

Outcomes of Operative Treatment of Displaced Intra-articular Calcaneal Fracture in Adult

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Abstract

Background and objectives: Management of calcaneal fractures is controversy. Many options of treatment have been described, but there is no agreement about absolute indications. Study of the functional outcome is carried out in surgically treated intra articular calcaneal fracture in this prospective study. We studied the functional outcomes and postoperative complications including; infection, impingement, varus, Synovitis and flap necrosis in operative management of intra articular calcaneal fracture. **Methods:**A total of 24 Patients with 26 calcaneal fractures operated over a period of 24 months (first January 2016 to first December 2017), in the study. Pre-operative computed tomography scans done in all patients. Maryland foot score was used to assess the functional outcome. **Results:**wenty-four patients (22 unilateral and 2 bilateral), the mean age is 35.41 years (range 18-60), consisting of 3(12.5%) female and 21(87.5%) male were included in this study. Most common mode of injury was fall from height in 23(95.8%) patients, while road traffic accident was in 1 (4.16%) patients. Results according to Maryland foot score were excellent in 25%, good in 62.5%, and 12.5% have fair outcome and none of them had poor results. **Conclusions:**Open reduction and internal fixation with restoring the articular congruity with low profile locking plate is the ideal treatment for Sanders Type II, III and IV. Even Sanders Type IV had a good result in short-term follow-up. Use of proper surgical timing, technique and asepsis can lead to excellent or good results in about (87.5%) of patients.

Keywords:fracture; Intra articular; Open reduction and internal fixation.

Introduction

Calcaneus fractures accounts for 2% of all fractures, 60% of tarsal bone fractures.10% of fractures are bilateral and 75% are intra articular¹⁻². At present, they reported that better results can be achieved by operation in young patients with intra articular calcaneal fractures³⁻⁷, 10% of fractures are associated with spine fractures. Mechanism of injury in majority of patients is axial loading i.e. fall from height, other mechanisms are car accident i.e. brake pedal and high velocity trauma⁸⁻¹¹. Current imaging technique has allowed better perceiving of this complex fracture. Sanders classification of intra articular Calcaneus fractures is widely used now a day because of its proven correlation with management and prognosis^{2,12-13}. Treating calcaneus fracture is controversial and challenging for orthopedic surgeon. Treatment options would be either non operative or operative methods. Some studies show that operative methods are better while others show no difference between operative and non-operative method^{5,6}. Calcaneal fractures are classified into two major types, intra-articular and extra-articular. Accurate description of fractures, position and displacement of fragments, is extremely helpful to surgeons, with significant importance for the fracture treatment¹⁴. About 75% of fracture calcaneus is intra-articular which has two separate fracture lines: shear and compression^{15,16}. A shear fracture line extends in the sagittal plane through the posterior facet, dividing calcaneus into two pieces posterolateral and anteromedial. The fracture line may run anteriorly to involve

the cuboid facet. A sagittal shear fracture line splits the calcaneus into the posterolateral "tuberosity" fragment and the anteromedial "sustentacular" fragment⁸. Complex classification systems have been developed with increasing use of CT; Although the Essex-Lopresti system has been used for many years and it is useful in describing the location of the secondary fracture line¹⁷, but it does not describe the overall energy absorbed by the posterior facet, shown by comminution or displaced fragments. Classification systems by Fitzgibbons and Sanders have become more widely accepted in evaluation of these fractures^{1,2}, based on the pathophysiology proposed by Soeur and Remy; it relies on sagittally reconstructed CT images reformatted parallel and perpendicular to the posterior facet of the subtalar joint^{2,12,13}. Type I fractures are not displaced. Type II fractures (its two articular fragments) involve the posterior facet which are subdivided into types A, B, and C, depending on the location of the fracture line (more medial ones are harder to be seen and reduction become difficult). Type III fractures (its three articular fragments) with an additional depressed piece and are subdivided into types AB, AC, and BC, depending on the location of the fracture lines from lateral to medial. Type IV fractures (its four or more articular fragments) which are highly comminuted. Sanders classification has good inter-observer variability, which is applicable in clinical practice². The Sanders classification system is also practical in prognosis. Open reduction is necessary with relevant joint displacement (> 1 mm) and in all extra-articular fractures

compromising the skin and soft tissues, with unacceptable positions like, shortening and broadening of the calcaneus (> 10° valgus / > 5° varus).

