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Research Paper

A Study of An Operative outcome of Joint Depression Variety of Intra Articular Calcaneal Fractures

Medical Science

KEYWORDS : AOFAS score , Bohler's angle, Calcaneum, essex Lopresti ,Joint congruity, malunion

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ABSTRACT

1.Background and objectives:

Calcaneum fracture when severe and comminuted leaves behind a lifelong disability.

Study conducted for the results of operative management of joint depression type of intra-articular calcaneal fractures and To assess functional outcome in patients as per AOFAS Score and disability score associated with outcome of method of reduction (open or closed).

2. Methods:

The study conducted at Civil hospital Ahmedanbad ,Gujarat, from july 2014 to Dec 2015.This study presents, 24 cases of calcaneal fractures in 20 patients with 4 patients had bilateral injury. Out of 24 cases, open reduction and intenal fixation was used in 12 cases, while rest 12 cases were treated by closed reduction with ESSEX LOPRESTI technique of ST pin elevation.

3. Results:

Most common occurrence of calcaneum fracture in young adult male due to fall from height and half of the patients managed with closed reduction and percutaneous pinning and rest were treated with open reduction and internal fixation with platting. AOFAS score at final follow up for both the modality were non-significant ($p<0.05$).Malunion was more common in closed reduction method and infection rate was high in open reduction technique.

4. Interpretation and conclusion:

The operative treatment in intra-articular calcaneal fractures yields overall better functional outcome.

Restoration of Bohler's angle and joint congruity are consistently associated with better functional outcome.

The operative outcome based on AOFAS score after open reduction is better than closed reduction. But closed reduction technique is useful in selected patients with co-morbidities and poor local condition.

Types of implants used for fracture fixation do not significantly affect ultimate results. Instead the overall final outcome depends on restoration calcaneal height and subtalar joint congruity.

Introduction

Calcaneum is a principle weight bearing bone and forms the subtalar joint which mainly helps in fine movements of the foot. So any intra articular fracture of calcaneum can cause subtalar arthritis and leads to walking on uneven surface extremely painful.

Calcaneum fracture when severe and comminuted leaves behind a lifelong disability. These fractures comprise about 60 percent of tarsal bone fractures and 1 to 2 percent of all fractures and involve working individual in peak earning age (20-40 years). Undeniably, a high energy calcaneal fracture is a life- and potentially career-changing injury for vast majority of the people who sustain them. The high incidence of these injuries and serious nature of disabilities that they produce constitute a serious socio-economic problem. Historically most fractures were treated non operatively because open reduction and internal fixation was associated with high complication rates and did not result in significantly improved outcomes. With better understanding of fracture patterns and improved surgical and fixation techniques, there appears to be a renewed interest in the surgical treatment of displaced intraarticular fractures of the calcaneus. In the last decade, operative management of intraarticular calcaneal fracture is increasingly preferred over conservative management. These operative techniques have its own advantages and disadvantages however, despite our best efforts and advances in fracture care of calcaneus over the past 100 years, we still have room for improvement. The assessment of result is done keeping in mind types of fractures types of treatment given, residual symptoms, duration of incapability and occupation before and after trauma. The last but not the least, objective of this thesis is to get conclusion which will be useful in selecting treatment in particular case to get maximum good results and improved outcomes.

Materials and Methods:

This is Prospective study of joint depression variety of intra-articular fracture of calcaneum treated at our institute within last three years by various operative techniques. This study presents, 24 cases of calcaneal fractures in 20 patients with 4 patients had bilateral injury. Out of 24 cases, open reduction and intenal fixation was used in 12 cases, while rest 12 cases were treated by closed reduction with ESSEX LOPRESTI technique of ST pin elevation.

