Injury, Int. J. Care Injured 49S (2018) S65–S70

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Arthroscopic posterior subtalar arthrodesis for salvage of posttraumatic arthritis following calcaneal fractures

Jesús Vilá-Rico[a,b,*], Cristina Ojeda-Thies[a], María Ángela Mellado-Romero[a], Enrique Javier Sánchez-Morata[a], Luis Rafael Ramos-Pascua[a,b]

[a] Department of Traumatology and Orthopedic Surgery, Hospital Universitario 12 de Octubre, Madrid, Spain
[b] Department of Surgery, School of Medicine, Universidad Complutense de Madrid, Madrid, Spain

ARTICLE INFO

Article history:
Received 16 May 2018
Received in revised form 1 July 2018
Accepted 23 July 2018

Keywords:
Subtalar arthritis
Hindfoot arthroscopy
Posttraumatic arthritis
Subtalar arthrodesis
Calcaneal fracture

ABSTRACT

Background: Subtalar arthrodesis is a treatment option for pain due to posttraumatic arthritis following calcaneal fractures. The goal of this study is to examine the results of arthroscopic subtalar arthrodesis for posttraumatic arthritis following calcaneal fractures.
Patients and Methods: We performed a retrospective case series reviewing 37 consecutive patients (36 male) treated for posttraumatic arthritis following calcaneal fractures by arthroscopic subtalar arthrodesis. The fractures were due to high-energy injuries in 81% of cases, and 12 fractures (32.4%) had been previously treated with internal fixation. Average follow-up was 57.5 months.
Results: Average American Orthopedic Foot and Ankle Society (AOFAS) scores significantly improved from 49.0 ± 10.9 points preoperatively to 76.0 ± 8.0 points at final follow-up. Average time to union was 12.5 weeks. Six patients (16.2%) suffered complications: superficial wound infection (2.7%), symptomatic hardware that warranted removal (5.4%) and nonunion (8.1%) presented nonunion. All three cases had prior internal fixation through an extensile lateral approach, and fused after a repeat surgery.
Conclusion: Arthroscopic subtalar arthrodesis offers consistent improvement in cases of posttraumatic arthritis following calcaneal fractures, with a union rate similar to published series of open arthrodesis. We observed more nonunions in patients who had been treated previously with internal fixation. In spite of this, we continue to recommend arthroscopic subtalar arthrodesis, as it preserves the soft tissue envelope better than open techniques.

Introduction

Calcaneal fractures are disabling injuries with an uncertain prognosis, and sequelae such as chronic pain are common in spite of recent advances in diagnosis and treatment. Pain can be due to subtalar and/or cuboid arthritis, widening of the lateral wall leading to impingement of the peroneal tendons, malalignment of the hindfoot, loss of heel height altering the normal declination of the talus (causing anterior ankle pain) and shortening the lever arm of the triceps surae lever arm (reducing push-off strength), as well as damage to the fat pad of the heel or injury of the sensory nerves of the hindfoot [1]. Stephens and Sanders classified calcaneal malunions in three categories: type I malunions are characterized by lateral wall exostosis, without malalignment, and with little or no subtalar arthrosis. Type II malunions have significant subtalar arthrosis and varus malalignment ≤ 10°. Type III malunions are similar to type II but have a varus malalignment greater than 10° [2].

Subtalar arthrodesis is recommended in cases of hindfoot pain of predominantly subtalar origin, such as in posttraumatic arthritis, adult-acquired flatfoot disorders, and tarsal coalitions, among others [3]. This procedure has been traditionally performed in an open fashion, with addition of bone graft. Nevertheless, the risk of complications has been reported to be as high as 36% [3], in part due to a compromised vascular supply and soft tissue envelope as a consequence of posttraumatic changes and scarring from prior procedures. Retained hardware and skin incisions from previous surgeries can also complicate open arthrodesis [4,5].

Arthroscopy of the hindfoot and ankle has progressed greatly in the past 3 decades, leading to less invasive surgical procedures, among them subtalar arthrodesis. Several published series have proven the safety and efficacy of posterior arthroscopic subtalar arthrodesis, but most include patients with varied indications, posttraumatic as well as non-traumatic [6–15]. The goal of this

* Corresponding author: c/Alcalde Sainz de Baranda 29. 2º, 28009, Madrid, Spain.
E-mail address: vilayrico@gmail.com (J. Vilá-Rico).

https://doi.org/10.1016/j.injury.2018.07.022
0020-1383/

study is to evaluate the results of a series of patients treated with posterior subtalar arthrodesis for posttraumatic arthritis following a calcaneal fracture, and compare them with the body of evidence for this procedure and indication.

Patients and methods

We retrospectively reviewed all patients who had undergone posterior arthroscopic subtalar arthrodesis for posttraumatic arthritis following calcaneal fractures (Fig. 1) between May 2004 and February 2011. Inclusion criteria were: (1) arthroscopic arthrodesis performed by a posterior approach with fixation by one or two 6.5 mm or 7.3mm-diameter cannulated screws; (2) a minimum 24-month clinical and radiological follow-up, and (3) no other associated surgeries (i.e. calcaneal osteotomy, posterior tibial tendon procedures, etc.). Patients were excluded if there were more than 10° of hindfoot misalignment, or if there were signs of tibiotalar or talonavicular involvement. Data was prospectively collected, and all surgeries were performed by the same surgeon. The hospital's institutional review board approved the retrospective review of patient records for this study.

