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Functional outcome of the sinus tarsi approach in the treatment of intraarticular calcaneal fractures

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ABSTRACT

Background: Intraarticular calcaneal fracture is reported as an acceptable less traumatic and reproducible procedure by several authors. We have evaluated the clinical, radiological, and functional outcome of such fractures in thirty patients, all of which were managed by sinus tarsi approach an average follow-up period of 18 months. Though open reduction is prevailing, this technique also gives favorable outcome.
Methods: Thirty patients with intraarticular calcaneal fracture were managed by dorsal tarsi approach using between March 2023 to November 2025 were included in this series. All cases were treated with closed reduction. The dominant side, gender ratio, surgery time, and fracture union time, and complications were noted.
Results: Of the Thirty patients in the study, twenty-two were males and eight were females. The mean age was 40.4 years (range 18 to 65 years). Eighteen out of thirty patients (60%) had the dominant side fractured). The mean fracture union (radiological) time was 8 weeks (range: 6-12 weeks) and clinical union time was 8.5 weeks week. However, ankle function was excellent in 30 cases (100%).
Conclusions: This study confirmed a high overall rate of union and excellent functional outcomes sinus tarsi approach for a intraarticular calcaneal fractures give good functional results and should be considered as an effective, cosmetically advanced surgical option in the treatment of type A humeral shaft fractures. It is a safe and less time-consuming method intraarticular calcaneal fracture. When the surgeon is experienced in the technique.

Keywords: Intraarticular, Bohler's angle, Gissane, Angle subtalar joint involvement, Heel widening

INTRODUCTION

Calcaneum fracture accounts for 2% of all fractures 1 and 60% of all tarsal bone fractures.

There are 2 types of calcaneal fractures[1]: extra-articular and intra-articular. Most of them around 60% to 75% of calcaneal fractures are displaced intra-articular calcaneal fractures (DIACFS).[2] Among these 10% patients have associated spine fracture and 26% have other extremity injury.[3-5] Most common in male and 90% of them from young working age groups. Fall from height at construction site is most common cause. DIACFS can cause hindfoot deformities and long-term disability due to pain and chronic stiffness. The treatment of displaced intra-articular calcaneal fractures remains challenging and controversial due to their complexity.

The treatment of calcaneal features has long been a challenge to the orthopaedic surgeon. Because of its unique shape, difficulties seen in understanding the patho-anatomy of the fracture.

Because of its location, surgical treatment was also with complications.

It has only been recently, however, since the development of computerized tomography scanning that the anatomy

and pathology of this fracture has been understood.

This technique has revolutionized the treatment of calcaneal features. With the development of antibiotics, standardized anaesthesia and internal fixation techniques, and image intensification, operative intervention of displaced intra articular calcaneal features has become a reality.

Soft-tissue complications still remain, but the development of microvascular tissue transfer has minimized this problem. Today, we are on the threshold of developing accurate and consistent treatment algorithms for this long-standing orthopaedic dilemma.[6] Calcaneal features has long been a challenge to the orthopaedic surgeon because of its unique shape, difficulties seen in understanding the pathoanatomy of the fracture. Because of its location, surgical treatment was also with complications.

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Treatments options, such as Cotton mallet, the Harris traction, percutaneous pins, primary fusion, open reduction, and total excision, have been used for DIACFS in the past. However, the clinical outcomes of these treatments are far from satisfactory

Objectives

To evaluate the functional outcome, anatomical reduction, and complication profile of intraarticular calcaneal fractures treated surgically via the sinus tarsi approach, with emphasis on pain relief, restoration of subtalar joint function, early mobilization, and overall improvement in quality of life.

METHODS

This prospective study will be conducted at our SMIMER medical college and hospital, Surat. In the period of February 2023-October 2024 for the patients who have undergone calcaneal fixation using sinus tarsi approach in intra-articular calcaneal fracture in skeletally matured patients in department of orthopaedics.

