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ORIGINAL RESEARCH

A Study of Efficacy of Internal Fixation of Calcaneum Fractures

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ABSTRACT

Background: Aim & Objective: The purpose of the present study is to verify the functional outcome of the internal fixation, in calcaneum fractures.

Materials and Methods: Our study included patients reporting to Osmania General Hospital, Hyderabad from June 2017 to October 2019 treated by internal fixation using various modalities and those who were available for follow up. All patients above l8years of age with communitedcalcaneum fractures, Fresh fractures and Patients should be walking prior to the fracture.

Results: Thirty patients with comminuted calcaneal fractures were operated from June 2017 till October 2019 Of the 30 patients 28 were male 2, were female with a mean age of 37 years, 2 patients had bilateral fractures.18 had left sided fractures while 12 had right sided fractures and mode of injury for the 23 patients was fall from a height and RTA for 67patients.20 patients had SANDERS type 3 fracture and 10 patients had SANDERS type 2 fractures. Days of hospital stay varied from 14 to 22 days {mean 16.04 days}. Post operatively 14 patients had swelling and 6 patients had persistent pain,2 had superficial infection and one had deep infection. The infections have healed with antibiotics and regular dressing. Of the 30 patients, 9 had excellent results, 15 had good results, 4 had fair results, 2 had poor results. Hence we concluded from the above findings the internal fixation helps in improving the functional outcome of the patients in view of their physical and radiological findings.

Conclusion: The technique of plate fixation with a lateral approach is good with regards to fracture union and functional outcome. It also shows that anotomical reduction in terms of the correction in BOHLER'S and GISSANE'S angle plays an important role in determining the good functional outcome.

Keywords: BOHLER'S, GISSANE'S angle, Calcaneal fractures, functional outcome, Internal Fixation, radiological findings

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INTRODUCTION

Calcaneum fractures account for approximately 2% of all fractures. These fractures can be classified broadly into intra-articular and extra-articular types, with the intra-articular variant being more common, representing 70-75% of all fractures of the OS calcis, frequently resulting from axial loading with carrying degrees of shear force. The treatment of calcaneum fractures continues to pose a challenge for the trauma surgeons despite advancement in surgical technique and implant devices. The primary source of disagreement has been the issue whether better results are achieved with operative or non-operative treatment. Operative treatment methods include, open reduction and internal fixation, percutaneous fixation and primary arthrodesis.[1,2]

So it is the need of the hour, to identify treatment techniques, which use lesser hardware, and provide better functional outcomes in terms of shorter duration of treatment, better stability and early weight bearing.[3,4]

Since early 1990s, enthusiasm for surgical procedures, for carefully selected fractures, in appropriate surgical candidates has increased. Because of its unique shape, difficulties arose in understanding the geometry of the calcaneal fractures. Because of its location, surgical treatment was fraught with complications till recently. Improvement in imaging technology has allowed a better understanding of fracture pathology and provided the basis for newer classifications, which has revolutionized the treatment of calcaneum fractures.[5]

There remains, however, no consensus regarding the surgical approach, with many having been described, including medial, lateral, combined medial and lateral, extended lateral and sinus tarsi approached. Further, the method of fixation remains a point of debate, with various proponents advocating fixation with pins, screws or plate fixation with screws. While the literature suggests significant benefit from operative management of these fractures, complications have been shown to be a common problem in many studies. There are many methods of stabilization of calcaneum fractures, each having their own merits and demerits. The contoured plate fixation has improved the functional results, limited indication for bone grafting and shortened duration of treatment.[6,7]

The purpose of the present study is to verify the functional outcome of the internal fixation, in calcaneum fractures.

Aims and Objectives of the Study

Aim of our study

- A study of efficacy of internal fixation of calcalneum fractures

Objectives:

- To evaluate the functional outcome with operative management.
- To evaluate the effect of time of surgery on functional outcome.
- To know the average union time.
- To assess the complications associated with open reduction and internal fixation

MATERIALS & METHODS

Source of Data

Our study included patients reporting to Osmania General Hospital, Hyderabad from June 2017 to October 2019 treated by internal fixation using various modalities and those who were available for follow up.

