



SINUS TARSI APPROACH IN MANAGEMENT OF DISPLACED INTRA-ARTICULAR FRACTURES OF CALCANEUM. IS IT REASONABLE!

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ABSTRACT

Background: The optimal method for treating intra-articular fractures of the calcaneus remains controversial. Extensile approaches allow excellent fracture exposure, but high rates of wound complications are seen. To lower the wound complications, a minimal incision approach at the sinus tarsi has been proposed. The aim of this study was to observe the results of this approach. **Methods:** The study was conducted over a period of 7 years from January 2015 to January 2022. A total of 100 patients were included in this study. After admission to hospital, CT scan with coronal and axial images were analysed. Fractures were classified according to Sander's Classification for calcaneal fractures. Clinical assessment was done according to American Orthopaedic foot and Ankle society (AOFAS) hind foot score. Additionally, all patients were contacted and asked to return for a research visit that included radiography and clinical examination. **Results:** A total of 100 patients were operated (male:67, female:33). The mean age of patients in our study was 42.5 years (male 40.5yrs, female 44.5yrs). 40% Of cases had Excellent score, good in 47% and fair in 13% of patient. Almost more than 80% returned to pre-injury status. Heel broadening (17.5%) and Subtalar impingment (12.5%) were the most common complications encountered during our study, although in almost all patients they were not a big problem clinically. **Conclusion:** The advantages of sinus tarsi approach observed in our study include restoration of the dimensions of calcaneus to pre fracture levels through a small incision, avoiding complications of lateral extensile approach. Thus it looks reasonable to use sinus tarsi approach for calcaneal fracture management when indicated.

KEYWORDS

calcaneal fractures; extensile lateral approach; minimally invasive; sinus tarsi approach

INTRODUCTION

Calcaneus, the largest bone of the foot is the major weight bearing osseous structure in the foot. Calcaneal fractures are commonly encountered clinical injuries resulting from high-energy trauma. Calcaneus fractures comprise 1% to 2% of all fractures of the human body, and 60% of all tarsal bones injuries [1]. High-energy axial traumas, such as fall from height or motor accidents, are the common causes for calcaneal fractures. There are 2 types of calcaneal fractures; extra-articular and intra-articular. 60% to 75% of calcaneal fractures are displaced intra-articular calcaneal fractures [2,3]. DIACFs (Displaced Intra-articular fractures) can cause hindfoot deformities and long-term disability due to pain and chronic stiffness, and serious economic implications. The treatment of displaced intra-articular calcaneal fractures remains challenging and controversial due to their complexity[4].

Controversies exist regarding an adequate surgical approach to produce optimal postoperative outcomes for a calcaneus fracture [5]. There was feeling of negativity and pessimism attached with treatment of calcaneal fractures throughout history. Cotton in 1916 said "The Man who breaks his heel bone is done". Calcaneal fractures are serious and debilitating injuries in which end results continue to be incredibly bad (Conn in 1935).

Treatment options consist of

- Conservative Treatment
- Extensile lateral approach
- Minimally invasive approach (Sinus Tarsi approach)

Factors for better patient outcome:

- Younger age group
- Simple pattern fractures
- Bohlers angle 0-14
- Articular reduction
- Subtalar motion

Factors for worse outcome

Patient factors

- Smoking
- Diabetes
- Peripheral vascular disease

Anatomical factors

- Bilateral
- Open
- Comminution
- Stiffness
- Edema

For decades, an extensile lateral approach has been considered to be a gold-standard modality to access a calcaneus fracture, providing both complete exposure of the calcaneus and convenience of plate application [6]. But complications like wound dehiscence, infection, lateral wall necrosis, subtalar arthritis, heel widening, [7,8]. Besides hematoma formation, sural nerve neuropathy, and complex regional pain syndrome make it less desirable and search for a technique devoid of these complications [9-11].

