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RESEARCH ARTICLE

A PROSPECTIVE STUDY FOR EVALUATION OF FUNCTIONAL OUTCOMES OF PLATE OSTEOSYNTHESIS FOR CLOSED INTRAARTICULAR CALCANEAL FRACTURES

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Abstract

Background: Calcaneal fractures account for 65% of tarsal injuries most (70%) of them are intra articular. It is the most repeatedly fractured tarsal bone. Axial loading is the most common mode of injury,falls from height, especially in male construction workers are the most frequent cause. Other fractures associated with falls from height have to be excluded such as pelvic and spinal fractures.

Aims and Objective: To analyze the functional outcome of closed displaced intraarticular calcaneal fractures treated by plating.

Materials and methods: This is a prospective study of 16 patients with displaced intraarticular fractures (Type–II Sanders and above) of calcaneum, which were admitted to the hospital and operated on with platingthrough extensile lateral approach, between November 2019to October 2021.

Result: In our study functional outcome according to the AOFAS(American Orthopaedic Foot And Ankle Society) score was Good(>75) in 14 cases(87.5%) and Fair(50-74) in 2(12.5%) and mean AOFAS score is 87.123.

Conclusion: Open reduction and internal fixation of displaced intra-articular calcaneal fractures by locking calcaneal plate maintain the joint congruity and decrease the incidence of subtalar arthritis. Althoughconservative treatment was considered the gold standard previously, there is an increased tendency toward internal fixation with excellent results.This study concludes that displaced intra-articular fractures of calcaneum give good results by open reduction and internal fixation with locking plates.

Introduction:-

Calcaneal fractures account for about 3% of all fractures. Most (70%) of them are intra articular. Fall from height, especially among male construction workers is the most frequent cause. Most of these persons unfortunately are the sole earning members of the family. Hence this results in a great financial burden apart from the significant morbidity for the patient. Calcaneal fractures often happen with thoracolumbar fractures .[1,2]

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Axial loading is the most common mode of injury, force is applied vertically to the talus, with thecalcanealtuberosityfixed to the ground, then shear stress takes place all the way through thebody of the calcaneum. Transmission of this downward energy of the talus occurs, with the calcaneal tuberosity fixed on the ground. Thus the talus and the sustentacular fragment move inferomedially, and so calcaneal tuberositybecomes more lateral and elevated. The talus powers its way and pushes the lateral part of the posterior facet into the cancellous bone of the tuberosity fragment. [3,4]The two main regular types of calcaneal fractures are **Joint depression,** type here the fragment is short; it extends only for a short distance behind the posterior facet. **Tongue type,**here the fragment is long, and it extends to the posterior aspect of the calcanealtuberosity.These fracture lines are according to the Essex-Lopresti classification. The fracture lines cross the posterolateral part of the posterior facet in each fracture.[5,6]If the operative procedure is chosen, the various methods range from lateral plating from the extended lateral L-shaped method to percutaneous reduction and internal fixation with pins or screws, or external fixation. Out of these tedious methods, the extended lateral method has been reported.

The point of this paper was to evaluate the functional outcome after open reduction and internal fixation of displaced intra-articular injuries of the calcaneum by locking the calcaneum plate.

Materials and Methods:-

This is a prospective study of 16 patients with displaced intraarticular injuries (Type–II Sanders and above) of calcaneum, which were inpatients in the orthopaedic ward and fixed with platingthrough the extended lateral method, betweenNovember 2019to October 2021.

All patients were screened using inclusion and exclusion criteria and those willing to participate in the study were included and were followed up at the time of discharge,at 6 weeks,8 weeks,12 weeks and 26 weeks and assessed according to the given parameters given below in each follow-up.

X-ray - AP view, lateral view, axillary view
AOFAS score
VAS scale.

