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Functional outcome assessment of intra-articular calcaneal fractures, operative vs conservative

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Abstract
The man who has actually 'fallen on feet' is perhaps less fortunate than the idiom would suggest as he may have sustained fractures of spine, pelvis, and most importantly, Calcaneum. Despite the surgeon's extensive experience with this injury, it's a major socio-economic impact with regard to the time lost from work and recreation, and despite the attention given to it for many years throughout the world, whether to operate or conserve the intra articular fracture remains a dilemma. To compare the functional outcomes of intra-articular calcaneal fractures, treated with operative management by open reduction and internal fixation with plating and conservative management with cast application. The objectives were determined by the following parameters a) functional scoring system which includes: pain on activity, pain at rest, Range of Inversion/Eversion, Activity Return to Work Change in shoe size, Swelling. b) Radiographic assessment in form of X-rays and CT scan Bohler's Angle, Heel varus deformity.
Aims & Objectives: To evaluate the functional outcomes of intra-articular calcaneal fractures, treated with operative management by open reduction and internal fixation with plating and conservative management with cast application.
Materials and Methods: It was a prospective, randomized, evaluative study. Patients in age group of 20-60 years were randomly divided into two groups of 20 each Group A – Operative group, Group B – Conservative group. Open fractures & Patients presenting after 2 weeks of injury were excluded from the study.
Results: The functional outcome of operative group (mean 83.9) was slightly better than the conservative group (mean 78.22). But this was not statistically significant. A large previous trial showed similar results. Approximately 73% (22) patients from both groups had good to excellent results.
Conclusion: Displaced and comminuted fractures managed surgically have a relatively better functional outcome as compared to conservative. Functional outcomes of operative group weren't significantly better than those of conservative group.

Keywords: Functional outcome assessment, intra-articular calcaneal fractures, operative vs conservative

Introduction
Calcaneal fracture, the most frequently injured tarsal bone, accounts for about 1–2% of all fractures in the human body. Approximately 75% calcaneal fractures are intra-articular, involving the subtalar joint, mostly caused by a fall from a height with the heel directly hitting the ground [1].
The man who has actually 'fallen on feet' is perhaps less fortunate than the idiom would suggest, as he may have sustained fractures of spine, pelvis, and most importantly, Calcaneum. Despite the surgeon's extensive experience with this injury, it's a major socio-economic impact with regard to the time lost from work and recreation, and despite the attention given to it for many years throughout the world, whether to operate or conserve the intra articular fracture remains a dilemma. So, the aim of our study was to determine the advantages and disadvantages of surgical and nonsurgical treatments of displaced intra articular calcaneal fractures, surgical being open reduction and internal fixation with plating [2].
Fracture of calcaneus leads to considerable morbidity and hence was historically quoted that 'Ordinarily speaking the man who breaks his heel bone is 'done', so far as his industrial future is concerned [3]. Even after emergence of CT and advanced surgical instrumentations and techniques, the treatment for the intra articular fractures has been a point of debate.

Reviews on this subject, have failed to demonstrate indisputable superior results by either operative or conservative approach to the treatment of displaced intra-articular calcaneal fractures [4, 5].

So, despite the surgeon's extensive experience with this injury, it's a major socio-economic impact with regard to the time lost from work and recreation, and even after attention given to it for many years throughout the world, there is still no method of treatment that yields consistently good results. So we believe such study will attempt to make some valuable contribution to this debate about superiority of operative or conservative treatment. To compare the functional outcomes of intra-articular calcaneal fractures, treated with operative management by open reduction and internal fixation with plating and conservative management with cast application. The objectives were determined by the following parameters a) functional scoring system which includes: pain on activity, pain at rest, Range of Inversion/Eversion, Activity Return to Work Change in shoe size, Swelling. b) Radiographic assessment in form of X-rays and CT scan Bohler's Angle, Heel varus deformity.

Methodology

This prospective comparative study comprised of 30 intra-articular calcaneal fractures in 40 patients from June 2018 to September 2020 (minimum follow up one year). Open fractures, extra articular fractures, fractures presenting after 2 weeks after injury were excluded from the study. Fractures were classified according to Sander's classification.6 The patients were divided into two groups (operative and conservative) with simple randomization technique with chits. 40 chits with 15 labelled conservative and 20 labelled operative were kept in a box, were mixed and one chit was picked whenever the treatment modality of new patient was to be decided. So out of 340 fractures, 20 were managed conservatively and 20 were managed surgically with open reduction and internal fixation with plating. All the results were evaluated by the same senior orthopaedic surgeon in the department who was unaware of the design and model of the study. It was a prospective, randomized, comparative study. Patients in age group of 20-60 years were randomly divided into two groups of 20 each Group A – Operative group, Group B – Conservative group. Open fractures & Patients presenting after 2 weeks of injury were excluded from the study.

