



Operative treatment of intraarticular calcaneal fractures: Anatomical and functional outcome of three different operative techniques



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ABSTRACT

Introduction: Management of the intraarticular calcaneal fracture is a challenge. The optimal method of treatment remains controversial. This study evaluates the anatomical and functional postoperative outcomes of displaced intraarticular calcaneal fractures that have been treated using three different techniques of ORIF.

Patients and methods: Between 2004 and 2011 we treated 143 patients with calcaneal fractures, 40 of these patients (28%) were treated conservatively. This is a retrospective study of the remaining 103 patients (72%) who were operated on consecutively, mainly by one surgeon (NG). Calcaneal fractures were classified according to the Sanders classification. Three types of osteosynthesis were used: standard anatomical plate (SP), locking anatomical plate (LCP) and standard anatomical plate with autologous bone graft (SP + ABG). Clinical outcome was assessed one year after the operation: anatomical reduction was evaluated according to the analysis of Bohler's angle at final follow-up, and functional assessment was conducted using the Maryland Foot Score (MFS).

Results: The fractures were classified as follows: 35 (34%) Sanders type II, 47 (45.6%) Sanders type III and 21 (20.4%) Sanders type IV. The SP was used in 67 (65%) fractures, LCP in 16 (15.5%) and SP + ABG in 20 (19.4%). The correlation test showed a weak association between the Sanders fracture type and the operation technique (Pearson correlation coefficient $r = 0.26$). The non-parametric tests showed that the fracture type did not significantly influence the postoperative Bohler's angle outcome ($p = 0.132$), or the type of operation ($p = 0.664$). Excellent or good reduction of the posterior calcaneal facet was achieved in all operated fractures. One year after the operation, the distribution of Bohler's angle was normal with a mean 31.9° (SD 4.84) in all three groups. There was no significant difference in the functional postoperative outcome in terms of MFS in the three groups ($p = 0.601$), but the Sanders fracture type had significant influence on the functional postoperative outcome in terms of MFS ($p = 0.001$).

Conclusion: In the representative sample of 103 operatively treated intraarticular calcaneal fractures, anatomical and functional postoperative efficacy outcomes appeared to be similar in all three treatment groups. High-grade displaced intraarticular calcaneal fractures (Sanders IV) had worse functional results irrespective of the type of operation. The optimal method for management of intraarticular calcaneal fracture is operative, using the standard anatomic calcaneal plate. Autologous bone grafting is not required. Large sample comparative studies are still needed.

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Introduction

Calcaneal fractures represent 1–2% of all fractures in humans. In most cases these fractures are the result of a fall from a great height. The question of treatment choice still remains open [1–8]. The operative treatment used varies on a case-by-case basis and is influenced by surgeon preference [3–7,10–14,16–18,21,22]. Several other factors also influence the choice of operative treatment: fracture factors (joint elements incongruence, deformity); patient factors (compliance, comorbidities, angiopathy, neuropathy, age, polytrauma); local factors (skin, osteoporosis); and surgeon factors (knowledge, skills, equipment) [2,9]. The radiological assessment is of crucial importance: the analysis of fracture line and comparing with AO classification, Zwipp classification or, even more useful, Sanders classification [2,7,8,10]. Usual indications for ORIF are: fragment displacement, articular step >1 mm, varus >5°, valgus >10° and Bohler's angle <15°. There is a wide spectrum of contraindications for open surgery: age, diabetes, peripheral vascular disease, cortisol therapy, AIDS, osteoporosis, smoking, soft tissue infection and non-compliance [9]. The risk of postoperative wound complications can influence the decision [5,6,9,12,13].

The timing of open surgery might be urgent in cases of open fracture or compartment syndrome; otherwise surgery may be early (within 6 h) or delayed (7–10 days). The incision may be lateral or medial. There are recommendations for bone grafting in calcaneal reconstruction [12,14–16]. Therefore, we also tried to analyse the contributions and benefits of bone grafting in our study.

This article presents calcaneal fractures treated operatively at the General Hospital of Pula between 2004 and 2011. The aim of the study was to analyse whether there is a difference in postoperative outcome between three different operative techniques.

Patients and methods

Between 2004 and 2011, 143 patients with a fracture of the calcaneus were admitted to the Trauma and Orthopaedic Department of the General Hospital of Pula; 40 of these patients (28%) were treated conservatively and are excluded from this study. The remaining 103 patients (72%) were treated operatively and had a mean age of 45.8 years (range 19–62 years), and 82 patients (79.6%) were male. Concomitant injuries were present in 18 patients (17.5%): contralateral foot fractures in two patients (1.9%), spinal fractures in 12 patients (11.6%) and soft tissue damage in four patients (3.9%).

