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FUNCTIONAL OUTCOME OF INTRA-ARTICULAR CALCANEAL FRACTURES FIXED WITH PERCUTANEOUS SCREWS - A PROSPECTIVE STUDY

Orthopaedics

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ABSTRACT

Background: The treatment of displaced calcaneum fractures has been a subject of intense discussion. Displaced intra-articular calcaneum fractures gives poor result with conservative treatment and requires reduction and internal fixation for favourable long-term results. Open procedures are more prone to complications regarding wound healing. Percutaneous fixation offers a middle pathway in treating simpler variety of displaced calcaneal fractures. The aim of the study was to access the functional outcome of intra articular fracture calcaneum managed with closed reduction and percutaneous screw fixation. **Methods:** This study was done in department of Orthopaedics Aarupadai veedu Medical college and hospital, Pondicherry. Twenty-six intra-articular calcaneal fractures treated with closed reduction and percutaneous screw fixation under image intensifier. For the research, 26 individuals of either sex were accepted. Patients received thorough information about the trial, and formal written consent was acquired. The study was conducted from August 2020 to September 2022. The follow-up phase lasted up to 6 months. Analysis and research were conducted on the outcomes of 26 fractures in 26 individuals. The examined data was discussed and compared to comparable series in the literature. A master chart that covers all the factors and variables taken into account was posted. **Results:** Twenty-six cases evaluated (one patient had lost follow-up), all fractures were united, average time of union was 8 weeks. The mean AOFAS score was 73.08% of 26 patients had good, 23.08% patients had fair and 3.85% patients had poor result on a 6 month follow up. Average postoperative Bohler's angle 26.42 degrees and post-operative Gissane angle was 122 degrees. **Conclusions:** Treatment of intra-articular fractures of calcaneum is challenging but close reduction and internal fixation with 4.5 cannulated cancellous screws yields favorable outcome in majority of cases.

KEYWORDS

Intraarticular calcanea fracture, Percutaneous screw, Bohler's angle, Gissane's angle, Prospective study.

INTRODUCTION

The calcaneum, being the largest weight-bearing bone in the foot, aids in regular walking (1). The most frequent tarsal injury, accounting for roughly 65% of cases, is a fracture of the calcaneum. Overall, it accounts for roughly 2% of all fractures in both sexes, with the majority occurring in males between the ages of 21 and 45. The most prevalent mechanism for calcaneum fracture is a fall from a height, while other causes like automobile accidents can also cause it. Patients with calcaneum fractures tend to be construction and industrial workers, which compromises the socioeconomic stability of the family since they are the usually the only source of income (2).

As the word Fracture suggests, the change in bone structural pattern, disruption of articular relationship remains challenging for a satisfactory reduction, preventing disability and achieving early restoration of well-being (3). The two types of calcaneal fractures are extra-articular and intra-articular, depending on the kind and degree of the injury. The fact that between 65 and 75 percent of fractures are intra-articular displacements calls for active involvement through anatomical reduction and stabilization. The best way to treat calcaneal fractures is still up for debate, particularly when it comes to whether to choose for conservative treatment or surgery, open or closed percutaneous repair or splinting to preserve reduction (4). Since the subtalar joint serves as the main load-bearing joint of the foot, it is important to restore mobility to the cancellous bone and realign the fracture as well (4).

Since the burst fracture is caused by the fall from height, the soft tissue envelope is compromised and edematous. As a result of the closed degloving injury, there is a delay in surgery by 3 weeks or more. Which attempts early cancellous healing, this makes articular reduction impossible. A procedure that is minimally invasive preserving soft tissue envelope. Maintaining fracture hematoma to speed up fracture healing. Early healing leads to prompt return of pre-fracture activity level. Our goal is to analyze the functional outcome of patients with displaced intra-articular calcaneal fractures managed by percutaneous technique.

Delayed surgery decreases the pliability of the lateral skin flap, reduces effective fracture reduction, skin breakdown due to the tension of Tendo Achilles. Need for early minimally invasive procedure with preservation of soft tissue envelope, maintaining fracture hematoma, Low risk of postoperative infection, particularly in elderly patients with poor glycemic control, early healing leading to prompt return of pre-fracture activity level and no implant removal required.

