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Original Research Article

Descriptive study of functional outcome and complication of fracture calcaneum treated with locking calcaneum plate

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ABSTRACT

Background: Fracture of calcaneum accounts for about 2% of all fractures and 75% of all calcaneum fractures are intra-articular. Numerous controversies existed regarding optimal treatment of displaced intraarticular calcaneum fractures. In this study evaluate post-operative functional outcome and complication of fracture calcaneum treated with locking calcaneum plate.
Methods: This hospital based prospective descriptive study was conducted on 108 patients (120 calcaneum fracture) operated between July 2016 to December 2018 by open reduction and internal fixation with locking calcaneum plate through extensive lateral approach at Department of Orthopaedics, SMS Medical college and hospital, Jaipur. All close displaced intraarticular calcaneal fracture was included in the study.
Results: Average duration between injury and surgery was 8.3±2.97 days. Out of 120 calcaneum fracture 52 fractures (43.33%) were Sander's type II, 52 fractures (43.33%) were Sander's type III, and 16 fractures (13.33%) were Sander's type IV. Pain on weight bearing was noted in 20 patients (16.66%) implant prominence was noted in 8 patients and delayed wound healing was seen in 4 patients. Maryland foot score was excellent in 44 fracture (36.67%), good in 56 fractures (46.67%), fair in 8 fractures (6.67%), and poor in 12 fractures (10%).
Conclusions: Open reduction and internal fixation (ORIF) with locking calcaneum plate in an indicated case, with respect to soft tissue envelope and early rehabilitation, leads to better therapeutic results as compared to other operative technique.

Keywords: Locking calcaneum plate, Maryland foot score, Sander's classification, Bohler's angle

INTRODUCTION

Calcaneum, the largest and strongest cancellous tarsal bone is very well designed to bear the body weight and endure a lot of stresses of daily activities.[1] The bone is hard on the outside and soft from inside because of sparse trabeculae, making it prone to impaction of articular surface, fragmentation and collapse with a high velocity impact to the heel mostly due to fall from height.

Fracture of calcaneum accounts for about 2% of all fractures and 75% of all calcaneum fractures are intra-articular.[2] The prognosis for an extra articular fracture is uniformly good but the intraarticular calcaneal fractures continue to be one of the most disabling injuries, as these injuries distort anatomy of hind foot and compromise the functions of the subtalar joint.[3]

Numerous controversies existed regarding optimal treatment of displaced intraarticular calcaneum fractures. Literature shows that the conservative treatment of intra articular fractures often leads to increased morbidity due to incongruency of the articular surface, widening of heel, talar dorsiflexion, loss of talo-calcaneal lever arm, and

peroneal tendon impingement. Because of these severe associated disabilities, many authors recommended open reduction by various surgical approaches to restore anatomy of sub talar joint as in other intra articular fractures.[4] Satisfactory outcomes require extensive experience and understanding the pathoanatomy of calcaneum for treating these fractures.[5]

In recent years, however, due to better understanding of fracture patterns with computed tomography (CT) scans and with availability of good quality implants, there is a remarkable improvements in the treatment outcome that has further led to growing interest in the surgery of these difficult fractures.[6] Current literature believes that displaced intra articular fracture should be treated on the same principal as any other injury of the weight bearing joints, that is by anatomical reduction and adequate fixation to allow early movement and weight bearing. The objective of our study to report the functional outcome of open reduction and internal fixation (ORIF) of intraarticular calcaneal fractures with locking calcaneum plate.

METHODS

This hospital based prospective descriptive study was conducted on 108 patients (120 calcaneum fracture) operated between July 2016 to December 2018 by ORIF with locking calcaneum plate through extensive lateral approach at high volume tertiary care trauma center at SMS Hospital Jaipur. All close intraarticular calcaneal fracture was included in the study.

All the cases were subjected to detailed history as regards to age, sex and occupation of patients, mode of injury, the mechanism of injury, fracture pattern, medical comorbidities, other associated bony injuries, interval between injury and reporting and nature of treatment taken prior to admission, if any.

