Original Research Article

Clinical study on surgical management of calcaneal fracture at a tertiary care hospital

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Abstract

Background: Operative management of calcaneal fractures also poses a significant fixation and reconstruction challenge to the surgeon. This challenge has its roots in the fact that there are three functionally interrelated joints that need to be reconstructed. In present study, we aimed to study the radiological, clinical and patient-reported outcomes of patients with intraarticular calcaneal fractures treated surgically. **Material and Methods:** Present study was single-center, prospective and observational study, conducted in ppatients of age >20 years, of either sex, with displaced intra-articular fractures with minimal or no soft tissue compromise/swelling at the time of surgery, underwent surgical treatment with minimum follow-up of 18 months. **Results:** In present study 29 patients (35 calcaneal fracture) were operated and follow up was taken till 18 months postoperatively. Mean age in present study was 43.1 ± 14.56 years. Male cases (69 %) were more than female cases (31 %). Most of fractures were Sander's type 2 (82.9 %). Most fractures were unilateral (79.3 %) as compared to bilateral 6 (20.7 %). Associated injuries were noted in 37.9 % cases. Mean time till surgery was 5.3 ± 1.4 days and average duration of hospital stay 8.4 ± 3.5 days. In present study 11.4 % cases had pre-operative Bohler's angle ≥20° and 88.6 % cases had pre-operative Bohler's angle < 20°. Excellent AOFAS (American Orthopedic Foot and Ankle Society)score was noted at 18 months post-op in majority of patients. No statistically significant difference was noted in AOFAS score among two groups (p - 0.56). Allmacher grade 0 and 1 was noted in majority of patients from both groups. No statistically significant difference was noted among two groups (p - 0.61). We compared pre-operative and post-operative Bohler's angle, at 18 months post-op follow up. In cases with Pre-operative Bohler's angle ≥20° , Post-operative Bohler's angle 25–29° was noted in 75% cases. While in cases with Pre-operative Bohler's angle <20°, post-operative Bohler's angle 25–29° was noted in 83.9% cases and statistically significant difference was noted among two groups (p - 0.043). In present study post-op complications noted were heel pain (34.3 %), stiffness (11.4 %), Wound infection (11.4 %), Gait abnormality (5.7 %) and Plaster sores (2.9 %). All complications were managed conservatively. **Conclusion:** Surgical management of calcaneal fracture by open reduction with internal fixation is the ideal treatment for joint depression type and Sanders Type II/III fractures and had a good outcome in short-term follow-up.

Keywords: calcaneal fracture, operative management, displaced intra-articular calcaneal fractures (DIACFs), ORIF

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INTRODUCTION

The Calcaneus, also called the heel bone, is a large bone that forms the foundation of the rear part of the foot. Calcaneal fractures are rare and account for about 1 – 2% of all fractures occurring in the human body and 60% of all tarsal bones' injuries.[1] Particularly, intra-articular fractures account for approximately 75% of calcaneal fractures and historically have been associated with poor functional outcome.[2] These fractures are uniformly caused by an axial load mechanism, such as a fall or a motor vehicle accident, and may be associated with other axial load injuries, such

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as lumbar, pelvic, and tibial plateau fractures.[3] Subtalar joint stiffness and arthritis, heel widening, peroneal impingement, implant-related problems and heel pad pain are the potential complications.[4] No treatment, conservative treatment, open reduction and internal fixation, primary subtalar arthrodesis, delayed primary arthrodesis and calcanectomy are treatment options in the literature.[5] Operative management of calcaneal fractures also poses a significant fixation and reconstruction challenge to the surgeon. This challenge has its roots in the fact that there are three functionally interrelated joints that need to be reconstructed. In present study, we aimed to study the radiological, clinical and patient-reported outcomes of patients with intraarticular calcaneal fractures treated surgically.

MATERIAL AND METHODS

Present study was single-center, prospective and observational study, conducted in patients of calcaneal fracture at Department of Orthopaedic Surgery, Department of Orthopaedics, MIMSR Medical College, India. Study duration was of 3 years (January 2018 to December 2020). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Patients of age >20 years, of either sex, with displaced intra-articular fractures with minimal or no soft tissue compromise/swelling at the time of surgery, underwent surgical treatment with minimum follow-up of 18 months.

