Arthroscopic subtalar arthrodesis in malunited fracture calcaneus

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Background
Post-traumatic subtalar arthritis is one of the most common complications of calcaneal fracture. Subtalar arthritis with its sequel may not meet the patient's needs or lifestyle and has a huge impact on the work force and society. The aim of this study was to evaluate the results of arthroscopic subtalar arthrodesis using two posterior portals in patients with subtalar arthritis type 1 Zwipp classification after calcaneal fracture.
Patients and methods
A prospective study was carried out on 15 heels in 15 consecutive patients with subtalar arthritis type 1 Zwipp classification after a calcaneal fracture for which nonoperative treatment had failed; arthroscopic subtalar arthrodesis was performed using cannulated screws.
The mean patient age at the time of surgery was 38 (range: 28–48) years. The average preoperative American Orthopaedic Foot and Ankle Society hind foot score was 43.4 (range 38–57) and the average preoperative visual analogue scale was 8.6 (range: 8–9). The average follow-up period was 36 (range: 30–38) months. One patient was lost to follow-up at the 20th month.
Results
The average postoperative American Orthopaedic Foot and Ankle Society hind foot score was 89.2 (range: 81–95; $P<0.01$), which is significantly high. The average postoperative visual analogue scale score was 2.4 (range: 1–4). The union rate was 100%.
Conclusion
Isolated subtalar arthrodesis using two posterior portals yields good functional results, high safety, and efficacy and a low complication rate with significant clinical improvements as a salvage procedure of G1 post-traumatic subtalar arthritis. Level of Evidence: IV.

Keywords:
arthroscopic, malunited calcaneus, subtalar

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Introduction

Post-traumatic subtalar arthritis is one of the most common complications of calcaneal fractures. These patients may need to change their lifestyle and jobs.

Subtalar arthrodesis is a good option to treat this problem and isolated subtalar arthrodesis is superior to double or triple arthrodesis to preserve some hind foot mobility [1].

The subtalar joint is a complex and functionally important joint of the lower extremity that plays a major role in the movement of inversion and eversion of the foot [2]. The frequency of calcaneal fractures is 60–75% of all tarsal bone injuries [3]. Most of them are intra-articular (56–75%) [4].

The wedge-shaped inferior surface of talus has its impact force on the posterior facet of subtalar joint [5]. As the talus is impacted further into the fracture, the inferior articular surface becomes affected and subsequently accelerates the arthritic changes.

It is known that the function of the talon avicular joint has the greatest influence on overall hind foot function [6]. Isolated subtalar arthrodesis is superior to double or triple arthrodesis as it preserves some hind foot mobility, thereby being of smaller risk for secondary degenerative disease of neighboring joints and nonunion or malunion of the tarsal transversal joint [1].

Our aim is to evaluate prospectively the results of arthroscopic subtalar arthrodesis using two posterior portals in patients with a type 1 Zwipp classification [7].

Our hypothesis in malunited fracture calcaneus, there are some sequels as subtalar arthritis and soft tissue affection with entrapment of tendons. Arthroscopy is a low invasive technique and preserves blood supply of the surrounding soft tissues from further damages with preservation of proprioception.

Patients and methods

After approval of ethical review board, a prospective study was carried out on 15 consecutive patients diagnosed with post-traumatic isolated subtalar arthritis (type 1 Zwipp classification) (Table1, Figs. 1 and 2).

Arthroscopic subtalar arthrodesis was performed using two posterior portals.

The exclusion criteria were types 2, 3, and 4 Zwipp classifications (Figs 1 and 2).

All patients provided their informed consent before their inclusion in the study. A careful assessment of history and physical examination were performed to assess the problems after the calcaneal fracture and identify the cause of pain. Radiographs were performed and preoperative scores using the American Orthopaedic Foot and Ankle Surgery (AOFAS) scale, and visual analogue scale (VAS) were documented for every case. We assessed the surgical time, hospitalization period, union time, and union rate.

We used 4.0-mm 30° arthroscope, 5.5-mm full-radius blades, a burr, an osteotome, a 21-G needle, K-wires, Drill, small curettes, pituitary, probes, and graspers with a normal saline and gravity system.

Under G/A or spinal anesthesia and using a thigh tourniquet, the patient is placed in the prone position. Subtalar arthroscopy is performed by the posterolateral and posteromedial portals.

In the prone position, it is easy to reach both the posteromedial and the posterolateral area of subtalar joint, and it also has the advantage of easy examination of the ankle joint posteriorly in addition to the release of FHL, which is usually impinged.

