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## A Single Center Study to Evaluate the Clinic-Radiological Outcomes of Patients with Intraarticular Calcaneal Fractures Treated Surgically

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### ABSTRACT

To assess the radiological, clinical and patient-reported results of surgically treated patients with intraarticular calcaneal fractures. This research was a single-center, prospective and observational study done on patients with calcaneal fractures at the Department of Orthopaedic Surgery. The study had a length of 3 years. Approval for the study was obtained from the institutional ethics committee. In this research, a total of 88 patients with 100 calcaneal fractures underwent surgery. The patients were followed up for a period of 18 months after the operation. The average age in this research was  $44.6 \pm 14.46$  years. Male cases (72.72%) outnumbered females (27.28%). 84% of fractures were Sander's type 2. Most fractures were unilateral (81.81%) against bilateral 16 (18.18%). In 36.6% of instances, injuries occurred. Pre-surgery time was  $5.5 \pm 1.3$  days, with an average hospital stay of  $8.2 \pm 3.7$ . Pre-operative Bohler's angle was  $\geq 20^\circ$  in 10% of patients and  $< 20^\circ$  in 90% of cases in this research. Most patients had excellent AOFAS scores 18 months post-op. No significant difference in AOFAS scores was seen across groups. Most patients in both groups had All macher grades 0 and 1. No significant difference was seen across groups. We compared pre-and post-op Bohler's angles 18 months after surgery. Instances with pre-operative Bohler's angle  $\geq 20^\circ$  had post-operative angles of  $25-29^\circ$  in 8 instances. In 76 instances with pre-operative Bohler's angle  $< 20^\circ$ , post-operative angle  $25-29^\circ$  was observed, with a statistically significant difference between two groups. In this research, post-op problems included heel pain, stiffness, wound infection, gait abnormalities and plaster sores. All complications were carefully treated. Open reduction and internal fixation are the best treatments for joint depression type and Sanders Type II/III calcaneal fractures, with favourable short-term outcomes.

## INTRODUCTION

The Calcaneus, known as the heel bone, is a substantial bone that serves as the base of the posterior portion of the foot. Calcaneal fractures are infrequent and make up around 1-2% of all fractures in the human body. They also constitute 60% of all injuries to the tarsal bones<sup>[1]</sup>. Specifically, fractures that occur inside the joint, known as intra-articular fractures, make up around 75% of all fractures in the heel bone (calcaneus). These types of fractures have traditionally been linked to unfavourable functional results<sup>[2]</sup>.

These fractures are consistently induced by a mechanism of force applied along the axis, such as a fall or a motor vehicle collision and may be linked to other injuries caused by force applied along the axis, such as fractures in the lumbar region, pelvis and tibial plateau<sup>[3]</sup>. Possible consequences include stiffness and arthritis in the subtalar joint, expansion of the heel, impingement of the peroneal nerve, difficulties connected to the implant and discomfort in the heel pad<sup>[4]</sup>. Therapy options mentioned in the literature include no therapy, conservative treatment, open reduction and internal fixation, primary subtalar arthrodesis, delayed primary arthrodesis and calcanectomy<sup>[5]</sup>. The calcaneus is the biggest bone among the tarsal bones of the foot and it is the first bone to undergo ossification. The calcaneus has articular surfaces located on its front half. Calcaneus fractures pose significant challenges for orthopaedic surgeons. Calcaneal fractures make up about 2% of all fractures and displaced intra-articular fractures make up 60%-75% of these injuries<sup>[6,7]</sup>. These fractures are consistently induced by a mechanism of force applied along the axis, such as a fall or a motor vehicle collision and may be linked to other injuries caused by force applied along the axis, such as fractures in the lumbar region, pelvis and tibial plateau<sup>[8]</sup>.

Possible consequences include stiffness and arthritis in the subtalar joint, expansion of the heel, impingement of the peroneal nerve, difficulties connected to the implant and discomfort in the heel pad<sup>[9]</sup>. The literature presents many treatment options, including no therapy, conservative treatment, open reduction and internal fixation, primary subtalar arthrodesis, delayed primary arthrodesis and calcanectomy<sup>[10]</sup>. Research on fracture patterns, soft-tissue care and outcomes of calcaneal fractures has sparked a discussion on the most effective approach to treating these fractures. Orthopaedic surgeons have strived to treat severe calcaneal fractures with the goal of expediting healing and minimising pain and deformity. Based on clinical, radiological and patient-reported results, surgical surgery is superior to conservative treatment for intra-articular calcaneus fractures<sup>[11]</sup>.

The objective of this research was to assess the radiological, clinical and patient-reported results of

patients who had surgical treatment for intraarticular calcaneal fractures.

