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Post-traumatic in situ fusion after calcaneal fractures: A retrospective study with 7–28 years follow-up

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ABSTRACT

Background: In situ fusion as salvage operation after calcaneal fractures has been used. In this retrospective investigation, a group of in situ fused patients is analyzed with long-term follow-up.
Methods: Twenty-nine patients with in situ single or multiple fusions performed between 1970 and 1990 were included. In 1998 these patients were examined with plain radiographs and computerized tomography (CT) scan of the affected foot. Also, a visual analogue score (VAS) for calcaneal fractures, short form health survey (SF-36), Olerud Molander score and American Orthopaedic Foot and Ankle society (AOFAS) hindfoot score were evaluated.
Results: The plain radiographs and CT scan showed severe remaining deformities in these patients. The outcome parameters were generally poor and correlated to the degree of remaining deformity.
Conclusions: Simple in situ fusion, without consideration of the deformity at hand, after a calcaneal fracture is not an adequate treatment and generally associated with poor outcome.

1. Introduction

Calcaneal fractures are the most common tarsal fractures of the foot and the rationale for their treatment remains controversial. Generally the results after calcaneal fractures, regardless treatment, are thought to be disabling with painful ambulation and difficulties to return to normal function or work [1,2]. In a randomized multi-centre study, we showed that there were no obvious differences between operative and non-operative treatment at 1 year while operative treatment gave better function and quality of life at 8–12 years [1].

For many patients the final solution for pain and dysfunction after a calcaneal fracture has been in situ fusion, sometimes as a triple fusion but commonly as a subtalar joint fusion since the pain was thought to originate from the posttraumatic osteoarthritis of the incongruent subtalar joint [9,13]. The post-fusion residual deformities were addressed by the classification of Zwipp and Rammelt [4,16]. Recently, there has been an interest towards restoring the architecture and biomechanical properties of the hindfoot with osteotomies and structural bonegrafts [2,3]. This restoration is however quite demanding in terms of surgery and even though the results seem encouraging we lack comparative data on the outcome with the in situ fusion.

The aim of the present study was to evaluate the long-term radiological and clinical outcome of a group of in situ fused patients after calcaneal fractures.

2. Materials and methods

By searching all hospital archives in the Stockholm area, 29 patients who had been fused after calcaneal fractures between 1970 and 1990 were found. They had all been treated with in situ single or multiple fusions. Several techniques were used, with and without bone-grafting in the joint space. The fusions had been secured with casting or staples or screws. No additional osteotomies or distraction-bone block procedures to correct the deformity were performed.

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Table 1
Deformity classification after calcaneal fractures by Zwipp and Rammelt.

Bony situation	A (mal-unions)	B (non-unions)	C (aseptic/septic necrosis of bone)
Deformity			
0: extra or intra-articular mal-union without osteoarthritis	A 0	B 0	C 0
I: no deformity only posttraumatic osteoarthritis	A I	B I	C I
II: added varus or valgus of hindfoot	A II	B II	C II
III: added loss of height and dorsal tilt of talus	A III	B III	C III
IV: added lateral translation of calcaneus, with abutment of fibula to dorsal facet of ST-joint	A IV	B IV	C IV
V: adds with a talar tilt out of the ankle joint	V	B V	C V

Table 2
Description of the cohort and clinical results.

Cohort	*N* = 29 (20 men, 9 female) 23 unilateral, 6 bilateral
Age when fractured	34 year (*SD* 9)
Age when fusion after fracture	37 year (*SD* 10)
Reoperations	12/29 (41%), 1–12 occasions
Infection	4/29 (14%)
Invalidity	13/29 (44%), degree: 17% (*SD* 8)
Shoe-fit problems	16/29 (55%)
Return to work	Fulltime: 13/29 (45%) Halftime: 1/29 (3.5%) Retired: 15/29 (52%)
Post-compartment syndrome (clawing toes)	10/29 (35%)
Signs of CRPS	8/29 (28%)
Iatrogenic nerve damage	13/29 (45%)

In 1999, patients were evaluated radiologically with plain radiographs (anteroposterior, lateral and Broden views) as well as CT-scan in axial and coronary planes to assess the residual deformity at healing according to a classification developed by Zwipp and Rammelt (Table 1).

Beside the radiological examination, the patients were also evaluated at a hospital visit with an interview and a study protocol that included, VAS score for calcaneal fractures [5], short form health survey (SF-36) [7], Olerud–Molander (OM) score [6] and the American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score [7].

Reoperations, time of casting and return to work were also registered as well as invalidity as scored by insurance company and problems with shoe wear.

To compare the influence of the residual deformity (presented by the different classes of Zwipp Rammelt classification) on the clinical outcome parameters, a Mann–Whitney *U*-test non-parametric analysis was used.

The study was approved by the local Ethics Committee of Umeå (Dnr 2013/163-31).

3. Results

The demographic data of the included patients are shown in Table 2.

In 12 patients (41%), 1 or more reoperation/revision had been necessary, mainly due to healing problems, but also due to infection and hardware problems.

Return to work was accomplished full time in 13 patients (45%) and half time in 1 patient (3%). The rest, 15 patients (52%) were retired/disabled.

In 13 patients (45%) the degree of invalidity had been registered by the insurance companies at a minimum of 1 year after the latest surgical procedure. The mean invalidity degree was 17.2% (7–35%).

Table 3
The pain measured by VAS at rest and exertion and PROM-data.

Outcome parameter	Mean (*SD*)
VAS at rest	1.5 (2.2)
VAS at exertion	4.1 (3.3)
Max VAS	6.1 (3.8)
Olerud–Molander	46.7 (28.6.)
AOFAS hindfoot	56.9 (24.7)
VAS scoring by patient	49.8 (28.4)
VAS scoring by doctor	56.9 (32.0)
SF-36 mental	65.9 (21.6)
SF-36 physical	46.5 (16.0)

Signs of sequelae after compartment syndrome (with clawing of toes) were noted in 10 patients (35%) while signs of Complex Regional Pain Syndrome (CRPS) according to The International Association for the Study of Pain (IASP) criteria (with or without nerve damage, oedema, allodynia, dull sensation, blueish skin, etc.) was noted in 8 patients (28%).

Residual sensory impairment secondary to iatrogenic injuries was noted in 13 patients (45%).

16 patients (55%) claimed they had shoe wear problem.

In Table 3 the results of the different outcome scores are outlined.

In Table 4 the results of the radiological deformity evaluation according to Zwipp and Rammelt classification [4,16] are shown. As seen, there was a variable degree of residual deformity where the less degree (class A I, 3 patients) had better clinical outcome compared with the more deformity (class A III, 20 patients and class A IV, 6 patients) (Tables 5 and 6).

4. Discussion

The long-term results of this historical material have shown poor outcome of in situ fusion after calcaneal fractures both radiologically and clinically. In the era when these surgeries were performed, the different sources for pain around the hindfoot after calcaneal fractures were poorly understood. No caution had been undertaken to lateral and peroneal tendon impingement. The anterior impingement in the ankle, varus or valgus malalignment of the heel and the width of the heel were not adequately addressed.

Table 4
Distribution of deformity evaluated by CT and plain films according to the deformity classification.

Zwipp–Rammelt class	Unilateral cases	Bilateral cases
A I	3	0
A II	0	0
A III	18	6
A IV	2	6