Calcaneal fractures were classified according to the Sanders classification. X-rays in three planes and axial plus coronal or three-dimensional CT were used regularly for accurate assessment. According to the Sanders classification, 35 fractures (34%) were Sanders II, 47 (46%) were Sanders III and 21 (20%) were Sanders IV.

The patients in this study were assigned to one of three groups according to the type of osteosynthesis applied: 1. standard anatomical plate (SP), 2. locking anatomical plate (LCP) and

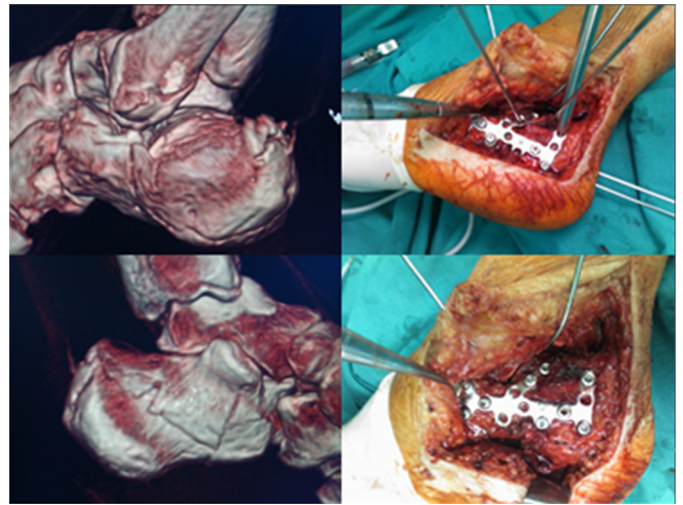


Fig. 1. Sanders III: Surgical exposure of the calcaneal lateral surface and subtalar joint after application of a standard anatomical plate.

3. standard anatomical plate with autologous bone graft (SP + ABG) (Table 1).

Twenty patients (19%) underwent surgery involving bone grafting. The other 83 patients (81%) were operated on without bone grafting and of these, 67 patients received SP and the remaining 16 received LCP.

The operation was performed on day 7 on average after the trauma (range day 5 to day 15) via the Zwipp extended lateral approach. The return of skin wrinkles to the lateral foot at the surgical incision site was used as a guide for timing surgery. Tourniquet (200–300 mmHg, 45–90 min) was allowed in all operations to enable improved precision, safety and speed. The reduction technique is a step-by-step process for reduction manoeuvres from anteromedial to posterolateral in relation to the “constant” sustentacular fragment. Particular care was taken to protect the soft tissue flap throughout the exposure and reduction (Fig. 1). Surgical incisions were always closed in two layers without wound drainage. Care was taken for the deep layer that incorporates the periosteum to ensure adequate reapproximation.

Antibiotic prophylaxis and thromboprophylaxis were administered to all patients. Range of motion exercises started from the second postoperative day. Partial weight bearing was delayed for 6–8 weeks, depending on the degree of comminution and the adequacy of the fixation. Activity progressed depending on the symptoms. Full weight-bearing was mainly achieved after four months.

Study follow-up was one year. The results were measured for each patient one year after the operation by two expert trauma surgeons who used the radiographic analysis of Bohler's angle at the final follow-up for anatomical reduction, and Maryland Foot Score (MFS) for functional assessment (Table 2). Statistical analysis

Table 1

Comparison of all three groups of calcaneal fracture operations according to anatomical and functional results.

| Group | Age Mean (SD) | Bohler's angle Mean (SD) | Maryland pain score Mean (SD) | Maryland functional score Mean (SD) | MFS Mean (SD) |
|----------|------------------|-----------------------------|----------------------------------|--|------------------|
| SP | 44.81 (8.31) | 32.06 (4.99) | 39.55 (7.11) | 45.13 (7.05) | 84.6 (12.92) |
| LCP | 51.44 (9.79) | 32.50 (5.19) | 41.56 (3.01) | 45.06 (5.95) | 86.63 (7.59) |
| SP + ABG | 44.65 (6.08) | 31.30 (4.16) | 37.75 (7.86) | 45.45 (6.84) | 83.20 (11.70) |

SP—standard anatomical plate.

LCP—locking anatomical plate.

SP + ABG—standard anatomical plate + autologous bone graft.

[Note to production: It would improve clarity if patient numbers were added to this table].

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