Table 1 Zwipp classification of calcaneal malunions

Type 1: subtalar incongruence
Type 2: plus hind foot varus/valgus
Type 3: plus loss of height
Type 4: plus translation
Type 5: plus talar tilt

First, we have to identify FHL and then debride all accessory callus and fibrosis to identify the ankle and subtalar joint. All sclerotic and avascular bone should be removed because this influences union rates. This stage should be meticulous and carried out with great care to avoid posterior tibial nerve, peroneal tendons injury, or misdirection of the subtalar joint.

A shaver or a curette is used to make a point of entry into the subtalar joint. The articular surfaces of posterior facets of the subtalar joint are denuded to the subchondral bone with small curettes until the subchondral cancellous surface appears (Fig. 3a).

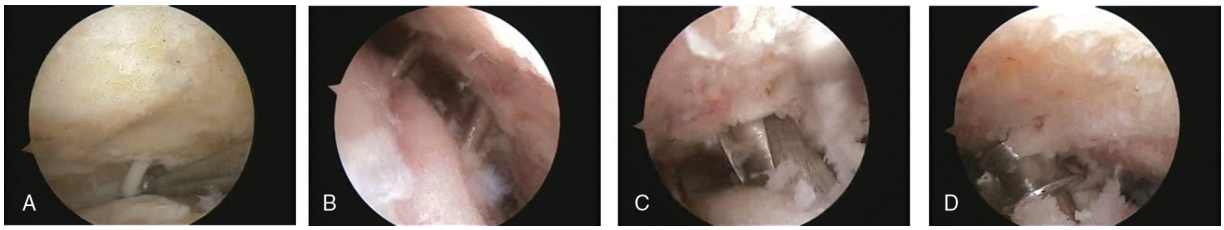
Figure 1

X ray of male patient 34 years of with history of RT calcaneus fracture since one year there is subtalar arthritis (black arrow) with sclerosis in subarticular surface.

Figure 2

CT sagittal section of LT calcaneal for male patient 28 years old with history fracture since 8 months note the joint depression (black arrow) with sub-articular sclerosis (red arrow).

Figure 3



Subtalar joint RT side viewed from posterolateral portal shows. (A) Joint debridement using small curette. (B) Wire introduction under arthroscopic vision. (C) Using cannulated drill bit. (D) Assessment the compression during screwing.

Figure 4

Postoperative X ray of male patient 30 years old with history of calcaneus fracture 10 months ago, arthroscopic subtalar arthrodesis with 2 cannulated screws, note the divergent direction of both screws for equal distribution of compression.

Joint debridement is performed; about 1–2 mm of the subchondral bone of both the talar and the calcaneus side is required for getting a bleeding surfaces and they should be parallel and compatible together, which is ideal for primary bony healing. By using a small long sharp osteotome, longitudinal multiple fish-scaling and micro fractures of the subchondral bone are performed to enable a very good chance for union.

An accessory anterolateral portal may be used to distract the joint using the trocar. Medial and lateral sides of the talus and calcaneus should be checked well for complete sound debridement.

Two guide pins are introduced in the direction from the posterioplanter aspect of the calcaneal tuberosity to the talar body under an image intensifier and we chick them also by arthroscope (Fig. 3b).

Two cannulated cancellus screws 7 mm were used in 13 patients, whereas in the other two cases, we used a single screw. We checked for good compression during screwing by arthroscopy and fluoroscopy (Fig. 3c and d). We did not use bone grafting; also, we did not use traction.

A well-padded slab is used for 1 week, followed by a below-knee cast for an additional 4 weeks. Free ankle motion is allowed in the sixth week. Partial weight bearing is allowed using two crutches for two weeks and then full weight bearing is started after that. Patients are advised to wear well-cushioned shoes. Postoperative radiograph was performed after 6, 10, and 16 weeks to assess the union (Figs 4–6).

Statistical analysis

Data collected were reviewed and coded, and statistical analysis was carried out using SPSS program version 16. The χ^2-test was used for comparison of qualitative data. Analysis of variance test was used for quantitative data. The level of significance was considered at a P value of up to 0.05.

Results

The average age of the patients at the time of the operation was 38 (range: 28–48) years; there were 13 men and two women. Ten patients were operated on the right feet, whereas five cases were operated on the left feet.

