

Original Research Article

Displaced calcaneal fractures, midterm results of the sinus tarsi approach and screw fixation

Manzoor Ahmad Halwai, Iftikhar Hussain Wani*, Naseemul Gani, Munir Farooq, Gulzar Ahmad Kutchay, Adil Bashir

Department of Orthopedics Hospital for Bone and Joint Surgery, Government Medical College, Srinagar, Jammu and Kashmir, India

Received: 07 April 2019

Revised: 20 April 2019

Accepted: 23 April 2019

*Correspondence:

Dr. Iftikhar Hussain Wani,

E-mail: drihwani@yahoo.co.in

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: We present the results of displaced intrarticular calcaneal fractures managed by limited sinus tarsi approach with good clinical and radiological outcome and less number of complications seen with conventional lateral approach.

Methods: We operated 42 patients of displaced calcaneal fractures (Sanders type II and III) from April 2016 to March 2018 by open reduction and internal fixation with limited sinus tarsi approach by cannulated screws. All patients were evaluated clinically and radiologically before and after surgery. Final evaluation was done by Maryland Foot and Ankle score.

Results: Patients were followed up for a mean period of 24 months. 30 patients returned to preinjury status activities while 12 patients confined themselves to sedentary schedule. The mean preoperative Bohler's angle was 3.00 (range -30 to 20) while as mean postoperative Bohler's angle was 26.4 (range 15 to 40). No wound dehiscence or skin necrosis was seen in our study. One patient developed superficial wound infection. Three patients reported prominent hardware related to screw heads. Four patients developed complex regional pain syndrome which was managed successfully at 6 month's period.

Conclusions: The limited sinus tarsi approach can be successfully used in displaced intra articular calcaneal fractures with good functional and radiological outcome. It allows good visualisation and reduction and can be used in patients with high risk. It is minimally invasive and undoubtedly avoids the major soft tissue problems of extensile approach.

Keywords: Calcaneal fractures, Sinus tarsi, Screw fixation

INTRODUCTION

Calcaneum is the most common bone to fracture among tarsal bones constituting 65% of all tarsal fractures and 1–2% of fractures, overall.¹ Approximately 70% of calcaneal fractures are intra articular.^{2,3} Although the standard treatment of displaced calcaneal fractures is still controversial, it has been reported that non operative treatment of displaced intra articular calcaneal fractures is associated with poor functional outcome and results due

to secondary subtalar arthritis and abnormal hind foot morphology.^{4,5} Thus many authors recommend for operative treatment in displaced calcaneal fractures over conservative treatment.^{5,6} Operative treatment has generally been superior to conservative treatment as it has been found to yield better functional outcomes with less pain and disability.^{7,8} The conservative approach is recommended for patients with peripheral vascular disease, advanced diabetes, chronic smokers and heavy labourers.

Extended lateral approach has been considered as the Gold standard for management of these fractures however major skin flap necrosis and wound infection remains a huge concern.⁵ The incidence of wound complications when using this approach is approximately from 5.8% to 43%.⁶ To minimize the incidence of wound complications several minimally invasive techniques have been developed in recent years like closed reduction and percutaneous fixation, open reduction and internal fixation via sinus tarsi approach and arthroscopic assisted fixation. The primary aim of this study was to assess the functional outcome of sinus tarsi approach at midterm follow up.

METHODS

From April 2016 to March 2018 we operated 42 displaced intra-articular calcaneal fractures admitted in our hospital. Out of them 31 were male and 11 female with a mean age of 42.5 years. The time from injury to surgery has been from 24 hrs to ten days (Table 1). Mechanism of injury is shown in Figure 1. Pre-operatively patients were evaluated by axial views, lateral and Broden's views for calcaneum. Procedure was explained to the patients and a detailed informed consent was taken. The study was approved by institutional ethical committee and was laid down in accordance with the declaration of Helsinki. A CT evaluation was done in all patients and fractures were classified by Sander's classification. We had 28 Sanders type II and 14 Sanders type III fractures in our study. All open fractures, bilateral calcaneal and Sanders type IV fractures were excluded from the study.