To lower the wound complications, a minimal incision approach at the sinus tarsi has been proposed [12-14]. Minimally invasive osteosynthesis using sinus tarsi approach is a middle path approach between open reduction internal fixation using lateral extensile approach and conservative management[7,15,16,17]. Its advantages are restoration of anatomical contours of calcaneum like calcaneal height, width, restoration of calcaneal length, visualisation of posterior facet and no need for extensile lateral approach and no guilt of not restoring anatomy as in conservative treatment [18,19]. In addition, there were reports that the operation time was relatively short and the functional outcome was excellent compared to the extensile lateral approach [12,20].

MATERIALS AND METHODS

The study was conducted at bone and joint hospital barzullah srinagar and AMINA Hospital Srinagar from January 2015 to January 2022. The inclusion criteria were as follows:

- 1) Age >18 years.
- 2) Closed fracture of the calcaneum.
- 3) Sanders types II, III and IV fractures.
- 4) Duration of injury within 3 weeks of trauma.

Exclusion Criteria

1. Extra articular fractures
2. Sanders type I fractures
3. Associated major fractures which hampers postoperative rehabilitation
4. Patients with associated neurological disorders
5. Bilateral calcaneal fractures
6. History of calcaneal, ankle, or other foot fractures

After admission to hospital, CT scan with coronal and axial images were analysed to determine displacement of the articular surface of posterior facet and number and location of articular fracture fragments. Fractures were classified according to Sander's Classification for calcaneal fractures. Complete resolution of the swelling and the wrinkle sign were used to judge when the patients were ready for surgery. All other routine investigations were done before surgery.

Operative Technique

All patients were operated under spinal anaesthesia and pneumatic tourniquet was applied. Preoperative antibiotic was given religiously in all patients. The patients were draped and placed in lateral decubitus position. C-Arm is mandatory in all cases. A 2-3 cm incision was made over the sinus tarsi (beginning from the tip of the lateral malleolus to the proximal cuboid). The incision lies in a plane between the superficial peroneal nerve and the sural nerve and after the skin incision the dissection is done bluntly to protect the above said nerves. By mobilizing the sinus tarsi fat pad dorsally, the incision was deepened. Posterior facet was exposed and elevated under vision (fig.1)

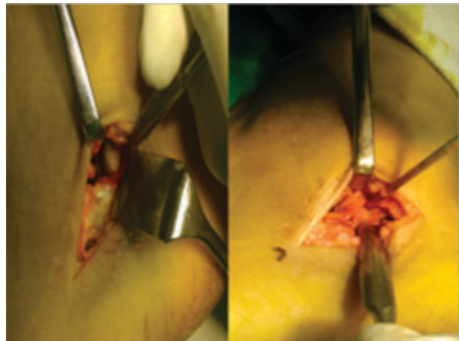


Figure 1

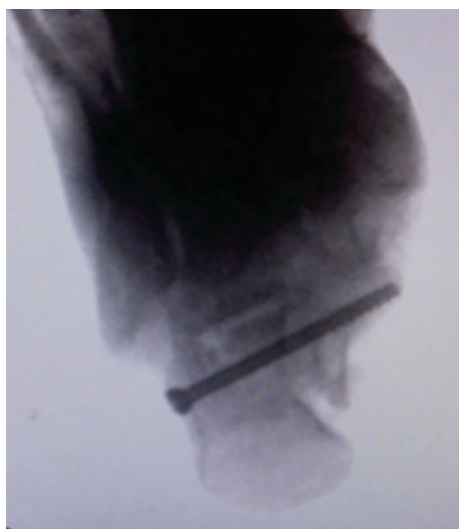


Figure 2

Provisional fixation was done with K wires. Once articular surface was restored, a subchondral screw was passed from lateral to medial in posterior to anterior direction directed towards sustentaculum tali. Once screw enters sustentaculum tali the feel of screw purchase changes from soft to hard. Screw position was checked under C-Arm in axial view at this time (fig 2).

A Steinmann pin was passed from medial to lateral in calcaneal tuberosity with equal lengths of pin on either side of tuberosity. Traction was applied on pin and at same time valgus stress was applied to correct varus deformity. While maintaining traction on pin and calcaneal length and heel valgus restored, provisional fixation was done with K wires. And finally two parallel screws were passed from posterior to anterior part of calcaneum for fixation, and its position confirmed on image intensifier (fig 3a,3b).