Exclusion criteria

- Calcaneal fractures which were open, extra-articular,
- Calcaneal fractures associated with other significant injuries
- Calcaneal fractures older than 10 days, pathological fractures
- Lost to follow up.
- Not willing to participate.

Written informed consent was taken from each of the patients after explaining the surgical procedure and other treatment modalities for similar fracture patterns.

Patients underwent detailed history taking and examination. initially conservative treatment was provided for average 7 days to allow soft -tissue swelling to resolve enough for the skin to wrinkle. Till then appropriate pre-operative investigations, assessment of Bohler's angle and width of calcaneum were done, and patients were put up for operation after proper anaesthetic check-up and counselling. All patients underwent open reduction and internal fixation with screws, operated in lateral decubitus/prone position under spinal/general anaesthesia. Indirect reduction achieved by closed method using bilateral JESS distracters, often with an elevation of depressed fragment by small lateral window. Internal fixation with 3 or more cannulated hip screws given percutaneously in posterior to anterior direction and occasional mediolaterally. Distracters were removed after the procedure.

Limb kept elevated in POP below knee back slab till subsidence of pain and edema, usually 10–12 days. Vigorous ankle mobilization exercise was started. Non-weight bearing crutch walking or protected weight bearing in a synthetic cast was started after 3 weeks post-operative and continued for the next 6 weeks. Cast removed and partial weight bearing crutch walking upto radiological or clinical evidence of fracture healing- then gradually full weight bearing along with physiotherapy. Patients were evaluated by a unified scoring system, the American Orthopedic Foot and Ankle Society (AOFAS) clinical rating system, the ankle hindfoot scale for the calcaneal area, and Allmacher grading for subtalar arthrosis.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

RESULTS

In present study 29 patients (35 calcaneal fracture) were operated and follow up was taken till 18 months postoperatively. Mean age in present study was 43.1 ± 14.56 years. Male cases (69 %) were more than female cases (31 %). Most of fractures were Sander's type 2 (82.9 %). Most fractures were unilateral (79.3 %) as compared to bilateral 6 (20.7 %). Associated injuries were noted in 37.9 % cases. Mean time till surgery was 5.3 ± 1.4 days and average duration of hospital stay 8.4 ± 3.5 days.

Table 1: Demographic data

Parameters	No. of cases (Percentage) / Mean ± SD
Age (in years)	43.1 ± 14.56
Gender	
Male	20 (69 %)
Female 20	9 (31 %)
Sander's type	

Type 2	29 (82.9 %)
Type 3	6 (17.1 %)
Fracture site	
Unilateral	23 (79.3 %)
Bilateral	6 (20.7 %)
Other factors	
Associated injuries	11 (37.9 %)
Time till surgery (in days)	5.3 ± 1.4
Duration of hospital stay (in days)	8.4 ± 3.5

In present study 11.4 % cases had pre-operative Bohler's angle ≥20° and 88.6 % cases had pre-operative Bohler's angle < 20°. Excellent AOFAS (American Orthopedic Foot and Ankle Society)score was noted at 18 months post-op in majority of patients. No statistically significant difference was noted in AOFAS score among two groups (p - 0.56).

Table 2: Distribution according to pre-operative Bohler's angle and AOFAS score ()

Pre-operative Bohler's angle	AOFAS(American Orthopedic Foot and Ankle Society) score (at 18 months post-op)			
	Excellent	Good	Fair	Poor
Pre-operative Bohler's angle ≥20° (n=4)	3	1	0	0
Pre-operative Bohler's angle <20° (n=31)	23	8	0	0

Allmacher grade 0 and 1 was noted in majority of patients from both groups. No statistically significant difference was noted among two groups (p - 0.61).

Table 3: Allmacher grade in respect of pre-operative Bohler's angle

Pre-operative Bohler's angle	Allmacher grade				
	0	1	2	3	4
Pre-operative Bohler's angle ≥20° (n=4)	3	1	0	0	0
Pre-operative Bohler's angle <20° (n=31)	17	9	2	3	0

We compared pre-operative and post-operative Bohler's angle, at 18 months post-op follow up. In cases with Pre-operative Bohler's angle ≥20° , Post-operative Bohler's angle 25–29° was noted in 75% cases. While in cases with Pre-operative Bohler's angle <20°, post-operative Bohler's angle 25–29° was noted in 83.9% cases and statistically significant difference was noted among two groups (p - 0.043).
P: 0.03903, so statistically significant

Table 4: According to pre-operative and post-operative Bohler's angle

Pre-operative Bohler's angle	Post-operative Bohler's angle 20–24°	Post-operative Bohler's angle 25–29°
Pre-operative Bohler's angle ≥20° (n=4)	1	3
Pre-operative Bohler's angle <20° (n=31)	5	26

In present study post-op complications noted were heel pain (34.3 %), stiffness (11.4 %), Wound infection (11.4 %), Gait abnormality (5.7 %) and Plaster sores (2.9 %). All complications were managed conservatively.