Method of Collection of Data

Adult patients with displaced calcaneal fractures, operated at OGH, using locking and Recon plating,cancellous screws and k-wires during the above mentioned period were evaluated during their hospital stay.

Inclusion Criteria

- All patients above l8years of age with communitedcalcaneum fractures
- Fresh fractures
- Patients should be walking prior to the fracture

Exclusion Criteria

- Open fractures

- Pathological fractures
- Calcaneal fractures with other associated fracture in lower limb
- Fractures in children
- Fractures in adults >55years
- Grossly comminuted fractures
- Severely osteoporotic bone

A thorough history and clinical examination was done. The swelling of the heel and status of the skin was recorded. X-rays of the calcaneum were taken on admission which included lateral and axial views. CT scans were taken to further evaluate the fracture pathology. The patient was temporarily put on a below knee slab with adequate limb elevation until the swelling subsided and there were wrinkles seen on the lateral aspect of the heel.
The fractures were classified based on the Essex-Lopresti and Sander's classification. All the fractures in our study were joint depression type with 17 patients having Sander's type II and 8 having Sander's type III fracture.
The patient was then posted for internal fixation with various implants. The lateral extensile approach was used for all the patients.

Follow UP and Criteria for Evaluation
The patients were followed up clinically and radiologically at 6weeks, l2weeks, 6 months, and 1 year, with respect to height of calcaneum, width of the clacaneum, range of movements at subtalar joint, tubero-talar angles. At every follow up clinical examination was done to assess status of the surgical wound, pain, tenderness, range of motion of subtalar joint, stability of the fracture and clinical union. Roentgenograms were taken in Lateral and axial views to look for signs of radiological union.
In our study we concluded clinical union when the fracture site had become stable and pain free. The union is confirmed radiologically when plain X-ray showed bone trabaculae or cortical bone crossing fracture site on at least three surfaces on orthogonal radiograms. The time taken for clinical and radiological union was noted. If there are no clinical and radiological signs of union by 16 weeks, the fracture was categorised as delayed union and in the absence of fracture union after 24 weeks after injury was categorized as non-union. We had 1 case of delayed union following fixation.
The functional outcome was measured by the "American Orthopaedic Foot and Ankle Society (AOFAS) Ankle Hindfoot scoring system" at twelve months. The AOF AS scoring system is a very useful tool to measure function of the foot developed by the American Academy of Orthopaedic Surgeons (AAOS) and has been validated by various studies. 58 The AOFAS score is a 100-point scoring system mainly assessing the pain, function and alignment of the foot. The functional outcome decreases as the score decreases.
The result was then graded as Excellent, Good, Fair and Poor as follows Excellent - 89 to 100 Points.
Good - 79 to 89 points.
Fair - 69 to 79 points. Poor - Less than 60 points.

RESULTS
There were 30 adult patients who presented with calcaneal fractures to our hospital during the course of the study. Of the 30 patients, 28 were male and 2 were females between the age group of 19-56 years (mean age 37 years).

Table 1: Age distribution

S. No	Age Group	No. of patients
1	18-24	02
2	25-34	12
3	35-44	10
4	45-54	06

Two patients had bilateral fractures. Of the 25 patients, 18 (60%) had left sided fractures, while 12 (40%) had right sided fracture.

Table 2: Limb involved

S. No	Side Involved	No. of patients
1	Right	12
2	Left	18

The mode of injury for 23 patients was fall from height and for 7 patients was RTA. Of the 30, 18 (66.66%) had Sander's type III fracture and 10 (33.33%) had a Sander's type II fracture.

Table 3: Sanders classification

S. No	Type	No. of patients
1	Sander's II	10 (66.66%)
2	Sander's III	20 (33.33%)

Of the 30, all patients had gross swelling of the foot following the injury. Of the 30,all patients had gross swelling of the foot following the injury. The number of days from the fall to surgery varied from 2-14 days (means 6.3 days). Days of hospital stay varied from 14-22 days (means 16.04 days).