MATERIAL AND METHODS

We have conducted a prospective study on 26 patients from August 2020 to September 2022 in the Department of Orthopaedics, Aarupadai veedu medical college. Thorough history and clinical examination was done followed by radiological evaluation to stage the fracture pattern and pre-operative planning was carried out. The follow-up phase lasted a minimum of 6 months. The patients were selected based on the following criteria: Matured skeleton, closed intra-articular fractures and not more than a week old.

The Sanders classification which is the most reliable method was used to categorize and classify the intra-articular calcaneal fractures in this study. 26 patients were managed using percutaneous screws in this article. Pre-operative and post-operative measurements of Bohler's angle, crucial angle of Gisanne and calcaneal height were done. The aim of this surgery was to retain and repair the subtalar joint's congruency and anatomical architecture as closely as feasible.

Surgical Procedure:

The patient is moved into the operating room after all the aforementioned prerequisites had been satisfied and a pre-anesthetic examination had been performed. Depending on the side concerned, the patient is positioned in lateral with the affected side up under spinal or general anesthesia. Lower limb on affected side was painted with betadine solution and covered with sterile drapes in layers. Under fluoroscopic guidance, a Steinmann pin of size 5 mm was passed into tuberosity (Figure 1). Disimpaction was accomplished by applying steady traction over the Steinmann pin.

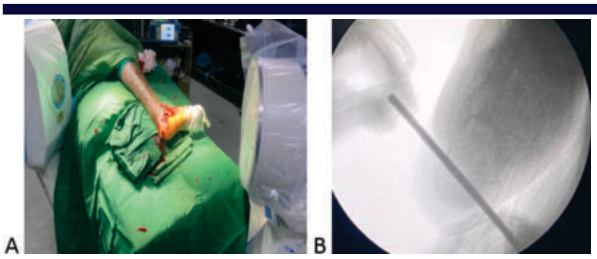

Figure 1: (A) shows intra-operative position of the patient with Steinmann pin in situ. (B) shows the fluorospic image.

The calcaneum's length and height were restored by traction along the long axis of calcaneum and long axis of the leg (Figure 2).

Figure 2: Long axis calcaneal traction being given.

A small incision was made over the lateral aspect of sinus tarsi and the posterior facet was visualized. It was elevated through a small cortical window/fracture in the lateral wall just below the posterior facet (Figure 3).

Figure 3 (A) shows incision site 1 cm below the lateral malleolus (B) posterior facet elevation being done (C) fluoroscopic image of the elevation.

After correcting the calcaneal height, length and alignment, transverse guide wires were passed from the lateral wall to the sustentaculum. This guidewire stabilizes the posterior facet fragment (Figure 4).

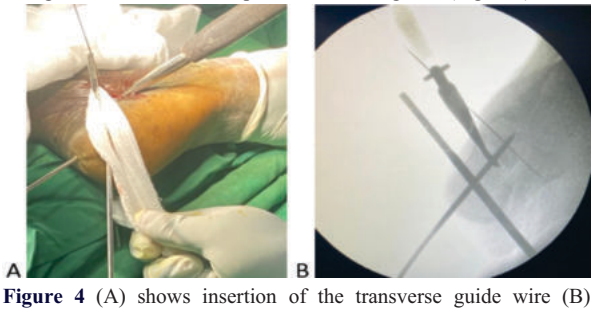

Figure 4 (A) shows insertion of the transverse guide wire (B) fluoroscopic image of the transverse guide wire.

Guide wires were passed from medial tuberosity to the sustentaculum tali, one from mid part of tuberosity to anterior calcaneum, third guidewire passed along the long axis of the calcaneum from lateral third of tuberosity. These wires maintain the length of the calcaneum (Figure 5).

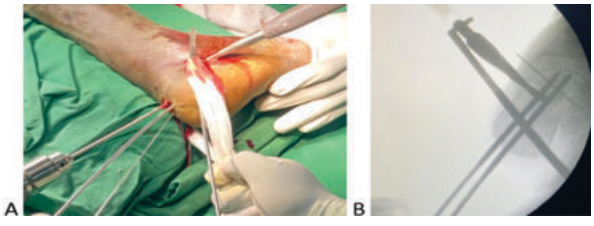

Figure 5 (A) shows longitudinal guide wires (B) shows the fluoroscopic image of the longitudinal guide wires.

