

Outcome of Calcaneal Fracture management by open reduction and fixation with bone grafting: A record based study

Sanjay Barnwal¹, Sanjay Gaikwad^{1*}, Amogh Zawar¹, Yogesh Rathod¹, Aman Singh Chandel¹ Aniruddha A. Malgaonkar²

¹Department of Orthopedics, Rajiv Gandhi Medical College, Kalwa, Thane, India

²Department of Community Medicine, Rajiv Gandhi Medical College, Kalwa, Thane, India.

Corresponding Author: Sanjay Gaikwad

Abstract: This hospital based study was conducted to evaluate the functional and radiographic outcome after ORIF of displaced or depressed intra-articular calcaneal fractures treated only by K (Kirschner) wires with CC (Cannulated Cancellous) screw fixation and augmented with bone grafts. Outcome of patients as per American Orthopaedics Foot and Ankle Score (AOFAS) was observed post operatively and after 3 and 6 months. The difference in the AOFAS score of pre and post operative patients was statistically highly significant ($p < 0.00001$). The difference between the participants in excellent category immediately post surgery and 6 months post surgery was statistically significant ($X^2 = 7.917$, $p = 0.005$). The lateral approach with K wire and CC screw fixation with bone graft is an effective option for management of displaced intra articular calcaneal fractures, resulting in good functional outcome.

Keywords – Calcaneal Fracture, Open Reduction and Fixation, Bone Grafting

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I. Introduction

Calcaneal fractures correspond to 2% skeletal fractures and about 60% of the fractures of tarsal bones.^{1,2} A total of 70% calcaneal fractures are intra articular and 30% are extra articular.³⁻⁵ The incidence of calcaneal fracture has remained relatively constant⁵ even with the advent of mechanized industry, increasing number of road traffic accidents as it has been a common injury since man began to climb trees, to work from heights & farms.

The most common modes of injury in fracture calcaneum are fall from height, brake pedal injuries and high velocity trauma. Talus is driven down into calcaneum by axial loading mode of injuries which results in primary fracture line. Essex lopresti described secondary fracture lines which can produce tongue type and joint depressed type calcaneal fractures.^{5,6}

Calcaneal fractures often result in early and late complications like a Varus deformity with heel widening, loss of calcaneal height, subtalar joint incongruency, peroneal tendon impingement, malunion ifv not treated properly, hence focus has been targeted on operative management as it provides the opportunity for anatomical reduction and rigid internal fixation of displaced intra articular fractures of the calcaneum by Open Reduction and Internal Fixation (ORIF).⁷⁻⁹

There are various modalities of treatment for fracture calcaneum such as cast, percutaneous fixation, external fixator, and ORIF with plating and each modality has its own pros and cons. Despite the great development of orthopaedic traumatology, modern surgical techniques, 3D computed tomography scans and other hardware, the best treatment option for these fractures is controversial. Conservative treatment of intra articular fractures is not that successful due to incongruency of articular surface, widening of heel, talar dorsiflexion, loss of calcaneal height and peroneal tendon impingement. Hence the focus has been based on operative management as it provides the opportunity for anatomic reduction thereby restoring the biomechanics and function of the hind foot, heel width and length and alignment of the Achilles tendon. The extensile lateral approach with lateral surface calcaneal plating is widely used for the surgical fixation of the intra articular calcaneal fractures because of its excellent exposure and good results. But it also has soft tissue complications such as wound edge necrosis, wound dehiscence, infection which is majorly seen in patients with co morbid conditions like smoker and diabetics.^{10,11}

Because of this reason there have been many new advances of various approaches for ORIF of calcaneal fractures. We evaluate the outcomes of ORIF of displaced intra articular fractures of calcaneum with minimal implantation through the lateral approach.

II. Objective

The objective of this study is to evaluate the functional and radiographic outcome after ORIF of displaced or depressed intra-articular calcaneal fractures treated only by K (Kirschner) wires with CC (Cannulated Cancellous) screw fixation and augmented with bone grafts.