Inclusion criteria:

1. Adult patients between 18 to 65 years of age with joint depression variety of Intra-articular calcaneum fracture
2. Patients who were weight bearing on same limb prior to the fracture
3. Fresh fractures

Exclusion criteria:

1. Extra-articular calcaneum fracture
2. Open fractures
3. Pathological fractures
4. Patients with other associated fracture in same lower limb
5. Patients with neurological deficits
6. Medically unfit patients

On admission vitals of the all cases were assessed and examination was done for any associated injury The entire cases evaluated radiologically with lateral and axial view of calcaneum, in addition x rays of spine and pelvis were also done to rule out associated injuries. CT scan was done in few patients if required and where feasible economically. patients were given strict limb elevation and below knee slab to reduce edema. Pre-operatively Bohler's[1] angle and crucial angle of Gissane [2] were measured in all patients. Heel width was measured with use of Vernier caliper. All the fractures of calcaneum were classified according to ESSEX-LOPRESTI [3] classification. CT scan classification was used

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in those patients whose CT scan was done. Pre-operatively all patients were given injectable antibiotic 30 minutes before surgery.

In patients who were treated with closed reduction, ESSEX- LOPRESTI technique was used in form of axial calcaneal ST pin insertion and elevation of depression followed by incorporating in below knee plaster cast. Out of 12 cases who were treated with closed reduction method, in 11 cases K-wires alone were used for fracture fixation while In one case K wire per cutaneous screw was used for fixation.

In all cases treated by ORIF, Surgical approach used was lateral universal approach of calcaneum. Out of 12 cases of ORIF, we used various types of calcaneal plates in form of simple reconstruction plate, Y reconstruction plate, H plate and anatomical calcaneal plate in 9 cases, while in rest 3 cases K-wires Cancellous Screws were used for fracture fixation.

Post operatively all patients were given strict limb elevation. Injectable antibiotic were given for three days in case of open reduction. Single dose of injectable antibiotic was given in case of closed reduction.

Stitch removal was done after 15 to 21 days in patients treated with ORIF. All patients of ORIF were allowed and encouraged ankle mobilization after edema subsides. Regular follow-up was done at one month, two month, three month and six month of surgery post operatively. Detailed physical examination including heel width and radiological evaluation in form of Bohler's [1] angle & Gissane's [2] angle measurement and patient satisfaction score were evaluated at each follow up and compared with preoperative findings. The duration of immobilization varied from 1.5 to 3 months in various cases; and the duration of nil weight bearing also varied from 2 to 4 months in different cases based on radiological signs of union. Final functional outcome of operative management was assessed by AOFAS Score[4] and disability score.

Observation and Results

The present study is an effort to study an overall outcome of operative management of joint depression variety of intra-articular calcaneal fractures, It is a randomized study of 24 cases of calcaneal fractures of 20 patients after deciding inclusion and exclusion criteria as described earlier under the heading of materials and methods. The minimum duration from surgery to final follow up is one year. While carrying out the study, following points are evaluated, which can be comprehensively divided in following headings:

Pre-operative: Age, Sex and other particulars of patients, Modes of injury; Associated injuries if any; Time interval between injury to surgery

Intra-operative: Method of reduction; implants used for fracture fixation; Position and Approach used Post-operative: Duration of hospital stay; complication like infection; period of immobilization; period of nil weight bearing Follow up: Gait of the patient; ROM of subtalar and ankle joints; Heel width, overall functional outcome based on AOFAS scoring; return of occupation and satisfaction of patient.

The important radiological points which are evaluated and compared pre-and post-operatively in this study are Bohler's Angle, Gissane's Angle, Union Status, varus deformity, Joint congruity.

TABLE-1
AGE INCIDENCE

Age in Years	No. of Patients	Percentage (%)
18-30	08	40
31-42	08	40
43-54	03	15
55-65	01	05
Total	20	100

In this series of 20 patients, most of patients belong to 3rd and 4th decades comprising more than 80% cases. It suggests that patients of active age group are more prone to calcaneal fractures.