Surgical technique:-

The patientwas in a lateral decubitus position. Under spinal anaesthesia, a pneumatictourniquet was applied after intravenousprophylactic antibiotics.Lateral extensile incision (Benirschke and Sangeorzan) was taken (FIG-1,2).The suralnerve was explored and protected within retracted flap(FIG-3,4). Sub-periostealdissection of anterior skin flap with K wire retraction was done. Peroneal tendonsheath was dislocated over the fibula.One K-wire was passed each in the fibula, talar neck and cuboid(FIG-3,4). The lateral wall of the calcaneum wasexposed (fig-5,6), and the body and the tuberosity of the calcaneum is mobilized. Correction of varus, loss of height, and increased width was done. This arrangement temporarily stabilized (tuberosity to medial fragment) with K wires (FIG-7,8). This is followed by reconstruction and fixation of the intraarticular fragment. This was again temporarily stabilized with K wires. Then insertion of 2 parallel partially threaded small fragment cancellous screws was done. Reduction of anterior and middle facets and the calcaneocuboid joint was done if necessary. Application of locking compression calcaneal plate, locking screws were used for plate fixation.

Intraoperative radiographic evaluation with image intensifier with lateral, axial and Anteroposterior view. 4 -0 Prolene“corner stitch” 2-0 Vicryl subcutaneous layer closure done with minimal sutures• Skin is closed withEthilon in ALLGOWER-DUNATI technique(FIG-9,10). Sterile dressing followed by a well-padded short below-knee slab is applied.

