

A Reliable Way in Treating Displaced Calcaneum Fractures: A Descriptive Analysis

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Abstract:

Background: Men, particularly industrial workers, are more likely to suffer from calcaneum fractures. Ages 21 to 45 are the ones where it occurs most frequently. Because many calcaneal fractures affect the subtalar joint and commonly result in persistent pain and osteoarthritic changes, they are receiving increased attention.

Objectives: The effectiveness of plate osteosynthesis in treating displaced intraarticular calcaneal fractures is evaluated clinically and radiologically.

Materials and Method: We included fifteen patients in this descriptive analysis, of whom seventeen had displaced intraarticular calcaneum fractures. Open reduction and internal fixation with a calcaneal plate were performed after preoperative and radiographic evaluation. Locking calcaneal plate was fastened with screws after anatomical reduction with use of k wire and intraoperative C-arm pictures. A mean of 12 months was spent following up with each of the 15 patients. American Orthopaedic Foot Ankle Society (AOFAS), Bohler's angle, and Gissane's angle score were used to determine the final evaluation.

Results: After 12 to 14 weeks, all patients had radiographic fracture union. At final follow up, mean AOFAS score is 90.83 ± 5.45 for Sander's type II fracture and 86.45 ± 6.97 for Sander's type III fracture. Bohler's angle improved from preoperative $5.59^\circ \pm 8.45^\circ$ to postoperative $24.29^\circ \pm 5.56^\circ$, Gissane's angle improved from preoperative $155.29^\circ \pm 6.95^\circ$ to post-operative $132.94^\circ \pm 6.13^\circ$.

Conclusion: One of the most crucial factors in determining treatment outcomes is when to have surgery, which is determined by the emergence of wrinkles and the subsidence of edema. Even without the use of a bone transplant, successful surgical therapy with a calcaneal plate is achieved.

Keywords: Calcaneum Fracture, Edema, Locking Calcaneal Plate, Radiographic Evaluation.

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Introduction

The earliest description of the calcaneum fracture was made by Malgaigne in 1843. About 60% of all tarsal bones can fracture, making it the most frequent. The remaining portion is extra articular, making up between 60% and 75% of it [1]. About 2% of all fractures in our body are caused by this. Compound calcaneum fractures, which also frequently involve the spine, pelvis, and hip, account for over 10% of all cases [2]. High velocity trauma, such as from a car collision or axial load, such as fall from height, is the predominant mode of damage. It can be challenging to accurately diagnose calcaneum on x-ray since there are no set, unambiguous diagnostic standards. The ability to diagnose fracture patterns with a CT scan has increased, and Sanders and Fitzgibbons classification was developed as a result [3, 4]. There was debate regarding how to treat intraarticular fractures. While some writers advocate surgical techniques, others favor conservative care. Closed or open reduction with

screws or plate fastening is the key component of operational management.

Materials and Methods

From June 2021 to December 2022, we conducted prospective research on 15 patients with 17 displaced Sanders type II and III calcaneum fractures who were seen in the OPD and emergency room at Silchar Medical College and Hospital in Assam, India.

Inclusion criteria

- Fractures with displacement >2mm.
- Fractures less than 2 weeks old.
- Patients age between 20 to 60 years of age.
- Fractures with Sanders type II and III fractures.

Exclusion criteria

- Sander's type I and IV intraarticular fractures.
- Patient who do not give consent for study.
- Compound calcaneum fractures

- Patients with irregular follow up.
- Extraarticular calcaneum fractures.

A clinical examination was performed for edema, skin condition, deformity and distal neurovascular function after obtaining a thorough history of the pain, the mechanism and length of the injury, prior sickness or therapy. Additionally, the pelvis and spine were examined. To confirm the fracture, standard radiographs of the foot were acquired in the lateral and axial views. Also performed was a CT scan. After fulfilling all inclusion requirements, the patient was made surgically ready.

Procedure methodology

3.5 mm calcium locking plate was employed. The patients had conventional surgery with the afflicted limb raised in the lateral position. Incision, which extends distally anterior to tendoachilles along back border of heel, was made about 5 cm away from lateral malleolus, or essentially in back midline. It is then twisted anteriorly along border of foot until it reaches root of the fifth metatarsal. Without any harsh soft tissue dissection, the lateral wall's periosteum was directly cut through during the incision [Fig 1(a)].