TABLE 2
SEX INCIDENCE

Sex	No of patients	Percentage (%)
Male	17	85
Female	03	15
Total	20	100

In our study, up to 85% of patients are males, suggesting males are prone to calcaneal fractures most ly due to they are involved in outdoor activities.

TABLE 3
SIDE INCIDENCE

Side	No of patients	Percentage (%)
Bilateral	04	20
Unilateral	16	80
Total	20	100

In this study, 4 patients had B/L calca neal fracture, which account for 8 cases of study rest 16 patients had unilateral injury

TABLE 4
OCCUPATION INCIDENCE

Occupation	No of Patients	Percentage (%)
Labourers	11	55
Drivers	06	30
Housewives	02	10
Others	01	05
Total	20	100

In this study, patients most commonly affected were laborers (55%), followed by drivers (30%), rest 15% were involved in other occupation including housewives. It suggests that persons involved in outdoor activity and heavy work are more prone to calcaneal fractures.

TABLE 5
MODE OF INJURY

Mode of Injury	No of Patients	Percentage (%)
Fall from height	14	70
RTA	05	25
Others	01	05
Total	20	100

In this study, major mode of injury was fall from height from different distances from ground level (70%) followed by road traffic accident (25%), again suggesting heavy labor work and outdoor activity are prone to have calcaneal fractures.

TABLE 6
INTERVAL BETWEEN INJURY AND SURGERY

No, of days of interval	No. of cases	Percentage (%)
0-5 days	15	63
6-10 days	08	33
>10 days	01	04
Total	24	100

Most of cases of this study were operated within 5 days of injury. All patients who were operated after 5 days of admission were treated by open reduction method. It suggests that the cases with poor local condition and significant oedema and which are to be operated by open reduction method, should be operated only after subsidence of oedema and positive wrinkle test.

TABLE 7
METHOD OF REDUCTION

Method	No of cases	Percentage (%)
Open	12	50
Closed	12	50
Total	24	100

In this study, half of cases (50%) were operated by open reduction and internal fixation method, while rests of cases (50%) by closed reduction technique. In open reduction technique approach used was extensile lateral approach in all cases. All cases were operated in regional anaesthesia and in lateral position.

TABLE 8
IMPLANTS USED

Implant	No of Patients	Percentage (%)
K wires	11	46
Kwires+ Screws	04	17
Plate	09	37
Total	24	100

In this study, K-wires alone were used in 11 cases, which all were treated by closed reduction method. K-wires and Screw in combination were used in 4 cases; out of those in one case fracture was treated by closed reduction and then fixed by K-wires and per cutaneous screw, while in rest three cases fracture was treated by open reduction. Out of 12 cases, which were operated by open reduction, different types of 3.5mm calcaneal plates were used for fracture fixation in 9 cases.

TABLE 9
DURATION OF HOSPITAL STAY

No of days	No of Patients	Percentage (%)
0-5 days	10	50
6-10 days	06	30
11-15 days	03	15
>15 days	01	05
Total	20	100

In this series, most of patients (up to 80%) were discharged within 10 days of hospital admission. All 4 cases which had duration of hospital stay for more than 10 days were operated by open reduction. It suggests that overall duration of hospital stay is more in cases treated by open reduction of fracture. This includes waiting for subsidence of oedema pre-operatively as well as time period given for dressing under observation post-operatively.

TABLE 10
DURATION OF IMMOBILIZATION

Time in months	No of cases	Percentage(%)
1.5	06	25
02	14	58
2.5	03	13
03	01	04
Total	24	100

In this study of 24 cases, mobilization of ankle and subtalar joints started within 2 months of post-operative period in more than 80% of cases, while immobilization was extended up to 2.5months in 3 cases and up to 3 months in one case. All 6 cases which were mobilized at months were treated by ORIF, while all 4 cases which were immobilized beyond 2 months were treated by closed method. Early mobilization is possible in cases treated with open reduction and internal fixation compared to closed method.