Figure 3a



Figure 3b

Wound was closed and below knee cast applied for 6 weeks with absolute non weight bearing on the involved side.

A. Clinical assessment; was done according to American Orthopaedic foot and Ankle society (AOFAS) hind foot score [7,10,21,22]. This scoring was graded as follows:

- Excellent: More than 90
- Good: 80-90
- Fair: 70-79
- Poor: Less than 69

B. Radiographic outcome;

- Bohler's angle
- Gissane angle

OBSERVATION AND RESULTS

The patients were operated from January 2015 to January 2022. The total number of 100 patients were operated. The records of patients were collected meticulously over this period. All cases were operated by same two consultants. The highest follow up was six years, average was three years.

Demographic details			
	Male	Female	All
N	67	33	100
Mean age in years	40.5	44.5	42.5

Percentage of patients according to Sander's Classification		
Type	N	%
II	60	60
III	30	30
IV	10	10

AOFAS Scale was used for clinical evaluation of the ankle and hind foot and outcome scores were calculated accordingly. 40% of cases had Excellent score, good in 47% and fair in 13% of patient. Almost more than 80% returned to pre-injury status.

Outcome score	
Result (AOFAS Scale)	Percentage
Excellent	40%
Good	47%
Fair	13%

Complications

Heel broadening (17.5%) and Subfibular impingement (12.5%) were the most common complications encountered during our study, although in almost all patients they were not a big problem clinically. Other minor complications like superficial wound infection and minimal wound break down were managed on out patient basis as no patient needed admission for the same. Two patients developed complex regional pain syndrome which resolved over a period of time after physiotherapy/exercises.

DISCUSSION

The statements: "The Man who breaks his heel bone is done" (Cotton 1916) and "Calcaneal fractures are serious and debilitating injuries in

which end results continue to be incredibly bad” (Conn 1935) from the stalwarts of their own eras show early pessimism associated with calcaneal fractures. Over period of years, treatment options have evolved, consisting of conservative and operative treatment options. Conservative treatment consists of short leg cast and non weight bearing for three months. Operative management of calcaneal fractures consists of restoration of calcaneus bone to pre-fracture dimensions. It involves restoration of calcaneal length, calcaneal height, pre-fracture heel valgus, restoration of calcaneal articular facets. Lateral extensile approach works on same philosophy, restoring calcaneus to pre fracture dimensions, but it has some serious complications most notably wound complications, lateral wall necrosis with complication rate approaching to 50% in some studies. To avoid complications of lateral extensile approach and non restoration of pre-fracture anatomy in conservative treatment, sinus tarsi approach has been advocated. It avoids complications of lateral extensile approach but restores dimensions of calcaneus to pre fracture levels, which can not be done in conservative treatment. There is less infection, less blood loss, less time of surgery, no lateral wall necrosis or wound dehiscence. It is an easy technique to learn.

CONCLUSION

The advantages of sinus tarsi approach in restoring the dimensions of calcaneus to pre fracture levels through a small incision, avoiding complications of lateral extensile approach, it looks reasonable to use sinus tarsi approach for calcaneal fracture management when indicated. In conclusion, the sinus tarsi approach is a reliable treatment for displaced intraarticular calcaneal fractures. This method exposes the surfaces of subtalar joint adequately and recovers the Böhler angle and the Gissane angle well. In addition, it correctly aligns the calcaneus, and reduces the incidence of wound complications.