Table 4: No. of days between the fall and operative procedure

S. No	Days between fall andsurgery	No. of patients
1	0-5	6
2	6-10	14
3	11-15	10

ALL 30 patients were treated with a lateral extensile approach and fixed with locking and nonlocking plates and cancellous screws. Post operatively 6 (32%) patients had persisting pain, 2 had superficial infection. Both the patients with superficial infections were treated with injectable antibiotics for a week, and oral antibiotics for another week. Suture removal was delayed till the wound infection subsided and patients were discharged. Further followup showed no signs of any infection.The one patient with deep infection was treated repeatedly with a course of injectables and oral antibiotics.

Table 5: Post operative complications

S. No	Post operative complications	No. of patients
1	Persistent pain	6
2	Swelling	14
3	Superficial infection	02
4	Deep infection	01

Mean number of days of hospital stay was 16.

All the operated patients has an increase in the Bohler's angle and decrease in the gissane's angle with statistically significant p value. The mean pre op Bohler's angle was 11.52 and gissane's angle was 126.8. The mean Post op Bohler's angle was 26.16 and Gissane's angle was 119.76. the p value for the increase in Bohler's angle was 3.13 x 10. the p value for the decrease in in Gissane's angle was 1.10 x 10.

Post operatively all patients had an increase in heel height and decrease in heel width with a statistically significant p value. The mean pre op heel height was 5.932 and heel width was 6.832. The mean Post op heel height was 6.38 and heel width was 6.272. The p value for increase in heel height value was 7.5 x 10-18. The p value for decrease in heel width was 1.2 x 10-11.

At 12 weeks of follow up, x rays of 27 patients showed radiological signs of union. Mean duration of radiological union was 12.5 weeks with SO of 1.79. Three patients had delayed union radiologically.

Table 6: Results as per AOFAS scoring

Results	Excellent	Good	Fair	Poor
	9	15	4	2

Of the 30, 9 had excellent results, 15 had good results, 4 had fair results and 2 had poor results.

The mean ROM of subtalar and ankle joints of patients with excellent results are as follows. Inversion and eversion are 23.66 and 18.90degrees respectively, and the mean dorsiflexion and plantarflexion of ankle are 30 and 25 degrees respectively.

The mean ROM of subtalar and ankle joints of patients with good results are as follows. Inversion and eversion are 20.28 and 15.34 degrees respectively, and the mean dorsiflexion and plantarflexion of ankle joints are 25 and 20 degrees respectively.

The mean ROM of subtalar and ankle joints of patients with fair results are as follows. Inversion and eversion are 16.42 and 12.85 degrees respectively, and the mean dorsiflexion and plantarflexion of ankle are 20 and 15 degrees respectively. The mean ROM of subtalar and ankle joints of patients with poor results are as follows. Inversion and eversion are 10 and 7.5degrees respectively, and the mean dorsiflexion and plantarflexion of ankle are 15 degrees each.

DISCUSSION

The calcaneum is the most commonly fractured tarsal bone. The prognosis for an extra-articular fracture is uniformly good, but that for an intra-articular fracture is very varied. The management of every aspect of intra-articular calcaneal fractures is controversial. There are many systems for classifying displaced intra-articular fractures, but there is no consensus amongst surgeons as to which is the most practical one. Although some studies with more than 100 cases have demonstrated good results after open reduction and internal fixation of intra-articular calcaneal fractures,[10,11] the best choice of treatment remains controversial because prospective randomized studies have not shown convincingly better results after surgery.[1] However, in the largest prospective randomized trial described to date, Buckley et al. found better results in some subgroups of patients after surgery.

It is difficult to compare outcome between studies since different measures of outcome are often used and there is no consensus among surgeons as to which is the most scientific and practical system. Essex-Lopressti, Rowe and Sanders are the commonly used classification systems for calcaneal fractures. There are varying degrees of agreement among users of these

classification systems. Although, classifications show positive correlation with outcome, there is no correlation with choice of treatment.[2,3] In our study we have used the Essex-Lopressti and Sander's classification systems.