TABLE 11
DURATION OF NIL WEIGHT BEARING

Time in Months	No of cases	Percentage (%)
02	01	04
03	19	79
04	04	17
Total	24	100

Average duration of NWB was 3 months with maximum was 4 months. In more than 80% of cases weight bearing was allowed at 3 months post-operatively while in rests of the cases it was at 4 months. Decision of weight bearing is based on radiological signs of union of fracture

TABLE 12
BOHLER'S ANGLE (Normal Range 20-40) IN CASESTREATED WITH ORIF

Bohler's Angle	Pre-operative	Post-operative	Final Follow-up
<10°	06	00	00
11-20 °	06	01	01
21-30°	00	09	09
>30°	00	02	02
Total	12 cases	12 cases	12 cases

Out of 12 cases treated with ORIF, half of patients had pre-operative Bohler's Angle was <10° while rests had between 10-20°. Post-operatively and on final follow up, most of them achieved Bohler's Angle between 20- 30°, while two cases had restoration more than 30° and in one case it was not restored to normal range.

TABLE 13
BOHLER'S ANGLE IN CASESTREATED WITH CLOSED REDUCTION

Bohler's Angle	Pre-operative	Post-operative	Final Follow-up
<10°	06	01	01
11-20 °	06	03	04
21-30°	00	08	07
>30°	00	00	00
Total	12 cases	12 cases	12 cases

Out of 12 cases treated with closed reduction, half of cases had pre- operative Bohler's Angle was <10° and rests had between 10-20°. Post operatively and on final follow up Bohler's Angle in 65% cases was between 20-30°, while in 25% cases it was between 10-20° and in 10% cases it was <10°.

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Bohler's angle was restored to normal range in 90% of cases treated with ORIF [5-10], while it was restored to normal range in 60% of cases treated with closed method. So overall restoration of calcaneal height, elevation of joint, and Bohler's angle restoration are better in open reduction technique in this study.

TABLE 14.
HEEL WIDTH (Normal 6-7 cm)
CASES TREATED WITH ORIF

Heel width	6-7 cm	7-8 cm	>8 cm	Total
Pre-operatively	01	10	01	12
Post-operatively	10	02	00	12
Finale Follow Up	10	02	00	12

CASES TREATED WITH CLOSED REDUCTION

Heel width	6-7 cm	7-8 cm	>8 cm	Total
Pre-operatively	01	10	01	12
Post-operatively	05	06	01	12
Finale Follow Up	05	06	01	12

In this study of 25 cases, most of patients had pre-operative heel width between 7-8 cm. Post-operatively, more than 80% of patients treated with ORIF had achieved heel width within normal rang (6-7 cm), while in closed method almost half of the cases had achieved heel width within normal range and rest half cases had heel width of 7-8cm.

TABLE 15
ROM OF SUBTALAR JOINT (Range 5-10°)

ROM	No of cases treated with ORIF	Percentage (%)	No of cases treated with closed reduction	Percentage (%)
Normal	02	17	00	-
Minimally Restricted	09	75	08	67
Significantly Restricted	01	08	04	33
Total	12	100	12	100

In our study, almost 70% cases treated either by ORIF or by closed technique had minimally restricted subtalar movements and were painful terminally. They were significantly restricted in only one case treated by ORIF, while in 30% cases treated by closed method. In 2 cases treated by ORIF had achieved normal ROM at subtalar joint. Subtalar joint movement is dependent on restoration of joint congruity, which can be achieved better in more number of cases treated with ORIF.

TABLE 16
ROM OF ANKLE JOINT

ROM	No of cases treated with ORIF	Percentage (%)	No of cases treated with closed reduction	Percentage (%)
Normal	07	58	03	25
Minimally Restricted	05	42	08	67
Significantly Restricted	00	-	01	08
Total	12	100	12	100

In this study, cases treated with ORIF had Normal ROM at ankle joint in more than half of cases while in 40% cases treated with ORIF had minimal restriction at ankle joint. In cases treated by closed technique 25% had normal ROM at ankle joint, while it was minimally restricted in 67% cases and in one case it was significantly restricted. The restriction of Ankle ROM is related to duration of immobilization which is less in cases treated by ORIF. The one case which had significantly restricted ROM at ankle joint was immobilized for around 3 months.

