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Locking calcaneal plate: A reliable way in treating displaced calcaneum fractures

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Abstract
Introduction: Calcaneum fracture are more commonly in male specially in industrial workers. It is more commonly in age group of 21-45 years. Fracture of calcaneum have more attention because a large number involves the subtalar joint and frequently lead to chronic pain and osteoarthritic changes.
Materials and Method: In this descriptive study we took fifteen patients with seventeen of displaced intraarticular calcaneum fracture. After preoperative and radiological investigation, open reduction and internal fixation carried out with calcaneal plate with lateral approach. After anatomical reduction with the help of k wire and intraoperative C-arm images locking calcaneal plate was fixed with screws. All 15 patients were followed up for a mean duration of 12 months. Final evaluation was done according to Bohler's angle, Gissane's angle and AOFAS (American Orthopaedic Foot Ankle Society) score.
Results: All the patients achieved radiological fracture union at a duration of 12 to 14 weeks. At final follow up the, the 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. The Bohler's angle improved from preoperative 5.59˚±8.45˚ to postoperative 24.29˚±5.56˚, Gissane's angle improved from preoperative 155.29˚±6.95˚ to post operative 132.94˚±6.13˚.
Discussion: Operative and non-operative management have both been suggested for acute treatment of calcaneal fracture, however it is generally accepted that in most cases operative treatment of displaced calcaneal fracture is warranted in order to avoid the negative consequences of malunion. Both medial and lateral approaches have been used, but the lateral approach allows direct exposure of articular surface, while the medial approach is limited to reduction of the body.
Conclusion: Timing of surgery is one of the most important determinants for the outcome of treatment and determined by subsidence of edema and appearance or wrinkle sign. Operative treatment with calcaneal plate gives a good outcome, even when bone graft is not used.

Keywords: Calcaneum fracture, locking calcaneal plate

Introduction
Malgaigne in 1843, describe the calcaneum fracture for the first time. It is the commonest tarsal bone to fracture, about 60% of all tarsal bone. About 60%-75% of it are intraarticular and remains are extraarticular [1]. It is about 2% of all the fractures of our body. Nearly 10% of all the calcaneum fractures are compound and associated with spine, pelvis and hip injury [2]. Mode of injury is mainly by high velocity trauma like road traffic accident, axial load like fall from height. Diagnosis of calcaneum on x-ray is sometimes difficult as there is no clear cut definitive diagnostic criteria. CT scan has improved to diagnosis of fracture pattern and based on this, Sanders and Fitzgibbons classification was made [3, 4]. Treatment of intraarticular fracture was controversial. Some authors suggest for surgical methods and other prefer conservative management. Operative management consist main open or closed reduction with screws or plate fixation.

Materials and Methods
We did a prospective study on 15 patients with 17 displaced Sanders type II and III calcaneum fractures attending OPD and emergency, department of Orthopaedic surgery, Silchar Medical College and Hospital, Assam, India who met the following inclusion criteria from June 2019 to December 2020.

Inclusion criteria
1. Patients age between 18 to 65 years of age.
2. Fractures less than 3 weeks old.
3. Fractures with displacement >2mm.
4. Fractures with Sanders type II and III fractures.

Exclusion criteria
1. Compound calcaneum fractures.
2. Extraarticular calcaneum fractures.
3. Sander's type I and IV intraarticular fractures.
4. Patients with irregular follow up.
5. Patient who do not give consent for study.

After taking detail history of pain, mode and duration of injury, previous illness or treatment clinical examination was done for deformity, swelling, skin condition, distal neurovascular status. Spine and pelvis examination was also done. Standard radiographs in lateral and axial view of foot were taken for confirming the fracture. A CT scan was also done. After meeting of all inclusion criteria patient was prepared for surgery.

Procedure methodology

We used 3.5 mm calcaneum locking plate. The patients were routinely operated in lateral position with the affected limb up. The incision was made about 5 cm proximal to lateral malleolus almost in the posterior midline and extends distally anterior to the tendoachilles along the posterior edge of the heel. It is then curved anteriorly along the edge of the foot to the base of the 5th metatarsal. The incision given directly down to the periosteum of lateral wall without any blunt soft tissue dissection [Fig 1(a)].

The flap was gently retracted while performing subperiosteal dissection along the lateral wall. It is essential to follow the contour of the blown-out lateral wall and not stray into the soft tissue to avoid damage to peroneal tendons. The entire flap elevated in one piece, and held it out of the way with a K-wire placed longitudinally into the fibula, one from lateral to medial in the talus, and one into the cuboid. These wire bend back to retract the flap which does not need to be touched again for remainder of the procedure. The entire lateral wall of the calcaneus is exposed distally to the calcaneocuboid joint. This extensile lateral approach exposes the lateral wall of the calcaneocuboid joint and posterior facet. Reduction of the tuber-sustentacular fragment is done indirectly.

