painful malunions or subtalar arthritis which lead to the patients seeking arthrodesis surgery.

This finding has been confirmed in 2005 by Bajammal et al who analyzed about 20 publications to compare the outcomes of fracture calcaneus treated by internal fixation vs those treated conservatively.<sup>8</sup> He concluded that there was statistically significant benefit to female patients, young males, simpler fracture patterns, lighter workload when they were treated by surgery. Similar findings were seen by Meena et al

in 2017 in a meta-analysis of a large number of randomized control trials. He concluded that patients managed conservatively failed to resume pre-injury work. Surgery benefits patients by quicker recovery and greater likelihood to resume pre-injury work.<sup>9</sup> Similarly, in our study we found that 58.3% patients had excellent result while 25% patients had good result. AOFAS-Ankle and Hindfoot score was improved when compared with pre-operative scoring. On statistical analysis, this improvement was found to be significant.

In all the patients in whom surgery was performed, we found that the complication rate was quite low. Only one patient had wound edge necrosis and one more had a severe infection which necessitated implant removal. This rate of complication was comparable to other studies. Hersovic et al in 2005 found that in individuals with high physical or recreational demands, open reduction techniques can result in high union rates and good outcomes.<sup>10</sup> Wang et al in 2019 did a study of 63 cases and found that excellent/good rate was 90.5%. One case of delayed wound healing occurred. No infection or sural nerve injury occurred.<sup>11</sup>

In our study, fracture was opened by traditional extensile lateral approach. Though there has been interest in minimally invasive tarsal approaches, however we feel that comminuted fractures are better reduced by open technique. Dingemans et al in a systematic review in 2018 concluded that conventional techniques might not be replaced completely by minimally invasive techniques owing to the inability to completely reduce severely comminuted fractures.<sup>12</sup>

Locking plates were used in our study in all the patients as they have greater pull out strength. They allow for earlier weight bearing. There is no need for bone grafting when using locking plates. A study by Stoffel et al concluded that the locking plates were beneficial in the case of displaced intra-articular calcaneal fractures in osteoporotic bone. However, the difference between ultimate displacement and work to failure was not significant in their study.<sup>13</sup>

Rak et al confirmed the benefits of implanting locking compression plates in displaced intra-articular fractures of calcaneus over non-locking calcaneal plates for all Sanders types of intra-articular fractures.<sup>14</sup>

### **Conclusion**

The treatment of calcaneus fracture by open reduction and locking plate is a satisfactory method. There is good outcome and better patient satisfaction. The incidence of complications is low. However, the small sample size in this study is a drawback. Further enrollment of more patients for a larger study with a longer follow-up is required to make a stronger recommendation.

### **Acknowledgement**

Authors are highly thankful to the entire faculty and supporting staff of the Department of Orthopaedics, without whose support, this study could not have been possible.

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Date of Submission: 20 December 2019

Date of Peer Review: 08 January 2020

Date of Acceptance: 01 March 2020

Date of Publishing: 12 March 2020

Author Declaration: Source of support: Nil , Conflict of interest: Nil

Ethics Committee Approval obtained for this study? Yes

Was informed consent obtained from the subjects involved in the study? Yes

For any images presented appropriate consent has been obtained from the subjects: NA

Plagiarism Checked: Urkund Software

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DOI: 10.36848/IJBAMR/2020/12125.51270