While completing subperiosteal dissection along lateral wall, the flap was softly pulled back. It is essential to follow shape of blown-out lateral wall and avoid veering into soft tissue in order to prevent damaging peroneal tendons. A K-wire kept entire flap up in one piece while keeping it out of way by being put longitudinally into fibula, one from lateral to medial in talus, and one into cuboid. After retracting flap, these wires bend back, allowing procedure to continue without having to touch them again. The whole lateral wall of calcaneus is visible distally to calcaneocuboid joint. When employing this extensile lateral approach, calcaneocuboid joint's posterior facet and lateral wall are visible. Indirect reduction of sustentacular fragment occurs.

After complete exposure, lateral wall was removed and put on back table for repair since this piece obscured posterior facet. Because space needed to accommodate the component must first be made, the posterior facet was not instantly decreased. To better expose link between medial region containing sustentacular fragment and lateral part with posterior facet and tuberosity, anterior process was first shortened where fracture line separates it from sustentacular fragment. After tuberosity was reduced to sustentacular fragment through manipulation of large threaded Steinmann pin placed into tuberosity fragment from either lateral to medial or directed posteriorly to correct varus and loss of height and length, we perform a provisional fixation using axially directed Kirschner wires introduced from heel into sustentacular fragment. After performing these two

reduction maneuvers, the bone has now reached its full length. We now focus our attention to depression of posterior facet, decreasing it to intact medial portion and retaining it with temporary fixation. Then, to evaluate the total decrease, we took lateral, axial, and broden's view intra-operative radiographs. Under the diminished posterior aspect, there is frequently a significant deficiency in the calcaneus material. This may be allowed if satisfactory fracture stability and reliable internal fixation are achieved without the use of bone cement or bone grafts.

Prior to performing fixation, we first decrease the lateral wall along the posterior facet's outside border. Most of the time, the most dependable fixation is provided by the thicker bone in the thalamic region that supports posterior aspect. To sustain reduction of posterior facet, a tiny cortical lag screw (3.5 mm) was placed into the sustentacular fragment. From anterior process of calcaneus into most posterior portion of tuberosity, a lateral plate was implanted. The plate aids in preserving the calcaneus' neutral position. Before applying the plate, intraoperative axial image was taken to verify neutral alignment. For maximum fixation, straight screws from plate into sustentacular fragment were used where it was possible. Subchondral bone that supports calcaneocuboid articular surface received most anterior screw. The posterior side of calcaneus received most posterior screw, which was inserted into thicker bone there. To cover remaining holes, plate is shaped into a "frown" (concave plantarly) [Fig. 1(b)]. Over a deep drain, the flap was fastened shut. Short-leg splint was put following antiseptic dressing.

Post-operative care and rehabilitation

Anti-inflammatory analgesics were used to treat pain and inflammation following surgery. Antibiotics were infused intravenously into each patient. Patients were advised to do vigorous toe motions starting on day one, and affected leg was kept raised. A below-knee splint was used to maintain operated limb in the neutral position, which is a 90-degree angle between foot and tibia. This posture is kept for up to 72 hr to lessen edema following surgery. On the third post-operative day, the wound was examined. Patients were instructed to move their ankles while wearing an elastocrepe bandage in place of the splints, which were removed.

After that, antimicrobial dressings were used every other day till day of suture removal. After sutures were removed at the 12th or 14th post-operative day, the patients were usually released. Following surgery, follow-up visits are scheduled every 3, 6, 9 and 12 weeks afterward. At every follow-up, a radiological examination was performed utilizing

Bohler's angle, height, breadth, Gissane angle, etc.

Functional assessments using the AOFAS score.

