

Is Using Sinus Tarsi Approach with Bone Block Substitute and Screws the Optimal Plan of Treatment of Articular Calcaneus Fracture?

TA Al-Sadek¹ and A Al-Sadek²

¹Trakia University, Medical college - Stara Zagora, Bulgatria

²UMHAT Tsaritsa Joanna- ISUL, Department of Orthopedics and Traumatology- Sofia, Bulgaria

*Corresponding Author: TA Al-Sadek, Trakia University, Medical college - Stara Zagora, Bulgatria

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Abstract

Objective: To evaluate the results of fixation of intra articular calcaneus fracture using sinus tarsi approach, bone block substitute, and screws fixation.

Background: Minimal invasive techniques for treatment calcaneus fractures have been developed to overcome soft tissue complications associated with the traditional lateral approach. Sinus tarsi approach has the advantage of visualization of posterior facet of subtalar joint.

Methods: All patients underwent preoperative calcaneal lateral and axial radiographs and CT scan of the injured foot. The injury type was graded according to the Sanders classification on the basis of the CT scan findings. Bohler and Gissane angles were measured as anatomical parameters before surgery. Sinus tarsi approach was done for all patients, in addition to use of percutaneous screws fixation and bone block graft substitute.

Results: A total of 14 patients were included in our study. The mean age was 37.8years, at the end of follow up radiological evaluation was done by measuring ; Bohler angle and angle of Gissan. American Orthopaedic Foot and Ankle Society (AOFAS) ankle/hindfoot score was calculated at the end of follow-up for all the cases. Excellent results were found in 7 patients, good results in 5 patients and fair results in only 2 patients. There was statistically significant improvement of Bohler angle at the end of follow up.

Conclusion: Treatment of intra articular calcaneal fractures using sinus tarsi approach with a bone block substitute and screws can provide satisfactory clinical outcomes.

Keywords: Sinus Tarsi; Articular Calcaneus Fractures; Bone Block Substitute

Introduction

Based on Computed tomography Scan, Sanders, *et al.* [1], classified intraarticular calcaneal fracture into 4 types depending on the fracture location at the posterior articular facet. Type I fracture is nondisplaced fractures with fracture displacement less than 2mm. Type II-IV fractures are displaced intraarticular calcaneal fracture and divided by different articular pieces [1]. The optimal operative approach for the treatment of displaced intraarticular calcaneal fractures continues to be controversial [2], but anatomical reduction of the posterior facet of the subtalar joint is critical for successful outcomes [3-6].

The extended lateral L-shaped approach is commonly used for the treatment of calcaneal fractures. This approach accurately

reduces the subtalar joint, fully exposes, and addresses the intra-articular calcaneal fragments and conveniently places the plate to achieve a stable fixation. However, the wound complications' rates were reported to be as high as 30% [7]. Deep bone infection or osteomyelitis rates of 2.5% have been reported [8,9].

Minimally invasive techniques have been developed, and sinus tarsi approach being the most commonly used [10-12]. This approach protects blood supply by avoiding wide dissection and can still provide direct visibility of the subtalar joint [13]. Whether to use bone graft or not in the operative treatment of displaced intra articular fracture calcaneus is still controversial [14]. The aim of our study was to evaluate the results of treatment intra articular fracture calcaneus using sinus tarsi approach, bone block substitute, and screws.

Patients and methods

A total of 14 patients were included in our study from February 2018 to March 2020. Exclusion criteria include; open fracture, bilateral calcaneal fractures, any other fracture in the same foot or bilateral cases. All patients underwent preoperative calcaneal lateral and axial radiographs and CT scan of the injured foot. The injury type was graded according to the Sanders classification on the basis of the CT scan findings. Bohler and Gissane angles were measured as anatomical parameters before surgery. The average time between injury and surgery was 7.4 days, (ranged from 6 to 11). Written informed consent was taken from all patients before enrollment in the study.