Patients and methods

This was a prospective study, which was carried out over a period of (23 months) (first January 2016 to first December 2017) in the private hospital, all surgeries done by one particular surgeon. All patients with fracture calcaneus were accepted to be enrolled for the study. All the patients above 18 years of age, with fracture calcaneus (Sanders Types II, III, IV), displaced intra-articular, closed fracture, bilateral fracture calcaneus and polytrauma had been included as well. All the patients were active and mobile before injury and they were willing to do operation. While skeletal immature or old age, pathological fracture, non-displaced, extra-articular, open fracture, medically unstable and non-ambulatory patients were excluded from the study. A total of 24 patients with fracture calcaneus were admitted in the Orthopedics Department; during that period of 23 months. Complete history, systemic, local and neurovascular examinations, radiological investigations - X-ray of the foot (anteroposterior, lateral and axial), spine (anteroposterior and lateral), pelvis (anteroposterior), and computed tomography scan (CT scan) of foot was done; other relative investigations were done whenever required. Parenteral antibiotic (ceftriaxone 1 g), painkillers was administered as needed. The temporary compressive bandage, ice packing was provided for 48 hours and the affected part was elevated. Planning of surgery done once

the edema subsided, and wrinkle sign developed. Surgery was performed under general or spinal anesthesia, with the following techniques; all of the patients were operated in lateral decubitus position under pneumatic tourniquet in mid-thigh. Intravenous antibiotic was given one hour before induction, scrubbing and draping done, after marking the site of incision skin incision and deep dissection done using lateral (L shaped) approach. Temporary fixation with a thick K-wire (tuber calcanei) and thinner K-wires were done after restoration achieved of the lateral and/or medial (sustentaculum) facets with radiological control shows an optimal reposition then fixation done by using low profile locked plate. The wound closed in layers by interrupted Allgower technique after achieving good hemostasis and insertion of drain, wound covered by sterile gauze, cotton and bandage, tourniquet deflated. Cast was not applied.

Drain removed within 12-48 hours, leg elevation was maintained, and foot was mobilized on the second post-operative day. Antibiotic was given (ceftriaxone 1 g intravenous (IV) twice daily for 5 days. The surgical site (wound) was checked at day 5 and sterile dressing was done using povidon-iodin solution. Sutures were removed after two weeks. Gradual weight bearing was started from 10 to 12 weeks. All the patients have been monitored regularly for 6, 12, and 24 and 72 weeks, outcome has evaluated according to Maryland foot score and AOFAS score questionnaires Table 1 and Table 2 respectively.

Table (1): Maryland foot score questionnaire

The Maryland Foot Score (100 Points Total)	
1. Pain	
2. Function: gait, cosmeses and motion	
(a) distance walked	(g) terrain
(b) stability	Gradations:
(c) walking aid	Excellent – 90–100 points
(d) limp	Good – 75–89 points
(e) shoes	Fair –50–74 points
(f) stairs	Failure –50 or less

Patients gave a score for satisfaction on a scale of 0 to 10 points. There were 21 men and 3 women with an average age of 35.41 years (range 18-60). Assuming normal distribution all data are expressed as means and ranges. Where appropriate, the results were tested for significance using linear regression tests. P < 0.05 was considered to be statistically significant. The study was approved from ethical committee of Kurdistan Board for medical Specialties.

Table (2): AOFAS questionnaire

Ankle-Hind foot Scale (100 points Total)	
1. Pain	
2. Function	3. Alignment
(a) Activity limitation	
(b) Maximum walking distance, blocks	
(c) Walking surfaces	
(d) Gait abnormality	
(e) Sagittal motion (flexion plus extension)	
(f) Hind foot motion (inversion plus eversion)	
(g) Ankle-hind foot stability	

Results

In this study, 24 patients 22 of them unilateral (91.6 %) and 2 of them bilateral (8.3 %) (26 calcaneus) were enrolled, the mean age was 35.41 years (range 18-60 years). Three in 24 patients (12.5%) were females and 21 in 24 patients (87.5%) were males. Most common mode of injury was fall from height in 23 of 24 patients (95.8%), while road traffic accident was 1 in 24 patients (4.16%). Three

patients among those 24 (12.5%) had associated spinal injuries, two in L1 vertebra and one in L2, although none of them needed intervention.

Table (3): Characteristics of study participants (n=24)

Characteristics	Male	Female	Overall
Age	34.8	34.7	34.7
Sex	21	3	24
Mode of injury			
Fall from height	20	3	23
RTA	1		1
Associated injury			
Spine	3	0	3
Pelvis		1	1
Classification			
Sanders type II			
Sanders type III	10	1	11
Sanders type IV	9	0	9
	2	2	4
Time to union(in weeks)			10.2±0.90
Weeks begin full weight bearing (week)			
Compliance no weight bearing			
poor, WB earlier than 10 weeks			
good, NWB >10weeks	3(12.5)		
	21(87.5)		
Weeks before able RTW			
< 14 weeks	8(33.3)		
> 14 weeks	16(66.6)		

About Sanders classification; 11 out of 24 patients (45.8%) were sanders type II, 9 of 24 patients (37.5%) were sanders type III and 4 of 24 patients (16.6%) were type IV Table 4. The mean delay in surgery was 11.66 days (range 6- 16 days). The average duration of surgery was 85 minutes (range 60 to 110 minutes). The average follow-up was 15 months (range 12 to 18 months). Regarding functional outcome in term of Maryland foot score; 6 of 24 patients (25%) have excellent outcome, 15 of 24 patients (62.5%) have good outcome and 3 of 24 patients (12.5%) have fair outcome and no poor outcome Table 4.