Operative group

- In operative group, open reduction and internal fixation was done with Stainless steel calcaneal plates with lateral Seligson's approach, once the oedema subsided after 7-10 days.
- Post operatively below knee slab was removed after 4-5 weeks with commencement of physiotherapy, partial weight bearing was started at 7-8 weeks which was gradually increased to full weight bearing.

Operative group

Conservative group

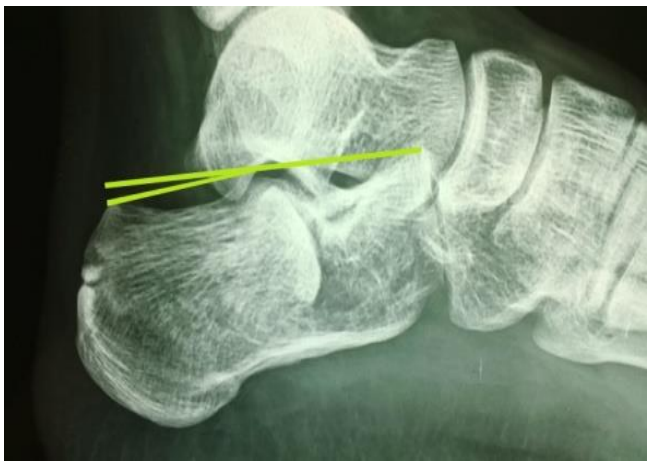
- Conservative management was in a form of below knee plaster cast initially if there was no gross swelling or else primary stabilization was done with below knee slab which was later converted into a cast.
- Slab was removed after 4-5 weeks with commencement of physiotherapy; partial weight bearing was started at 7-8 weeks which was gradually increased to full weight bearing.

Conservative group

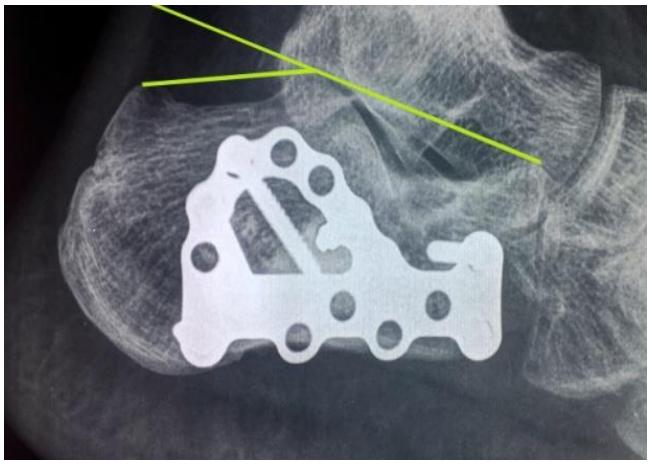
Follow UPS

1. Initially, every 2 weeks till Cast/slab removal.
2. Radiological evaluation at – 2nd, 6th, 12th, 18th, 24th month.
3. Functional evaluation with Creighton-Nebraska health foundation score at 18th month follow up.

Case No 13 (Operative)



Pre- treat. BO's angle - 6^0



Post- treat. BO's angle - 28^0

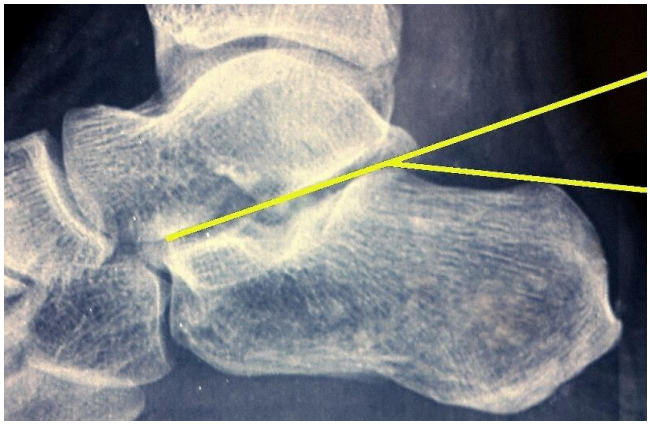
Sagittal section of CT

Pre- treat. varus angle – 15^0 (Pre-Op)

Post- treat. varus angle – 0^0 (24th month)

Case No 6 (Conservative)

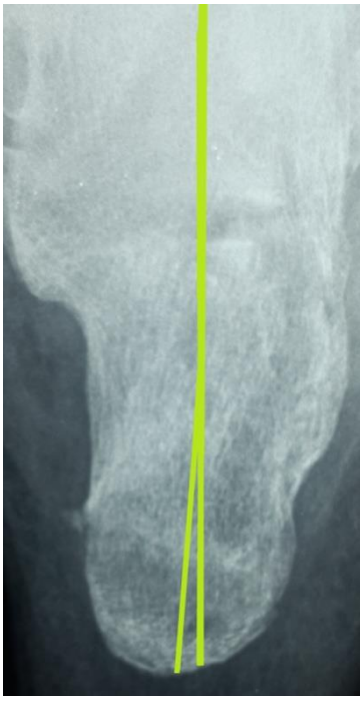
Pre- treat. BO's angle - 24^0



Post- treat. BO's angle - 24^0

Sagittal section of CT

Pre- treat. varus angle - 5^0 (Pre Cast)



