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Outcome following osteosynthesis or primary arthrodesis of calcaneal fractures: A cross-sectional cohort study

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ABSTRACT

Background: Calcaneal fractures are uncommon and have a substantial impact on hindfoot function and quality of life. Several surgical treatment options are available; both in surgical approach and type of operation. The aim of this study was to compare functional outcome and quality of life following ORIF and primary arthrodesis. Furthermore, predictors of worse functional outcome were explored.
Methods: A retrospective cross-sectional cohort study was performed in patients with surgical fixation of a calcaneal fracture with a minimum follow-up of 18 months. Patients received ORIF through the 1) Extended Lateral Approach (ELA), 2) Sinus Tarsi Approach (STA) or 3) primary arthrodesis via STA. Participants were presented a questionnaire containing demographics, the AOFAS hindfoot scale, Foot Function Index, SF-36, EQ-5D and patient satisfaction.
Results: In total 95 patients participated in this study. The three groups were comparable regarding patient characteristics. A median score of 74.5 points on the AOFAS hindfoot scale and 11.9 on the FFI was found for the entire group. There were no statistically significant differences between patients with ORIF of primary arthrodesis. Patients scored a median of 49.0 on the Physical Component Scale of the SF-36 and 55.4 on the Mental Component Scale. On the EQ-5D patients scored a median of 0.8 points. Again no statistically significant differences were observed between the three subgroups. Socio-economic status was the only statistically significant predictor of worse functional outcome (β: 4.06, 95% CI: 0.50–7.62) after multivariable analysis.
Interpretation: Good midterm outcomes following in terms of functional outcome and in quality of life are observed. We observed no statistical significant difference in functional outcome between patients with ORIF and patients with primary arthrodesis. The only predictor of worse functional outcome is a lower socio-economic status.

Introduction

Calcaneal fractures are a rare entity and count for less than 2% of all fractures [1]. They are often the result of a high energy trauma such as fall from height and usually occur in relatively young and active patients [2]. This, combined with difficulties in treatment of calcaneal fractures is responsible for long-term disabilities in a large group of patients [3], which leads to a substantial socioeconomic impact of calcaneal fractures on society [4].

Traditionally the Extended Lateral Approach (ELA) is used for open reduction and internal fixation (ORIF) of calcaneal fractures; it provides good overview of the fracture and allows anatomical reduction [5]. The subtalar joint however is difficult to visualise using this approach and high complications rates have been described [6,7]. Complications may lead to worse outcome and therefore their prevention is of paramount importance [8]. Nowadays, a less invasive approach, the Sinus Tarsi Approach (STA) is used more often. The subtalar joint is visualised using this approach, ensuring adequate reduction of the subtalar joint. Furthermore a less extensive soft tissue dissection is needed, potentially lowering the risk of postoperative wound infections [7].

For severely displaced fractures adequate restauration of the subtalar joint is challenging and a large proportion of these patients may develop posttraumatic osteoarthritis demanding a secondary subtalar arthrodesis [9]. Because of this a primary subtalar arthrodesis may be considered in patients with a severely displaced intra-articular fracture (i.e. Sanders IV) [10,11]. Furthermore, in patients in whom there doubts whether they are able to

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adhere to a non-weight bearing regime, a subtalar arthrodesis may be the treatment of choice as this allows earlier mobilisation [12]. However, as the subtalar joint is fused it may lead to decreased hindfoot function.

The aim of this study was to compare the mid-term functional outcome of patients with a calcaneal fracture following 1) ORIF with the ELA, 2) ORIF with the STA and 3) primary arthrodesis through a retrospective cross-sectional cohort study. Secondary aim was to assess quality of life following surgical fixation of a calcaneal fracture and compare these amongst the three groups. Lastly, we aimed to explore possible predictors of worse functional outcome following a calcaneal fracture.

Level of Evidence: IV.

Methods

All patients who were operated on a calcaneal fracture at a single level 1 academic centre from the 1st of January 2012 until 1st of July 2015 were eligible. All patients were at least 1 $^{1}/_{2}$ year past the initial procedure (ORIF or primary arthrodesis). Excluded from the current study were; (1) patients younger than 18 years old, (2) mentally ill patients, (3) deceased patients, (4) patients without contact details or living abroad or (5) insufficient understanding of the Dutch language. Patients were contacted by phone or at the outpatient clinic to invite them to participate in the study. A flowchart of the included patients is available in Fig. 1. For all patients (including the non-responders) the following data was extracted from electronic patient charts; gender, age, date of operation, severity of fracture (i.e. Sanders classification [11]), Essex-Lopresti classification [13], side of the fracture (left, right or bilateral), postoperative wound infection (POWI) sub classified in superficial and deep wound infection according to the criteria of the Centers for Disease Control and Prevention (CDC) [14]. Superficial infection was treated with local wound therapy or oral antibiotics; deep infection was as an infection for which readmission with intravenous antibiotics or a reoperation was mandatory. For the responders it was noted whether or not an arthrodesis was performed (both primary and secondary arthrodesis) and which surgical approach was used. Two surgical approaches were used; the Extended Lateral approach (ELA) and the (minimally invasive) Sinus Tarsi approach (STA). In 2013 we started to use the STA instead of the ELA due to the high complication rate following surgical fixation trough the ELA [7]. After 2013 we did not use the ELA in any of the included patients. The subtalar fusions were performed after open reduction and internal fixation via a sinus tarsi approach. Cartilage was removed prior to reduction, no graft was used in any of the patients.

In our institution we use the following rule to opt for a primary fusion: a primary fusion is considered and discussed pre-operatively with the patient if two or more of the following fracture or patient characteristics are present: Fracture characteristics: (1) A Sanders type III or IV, (2) fracture-dislocations, (3) Böhler's angle <0, (4) open fracture, (5) extensive damage to the cartilage (noted per-operatively) and patient characteristics: (1) age above 65, (2) lower physical demand, (3) doubts on compliance (ability of the patient to adhere to a non-weight bearing regime), (4) comorbidities (diabetes, smoking, obesity) or (5) at the request of the patient).

All surgeries were performed by two dedicated foot/ankle specialized surgeons. An example of an ORIF through the ELA, STA and primary arthrodesis are depicted in Fig. 1.

All patients who agreed to participate in the study received a questionnaire with a short demographical section containing questions regarding their postal-code, weight & length, medical history (i.e. diabetes) and smoking status. Also, they were presented the Dutch version of the Foot Function Index (FFI) [15], American Orthopaedic Foot & Ankle Society (AOFAS) Hindfoot scale [8], SF-36 [16] and EQ-5D [17]. The AOFAS range-of-motion and foot alignment was documented in the electronic charts for all patients. Missing data in the AOFAS, FFI and SF-36 were handled through the instructions described [18–20]. In addition, patients were asked whether they had undergone implant removal and if so, if this had been beneficial. Lastly, they were asked how satisfied they were with the treatment using a visual analogue scale ranging from zero to 100. A list was obtained from the Netherlands Institute for Social Research ('Sociaal Cultureel Planbureau') with the socioeconomic status (SES) of each postal-code in the Netherlands. The SES of a postal-code is reflected by a figure ranging from −6.7 to +3.1 in which '0' is the average SES of a postal-code in the Netherlands.

Fig. 1. 1 & 2: fracture fixation through the Extended Lateral Approach, 3 & 4: fracture fixation through the Sinus Tarsi Approach, 5 & 6: fracture fixation through a primary arthrodesis through the Sinus Tarsi Approach.