



“FUNCTIONAL OUTCOME OF CALCANEAL FRACTURES TREATED THROUGH OPEN REDUCTION AND INTERNAL FIXATION”

Orthopaedics

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KEYWORDS

INTRODUCTION

Calcaneum is the most common fractured which leads to significant morbidity in patients. At present most widely accepted management for displaced intra-articular 1,2 3 fracture is open reduction and internal tarsal bone. It accounts for about 2% of 2 all fractures and 65% of tarsal injuries.

Most (60-75%) of them are intra-3,4 articular . Several of them are bilateral and are often accompanied by spinal and acetabular fractures. These fractures are uniformly caused by an axial load mechanism such as a fall from 5 height or a motor vehicle accident.. th Between the end of 19 century and early th of calcaneal fractures after closed reduction include heel pain and sub-talar arthritis fixation through lateral extensile approach. Outcome in patients with calcaneal fractures have been shown to be, not as good as outcome in patients with other orthopaedic conditions and were significantly worse in patients with major health issues including organ transplant and myocardial infarction .This injury results in financial burden apart for the significant morbidity for the patient.

Hence a study has been carried out aiming functional outcome of calcaneal fractures treated through open reduction, internal 20 century there were remarkable development in the management of calcaneal fractures and significant decrease in complication rates connected with the existing intervention of these potentially disturbing injuries. Management remains controversial mainly due to low level of evidence. However common complications fixation and to determine whether open reduction and internal fixation is beneficial for maintaining and restoration of bohlers angle .

MATERIALS AND METHODS

The present study —functional outcome of calcaneal fractures treated through open reduction internal fixation□ is a prospective observational study All the skeletally matured patients who attended and got admitted in Department of Orthopaedics with fracture calcaneum were selected as per inclusion criteria. 22 cases of either sex were taken up for the study.The period of the study was from May 2018 to May 2020. The period of follow up was from 3 months to 1 year.

INCLUSION CRITERIA:

- 1 Patients of either gender and aged>18years
- 2 Patients with calcaneal fracture classified as sanders type II and III
- 3 Patients who are fit for surgery 4.Duration from injury less than 3 weeks

EXCLUSION CRITERIA:

1. Open fractures
2. Age <18 years
3. Patients with calcaneal fractures classified as sanders type I and IV
4. Those who had undergone prior foot surgery and patients with ankle arthritis.
5. Duration from injury more than 3 weeks 6.Loss of followup

The present study included 22 cases of Sanders type II and Sanders type III calcaneum and were treated by lateral extensile approach of open reduction internal fixation with calcaneal locking compression plate. The basic aim of the surgery was to achieve as near anatomical

realignment and perfect subtalar joint congruity as possible. Results were analysed with the help of AOFAS(ANKLE AND HINDFOOT SCALE)6 at 24 week follow- up.

I Pain (40 points)	
None	40
Mild, occasional	30
Moderate, daily	20
Severe, almost always present	0

II Function (50 points)	
Absent limitation, no support, no assist.	10
No limitation of daily activities, limitation of recreational activities, no support	7
Limited daily and recreational activities, cane	4
Severe limitation of daily and recreational activities, walker, crutches, wheelchair, brace	0

Maximum walking distance, miles	
Unrestricted	5
4-6	4
1-3	2
Less than 1	0

Walking surfaces	
No difficulty on any surface	5
Some difficulty on uneven terrain, stairs, inclines, boulders	3
Severe difficulty on uneven terrain, stairs, inclines, boulders	0

Gait abnormality	
None, slight	5
Obvious	4
Marked	0

Sagittal motion (Flexion plus extension)	
Normal or mild restriction (70° or more)	5
Moderate restriction (45°-70°)	4
Severe restriction (less than 45°)	0

Hindfoot motion (Inversion plus eversion)	
Normal or mild restriction (75%-100% normal)	6
Moderate restriction (25%-74% normal)	3
Marked restriction (less than 25% normal)	0

Ankle-hindfoot stability (anteroposterior, varus-valgus)	
Stable	8
Definitely unstable	0

