Mini approach and percutaneous fixation of intra-articular calcaneous fractures

Taher A. Eid, Ahmed Shams, Mohamed El-Sawy

Orthopedic Surgery Department, Faculty of Medicine, Menoufia University, Shebin El-Kom, Egypt

Correspondence to Taher A. Eid, Assistant Professor Orthopedic Surgery Department Faculty of Medicine Menoufia University, Menoufia, Egypt. Mob: +201006639362; e-mail: tahereid1@yahoo.com

Received 6 May 2014
Accepted 15 June 2014

The Egyptian Orthopaedic Journal
2017, 52:134–138

Introduction
Intra-articular calcaneous fracture is one of the most aggravating fractures if not properly managed. Open reduction and internal fixation are associated with high incidence of postoperative soft-tissue complication. Closed reduction and percutaneous fixation had a high incidence of postoperative subtalar osteoarthritis due to an improper reduction of the articular surface, and therefore the mini approach was used for restoring the articular surface and for fixing the fracture by K-wires.

Patients and methods
A total of 22 patients with 27 intra-articular calcaneous fractures from March 2009 to July 2012 were treated at Menoufia University Hospital. All patients were treated with the miniapproach and percutaneous K-wire fixation for intra-articular calcaneous fractures. The patient sample included 15 males and seven females. In 14 patients, the fractures were caused by falling from heights, whereas in eight patients the cause was road traffic accidents. Five patients had bilateral fractures. According to Sander's Classification, 13 fractures were of type II, 10 were type III, and four were type VI.

Results
The average age was 29 years with a range of 21–55 years. The mean follow-up period was 16 months with a range of 12–36 months. The average union period of fractures was 12 weeks, ranging from 10 to 16 weeks. Seven patients had wedge fracture of the dorsolumbar spine but without neurological manifestation. The average operative time was 53 min with a range of 37–109 min. The clinical results according to the Maryland foot score revealed 21 (78%) cases with satisfactory scores (eight excellent and 13 good) and six cases (22%) with unsatisfactory results (four moderate and two poor).

Conclusion
Percutaneous treatment of fracture calcaneous minimizes soft-tissue complications and postoperative scar formation, which improves functional outcome. The miniapproach for elevation of depressed posterior facet restores joint congruity and decreases late subtalar arthritis.

Keywords:
Calcaneal fracture, miniapproach, percutaneous fixation

Egypt Orthop J 52:134–138

1110-1148

Introduction

The incidence of calcaneal fractures has been presumed to be around 2% of all fractures presenting to emergency departments, and the proportion of intra-articular calcaneal fractures represent about 75% of all calcaneal fractures [1,2].

Although there are different types of treatment, either operative or conservative treatment, intra-articular fractures carry a high morbidity incidence [3,4].

Open reduction is associated with high incidence of secondary damage to soft tissues after extensive surgical procedures. The reported rates of wound edge necrosis vary between 2 and 11% and those of soft tissue infections vary between 1.3 and 7% after plate fixation via an extended lateral approach. To avoid soft-tissue complications, several less-invasive procedures have been introduced [5,6].

Westhues [7] was the first surgeon who introduced the method of closed reduction with percutaneous pinning fixation and subsequent plaster immobilization. This technique was later modified and popularized by Gissane and Essex-Lopresti. More recently, this method has been advocated for tongue-type fractures with the posterior calcaneal

facet to the subtalar joint being displaced as a whole [7,8].

Patients and methods

Twenty-two patients with 27 intra-articular calcaneous fractures from March 2009 to July 2012 were treated at Menoufia University Hospital. All patients were treated with the miniapproach and percutaneous Kirschner wire (K-wire) fixation of intra-articular calcaneous fractures. Fifteen patients were males, and seven patients were females. In 14 patients, the cause was falling from heights, whereas in eight patients the cause was road traffic accident. Five patients had bilateral fractures. Preoperative clinical evaluation was carried out to detect soft-tissue damage and the presence of associated injuries. Radiological assessment by anteroposterior, lateral, and axial radiograph of the ankle for preoperative diagnosis was carried out, as well as assessment of the Bohler's and the crucial angle of Gissane. Preoperative computed tomography was performed for all patients for classification and surgical planning. According to Sander's classification [9], 13 fractures were type II, 10 were type III, and four were type VI. Surgery was performed within the first week after the injury.

Surgical technique

Spinal anesthesia was preferred for good postoperative pain control. The lateral decubitus position was used with the patient lying on the unaffected side with the knee flexed to the injured side, supported by a pillow to facilitate manipulation and c-arm monitoring. In bilateral cases, one side was operated first and then the position was changed.

With the use of a pneumatic tourniquet, the foot, ankle, and leg were sterilized till the knee level. One gram of third-generation cephalosporin was administered just before tourniquet inflation.