Figure-1:-

Figure-2:-

Skin incision

Figure3:-

Figure4:-

Full-thickness flap is retracted using 3 k wiresand lateral wall exposed

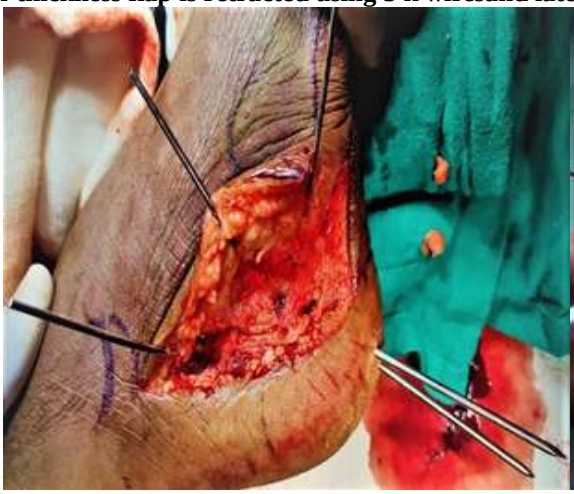

Figure5:-

Figure6:-

Preliminary reduction with the help of k wires

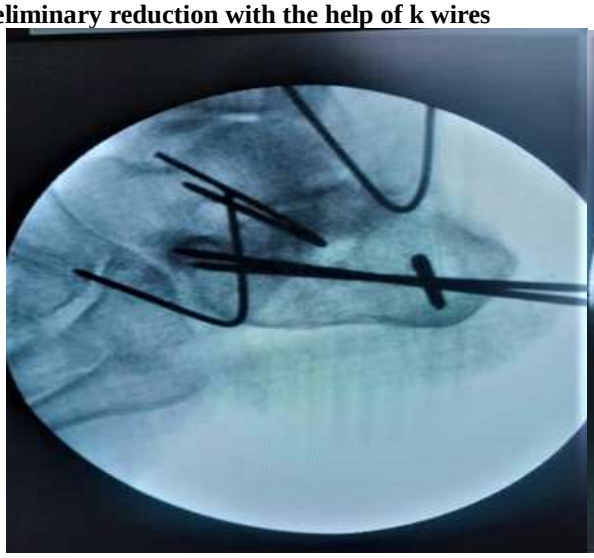

Figure7:-

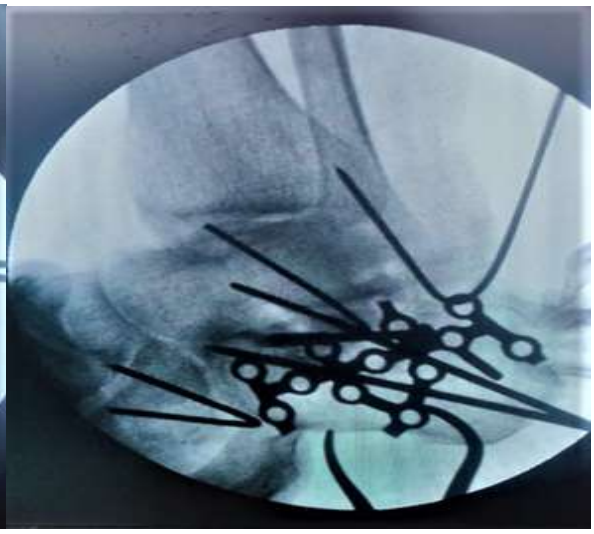

Figure8:-

Reduction under C arm

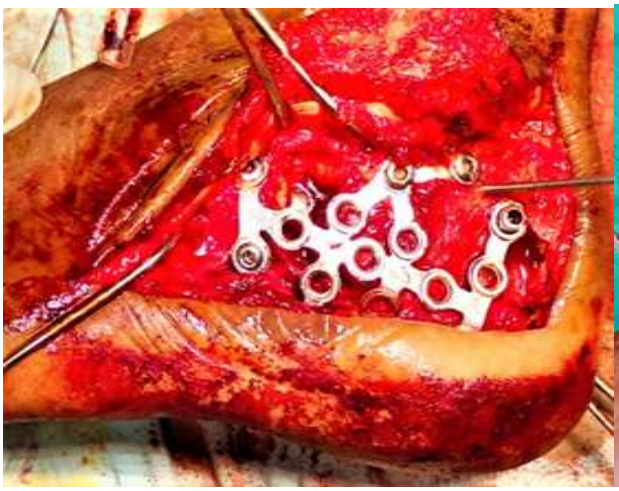

Figure9:-

Figure10:-

Final placement of plate and closure with ALLGOWER DUNATI suture.

Result and Observation:-

In the given study, 16 patients of closed fracture calcaneum attending Department of Orthopaedics, Traumatology and Rehabilitation N.S.C.B Medical college, Jabalpur in the academic session 2019-2021, were included. The selected patients were thoroughly investigated, including local examination, haematological, and radiological investigations and underwent surgery.

Table No1:- Gender Distribution.

GENDER	FREQUENCY	PERCENT
FEMALE	2	12.5
MALE	14	87.5
TOTAL	16	100

In our study majority of 14(87.5%) patients were males and 2 patients (12.5%) were females.

Table no2:- Age Distribution.

AGE	FREQUENCY	PERCENT
20-30	9	56.25

31-40	3	18.75
41-50	3	18.75
51-60	1	6.25
TOTAL	16	100

Majority of patients in our study 9(56.25%) were in the age group of 20-30 years,3 patients (18.75%) in 31-40 age group,3 patients (18.75%) in 41-50 age group and 1 patient (6.25%) in 51-60 age group. The youngest patient in our study was 23 years and the oldest patient in our study was 42 years. The mean age was 29.187 years.

Table no3:- Of Injury.

MOI	FREQUENCY	PERCENT
FFH	11	68.75
RTA	5	31.25
TOTAL	16	100

In our study major mode of trauma was fall from height in 11 patients (68.75%) and road traffic accident in 5 patients (31.25%).

Table no4:- Sander Types.

SANDERS	CASES	PERCENTAGE
Type-1	0	0
Type-2	8	50
Type-3	6	37.5
Type-4	2	12.5

In our study, we classified and distributed patients according to Sanders classification. Out of 16 patients,8 patients(50%) had Sander type 2, 6 patients(37.5%) had Sander type 3 and 2 patients (12.5%) had Sander type 4 fracture.

Table No5:- Gissane Angle.

TREATMENT	GISSANE ANGLE	TOTAL	MEAN	MEAN DIFFERENCE	P VALUE
OPERATIVE	PRE OP	16	160.56	21.94	0.01
	POST OP		138.62		

In this study mean Gissane angle preoperatively was 160.56 and postoperative was 138.62

Table6:- Bohler Angle.