III Alignment (10 points)	
Good, plantigrade foot, midfoot well aligned	15
Fair, plantigrade foot, some degree of midfoot malalignment observed, no symptoms	8
Poor, nonplantigrade foot, severe malalignment, symptoms	0

Total=100

American Orthopaedic Foot and Ankle Society

From: <http://www.aofas.org/14a/pages/index.cfm?pageid=3494>

Preoperative evaluation

All fracture calcaneum patients fulfilling our inclusion criteria were taken for study.On admission,detailed history was taken ,thorough clinical examination was done to rule out vascular or neurological deficits, open or closed injury, associated spine or extremity injuries.

These patients were preoperatively treated by limb elevation, ice application and below knee slab(split at ankle for ice application). Most of the patients were operated within 10-12 days of injury after appearance of wrinkle sign.

Investigations 1).X-RAY

A. Foot -AP views

Harris Axial View^{7,8}

Broden's view⁹

B. Foot lateral view

The lateral view of the foot allows for evaluation of the Bohler's (tuberosity-joint angle) and the crucial angle of Gissane.

A) The tuberosity joint angle (Bohler's angle):

This angle is formed by the intersection of two lines (Figure 3)

1. A line from the highest point on the posterior articular surface to the most superior point of the calcaneal tuberosity.
2. A line from the highest point on the anterior process of the calcaneus to the highest part of the posterior articular surface.

Bohler¹⁰ considered the normal angle to be between 20 and 35 degrees, while Palmer¹¹ reported that the angle can vary from 10 to 40 degrees.



Figure 3

Image showing normal Bohler's angle (tuberosity-joint angle)

B) Crucial angle of Gissane:

A thick and strong cortical strut exists within the calcaneus and extends from front of the bone to the posterior margin of the posterior subtalar facet (Figure 4). This strut is angled, and the angle supports the lateral process of 12 the talus. This angle was named crucial angle by Gissane^{12,13}

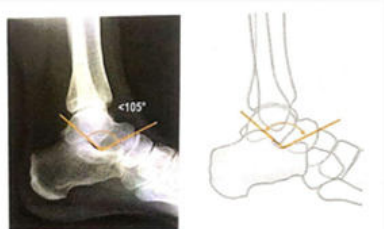


Figure 4 Image showing normal Gissane angle

2) CT scan of both normal and injured calcaneum Computerized Tomographic Scan:

All patients who are possible candidates for surgical intervention must undergo CT scan study before surgery. It allows the identification of fragments best. 14,15 Sanders classification is based on coronal and axial CT scan sections.

SURGICAL TECHNIQUE FOR OPEN REDUCTION AND INTERNAL FIXATION

The extended lateral approach to the most common approach used for displaced intraarticular calcaneal fractures. All the calcaneal fractures in our study were treated with this approach, as it is the safest and 3 most utilitarian if used with care.

In this approach an L shaped incision (figure 8) was carried directly down to the periosteum of the lateral wall. The posterior arm of the incision was placed midway between the fibula and Achilles tendon. The horizontal arm was placed in line with the base of the fifth metatarsal. The sural nerve may cross the incision at its proximal and its distal end so soft tissue dissection was done in these areas to avoid cutting the nerve. The vascular supply to the planned flap is a watershed area. The corner of the soft-tissue flap at the juncture of the longitudinal and vertical posterior incisions must be treated with infinite care.⁵



Figure 8 :Image showing incision marking before open reduction internal fixation

At the corner, the incision was made directly to bone to ensure that one raises a full-thickness flap. The entire flap was elevated in one piece and held out of the way with k wires placed longitudinally into the fibula, one from lateral to medial, in the talus and one into the cuboid (figure 9). Entire lateral wall of calcaneus was exposed up to calcaneocuboid joint distally. Once the lateral extended approach is completed and the hematoma was removed, the fracture lines were visualized and identified. Fragments were reduced and then a lateral plate was applied



Figure 9:Image showing full thickness flap retracted with the help of three k-wires



Figure 10 : Image showing calcaneal plate fixation over lateral wall after reduction of fragments

Thorough wash was taken and flap was closed over a deep drain. Subcutaneous layer closure done with the help of vicryl 2.0 with minimal sutures. Skin was closed with ethilone using interrupted Allgower-Donati technique (figure 12). Sterile dressing followed by well padded short below knee slab was applied.