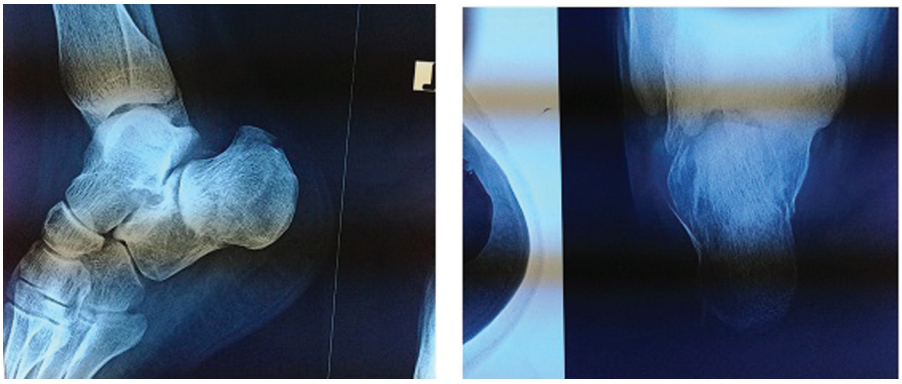
A 1–2-cm-long transverse incision was used just below the level of the tip of the lateral malleolus and guided by the image intensifier. A small, tipped, periosteal elevator was introduced through the incision and then through the lateral wall of the os calsis till the inner cortex of the medial wall. Disimpaction and reduction of the body fragment were performed under fluoroscopic control. With the use of the periosteal elevator, the depressed posterior thalamic fragment was reduced under its talar location.

A 5-mm K-wire was passed under the posterior facet till the angle of Gissane perpendicular to the fracture site. By plantarly flexing the ankle and bending the K-wire with the use of the power drill, the fragment can be reduced. Broadening was reduced by using the Omoto [10] technique to achieve compression, using the bimanual grip through the lateral and medial surfaces. Supplementary compression can be achieved by using a soft-tissue self-spinal retractor.

Fixation can be maintained by using a two-threaded 2-mm K-wire passing from the posteroinferior calcaneal surface of the posterior facet till the talus. The bended K-wire was then removed. Another two-threaded 2-mm K-wire can be used, with the first one in the calcaneocuboid direction and the second one in calcaneonavicular direction. Concomitant lateral wall and sustantacular fractures were fixed by separate K-wires.

Postoperative elevation of the injured side over a pillow was carried out to decrease postoperative edema. Parenteral antibiotics were administered for 2 days followed by oral antibiotics for 10 days and anti-edematous drugs. Patients were followed up at 2, 4, and 6 weeks and then every month. The stitches were

Figure 1



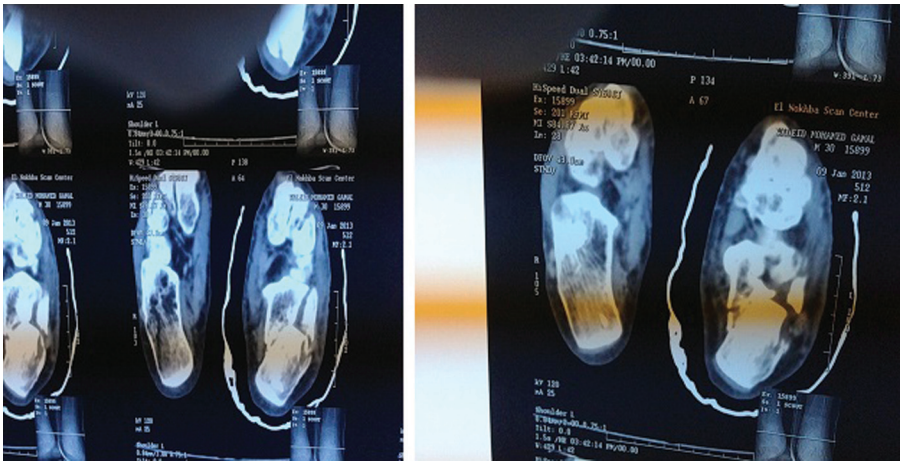
Preoperative radiograph, lateral and axial view.

removed on the second postoperative week. Cast below the knee was applied for 1 month. The K-wire was removed on the sixth postoperative week. Inversion and eversion exercises were encouraged with no weight bearing till the third postoperative month. Radiographs were taken before K-wire removal and before weight bearing Figs. 1–4.