Table 5: Postoperative Complications

Complications	Number of cases	Percentage
Heel pain	12	34.3
Stiffness	4	11.4
Wound infection	4	11.4
Gait abnormality	2	5.7
Plaster sores	1	2.9

DISCUSSION

Orthopaedic surgeons have aimed to treat severe calcaneal fractures to accelerate recovery and reduce pain and deformity. Surgical treatment is more effective in intra-articular calcaneus fractures compared to conservative treatment according to clinical, radiological and patient-reported outcomes.[6] An axial load causes a displaced intra-articular calcaneal fracture (DIACF) and leads to crushing and sheering injury of the bone. Primary and secondary fracture lines develop. The primary fracture lines run through the posterior facet of the subtalar joint creating a superolateral fragment and a superomedial or ''constant fragment'' which includes the sustentaculum tali. If this force continues even further, a secondary fracture line is created. Depending on the direction of the force, it may form a tongue-type fracture or joint depression-type

fracture.[7] Assessment of fracture fragments, displacement, intra-articular extension, lateral wall blow-out, bone quality and comminution are part of reading a calcaneal fracture radiograph.[8] With conservative treatment alone, the calcaneus can heal but remain deformed. This leads to incongruity of the subtalar joint and loss of alignment of the leg through the ankle to the heel.[9] Surgical approach is one of the factors affecting the outcomes of surgical treatment. Medial approach which allows direct reduction of the primary fracture line is associated with poor outcomes and high complication rates. [10] The use of the intra-operative imaging at surgery aids close reduction and internal fixation thus reducing the injury to soft tissues with poor healing potential.[11] The Bohler's angle preoperatively did not correlate with functional outcome. Postoperative Bohler's angle correlated significantly with AOFAS hind foot score and Visual analogue scale.[12] Surya CM., *et al.*,[13] studied functional outcome of surgically managed calcaneal fractures in 25 cases. All the operated patients had a joint depression type of fracture. Of the 25 patients, 23 were males and 2 were females. Of the 25, 16 had good results with mean AOFAS score of 83.6, 7 had fair results with mean score of 73.28 and 2 had poor results with mean score of 54. In study by Mukherjee D *et al.*,[14] 80% achieved excellent results, whereas 20% achieved good results functionally according to the AOFAS scale. At 1-year follow-up, patients with pre-operative Bohler's angle ≥20° achieved no clinically significant subtalar arthrosis (Allmacher grade 0–1) while patients with Bohler's angle <20° (89%) suffered clinically significant subtalar arthrosis (Allmacher grade 2–4) in 7 (20%) cases. At 1-year follow-up patients with pre-operative Bohler's angle ≥20° achieved post-operative Bohler's angle at a range of 25°–29° (100%); patients with pre-operative Bohler's angle <20° (n = 32) achieved postoperative Bohler's angle at 1 year at a range of 20°–24° in 25% cases and at a range of 25°–29° in 75% cases. 34 patients with 42 displaced intra-articular calcaneal fractures (DIACF) were operated with percutaneous fixation with 4 mm CC screw with a minimum follow-up of 24 months. All radiological parameters were attained within anatomic normal range and maintained at 24 months of follow-up. AOFAS score showed a mean value of 90.10 which is considered an excellent outcome. Superficial wound infection was seen in two patients, but no patients required a revision surgery.[15] It is also well established that pre-existing co-morbidities such as peripheral vascular disease, diabetes and smoking adversely affect wound healing following operative management.[16] Recent advances in fixation devices and antibiotics have improved outcomes with operative management.[16] Despite a high level of interest in calcaneal fractures, the current evidence in published literature does not support a specific management protocol for DIACFs, although detailed analysis points to importance of patient selection, surgeon experience and soft tissue status. As of today, there is a need for larger randomized trials, which should also clarify the role of extensile approach vis a vis Minimally Invasive Surgery, to address this question and bring out a conclusive answer.[17] The treatment of calcaneal fractures must be planned according to different factors such as type of trauma, classification of the fracture, skin condition and injury mechanism. Good evaluation, preoperative planning and appropriate treatment bring out better results.[18]

CONCLUSION

Surgical management of calcaneal fracture by open reduction with internal fixation is the ideal treatment for joint depression type and Sanders Type II/III fractures and had a good outcome in short-term follow-up.