REFERENCES

- Zwipp H, Rammelt S, Barthel S. Fracture of the calcaneus. *Unfallchirurg* 2005;108:748.
- Sanders R. Displaced intra-articular fractures of the calcaneus. *J Bone Joint Surg Am* 2000;82:225–50.
- Besch L, Schmidt I, Mueller M, et al. A biomechanical evaluation to optimize the configuration of a hinged external fixator for the primary treatment of severely displaced intraarticular calcaneus fractures with soft tissue damage. *J Foot Ankle Surg* 2008;47:26–33.
- Meng et al. Clinical application of the sinus tarsi approach in the treatment of intra-articular calcaneal fracture *Medicine* (2018) 97:13(e0175)
- Essex-Lopresti, P. The mechanism, reduction technique, and results in fractures of the os calcis. *Br. J. Surg.* 1952, 39, 395–419.
- Tennent, T.D.; Calder, P.R.; Salisbury, R.D.; Allen, P.W.; Eastwood, D.M. The operative management of displaced intra-articular fractures of the calcaneum: A two-centre study using a defined protocol. *Injury* 2001, 32, 491–496.
- Abidi, N.A.; Dhawan, S.; Gruen, G.S.; Vogt, M.T.; Conti, S.F. Wound-healing risk factors after open reduction and internal fixation of calcaneal fractures. *Foot Ankle Int.* 1998, 19, 856–861.
- Lim, E.V.; Leung, J.P. Complications of intraarticular calcaneal fractures. *Clin. Orthop. Relat. Res.* 2001, 391, 7–16.
- Wu, Z.; Su, Y.; Chen, W.; Zhang, Q.; Liu, Y.; Li, M.; Wang, H.; Zhang, Y. Functional outcome of displaced intra-articular calcaneal fractures: A comparison between open reduction/internal fixation and a minimally invasive approach featured an anatomical plate and compression bolts. *J. Trauma Acute Care Surg.* 2012, 73, 743–751.
- Yeo, J.-H.; Cho, H.-J.; Lee, K.-B. Comparison of two surgical approaches for displaced intra-articular calcaneal fractures: Sinus tarsi versus extensile lateral approach. *BMC Musculoskelet. Disord.* 2015, 16, 63.
- Weber, M.; Lehmann, O.; Sägeser, D.; Krause, F. Limited open reduction and internal fixation of displaced intra-articular fractures of the calcaneum. *J. Bone Jt. Surgery. Br. Vol.* 2008, 90, 1608–1616.
- Holmes, G.B., Jr. Treatment of displaced calcaneal fractures using a small sinus tarsi approach. *Tech Foot Ankle Surg* 2005, 4, 35–41.
- Schepers, T.; Kieboom, B.C.; Bessems, G.H.; Vogels, L.M.; van Lieshout, E.M.; Patka, P. Subtalar versus triple arthrodesis after intra-articular calcaneal fractures. *Strateg. Trauma Limb Reconstr.* 2010, 5, 97–103.
- Wiley, W.B.; Norberg, J.D.; Klunk, C.J.; Alexander, I.J. “Smile” incision: An approach for open reduction and internal fixation of calcaneal fractures. *Foot Ankle Int.* 2005, 26, 590–592.
- Stulik J, Stehlik J, Rysavy M, Wozniak A (2006). Minimally Invasive treatment of intra-articular fractures of the calcaneum. *J Bone Joint Surg B* 88:1634-1641.
- Westphal T, Piatek S, Halm J, Schubert, Winckler. Outcome of surgically treated intraarticular calcaneus fractures—SF-36 compared with AOFAS and MFS. *Acta Orthop.* 2004;75(6):750–5.
- Lu D, Zhu SY, Yang J, Chen H, Sun LJ. IA comparison of two minimally invasive procedures for intra-articular displaced calcaneal fractures in older children. *Acta Orthop Belg.* 2016;82(4):779–86.
- Al-Mudhaffar M, Prasad C, Mofidi A. Wound complications following operative fixation of calcaneal fractures. *Injury.* 2000;31(6):461–4.
- Benirschke SK, Kramer PA. Wound healing complications in closed and open calcaneal fractures. *J Orthop Trauma.* 2004;18(1):1–6.
- Hospodar, P.; Guzman, C.; Johnson, P.; Uhl, R. Treatment of displaced calcaneus fractures using a minimally invasive sinus tarsi approach. *Orthopedics* 2008, 31, 1112.
- Folk JW, Starr AJ, Early JS. Early wound complications of operative treatment of calcaneus fractures: analysis of 190 fractures. *J Orthop Trauma.* 1999;13(5):369–72.
- Harvey EJ, Gruijic 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(11):868–73.