

Early Weight-bearing Using Percutaneous External Fixator for Calcaneal Fracture

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INTRODUCTION

Fracture of the Calcaneus was first described by Malgaigne in 1843.^[1,2] They account 60% of tarsal bone injuries and 2% of all fractures.^[3] Displaced intra articular fractures account for 60-75% of calcaneal injury.^[4] The usual mode of injury is fall from height among industrial workers, in the rural villages of Africa and the far East it is mostly due to fall from a tree or from a ladder. Hence most of the sufferers are manual laborers below the poverty line. Seventy five percent of calcaneal fractures occur in men between 21 and 45 years of age, with the majority being in industrial workers; thus, the economic implications of this injury are substantial.^[5-10] The calcaneal fractures are treated by conservative or surgical method. In the non operative method weight bearing is usually not permitted for approximately 10-12 weeks.^[4] Open reduction and internal fixation with plate osteosynthesis by lateral approach is the current surgical approach of choice. The lateral surface of the calcaneum is subcutaneous with poor blood supply. Ligaments on the lateral surface of the calcaneum are also injured during the genesis of calcaneal fracture and they are left unattended during internal fixation. In the management of compound calcaneal fractures, the role of internal fixation is very limited and the need for external fixation is obvious.

Even with surgical treatment early weight bearing is not permitted for 10-12 weeks.

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ABSTRACT

Calcaneal fracture, the most common tarsal bone fracture, occurs predominantly in manual labors and subsequently has got considerable socioeconomic implications. Treatment modality which can offer early weight bearing and early return to work is therefore needed for those patients. We have used a biplanar percutaneous external fixator for treating calcaneal fractures without operative and per operative visualization of the fractures. We have treated 17 calcaneal fractures in 16 patients, 12 intra articular and five extra articular, with our percutaneous external fixator system without preoperative X-ray control or reduction. Functional outcome was measured using the American Orthopaedic Foot and ankle society Hind foot score. All fractures united with a mean of 55 days. Partial weight bearing was possible in a mean of 1.8 days and full bearing was possible in a mean of 11.6 days. All the patients were returned to their original work within six weeks. Minor infectious complications occurred in 17.6 percent of cases. The average AOFAS score at six months follow up was 83.8. We conclude that our percutaneous external fixator technique for fracture calcaneum is an effective alternative to the currently available – surgical and conservative treatment modalities especially in lower socio economic labor population who need to return to their job as early as possible. Level of Evidence – IV Case series.

Key words: External fixator, fracture calcaneum, percutaneous

Whenever reduction is not possible the other alternative is primary subtalar arthrodesis. Patients are not allowed to bear weight on the affected extremity for eight weeks after surgery and the average time to return to work with full activity is approximately eight months after injury. The use of temporary uniplanar, unilateral external fixation, Joshi's external system has also been described^[11,12] The early results of these minimally invasive approaches are comparable to traditional open methods.^[4]

We have made an attempt to change this scenario and come with an alternative modality of treatment wherein the patients with a calcaneal fracture can be treated in any peripheral centre and could start early weight bearing and early return to their work which is not advocated at present with any available treatment modality. A biplanar percutaneous external fixator using the components of universal mini external fixator (UMEX) for treating

calcaneal fractures was used, without attempting direct or indirect intra articular reduction. To the best of our knowledge no such technique has been described in English literature so far.

Aim

The aim of our study is to analyze the role of non scalpel surgical bi axial external fixator in calcaneal fracture.

CASE REPORT

Sixteen patients with 17 calcaneal fractures underwent external stabilization system were included in the prospective study. All the cases were operated in the Department of orthopedics, Coimbatore medical college hospital Coimbatore between June 2005 and December 2010.

All types of calcaneal fractures (*Sanders and Essex Lopresti classification*) of less than three weeks including avulsion and compound fractures were included in our study.

Calcaneal fractures more than three weeks old and those associated with other fractures in lower limb are excluded in the study.

Twelve were intra articular [Figure 1] and five were extra articular fractures. CT scan was done in all the cases for Sanders classification.

Among 16 patients, one was bilateral fracture. There were two grade II open fractures and 4 cases had fracture blisters around heel and ankle [Figure 2]. Mode of injury was fall from height in 15 and road traffic accident in two.

14 patients were males and two were females. The age group was in the range of 14 years to 67 years.

Mean interval between injury and surgery was three days (range -1 to 9 days).

All the cases were operated by a single surgeon (First author).

Operative technique

Under regional anesthesia, patient is placed in supine position on the ordinary operative table. Direct or indirect intra articular reduction is not attempted in our study. The lateral side of calcaneus is subcutaneous and the fracture line is palpable. 1.8 mm Kirschner wires are passed from lateral to medial side. Usually three or four Kirschner wires are passed through the major fragment depending

upon the fracture pattern, without opening and without intraarticular reduction of the fracture pattern. Kirschner wires are passed without per operative radiological control. The Kirschner wires are connected with components of UMEX namely threaded rods and square nuts, in a triangular fashion when three Kirschner wires are used and in a quadrangular fashion when four Kirschner wires are used to achieve compression between the major fragments which will facilitate fracture healing [Figures 3 and 4]. The square nuts are tightened everyday by the patient using Allen key under supervision, to prevent loosening of the construct.

