

The Results of Various Surgical Management of Fracture Calcaneum: Comparative Evaluation and Complications

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Abstract:-

Background: Fracture of calcaneum results in serious and prolong disability. Considering the high rate of malunion and severe loss of function, it will be better to choose open reduction and internal fixation as a primary mode of treatment for the calcaneum fractures.

Methodology: The present study consists of 45 fractures of calcaneum treated by open reduction and internal fixation and subtalar arthrodesis. Of the 45 fractures, 16 (35.56%) were treated by open reduction internal fixation by plates within 2 weeks of injury and 29 (64.44%) treated by percutaneous k-wire or Steinman pin or C-C screw.

Results: At final follow up group A patients treated by plate) has mean AOFAS score was 89.28 however group B patients (treated by pin or C-C screw) has it was 79.53 with p-value ≤ 0.0001 .

Conclusion: Early motion prevent stiffness of subtalar joint and ankle joint and leads to early function and psychological rehabilitation. Open reduction and internal fixation by plating is safe and effective method of treating displaced intra-articular fracture of calcaneum.

Keywords:- Calcaneum plate; calcaneum fracture; Steinman pin; AOFAS score.

I. INTRODUCTION

The primary bone that makes up the posterior pillar of the locomotion is the calcaneus. The calcaneus has three facets on its superior side (anterior, middle, and posterior) that articulate with the talus to form the subtalar joint. The posterior facet is the largest of the three facets and the calcaneum's main weight-bearing surface. A sulcus separates the middle and posterior facets from one another. The sustentaculum tali, a protrusion of the calcaneus that articulates with the medial section of the talus, reinforces the middle facet. The sustentaculum goes beneath the flexor hallucis longus tendon. Calcaneum fractures are the most common tarsal bone fracture. Calcaneal fractures are infrequent, accounting for about 1 to 2% of all fractures, but they are significant because they can result in long-term impairment. The most prevalent mechanism for severe calcaneal fractures is axial stress of the foot after a fall from a height. Multiple concurrent injuries are common in patients with calcaneus fractures, and it is crucial to consider this possibility while evaluating patients. With the growth in speed and quantity of vehicles in the modern world, there

has been a significant increase in the incidence and severity of fractures, including calcaneal fractures as a result of falls from large heights and high-velocity trauma. Calcaneal fractures are divided into two types: extraarticular and intraarticular. The majority of the fractures are intra-articular. It is widely acknowledged that calcaneal fractures have poor outcomes and that rehabilitation is slow and partial. Extraarticular fractures are usually easier to diagnose and treat than articular fractures. The calcaneum fracture causes substantial and long-term impairment. The best way to treat intra-articular calcaneal fractures is debatable. The goal of operational management is to reduce the anatomic joint and restore the calcaneus' height, length, width, and axis. Internal fixation that is stable should allow for early movements to restore function. Intra-articular fractures with significant joint displacement (>1 mm) and extra-articular fractures compromising the soft tissues and/or with unacceptable positioning, shortening, and malalignment of the calcaneus ($>10^\circ$ valgus/ $>5^\circ$ varus) are usually treated with open reduction and stable internal fixation. Old age, significant co-morbidities, smoking, diabetes mellitus, steroid drug use, and vascular insufficiency are all relative contraindications. The results of several large series of intra-articular fractures identified by CT scanning and treated with open reduction and internal fixation (ORIF) were satisfactory to excellent in 60–85 percent of cases. However, no clear link has been established between anatomical restoration and result (function, quality of life), and calcaneal fractures are infamous for post-operative problems. The timing of surgery and wound healing are both affected by injury to the soft-tissue covering of the hindfoot. After ORIF of calcaneal fractures, wound healing difficulties occur in 16–25 percent of patients, with rates as high as 43 percent. External fixation, minimally invasive percutaneous fixation, and arthroscopically assisted fixation are all options for operative management. Elevation, ice, analgesia, and early ankle and subtalar joint mobilisation are all non-operative options. To avoid equinus of the ankle and allow soft tissue recovery, some surgeons recommend wearing a splint for two weeks. To prevent the fracture from collapsing further, weight bearing is first restricted. The use of impulse compression as a treatment to minimise edema and increase range of motion and function has been recommended. Despite the fact that the benefits of operative versus non-operative management have been debated, many orthopaedic surgeons treat displaced calcaneal fractures surgically. Only a few small scale, randomised trials on calcaneal fracture treatment were included in a prior Cochrane Review, which included research published before 1998. All of them had methodological faults, so the authors concluded that large-scale, high-quality randomised