Inclusion criteria

Patients with closed intra-articular calcaneal fracture, with age: 18 to 75 years, sex-male or female and fit for anaesthesia were included.

Exclusion criteria

Open calcaneal fracture, diabetic neuropathy, significant coexisting comorbidity, with contraindication to anaesthesia, forty patients with intra-articular fractures of the calcaneal visited our hospitals were excluded.

Of these, following a detailed history and examination including eventual functional demands, thirty patients were selected for study.

All calcaneal fractures that are seen in the O.P.D were discussed with concerned unit chief and further management was planned.

All the patients were sent for X-rays; CT scan and patients were admitted. The patients were once again reviewed with my guide after admission**.**

Calculation of no of cases (Sampling size)

$$N=\frac{Z^2_{\alpha/2}PQ}{L^2}$$

P=0.033, Q=(1-0.033), Zα½=Standard normal value at 95% level is 1.96 and L=allowable error=5%, N=30.

RESULTS

The mean age was 35.93 years (21-43). 40% of the cases were between the age group 18-30 years. Majority of patients were males 22 (73.33%) and 8 (26.67%) were females. Male to female ratio is 2.75:1. Mode of injury was fall from height in 83.33% of cases while the rest gave a history of road traffic accident. The side of affection was quite uniform with the right foot being affected in 56.67% and the left foot in 43.33%. The mean pre op heel width was 7.51 cm which post-operatively reduced to a mean of 6.83 cm. the 26 cases (86.67%) were of the joint depression type based on Essex Lopresti classification.

Table 1: Age distribution site.

Age (in years)	Incidence	Percentage (%)
18-30	12	40
31-40	8	26.67
41-50	5	16.67
50-60	3	10
>60	2	6.66
Total	30	100

Table 2: Site.

Side of affection	N	Percentage (%)
Right	17	56.67
Left	13	43.33
Total	30	100

Table 3: Gender.

Gender	N	Percentage (%)
Men	22	73
Women	8	27
Total	30	100

Table 4: Union time.

Months	N	Percentage (%)
3 months	10	33.33
4 months	16	53.34
5 months	04	13.33

Table 5: X-ray-based classification.

Essex Lopresti classification	N	Percentage (%)
Joint depression	26	86.67
Tongue type	4	13.33
Total	30	100