We included 37 consecutive surgeries in 36 males and 1 female with a mean age of 38.2 years (range 21–57 years). 22 surgeries (59.5%) were performed on the right foot and 15 (40.5%) on the left foot. Surgery was indicated following Sanders type III fractures in 24 (64.9%) cases and for sequelae of Sanders type IV fractures in 13 (35.1%) cases (Figs. 1a, 1b). Twenty-three patients (62.2%) were construction workers and five (13.5%) were professional drivers. Injuries were due to motor vehicle accidents in 5 cases (13.5%) and falls from height in 25 patients (67.5%), from greater than 3 m height in 9 of these cases (24.3%). The average time elapsed between the initial injury and the arthrodesis was 15.3 months (range 9–23 months). Twelve patients (32.4%) had previous surgeries to fix the fracture (Figs. 1c, 1d). Average follow-up was 57.5 months (range 24 to 105 months).

Arthroscopic subtalar arthrodesis was performed under spinal anesthesia in all cases, with the patient in the prone position and a pneumatic tourniquet applied to the thigh. We performed the surgery through two posterior portals using a 4-mm 30° arthroscope. The joint was debrided using a 3.5-mm shaver and burr until subchondral bone was exposed throughout the joint and the structures of the sinus tarsi could be identified (Fig. 2a). Hardware already present from previous surgeries was not removed if it did not protrude into the joint or interfere with adequate exposure of subchondral bone or with the trajectory of the percutaneous screws. In these cases, the screws could be extracted through a separate percutaneous incision, leaving the rest of the implants in place (Fig. 1c, asterisk). The joint was fused using one or two parallel 6.5 mm to 7.3 mm cannulated partially threaded screws (Synthes, Paoli, PA, USA) or Acutrak headless compression screws (Acumed, Hillsboro, Oregon, USA) in a calcaneo-talar direction through the most anterior part of the posterior subtalar joint (Figs. 1e, 1f). The screws were inserted under direct arthroscopic visualization (Fig. 2b), though we used fluoroscopy to confirm adequate length and placement of the screws. The type and number of screws were decided by the surgeon, depending on screw purchase during placement and bone quality. Bone graft was not used in any cases. After surgery, the joint was immobilized in a posterior ankle splint for three weeks, followed by progressive partial weight-bearing protected by crutches and a walker type ankle-foot orthosis, until allowing complete and unprotected weight-bearing after 8–12 weeks.

The postoperative clinical and radiographic evaluation included union rate, time to union, presence of postoperative complications, as well as the American Orthopedic Foot and Ankle Society (AOFAS) ankle-hindfoot score. The six points for the subtalar motion were not assigned in the postoperative evaluation; thus, the maximum score at final follow-up was 94 points, while it was 100 points preoperatively. Radiographic follow-up was performed by lateral, oblique and axial views of the hindfoot. Criteria for union were: (1) ability to ambulate comfortably without immobilization, (2) lack of subtalar motion on examination and (3) evidence of osseous trabeculae across the subtalar arthrodesis area on plain radiographs. A CT scan was performed to assess union or lack thereof in patients with persistent pain and lack of radiographic evidence of union.

The demographics, clinical characteristics and functional and radiographic outcomes were described using usual descriptive statistics. Improvement in AOFAS scores was evaluated using Student's *t*-test for paired samples. For bivariate analysis comparing patients who had achieved union with those who suffered nonunion, Mann-Whitney U test was used to compare the means of independent samples, and Fisher's exact and Chi-square test for comparison of proportions. The level of significance was set a $p < 0.05$.

Results

The characteristics of the patient population as well as the results achieved are summarized in Table 1. One screw was used in 30 cases and two screws in the other seven. Average time to union was 12.5 weeks (range, 10–37 weeks). Six patients (16.2%) suffered complications: one patient (2.7%) had a superficial wound infection that was successfully treated with oral antibiotics, two (5.4%) complained of symptomatic hardware which ultimately required removal of the prominent screws, and three (8.1%) presented nonunion. All three cases fused after a repeat surgery, which was open in two cases and arthroscopic in one. Average AOFAS scores improved from 49.0 ± 10.9 points (of a maximum of 100 points) preoperatively to 76.0 ± 8.0 points (of a maximum of 94 points) at final follow-up ($p < 0{,}001$). Patients improved in all categories of the AOFAS score, though the greatest increase was observed in the pain category (16.2 ± 7.9 of a maximum of 40 points preoperatively versus 31.9 ± 4.0 points after surgery). Patient satisfaction was high, and when questioned, all assured they would undergo the surgery again if they were in the exact same situation as they had been before the procedure.

All three cases of nonunion occurred in construction workers who had prior internal fixation with plate fixation for high-energy calcaneal fractures, Sanders III in two cases and Sanders IV in the remaining case. As a consequence, postoperative AOFAS scores were significantly worse for patients who had prior internal fixation (71.8 ± 7.8 points versus 78.0 ± 7.4 points, $p = 0.041$). Significance was lost, however, when the three cases of nonunion were excluded.

Discussion

Our data shows that posterior subtalar arthrodesis can be reliably achieved arthroscopically, with a general improvement in AOFAS scores and an acceptable complication rate, though all cases of nonunion occurred in patients who had prior internal fixation.

Subtalar arthrodesis has been traditionally performed as an open surgery, with generally good results; union rates have been reported to vary between 52% and nearly 100% for in situ subtalar arthrodesis following calcaneal fractures [3,4,11,14,16–31]. Poor fusion is one of the most feared complications, and bone graft is commonly added in order to avoid nonunion. Most series show nonunion rates between 4 and 16%, in line with the 8% observed in our study. Postoperative AOFAS scores in our series were also similar to most other studies published (Table 2).