



Primary Subtalar Arthrodesis with Percutaneous Screw Fixation and Bone Grafting Through Mini-Open Sinus Tarsi Approach for Sanders Type IV Bilateral Calcaneal Fracture - Three-Year Follow-Up Case Report

Zelimir J Jovanovic^{1*}, Lazar D Miceta^{1,2*}, Nemanja S Jovanovic¹, Danilo T Jeremic^{1,2} and Nemanja S Slavkovic^{1,2}

¹Department of General Orthopaedics, Institute for Orthopaedics "Banjica", Serbia

²Medical Faculty University of Belgrade, Dr Subotica, Belgrade, Serbia

*Corresponding Author: Zelimir J Jovanovic, Department of General Orthopaedics, Institute for Orthopaedics "Banjica", Serbia.

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Abstract

Introduction: Calcaneus fractures are rare but potentially debilitating injuries. Most of them are displaced intraarticular fractures, which management represents one of the controversial issues. There is no consensus on whether to operate or not. The most often chosen surgical treatment is open reduction and internal fixation as the primary method. Failure of this surgery often needs secondary subtalar arthrodesis as definitive management, so primary subtalar arthrodesis in cases with severe comminution represents definitive treatment in one stage with good functional results.

Case Presentation: We present the case of a 54-year-old male patient with severely comminuted (Sanders type IV) bilateral calcaneus fracture. After the withdrawal of local swelling and disappearance of fracture, blisters patient was operated on using one-stage bilateral subtalar arthrodesis with percutaneous screw fixation and bone grafting performed through a mini-open sinus tarsi approach. The early postoperative period went unremarkably. The patient did not walk for the first seven postoperative weeks, after which rehabilitation was continued with partial-weight bearing with a gradual increase of weight-bearing to full through the next five weeks, after which walking aids were completely phased out. Three years after surgery patient has no symptoms and has a close-to-normal gait.

Conclusion: Although this type of injury has traditionally been treated with open reduction and internal fixation, we believe that primary subtalar arthrodesis with bone grafting through a mini-open sinus tarsi approach can benefit patients with severe comminution of calcaneus, allowing good functional results and patient satisfaction, with fewer postoperative complications and faster definitive recovery.

Keywords: Intra-Articular Fractures; Calcaneus; Subtalar Joint; Arthrodesis

Abbreviations

DIACF: Displaced Intraarticular Calcaneus Fracture; ORIF: Open Reduction and Internal Fixation; PSTA: Primary Subtalar Arthrodesis; ROM: Range of Motion; CT: Computerised Tomography; AO-FAS: American Orthopaedic Foot and Ankle Society Score; STA: Sinus Tarsi Approach; Mini-STA: Minimally invasive Sinus Tarsi Approach

Introduction

Fractures of the calcaneus are rare, potentially debilitating injuries, which represent a therapeutic challenge even for the experienced surgeon. About 60-75% of calcaneus fractures are displaced intraarticular (DIACF) [1,2]. Operative and nonoperative treatment of DIACF have similar results, but some patient groups benefit from surgery more than others. The most widespread surgical treatment

is open reduction and internal fixation (ORIF), but the results are not uniformly satisfactory. Failure to achieve an anatomical reduction of the articular surface leads to the development of painful arthrosis of the subtalar joint, requiring secondary arthrodesis in many cases. [2] This led to primary subtalar arthrodesis (PSTA) as the appropriate treatment method for DIACF [2,3].

This paper aims to present a case of a patient with Sanders type IV calcaneus fracture treated by reduction and PSTA through a mini sinus-tarsi approach with osteoplasty with a graft from the bone bank and results of a three-year follow-up.

Case Presentation

The patient, a 54-year-old male, sustained a bilateral calcaneus fracture accompanied by swelling, limited range of motion (ROM), and palpatory pain after a fall from three meters. There was no skin or neurovascular lesions. The patient's history revealed that he is a smoker. Radiography and CT scan showed Sanders type IV intra-articular fractures of both (Figure 1).

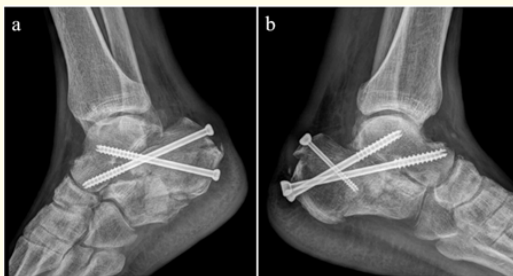


Figure 1: CT scan of both feet.

CT scan of both feet at the admission showing severely displaced comminuted fracture of both calcaneus; a. Right calcaneus fracture, b. Left calcaneus fracture.