controlled trials were needed to give scientific data on therapies for calcaneal fracture care. This review finds and assesses randomised controlled clinical studies comparing various calcaneal fracture treatment options. The following null hypotheses for patients with intra-articular calcaneal fractures were tested based on the identified randomised trials.

The fracture carries a considerable risk of long-term disability. Disruption of normal anatomy of bone, joints, or soft tissue of the heel may result in painful dysfunction since it is an injury to the fundamental weight-bearing components of the foot. Because of the high likelihood of malunion and severe loss of function, open reduction and internal fixation should be used as the primary modality of therapy for calcaneum fractures. The goal of open reduction and internal fixation of calcaneum fractures is to achieve precise anatomical reduction and optimal functional results in depressed type calcaneum fractures with a low complication rate using a brief surgery that is not technically demanding.

Whether or not the subtalar joint is affected in a calcaneum fracture determines the treatment. Traction, plaster, compression bandaging, open reduction and internal fixation, and posterior-subtalar arthrodesis are the six methods for treating fractures. The painful heel caused by calcaneum fractures that have not united is a very common condition. The surgical treatment of fracture calcaneum avoids the major problems of conservative therapy of fracture calcaneum, such as uncomfortable heel, stiffness, and deformity (valgus heel).

II. METHODOLOGY

The patients for the present study were selected from the out-patients department and Emergency department of orthopaedics, S. N. Medical College, Agra. Each patient was subjected to clinical and radiological examination along with routine investigation.

• Criteria for selection of cases:

- Fresh fractures of calcaneum: These fractures are classified based according to the mechanism of injury (Shear, Compression and Shear-compression). Two groups -
 - Group A: Not involving subtalar joint (25%)- Tuberosity fractures, involving calcaneocuboid joint
 - Group B: Involving subtalar joint (75 %)
- Old fracture of calcaneum: where subtalar osteoarthritis develops.

The present study consists of 30 fractures of calcaneum treated by open reduction and internal fixation and subtalar arthrodesis. The age of patients were ranged from 16 to 65 years (average age 25 years). Out of 30 patients 24(80%) were male and 6 (20%) were female. Initially all patients were managed by below knee plaster slab.

III. SURGICAL TECHNIQUE

- Open reduction internal fixation by calcaneal plate and (Lateral approach): Patient was kept in semi prone position. Incision was given inferior to lateral malleolus and parallel to superior border of calcaneum extending from tendoachlies posterioly to calcaneocuboid joint anterioly. Depressed fragment was elevated and 1/3 tubular plate applied. After treatment below knee plaster slab was given. After 10-12 days stitches were removed and plaster given for 4-6 weeks. After that plaster was removed and physiotherapy was started.

