ORIGINAL ARTICLE

A STUDY ON OUTCOME EVALUATION OF MANAGEMENT OF CALCANEAL FRACTURE FIXATION

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ABSTRACT:

Back ground: Fractures of the calcaneum are one of the common fractures affecting present generation and treatment modality has to be decided carefully. The contoured plate fixation has improved the functional results, limited indication for bone grafting and shortened duration of treatment. Aim: Study was done to evaluate the results of operative management for intra-articular calcaneum fractures on basis of subjective, clinical and radiological criteria in our hospital setup. Materials and methods: This is combined retrospective and prospective study of 26 intra-articular. Patients who have already undergone treatment for this fracture and also the patients newly diagnosed as intra-articular calcaneum fracture were taken in study with followupperiodof1year. Results: Mean age of 38 years, 2 patients had bilateral fractures.14 had left sided fractures while 08 had right sided fractures and mode of injury for the 19 patients was fall from a height and RTA for 5 patients.15 patients had SANDERS type 3 fracture and 11 patients had SANDERS type 2 fractures. Post operatively 6 patients had swelling and 9 patients had persistent pain, 2 had superficial infection and one had deep infection. Of the 24 patients (26 fractures), 5 had excellent results, 15 had good results, 4 had fair results, 2 had poor results .Conclusion: So operative treatment of comminuted 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.

Key words: Calcaneum, Intra-articular, Plate fixation.

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NTRODUCTION

The calcaneus (oscalcis) is the largest and most often fractured tarsal bone. It is the major weight bearing osseous structure of the foot and is one of the components of the tri-tarsal articulation and has important functional tasks with regard to normal ambulation. With a bone so vital to the normal mechanics of locomotion, it is easy to see why a fracture of calcaneus is attended by considerable morbidity. Despite the physicians extensive experience with this injury, its major socio-economic impact in regard to the time lost from work and recreation, and the attention given to it for many years throughout the world, still there is no method of treatment that yields consistently good results. Calcaneum fractures account for approximately 2% of all fractures. These fractures can be classified broadly into intra-articular and extraarticular types, with the intra-articular variant being more common, representing 70-75% of all fractures of the oscalcis, frequently resulting from axial loading with varrying 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.

So it is the need of the hour, to identify treatment techniques, which use lesser hardware, and to provide better functional outcomes in terms of shorter duration of treatment, better stability and early weight bearing and the role non-operative treatment in the calcaneal fracture management.

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. Over the last 25 years, however, marked advances in anesthesia, prophylactic antibiotics, computed tomography (CT) scanning, and fluoroscopy have allowed surgeons improve outcomes when operating on fractures and these techniques have been applied to calcaneal fractures as well.¹ 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.

There remains, however, no consensus regarding the surgical approach, with many having been fragments, comminution and to classify described, including medial, lateral, combined fracture according to Sanders classification. medial and lateral, extended lateral and sinus tarsi Bohler's angle and gissane's angles were measure. 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. This study was done to evaluate the results of operative management for intra-articular calcaneum fractures on basis of subjective, clinical and radiological criteria in our hospital setup.

MATERIALS AND METHODS

This is combined retrospective and prospective study from October 2009 to October 2014) of 26 intra-articular fractures treated in department of orthopedics. It includes the patients who have already undergone treatment for this fracture and also the patients newly diagnosed as intra-articular calcaneum fracture.Followup period ranged from 6 months to 2years with an average followup period of 1 year.

Inclusion criteria: 20-80 yrs of aged males and females who had fall from height and malunited calcaneal fractures and RTA.

Exclusion criteria: more than 4 weeks, with anaesthetically compound fractures, unfit patients, associated with other serious injuries or comorbid medical conditions, fracture associated with severe crushing and gross contamination of wound, Any history of massaging and distal neuro vascular deficits.

When the patients were seen for the first time after injury, a thorough history was taken regarding the time of injury, mechanism of injury, any significant past or personal history (especially diabetes and smoking). Patients were examined giving special importance to whether the fracture was open or closed, presence of gross swelling, fracture blisters, features of compartment syndrome and presence of other associated injuries.

Routine investigations were done as were necessary. The diagnosis was confirmed by antero-posterior (dorso plantar), lateral and axial radiographs. CT scan was done to assess the pattern, displacement fracture of fracture the The fractures were classified based on the Essex-Lopresti and Sander's classification. All the fractures are joint depression type and 11 patients having type II and 15 patients having type III

fractures. The patient was posted for internal fixation with 3.5 mm contoured recon plates, cancellous screws and K-wires whatever is appropriate. The lateral exentile approach was used for all patients.

The patients were followed up clinically and radiologically at 6weeks, 12weeks, 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. The functional outcome was measured by the "American Orthopaedic Foot and Ankle Society (AOFAS) Ankle Hind foot 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. 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

All of the cases were treated as in-patients. The form of treatment, conservative or operative was decided depending on type of fracture, patients age, condition of soft tissues, associated injuries, co-morbidities, patients occupation, affordability as well as surgeon's decision.

The main indication for operative management was displaced intra-articular fractures within congruous subtalar joint and reduced Bohler's angle. The method of reduction and fixation were decided according to the fracture pattern, the surgeons experience, associated injuries and affordability of the patient. Open reduction and fixation was done once the skin condition was good but within 3 weeks of injury. The basic idea was to achieve near anatomical reduction and a congruous subtalar joint.

RESULTS

A

There were 24 adult patients with 26 calcaneal fractures to our hospital during the course of the study. Of the 24 patients, 22 were male and 2 were females between the age group of 21-58years (mean age 38 years).