Table 1: Baseline data.

Mean age (years)	42.5
Sex (M/F)	31/11
Number of patients	42
Time from injury to surgery	24 hrs to 10 days
No of Sanders type fracture. II/III	28/14
Mean follow up (months)	24 (18-36)

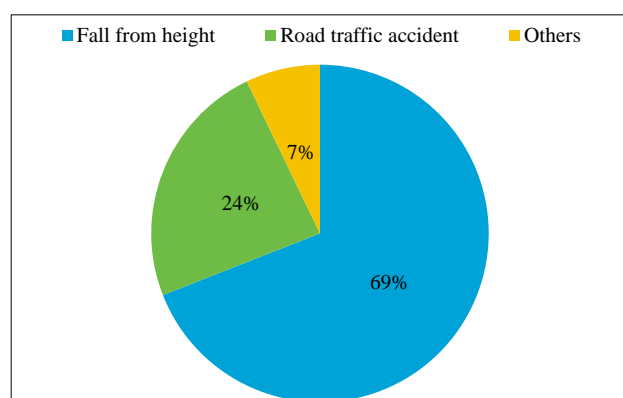


Figure 1: Mechanism of injury.

Surgical technique

All surgeries have been performed in a lateral decubitus position with the injured side up and tourniquet applied. Cefuroxime 1.5 grams was given as antibiotic prophylaxis in all patients half an hour before surgery and the average surgery time ranged from 45 minutes to one hour. Using an image intensifier an axial and a lateral view is taken in all patients. Schanz pin is inserted into the calcaneal tuberosity and any calcaneal varus or valgus corrected. An incision approximately of 3 cms to 4 cms is given in the subfibular region along the base of 4th metatarsal and just anterior to the lateral malleolus (Figure 2). Peroneal tendons remain inferior and posterior to the incision and can be evaluated and mobilised as and when necessary. Posterior facet is identified and reduced with a curved periosteal elevator which allows to elevate it from the calcaneum body (Figure 3). Sustentaculum tali is identified and posterior facet is held reduced with temporary k wires in position and confirmed under fluoroscopy. This is followed by reduction of the anterior facet and medial wall through sinus tarsi. Fixation of posterior facet is obtained with 4mm Cannulated screws or 2.5 mm screws from lateral to medial into the sustentaculum. The anterior facet is reduced and fixed to the medial wall by cannulated 4 mm screws. The last step is represented by percutaneous screw fixation from the posterior tuberosity directed towards the calcaneocuboid joint to maintain the axial length of the calcaneum. Cannulated 6.5 mm screws are used for this. It permits to maintain the reduction of the extra articular component and supports the articular component thereby avoiding the use of bone graft. We never used bone graft or any bone substitute in our series. We did not use any plates in our study (Figure 4). The reduction and screw position is continuously monitored under fluoroscopy. Wound is closed with sutures without positioning any drain. Patients are followed weekly for two weeks and then monthly for next 6 months. A short leg back slab is applied for two weeks and sutures are removed at that time. Short leg cast is applied for further 4 weeks. Ankle exercises are started and toe touch is allowed. Partial weight bearing is allowed at 9 to 10 weeks and full weight bearing is advised only after 12 weeks.



Figure 2: Incision and surface marking.

Clinical and radiological evaluation is done at 3 months, 6 months and at final follow-up for completion of this study. Maryland foot score was used for clinical evaluation. Radiological assessment was done by Bohler's and Gissane angle evaluation. Any complication observed during the course of treatment and follow up was noted down and treated appropriately.



Figure 3: Depressed posterior facet seen via sinus tarsi approach.

Example 1: 35-year-old female with history of fall from height



Figure 4: Preoperative X-rays, axial CT scan and final follow up X-rays of a patient.