TREATMENT	BOHLER ANGLE	TOTAL	MEAN	MEAN DIFFERENCE	P VALUE
OPERATIVE	PRE OP	16	9.87	14.56	0.01
	POST OP		24.43		

Mean preoperative Bohler's angle was 9.87 and postoperative was 24.43.

Table No7:- Functional Outcome At 26 Weeks.

TREATMENT	TOTAL	AOFAS SCORE			MEAN SCORE
OPERATIVE	16	POOR	FARE	GOOD	83.125
		0	2	14	
		0%	12.5%	87.5%	

In our study functional outcome according to the AOFAS score was Good (>75) in 14 cases (87.5%) and Fair (50-74) in 2(12.5%) and the mean AOFAS score is 87.123

Discussion:-

In the given prospective study, 16 patients with intraarticular calcanealfracture attending the Department of Orthopaedics, Traumatology and Rehabilitation N.S.C.B Medical College and Hospital, Jabalpur, were included. All the patients were managed by open reduction and internal fixation with a locking calcaneal plate.

The patients were followed up for a period of 6 months and the functional outcome of the affected hip was assessed at regular intervals using AOFAS Score and VAS pain score.

The mean age of our cases at the time of surgery was 29.187 years, with an age group between 20-and 60 years. This was comparative to studies by **Kiran L.Gaonkar et al**, where it was 31 years and **DenizGulabi** et al where it was 29.2 years.

In our study, of the entire sample of 16 patients, 87.5% of the participants i.e. 14, were male. The rest of the 2 participants, 12.5, were females. Our results were comparable with other similar studies. In a similar study by **Cengiz Sen**, had 81% males and 19% females.

Vilas S. Mane et al studied 29 patients with intraarticular calcaneal fracture, 77% of the cases were due to falls from height and 23 % of the cases were due to road traffic accident. Similar findings were found in our study where 68.75(n=11) sustained their injury due to fall on ground, 31.25%(n=5) due to road traffic accidents.

Jianming Chen et al studied 20 patients with intraarticular calcaneal fracture, 65%(13) of the cases were right sided and 35%(7)of the cases were left sided. . Similar findings were found in our study where 62.5%(n=10) were right sided and 37.5%%(n=6) were left-sided.

Ye Peng et al studied open reduction and plate fixation in 24 patients out of which 11(45.8%) were Sander type 2, 10(41.6%) were Sander type 3 and 3(12.5%) were Sander type 4. Similar findings were found in our study where 50%(n=8) were Sander type 2 and 37.5%%(n=6) were Sander type 3 and 2(12.55) were Sander type4.

In our study average time of partial weight-bearing is 8 weeks and full weight bearing is 12 weeks and returns to work is around 16 weeks. Our results were comparable with other similar studies e.g. **Michal Maseket al.**

Vaclav Raket al studied open reduction internal fixation of closed intraarticular calcaneal fracture by plating in 67 patients and evaluated functional outcome by using AOFAS score and found Good results in 85% which is comparable to our study.

Jianming Chen et al studied plating for intraarticular calcaneal fracture in 20 patients and found good results in 80% according to the AOFAS score which is comparable to our study.

Xinran Ji et al studied plating for closed calcaneal fracture in 24 patients and found Good results in 80% of the cases according to AOFAS score which is similar to our study.

16 calcaneum were operated and followed up. Their were assessed using AOFAS score at 6^{th} and 12^{th} week and 26^{th} week. Various outcomes from various studies done globally are presented in the table below.