A thorough clinical evaluation was carried out. Skin condition, swelling, edema, ecchymosis, deformity of the heel or plantar arch, symptoms and signs of compartment syndrome like severe relentless, burning pain that typically cannot be pinpointed to a specific location, blister formation, decreased or absent pulse were noted. Informed and written consent was taken from all patient to be included in the present study.

Anteroposterior, lateral and axial radiographs of the injured and normal feet were taken for all the patients. CT scan of calcaneum was done in all patient of the study group for classification purpose and for operative planning. All fracture were classified according to Sander's classification. Bohler's angle, the crucial angle of Gissane, height and width were measured in all the patient (Figure 1).

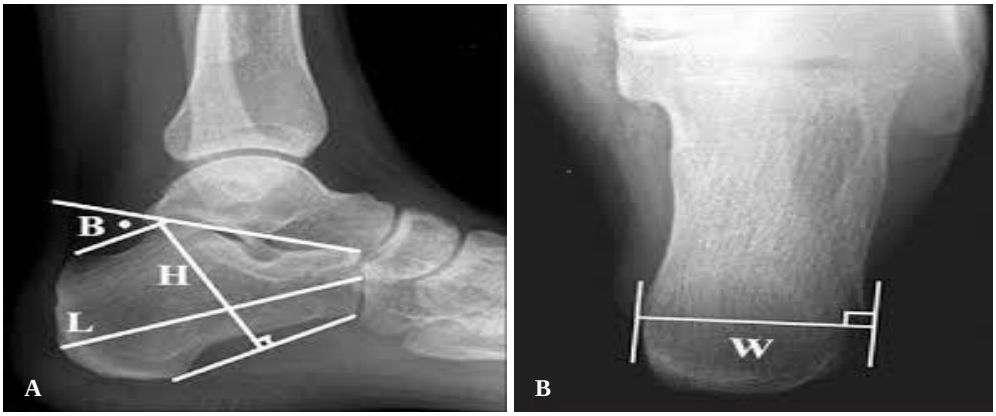

Figure 1 (A and B): Measurements calcaneum radiograph in lateral view and axial view.

Calcanean length (L): measured on lateral view from most posterior point of tuberosity to calcaneocuboid joint; posterior facet height (H): measured by a line perpendicular on calcanean axis to highest point of posterior facet; Calcanean width (W): measured on axial view; Bohler's angle (B).

Operative technique

Surgical procedure was delayed till wrinkle sign appeared. As soon as skin condition permitted surgery was performed under general or spinal anesthesia. Position for surgery was lateral decubitus in single feet involvement and in bilateral cases prone position used. All surgeries were performed by a single fellowship trained traumatologist. Standard lateral extensile incision was made, full thickness flap was retracted with help of K-wire placed in fibula, neck of talus and cuboid to prevent the flap necrosis. The fractured lateral wall was lifted and all fractured fragment sequentially reduced under image intensifier from anteromedial to posterolateral in relation to the constant sustentacular fragment to maintain articular congruence, angle, height and width. After reduction all fragments were provisionally stabilized with K-wire and fixed with locking calcaneum plate and screw. Wound was sutured without tension of the suture line with Allgower-Donati technique. A uniform rehabilitation protocol was followed for all the patients. Active range of motion and

non-weight bearing ambulation were started from next day after surgery. Lateral and axial views were taken at 6th weeks, 3 month, 6th month and 1 year (Figure 2). After 6th week partial weight bearing was allowed with support which was gradually increased to full weight bearing.

Figure 2: Radiograph post-operative. (A) post-operative; (B) 3 month; (C) 6 month; (D) 1 year.

After 3 month full weight bearing was allowed. Minimum follow up period were 1 year. Assessment of results were be done at 6 weeks, 3 month, 6 month and 1 year in term of Maryland foot score and VAS score at various follow ups.

Maryland foot score of 90 to 100 points is judged to be an excellent result; 75 to 89 points, a good result; 50 to 74 points, a fair result; and less than 50 points as poor results.