Cannulated cancellous screws of size 4.5 mm were used to secure the reduced fracture fragments. Compression achieved from lateral wall to sustentaculum tali with transverse screw which supports the elevated posterior facet, maintains correct width of the calcaneum (Figure 6).

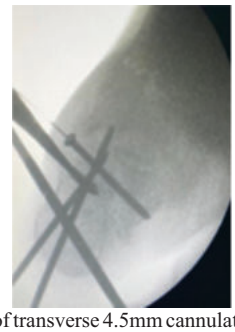

Figure 6: Insertion of transverse 4.5mm cannulated cancellous screws Longitudinal screws maintain the length of the calcaneum support the elevated posterior fragment. The corrected width and length, naturally restores the calcaneal height (Figure 7).

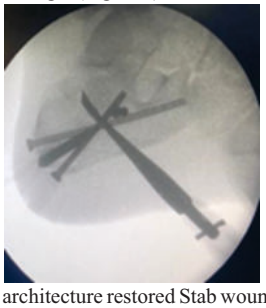

Figure 7: Calcarea architecture restored Stab wounds were stitched up with 3-0 ethylon. Sterile dressing was done and supported in a plaster-of-Paris slab with sufficient cushioning below the knee.

Post-operative Period:

The administration of enough analgesics, anti-inflammatory drugs, intravenous antibiotics, calcium and vitamin supplements were initiated. At periodic basis, wound examination and dressing were performed. Patient was immobilized with a below knee slab for 6 weeks. Active knee range of motion exercises and active toe motions were encouraged at the end of 3 weeks, non-weight bearing mobility with walker assistance was initiated at the end of 6-8 weeks. Patients were assessed both clinically and radiologically at regular intervals of about 4,8 and 12 weeks and noticed for radiological evidence of union and were followed up for a period of 6 months. The results were assessed according to: American Orthopedic Foot and Ankle Society scoring system, Pre and post crucial angle of Gisanne measurements, Pre and post Bohler angle measurements, Pre and post calcaneal height.

RESULT

In this study, the mean age of the patients with intra articular calcaneum fracture was 41.76 years with a predominance of 6 people from the age group of 32 to 37 years and 6 people from 42 to 47 years. With majority of them being men (88.46%), who were industrial workers with low socio-economic status. 22 patients (85%) gave history of fall from height while 4 patients (15%) were involved in high velocity injury (RTA), out of which 16 patients (61%) reported to our hospital within 1 day after injury with a mean of 1.53 +/- 0.8.

14 patients (53.8%) got surgically intervened on 3rd day of admission and 4 (15%) patients got operated on the 4th day as their comorbid conditions needed prior treatment in view of preventing post-operative complications. Majority of the patients belonged to Type 3 of Sanders (50%) followed by Type 2 (38.48%) and Type 4 being the least (11.54%). Out of these type 2 and type 3 showed good prognosis while type 4 showed fair to poor prognosis.

Comparison of the pre-operative and post-operative Bohler's angle was done in our study (Table 1). The mean pre-operative Bohler's angle was 17 +/- 2 degrees while the mean post-operative Bohler's angle was 26 +/- 5 degrees. Similarly, the mean pre – operative calcaneal height

was 39 +/- 4 mm while the mean post – operative calcaneal height was 46 +/- 5 mm. Mean pre – operative critical angle of Gisanne was 138 +/- 3 degrees while the post – operative critical angle of Gisanne was 122 +/- 4 degrees.

AOFAS scoring system is one of the most reliable scoring system to calculate the functional outcome of the foot. This is being followed in our study. AOFAS scoring of the patients who underwent closed reduction with cannulated cancellous screws were calculated at the end of 3 month and 6 months. At 3 months of follow up majority of the patients 46.15% had a score of 70 – 79 with fair prognosis. At 6 months of follow up, 61.54% of the patients had a score of 80 – 89 with good functional outcomes.

