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## Mid-term results of calcaneal plating for displaced intraarticular calcaneus fractures

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### Abstract

**Introduction:** Calcaneum fractures account for approximately 2% of all fractures, with displaced intra-articular fractures comprising 60% to 75% of these injuries. There are many methods of stabilization of calcaneal fractures, each having their own merits and demerits. The plate fixation has improved the functional results, limited indication for bone grafting, and shortened the duration of treatment.

**Materials and Methods:** 30 displaced calcaneal fractures were surgically treated in GMC Jammu between January 2015 and May 2017 were included in this study. Ten were excluded due to lack of follow up, which left the study group of 20 displaced intraarticular calcaneus fractures. Only closed fractures were included in this study. Fractures were classified according to Sanders Classification and only Sanders type 2 and type 3 fractures were included in this study. The extended lateral incision was used in all patients. All patients were evaluated according to the Maryland foot score and on their last follow-up day.

**Results:** The average follow-up time was 18 months (12 to 24 months). Twelve fractures were Sanders type 2 (60%), 8 were type 3 (40%). According to Maryland foot score, very good results were obtained in 6 patients (3.33%) and good results in 4 patients (20%) in Sanders type 2 fractures; good results were obtained in 8 patients (40%) and average results in 2 fractures (10%) in Sanders type 3 fractures.

**Conclusion:** In light of both the available literature and our own experience, we conclude that open reduction and a stable fixation method yield more satisfactory results when compared to the conservative treatment methods in the treatment of displaced intraarticular calcaneus fractures.

**Keywords:** Hip fracture, Bone turnover markers, CTX, PINP, Vitamin D

### Introduction

Calcaneum fractures account for approximately 2% of all fractures, with displaced intra-articular fractures comprising 60% to 75% of these injuries<sup>[1]</sup>. The treatment of calcaneum fractures continues to pose a challenge for the trauma surgeons despite advancement in surgical technique and implant devices. Calcaneus fractures occur due to high-energy trauma such as falls from height and traffic accidents.

Intraarticular calcaneus fractures comprise 75% of all the calcaneus fractures. Another important point to note is that the forces that cause the calcaneus fracture also injure the surrounding tissues to some extent. Plate osteosynthesis of the intra-articular fractures is a standard treatment method, but it has potential complications such as, poor wound healing and infection<sup>2</sup>. There are many methods of stabilization of calcaneal fractures, each having their own merits and demerits. The plate fixation has improved the functional results, limited indication for bone grafting, and shortened the duration of treatment.

The purpose of the present study, is to score the midterm functional outcome of the calcaneal plate fixation, in displaced calcaneum fractures.

### Materials and Method

30 displaced calcaneal fractures were surgically treated in GMC Jammu between January 2015 and May 2017 were included in this study. Ten were excluded due to lack of follow up, which left the study group of 20 displaced intraarticular calcaneus fractures. Only closed fractures were included in this study. Necessary radiological investigations and hematology were done

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on admission. Preoperative evaluation was done by standard x-ray and CT scans, Type of surgery and details were noted. Fractures were classified according to Sanders Classification and only Sanders type 2 and type 3 fractures were included in the study. The immediate post-operative x-rays were evaluated. All the cases were evaluated again clinically, radiologically and functionally at 6weeks, 12weeks, 6 months, 12months with respect to height of calcaneum, width of the calcaneum, range of movements at subtalar joint, tuber joint angle (Bohler's angle), angle of gissane, Heel varus, heel broadening. The time interval from trauma to surgery was eight days on average.

**Surgical technique.** The patient was placed on a radiolucent table in the lateral decubitus position so that the fractured extremity would face upwards. The extended lateral incision was used in all patients. The fractured lateral wall was lifted with the help of an osteotome, followed by reduction of the sustentaculum calcaneus, anterior process, tuberosity and then the posterior facet. Once the correction was checked with the c-arm and found to be accurate, internal fixation was performed using a plate. Active ankle and foot range-of-motion exercises were initiated on day 2. The same day, patients were mobilized with crutches if not contraindicated due to an associated injury, without weight-bearing. At 15 days postoperatively, the sutures were removed and the posterior splint was discharged. The patients were allowed to bear weight by an average of 10.4 weeks (9-13 weeks) after the surgical treatment. All patients were evaluated according to the Maryland foot score and on their last follow-up day.