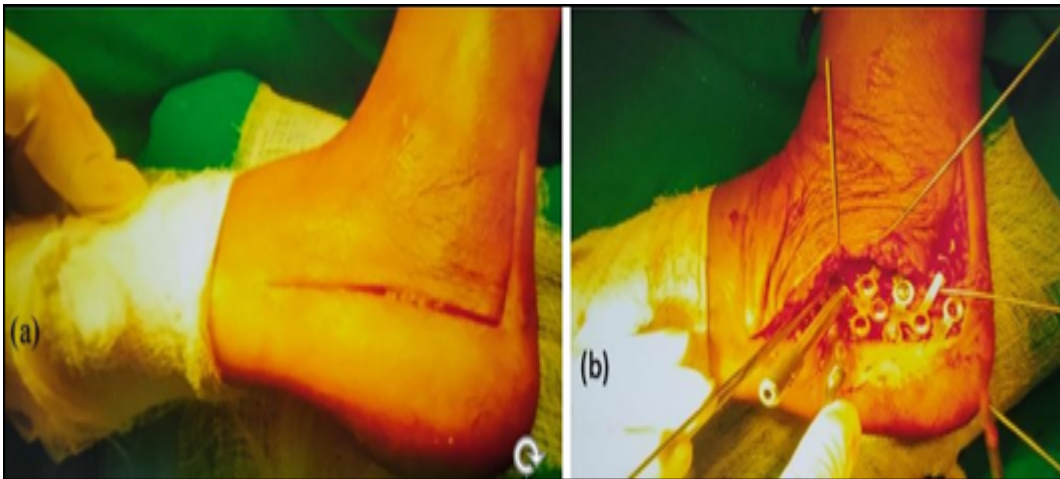


Fig 1: a) Standard extended lateral approach b) K-wire fracture reduction and plate fixation

Results

There are 2 female patients and 13 male patients among the 15 instances. The range of ages was 21 to 50, with mean age of 40.07±8.03 years. Majority of them (53.33%) were between the ages of 31 and 40. Out of 15 patients, 46.67% (7) on the left, 40% (6) on the right, and 13.33% (2) were bilateral. Most common injury method was falling from a height (73.33%), while 2 patients had a road traffic collision (26.67%).

According to Sander's categorization, fracture patterns were type II in 35.3% of cases and type III in 64.7%. Average time for radiological union was 13.06±1.60 (10 -16 weeks). On calculation of functional results, mean AOFAS score found 90.83±5.45 for Sander's type II and 86.45±6.97 for

Sander's type III (Total mean score 88±6.66) [Table 1]. Gissane's angle was also improved from preoperative 155.29°±6.95° (range 140°-160°) to an instant post-operative 132.94° ±6.13°. Similarly, Bohler's angle was also better from preoperative 5.59°±8.45° to postoperative 24.29° ±5.56° [Table 2] [Fig 2].

In this investigation, we also discovered problems; however, in 12 (70.5%) of the instances, there were no wound complications and the wounds largely healed. Four patients (23.5%) had superficial wound defects that were treated with antibiotics and standard antiseptic dressings; one case (5.7%) had severe wound defects that required subsequent suturing and wound debridement. There are no documented instances of implant failure, screw loosening, or postoperative loss of reduction.

Table 1: AOFAS score Vs. Sander's classification

Sander's type	Excellent	Good	Fair	Poor	Total
II	4(66.66%)	2 (33.33%)	0	0	6 (100%)
III	4(36.36%)	3 (27.27%)	4(36.36%)	0	11 (100%)
Total	8(47.04%)	5 (29.41%)	4(23.52%)	0	17 (100%)

Table 2: Assessment of Bohler's and Gissane's angle

Sander's type	Bohler' angle (OT)		Gissane's angle (OT)	
	Before	After	Before	After
II (n=6)	11.67°±5.16°	29.17°±3.76°	151.67°±6.83°	131.5°±5.24°
III (n=11)	2.27°±8.17°	2164°±4.52°	157.27°±6.46°	133.18°±6.81°