Operative procedure

Surgery was performed under general or spinal anesthesia and under antibiotic prophylaxis. The patient was placed in a lateral position with a tourniquet at the thigh. The incision was made approximately 1 cm distal and posterior to the fibula and extended toward the base of the fourth metatarsal. Incision lengths ranged from 3-5 cm. The anterior process of the calcaneus was in the distal aspect of the wound. The peroneal tendon was identified and pulled gently in a cephalic direction. The fracture segments of the lateral wall were taken down to clearly expose the subtalar joint and the initial fracture line. Reduction techniques were done under image intensifier; included the use of distraction with a Schanz pin or 4.0-mm K-wire transversely through the tuberosity segments. The traction was directed in a backward, downward, and external-oblique motion, aiming to recover the original fracture line by aligning the interior wall, correcting the varus, shortening deformity, and restoring the Böhler angle. Temporary fixation was performed with K-wires ranging in size from 1.5 to 2mm according to the size of the displaced fragment. One or two bone block substitute was placed to fill the gap inside and give support to the underneath the posterior facet (Figure 1). External segments of the subtalar joint were relocated to reconstruct the joint, and the lateral wall was realigned. Percutaneous fixation with three fully serrated cannulated screws was done. Finally, irrigation and closure of the wound. A removable splint was applied to keep the foot in a plantigrade position (90°).

Postoperative care

Prophylactic antibiotics were given (24-48 hours) to prevent operative site infections. On the postoperative 3rd day, the patients began to perform ankle dorsal flexion function exercise. Full weight bearing was not allowed until the signs of bone union were observed on the radiographs.

Outcome measurement

At the end of follow up radiological evaluation was done by measuring; Bohler angle and angle of Gissan. American Orthopaedic

Figure 1: Intraoperative impaction of bone block substitute.

Foot and Ankle Society (AOFAS) ankle/hindfoot score was calculated at the end of follow-up for all the cases [15].

Statistical analysis

Statistical analysis was carried out using SPSS18.0 software (SPSS, Chicago, Illinois, USA). Data are presented as means + standard deviation (SD). Preoperative, and the last follow-up variables were compared using Student's paired t test. $p < 0.05$ was considered to be statistically significant difference.

Results

Fourteen patients had mean age of 37.8 years, (range from 23 to 52), there were 13 males and four patients had diabetes. The average follow-up period of 14 patients was 14.8 (range, 13-29) months. All the patients had full weight bearing at mean of 12.5 weeks (range, 11-15) weeks, and all of them had returned to their work at mean of 4.7 (range, 4-6) months. Superficial wound infection was reported in 2 patients and healed without any secondary procedure. No deep infection was reported.

The AOFAS hindfoot score at the end of follow-up was 86.52 ± 9.5 (range, 70 to 100) points. Excellent results were found in 7 patients, good results in 8 patients and fair results in only 2 patients. There was statistically significant improvement of Bohler angle at the end of follow up (Table 1 and Figure 2).

Discussion

The selection of operative approach to calcaneal fractures is controversial, the extended lateral approach has been considered the gold standard treatment for intra-articular calcaneal fractures. However, soft tissue complications remain a major concern, ranging from 2 to 30% with the extended lateral approach [7,16,17]. Many minimally invasive approaches have been developed to decrease the wound-related complication rates. Among them, the sinus tarsi approach has become one of the most popular minimally invasive methods as it can provide direct visualization of the poste-

Radiological measure	Mean	range	Paired sample T test (Sig if p <.05)
Bohler angle			
Preoperative	13.76	-6-23	P =.000
End follow up	26.94	13-35	significant
Angle of Gissane			
Preoperative	125.1	105-140	P = .445
End follow up.	124.7	109-140	Non significant

Table 1: Radiological assessment.