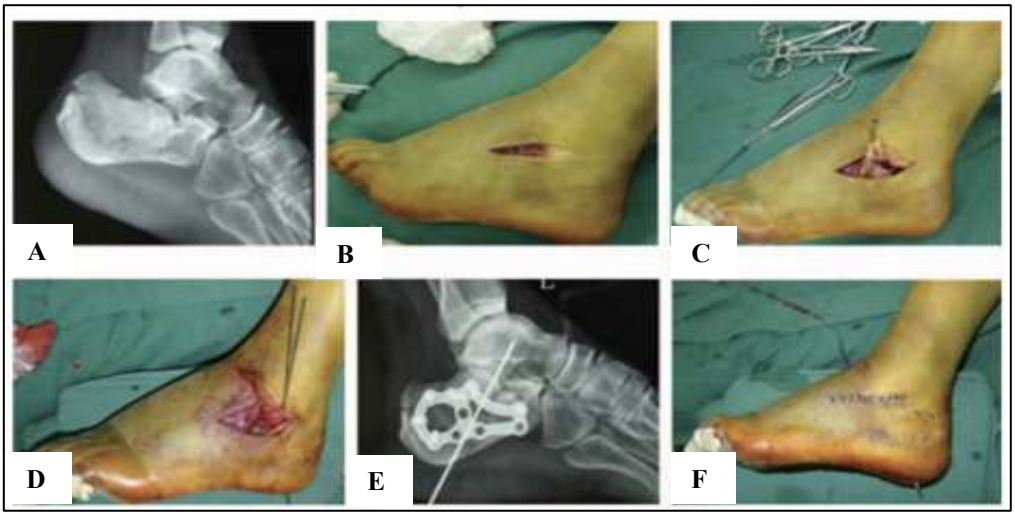

Figure 1 (A-F): Open reduction and internal fixation with an plate or screw via sinus tarsi approach. (A) Preoperative lateral X-ray indicated that calcaneal height, Böhler's angle, and Gissane's angle were significantly reduced, (B) incision was placed through sinus tarsi approach, (C) introduction of sinus tarsi, (D) internal fixation with a plate or screw or k-wire, (E) postoperative lateral X-ray indicated that the placement of CC screw and (F) postoperative view of the wound closure.

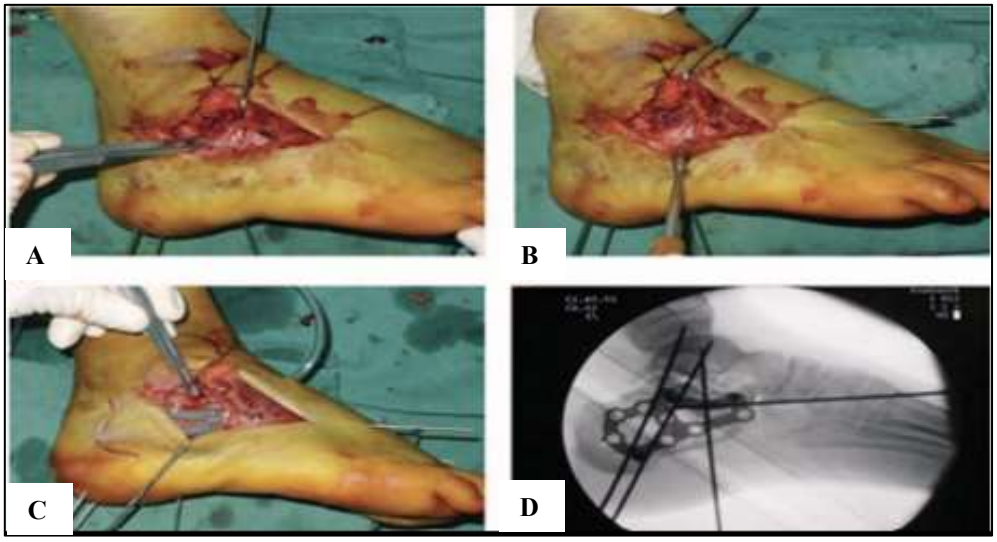

Figure 2 (A-D): DICAFs with involvement of the calcaneocuboid joint. (A) the skin incision was stretched anteriorly to expose the calcaneocuboid joint, (B) the relocated calcaneocuboid joint was fixed with K-wires, (C) internal fixation with a plate or screw or k-wire, (D) postoperative lateral X-ray indicated that calcaneus was reduced properly and the insertion of CC screw=displaced intra-articular calcaneal fractures.