Statistical analyses

Statistical analyses were done using computer software (SPSS Trial version 23 and primer). The qualitative data were expressed in proportion and percentages and the quantitative data were expressed as mean and standard deviation. The difference in means among the group was analyzed using the student t test and for paired analysis paired t test was used. Significance level for test were determined as 95% ($p<0.05$).

RESULTS

Average age of the cohort was 28.89±7.56 (19 to 50 years). Male to female ratio was 3.5:1. Fall from height was found to be most common mode of injury (85.19%). Average duration between injury and surgery was 8.3±2.97 days (2 to 15 days). 12 patients had bilateral involvement in this study group. Out of 108 patient, 100 (93.6%) reported within a week time. 12 patient had associated skeletal injuries, among them 4 spine injury, 4 tibial fractures and 4 patients had acetabulum injury. Out of 120 calcaneum fracture 52 fractures (43.33%) were Sander's type II, 52 fractures (43.33%) were Sander's type III, and 16 fractures (13.33%) were Sander's type IV.

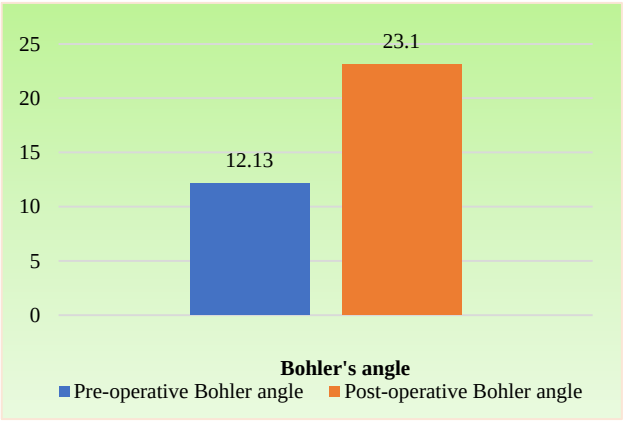

Figure 3: Bohler's angle.

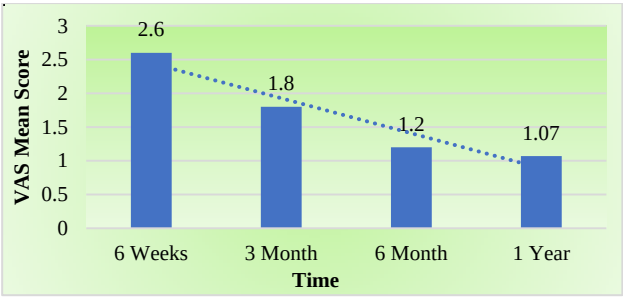

Figure 4: VAS Score at various follow up.

Mean preoperative Bohler's angle was 12.13±4.99^0 which improve to 23.10±4.40^0 post-operatively (pre to post-operative mean Bohler's angle improvement was 10.96±4.40^0) (Figure 3). Preoperative mean value of Gissane's angle, height, and width were 145.85, 3.63cm and 4.51 cm respectively, which were improved significantly to post-operative mean 125.80^0, 4.51cm and 3.70cm respectively (Table 1). Minimum duration of follow up was 1 year. Mean VAS score in all the patients decreased significantly from 2.60±1.90 at 6 weeks 1.07±1.55 at 1 year (Figure 4).

Table 1: Descriptive statics.

Descriptive Statistics							
X-ray				**Pre-operative**		**Post-operative**	
	N	Minimum	Maximum	Mean	SD	Mean	SD
Bohler's angle degree	120	13	29	12.13	4.99	23.10	4.40
Gissane angle degree	120	130	160	145.83	7.99	125.80	9.09
Height(CM)	120	3.5	5.2	3.63	0.30	4.51	0.40
Width (CM)	120	3.2	5.0	4.51	0.40	3.70	0.30

Table 2: Results.

Results	Number	Percentage (%)
Exellent	44	36.67
Good	56	46.67
Fair	8	6.67
Poor	12	10.00
Total	120	100

Table 3: Complication.

Complication	Number (n=120)	Percentage (%)
Pain and swelling on weight bearing	20	16.66
Implant prominence	8	6.66
Delayed wound healing	4	3.33
Total	32/120	26.66

Table 4: Correlation of type of fracture (Sander's classification) with post-operative Bohler's angle.