After complete exposure, the lateral wall was removed and placed in a secure place on the back table for later replacement because this fragment block direct visualization of the posterior facet. The posterior facet was not reduced immediately because room for the piece must first be created. When a fracture line separates the anterior process from the sustentacular fragment, this part was reduced first to allow better exposure of the relationship between the medial part containing the sustentacular fragment and the lateral part with the posterior facet and tuberosity.

The tuberosity was reduced to the sustentacular fragment with manipulation of a large threaded Steinmann pin placed into the tuberosity fragment from either lateral to medial or directed posteriorly to correct the varus and loss of height and length; we perform a provisional fixation using axially directed Kirschner wires introduced from the heel into the sustentacular fragment. With the bone now out to length from these two reduction manoeuvres, we turn attention to the depression of the posterior facet, reducing it to the intact medial piece and holding it with provisional fixation. We then obtained intra-operative radiographs lateral, axial and broden's view to assess overall reduction. A large defect often remains in the substance of the calcaneus beneath the reduced posterior facet. If good stability of the fracture and secure internal fixation are obtained, this may be accepted, we hadn't use bone graft or bone cement to fill the void.

We reduce the lateral wall along the outer edge of the posterior facet, and then perform fixation. The thickened bone in thalamic portion, which support the posterior facet, provides the most reliable fixation in most instances. The small cortical lag screw (3.5 mm) were inserted into the sustentacular fragment to maintain the reduction of posterior facet. A lateral plate was applied that extends from the anterior process of the calcaneus into the most posterior aspect of the tuberosity. The plate helps to maintain a neutral alignment of the calcaneus. An intraoperative axial view was obtained to confirm neutral alignment before application of the plate. When possible, direct screws from the plate into the sustentacular fragment were inserted for maximal fixation. The most anterior screw was placed into the subchondral bone supporting the calcaneocuboid articular surface. The most posterior screw was placed into the thickened bone at the posterior aspect of the calcaneus. The plate is contoured into a "frown" shape (concave plantarly), and fill the remaining holes[Fig 1(b)]. The flap was closed over a deep drain. After antiseptic dressing a short-leg splint was applied.

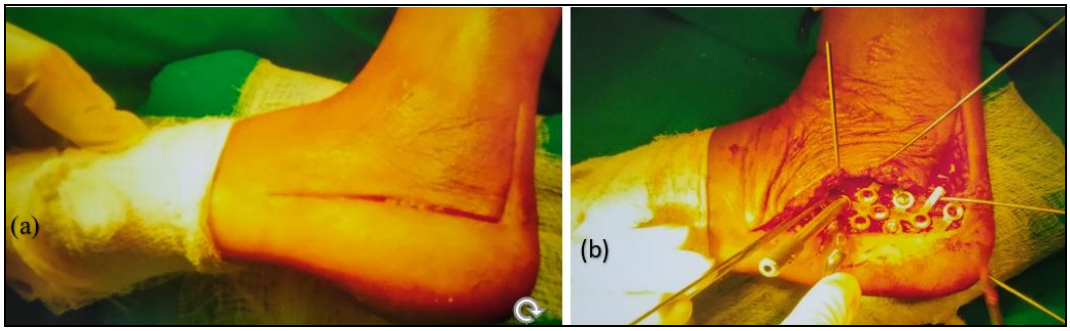

Fig 1: a) standard extended lateral approach b) reduction of fracture with k-wire and fixation of plate.

Post-Operative Care and Rehabilitation

Post-operative pain and inflammation were managed using anti-inflammatory analgesics. All patients were given intravenous antibiotics. Affected limb was kept elevated and patients were asked to perform active toe movements from day one. The operated limb was supported with a below knee splint in standard neutral position of 90˚ angle between the foot and the tibia. This position is maintained for up to 72 hours to reduce post operative swelling. Wound was inspected on the 3rd post-operative day. The splints were discarded and

replaced by an elastocrepe bandage and patients were advised to perform ankle movements within the elastocrepe bandage. Then alternate day antiseptic dressings were done till the day of suture removal. The patients were routinely discharged after suture removal at 12-14th post operative day. Post operative follow up done on 3 weeks, 6 weeks, 9 weeks, 12 weeks then every 3 months. Radiological assessment was done using Bohler's angle, Gissane angle, height, width etc at every follow up. Functional evaluation done using AOFAS score