Figure 12: Image showing L-flap after closure

Follow up: All patients were followed up clinically and radiologically in the orthopaedic opd at an interval of 6 weeks, 12 weeks, 24 weeks. At the end of 24 weeks functional result was assessed as per 6 AOFAS score and results were categorised into excellent, good, fair and poor as per the score.

OBSERVATION AND RESULTS

In the present study 25 fractured calcaneum in 24 patients were treated with open reduction internal fixation with locking calcaneal plates using lateral extensile approach. 3 patient lost to followup and were excluded from study. Thus 22 fractured calcaneum in 21 patients which were completely followed for 6 months were included in the study. The study was done from may 2018 to may 2020.

1. Distribution of patient on the basis of age

AGE GROUP	NO: OF Pts	PERCENTAGE
18-30	16	66.6%
31-50	6	25%
51-65	2	8.4%

2. Sex incidence

SEX	NO: OF Pts	PERCENTAGE
MALE	17	70.84
FEMALE	7	29.16

3. Mechanism of injury

MECH OF INJURY	NO OF Pts	PERCENTAGE
RTA	17	70.86%
FALL FROM HEIGHT	7	29.14%

4. Unilateral/bilateral involvement

unilateral/ bilateral	Number of patients	Percentage (%)
Unilateral	22	81.67%
Bilateral	2	8.33%

5. Sander's type distribution

SANDER'S TYPE	NO OF Pts	PERCENTAGE
TYPE 2	16	64%
TYPE 3	9	36%

6. Complications after ORIF

COMPLIC ATIONS	NO OF Pts	PERCENT AGE	INCIDEN CE
SUPERFI CAL INFECTION	3	50%	13.6
DEEP INFECTION	1	16.6%	4.5
INADEQU ATE REDUCTI ON	1	16.6%	4.5
SURAL NERVE HYPOAST HESIA	1	16.6%	4.5

7. Distribution of patients according to bohlers angle achieved intra-operatively

BOHLER'S ANGLE	NO OF Pts	PERCENTAGE
20-35	18	72%
<20	3	12%
>35	4	16%

8. Results after ORIF(based on AOFAS score)

Results by AOFAS	ORIF done	Percentage
Excellent (score>90)	2	9.1%
Good (score 75-90)	15	68.18%
Fair (score 50-74)	4	18.18%
Poor (score <50)	1	4.54%

9. Result analysis in particular Sander's type

Sanders type	Fractured calcaneum with excellent / good outcomes	Percentage of good/excellent outcome in sander's type 2 or 3(%)
Type 2	14 out of 15	93%
Type 3	3 out of 7	42.8%

NOTE:-

Fischer exact test : p value = 0.0207 < 0.05 NS , so We have found that there is a significant association between the sanders type and the outcome.

10. Result analysis in particular age groups

Age group	Excellent / good outcomes	% of good/ excellent outcome in age group(%)
18-30 yrs	12 out of 15	80%
31-50 yrs	4 out of 5	80%
51-65 yrs	1 out of 2	50%

NOTE:-

One way ANOVA test : p value = 0.906 >

0.05 NS , so We have found that there is no significant association between the age and the outcome.

11. Result analysis with respect to preoperative timing

Preoperative time in days	No. Of patients with excellent or good outcome	Percentage of good/excellent outcome in surgery performed whitin particular time frame(%)
Unto 7 days	15 out of 18	83.33%%
More than 7 days	2 out of 4	50%

NOTE

Fischer exact test : p value = 0.206 > 0.05 NS , so we cannot find any significant statistical association between the pre-op period and the outcome.