TABLE 17
COMPLICATIONS

	No of cases treated by ORIF	Pertcentage (%)	Cases Treated by closed Reduction	Percentage (%)
Malunion at final follow up				
Present	01	08	04	33
Absent	11	92	08	67
Total	12	100	12	100
Infection at 1st follow up				
Present	02	17	00	-
Absent	10	83	12	100
Total	12	100	12	100

In this study, malunion at final follow up was present in 8% cases treated by ORIF while it was present in 33% cases treated by closed method. This finding suggests that better reduction of fracture and elevation of depressed joint is achieved by open technique compared to closed reduction method.

In our study, at first follow up we found infection as wound complication in 17% cases treated by ORIF, while infection rate was nil in closed method. So this can be said to be important disadvantage of ORIF compared to closed technique. In both of those cases which had infections were by antibiotic and dressing and none required secondary treated procedure like debridement or implant removal.

TABLE 18
OCCUPATION

	No of patients	Percentage (%)
Return to same occupation	16	80
Change of occupation	03	15
Not returned to any work	01	05
Total	20	100

In our study, 80% patients treated by operative management were returned to original occupation while 15% had changed their job and one patient had not returned to any occupation at all. Out of 3 patients who did not returned to same occupation, one had bilateral injury and was treated with closed method bilaterally. While out of rest two cases one was treated by closed method and other one by ORLF. The patient who had not returned to any work was also treated by closed method. All 4 patients who were not returned to same occupation were involved in heavy construction work pre-operatively and had history of fall from height as mode of injury.

TABLE 19
RESULTS ACCORDING TO AOFAS Score

Results	No of patients treated by ORIF	Percentage (%)	No of patient treated by closed reduction	Percentage (%)
Excellent(90-100)	02	20	00	-
Good(75-89)	07	70	07	70
Fair(50-74)	01	10	02	20
Poor(<49)	00	-	01	10
Total	10	100	10	100

In our study, functional outcome and patient satisfaction based on AOFAS score were Excellent to Good in 90% of patients treated with ORIF and was fair in 10% patients treated with ORIF. The results were Good in 70% patients treated with closed method, while it was Fair to Poor in 30% patients treated by closed reduction technique. So overall outcome of operative management of calcaneal fractures is good and outcome of ORIF is superior to closed reduction method. The patients who had difficulties in routine activity were advised physiotherapy in form of wobble board exercise and wax bath on final follow up, while the patients who had fair to poor results with significant malunion radiologically were explained for requirement of future arthrodesis.

Conclusion:

Since this is a very small study without any control, conclusions are difficult to be drawn. Still following important conclusive remarks are made from our study.

- Calcaneal fractures commonly occur in males of active age group of 3rd and 4th decade
- Labourers and persons involved in outdoor activity are prone to calcaneal fractures
- The common modes of injury of calcaneal fractures are fall from height and road traffic accident.
- The operative treatment in intra-articular calcaneal fractures yields overall better functional outcome.
- Restoration of Bohler's angle and joint congruity are consistently associated with better functional outcome.
- The operative outcome based on AOFAS score after open reduction is better than closed reduction. But closed reduction technique is useful in selected patients with co-morbidities and poor local condition.
- Types of implants used for fracture fixation do not significantly affect ultimate results. Instead the overall final outcome depends on restoration calcaneal height and subtalar joint congruity.
- Important complication after open reduction and internal fixation is wound complication and infection. This complication rate can be reduced by waiting for surgery till edema reduces and wrinkle sign appears.
- A larger controlled study is needed to associate types of fracture and management to be offered for best functional results.

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