Results

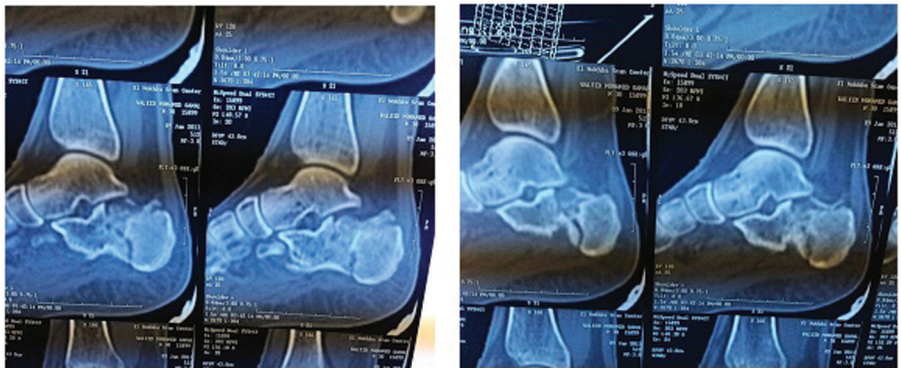
The average age of our patients was 29 years with a range of 21–55 years. The mean follow-up period was 16 months with a range of 12–36 months. The average union period of fracture was 12 weeks with a range of 10–16 weeks. Seven patients had a wedge fracture of

Figure 2



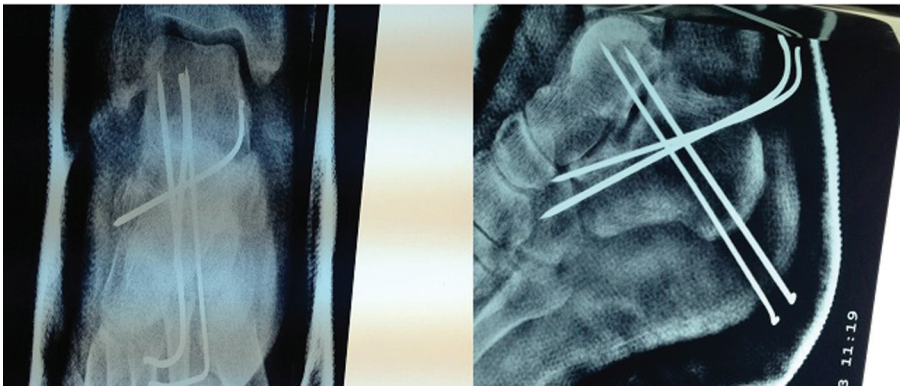
Preoperative computed tomography axial cuts.

Figure 3



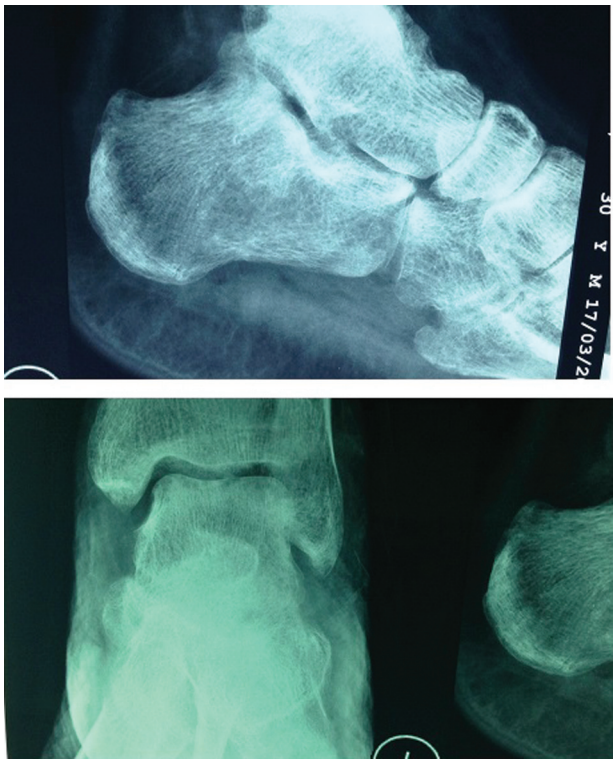
Preoperative computed tomography sagittal cuts.

Figure 4



Postoperative radiograph at one-and-half months.

Figure 5



Three-months postoperative radiograph.

Figure 6

1.5-Year postoperative radiograph.

the dorsolumbar spine but without neurological manifestation. The average operative time was 53 min with a range of 47–109 min. The clinical results according to the Maryland foot score revealed 21 (78%) cases with satisfactory results (eight excellent and 13 good) and six (22%) cases with unsatisfactory results (four moderate and two poor). Three patients had superficial pin-tract infections around the K-wires that resolved completely after removal and with antibiotics (Figs. 5–6).

Discussion

Increased incidence of wound complications after extensile open approach of treatment for calcaneal fractures was the main cause for developing the percutaneous fixation as an alternative method of treatment [11–13].