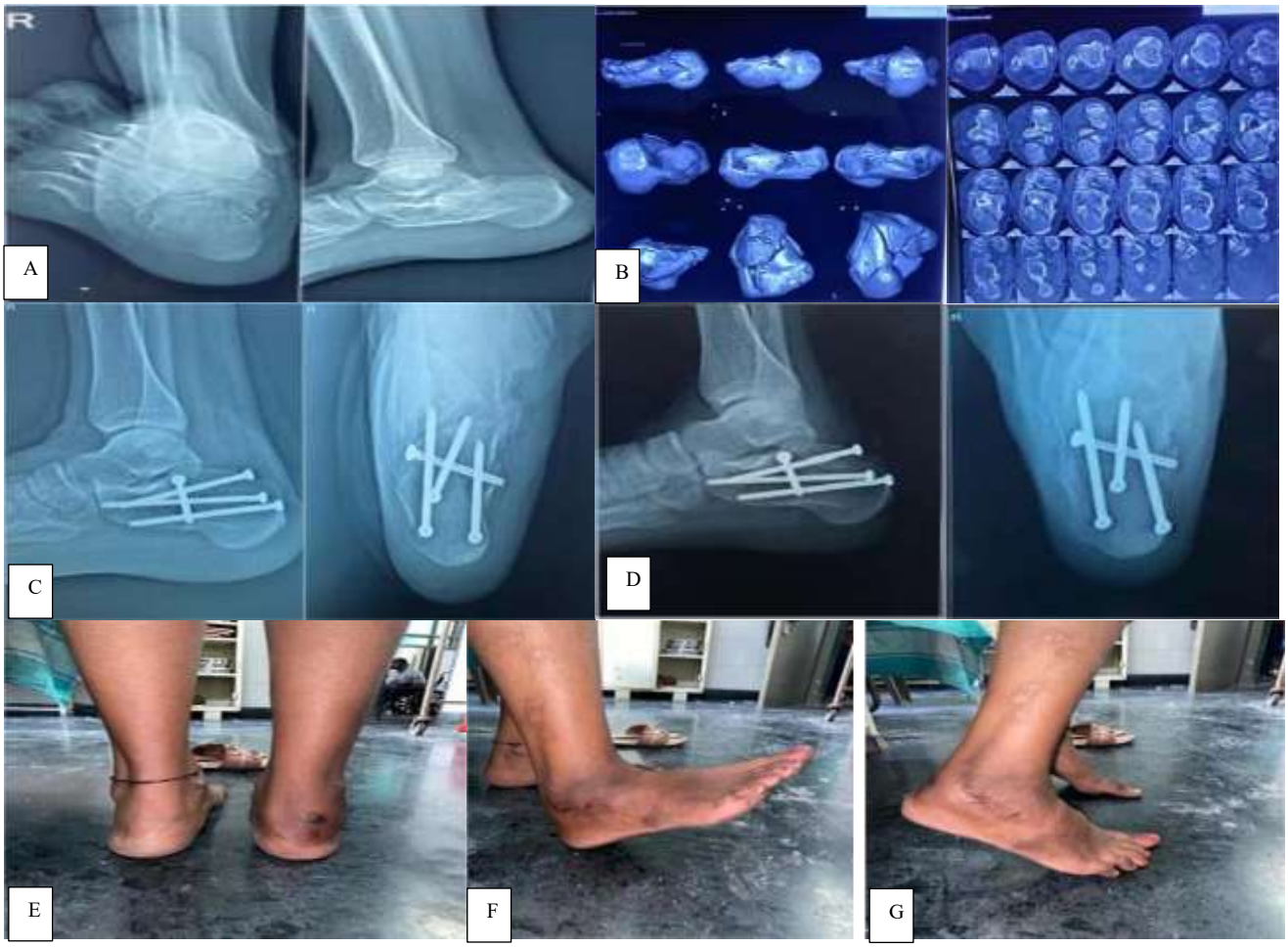

Figure 3: A-pre op x-ray, B-pre op CT scan, C-immediate post op x-ray, D-follow up, E-heel width, F-Dorsi flexion and G-planter flexion.