Table 1: Variables And Descriptive Statistics

Variables / Descriptive Statistics	Count	Mean	Std	Min	25%	50%	75%	Max
Age	26	41.76923	9.542778	22	34.25	43	48.5	65
Time Of Presentation (In Days)	26	1.538462	0.811456	1	1	1	2	4
Time Interval Between Fracture And Intervention (In Days)	26	3.076923	0.844894	2	3	3	3	5
Pre Bohler's Angle (In Degree)	26	17.26923	2.069931	13	16	17.5	19	20
Post Bohler's Angle (In Degree)	26	26.42308	5.529362	20	22.25	25.5	28.75	40
Pre-Calcaneal Height (In Mm)	26	39	4.882622	28	36	39.5	43	47
Post Calcaneal Height (In Mm)	26	46.57692	5.790842	31	42.25	48.5	51	55
Pre-Critical Angle Of Gisanne (In Degree)	26	138.8077	3.510205	132	137	139	140.75	149
Post Critical Angle Of Gisanne (In Degree)	26	122	4.621688	114	119	121.5	125	130
Aofas Scoring - 3 Months	26	72.42308	5.859509	58	69.25	72	76.75	81
Aofas Scoring - 6 Months	26	80.88462	6.414527	62	79.25	82.5	85	89

DISCUSSION

Fracture of the calcaneum is the most common tarsal injury accounting for almost 65% (5). Overall, it constitutes almost 2% of all the fractures occurring in both sex with majority being the male between 21 to 45 years of age. Fracture of calcaneum occurs because of high energy trauma and the most common modality being Fall from height and by other means such as Road traffic accidents. Patients reported with calcaneum fracture are those industrial and construction workers thus impairing the socio-economic stability as they are the sole earning member of the family (6). In our study the key feature was to restore and achieve anatomical architecture of the calcaneum by percutaneous techniques using cannulated cancellous screws, preventing soft tissue dissection and damage, prevention of infection and promoting early motion with near to daily activities restored.

Matthew DeWall et al (7) conducted his study on 125 intra articular fractures, was divided into two groups subjected to both open reduction and internal fixation (42 fractures) through extended lateral approach fixed with plate and screws and the other group had percutaneous fixation (83 fractures) using kirsckner wires and cannulated cancellous screws. He concluded that percutaneous reduction and fixation minimised the complications compared to open reduction. Martijin Poeze et al., (8) conducted a study to compare percutaneous reduction and screw fixation, minimally invasive open methods and external fixation on 2018 calcaneal fractures . 924 fractures (46%) were classified under sander's II ,558 fractures (28%) under Sander's III and 245 fractures (12%) under Sander's IV and concluded that percutaneous reduction and screw fixation resulted in significantly better outcomes compared to other groups with AOFAS score of 83 (excellent). Kawalkar (9) suggested that for patients to undergo the surgical procedure timing of surgery is very important for the outcome of treatment, determined by the presence of skin envelope and prolonging it more than 3 weeks can lead to difficulty in reduction due to early consolidation of the fracture. Paley D et al., (10) in his study found that decrease in Bohler's angle had led to poor functional outcome. Birender (11) in his study found to have mean pre op calcaneal height 35.2±2.2 and the mean post op calcaneal height as 40.04 ± 2.17 and had excellent outcome.

Mowafi et al.,(12)found the mean pre op calcaneal height as 39 ± 2 and the post op calcaneal height as 46 ± 4 showing their averge AOFAS score of 85(excellent). Kawalkar et al., (9) in his study on 16 calcaneal fractures treated by percutaneous technique found that mean period of radiological union was 13 weeks ranging from 11 to 16 weeks. Nambiar (13) (13%), Poupa (15) (17%) and Tornetta (15) (10%) had reported subtalar arthritis in their series. In percutaneous fixation prolonged manipulation of the soft tissue, reduction, extensile skin incision with tendency of infection, difficult skin closure, wound dehiscence, skin necrosis, more chance of osteomyelitis of calcaneum is avoided, providing early restoration to work and daily activities especially in patients with co-morbidities like diabetes mellitus.