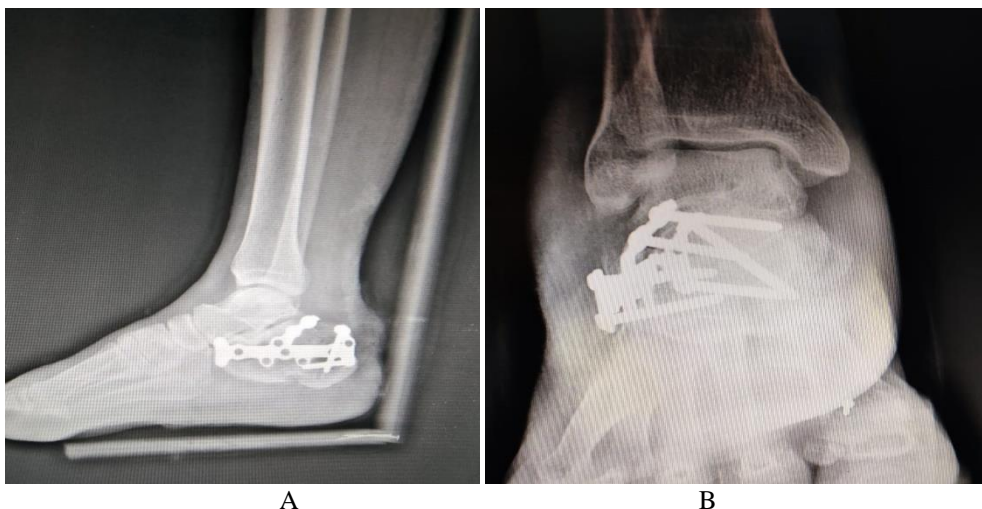


Fig. 1: Calcaneal plate A) Lateral view B) Anteroposterior view

- Closed reduction and internal fixation with k-wire, Steinman pin or c-c screw was done. Incision was given from tip of lateral malleolus extending backward upto tendoachlies. A triangular slot was made by removing the articular cartilage and subchondral bone of contiguous surface of talus and calcaneum. Gap was filled by appropriate graft.

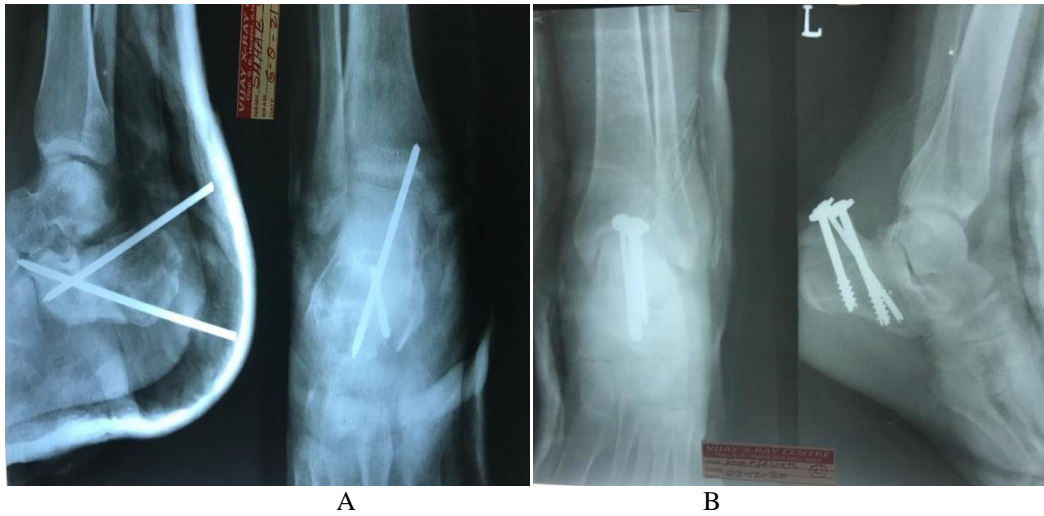


Fig. 2: a) calcaneum fixation by Steinman pin b) or by C-C screw

After treatment below knee plaster slab was given. After 10-12 days stitches were removed and non-weight bearing plaster given for 6 weeks. After that plaster was removed and then weight bearing plaster given for 6 weeks. Consolidation of subtalar joint fusion was confirmed by x-ray. The physiotherapy of ankle joint movement was started after the removal of cast. Majority of the patients were discharged within 4 weeks after injury.