Table (4): Functional outcome of subject in terms of Maryland foot score

Functional outcome	Overall number	Sanders type II	Sanders type III	Sanders type IV
Maryland foot score	82.81	82.46	84.77	81.22
Excellent	6	2	4	0
Good	15	8	4	3
Fair	3	1	1	1
Poor	0	0	0	0
Over all	24	11	9	4

Average AOFAS score at final follow-up was 85.3 (range 74 to 96), with 87% having excellent to good results and 2 (8.3%) and 1 (4.16%) had fair and poor results respectively Figure 1.

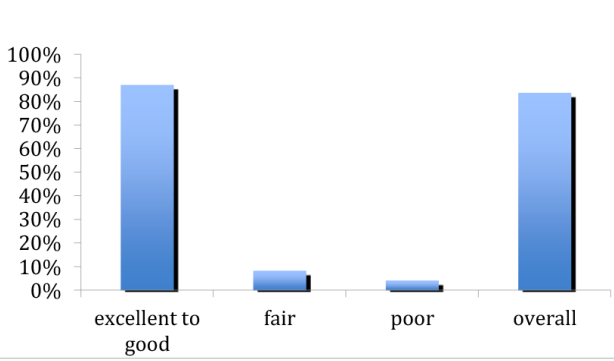


Figure (1): AOFAS ankle and foot scale score

Two patients (8.3%) had limited flap necrosis at incision site and 2 (8.3%) had superficial infection, both of which healed by extended antibiotics and frequent dressing. Subtalar arthritis was seen in 3 patients (12.5%), whereas sural nerve hypoesthesia in 1 patient (4.1%), broadening heels 2 patients (8.3%), varus 1 patient (4.1%) in 24 patients Table 5. None of the patients had compartment syndrome, heel pad problems, peroneal tendinitis, reflex sympathetic dystrophy or implant failure. All fractures united and none needed bone grafting. Patients returned to work on an average of 13.45 week.

Table (5): Postoperative complications

Complication	Number of patients
Broadening of heel	2 (8.3%)
Synovitis	3 (12.5%)
Infection	2 (8.3%)
Impingement	1 (4.1%)
Varus	1 (4.1%)
Range of motion	
Ankle	57.4±4°
Subtalar	22.3±7°
Sural hypoesthesia	1 (4.1%)
Flap necrosis	2 (8.3%)

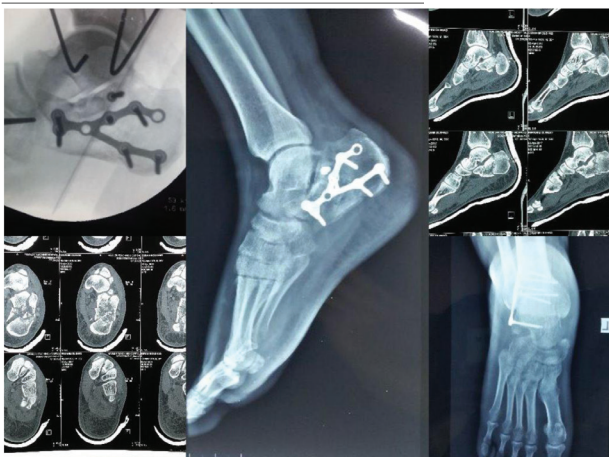


Figure (2): Case no.1 pre and post-operative images.

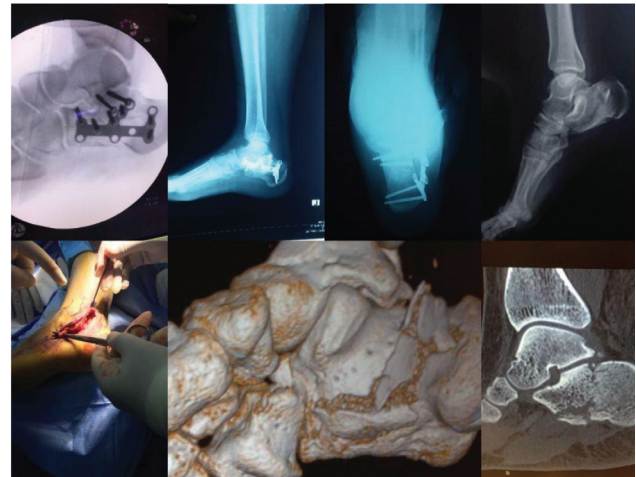


Figure (3): Case no.2 pre, intra and post-operative images.