## MATERIALS AND METHODS

The present investigation was a single-center, prospective and observational study done on patients with calcaneal fractures at the Department of Orthopaedic Surgery. The study had a length of 3 years. Approval for the study was obtained from the institutional ethics committee. In this research, a total of 88 patients with 100 calcaneal fractures underwent surgery. The patients were followed up for a period of 18 months after the operation.

### Inclusion Criteria:

- Patients over 20 years old, regardless of gender, with displaced intra-articular fractures and little or no soft tissue oedema had surgery with an 18-month follow-up.

### Exclusion Criteria:

- Open, extraarticular calcaneal fractures.
- Associated with additional major injuries.
- Calcaneal fractures older than 10 days.
- Pathological fractures.
- Lost follow-up.

**Methodology:** Written informed consent was taken from each of the patients after explaining the surgical procedure and other treatment modalities for similar fracture patterns. Patients underwent detailed history taking and examination. Initially conservative treatment was provided for average 7 days to allow soft-tissue swelling to resolve enough for the skin to wrinkle. Till then appropriate preoperative investigations, assessment of Bohler's angle and width of calcaneum were done and patients were put up for operation after proper anaesthetic check-up and counselling. All patients underwent open reduction and internal fixation with screws, operated in lateral decubitus/prone position under spinal/general anaesthesia. Indirect reduction achieved by closed method using bilateral JESS distracters, often with an elevation of depressed fragment by small lateral window. Internal fixation with 3 or more cannulated hip screws given percutaneously in posterior to anterior direction and occasional mediolaterally. Distracters were removed after the procedure. Limb kept elevated in POP below knee back slab till subsidence of pain and edema, usually 10-12 days. Vigorous ankle mobilization exercise was started. Non-weight bearing crutch walking or protected weight bearing in a synthetic cast was started after 3 weeks post-operative and continued for the next 6 weeks. Cast removed and partial weight bearing crutch walking up to radiological or clinical evidence of

fracture healing-then gradually full weight bearing along with physiotherapy. Patients were evaluated by a unified scoring system, the American Orthopedic Foot and Ankle Society (AOFAS) clinical rating system, the ankle hind foot scale for the calcaneal area and Allmacher grading for subtalar arthrosis.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. P-value less than 0.5 were considered as statistically significant.

## RESULTS AND DISCUSSIONS

**Table 1: Demographic data**

Parameters	No. of cases (Percentage)/Mean $\pm$ SD
Age (in years)	47.5 $\pm$ 11.44
<b>Gender (N=88)</b>	
Male	64 (72.72)
Female	24 (27.28)
<b>Sander's type (N=100)</b>	
Type 2	84 (84)
Type 3	16 (16)
<b>Fracture site (N=88)</b>	
Unilateral	72 (81.81)
Bilateral	16 (18.18)
<b>Other factors</b>	
Associated injuries	32 (36.36)
Time till surgery (in days)	5.5 $\pm$ 1.3
Duration of hospital stay (in days)	8.2 $\pm$ 3.7

Mean age in present study was 44.6 $\pm$ 14.46 years. Male cases (72.72%) were more than female cases (27.28%). Most of fractures were Sander's type 2 (84%). Most fractures were unilateral (81.81%) as compared to bilateral 16 (18.18%). Associated injuries were noted in 36.6% cases. Mean time till surgery was 5.5 $\pm$ 1.3 days and average duration of hospital stay 8.2 $\pm$ 3.7 days.

**Table 2: Distribution according to pre-operative Bohler's angle and AOFAS score**

Pre-operative Bohler's angle	AOFAS (American Orthopedic Foot and Ankle Society) Score (at 18 months post-op)			
	Excellent	Good	Fair	Poor
Pre-operative Bohler's angle $\geq 20^\circ$ (n=10)	8	2	0	0
Pre-operative Bohler's angle $< 20^\circ$ (n=90)	70	20	0	0

In present study 10% cases had pre-operative Bohler's angle  $\geq 20^\circ$  and 90% cases had pre-operative Bohler's angle  $< 20^\circ$ . Excellent AOFAS (American Orthopedic Foot and Ankle Society) score was noted at 18 months post-op in majority of patients. No statistically significant difference was noted in AOFAS score among two groups.

**Table 3: Allmacher grade in respect of pre-operative Bohler's angle**

Pre-operative Bohler's angle	Allmacher grade				
	0	1	2	3	4
Pre-operative Bohler's angle $\geq 20^\circ$ (n=10)	8	2	0	0	0
Pre-operative Bohler's angle $< 20^\circ$ (n=90)	60	14	12	4	0

Allmacher grade 0 and 1 was noted in majority of patients from both groups. No statistically significant difference was noted among two groups.