Post- treatment varus angle - 5^0 (24th month

Results

In our study, 30 patients were males, and 10 were females. The mean age of patients in operative group was 31 years and that of conservative group was 34 years. Majority of calcaneal fractures were caused by fall from height (77% of cases), and 23% were due to road traffic accidents. Out of 40 Fractures, only one patient had bilateral intra-articular calcaneal fractures this series. Nine patients had associated fractures with calcaneal fractures. There were 5 vertebral fractures, 2 lower extremity fractures and 2 fracture of distal radius associated.

The fractures were classified according to Sander's classification based on computerised tomography. Most of the fractures were type II and type III fractures, forming almost 76% of the total number. There was only one Type I fracture in our study.

1. Pre and post treat. Bohler's angle

In our study we found that the difference between Pre and post treatment values, Bohler's angle in operative group was extremely significant. The mean difference between pre and post treatment values of conservative group was only 1.10 indicating that the restoration of Bohler's angle with conservative method was not possible

Table 1: Pre and post treat. Bohler's angle

TREAT	BOA	N	MEAN^0	M. DIFF^0	p VAL
CONS	PRE	20	13.4	0.7	0.391
	POST	20	14.1		
OPER	PRE	20	12	11.66	**<0.0001**
	POST	20	23.66		

2. Pre and post treat. Heel Varus angulation

Similarly, the heel varus angulation, which ultimately leads to loss of heel height, was found to be correctable only by operative method. The mean values of both pre-operative groups were almost similar, but in operative group the varus angulation could almost completely be corrected with mean value being only 0.20

Table 2: Pre and post treat. Heel Varus angulation

TREAT	VAR A	N	MEAN ^{0}	M. DIFF^0	p VAL
CONS	PRE	20	8.9	0.3	0.9139
	POST	20	8.6		
OPER	PRE	20	9.0	8.5	<0.0001
	POST	20	0.5		

3. Copmparision of mean Creighton-Nebraska score

Evaluation of functional outcome was done according to C–N score at the end of 1 year. It was observed that almost 63% patients, i.e. 19 patients out of 30 had good results. 10% i.e. 3 patients had excellent results at the end of 1 year. 16.6% patients had fair outcomes and only 3 patients had poor outcome. Both groups had almost similar outcomes without taking the fracture type into consideration

Table 3: Comparison of mean Creighton-Nebraska score

TREAT	N	MEAN	MIN	MAX	T VAL	p VAL
CONS	20	78.22	60	90	1.397	0.1734
OPER	20	83.9	64	90		

4. Post treatment Bohler's angle vs C-N score correlation

Table 4: Post treatment Bohler's angle vs C-N score correlation

Treatment	N	Pearson correlation	p value (Two Tailed)
CONS	20	0.5000	0.0109 (Sig)
OPER	20	0.5391	0.0054 (Very Sig)
Total	40	0.4276	0.0184 (Sig)

Discussion

The treatment of calcaneal fractures remains controversial. In this study the outcomes of operatively managed and conservatively managed calcaneal fractures was compared in order to find out the better method for different type of fracture. Two different parameters were used to compare the outcome and finally correlation between the two parameters was evaluated. The results of present study are compared with those of previous similar studies.

In our study, we found that the functional outcomes of patients treated with both operative and conservative groups were almost similar. This was in conjunction with most of the previous studies we compared our study with [7, 8].

The functional outcome of operative group (mean 83.9) was slightly better than the conservative group (mean 78.22). But this was not statistically significant. A large previous trial showed similar results [9]. Approximately 73% (22) patients from both groups had good to excellent results.

It was observed that correction of the post – trauma varus deformity of the heel was only possible in operative method, and not conservative method. It was proved statistically [10].

We observed that restoration of Bohler's angle was significantly in correlation with better functional outcome.

Outcome was found to be better in operative group in severely comminuted (Type 4) fractures. Type II and type III fractures had almost similar outcomes in both groups and those were good. The only type I fracture managed conservatively had an excellent outcome [11].

The only post operative complication that was encountered was wound dehiscence in 3 cases of operative group. No other complications like sural nerve injury, peroneal tendons dislocation, implant failure was encountered in our study.

Conclusions

- Functional outcomes of operative group weren't significantly better than those of conservative group
- Displaced and comminuted fractures managed surgically have a relatively better functional outcome as compared to conservative managed provided the Bohler's angle is restored.
- Post treatment Bohler's angle has a prognostic importance on functional outcome.
- The varus deformity of calcaneum which ultimately leads to loss of heel height can only be corrected by operative method.
- Wound dehiscence with infection and longtime taken for the wound healing remains a major risk in operative group.

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