	Postoperative Bohler's angle ≤20^0	Postoperative Bohler's angle 21^0-40^0
Sander's type II	4 (16.67)	48 (50)
Sander's type III	8 (33.33)	44 (45.83)
Sander's type IV	12 (50)	4 (4.16)
Total	24 (100)	96 (100)

Post-operative mean Bohler's angle was 23.92±3.15^0, 24.08±3.88^0 and 17.25±5.91^0 in Sander's type II, III and IV respectively. Mean Maryland foot score improved significantly from 49.93±8.00 at 6 weeks to 85.20±16.25 at 1 year (Figure 5). Maryland foot score was excellent in 44 fracture (36.67%), good in 56 fractures (46.67%), fair in 8 fractures (6.67%), and poor in 12 fractures (10%) (Table 2).

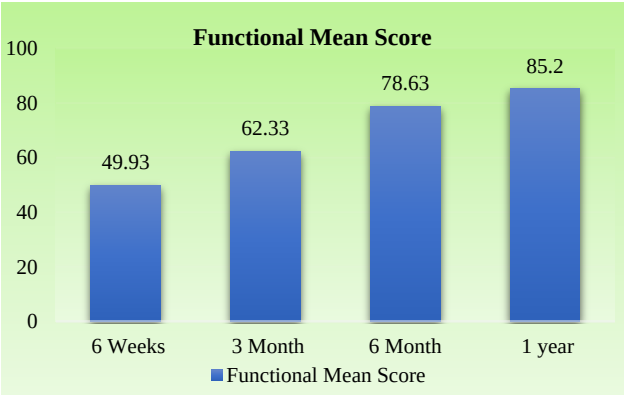

Figure 5: Functional mean score.

DISCUSSION

The aim of this study is to assess the functional outcome of open reduction and internal fixation with locking calcaneum plate in displaced intraarticular closed calcaneal fractures which comprise of approximately 75% of all calcaneal fractures. The functional results of displaced intraarticular calcaneum fracture are better after ORIF than conservative management.[7] Recently most calcaneum fractures have been managed aggressively and various methods of internal fixation have been developed.[8,9] Osteosynthesis by locking plate provide good functional results by both protecting the anatomic reduction and enabling early movement.[10] In the present study fall from height was found to be most common mode of injury (85.19%), signifying the role of axial

loading due to high velocity impact to the heel during fall from height.

Average duration between injury and surgery was 8.3±2.97 days. The main determination of this duration was appearance of wrinkle sign, because absence of which leads to higher rate of infection. After 3 weeks of injury surgery is not recommended because difficulty in obtaining anatomical reduction due to early consolidation of fracture.[11-13] For better outcome of operative treatment restoration of calcaneal height, width and length along with restoration of the Bohler's angle and crucial angle of Gissane are emphasized.[14] In the present study most common complication was pain during weight bearing (26.67%) (Table 3), It might be due to inaccurate reduction and sub-talar arthritis. We did not have any complication of wound necrosis as no touch technique was used and full thickness flap was raised during surgery in all the cases.

In this study we found congruency of subtalar joint and post-operative Bohler's angle were major prognostic indicators of post-operative better outcome. This has also been confirmed by many authors.[12,15,16] With passage of time functional score improved in all the patients. This fact was also noted by other authors.[17]

In this study found significant correlation between the type of fracture and post-operative Bohler's angle. Patient having post-operative Bohler's angle $<20^0$ were more in sanders type IV as compared to type II and III (Table 4).[17]

A previous study by Longino et al reported no significant difference between post-operative radiological and clinical results of locking calcaneum plate osteosynthesis with and without bone grafting, thus bone grafting was omitted from our study.[18]

CONCLUSION

Open reduction and internal fixation with locking calcaneum plate in an indicated case, with respect to soft tissue envelope and early rehabilitation, leads to better therapeutic results as compared to other operative technique. We, through our study and by reviewing the literature, concluded that locking compressive calcaneal plate useful in preventing unstable fracture displacement and maintain good reduction, gives satisfactory results with improved functional outcome and less complications.

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Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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