REFERENCES

1. Meng Q, Wang Q, Wu X, Peng A, Yan J. Clinical application of the sinus tarsi approach in the treatment of intra-articular calcaneal fracture. Medicine. 2018 Mar;97(13).
2. Zwipp H, Rammelt S, Barthel S. Fracture of the calcaneus. Unfallchirurg 2005;108:737-48.
3. Lim EA, Leung JP. Complications of intraarticular calcaneal fracture. Clin Orthop Rel Res 2001;391:7-16.
4. Dhillon MS, Bali K, Prabhakar S, Controversies in calcaneus fracture management: a systematic review of the literature. Musculoskelet Surg 2011, 95: 171-181.
5. Jain S, Jain AK, Kumar I (2013) Outcome of open reduction and internal fixation of intraarticular calcaneal fracture fixed with locking calcaneal plate. Chin J Traumatol 16: 355-360.
6. Aslan A, Sargın S, Gülcü A, Konya MN. Clinical, radiological and patient-reported outcomes in intra-articular calcaneal fractures: Comparison of conservative and surgical treatment. Eklem Hastalik Cerrahisi 2019;30(2):143-148.
7. Razik A, Harris M, Trompeter A. Calcaneal fractures: Where are we now? Strateg Trauma Limb Reconstr. 2018; 13:1-11.
8. Schepers T, Ginai AZ, Mulder PGH, Patka P. Radiographic evaluation of calcaneal fractures: To measure or not to measure. Skeletal Radiol. 2007; 36:847-52
9. Maskill JD, Bohay DR, Anderson JG. Calcaneus fractures: a review article. Foot Ankle Clin 2005;10:463–89.
10. Jain S, Jain AK, Kumar I (2013) Outcome of open reduction and internal fixation of intraarticular calcaneal fracture fixed with locking calcaneal plate. Chin J Traumatol 16: 355-360.
11. Walde TA, Sauer B, Degreif J, Walde HJ. Closed reduction and percutaneus Kirschner wire fixation for the treatment of dislocated calcaneal fractures: surgical technique, complications, clinical and radiological results after 2–10 years. Archives of orthopaedic and trauma surgery. 2008 Jun 1;128(6):585-91.

12. Mallya, S., Kamath, R., Hegde, A., and Annappa, R. Can bohler's angle predict the functional results of intra-articular displaced calcaneal fractures? Journal of Clinical and Diagnostic Research,2018, 12(11).
13. Surya Chandramurthy M., Vivek Dubey, Rajeev B. Reddy, Hardik Kapopara, Sunil M. Shahane, Ashwin Samant. Functional outcome of surgically managed calcaneal fractures. International Journal of Contemporary Medical Research 2017;4(8):1676-1679
14. Mukherjee D, Roy S, Rakshit D, Chakraborty K. Clinical Experience of Close Reduction and Internal Fixation of Displaced Intra-articular Fractures of Calcaneum. Int J Sci Stud 2019;6(12):21-27.
15. Rachakonda KR, Nugur A, Shekar NA, Kidiyur B, Kilaru P, Gannamani S, Joseph VM. Minimally invasive fixation for displaced intra-articular fractures of calcaneum: a short-term prospective study on functional and radiological outcome. Musculoskelet Surg. 2019 Aug;103(2):181-189.
16. Razik A, Harris M, Trompeter A. Calcaneal fractures: Where are we now? Strateg Trauma Limb Reconstr. 2018; 13:1-11.
17. Dhillon MS, Gahlot N. Are Results of Surgical Treatment for Calcaneal Fractures better than Nonoperative Treatment? J Foot Ankle Surg (Asia-Pacific) 2014; 1(1):17-23.
18. Türkmen F, Korucu IH, Sever C, Göncü G, Kaçira BK, *et al.* Calcaneal Fractures, Treatments and Problems. Clin Res Foot Ankle 2014, 2: 138.

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