



MANAGEMENT OF CALCANEAL FRACTURES WITH TENTACLE PLATE - PROSPECTIVE OUTCOME ANALYSIS

Orthopaedics

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ABSTRACT

This is a prospective cohort study to evaluate the results of open reduction through an extensile lateral approach and internal fixation with calcaneal tentacle plate as surgical treatment of the displaced intra-articular calcaneal fracture. The extended lateral approach accounts for low incidence of complication. After suitable interval to improve the soft tissue status, this series recommend to take the cases for surgery between 14 to 21 days from the time of injury. Wound dehiscence is the common complication, which can be minimized by raising cutaneous-subcutaneous flap during incision. Prevention of collapse is mainly by the rigid fixation & perfect anatomical plating and delayed weight bearing. Bone grafting is needed for severely comminuted cases. We systematically obtained anatomical reduction, whatever the Sanders type. This reconstruction and subtalar joint congruence, essential for a good result. Post operative subtalar joint incongruence may lead to early subtalar arthritis, which can be managed with subtalar arthrodesis. Osteosynthesis of type II calcaneal fractures give excellent result compared to other fracture patterns. In case of contra-indication relating to age, associated pathology such as diabetes or arteriopathy, or psychiatric disturbance, we advise plaster cast immobilization for relatively congruent fractures, and closed percutaneous pinning or screwing for more displaced and incongruent fracture. Proper pre-operative planning, rigid fixation with calcaneal tentacle plate and adequate screws through extensile lateral approach, anatomical reduction to achieve subtalar joint congruency, using bone grafts in comminuted fractures, early post op rehabilitation, delayed weight bearing will give good results in case of displaced intra articular calcaneal fracture

KEYWORDS

calcaneal fracture,arthrodesis,post operative,subtalar joint.

1.INTRODUCTION

Calcaneal fractures are the most common fracture of the tarsal bones, yet controversy still exists on the best treatment for these disabling injuries [2]. However, as a better understanding of fracture patterns with computed tomography scans and modern surgical techniques and hardware has improved outcomes and lowered morbidity, a trend has developed toward open reduction and internal fixation (ORIF) for displaced, intra-articular calcaneus fractures [2, 4]. Calcaneal fractures often results in a varus deformity with heel widening, loss of calcaneal height, and subtalar joint incongruency. Open reduction and internal fixation can be used to address deformities, restoring the anatomic morphology of the calcaneus, and thereby the biomechanics and function of the hindfoot. Restoring heel width prevents chronic peroneal tendinitis secondary to impingement from lateral wall blowout of the calcaneus, and restoring the length and alignment of the Achilles tendon maintains plantar flexion strength Open Reduction & Internal Fixation also provides the opportunity for anatomic reduction and rigid internal fixation of the subtalar joint. Normal subtalar motion is integral for the foot to adapt on uneven surfaces with inversion and eversion. Plate osteosynthesis of the intra-articular fractures is a standard treatment method, but it has potential complications such as poor wound healing and infection. Calcaneal shape restoration by means of open reduction internal fixation (ORIF) or primary subtalar arthrodesis if needed is mandatory prevention of late complications such as malposition, flattening of the longitudinal arch, anterior ankle impingement syndrome, lateral impingement syndrome, and axial malalignment of the hind foot.[1]

2.AIM OF THE STUDY

This is a prospective cohort study to evaluate the results of open reduction through an extensile lateral approach and internal fixation with calcaneal tentacle plate as surgical treatment of the displaced intra-articular calcaneal fracture.

3.MATERIALS & METHODS

Total no. of 25 cases with calcaneal fracture, admitted in Rajiv Gandhi Govt. General Hospital, Chennai, were included in the study. All the cases were operated and followed up by using single protocol with regard to extensile lateral approach, surgical techniques, pre-op & post-op evaluation.