III. Methodology

This record based study was conducted in a tertiary hospital situated in a satellite township near a metropolitan city in Maharashtra state in western India. After obtaining permissions from the institutional authorities and the ethics committee, patients between 20-60 years of age with closed and displaced intra-articular calcaneal fractures who were managed surgically with open reduction and internal fixation through K wire or CC Screw by a lateral incision and minimal implantation with bone graft were included in the study. Patients with oedema, skin blisters or poor skin condition and patients with compound wounds around the ankle which could not be resolved before the date of planned surgery were excluded. Fractures were classified by Essex-Lopresti Classification. (n=20)

At the time of admission to the hospital the patient's foot was placed in a Jone's pressure dressing and a below knee slab applied. The extremity was elevated and ice applied in an effort to minimize swelling and avoid blisters.

Antero posterior, lateral, axial and Broden's view radiographs of the fractured calcaneus as well as the normal calcaneus were taken. From the radiographs the type of fracture was determined and the calcaneal height, width and joint angles were measured and determined. Any of the sanders type II or type III fractures can be joint depression types or tongue types according to Essex Lopresti.¹² All routine investigations were done and patients were operated as early as possible, once the patient was fit for surgery and skin condition was good.

The surgery was carried out in spinal anesthesia. A systemic antibiotic was administered just half an hour before induction of patient. After placing the patient in lateral position with affected side up, a pillow was fixed to the table below the operative foot to keep it in neutral position. A thigh tourniquet was applied and whole foot and ankle painted up to leg and draped. Classical L-shaped lateral incision was planned. Tip of lateral malleolus, base of 5th metatarsal and tendoachiles tendon were the 3 landmarks which were marked on the skin.

Incision was taken starting from midway between tendoachiles tendon and tip of lateral malleolus which was extended downwards vertically to the junction of skin and sole of foot where it was turned towards the base of fifth metatarsal. Angle was curved and not sharp. After careful dissection the short saphenous and sural nerve along with skin was retracted subperiosteally with the whole flap of tissue was elevated to avoid skin necrosis. Proper care was taken to avoid injury to the peroneal sheath. K wires were inserted in the lateral malleolus, neck of talus and calcaneo-cuboid joint to maintain the retraction of the whole lateral flap with peroneal tendon which were bent away from operating field. In case of the joint depressed type fractures we created a window and busted the lateral wall of the calcaneum to approach the depressed posterior calcaneal facet. After the depressed fragment was visualised, it was gently elevated with the help of L-punch and temporarily fixed to the medial aspect of calcaneum after confirmation of reduction by image intensifier. Fixation was aimed at restoring the length, axial alignment and alignment of articular surface of subtalar joint, inter-fragmentary 4 mm CC screw was used to fix the sustentaculum tali to the lateral wall. Number of screws used depended upon the size of the depressed fragment. Ipsilateral tricortical iliac crest bone graft was used to fill the cavity left after elevation of the depressed fragment to maintain the height of calcaneum. Articular reduction, screw length was confirmed under C arm. Skin closure was done with or without mini vac drain. Compression bandage was applied.

Post operatively foot was elevated. Active ankle, subtalar and knee exercises were started after 48 hours. Drain was removed after 2 days. Post-operative dressing was done on second and fourth day. Delayed suture removal was done after twenty one days and patient discharged with advice of strict no weight bearing for 2 months. Follow up was done at 3 and 6 months. Serial X-rays were taken. The K wires were removed after 8-10 weeks.



Fracture site exposure	Elevation of depressed fragment	Bone graft in the defect	Fixation with Screw and k-wires
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Final Closure	Pre-operative X-ray	Intra-operative X-ray	Post operative x-ray
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The final outcome based on above observation was done as per American Orthopaedics Foot and Ankle Score (AOFAS). Clinical results were graded as 90 excellent, 80 good, 70 fair and <70 as poor.

The obtained data were tabulated and statistically analysed using EpiInfo Version 7.0 (public domain software package from the Centers for Disease Control and Prevention, Atlanta, GA, USA). Continuous data were presented as Mean and Standard Deviation (SD). Categorical data were presented as percentage distribution. Statistical significance of difference (taken as p-value<0.05) was calculated using Student's t-test and Karl Pearson's Chi-square test, with Mantel-Haenszel correction where applicable.

IV. Results

4.1. Participant details:

Out of the total participants (n=20), 3 (15%) were females while 17 (85%) participants were males. Mean age of participants was 34.25 years with a SD of 7.57 years. 8 (40%) participants had joint depressed fractures while 12 (60%) had tongue type fractures. 9 (45%) participants fractured their feet due to fall from a height while 5 (25%) participants met with a road traffic accident. Mean hospital stay duration was 11.8 days with a SD of 4.34 days. Complications were present in 4(20%) of the participants.