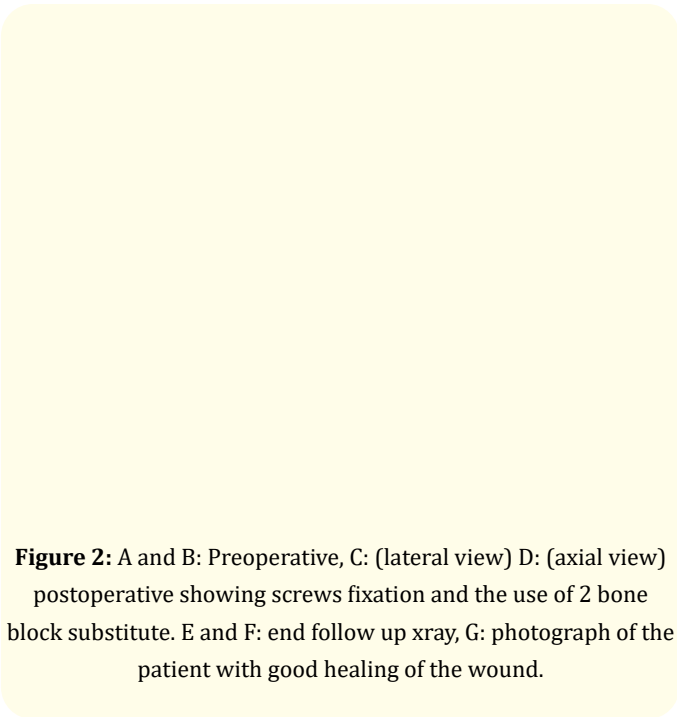


Figure 2: A and B: Preoperative, C: (lateral view) D: (axial view) postoperative showing screws fixation and the use of 2 bone block substitute. E and F: end follow up xray, G: photograph of the patient with good healing of the wound.

rior articular facet and has fewer soft-tissue-related complications [18,19].

According to Sanders, the correct timing for surgery is between 7 and 10 days from trauma, because if treated earlier there is risk of compartmental syndrome or soft tissue damage, and if treated later the results could be otherwise unsatisfactory [1]. In our study time between injury and surgical interference was 7.4days (range 6to11). Sinus tarsi approach was used in all 14 patients and only 2 patients (11.8%) got superficial wound problem which resolved without any secondary procedure. Schepers reported an average wound complication rate of 4.8% (range, 0% to 15.4%) for patients treated with use of the sinus tarsi approach [18].

In our study Good visualization and open reduction of posterior articular facet through sinus tarsi approach were achieved in all our patients. Bone block substitute was placed into the void of the

calcaneal body to support and maintain the already elevated and fixed construct of the intra-articular calcaneal fracture. Percutaneous cannulated screwing from the posterior calcaneal tuberosity was performed in all patients. However, we do not much believe that screwing alone can guarantee maintenance of reduction of the intra-articular calcaneal fractures and facilitate rehabilitation. Therefore, we added bone block substitute in all cases to prevent the collapse of reduction and facilitate weight-bearing. Our concept of using bone graft was supported by some authors [20].

Nevertheless, others believe that whether there is need for bone grafting remains to be proved in the future because there has been little report of need for bone grafting in the treatment of calcaneal fractures [21]. Some researchers believe that bone grafts are not generally needed because the calcaneal cancellous bone has a strong regenerative ability [22,23].

To date, there are several radiographic parameters used for the description of the calcaneal fractures. The Böhler’s angle is a well-established tool to quantify fracture displacement with a prognostic value in predicting morbidity associated with calcaneal fractures [24]. One of the main surgical goals is to restore the Böhler’s angle back to normal range of 25 to 40 degrees to yield satisfactory results [25]. In our study there is a significant improvement of Bohler angle at the end of follow up, with mean of 26.94° (range 13to 35). Böhler’s angle has a significant positive role in predicting the functional recovery. Restoration of Böhler’s angle should be an important reduction index during displaced intra-articular calcaneal fractures, and of ≥9 degrees is essential to achieve satisfactory functional outcomes [26].

The mean AOFAS ankle-hindfoot score at the final follow up was 86.5 ± 9.5 (range, 70-100) points. The overall satisfactory (excellent and good) results were obtained in 12 patients (88.2%). Our results were comparable with the results achieved using other minimally invasive techniques [27,28]. Zhan J., *et al.* [29] reported

close score to our results, their mean AOFAS ankle/hindfoot score was 90.2 + 17.7 (range 70-98), with good and excellent rates of 89.7%.

Conclusion

Treatment of intra articular calcaneal fractures using sinus tarsi approach with a bone block substitute and screws can provide excellent or good clinical outcomes with few soft tissue complications. The recommendation for routine use bone graft still needs further evaluation.

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