Inclusion & exclusion criteria for surgery as follows :

Inclusion criteria:

Age more than 16 years
Occupation of the patient (laborer, tailor)
Bohler's angle < 20 o
Gissane's angle > 115 o

Sander's type II, III and IV

Exclusion criteria:

Fractures > 4 weeks
Sander's type I calcaneal fracture
Extra articular fractures
Patients with other medical problems

Pre Op X-ray Assessment:

At the time of admission to the hospital, anteroposterior, lateral, axial, and internal oblique radiographs of the fractured calcaneus and oblique radiographs of the injured foot as well as lateral and axial(harrison's view) radiographs of the normal calcaneus were taken. A pre-operative CT scan was taken for all cases to obtain better appreciation of the size of the displaced fracture fragments and the number of fracture lines that had to be identified and surgically reduced. From the radiographs and CT scan, the type of fracture was determined, and the pre-operative Bohler's angle, and calcaneal height and width were measured.

Classification:

With increasing use of CT, more complex classification systems have been developed for these fractures that have been shown to have prognostic value in the treatment of these injuries. Although the Essex-Lopresti system has been used for many years and is useful in describing the location of the secondary fracture line, it does not describe the overall energy absorbed by the posterior facet, shown by comminution or displaced fragments Classification systems by Crosby and Fitzgibbons and Sanders have become more widely accepted in evaluation of these fractures [8]. Both classifications are based on CT scans and describe comminution and displacement of the posterior facet. The advantage of the Sanders classification is its precision regarding the location and number of fracture lines through the posterior facet [23]. Both systems lack descriptions of other important aspects of these fractures, however, including heel height and width, varus-valgus alignment, and calcaneo cuboid involvement.

In our study we have used Sander's classification to classify the fracture pattern

Preparation for Surgery:

Mean interval for surgery is 15 +/- 6 days (range 10-30 days).

Operation was planned according to type of fracture, whether displaced or undisplaced, severity of comminution, skin status (blisters), open or closed fracture, & edema regression.

Post-Op Protocol:

Compression bandage & limb elevation in immediate post op period to reduce the edema. Below knee slab was applied for two weeks. Suture removal was done in 14th post operative day. After two weeks, ankle and subtalar joint mobilisation were started.

Follow Up:

Regular follow up of all the patients at monthly interval for first three months followed by three months interval were done. During the follow up period, subjective evaluation (patient satisfaction), clinical assessment (gait, healing), radiological assessment were done using Weber scoring system.

All the patients were taken radiographs in anteroposterior, lateral view and Harrison's axial view to assess radiological union, post operative Bohler's angle, calcaneal height, width, subtalar joint congruency.

Minimum follow up period – 6 months

Maximum follow up period -2 yrs

Rehabilitation programme was same for all the patients

75% of people attended the rehabilitation center

First 2 weeks – active & passive ankle joint and toe mobilisation was done.

All the cases were treated with below knee slab for three weeks

Active Subtalar inversion and eversion movements were started after three weeks. Non-wt bearing walking for 2 months, then gradual weight bearing allowed based on radiological union & pain tolerance. At the end of 3rd month, patient normal weight bearing was allowed.

4.OBSERVATION & RESULTS

In our series, five cases (20%) were in between the age group of 16-25 yrs, seven cases (28%) were in 26-35 yrs, ten cases (40%) were in 36-45 yrs and three cases were in 46-60 yrs. Among them, 19 cases (76%) were male and 6 cases (24%) were female

Radiological Analysis:

In our series 8 (32%) cases were Sander's type –II fracture, 11 cases (44%) were Sander's type-III, and 6 cases (24%) were type IV. Bone grafting (allograft) was used in fourteen cases (56%) and not used in eleven cases (44%). Among them Bone graft was used in one case (4%) of type II fractures, seven cases (28%) of type III fractures and in six (24%) cases of type IV fractures. Pre operative Bohler's angle in the study group was between 10 o -20 o in 72% of cases and remaining 28% of cases had less than 10 o angles (average -14.6 o). Mean pre-operative Bohler's angle among type II fractures was 18.87 o, among type III fractures was 14.18 o, and among type IV fractures was 10o (Table – 3). Post operatively Bohler's angle was corrected to 20 o -30 o in 84% of cases and 15 o -20 o in 16% of cases (average - 24.56 o). Mean post-operative Bohler's angle among type –II fractures was 28.25 o, among type III fractures was 22.54 o and among type IV fractures was 20o (Table – 4). Mean pre-op calcaneal height was 38.6 mm (range 26 mm to 46 mm). Mean pre-op calcaneal height among type II fractures was 41.87 mm, among type III fractures was 40mm and among type IV fractures was 31.66 mm. Post operatively calcaneal height was corrected to an average of 49.64 mm (range – 44 mm to 56 mm). Mean post-op calcaneal height among type II fractures was 50.5 mm, among type III fractures was 50.81 and among type IV fractures was 46.33 mm. Pre operatively subtalar joint incongruence was present in 23 cases (92%). Post operatively Subtalar joint congruence was achieved in 19 cases (76%) and the remaining 6 cases (24%) had subtalar joint incongruency. Post operative subtalar joint incongruence present in 5 cases of type IV fracture and 1 case of type III fracture. In our study post operative functional analysis of the calcaneal fractures were done with Modified Weber's Ankle & Foot functional scoring system. This scoring system analyses the patients both subjectively and objectively. Subjective analysis includes pain, walking, activity and objective analysis includes radiographic evaluation, ankle joint & subtalar joint function.

Pain at the lateral aspect of heel was the main complain of the majority of patients. Nine cases (36%) had no pain at rest or activity. Eleven patients (44%) developed slight pain on lateral aspect of the foot on excess activity and the pain was tolerable and related to peroneal tendon irritation. Only five patients (20%) had pain on normal activity and the pain was related to subtalar joint incongruity. These five patients required mild analgesics to relief pain at rest.

Eighteen patients (72%) could walk and stand for unlimited time despite the presence of pain in nine of them. The remaining six patients (24%) had restriction of walking in strenuous activities and one patient (4%) had slight limping. 76% of patients use normal foot wear and return to their job at average of 5 months. 20% of patients were able to work normally but were restricted in some activities, which necessitated slight modification in their work pattern. One case (4%) had very limited in activity and use protective orthosis. This patient had a type IV joint depression fracture, had a preoperative Bohler's angle of <10o, and had the highest Weber's functional score. Scars had a satisfactory healing in 88% of cases (pain free) and 12% of cases had wound dehiscence which were treated with antibiotics & daily dressing. Swelling of the heel was a common subjective and objective finding which was mostly soft tissue in origin and took a long time (average 6 months) to resolve. Out of the twenty five patients included in this study, twenty patients (80%) had mild swelling and five patients (20%) had moderate swelling. Ankle dorsiflexion, plantar flexion was identical to the opposite foot in 92% of cases and the remaining 8% of cases had ankle movement restriction. Subtalar joint inversion & eversion movements were near normal (average of 95% from normal) compared to the opposite foot in 76 % of cases and the remaining 24% of cases had subtalar joint restriction (average of 70% of normal)

5.DISCUSSION

In our series, calcaneal fractures are more commonly occur in the middle age group (36-45 yrs) (35%). Males (76%) had sustained calcaneal fracture more commonly compared to females (24%). History of accidental fall from height predominate the series by 72% (18 cases). 40% of the cases presented with associated injuries (spinal injury, pelvic fractures, multiple fractures, ipsilateral lower limb injury). In our study Sander's type III fractures (44%) predominates the series, compared to type II (32%) and type IV (24%) and fall from height is the most common mode of injury (%). Joint depression type of intra-articular fracture type is the most common type in our series.

