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## A study of calcaneum fractures treated by different methods

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### Abstract

**Background:** Calcaneal fracture is a complex injury that represents 1%–2% of all fractures. However, they make up 60% fractures of the midfoot bones. Due to debatable management of calcaneal fractures, we decided to evaluate the long term outcome of the same.

**Method:** In this study, we have treated 38 feet with calcaneum fractures of 30 patients, out of which 18 feet were treated conservatively and 20 feet were treated operatively. This was comparable to other study. Maryland foot score has been chosen, being based on results rather than radiographic criteria. Our average duration of follow is 18 months.

**Results:** In this study total 38 feet of 30 patients were included, Out of this excellent outcome was seen in 13 (34.22%), good in 17 (44.74%), fair in 5 (13.15%) and poor in 03 (7.89%). Complication included infection, plantar fasciitis, subtalar arthritis.

**Conclusion:** Results of extraarticular fractures are good whatever be the method of treatment. Outcome of intraarticular displaced fracture is better with operative intervention than with conservative management.

**Keywords:** intraarticular fracture, calcaneum

### Introduction

Calcaneal fracture is a complex injury that represents 1- 2% of all fractures. However they make up 60% of fractures of the mid foot bones. Men are more often affected than women and the incidence is higher in young and middle aged person. The fracture generally occurs by high energy trauma. A common fracture mechanism is an axial stress to the talo-calcaneal joint caused by a fall from a height of more than 1 meter or by a road accident. It can be bilateral and associated with other fractures, and it can be seriously disabling it can be the most severe cases. Calcaneal fractures may be divided into extra-articular (Not affecting the joint) and intra-articular. The best evaluation of these fractures is traditional imaging, including plain x-rays in anteroposterior (AP), lateral and oblique views of the foot, Harris view of the heel and Broden's views of the hindfoot. CT scan best assesses heel fractures, provides a three-dimensional image and may be useful to understand fracture details and to plan a correct surgical approach<sup>[2]</sup>. The management of heel fractures is a real challenge for the orthopaedic surgeon: it varies widely and no clear consensus has been reached, Conservative treatment is well accepted for extra-articular fractures and it is based on cast immobilization, early range of motion, early compression of the plantar arch. Operative management includes closed reduction and internal fixation with pins, wires, screws or plates, with different medial or lateral incisions (or both), and arthrodesis.

Fractures of the calcaneum continue to pose a therapeutic challenge out of proportion to their incidence. There remains great deal of controversies regarding the treatment: operative vs non operative. In operative, this controversy is further fueled by the disagreement on which operative approach is preferable. The success of treatment requires an understanding of the fracture, its deforming force and of the fracture classification. These allows the selection of the treatment that is specific for fracture deformity. Unfortunately, the pattern of calcaneal injury was not adequately delineated for the orthopaedic surgeon who had not spent a significant amount of time examining the fracture to understand subtle nuances of the injury. The aim of this study was to collect and evaluate the scientific evidence supporting the different treatment

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in the management of calcaneal fractures.

### Materials and Methods

Our study was performed from February 2016 to February 2019 at the department of orthopaedics civil hospital and ZMCH, dahod. The average follow up period was 18 months. Most of the patients belonged to the 5<sup>th</sup> decade with male predominance ratio is 5:1. Commonest mode of injury is fall from height. Ap, lateral and axial radiographs of the calcaneum with or without CT were taken of all the patients at the time of injury, during surgery and after discharge. These were used to classify the fractures. The outcome measures included assessment of pain, walking ability, range of motion, wear shoes and complication. Classification used for this study describe below.

Extraarticular fractures and intraarticular fractures. Intraarticular fractures describe by Essex Lopresti. 1) Tounge type- in this type, secondary fracture line runs straight back to posterior border of the tuberosity from the crucial angle, so that tuberosity fragment remain attached to articular fragment. 2) Joint depression type –here the secondary fracture line runs across the body just behind the joint, so that the tuberosity fragment is not attached to the articular fragment.

In this study for conservative management initially below knee slab given than after reduction of swelling and wrinkling of skin, below knee cast is given applying side to side compression and the patient is kept non weight bearing with subsequent changes of cast till there are radiological signs of fracture union. After the removal of the final cast, the patient is advised physiotherapy in the form of heat and active mobilization exercises and use of hot soaks at home.