Table 1: Participant Details (n=20)

		Female	Male
Type	Joint Depressed	1(5)	7(35)
	Tongue type	2(10)	10(50)
Cause	Fall from height	1(5)	8(40)
	RTA	2(10)	3(15)
	Others	0(0)	6(30)
Complications	Infection	0(0)	1(5)
	Wound dehiscence	1(5)	0(0)
	Wound edge necrosis	0(0)	2(10)

Figures in parentheses indicate percentages

1.2. Outcome:

Mean AOFAS score in pre-operative patients was 36.8 with a SD of 5.38 while that in post-operative patients was 83.85 with a SD of 6.83. The difference in the AOFAS score of pre and post operative patients was statistically highly significant (p<0.00001).

Mean AOFAS score of the same patients at 3 months follow-up was 87.65 with a SD of 7.17 while that in 6 months follow up was 91.75 with a SD of 7.57. The difference in the AOFAS score of post operative patients and that of patients at 6 months follow-up was statistically highly significant (p=0.00068).

Table 2: Surgery Outcome (AOFAS Score)

	Female		Male	
	Mean	SD	Mean	SD
Pre-operative Status	38.33	4.51	36.53	5.59
Post-operative Status	81	9	84.35	6.59
3 months Follow-up	84.33	10.02	88.24	6.79
6 months Follow-up	87.67	12.74	92.47	6.64

1.3. Outcome (Categorisation):

According to AFOAS score all of the participants were in poor category pre-operatively but none in that category post-operatively.

5 (25%) of the participants were in excellent category immediately post surgery while 10 (50%) of the participants were in excellent category after 3 months post surgery and 14 (70%) of the participants were in excellent category after 6 months post surgery.

The difference between the participants in excellent category before surgery and immediately post surgery was statistically highly significant ($X^2=21$, $p=0.00005$).

The difference between the participants in excellent category immediately post surgery and 6 months post surgery was statistically significant ($X^2=7.917$, $p=0.005$).

Table 2: Surgery Outcome Categorisation (AOFAS Score)

		Female	Male
		Pre-operative Status	Poor
Post-operative Status	Fair	1(5)	4(20)
	Good	1(5)	9(45)
	Excellent	1(5)	4(20)
3 months Follow-up	Fair	1(5)	2(10)
	Good	1(5)	6(30)
	Excellent	1(5)	9(45)
6 months Follow-up	Fair	1(5)	2(10)
	Good	0(0)	3(15)
	Excellent	2(10)	12(60)

V. Discussion

Calcaneal joint fractures are severe injuries and may cause permanent and disabling sequelae. They usually affect young and economically active men, and thus these fractures can have an important socioeconomic impact.¹ In our study the outcome after 6 months was excellent in 14 (70%) of the cases suggesting this approach as an equally favourable choice of treatment for displaced intra articular fractures.

The Essex-Lopresti radiological classification is a classical tool that determines the line of fracture and allows treatment planning.² Tomographic classifications help to assess the severity and prognosis of the injury; the Sanders classification is the most commonly used. However tomographic classifications are not uniform and each group aims to create its own classification, which makes it difficult to compare results as well as to identify the type of injury they describe. Tomography is considered to be an excellent test to identify details of the fragments and the joint impairment; however, it is not available in all services. This limitation justifies the use of a radiological classification.³ AOFAS Score was used in the present study and the difference in scores before and after surgery are statistically highly significant.

Open reduction and internal fixation of displaced intra-articular calcaneal fractures by k wire, cc screw and bone graft maintains the joint congruity and decrease the incidence of subtalar arthritis.⁵ Although conservative treatment was considered gold standard previously, there is increased tendency towards internal fixation with excellent results.⁶ Even 6 mths post surgical results are encouraging in this study.

VI. Conclusion

Despite the limitation of the current study, the lateral approach with K wire and CC screw fixation with bone graft has proved to be effective for management of displaced intra articular calcaneal fractures, resulting in good functional outcome. Local skin condition, timing of surgery and soft tissue dissection are most important in determining the success of surgery and rate of infections. As serious complication rates are relatively low and most of the complications are minor/nil complications and the functional and radiological outcome is at par with plating, this should be considered as an equally favourable choice of treatment for displaced intra articular fractures.

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