Two patients had bilateral fractures. Of the remaining 22 patients 14 (58%) had left sided fractures, 8 (34%) had right sided fractures. The mode of injury for 19 patients was fall from height and for 5 patients had RTA. Of the 24 patients(26 fractures), 11(42.30%) had type II Sander's fracture and 15(57.69%) had Sander's type III fractures.

Of the 24 patients all had gross swelling, loss of height and width of the heel. Three patients had accompanied blister's present. In those two patients were kept on Below Knee slab with limb elevation for one week. One patient was operated immediately two days after the admission.

All the patients were waited till the appearance of wrinkles at the ankle, for appropriate wound closure and to avoid the complication of wound dehiscence. The number of days from the fall to surgery varied from 2 - 15 days (mean 8.6 days). Days of post-surgery hospital stay varied from 7 – 30 days (mean 16.61 days).

Of all 26 fractures, 25 were treated with a lateral extensile approach and fixed with Recon plates and cancellous screws and one was treated with percutaneous K-wire fixation.

Table-1: Demographic distribution.

Age Group	No. of Patients	Percentage (%)
20-29	7	29.16
30-39	8	33.3
40-49	5	20.83
50-59	4	16.66
Gender		
Male	18	66
Female	6	34
Side Involved		
Right	8	33.33
Left	14	58.33
Bilateral	2	8.33
Туре		
Sanders"s	11	42.3
type II		
Sander s type III	15	57.7

Table 2: Number of days between the fall and operative procedure

Days	between	fall	and	No.	of	percentage
surgery				fractures		
0-5days	;			03		12.5
6-10 da	ys			14		58
11-15 d	ays			09		37.5

Graph 1: Post operative complications



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 11.76 and gissane's angle was 126.9. The mean Post op Bohler's angle was 26.30 and Gissane's angle was 119.76. The p value for the increase in Bohler's angle was 0.998. The p value for the decrease in in Gissane's angle was 0.99.

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 $1.2 \times 10-11$.

At 12 weeks of follow up, x rays of 18 fractures out of 26 fractures showed radiological signs of Reddy JAV et al. Management of Calcaneal Fracture Fixation.

union. Mean duration of radiological union was 13.38 weeks with SO of 1.79. Five patients had delayed union radiologically.

The mean ROM of subtalar and ankle joints of patients with good results are as follows. Inversion and eversion are 20.33 and 17 degrees respectively, and the mean dorsiflexion and plantar flexion of ankle joints are 26.66 and 22.66 degrees respectively.

The mean ROM of subtalar and ankle joints of patients with fair results are as follows. Inversion and eversion are 17.5 and 13.75 degrees respectively, and the mean dorsiflexion and plantarflexion of ankle are 25 and 18.75 degrees respectively. The mean ROM of subtalar and ankle joints of patients with poor results are as follows. Inversion and eversion are 15 and 15 degrees respectively, and the mean dorsiflexion and plantarflexion of ankle are 22.5 and 20 degrees respectively.

Figure-1: Presentation of case before and after surgery



- a) Pre operative x-ray
- b) Immediatepost operative
- c) post operative after 2yrs



- d) Dorsiflexion after 2 yrs
- e) Plantar flexion after 2 yrs

Figure-2: Presentation of case before and after surgery



- a) Pre operative x-ray
- b) Immediatepost operative

c) post operative after 6 months



d) Dorsiflexion after 2 yrs

e)Plantar flexion after 2 yrs

DISCUSSION

The calcaneum is the most commonly fractured tarsal bone. The prognosis for an extra-articular fracture is uniformly good, but that for an intraarticular 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^{2,3,4} the best choice of treatment remains controversial because prospective randomized studies have not shown convincingly better results surgery^{36,44}. However, in the largest after prospective randomized trial described to date, Buckley et al. found better results in some subgroups of patients after surgery⁵.

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 A calcaneal fractures. There is varying degrees of complication^{32,33} agreement among users of these classification. Outcome measurements can be expressed by systems. Although, classifications show positive correlation with outcome, there is no correlation with choice of treatment 6,7,8 . In our study we have Essex-Lopressti used the and Sander's classification systems.

Historic cohort studies^{9,10,11} have suggested equal clinical outcomes with operative and conservative treatment of displaced intra-articular calcaneal fractures. While some of the more recent studies^{12,13,14} have also shown no advantage of operative treatment, many other studies,15,16,17,18,19 have shown superior results with operative surgical treatment treatment. Earlier, was associated with significant incidence of wound complications, particularly sepsis²⁰. However, conservative treatment is not without its complications of subtalar joint pain, heel varus and peroneal tendon impingment²¹.

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 outcome²². 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

fixation²³. 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.²⁴⁻²⁸ The lateral approach is the most popular approach. A lateral extensile exposure popularized by Benirschke and Sangeorzan was used in all our Various fixation devices like pelvic cases. reconstruction plates²³, calcaneal plates²², K-wires²⁹or a combination³⁰ of K-wires and screws³¹ can be used for fixing these frature. We 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 contoured plate was fixed extending from anterior process into the most posterior aspect of the tuberosity.

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

various scoring systems^{10,34} 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 evaluation³⁵. 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 a 3 years follow up.³⁶

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.³⁷ In our study, 77% of patients had excellent or good and 23 % 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 ³⁸. The rate of wound complications (superficial and deep infection) in this study was 19 %, similar to that in many studies in the literature ^{11,39,40}. In our study, one patient had 5. 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, as was seen in our study. In a meta-analysis published in 2000, Randle et al.¹⁶ stated that " there is a trend for surgically treated patients to have better outcomes; however the strength evidence of for recommending operative treatment is weak". They concluded that before a strong recommendation could be made for operative treatment, a randomized trail with controls and validated outcomes was needed⁴¹.

There were certain limitations to our study.Only 24 patients with 26 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, So operative treatment of comminuted 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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