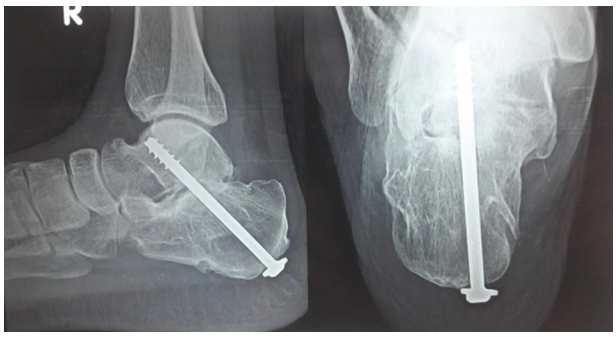
The average duration of complaint after the date of fracture treatment was 2 (range: 0.5–3) years. The surgical time varied between 98 and 50 min depending on the learning curve.

The mean hospitalization period was 1.8 (range: 1–2) days. The average follow-up period was 36 (range: 30–38) months. One patient was lost to follow-up at the 20th month.

The union rate was 100%, ranging from 8 to 12 weeks, with an average of 8.6 weeks.

The union was achieved after 10 weeks in three patients and after 8 weeks in 11 patients. The union was achieved at the 12th week in one patient (who had type II diabetes and was a smoker of 30 cig/day). The operation time was 90 min. He received the same postoperative protocol, but partial weight bearing was allowed after 10 weeks and then full weight bearing started after the 12th week; he returned to daily activities after 18 weeks with moderate daily pain.

Figure 5



Postoperative X-ray of male patient 28 years old with history of calcaneus fracture 14 months before, arthroscopic subtalar arthrodesis with one cannulated screw.

The average preoperative AOFAS hind foot score was 43.4 (range: 38–57) and the average postoperative score was 89.2 (range: 81–95; $P<0.01$) (Table 2). The preoperative VAS average score was 8.6 (range: 8–9) and the postoperative VAS average score was 2.4 (range: 1–4) (Table 3).

At the end of this study, two patients had no pain, 10 patients had mild occasional pain, and three

Figure 6

X-ray 8 weeks after arthroscopic subtalar arthrodesis shows good union in subtalar joint for a male patient 33 years old with history of implant removal 8 months before.

Table 2 Change in preoperative and postoperative American Orthopaedic Foot and Ankle Society scores.

	Preoperative	Postoperative 6 months	Postoperative 1 year	Postoperative 2 year	Postoperative 3 years	Test of significance	*P* value
Mean ±SD	43.4±4.8	84±4.3	89.7±3.8	88.5±4.1	88.5±3.6	ANOVA *F*=345	0.000 (HS)*
Minimum	38	74	81	81	81		
Maximum	57	90	95	95	92		

ANOVA, analysis of variance; *HS, highly significant.

Table 3 Change in preoperative and postoperative visual analogue scale scores

	Preoperative	Postoperative 2 year	Test of significance	*P* value
Mean±SD	8.6±0.5	2.3±1	Paired *t*-test=486	0.000 (HS)*
Minimum	8	1		
Maximum	9	4		

*HS, highly significant.

patients had moderate daily pain. Ten patients had no support and there was no limitation of activity. Four patients had no limitation of normal daily activity, but limited recreational activity

Twelve patients walked a distance of more than 150 m without aid, whereas two patients walked a distance of less than 150 m and one patient walked a distance of less than 100 m. Nine patients had no difficulty in walking on any surface, whereas six patients had some difficulty on an uneven terrain. Eleven patients had no gait abnormality and four patients had limping.

No operative complications occurred in this series. There were no complications of skin breakdown, infection, nonunion, valgus or varus angulation of the hind foot, lateral impingement, and sural neuralgia.

Discussion

Although subtalar arthrodesis is generally accepted as the procedure of choice for the treatment of post-traumatic subtalar arthritis, there were some controversies about arthroscopic arthrodesis. Joint narrowing and subtalar arthrofibrosis were suggested to be a contraindication by some authors [8,9], whereas others do not see a contraindication as long as there is no joint collapse or loss of stock bone [10].

The most important finding of our study is that arthroscopic subtalar arthrodesis using two posterior portals is an effective method of treating post-traumatic subtalar arthritis G1 with good functional outcomes and a 100% union rate.

Prone position has the advantage of reaching both the posteromedial and the posterolateral area of the subtalar joint easily to examine the ankle joint posteriorly and release of FHL, which is usually impinged.

Extensive callus and fibrous tissue in the posterior aspect of calcaneus should be shaved meticulously with identification and release of the FHL tendon.