Table-8

SL NO.	AUTHORS	YEAR	GOOD RESULTS IN % OF CASES
1	McREYNOLDS	1982	82.5
2	Palmer	1984	90
3	Stephenson	1993	77
4	Benirschke	1993	75.38
5	Thordarson and Krieger	1996	75
6	Our study	2021	87.5

Case-1

Preoperativex Rays

Figure11:-

Figure12:-

CT SCAN

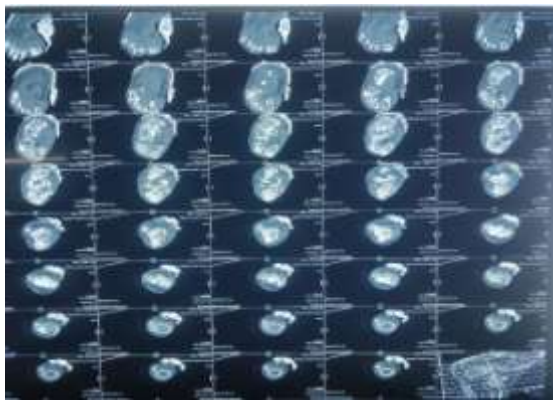

Figure13:-

figure14:-

Post Operative Xrays

Figure15:-

Figure16:-

Follow Up Xrays At 8 Weeks

Figure17:-

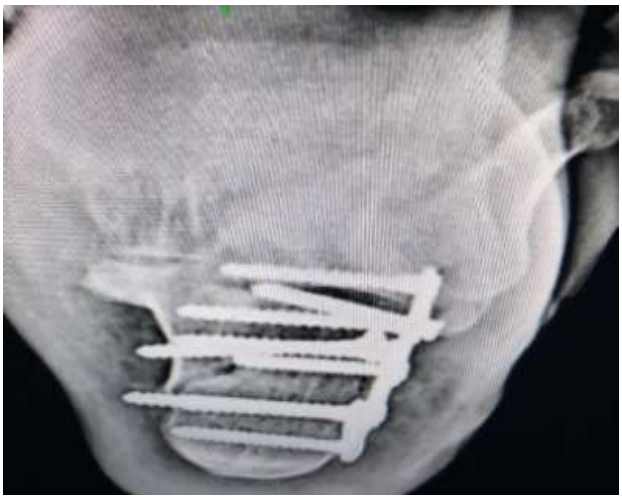

Figure18:-

Follow Up X Rays At 6 Month

Figure19:-

Figure20:-

Clinical Pics At 8 Weeks

Figure21:-

At 16 Weeks

Figure22:-

Figure23:-

CASE 2

Preoperative X Rays

Figure24:-

Figure25:-

CT SCAN

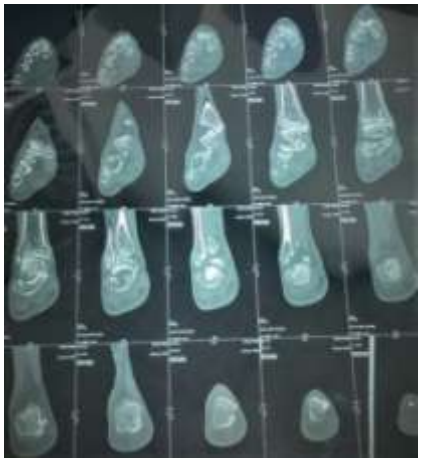

Figure26:-

Figure27:-

Post Operative X Rays

Figure28:-

Figure29:-

X Rays At 8 Weeks

Figure30:-

Figure31:-

X Rays At 6 Months

Figure32:-

Figure33:-

At 8 Weeks

Figure34:-

Figure35:-

At 16 Weeks

Figure36:-

Figure37:-

Conclusion:-

1. The timing of the surgery is a vital determinant for the treatment outcome and determined by subsidence of edema and appearance of wrinkle sign. Hence it is better to delay surgery till soft tissue heals and during this presurgical period patients should be managed by splinting with proper padding and limb elevation.
2. Our study showed that instead of using plaster of paris slab for immobilization, it is better to apply crepe bandage
3. If for other reasons operation is done after three weeks, it causes not only soft tissue healing problems and high infection rate but also only soft tissue healing problems and high infection rate but also intraoperative difficulty in fracture reduction, as the fracture has started consolidation.
4. In our opinion, this study concludes that displaced intra-articular fractures of calcaneum gives good results by open reduction and internal fixation with locking plates.

5. The results of this study support the existing literatures and are comparable to reviewed literatures.
6. Due to covid 19 we had to limit our number of cases. Study with more number of cases should be done.

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