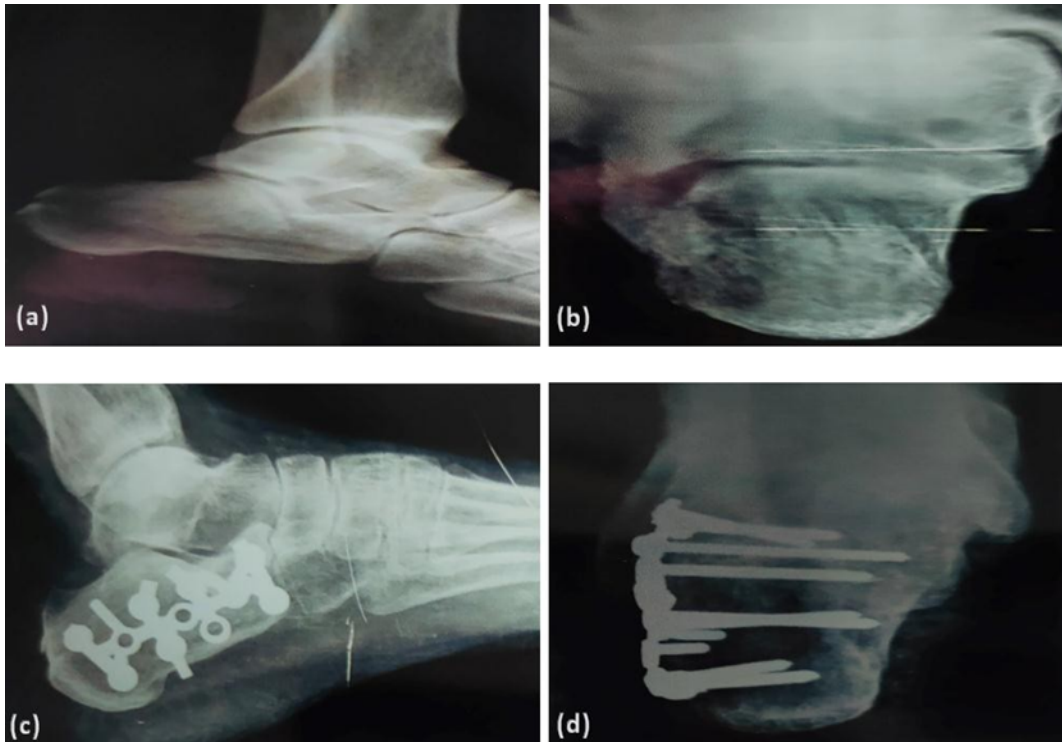


Fig 2: a) preoperative x-ray of calcaneum (lateral view) b) Axial view c) post-operative AP view of x-ray after 6-months of follow up d) axial view

Discussion

We looked at how plate osteosynthesis in displaced intraarticular calcaneal fractures performed clinically and radiologically. We discovered that maximum of patients were between ages of 31 and 40. In contrast, Vaclav Rak et al. [5] in 2009 and Lamichhane A et al. [6] in 2013 reported that average age was 44 years and 30.5 years, respectively. The majority of the patients in our research were men. Male preponderance was also observed in investigations by Vaclav et al. [5], Lamichhane et al. [6], and all other research. Out of 15 patients in our investigation, there were 17 fractures, including 2 bilateral fractures, 6 (35.30%) cases of Sanders Type II fractures and 11 (64.70%) cases of Sanders Type III fractures, consistent with findings by D. Makki et al. [7] According to Deniz Gulabi et al. [8], 54.5% of cases are type II and 45.45% are type III, while Cheng Long et al. [9] find that 69.5% of cases are type II and 30.4% are type III.

Our study, the Bohlers angle was improved from a preoperative value of $5.59^{\circ} \pm 8.45^{\circ}$ to a postoperative value of $24.29^{\circ} \pm 5.56^{\circ}$. According to studies by Chang Long et al. [9] and Saurabh et al. [10], mean post-operative Bohlers angle was 25.31° , and it had improved from 4.15° to 25.47° after surgery, Vaclav et al. [5] shows improved from preoperative 11° to post-operative 30.5° in type II fracture and 6° to 33° in type III fractures. In term of Gissane angle, it better-quality from preoperative $151.67^{\circ} \pm 6.83^{\circ}$ to $132.5^{\circ} \pm 5.24^{\circ}$ for

Sander's II fractures and from $157.27^{\circ} \pm 6.46^{\circ}$ to $133.18^{\circ} \pm 6.81^{\circ}$ for Sander's type III fractures. Cheng Long et al., [9] mean post-operative angle was 117.5° . Angle improved from preoperative 151° to postoperative 120° in Saurabh et al. research [10]. In the study by Vaclav Rak et al. [5], angle increased to 121° for type III fractures and 123° for type II fractures. In our study, the mean AOFAS scores for Sander's type II fracture were 90.83 ± 5.45 and for Sander's type III fracture were 86.45 ± 6.97 . According to a study by Saurabh et al. [10], typical AOFAS score at the end of the follow-up was 86.3. According to a research by Vaclav Rac et al. [5], 32% of patients had outstanding outcomes, 37% had good outcomes, 18% had acceptable results, and 13% had poor outcomes.

Conclusion

Understanding pathological anatomy, the fracture pattern, and the displacement of different calcaneal fragments are necessary for accurate preoperative planning and reduction. AOFAS Bohler's angle, and Gissane's angle score indicate a favorable functional result following open reduction and internal fixation with locking plate. The most frequent prolonged lateral method consequence is linked to wound healing, which can be minimized by rigorously adhering to surgical principles, performing surgery at the optimal time, maintaining strict asepsis, and following the right postoperative protocols.

Declaration of Competing Interest:

Authors affirm that they have no relationships or financial conflicts that may have seemed to affect the research presented in this study.

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