There were no wound complications and no soft-tissue problems in this study, and only three patients had superficial pin-tract infections. Percutaneous fixation using small stab incisions of 1–2 cm reduces the risk of postoperative complications regarding wound healing and the amount of scar formation leading to postoperative stiffness of the subtalar joint that regularly occurs after open reduction and lateral plate fixation despite careful preparation and anatomical reduction [14,15].

Tornetta [16] reported good to excellent results in 85% of his patients with the Maryland foot score. Reviewing his study revealed that 37 (87%) of his patients had Type II and only five (13%) had Type III fractures, but in our study 13 (48%) were type II, 10 (37%) were type III, and four (15%) were type VI according to Sander's Classification.

Anatomic reduction of the calcaneal articular surface of the subtalar joint cannot be achieved with percutaneous methods alone in the majority of calcaneal fractures due to the deep impaction of the posterior facet fragment into the calcaneal body and multiple fragmentation; therefore, mini-incision was used to reduce the risk of inadequate reduction of the posterior facet, which led to inferior functional scores and a higher rate of post-traumatic subtalar arthritis [17–19].

Conclusion

Percutaneous treatment of fracture calcaneous minimizes soft-tissue complications and postoperative scar formation, which improves functional outcome. Miniapproach for elevation of depressed posterior facet restores joint congruity and decreases late subtalar arthritis.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1 Atkins RM, Allen PE, Livingstone JA. Demographic features of intra-articular fractures of the calcaneum. Foot Ankle Surg 2001; 7:77–84.

2 Bajammal S, Tornetta P III, Sanders D, Bhandari M. Displaced intra-articular calcaneal fractures. J Orthop Trauma 2005; 19:360–364.

3 Buckley R, Tough S, McCormack R, Pate G, Leighton R, Petrie D, Galpin R. Operative compared with nonoperative treatment of displaced intra-articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. J Bone Joint Surg Am 2002; 84-A:1733–1744.

4 Essex-Lopresti P. The mechanism, reduction technique, and results in fractures of the os calcis. Br J Surg 1952; 39:395–419.

5 Abidi NA, Dhawan S, Gruen GS, Vogt MT, Conti SF. Wound-healing risk factors after open reduction and internal fixation of calcaneal fractures. Foot Ankle Int 1998; 19:856–861.

6 Bezes H, Massart P, Delvaux D, Fourquet JP, Tazi F. The operative treatment of intraarticular calcaneal fractures: indications, technique, and results in 257 cases. Clin Orthop Relat Res 1993; 290:55–59.

7 Westhues H. A new method of treatment of calcaneal fractures. Arch Orthop Unfallchir 1934; 35:121.

8 Rammelt S, Amlang M, Barthel S, Gavlik J-M., Zwipp H. Percutaneous treatment of less severe intraarticular calcaneal fractures. Clin Orthop Relat Res 2010; 468:983–990.

9 Sanders R, Fortin P, DiPasquale T, Walling A. Operative treatment in 120 displaced intraarticular calcaneal fractures. Results using a prognostic computed tomography scan classification. Clin Orthop 1993; 290:87–95.

10 Omoto H, Nakmura K. Manual reduction of displaced intra-articular fracture of the calcaneous; techniques, indications and limitation. Foot Ankle Int 2001; 22:874–879.

11 Folk JW, Starr AJ, Early JS. Early wound complications of operative treatment of calcaneus fractures: analysis of 190 fractures. J Orthop Trauma 1999; 13: 369–372.

12 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; 22:868–873.

13 Fernandez DL, Koella C. Combined percutaneous and “minimal” internal fixation for displaced articular fractures of the calcaneus. Clin Orthop Relat Res 1993; 290:108–116.

14 Sanders R. Displaced intra-articular fractures of the calcaneus. J Bone Joint Surg Am 2000; 82:225–250.

15 Walde TA, Sauer B, Degreif J, Walde H-J. Closed reduction and percutaneous Kirschner wire fixation for the treatment of dislocated calcaneal fractures: surgical technique, complications, clinical and radiological results after 2–10 years. Arch Orthop Trauma Surg 2008; 128:585–591.

16 Tornetta P III. Percutaneous treatment of calcaneal fractures. Clin Orthop Relat Res 2000; 375:91–96.

17 Benirschke SK, Sangeorzan BJ. Extensive intraarticular fractures of the foot: surgical management of calcaneal fractures. Clin Orthop Relat Res 1993; 292:128–134.

18 Boack DH, Wichelhaus A, Mittlmeier T, Hoffmann R, Haas NP. Therapy of dislocated calcaneus joint fracture with the AO calcaneus plate [in German]. Chirurg 1998; 69:1214–1223.

19 Schepers T, Patka P. Treatment of displaced intra-articular calcaneal fractures by ligamentotaxis: current concepts’ review. Arch Orthop Trauma Surg 2009; 129:1677–1683.