Results

Out of 15 cases there are 13 patients are male and 2 patients are female. The mean age was 40.07+-8.03 years ranging from 21 to 50 years. Majority of them (53.33%) are were between 31 to 40 years of age. Out of 15 patients 40% (6) were in Right side, 46.67% (7) were on Left side and 13.33% (2) were bilateral. The mode of injury mostly were fall from height (73.33%), 26.67% i.e. 2 patients with road traffic accident. Fracture pattern were type II in 35.3% and type III in 64.7% according to Sander's classification. The average time for radiological union was 13.06±1.60 weeks (10 -16 weeks). On evaluation of functional outcome, the 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][fig 3]. The Gissane's angle was also improved from preoperative 155.29˚±6.95˚ (range 140˚-160˚) to at immediate post operative 132.94˚ ±6.13˚. Likewise, Bohler's angle was also improved from preoperative 5.59˚ ±8.45˚ to postoperative 24.29˚ ±5.56˚ [Table 2] [Fig2]. In our study we found complications also, in 12(70.5%) cases there was no wound complications and they healed primarily[fig 4]. Superficial wound defect found in 4 cases (23.5%) which was treated with antibiotic and regular antiseptic dressing, 1(5.8%) case presented with severe wound defect for which wound debridement and secondary suturing was done. There are no cases with post operative loss of reduction, screw loosening, or implant failure.

Table 1: AOFAS score versus 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		Gissane's angle	
	Before OT	After OT	Before OT	After OT
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˚

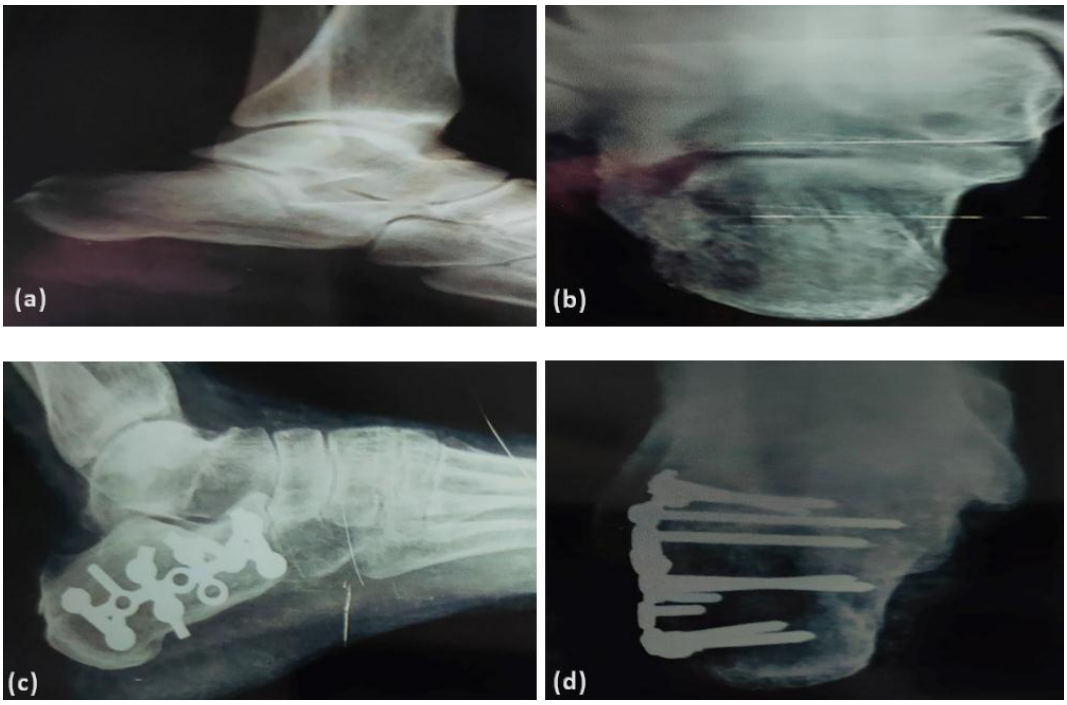

Fig 2: a) preoperative x-ray of calcaneum(lateral view) b)Axial view c) post operative AP view of x- ray after 6 months of follow up d) axial view

Discussion

We studied the clinical and radiological assess the outcome of the plate osteosynthesis in displaced intraarticular calcaneal fracture. We found the largest age group of the patients was in between 31-40 years where Vaclav Rak *et al.* [5] in 2009, Lamichhane A *et al.* [6] in 2013, found the average age to be 44 years, 30.5 Years, years respectively. In our study most of the patient were male. Studies by Lamichhane *et al.* [6], Vaclav *et al.* [5], and all other studies also showed male predominance. In our study out of 15 patients with 17 fractures (2 are bilateral), 6(35.30%) cases of Sander's Type II and 11(64.70%) cases of Sanders Type III fractures, where studies done by D Makki *et al.* [7] shows 55.3% are of type II and 38.3% are of type III, Deniz Gulabi *et al.* [8] shows 54.5% are of type II and 45.45% are of type III, Cheng Long *et al.* [9] shows 69.5% are of type II and 30.4% are of type III.