A biomechanical study of Perry has confirmed the important role of the subtalar joint in relieving the ankle from rotational forces during walking. Without this relieving mechanism, the ankle may develop secondary degenerative arthritis. Fractures of the calcaneus with involvement of the subtalar joint are actually split-depressed fractures analogous to displaced fractures of the tibial plateau. Such fractures should be treated like any other intra-articular fractures by anatomical reduction, absolute stable fixation, and early mobilization. Stephenson [26] used a combined medial and lateral approach and found that the small lateral approach made it possible to reduce the posterior facet accurately under direct vision and to obtain secure fixation that allowed early subtalar motion. Also, by using the medial approach, an accurate reduction of the tuberosity fragment relative to the superomedial fragment was possible. Paley and Hall used only the medial approach for all his cases and reported that this approach was not adequate to address the lateral extrusion of bone fragment. This lateral extrusion lead to fibulocalcaneal impingement and irritation of the peroneal tendon sheath which is the most common cause of pain at the lateral aspect of hind foot. In our study, extensile lateral approach was used for all cases and thick flap was raised along with incision to avoid the common wound problems encountered with the extensile approach especially in smokers and patients with diabetes. This approach was familiar, easy, simple, rapid, and adequate for the reduction and fixation of the posterior facet; it also allowed for the insertion of bone graft and reduction of the lateral wall. And also, it was easier to visualize the far medial fracture of the posterior facet and to address the displaced medial wall fracture through this approach. Hammesfahr and Fleming as well as Paley and Hall reported better outcomes in patients who had a tongue type fracture than in those who had a joint depression fracture. They added that moderate comminution of the joint depression fractures worsened the prognosis, and extensively comminuted fractures were associated with the worst prognosis. In our study type II and type III fractures had excellent to good results, type IV fractures had fair to bad results. We also found the more comminuted the fracture, the more unsatisfactory the results. One patient with poor result had type IV fractures, while majority of patients (32%) with excellent results had type II fractures. All the patients irrespective of age and Sander's types were taken up after 10-14 days for surgery to allow the edema to subside and the skin status to improve. Because the post op wound dehiscence is one of the major complications in our study, subsidence of edema is important before taking the patient for surgery. Tourniquet application, restricted surgical time, soft tissue handling, arising thick flap along with

incision, postoperative crepe bandage application & limb elevation minimizes the wound dehiscence. Standard lateral, axial, and internal oblique radiographs are adequate for the assessment of the subtalar joint. Oblique radiographs offfoot were valuable for addressing the extension of fracture into the calcaneo cuboid joint. Preoperative CT scan was useful for analysis of the fracture and planning; this helped to reduce surgical time and soft tissue morbidity. Preoperative CT scan with 3D reconstruction is essential to plan the number & positioning of the screws, need of bone graft depending on the comminution. However, it is of less value in postoperative assessment because of interference by the metallic implants. We found a strong correlation between the restoration of normal anatomy (congruity of the subtalar joint, Bohler's angle, calcaneal height and width, as assessed radiologically) and a satisfactory functional outcome. Stephenson concluded that anatomical reduction of calcaneus is essential to achieve good result. Leung et al. found a significant correlation between the radiological assessment and the clinical findings with regard to the subtalar joint. Paley and Hall stated that Bohler's angle is an indirect reflection of both calcaneal height and the arch angle; a small Bohler's angle is associated with a poor result. This implies that preservation of the calcaneal height and arch angle is important. In McReynolds' series in which the feet were immobilized in a plaster cast postoperatively, the motion of the subtalar joint at follow-up was 25% of normal in 90% of patients. In Stephenson's series in which secure fixation was accomplished from the lateral side and early motion instituted, the average subtalar motion at follow-up was 75% of normal. In our study, ankle joint and subtalar joint mobilisation were started earlier at an average of three weeks. At average of 11 months of follow up 92% of patients had normal ankle movements and 76% of patients had normal subtalar movements. Remaining 24% of cases (Sander's type III & IV) with post operative subtalar incongruity, had restriction of subtalar movements. 95% of people had gone back to the original progression. In our series the anatomical reduction, subtalar congruity, Bohler's & Gissane's angle, calcaneal height & width were well achieved postoperatively using calcaneal tentacle plate. Maintenance of Subtalar congruity and calcaneal height & width are essential to make the patient to walk in uneven surfaces without pain and to get good post operative inversion and eversion of foot [13, 14]. Any post osteosynthesis subtalar joint incongruence would give poor result with early secondary arthritis and painful inversion-eversion movements. In our series, congruence of subtalar joint was achieved in 76% of cases. In most of our cases the Bohler's & Gissane's angles were well maintained compare to other series. Post operative Bohler's angle collapse complication is mainly due to lateral thalamic fragment partial necrosis, which was minimized in our study by taking thick flap during incision.