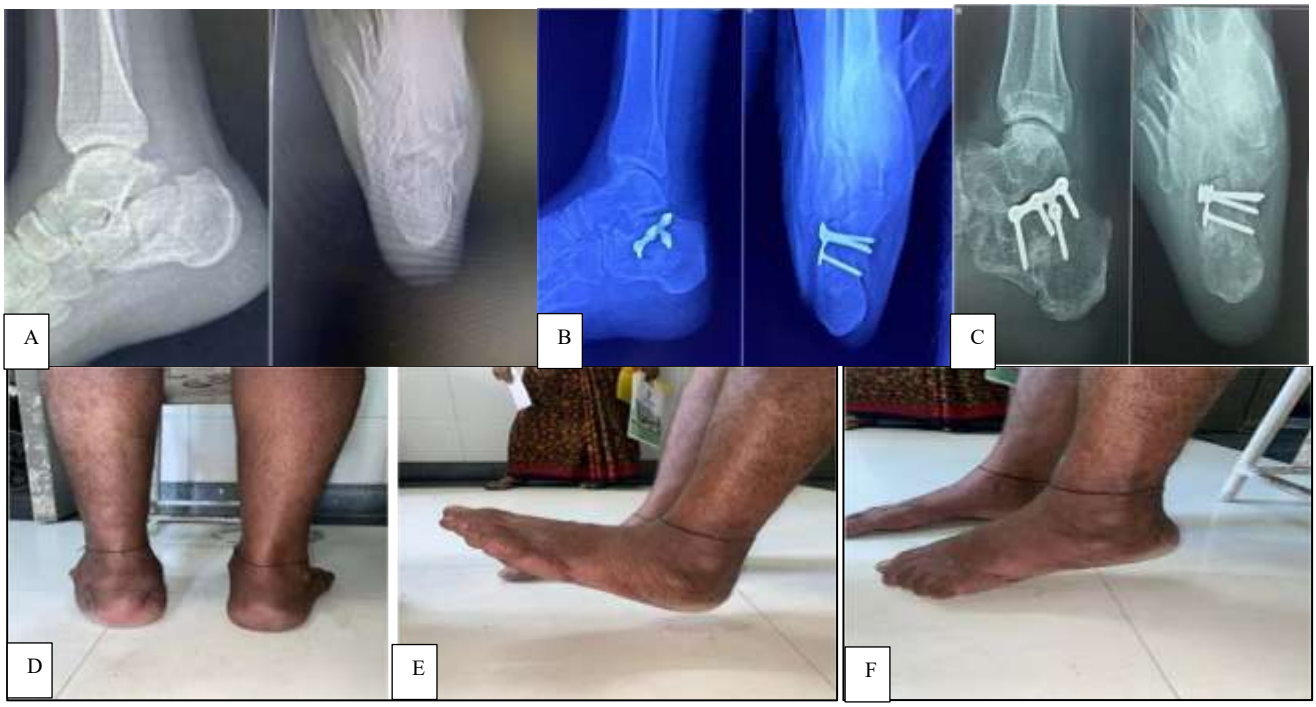

Figure 4 (A-F): A-pre op x-ray, B-immediate post op x-ray, C-follow up, D-heel width, E-Dorsi flexion and F-planter flexion.

DISCUSSION

Calcaneal is the most commonly fractured bone Among the tarsal bones. It accounts for 2% of all fractures and 60-75% of these fractures are displaced, intra-articular. Calcaneal fractures end up with loss of height, varus deformity, heel widening and subtalar joint incongruity. The results for an extra-articular fracture are good with a good prognosis then intra-articular fracture. There is controversy with every part of management of intra-articular fractures. Though there are different classifications for intra-articular calcaneal fractures, there is no clearance as which is the most practical one among them. Although some studies have demonstrated good results after open reduction and internal fixation of intra-articular calcaneal fractures, the best choice of treatment remains controversial because prospective randomized studies have not shown convincingly better results after surgery.[23,33] However, in the largest prospective randomized trial done till date, Buckley et al found better results in some subgroups of patients after surgery.[24]

Also, it is difficult to compare between different studies as, different measures of out- come are used in different studies and there is no clearance as to which is the most reliable outcome measure. Essex Lopresti and Sander's are commonly used classification system and these show a positive correlation with outcomes but there is no correlation with the choice of treatment.[34,35] Essex Lopresti classification based on X rays and Sander's classification based on CT scans have been used in this study.

Operative and non-operative treatment of displaced and comminuted calcaneal fractures revealed similar results in previously done cohort studies.[26-28] While some of the most recent studies show no advantage of operative management, others have shown superior results with operative treatment.[23,36,37]

Earlier operative treatment was considered to be related with wound complications and sepsis; however, non-operative treatment is also likely to cause complications like subtalar joint pain, heel varus and peroneal tendon impingement.