**Operative technique:** these cases were operated by me and senior orthopaedic surgeon. Anaesthesia decided by consultant anesthetist. Preoperative IV antibiotics were given. The tongue fracture treated by the axial pin fixation of gissane, which was popularised by Essex- Lopresti. With patient in prone position, a small satb incision is kept over the displaced tuberosity of the calcaneus, just lateral to the attachment of the tendoachilles. A heavy steinmann pin is introduced into the tongue fragment in a longitudinal direction, angling slightly to the lateral side. Under image intensifier control, the fracture is manipulated to elevate the tongue fragment from its depressed position in the body of calcaneus. The widening of the calcaneum is now reduced by applying side to side pressure with the clasped hands. The pin is now advanced across the fracture into the anterior fragment of the calcaneus. The foot is carefully padded and a cast is applied, incorporating the protruding portion of the pin. The initial cast and pin are usually removed at 4 to 6 weeks and a simple below knee cast is given. If roentgenograms confirm union and reconstitution of the depressed cancellous bone below the elevated articular surface,



(Pre-operative x-ray)



(Post-operative x-ray)

Weight bearing can be gradually started 8 to 10 weeks after reduction. Surgery performed within three weeks after injury to prevent difficulties in reduction secondary to early consolidation of the fracture. We have exclusively used the lateral approach<sup>[9]</sup>. True lateral position given and Tourniquet is applied after exsanguinating the limb. Lateral incision parallel to peroneal tendons is taken and extended upwards behind the lateral malleolus. The incision is carried down to the periosteum of lateral wall. The sural nerve may cross the incision both at its proximal and distal ends, so care is taken to retract it. After incision up to periosteum, subperiosteal dissection along lateral wall is performed, the entire flap with the peroneal tendons and sural nerve is elevated and held out of the way with a kirschner wire placed into the lateral malleolus. The entire lateral wall of the calcaneus is exposed distally to the calcaneocuboid joint. When the exposure is completed, a stepwise reduction is performed. When a fracture line separates the anterior process from the sustentacular fragment, this part is reduced first to allow better exposure of the relationship between the medial part containing sustentacular fragment and the lateral tuberosity. The tuberosity is reduced to the sustentacular fragment and provisionally fixed with Kirschner wires. Now the lateral wall is replaced outwards to allow an anatomical reduction of the posterior facet. Again this provisional fixation is held with kirschner wires. Intra-operative roentgenograms are taken to assess overall reduction. Any defect created under the reduced posterior facet may be filled with bone graft. The lateral wall is now reduced along the outer edge of the posterior facet and fixation is performed using lag screws and plates. The plate helps to maintain a neutral alignment of the calcaneus. The most anterior screw must be placed into the subchondral bone supporting the calcaneocuboid articular surface and the most posterior screw into the thickened aspect of the calcaneus. After closure of the surgical wounds under suction drainage a well padded dressing is done. A posterior short leg splint is given and the limb is kept elevated. Closed suction drainage is continued for 48 to 72 hours until the collection reduces. If the wound flap shows uncomplicated healing and the fixation is considered secure, the below knee splint may be removed at 3 to 5 days post operatively and early active range of motion exercises of the ankle and the subtalar joint are started. Else the splint may be continued till suture removal, after which a below knee cast is given. No weight bearing is allowed for at least 12 weeks. If after 12 weeks, there are radiological signs of union, guarded weight bearing may be started. The gait and joint range of motion are known to improve gradually with time & exercise.