An average post-operative hospital stay was 18 days. Full weight-bearing was allowed from 10-12 post-operative weeks in open reduction internal fixation and 12 to 14 post-operative weeks in posterior subtalar arthrodesis. The average duration of follow up was 8 to 10 months. Radiological consolidation was seen in about 4 to 5 months. Most of the fractures were united within 8 to 10 weeks.

During follow up functional assessment were done by using AOFAS ankle hind foot scale.

- Pain (40 points)
- Function (50 points)
- Alignment (10 points)

IV. RESULTS

Our study included 45 patients diagnosed with fracture calcaneum. The youngest patient was of 18 years and the oldest one of 69 years of age. Mostly patients were between 21-40 years. Most patients were bilateral involvement. Most of the patients in our study were having signs and symptoms indicating towards operative indication in calcaneal fracture. Pain and swelling was the most common complain of patients.

Variable	Data	Percentage
Mean age (years)	38.33	-
Male	26	57.78%
Female	19	42.22%
Side- 1) unilateral	31	68.89%
2) bilateral	14	31.11%
Mean duration of presentation(days)	4	-
Mode of injury- 1) Fall from height	31	68.89%
2) RTA	14	31.11%
Associated injury (like compression fracture vertebrae or neck of femur)	13	28.89%

Table 1: Various demographic details of study

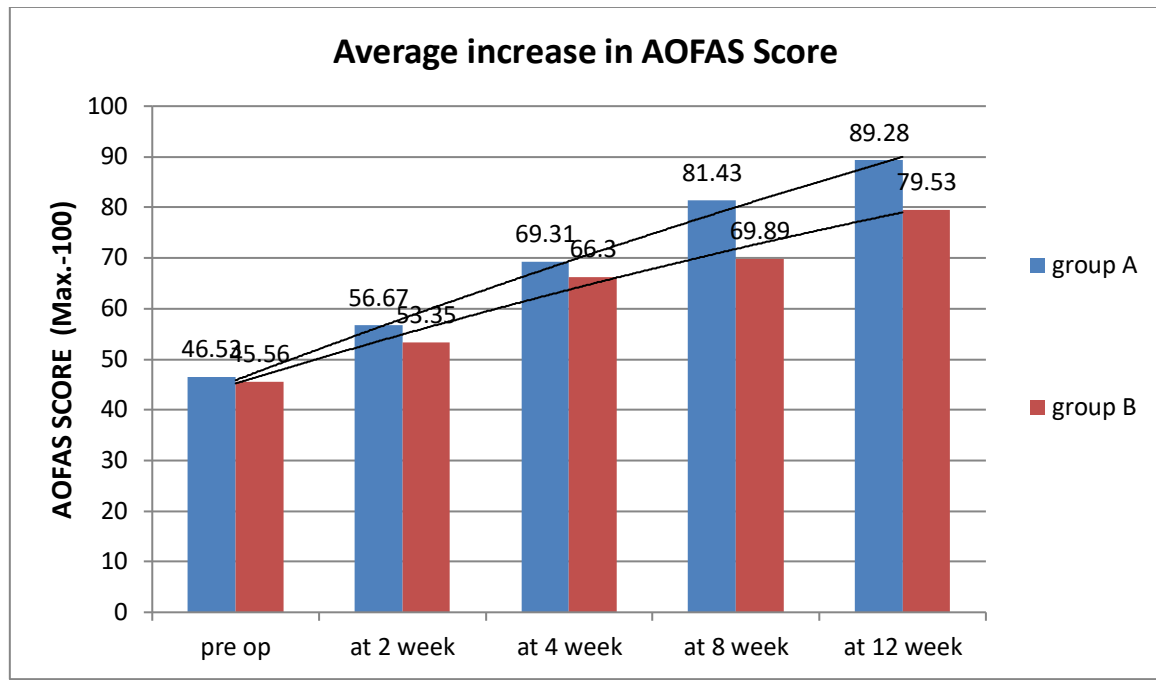
Procedure	Frequency	Mean	SD	t-value	P-value
GROUP-A (ORIF With plate)	16	46.53	4.69	-0.502	0.6183 ^{NS}
GROUP-B (CRIF with Steinman pin, k-wire or c-c screw)	29	45.56	6.52		