Figure 1

The patient was initially immobilized with compressive Robert Jones bandages. Throughout the following days, swelling of soft tissue developed in the hindfoot, and occasional fracture blisters started to appear.

The operative procedure was performed 16 days after the injury, after reducing swelling and withdrawal of fracture blisters. Surgery was performed in two acts: first on the left foot, then on

the right with a patient in lateral decubitus position. Preoperatively tourniquet cuffs were placed on both lower legs but inflated separately.

The incision, around four centimeters long, was made above the projection of sinus tarsi. Extraction of the articular cartilage of the talocalcaneal joint was performed. The articular space and bone defect were filled with a combination of allogenic cancellous bone grafts from our institution's bone bank and extracted bone parts of the fractured calcaneus.

The reduction of major fragments was performed by percutaneous manipulation using a Schanz screw. Fixation of fragments was obtained with two K-wires advanced from calcaneus tuberosity to the talus body. Two cannulated screws of 7mm in diameter and 105mm and 120mm in length were introduced over wires, ensuring definitive fixation of fragments and arthrodesis of the talocalcaneal joint. The posterior-upper fragment was reduced percutaneously by another Schanz crew and then fixed with cannulated screw 5mm in diameter and 50mm in length.

After fluoroscopic evaluation and wound closure, Robert Jones dressing was applied, and the patient was turned over to the other side. Then the talocalcaneal joint of the right leg was approached in the same way, and the same procedure was performed with the difference of using two cannulated screws of 7mm in diameter and 95mm and 105mm in length (Figure 2).



Figure 2: Immediate postoperative lateral X-rays. Plain radiograph obtained immediately after surgery, a. Right foot, b. Left foot.

Figure 2

The early postoperative period went unremarkably. On the sixth postoperative day, patient was discharged, and suture removal was performed on the 14th.

For the first seven postoperative weeks, the patient was without weight-bearing. Ankle joints ROM were slightly limited painless, and there was no motion in subtalar joints. For the next five weeks, rehabilitation was continued with partial weight bearing on the forefoot and the application of silicone heel pads in footwear.

After twelve weeks, the patient was able to walk independently with crutches. In both ankles, ROM was close to physiological. Slightly lowered, painless feet arches were noted bilaterally. The patient gradually phased out walking aids and started with full-weight bearing.

Five months after surgery, the patient could walk normally, with full weight bearing and without walking aids. The total AOFAS (American Orthopedic Foot and Ankle Society Score) was 73 of 100 (Pain 30/40; Function 38/50; Alignment 5/10).

On three more check-ups, 11 months, 24 months, and 35 months after surgery, the patient exhibits no significant symptoms, with AOFAS scores of 72, 73, and 73, respectively, and a close-to-normal gait (Video 1), and complete return to normal life activities, including working as an electrician, as before the injury.

Discussion

The outcome of surgical treatment of DIACF is uncertain. Threatening postoperative complications are the most common reasons surgeons continue to opt for non-surgical treatment.

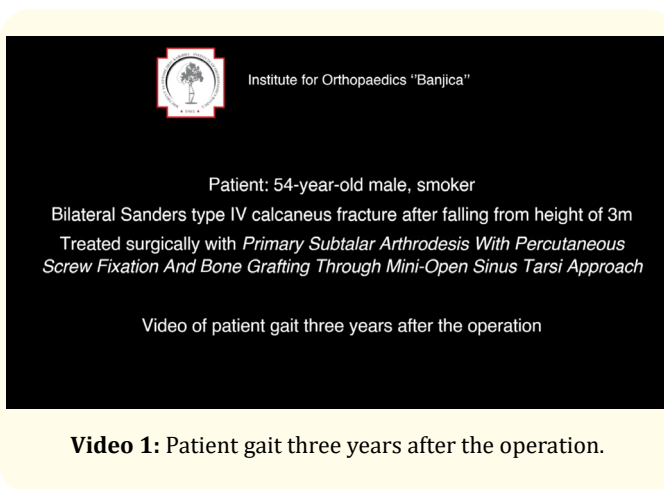
There are indications that less displaced DIACF treated non-operatively have similar functional results as operatively treated [3]. Some authors did not find a statistically significant difference in the outcome between operative and nonoperative treatment of DIACF, emphasizing the risk of postoperative complications. Nevertheless, the prevailing view is that surgical treatment of these fractures gives better functional results than nonoperative treatment [3]. Buckley, *et al.* reported significantly better functional outcomes in surgically treated patients [4].