Discussion

At the present study, we have studied 24 patients operated in private hospital from (first January 2016 to first December 2017), 26 calcaneal fractures in 24 patients were included in the study. Though this study is relatively small, and period of follow-up is short, we have compared our observations with that of available literatures whenever possible. In the present study, there were 21 (87.5%) males and 3 (12.5%) female patients. Our observation is consistent with the other studies^{3, 18-20}. In all study, male outnumber female. More number of male patients can be explained as more number of males is working in industries. In the present study, 22 were having unilateral fractures, whereas, 2 were having bilateral fractures. In the study reported by Joshi et al³, 30 had unilateral fractures and 2 had bilateral fractures over 32 patients. In present study 23 patients had fall from height as their mode of injury. One patient had road traffic accident. This is in consistent to other literatures^{18, 20}. Three patients (12.5%) had spinal injury, 1 patient (4.1%) had pelvic injury. We found that, spinal injury among the most common associated injuries this is supported by other studies^{3, 18}. This shows the importance of examining patients in detail to detect associated injuries at time of admission. In our study, we have followed Sanders classification; 11 of 24 patients (45.8%) were sanders type II, 9 of 24 patients (37.5%) were sanders type III and 4 of 24 patients (16.6%) were type IV which is CT based, this is in consistent with the study reported by Joshi³ and Saurabh¹⁸. Meantime duration between injury and surgery in our study is 11.6 days because we waited for the wrinkle sign before taking the patient to surgery. This is recommended in the other literatures^{18, 19-20}, and hence we could prevent wound complication. The lateral approach was used in all patients where ORIF was performed. In study reported by Gülabi et al²⁰ lateral approach was used in 26 out of 27 patients they found that good and excellent results can be obtained with this approach. The average duration of surgery in our study was 85 min. ranging from (60-110), while in literature reported by Sau-

reb¹⁸ the average time was 76 min. ranging from (60-98). Physiotherapy is also very important for the rehabilitation of the patients all the patients went through a course of active physiotherapy, inversion - eversion exercise from 2nd postoperative day in patients with ORIF. Also other studies recommended that^{19,20}. The patients were allowed gradual weight bearing after 10-12 weeks after clinical and radiological signs of union. All patients started full weight bearing after 3-4 months of injury. This is in consistent to other studies^{18,20}. In the present study, the results were evaluated according to the criteria of the AOFAS score and "Maryland foot score." (Internal consistency [Cronbach's alpha, reliability] for the ministeriums für staatssicherheit [MFS] is 0.82)²². The AOFAS score was 85.3% at final follow up ranging from (74-96). In literature reported by Saurabh¹⁸ we found near the same result; average score was 86.3 %. According to Maryland foot score the average good to excellent outcome was 87.5 % in comparison to other studies^{12,20,23}, which is less, this better functional outcome may be due to using locking plate which provide better stability as compared to conventional plates. In present study the common complications include; Synovitis ³ cases, broadening of heel 2 cases, superficial infection 2 cases, and flap necrosis 2 cases and varus, impingement and sural hypoesthesia 1 case in each of them, this is in consistent to other literatures^{3,18}. At final follow up average range of motion of ankle was 57.4±4° and subtalar was 22.3±7°. This is in consistent to literature reported by Joshi et al³. May be due to early 2nd post-operative day active movement. In our study we obtain good result in 3 cases and fair result in 1 case in sanders type IV fracture treatment, in contrast to other study reported by Gülabi et al²⁰ and John et al²¹ they found that sanders type IV fracture had poor outcome despite open reduction and internal fixation they developed arthritis and ended with arthrodesis, this is may be due to short term follow up of our study. Multiple linear regression analysis was used to identify factors which affecting the general outcome. Detrimental host factors which can affect outcomes in this study had been eliminated and there was no bias in the surgeon factors because only one qualified Ankle and Foot surgeon had performed this surgery. There were 5 main factors found to be affecting the patient's outcome. There was a significant positive linear relationship found between compliance of no weight bearing and the MFS. The patients who had well compliance of not weight bearing for more than 10 weeks had higher MFS outcome compared to those started early weight bearing before 10 weeks. There was a significant negative linear relationship between weeks before they were able to RTW and the MFS.

Conclusions

Our study confirms the effectiveness of the Open reduction and internal fixation with restoring the articular congruity with low profile locking plate is the ideal treatment for Sanders Type II, III and IV. Even Sanders Type IV (which associated with poor outcome) had a good result in short-

term follow-up. Use of proper surgical timing and aseptic technique can lead to excellent results in majority of patients.

Limitations

Small number of patients, short-term follow-up period, subjective scoring system.

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