RESULTS

The mean follow up of our study was 24 months (range 18-36 months). Bohler's and Gissane angles were restored in 95% of our patients in Sanders type II and III fractures. Varus was corrected in all patients at final follow up. Reduction of posterior facet has been restored and maintained in 39 patients. Three patients had loss of reduction in the postoperative period as they were non compliant and did not follow the postoperative protocol. Subtalar joint motion was 80% in 20 patients, 70% in 12 patients and 60% in 5 patients and less than 50% in 5 patients. According to Maryland foot and ankle score, 32 (76%) of our patients had excellent and good results and returned to their pre injury activities while as 10 (24%) patients had fair Maryland foot and ankle score and

confined their activities to sedentary schedule or changed their profession (Table 2).

There was no sural nerve numbness in any of our patients at final follow up. We encountered complications in the form of prominent screw heads at tuberosity in three of our patients which were removed once fracture was healed. We did not report any extensive wound necrosis in any of our patients. Superficial wound infection was seen in one patient. Four patients developed complex regional pain syndrome which was managed conservatively. Peroneal tendon dislocation was not seen in our study.

Table 2: Maryland foot and ankle score.

Maryland foot and ankle score	Number of patients	Percentage (%)
Excellent	7	16
Good	25	60
Fair	10	24
Failure	0	0

Table 3: Complications.

Complication	Number of patients	Percentage (%)
Superficial wound infection	1	2.38
Prominent hardware	3	7.14
Complex regional pain syndrome	3	
Loss of reduction	3	7.14

DISCUSSION

Displaced intra articular calcaneal injuries are very disabling and present a challenging scenario to the operating surgeon. Extensive soft tissue necrosis and other wound complications is a known entity in these fractures. Moreover delay in treatment of these fractures delays functional rehabilitation. Conventionally extensile lateral approach has been very popular in managing these fractures and is considered to be the "Gold Standard" but in view of soft tissue problems, swelling and necessary delay in treatment, the popularity of this approach has been decreasing over past few years.⁹⁻¹¹ The main problem the surgeon has to solve is to decrease the high rate of complications which is approximately 10% to 20%, the dehiscence of the wound in 14% of the cases, deep infection in 1.3-8.5%, peroneal tendinitis in 4%, tarsal tunnel syndrome in 2%, compartmental syndrome in 2%.^{8,12,13,15,16,18}

Sinus tarsi approach is gaining popularity from last few years as it has been hypothesised to reduce soft tissue complications and improve functional outcome.¹⁷ The less invasive approach through the sinus tarsi permits to rebuild the articular surface through a window and

restores the posterior facet and anterolateral fragment. There is less disruption of the periosteum thereby increasing the vascularity and decreasing the postoperative complications like hardware failure or infection.¹⁷ We did not report any major soft tissue complication in our study (Table 3).

The incision we are using has an advantage that subtalar arthrodesis if needed can be done through the same incision. We did not use any bone graft to fill the cavity that is left after elevating the posterior facet and anterolateral fragment. In literature different opinions have been explained.^{15,16} We used only screws in different planes for fixation after maintaining the length, restoring height and width. We did not use plates to avoid major sufferings of the soft tissues as plates even if applied could not afford early weight bearing.¹⁵

We did not report any sural nerve injuries in our study. The number of sural nerve injuries is very low in the sinus tarsi approach while as in extended lateral approach percentages up to 10% have been reported as the nerve is at risk at both the proximal and distal end of the approach.^{19,20} Weber et al reported 7.7% of sural nerve injuries in their series on extended lateral approach and zero injuries in their sinus tarsi approach.²¹