In postoperative assessment of Bohlers angle, in our study it was improved from preoperatively 5.59˚±8.45˚to post operative 24.29˚±5.56˚. Studies done by Chang Long *et al.* [9] shows the mean post operative Bohlers angle was 25.31', Saurabh *et al.* [10] shows it was improved from 4.15˚ to postoperative 25.47˚, 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 improved from preoperative 151.67˚± 6.83˚ to 132.5˚± 5.24˚ for Sander's II fractures and from 157.27˚±6.46˚ to 133.18˚±6.81˚ for Sander's type III fractures. In study done by Cheng Long *et al.* [9] the mean post operative angle was 117.5˚. In Saurabh *et al.* study [10], the angle improved from preoperative 151˚ to post operative 120˚. In Vaclav Rak *et al.* [5] study, the angle improved to 123˚ in type II and 121˚ in type III fracture. The mean AOFAS score in our study is 90.83±5.45 for Sander's type II fracture and 86.45±6.97 for Sander's type III fracture. Study done by Saurabh *et al.* [10], the average AOFAS score at final follow up was 86.3. In Vaclav Rac *et al.* [5] study, the found 32% of patients with excellent result, 37% with good results, 18% with fair results and 13% with poor result.

Conclusion

Computer tomography scanning is required to understanding the pathological anatomy, the fracture patten, and displacement of various fragment of calcaneum which help in preoperative planning and proper reduction. Open reduction and internal fixation with locking plate gives a good functional outcome in terms of Bohler's angle, Gissane's angle, AOFAS score. Most common complication faced with extended lateral approach is related to wound healing, which can be minimised if surgical principles are strictly adhered to, appropriate timing of surgery, strict asepsis, and proper post operative protocols.

Declaration of Competing Interest:

The authors declare that they have no known competing financial interests or personal relationship that could have appeared to influence the work reported in this paper

Conflicts of interest: The authors declare no conflicts of interest.

References

1. Cotton FJ, Wilson LT. Fractures of the os calcis. The Boston Medical and Surgical Journal. 1908 Oct 29;159(18):559-65.
2. Crosby LA, Fitzgibbons T. Intraarticular calcaneal fractures. Results of closed treatment. Clinical orthopaedics and related research. 1993 May 1(290):47-54.
3. Sanders R. Radiological evaluation and CT classification of calcaneal fractures. Disorders of the Foot and Ankle. M. Jahss, MD Editor.
4. Crosby LA, Fitzgibbons T. Computerized tomography scanning of acute intra-articular fractures of the calcaneus. A new classification system. The Journal of bone and joint surgery. American volume. 1990 Jul 1;72(6):852-9.
5. Rak V, Ira D, Masek M. Operative treatment of intra-articular calcaneal fractures with calcaneal plates and its complications. Indian journal of orthopaedics. 2009 Jul;43(3):271.
6. Lamichhane A, Mahara D. Management of intra-articular fracture of calcaneus by combined percutaneous and minimal internal fixation. Journal of Nepal Health Research Council. 2013 Jan 1;11(23):70-5.
7. Makki D, Alnajjar HM, Walkay S, Ramkumar U, Watson AJ, Allen PW. Osteosynthesis of displaced intra-articular fractures of the calcaneum: a long-term review of 47 cases. The Journal of bone and joint surgery. British volume. 2010 May;92(5):693-700.
8. Gulabi D, Sari F, Sen C, Avci CC, Saglam F, Erdem M, *et al.* Mid-term results of calcaneal plating for displaced intraarticular calcaneus fractures.
9. Long C, Fang Y, Huang FG, Zhang H, Wang GL, Yang TF, *et al.* Sanders II–III calcaneal fractures fixed with locking plate in elderly patients. Chinese Journal of Traumatology. 2016 Jun 1;19(3):164-7.
10. Jain S, Jain AK, Kumar I. Outcome of open reduction and internal fixation of intraarticular calcaneal fracture fixed with locking calcaneal plate. Chinese Journal of Traumatology. 2013 Dec 1;16(6):355-60.