Radiographic criteria have not been included in clinical evaluation score because it is believe that patients do not complain of the problems on their x-ray but rather, about problems relating to pain and function. So, the MARYLAND FOOT SCORE<sup>[12]</sup> has been chosen, being based on result rather than the radiographic criteria

**Maryland foot score****(1) Pain**

- a. None (45)
- b. Slight (No change in daily work ability) (40)
- c. Mild (Minimal change in working condition) (35)
- d. Moderate (Significant decrease in work ability) (30)
- e. Marked (During minimal daily work) (10)
- f. Disabled (Unable to work) (0)

**(2) Function****(i) Gait****(a) Distance walked**

- Unlimited (10)
- Slight limitation (Up to >1.) (08)
- Moderate limitation (1/2Km.to 1Km) (05)
- Severe limitation (Up to neighborhood only) (02)
- Able to walk indoor only (00)

**(b) Stability**

- Normal (04)
- Weak feeling –no –giving way (03)
- Occasional giving way (02)
- Frequent giving way (01)
- Orthotic devices used (00)

**(c) Support**

- None (04)
- Cane (03)
- Crutches (01)
- Wheelchair (00)

**(d) Limp**

- None (04)
- Slight (03)
- Moderate (02)
- Severe (01)
- Unable to walk (00)

**(e) Stair climbing**

- Normal (04)
- With support (03)
- Any method (02)
- Unable (00)

**(f) Shoes**

- Any type (10)
- Minor alterations (09)
- Flat, laced (07)
- With orthotics (05)
- Unable to wear shoes (00)

**(g) Terrain (Type of floor)**

- No problem on any surface (04)
- Problem on uneven surface (02)
- Problem on flat surface (00)

**(ii) Cosmesis (Deformity)**

- a. Normal (10)
- b. Mild deformity (08)
- c. Moderate deformity (06)
- d. Severe deformity (00)

**(iii) Movement (Subtalar joint)**

- a. Normal (05)
- b. Slight decreased < 50% (04)
- c. Markedly decreased > 50% (02)
- d. Ankylosed (00)

**Final functional outcome**

- Excellent - 90 to 100
- Good - 75 to 89
- Fair - 50 to 74
- Poor - <50

**Result**

In this study total 38 feet of 30 patients were included, Out of this excellent out comes was seen in 13 (34.22%), good in 17 (44.74%), fair in 5(13.15%) and poor in 03(7.89%). In our series, 69.23% of intraarticular fractures treated conservatively showed good results, which were all tongue type of fractures whereas in Thordason & Kreiger series 36.36% showed excellent to good results and 30.77% of our patients showed fair to poor results which were mostly joint depression type fractures in Thordason & Kreiger series 63.63% showed same results, which was statistically significant.( $p=0.013$ ,  $P<0.05$ ) (Table-1) In our series, 81.25% operated intraarticular fractures showed excellent to good results when compared with Thordason & kreiger series, 80% showed same results, which was statistically not significant. ( $p=0.98$ ,  $P>0.05$ ) (Table-2) In tongue-type of fractures, 90% had excellent to good results with conservative treatment which was compared with operative treatment where in 100% of fractures had excellent to good results, This was statistically not significant. ( $P=0.90$ ,  $P>0.05$ ) In joint depression type, no fractures had excellent to good results with conservative treatment which was compared with operative treatment where in 72.72% of fractures had excellent to good results, This was statistically significant. ( $P=0.0072$ ,  $P<0.05$ ) (Table-3).

**Table 1:** Comparing result of conservative treatment in intraarticular fractures (Based on Maryland foot score)

Result	Present Series			Thordason & Kreiger <sup>15</sup>
	Conservative	Type of fractures		Conservative
		Tongue type	Joint depression	
Excellent	-	-	-	01(9.09%)
Good	09(69.23%)	09	00	03(27.27%)
Fair	03(23.07%)	01	02	01(9.09%)
Poor	01(7.7%)	00	01	06(54.54%)
Total	13	10	03	11

**Table 2:** Comparing result of operative treatment in intraarticular fractures (based on Maryland foot score)

Result	Present Series			Thordason & Kreiger <sup>15</sup>
	Operative	Type of fractures		Operative
		Tongue type	Joint	

			depression	
Excellent	06(37.5%)	01	05	07(46.67%)
Good	07(43.75%)	04	03	05(33.33%)
Fair	01(6.25%)	00	01	02(13.33%)
Poor	02(12.5%)	00	02	01(6.67%)
Total	16	05	11	15

**Table 3:** Comparing results of conservative and operative treatment in tongue type and Joint depression type of fractures.