Historic cohort studies have suggested equal clinical outcomes with operative and conservative treatment of displaced intra-articular calcaneal fractures.[4-6]

While some of the more recent studies have also shown no advantage of operative treatment, many other studies, have shown superior results with operative treatment.[1,7] Earlier, surgical treatment was associated with significant incidence of wound complications, particularly sepsis. However, conservative treatment is not without its complications of subtalar joint pain, heel varus and peroneal tendon impingment.[1]

We believe that displaced intra-articular fractures of the calcaneum should be treated on the same principles as any other injury of the weight bearing joint; that is by anatomical reduction and rigid internal fixation, to allow early movement and get a better functional outcome.[8-10] Application of these principles to intra- articular calcaneal fracture have been slow because of complex bony and fracture anatomy, tenous soft tissue envelope and difficulty of achieving anatomic reduction and rigid fixation.[9] Improvements that have occurred in surgical techniques and complication rates have made many surgeons more operative in the treatment of these fracture.

Calcaneal fracture surgery can be performed using medial, lateral or combined approached 8. The lateral approach is the most popular approach. A lateral extensile exposure popularized by Benirschke and Sangeorzan was used in all our cases. Various fixation devices like locking plates, pelvic reconstruction plates, calcaneal plates, K-wires or a combination of K-wires and screws can be used for fixing these frature.[9-11] In our study, anatomical locking and non-locking calcaneal plates were used. We also used a 3.5 mm reconstruction plate contoured to the lateral wall of the calcaneum and screws to fix these fractures. The “blow out” of the lateral wall, when present, could be well reduced and held in place with this plate. The plate was fixed extending from anterior process into the most posterior aspect of the tubersity.

In our analysis, we confirmed correlation between the Bohler’s angle size and patient satisfaction in terms of their functional outcome. This fact, proved and verified by a lot of other authors, confirms the role of Bohler’s angle and Gissane’a angle size as a predictive factor for subsequent late complication.[12-14]

Outcome measurements can be expressed by various scoring systems or its modifications based on the authors experience of important symptoms and functional abilities. AOFAS clinical rating system the Ankle Hindfoot scale for calcaneal area is a standard scoring system for foot function evaluation58. Using this standard scoring system that takes into account subjective and objective assessments enables to achieve relevant results and comparision of different patients studies. Finally one has to mention optimistic findings of Melcher who followed up patients operated by ORIF for 3 and 10 years after the surgery. In his study, subjective and objective results assessed after ten years were better than those achieved in 3 years follow up.[15]

In sanders study, execellent or good results were obtained in 73% of type-II,70 % of type -III, and only 27% of type IV fractures.[14] In our study, 80% of patients had excellent or good and 20 % had fair or poor results, despite anatomical calcaneal restoration. Complications occur regardless of the management strategy chosen for displaced intraarticular fractures and despite managed by experienced surgeons. complications are a cause of significant morbidity for patients.[16] The rate of wound complications (superficial and deep infection) in this study was 16 %, similar to that in many studies in the literature.[17] In our study, one patient had developed deep infection.

A prospective, randomised, CT -based study comparing operative versus non- operative treatment for type II and III fractures, revealed that the former type of treatment followed by early mobilisation produced superior results 25, as was seen in our study. In a meta-analysis published in 2000, Randle et al. stated that " there is a trend for surgically treated patients to have better outcomes; however the strength of evidence for recommending operative treatment is weak". They concluded that before a strong recommendation could be made for operative treatment, a randomisedtrail with controls and validated outcomes was needed.
There were certain limitations to our study. Only 30 patients with calcaneal fractures were operated and their functional outcomes scores were measured at a mean follow up of 12 months.A study involving more patients followed up for a longer period of time can more accurately define the functional outcome of calcaneal fractures treated by this method.Therefore, this discussion is essentially a preliminary assessment.

CONCLUSION

Fractures of the calcaneum are one of the common fractures affecting present generation and treatment modality has to be decided carefully. We are of the opinion that the operative treatment of calcaneum fractures should be done as anotomical reduction and rigid internal fixation is essential to allow early movement and weight bearing. The technique of plate fixation with a lateral approach is good with regards to fracture union and functional outcome. It also shows that anotomical reduction in terms of the correction in BOHLER'S and GISSANE'S angle plays an important role in determining the good functional outcome.

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