CONCLUSION

Minimally invasive sinus tarsi approach with screw fixation is a valid surgical option in displaced calcaneal fractures as it provides adequate visualisation, anatomical reduction, stability of the fracture and good functional outcome. It aims at soft tissue preservation and early rehabilitation and minimal number of complications. However, studies with long-term follow up and adequate number of cases need to be done to establish this method for universal fixation of calcaneal fractures.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Luo X, Li Q, He S. Operative versus nonoperative treatment for articular calcaneal fractures: a meta-analysis of randomized controlled trials. *J Foot Ankle Surg.* 2016;55:821–8.
2. Buckley RE, Tough S. Displaced intra-articular calcaneal fractures. *J Am Acad Orthop Surg.* 2004;12:172–8.
3. Zwipp H, Rammelt S, Barthel S. Fracture of the calcaneus. *Unfallchirurg.* 2005;108:737–47.
4. Griffin D, Parsons N, Shaw E, Kulikov Y, Hutchinson C, Thorogood M, et al. Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial. *BMJ.* 2014;349:4483.
5. Jiang N, Lin QR, Diao XC, Wu L, Yu B. Surgical versus nonsurgical treatment of displaced intra-articular calcaneal fracture: a meta-analysis of current evidence base. *Int Orthop.* 2012;36:1615–22.
6. Buckley R, Tough S, McCormack R, Pate G, Leighton R, Petrie D, et al. Operative compared with nonoperative treatment of displaced intra-articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. *J Bone Joint Surg Am.* 2002;84:1733–44.
7. Schepers T. Calcaneal Fractures: Looking Beyond the Meta - Analyses. *J Foot Ankle Surg.* 2016;4:897-8.
8. Eastwood DM, Langkamer VG, Atkins RM. Intra-articular fractures of the calcaneum. Part II: Open reduction and internal fixation by the extended lateral transcalcaneal approach. *J Bone Joint Surg Br.* 1993;75:189-95.
9. Andermahr J, Helling HJ, Rehm KE, Kobe ZE. The vascularisation of the os calcaneum and the clinical consequences. *Clin Orthop Related Res.* 1999;363:212–8.
10. Letournel. Open treatment of acute calcaneal fractures. *Clin Orthop.* 1993;290:60-7.
11. Gujic L, Macey LR, Early JS, Benirschke SK, Sangeorzan BJ. Incidence of morbidity associated with open reduction and internal fixation of displaced intra-articular calcaneus fractures using lateral approach. In: 61st annual meeting proceeding. AAOS, Rosemont, IL, p 259.
12. Abidi NA, Dhawan S, Gruen GS, Vogt MT, Conti SF. Woundhealing risk factors after open reduction and internal fixation of calcaneal fractures. *Foot Ankle Int.* 1998;19:856–61
13. Harvey EJ, Grujic L, Early JS, Benirschke SK, Sangeorzan BJ. Morbidity associated with ORIF of intra-articular calcaneus fractures using a lateral approach. *Foot Ankle Int.* 2001;22:868–87.
14. Stulik J, Stehlik J, Rysavy M, Wozniak A. Minimally invasive treatment of intra-articular fractures of the calcaneum. *J Bone Joint Surg B.* 2006;88:1634–41.
15. Zwipp H, Tscherne H, Thermann H, Weber T. Osteosynthesis of displaced intra-articular fractures of the calcaneus. Results in 123 cases. *Clin Orthop.* 1993;290:76–86.
16. Ebraheim NA, Elgafy H, Sabry FF, Freih M, Abou-Chakra IS. Sinus tarsi approach with trans-articular fixation for displaced intra-articular fractures of the calcaneus. *Foot Ankle Int.* 2000;21:105–13.
17. Spagnolo R, Bonalumi M, Pace F, Capitani D. Calcaneus fractures, results of the sinus tarsi approach: 4 years of experience. *Eur J Orthop Surg Traumatol.* 2010;20:37–42.
18. Carr JB. Surgical treatment of the intra-articular calcaneus fractures. *Orthop Clin North Am.* 1994;25:665–75.

19. Chan S, Ip FK. Open reduction and internal fixation for displaced intra-articular fractures of the os calcis. *Injury.* 1995;26:111–5.
20. Lim EVA, Leung JPE. Complications of intraarticular calcaneal fractures. *Clin Orthop.* 2001;391:7–16.
21. Weber M, Lehmann O, Sagesser D, Krause F. Limited open reduction and internal fixation of displaced intra-articular fractures of the calcaneum. *J Bone Joint Surg Br.* 2008;90:1608–16.

Cite this article as: Halwai MA, Wani IH, Gani N, Farooq M, Kutchay GA, Bashir A. Displaced calcaneal fractures, midterm results of the sinus tarsi approach and screw fixation. *Int J Res Orthop* 2019;5:573-7.