No patient was immobilized with plaster of paris post operatively. Post operatively patients were allowed to weight bear with support on an average of two days. Full weight bearing was allowed on an average of 12 days [Figure 5]. Fixator was removed on an average of 56 days as a day care procedure usually without anesthesia, after the fracture union.

Follow up

Clinical, radiological and functional evaluations were performed pre operatively, and at four weeks, 12 weeks, six months, 12 months post operatively. Compound fractures and fracture with blisters required additional follow ups as per the status of the wound [Figure 6]. All the patients were followed up for a minimum period of 6 months [Figure 7].

Boehler angle, Gissane angle and calcaneal height were measured pre operatively, and after removal of the fixator for the injured limb. Boehler angle, Gissane angle and calcaneal height were measured on the contra lateral uninvolved calcaneum also for comparative analysis.

Functional outcome was measured using American foot and ankle society score.

RESULTS

In all the cases fracture united. The mean time for fracture union was 55 days. The fixator was removed at a mean of 57 days. Partial weight bearing was allowed as the pain tolerated and the mean was 1.8 days (range 0 to 6 days). And full bearing was possible at a mean of 11.6 days (range 4 to 17 days).

The patients were able to attend their original job within a month (range 16 to 38 days, mean 27.4 days)

There was a significant reduction in the Boehler angle due



Figure 1: Pre-operative X-ray calcaneum lateral view showing tongue type fracture



Figure 2: Pre-operative clinical picture of left foot showing blisters



Figure 3: Clinical photograph after applying UMEX fixator



Figure 4: Post-operative X-ray left calcaneum lateral view showing fracture reduction



Figure 5: Clinical photograph showing full weight bearing walking two days following surgery

to trauma when compared to the normal side ($P < 0.05$). But it was maintained till union as the fixator resisted further collapse.



Figure 6: Two weeks follow up showing healed blisters

The mean Gissane angle also showed a similar phenomenon except that the mean pre operative angle was more than the mean of the normal side.

The average AOFAS score at 6 months follow up was 83.8.

Complications encountered were pin track infection in two cases and superficial wound infection in one of the compound fractures. All of them eventually healed with regular dressing, pin track care and oral antibiotics.

DISCUSSION

As early as in 1923 Magnuson stated that he “saw practically no fracture of the Os calcis which did not result in significant disability of the foot”.^[11] The scenario has not

changed dramatically unlike in other bone fractures, in spite of the advances in our understanding of biomechanics and technology.

The inherent complications of open reduction and internal fixation with plate osteosynthesis are many a fold. Wound dehiscence (25%), deep infection and osteomyelitis (4% in closed and up to 19% in compound) and iatrogenic injury to sural nerve (up to 15%) are to name a few.^[4,13-20] The mechanical reconstruction of the bony anatomy does not necessarily improve the functional outcome.^[14] The cartilage damage at the time of injury is responsible for subtalar arthritis in those cases which is more common than actually thought of.

Although persistent pain in foot after a fracture of the calcaneous may result from inadequate or inappropriate primary treatment, fractures that are comminuted or intra articular may not do well regardless of the initial treatment.^[3]

Intra articular reduction was not attempted in our study like conservative treatment. Our aim is to maintain the contact between the major fragments by the fixator which will facilitate healing and allow early weight bearing.

Most of the calcaneal injuries occur in younger male industrial workers between the ages of 20 and 40 years. His foremost demand would be to return to his bread winning

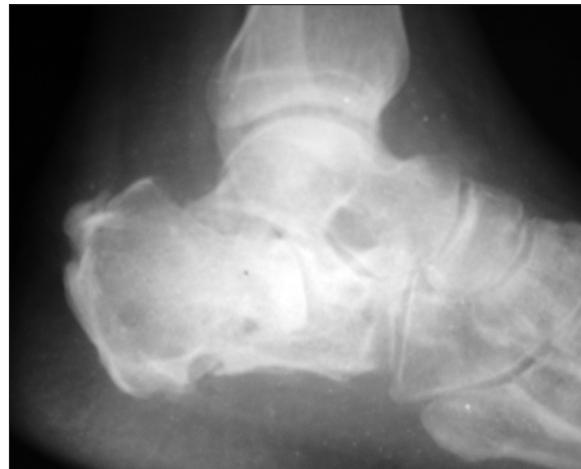


Figure 7: X-ray left calcaneum lateral view showing fracture union at 6 months follow up