12. Association of outcome with Bohler's angle

Intraoperative Bohler's angle	No. Of patients with excellent or good outcome	Percentage of good/excellent outcome (%)
20-35 degree	16 out of 18 patients	88.89%
<20 or >35 degree	1 out of 4 patients	25%

NOTE

Fischer exact test : p value = 0.0239 < 0.05 NS

We have found that there is a significant association between the intra-operative bohlers angle and the outcome, indicating that maintaining bohlers angle can be used as a predictive factor for the outcome.

SUMMARY

22 cases of intra-articular fracture of calcaneum which were admitted in Gandhi Medical College and associated hamidia hospital, Bhopal were studied. The statistical data and analysis of the cases studied during this period are presented in this study.

- Incidence of fracture of calcaneum was highest in 18-30 years age group.
- It was more common in males than in females with a ratio of 2.3:1
- The mechanism of injury was either fall from height and landing directly over the
- heel (29.14%) or road traffic accidents (70.86%).
- All cases were operated by open reduction internal fixation with locking calcaneal plate using lateral extensile approach.
- The outcome was excellent in 9.1%, Good in 68.18%, Fair in 18.18% and Poor in 4.54% patients according to AOFOS
- Follow up range from 6 week to 24 week with an average of 15 weeks.
- All fractures united within 8-12 weeks. No cases of non-union were encountered.
- Subtalar Arthritis (inadequate reduction) development was seen in 1 patient (4.5%), this patient ended up having fair results.
- Superficial wound infection was seen in 3 patients (13.5%), all 3 patients ended up having fair results. While Deep wound infection occurred in 1 patient (4.5%) showing poor result in further follow-up.
- No cases of osteomyelitis were seen.
- Sander's classification seems to be adequate in defining the fracture pattern and to plan further management.
- There was no surgery related mortality in the study.
- Type 2 sanders fracture when treated through ORIF show statistically better results than sanders type 3 fractures
- There is a significant association between the intra-operative bohlers angle and the outcome.

CONCLUSION

Good results and early functional recovery can be obtained after adequate preoperative planning of intra articular calcaneal fracture when operated through open reduction internal fixation with calcaneal locking plates, using extensile lateral approach.

Judicious consideration of the surgical technique is must.

Osteosynthesis calcaneal plating through open reduction internal fixation restores anatomy of calcaneum as well as Bohler's angle. It also allows early mobilization of patient.

The timing of the surgery is a vitally important for the functional outcome and surgery is considered only after subsidence of oedema and appearance of wrinkle sign. Although those cases which were taken up for fixation early, within 7 days (after appearance of wrinkle sign) had good results than those operated later. However if the operation is delayed more than 3 weeks due to any reason, soft tissue healing problem appeared in most of the cases and infections rate is also higher. Hence it is always better to wait for 4-5 days before surgery for adequate soft tissue healing meanwhile managing it with splinting, below knee slab and limb elevation with ice fomentation.

Sanders type 2 fractures when treated with open reduction internal fixation shows significantly better results than sanders type 3. However good and excellent results are obtained in 77.2% type 2 and 3 calcaneal fractures. Hence ORIF should always be considered in sanders type 2 and 3 calcaneal fracture over other modalities of treatment.

We have also found that there is a significant association between the

intra-operative Bohler's angle and the outcome. Hence intraoperative Bohler's angle is must to maintain so as to get better functional outcome after open reduction internal fixation.

Overall results of open reduction internal fixation with locking calcaneal plate using lateral extensile approach was found to be satisfactory in Sanders's type 2 and 3 fractures and should always be considered over other modalities of treatment.

Calcaneal locking plates should be considered and analyzed along with the benefits of the procedure because implant affordability and availability of technical expertise is often a problem or challenge in developing countries. It is very important to consider that calcaneal fracture surgery using complex implants has a steep learning curve and requires more professional expertise.

To conclude in the end we must emphasize that calcaneal fractures are complex fractures which are difficult to manage.

However we have got good results using open reduction internal fixation via locking plates through lateral extensile approach which maybe due to less traumatic technique and judicious use of good implant. We also found that calcaneal plate decreases the need for bone graft, allows early weight bearing and provide rigidity to calcaneus especially in old and osteoporotic bone. Although higher implant cost and steep learning curve are the present limitations.

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