Table 2: Pre-op ankle hind foot score (AOFAS)

Procedure	Frequency	Mean	SD	t-value	P-value
GROUP-A (ORIF With plate)	16	89.28	3.48	6.798	<0.0001
GROUP-B (CRIF with Steinman pin, k-wire or c-c screw)	29	79.53	5.62		

Table 3: AOFAS ankle hind foot score at final follow up

- **Functional outcome:** comparative evaluation of functional outcome by using AOFAS score during follow up is showing more increases in score in group A patients as compare to group B.



Graph 1

Complications noted during follow up of patient are following:

Complications	Number of patients (%)
Pain	5(11.11%)
Swelling	2(4.44%)
Infection(osteomyelitis)	1(2.22%)

Table 4: Complications found during follow up

V. DISCUSSION

It has long been generally accepted that the results of fracture calcaneum are bad, and that recovery is slow and incomplete. McReynold reported 100% good results after the treatment of tongue fracture from the medial side. The reason for these good results is that by using this approach the normal length of the calcaneum can be restored and the long medial fracture of the tongue fragment can be accurately reduced, which indirectly reduced the fracture of the posterior facet. He also reported that the results were good in 70% of the joint-depression fracture, and suggested that a graft of bone or a screw, staples, plate, inserted laterally as it would support the depressed fragment.

In our series we have used lateral approach for open reduction and internal fixation of tongue- fracture and joint-depression fracture by plate, screws. The results are evaluated on the basis of criteria given by Widen. There are 100% good results in 2 part intra-articular fracture, about 85% good results in 3 part intra-articular fracture, and about 75% good result in 3 part joint-depression fracture. In McReynold's series, in which the feet were also placed in a plaster cast post-operatively, the subtalar motion was than 25% of normal in 90% of the patients. In the present series in which secure fixation was accomplished from lateral side

and early motion was substituted, the average subtalar motion at follow up was 75% of normal

In our series, the average subtalar motion at follow up was 90-95% of normal in 42% cases, about 70% of normal in 33% cases, and 50% of normal in 25% cases. Pain, swelling, deformity, and difficulty in walking persist in complicated fracture calcaneum particularly where the subtalar joint is involved. Patients are not able to walk on uneven surface. Traumatic arthritis and disturbed tuber joint angle of subtalar joint are constant feature in these patients. Thomas 1967 described a method of subtalar arthrodesis in which sinus tarsi was exposed from lateral incision and graft taken from the iliac crest was inserted. The method of treatment of displaced fracture of os calcis involving the subtalar joint was previously described by Dick 1953, who advocated early posterior subtalar arthrodesis as soon as primary swelling has been controlled in fractures which are likely to result in painful osteoarthritis of the subtalar joint.

However no authors, mentioned in favouring conservative treatment, have been able to approach out result of over 90% of patients returning to same work within 6 months of injury. Our series had relatively better results. In 25% of cases there was restriction of subtalar joint after open reduction and internal fixation. Only in 10% of cases of old malunited fractures with painful heel, pain continues

to persist after posterior subtalar arthrodesis. At the end of follow up the patients were evaluated according to criteria described by Widen and the functional results classified into excellent, good, fair, poor. About 47% patients had excellent results, 30% had good, 13% had fair and 10% had poor results.

VI. CONCLUSIONS

Open reduction and internal fixation by plating is safe and effective method of treating displaced intra-articular fracture of calcaneum. Early motion prevents stiffness of subtalar joint and ankle joint and leads to early function and psychological rehabilitation. Procedure is relatively easy to perform, operative time is less and does not require expensive instruments and implants. While posterior subtalar arthrodesis is an effective method of treatment in old fracture of calcaneum with subtalar osteoarthritis.

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