Table 1: Clinical details of patients

Age/ sex	1 Side	2 Open/closed	Classification	3 X-ray CT	Bohler's angle			Gissane's angle			Calcaneal height			Weight bearing			4 Time for union in days	5 Fixator removal in days	6 AOFAS score at 6 months follow-up	7 Time to return to job in days	Complications
					Pre-op	Post-op	Normal	Pre-op	Post-op	Normal	Pre-op	Post-op	Normal	Partial	Full	51	85	28	Sup inf		
31 F	R	C	A	IIC	3	16	25	33	150	161	115	4.2	4	4.3	0	5	50	51	85	28	
35 M	R	C	A	IIC	9	5	10	30	116	135	130	4.5	4.3	4.5	1	13	85	87	90	26	
55 M	L	C	F	IIIA/C	2	5	10	22	155	154	110	4.9	4.8	5	3	6	80	81	80	38	
29 M	R	C	B	IIIB/A/B	1	6	18	38	143	131	130	4.2	4.1	4.3	0	15	50	57	80	34	
37 M	R	C	A	IIC	5	30	36		127	121		4	3.8		0	11	70	74	80	26	
37 M	L	C	C	IIIA/C	1	12	11		162	134		4	4		0	15	52	55	85	30	
52 F	R	C	A	IIA	2	26	4	35	118	105	126	4	3.9	4	1	12	54	55	85	24	
14 M	L	O	A	Crack #	2	28	32	32	112	104	115	4.5	4.6	4.5	3	15	58	60	80	18	Sup inf
50 M	R	C	A	Avulsion#	3	11	12	30	135	126	139	4.8	4.6	4.4	3	15	48	50	86	20	
67 M	R	C	A	IIIA/C	3	25	12	36	104	113	122	5	5	5.5	2	12	50	56	85	32	Pin tra inf
48 M	L	C	B	IIIB/A/B	7	4	5	35	105	126	124	4	4	4.3	1	9	30	34	80	36	Pin tra inf
53 M	R	C	F	Avulsion#	2	12	28	25	120	126	133	4.9	4.9	5	6	17	55	59	84	28	
22 M	L	O	B	IV	2	15	4	28	148	140	123	4.2	4	4.3	2	4	54	55	87	38	
50 M	R	C	F	IIC	2	22	6	31	144	130	110	4	4.1	5.1	2	7	58	60	85	26	
51 M	R	C	A	IIIA/C	2	5	7	24	110	108	120	4.7	4.5	5.1	2	12	48	48	85	28	
46 M	L	C	A	#Body-non articular	3	25	24	37	114	114	104	5.5	5.2	5.8	2	14	48	48	83	18	
50 M	L	C	A	#Body-non articular	2	16	25	25	110	105	105	4	3.9	5.2	3	15	52	55	85	16	
Mean					3	15.5	15.8	30.7	128	125	120.4	4.4	4.3	4.8	1.8	11.6	55.4	57.9	83.8	27.4	

Mean: 1-Side; 2-Open/closed; 3-Injury-surgery interval; 4-Time for union in days; 5-Fixator removal in days; 6-AOFAS score at 6 months follow-up; 7-time to return to job in days; F-Female; M-Male; R- Right side; L-Left side; C-Closed; O-Open; A,B,C and F – Type of fracture as per Essex-Lopresti

job as early as possible. When the currently available treatment options do not satisfy his essential demands the alternate has to be thought of.

It is important to evaluate these patients carefully, because physical, economical, and psychosocial issues may all contribute to the patient's continued discomfort. These issues can be dramatic for the patient and their families. The longer the patient remains out of work, more the difficulty to retain the normal activities of daily living. For these reasons some of the centers started performing more primary subtalar fusions.^[3]

The literature evidences provided are from the western part of the world, where the socioeconomic status is relatively better when comparing to the developing countries like ours. Considering the socio, cultural and economic background, the common Indian manual laborer cannot afford multiple procedures for an injury.

The success behind conservative treatment in calcaneal fracture is that it can be done in any centre, no need for image control, and day care procedure. All these are satisfied in our method.

Any innovative method in calcaneal fracture should be cost effective, should not require a sophisticated infrastructure, applicable in all types of calcaneal fractures, patient friendly, minimal risk of wound infection, allowing early weight bearing and early return to work. Our percutaneous technique has almost addressed all the above requirements.

In our series the mean time for partial weight bearing is about two days and full weight bearing is 11.5 days. And 76% of the patients returned to their job within four weeks and 100 % within six weeks [Table 1]. We have done the procedure without any image control, and hence it can be done even in a primary hospital. The AOFAS score (83.8) is comparable to other modalities of treatment published in literature.

The pitfalls in our study include less number of cases, short follow up and not a randomized control study.

CONCLUSION

We conclude that our percutaneous technique for fracture calcaneum is much superior to conservative treatment and an effective alternative to the currently available surgical treatment modalities especially in lower socio economic

labor population who need to return to their job as early as possible. However further randomized control study is needed to confirm it.

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