CONCLUSION:

In our study, 26 patients with displaced intra-articular calcaneal fractures were selected in this analysis based on the specified inclusion and exclusion criteria. All the patients underwent closed reduction with cannulated cancellous screws. Care was taken to restore the calcaneal length, height, Bohler's angle and talar inclination, critical angle of Gisanne and subtalar joint congruity thereby preventing post-operative wound complications being a minimally invasive technique. This technique allowed us to operate early resulting in a good functional outcome with rapid fracture union and return to work. With AOFAS score of 61% patients having a good prognosis and with minimal post – operative complications, it is safe to say that the percutaneous fixation with cannulated cancellous screws is an effective method of management for intra articular calcaneal fractures.

Author Contributions

The authors contributed equally for its content, writing and reviewing and/or editing of the manuscript before submission.

Conflicts Of Interest

The authors declare no conflict of interest.

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REFERENCES

1. Giddings VL, Beaupré GS, Whalen RT, Carter DR. Calcaneal loading during walking and running. Med Sci Sports Exerc. 2000 Mar;32(3):627–34.
2. Zhu Y, Li J, Liu S, Chen W, Wang L, Zhang X, et al. Socioeconomic factors and lifestyles influencing the incidence of calcaneal fractures, a national population-based survey in China. J Orthop Surg Res [Internet]. 2019;14(1):423. Available from: https://doi.org/10.1186/s13018-019-1493-2
3. SLĂTIS PĂR, Kiviluoto O, Santavirta S, LAASONEN EM. Fractures of the calcaneum. J Trauma Acute Care Surg. 1979;19(12):939–43.
4. Griffin D, Parsons N, Shaw E, Kulikov Y, Hutchinson C, Thorogood M, et al. Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial. BMJ. 2014 Jul;349:g4483.
5. Allegra PR, Rivera S, Desai SS, Aiyer A, Kaplan J, Gross CE. Intra-articular Calcaneus Fractures: Current Concepts Review. Foot Ankle Orthop [Internet]. 2020 Jul 1;5(3):2473011420927334. Available from: https://doi.org/10.1177/2473011420927334
6. Sanders R. Current concepts review-displaced intra-articular fractures of the calcaneus. JBJS. 2000;82(2):225–50.
7. DeWall M, Henderson CE, McKinley TO, Phelps T, Dolan L, Marsh JL. Percutaneous reduction and fixation of displaced intra-articular calcaneus fractures. J Orthop Trauma. 2010;24(8):466–72.
8. van Hoeve S, Poeze M. Outcome of minimally invasive open and percutaneous techniques for repair of calcaneal fractures: a systematic review. J Foot Ankle Surg. 2016;55(6):1256–63.
9. Kawalkar AC, Badole CM. Percutaneous fixation of displaced intra-articular calcaneal fractures. J Orthop Traumatol Rehabil. 2017;9(2):69.
10. Paley D, Hall H. Intra-articular fractures of the calcaneus. A critical analysis of results and prognostic factors. JBJS. 1993;75(3):342–54.
11. Ali MS, Kumar B, Kachhap ND, Eapen J, Khurshid S, Roy C. Management of displaced intraarticular calcaneal fractures by minimally invasive technique: A prospective study. Int J Orthop. 2018;4(4):192–6.
12. El-Mowafi H, Abulsaad M, WailLotfyAbd el naby, Kandil Y. Closed Reduction of Displaced Intra articular Calcaneal Fractures Using Ilizarov Frame. J Limb Lengthening Reconstr. 2017 Mar 16;3:57–64.
13. Nambiar MR, Umesh SN, Kamath KR. Percutaneous pin fixation of calcaneal fractures. J Orthop Assoc South Ind. 2004;1:64–7.
14. Poupa J, Pribyl J. Surgical results of the Essex Lopresti method in calcaneum fractures. Acta Chir Orthop Traumatol Cech. 1971;38(1):23–5.
15. Tornetta III P. Percutaneous treatment of calcaneal fractures. Clin Orthop Relat Res. 2000;375:91–6.
16. Ni M, Lv ML, Sun W, Zhang Y, Mei J, Wong DW-C, et al. Fracture mapping of complex intra-articular calcaneal fractures. Ann Transl Med. 2021 Feb;9(4):333.