The most commonly used approach for calcaneus is the extensive lateral approach, allowing good visualization and can result in difficult wound healing and is more prone to bone infections, scarring, and arthrofibrosis of the subtalar joint. One of the less invasive approaches is sinus tarsi (STA). Shortening the operative incision only to the space immediately above the tarsal sinus (Mini-STA) enables satisfactory visualization with minimal trauma to the soft tissues.

Mini-STA and classical STA can be combined with percutaneous techniques to reduce and fix large bone fragments. Several authors presented their results with lower postoperative complications with adequate repositioning and stabilization of the subtalar joint when using STA compared to the extensive lateral approach [5]. Holmes, *et al.* reported that after 18 years of STA use, they did not have any complications associated with wound healing or soft tissue and bone infection [5].

In patients with Sanders type IV fractures, there was not yet been found a significant difference in the outcome between ORIF and PSTA, and a low number of patients and quality studies are limiting factors for reaching a definitive conclusion. The advantages of PSTA include shorter treatment time, shorter postoperative recovery and absence from work, and lower treatment costs [6].

The results of ORIF in multifragmental DIACF can be uncertain. In Sanders type IV fracture, anatomical reposition, good joint con-



Institute for Orthopaedics "Banjica"

Patient: 54-year-old male, smoker
Bilateral Sanders type IV calcaneus fracture after falling from height of 3m
Treated surgically with *Primary Subtalar Arthrodesis With Percutaneous Screw Fixation And Bone Grafting Through Mini-Open Sinus Tarsi Approach*

Video of patient gait three years after the operation

Video 1: Patient gait three years after the operation.

gruence, and stable fixation are challenging to achieve, and many authors advocate using PSTA as the treatment method [3,7]. Even when anatomical reconstruction and stable fixation are achieved, early posttraumatic arthrosis of the subtalar joint may occur. Potenza, *et al.* reported good to excellent functional results after a five-year follow-up in six operated patients (seven calcanei) with Sanders IV type of fracture managed using PSTA through sinus tarsi approach with cannulated screws and filling of the bone defect with heterologous grafts [2].

Hufner, *et al.* state that in 2-17% of patients, it is necessary to perform secondary subtalar arthrodesis due to degenerative disease that developed after reduction and osteosynthesis. They further report good to excellent results after open reduction and PSTA in patients with Sanders IV fracture, and their return to total working activity was observed within 6.4 months on average [8].

It is necessary to point out that obliteration of the subtalar joint reduces ROM of the foot, affects normal gait, and can cause diminished functionality. Almeida, *et al.* reported a slightly higher average AOFAS score in PSTA than in osteosynthesis groups, ranging between 65.8 to 86.8 and 62 to 82.4, respectively [9]. Considering that our patient had a total AOFAS score of 73 out of 100 three years after surgery, it encouraged us to give even more space to PSTA as the solution for DIACF.

The study, which included 424 non-operatively and operative treated patients, stated that 10% required secondary arthrodesis of the subtalar joint. For certain patients, secondary subtalar arthrodesis was more common: men who do hard physical work, workers who receive compensation for injuries at work, patients with Sanders type IV fracture, and lower Bohler's angle [4]. Sanders, *et al.* stated that the results of ORIF of type IV fractures are unpredictable even with experienced surgeons performing operations because successful anatomical repositioning and stable fixation are extremely difficult to achieve and that better results can be obtained by performing PSTA [10].

The advantages of using bone grafts are reflected in the stimulation of fracture healing and a shortening of the period to full weight-bearing, increasing mechanical support of the calcaneus and avoiding its collapse and posttraumatic arthrosis of the subtalar joint. Singh, *et al.* reported similar results in patients undergo-

ing calcaneus osteosynthesis with or without bone grafts, but with earlier full weight-bearing and better re-establishment of calcaneus anatomy in the group where bone grafts were used [1].

Conclusion

Despite the adequate choice of treatment, DIACF can cause severe patient disability. Performing PSTA in these patients reduces the risk of reintervention and shortens the postoperative recovery. The biggest obstacle to the widespread use of PSTA is the small number of reported patients treated this way. Our opinion is that the excellent results of treating our patient's extremely severe injuries should encourage others to use PSTA more often, improving their patients' quality of life.

Consent

The patient has given his written consent for the publication of data of this case. Written consent will be provided to the journal or editor app on reasonable request.

Conflicts of Interest

The authors declare that they have no competing interests

Authors' Contributions

Conceptualization, ZJ, LM, NJ, and NS; Data acquisition and processing LM and NJ; Patient care, ZJ, NJ, and NS; the Patient follow-up, ZJ, and DJ; Writing – original draft preparation, LM, NJ, DJ, and ZJ; Writing – review and editing, NS; Visualization, LM; Supervision, NS; Project administration, LM and ZJ. All authors read and approved the final version of the manuscript.

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