We consider that like the principles followed for any other weight bearing joints, displaced and comminuted calcaneal fractures should also be treated on the same lines, that is anatomical reduction and rigid internal fixation to allow early movement and get a better functional outcome.[38] Application of these principles to intra-articular calcaneal fractures have been delayed because of complex bony and fracture anatomy, tenuous soft tissue envelope and difficulty of attaining anatomic reduction; improvements that have occurred in surgical techniques, better understanding of the fracture anatomy, better radiographic assistance and improvement in antibiotics have stimulated surgeons for surgical managements more on these fractures without the fear of complications.[39]

Calcaneal fractures can be approached medially, laterally or by using a combined approach.[29-32,40,41] The sinus tarsi approach is the most commonly used approach with better visualization of the intra-articular fracture and the subtalar and calcaneocuboid joints. This approach prevents from major complication associated with neurovascular bundles of the foot. It allows fixation the fracture with internal fixation and allowing early mobilization.[25] A sinus tarsi approach was used in all cases in this study. Various implants like calcaneal plates, K wires and a combination of K wires and screws can be used for fixation.[38,42] In our study, calcaneal plates/Steinmann pins/K wire were used and fixed with corresponding screws.

In this study, restoration of Bohler's and crucial angle of Gissane was associated with a better functional outcome. This fact, proved and verified by a lot of other authors, confirms the role of Bohler's angle and Gissane's angle as predictive factor for development of late complications.[43,44]

Limitations

Limited exposure: Restricted visualization of the sustentaculum tali or medial wall of the calcaneus. May not be ideal for highly comminuted fractures, especially those extending medially or severely displaced fractures.

Difficulty in fixation: Reduced working space may limit implant placement, especially for large or multiple plates. Technically more demanding for complex reconstructions.

Inadequate reduction in some cases: Less direct access to the anterior process or calcaneocuboid joint. Achieving anatomical reduction of multi-fragmentary fractures may be difficult compared to extensile lateral approaches.

Risk of injury to structures: Potential injury to: Extensor digitorum brevis (which must be mobilized or partially resected). Peroneal tendons and sural nerve if dissection extends posteriorly.

Hardware complications: Suboptimal placement of screws or plates due to limited angle of approach can lead to hardware irritation or failure. May require secondary surgeries for hardware removal.

Limited use in certain fracture patterns not suitable for: Severe comminuted Sanders type IV fractures. Fractures with significant medial displacement or those involving bilateral involvement.

Subtalar stiffness: Although less invasive, stiffness in the subtalar joint can still develop postoperatively if not properly rehabilitated.

CONCLUSION

Our study shows that the incidence of calcaneal fractures is about 3 times more in men as compared to women, probably due to their increased involvement in light to heavy outdoor manual work, their risk-taking behaviour. Fall from height emerges to be the most common mode of injury due to the direct axial impact borne by calcaneal, while indirect injuries have a secondary role in their causation. We conclude that displaced and comminuted calcaneal fractures can be better managed operatively by understanding the fracture anatomy better, by properly timing the surgery, by attempting to minimize the surgical trauma to the soft tissue envelope and by attempting to restore the normal anatomy of the fracture and the joint. It also is important to administer good post-operative wound care to avoid complications of the wound, which should be supplemented with perioperative coverage with a broad-spectrum antibiotic. This study has reproduced and thus, reinforces the good results produced by of some of the recent studies which are proponents of surgical management of displaced calcaneal fractures. Hence, we advocate surgical management and accurate anatomical reduction in cases of displaced and comminuted calcaneal fractures with appropriate surgical principles which would aim at accurate reduction of the fracture and the involved joints thus preventing malunion and development of post traumatic arthritis in the long run in turn preventing patients from developing devastating complications that have historically been associated with displaced and comminuted calcaneal fractures.

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