Comparison of results among studies is relatively difficult because of the number of variables in evaluation methods and surgical techniques.

Eid *et al.* [11] subjected 16 patients to minimally invasive subtalar arthrodesis through a mini-invasive approach with a posterior iliac graft without hardware to transfix the arthrodesis of subtalar joint arthritis. Patients were followed up for a period of 40.8 (range: 36–48) months. AOFAS improved from 36 preoperatively to 78. The union rate was 94%. Complications were graft nonunion in one patient and transient tendoachilles tendinitis in another [11].

Easly *et al.* [12] reported a union rate of 84% in 148 patients after open surgical techniques. This was inferior to the reported results using arthroscopic techniques, with a healing rate ranging from 84 to 100% and a healing time ranging from 6 to 15 weeks [12].

El Shazly *et al.* [10] carried out retrospective study on 10 patients who had isolated subtalar arthritis after calcaneal fracture and were treated by posterior subtalar arthroscopic fusion using anterolateral, accessory anterolateral, and posterolateral portals. Fixation was performed by percutaneous 7-mm cannulated screws and an A–C guide through a small skin incision over the neck of the talus. The mean follow-up period was 28.4 months. They reported a statistically significant improvement in AOFAS after 2 years. The mean time for fusion was 11.44 weeks, with a union rate of 100%. One patient had painful neuroma at the site of the anterolateral portal [10].

In Scranton [13], a comparative study was carried out between open and arthroscopic subtalar arthrodesis in five patients who had arthroscopic arthrodesis with a supplemental injectable osteoinductive enhanced-graft gel. He used AL, PL, PL-acc. The length of stay decreased 1.7 days with the arthroscopic procedure, with a fusion rate of 100%. One patient required screw removal [13].

Tasto [8] operated on 25 cases of subtalararthrosis using AL; PL yielded a fusion rate of 100%, with an average time of fusion of 8.9 weeks.

In the Glanzmann and Sanhueza-Hernandez [14] study, 41 patients diagnosed with primary arthritis or post-traumatic osteoarthritis underwent arthroscopic subtalar arthrodesis using AL, PL; the fusion rate was 100% and the average time to fusion was 11 weeks. They used AOFAS and it is improved from 53 to 84 [14].

The results of our study are compatible with the results of studies that used AL and PL portals as in the studies of El Shazly *et al.* [10], Scranton [13], Tasto [8], and Glanzmann *et al.* [14], but we did not use an A–C guide as in the El Shazly *et al.* [10] study, which increase the time of operation and we used the prone position with PL and AM portals with the advantage of release of FHL. Also, we did not record any painful neuroma form the portals. The average time of fusion in this study was 8.6 weeks which is faster than their results which were 11.4, 8.9, and 11 weeks respectively.

In the Amendola *et al.* [15] study, 11 cases diagnosed with primary arthritis, post-traumatic osteoarthritis, tarsal coalition underwent arthroscopic subtalar arthrodesis using PL, PL-acc, and PM with a union rate of 91%, and the average time of fusion was 10 weeks. AOFAS improved from 36 to 86.Gomez *et al.* [16] used PL, PM, and accessory PL in 12 patients with post-traumatic arthrosis, with a fusion rate of 84% for an average of 15 weeks, but they did not use AOFAS.

Lee *et al.* [17] treated 16 cases of post-traumatic arthritis (calcaneal fracture) through PL and PM, with a fusion rate of 94% for an average of 11 weeks; AOFAS improved from 35 to 84.

The results of this study are compatible with the results studies that used PL and PM portals such as Amendola *et al.* [1], Gomez *et al.* [9], and Lee *et al.* [11]. The average time of fusion was 8.6 weeks, which is faster than their results which were 10, 15, 11 respectively. We achieved a fusion rate of 100% for all cases whoever the fusion rate at their results were 91, 84 and 94%, respectively. This might be because of the inclusion and exclusion criteria of this study and inclusion of other pathologies in their studies such as tarsal coalition and primary osteoarthritis.

In terms of hospitalization period, Scranton [15] reported an average of 1.7 days, whereas Glanzmann and Sanhueza-Hernandez [8] reported an average hospitalization duration of 2 days, and these results are compatible with the results of this study: 1.8 day.

Conclusion

Isolated subtalar arthrodesis using two posterior portals yields good functional results, high safety, and efficacy and a low complication rate with significant clinical improvements as a salvage treatment for G1 post-traumatic subtalar arthritis.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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