**Fig 2: Plate Application**



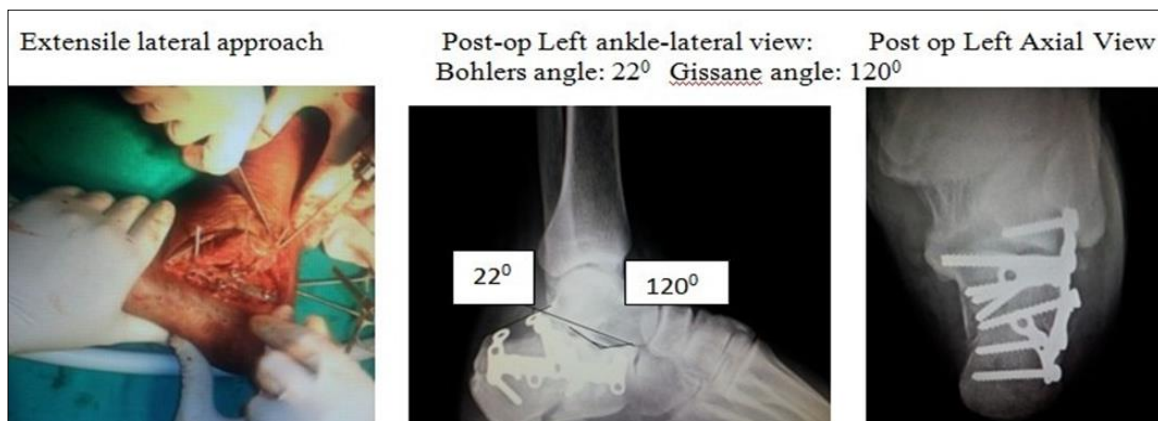
**Fig 3: Wound Closure**



**Fig 1: The standard extended lateral approach incision**



**Fig 4**



**Fig 5**

## Results

The average follow-up time was 18 months (12 to 24 months). Twelve fractures were Sanders type 2 (60%), 8 were type 3 (40%). According to Maryland foot score, very good results were obtained in 6 patients (3.33%) and good results in 4 patients (20%) in Sanders type 2 fractures; good results

were obtained in 8 patients (40%) and average results in 2 fractures (10%) in Sanders type 3 fractures. The patients' scores were obtained at the last follow-up.

The change in Bohler and Gissane angles is shown in Table 1. At the last follow-up, the mean Böhrer angle was improved 17.375° and Gissane angle was improved by 26.197°.

Two patients developed superficial soft tissue infection during the postoperative period, which responded to oral antibiotic

treatment and wound care.

**Table 1:** Patients characteristics

No Fracture	Maryland	Böhler	Böhler last	Gissane	Gissane last
Type	score	injury	follow-up	injury	follow-up
1 2B	Very good	11.32	28.6	130.32	104.2
2 2B	Very good	6.2	29.4	129.25	103.4
3 2B	Very good	11.13	27.2	128.42	104.1
4 2B	Very good	15	30	131	105
5 2B	Very good	10.22	29.4	126.12	103.1
6 2B	Very good	10.07	29.2	124.4	102.2
7 2A	Good	6.7	18	120.22	100.1
8 2A	Good	10.1	28.7	127.8	99.2
9 2A	Good	9.2	27	119	99.4
10 2C	Good	8	28	121.48	99.1
11 2C	Intermediate	5	26.54	120	99
12 2C	Intermediate	10.1	27	125.35	101.72
13 3AC	Good	9.2	24.4	125.6	99
14 3AC	Good	8.4	23.8	131	103.2
15 3AC	Good	9.2	24.2	133	98
16 3AC	Good	10	24.2	132.5	99.2
17 3AB	Good	6.8	27	125	110
18 3AB	Good	7.4	23.3	134.2	102.5
19 3BC	Good	8.2	24.8	133.4	99.1
20 3BC	Good	3	22	140	102.6

## Discussion

Calcaneus fractures comprise 2% of all fractures, and 60-75% of these fractures are intraarticular. Ten percent of the patients with calcaneus fractures have accompanying spine fractures and other extremity injuries. Calcaneus fractures are generally due to high-energy traumas such as a fall from height and traffic accidents.

We used Sanders classification based on computed tomography for our patients [3]. Twelve of the 20 calcaneus fractures comprising our task group were found to be type 2 and 8 were type 3. The options for treating intraarticular calcaneus fractures may be evaluated in four groups [1, 4, 5] as: Conservative treatment, closed reduction percutaneous fixation, open reduction internal fixation and primary subtalar arthrodesis, and mini open approaches with percutaneous fixation [6, 8].

Kitoaka *et al.* [9] reviewed the results of the walking analyses of 16 of 27 patients, who were not subjected to reduction and were treated with plaster. Many patients in their study showed differences in walking especially on uneven grounds, which showed that conservative treatment of displaced calcaneus fractures results in permanent functional disorders, at least to some extent.

O'Farrel *et al.* [10] treated 12 patients with surgical methods and 12 patients with conservative methods. They concluded that the surgical treatment was superior.

The timing of the operation is very important. Surgical intervention should preferably take place after regression of the excessive edema and should not be delayed beyond two weeks, as it will be difficult to provide anatomic reduction [11, 1]. The period between injury and operation was eight days on average in our cases.

All patients were operated by standard lateral approach, in which the reduction of the calcaneus body and calcaneus height, length and width can be regained regardless of the disintegration level [3, 13].

We used Sanders calcaneus plate in all patients. We did not observe any reduction loss in the early or late period due to osteosynthesis material. We did not use bone graft in any

patient. Active ankle and foot range-of-motion exercises were initiated on day 2. The same day, patients were mobilized with crutches if not contraindicated due to an associated injury, without weight-bearing. At 15 days postoperatively, the sutures were removed and the posterior splint was discharged. The patients were allowed to bear weight by an average of 10.4 weeks (9-13 weeks) after the surgical treatment

The key to success in the surgical treatment of intraarticular calcaneus fractures is ensuring reduction. The most common complication faced following calcaneus fracture is related to wound healing. In our study, 4 patients had a superficial wound infection that responded to oral antibiotics according to culture and sensitivity

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