**Table 4: According to pre-operative and post-operative Bohler's angle**

Pre-operative Bohler's angle	Post-operative Bohler's angle 20-24°	Post-operative Bohler's angle 25-29°
Pre-operative Bohler's angle $\geq 20^\circ$ (n=10)	2	8
Pre-operative Bohler's angle $< 20^\circ$ (n=90)	14	76

We compared pre-operative and post-operative Bohler's angle, at 18 months post-op follow up. In cases with Pre-operative Bohler's angle  $\geq 20^\circ$ , Post-operative Bohler's angle 25-29° was noted in 8 cases. While in cases with Pre-operative Bohler's angle  $< 20^\circ$ , post-operative Bohler's angle 25-29° was noted in 76 cases and statistically significant difference was noted among two groups.

**Table 5: Postoperative Complications**

Postoperative Complications	N
Heel pain	32
Stiffness	10
Wound infection	8
Gait abnormality	6
Plaster sores	2

In present study post-op complications noted were heel pain, stiffness, Wound infection, Gait abnormality and Plaster sores. All complications were managed conservatively.

The Calcaneus, commonly known as the heel bone, is a substantial bone that serves as the base of the posterior portion of the foot. Calcaneal fractures are infrequent and make up around 1-2% of all fractures in the human body, as well as 60% of all injuries to the tarsal bones<sup>[12]</sup>. Specifically, intra-articular fractures make up-75% of calcaneal fractures and have traditionally been linked to unfavourable functional results<sup>[13]</sup>. These fractures are consistently induced by a mechanism of force applied along the axis of the bone, such as a fall or a motor vehicle collision. They may also be linked to other injuries caused by force applied along the axis, such as fractures in the lower back, pelvis and tibial plateau<sup>[14]</sup>. Possible consequences include stiffness and arthritis in the subtalar joint, expansion of the heel, impingement of the peroneal nerve, difficulties connected to the implant and discomfort in the heel pad<sup>[15]</sup>. The literature presents many treatment options, including no therapy, conservative treatment, open reduction and internal fixation, primary subtalar arthrodesis, delayed primary arthrodesis and calcanectomy<sup>[16]</sup>. The average age in the current research was 44.6 $\pm$ 14.46 years. The number of male cases accounted for 72.72% of the total, while female cases accounted for 27.28%. The majority of fractures were detected in young male patients (84.6%), with an average age of 36.8 years, which aligns with the findings reported in the literature<sup>[17]</sup>. The majority of fractures seen were

classified as Sander's type 2, accounting for 84% of cases. The majority of fractures (81.81%) were unilateral, whereas a smaller proportion (18.18%) were bilateral. According to the research, bilateral calcaneal fractures tend to show a more significant drop in the Böhler angle and higher rates of complications, related injuries and poorer outcomes compared to unilateral fractures<sup>[18,19]</sup>. Concomitant injuries were seen in 36.6% of the cases. The data on related injuries vary across the research, with some indicating a high occurrence and others showing statistics of little importance<sup>[13]</sup>. The mean duration until surgery was  $5.5 \pm 1.3$  days and the average length of hospital stay was  $8.2 \pm 3.7$  days. In the current research, 10% of the patients had a pre-operative Bohler's angle more than or equal to  $20^\circ$ , whereas 90% of the cases had a pre-operative Bohler's angle  $<20^\circ$ . The majority of patients had an outstanding AOFAS (American Orthopaedic Foot and Ankle Society) score at 18 months after the operation. There was no statistically significant disparity seen in the AOFAS score between the two groups. In research conducted by Mukherjee<sup>[21]</sup>, 80% of participants received outstanding results, while the remaining 20% achieved good results based on the AOFAS scale, which measures functional outcomes. The majority of patients from both groups had Allmacher grade 0 and 1. There was no statistically significant difference seen between the two groups. We conducted a comparison between the Bohler's angle before and after the operation, namely at the 18-month post-operative follow-up. Among the instances where the Pre-operative Bohler's angle was equal to or greater than  $20^\circ$ , there were 8 cases where the Post-operative Bohler's angle was reported to be between  $25$  and  $29^\circ$ . Among the patients with a pre-operative Bohler's angle less than  $20^\circ$ , a post-operative Bohler's angle of  $25$ - $29^\circ$  was seen in 76 instances. A statistically significant difference was found between the two groups. Two patients exhibited superficial wound infection, however, no patients needed a revision operation<sup>[22]</sup>. It is well recognised that underlying conditions such as peripheral vascular disease, diabetes and smoking have a negative impact on wound healing after surgery<sup>[23]</sup>. The observed postoperative consequences in this research were heel discomfort, stiffness, wound infection, gait abnormalities and plaster sores. All complications were treated using conservative methods. The management of calcaneal fractures requires careful consideration of several criteria, including the nature of the trauma, categorisation of the fracture, state of the skin and method of damage. Effective assessment, meticulous preoperative strategising and suitable intervention provide superior outcomes<sup>[24]</sup>.

## CONCLUSION

The optimal therapy for joint depression type and Sanders Type II/III fractures of the calcaneus involves performing open reduction with internal fixation. This surgical approach has shown favourable results during short-term follow-up.

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