Post operative collapse at the fracture site can be prevented by using rigid fixation with adequate screws, using bone graft in severely comminuted fractures, delayed weight bearing. Three areas of dense cortical bone will hold fixation well- distal portion of the calcaneus (near the calcaneo cuboid joint), below the angles of Gissane (below the posterior facet, into the sustentaculum tali), the calcaneal tuberosity. The success is mainly because of rigid tentacle plate kept the fragment in good position and avoiding the early load bearing also important in preventing collapse. In this series minimum time taken for partial weight bearing was 2 months & for full weight bearing was 3 months. Depending upon the fracture pattern, comminution, anatomical reduction & fixation the weight bearing was started. Weight bearing was started earlier (8 wks) in those cases with type-II fractures, good anatomical reduction & rigid fixation, without comminution. The bone grafting in selected cases with severe comminution (type III & IV) also main reason for prevention of collapse as in Longino's report [32]. In our study, depending upon the severity of comminution, bone grafting was used for 14 cases (56%). Bone grafting was mainly indicated for type III and type IV fractures. In this series, one patient with type IV fracture had developed chronic osteomyelitis. That patient was managed with implant removal; daily dressing under antibiotic coverage and later on hindfoot arthrodesis was done. Among 25 patients operated, 14 patients (56%) were very much satisfied, 10 (40%) were satisfied & 1(4%) had a poor result. All eight types II (32%) fractures had excellent result, anatomical reduction, normal subtalar congruency and none of them required bone grafting. In type III fractures, six out of 11 cases (24%) had excellent results, one case had subtalar incongruency and seven cases required bone grafting. In type IV fractures, five patients had good result & one patient had poor result, five patients had subtalar incongruency and six patients required bone grafting. In Our study of 25 cases with Sander's

type II, III & type IV calcaneal fracture, osteosynthesized with calcaneal tentacle plate and followed up for an average period of 11 months, 96% of cases had satisfactory results both functionally and radiologically. Further follow up is needed for long term results.

The extended lateral approach accounts for low incidence of complication.

After suitable interval to improve the soft tissue status, this series recommend to take the cases for surgery between 14 to 21 days from the time of injury.

Wound dehiscence is the common complication, which can be minimized by raising cutaneous-subcutaneous flap during incision. Prevention of collapse is mainly by the rigid fixation & perfect anatomical plating and delayed weight bearing. Bone grafting is needed for severely comminuted cases. We systematically obtained anatomical reduction, whatever the Sanders type. This reconstruction and subtalar joint congruence, essential for a good result. Post operative subtalar joint incongruence may lead to early subtalar arthritis, which can be managed with subtalar arthrodesis. Osteosynthesis of type II calcaneal fractures give excellent result compared to other fracture patterns. In case of contra-indication relating to age, associated pathology such as diabetes or arteriopathy, or psychiatric disturbance, we advise plaster cast immobilization for relatively congruent fractures, and closed percutaneous pinning or screwing for more displaced and incongruent fracture. Proper pre-operative planning, rigid fixation with calcaneal tentacle plate and adequate screws through extensile lateral approach, anatomical reduction to achieve subtalar joint congruency, using bone grafts in comminuted fractures, early post op rehabilitation, delayed weight bearing will give good results in case of displaced intra articular calcaneal fracture

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