Result	Tongue-Type		Joint Depression Type	
	Conservative	Operative	Conservative	Operative
Excellent	00	01(20%)	00	05(45.45%)
Good	09(90%)	04(80%)	00	03(27.27%)
Fair	01	00	02	01
Poor	00	00	01	02
Total	10	05	03	11

## Discussion

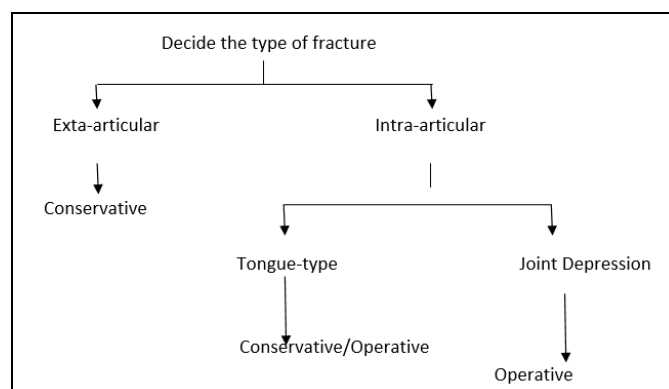
In our series, we have treated 38 feet with calcaneum fractures of 30 patients, out of which 22 feet were treated conservatively and 16 feet were treated operatively. Most of the patients belonged to the 5<sup>th</sup> decade with male predominance. Ratio is 5: 1. This was comparable to Soeur and Ramy's<sup>13</sup> series, in which M: F ratio was 8.54:1, which was statistically not significant. ( $p=0.95$ ,  $p>0.05$ ). The commonest mode of injury is fall from height. 73.33% patients had unilateral fractures with unilateral ratio of 2.75:1, when compared to Soeur & Ramy<sup>[13]</sup> series was statistically not significant. ( $p=0.84$ ,  $p>0.050$ ) In our series patients with internal fixation were allowed ankle and subtalar joint mobilization at an average duration of four weeks which was very early as compared with series of Lance & Carey where average duration was fourteen weeks, which was found statistically significant. ( $p=0.0012$ ,  $p < 0.05$ ) Increase in heel width was found in more number of patients treated operatively as compared to patients treated conservatively. In our series 70.3% feet had intra articular # and 29.7% feet had extra articular #. In our series, we have compared pain at time of follow-up in conservative as well as operative patients at an average duration of about 16 weeks and we have found more percentage of patients treated operatively reported no pain as compared to conservatively treated patient. In our series, 18.75% fractures had post operative infection when compared with Mudhaffar & Prasad series, 18.1% fractures had infection, which was statistically not significant. In our series 21.05% Patients had subtalar joint arthritis when compared to Soeur & Remy Series 10.71% Patients had subtalar joint arthritis, which was statistically not significant. ( $P>0.05$ ,  $P=0.61$ ) Distance walked at follow up was compared between operative and conservatively treated patients in intraarticular fractures and it was found that 50% of operated patients walked unlimited distance as compared to 30.77% of conservatively treated patients. Stair climbing was compared in intraarticular fractures in both modes of treatment and it was found that 46.15% of conservatively treated patients can climb stairs normally whereas 62.5% operated patients fall in the same category, which was statistically not significant. Motion at subtalar joint was compared in intraarticular fractures in both modes of treatment, which was found statistically not significant. Support required while walking was compared in intraarticular fractures in both modes of treatment, 56.25% operated patients required no support while walking whereas 46.15% of conservatively treated patients fall in the same category, which was found statistically not significant. ( $P=0.88$ ,  $P>0.05$ ) Stability was compared in both modes of treatment in intra articular fractures, 56.25%

operated patients were normal whereas 38.46% of conservatively treated patients fall in the same category, which was found statistically not significant. ( $P=0.48$ ,  $P>0.05$ ).

## Conclusion

After analyzing the results of both conservative and operative methods of treatment, the following conclusions can be drawn:-

Accurate evaluation of fracture morphology is an essential prerequisite for deciding the line of management. Good roentgenography which includes lateral, axial and if required, oblique views of calcaneum is necessary in understanding the displacement of major fragments. Results of extra-articular fractures are good, whatever be the method of treatment. Outcome of intraarticular displaced fractures is better with operative intervention than with conservative management. Suggested protocol is as follows:



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