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# Fractures of the calcaneus

## A comparison of open and closed treatment

**Ulf Järvholm**
**Lars Körner**
**Olle Thorén[1]**
**Lars-Martin Wiklund[2]**

Departments of Orthopaedics East Hospital, S-416 85 Göteborg, Sweden, [1]Central Hospital, Vänersborg-Trollhättan, and [2]Diagnostic Radiology, East Hospital, Göteborg, Sweden

Twenty patients with displaced intraarticular fractures of the calcaneus treated by open reduction and early postoperative motion exercises were compared after 2–12 years with 19 patients with similar fractures treated closed. The two groups were comparable regarding follow-up time, age, sex-distribution, and preinjury occupation. The pain and disability were almost equal in both groups. Three patients in both groups had marked residual symptoms, and equally many had negligible symptoms. The operated patients had less reduced subtalar motion, better ability to jump and run, longer walking distances on uneven surfaces, and reduced forward tilting of the lateral part of the posterior articular surface, but only a slightly improved Böhler angle. Nine operated and eight conservatively treated patients had radiographic signs of osteoarthrosis.

Open reduction of the intraarticular fracture of the calcaneus may provide stability, allowing early motion and eventually improved subtalar function. However, postoperative complications are common, and the overall end results of open and closed treatment are almost equal. Primary operation of the fractured calcaneus should therefore rarely be indicated.

Most fractures of the calcaneus are displaced intraarticular fractures which involve the posterior articular facet (Soeur & Remy 1975, Tanke 1982). The prognosis is generally unfavourable (Thorén 1964), and there is no consensus regarding treatment. Recommended non-operative methods have been early motion exercises and non-weight bearing for 6–8 weeks (Lance et al. 1963, Shannon et al. 1978), plaster of Paris with or without attempts at closed reduction (Barnard & Odegard 1970) and pin traction (Böhler 1928). The operative treatments have been open reduction (Palmer 1948, McReynolds 1982), instrumental reduction (Essex-Lopresti 1952), and arthrodesis (Pennal & Yadav 1973).

There is no agreement on how to classify calcaneal fractures, and the methods used for follow-up and evaluation differ, which, in part, may explain the lack of treatment consensus.

Our study compared the outcome of displaced intraarticular calcaneus fractures treated by open reduction and early postoperative mobilisation with similar fractures treated closed.

## Patients and methods

During the years 1970–1980, 28 patients had open reduction of displaced intraarticular fractures of the calcaneus by the senior author (O.T.) at the Central Hospital of Vänersborg-Trollhättan, Sweden. Three patients with bilateral fractures and five patients who could not be traced were excluded from the follow-up, which comprised 20 patients. To get a comparable group of patients the senior author examined a large number of primary radiographs of calcaneal fractures treated closed in the hospitals of Göteborg during the same period. From this material he selected patients he would probably have operated on. All fractures in both groups were similar regarding dislocation and comminution of the posterior articular facet, and corresponded to the Grade II fractures of Soeur & Remy (1975). Nineteen of these conservatively treated patients could be traced.

The 20 operated patients (14 men, 6 women) had a mean age of 46 (23–70) years, and the 19 non-operated patients (18 men, 1 woman) had a mean age of 44 (31–66) years. The mean follow-up time was 5 (2–12) years in the operated group and 4 (2–9) years in the non-operated group. The preinjury occupation was similar in both groups. Five patients in the operated group and three patients in the non-operated group had other simultaneous injuries, most commonly a compression fracture of the lumbar spine (four patients). No patient in either group had any other injury that could interfere with evaluation at

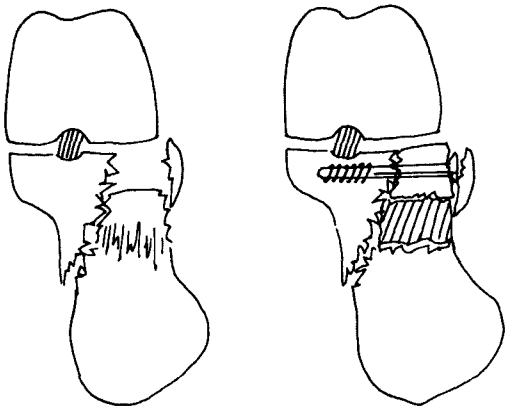

Figure 1. Posterior oblique view of the calcaneus with depressed and rotated lateral part of the posterior articular surface before and after open reduction and fixation with an AO-screw and a bone transplant.

follow-up. The fracture mechanism in almost all patients was a fall from a height.

## Treatment

The non-operative treatment consisted of elevation of the foot until the oedema subsided, usually for 2–5 days, followed by non-weight-bearing exercises. Full weight bearing was allowed after 6–10 weeks.

Open reduction was performed according to Palmer (1948) with slight modifications. Preoperatively the foot was elevated and a compression bandage was applied. The operation was performed within the first week (average 3 days). A tourniquet was used. Occasionally, pin traction through the tuber calcanei was used peroperatively. The calcaneus was exposed through a lateral incision. The peroneal sheath was bluntly dissected off the calcaneus. The compressed and rotated lateral part of the posterior articular facet was elevated and aligned with the medial part of the joint facet and held in position with a bone block taken from the iliac crest and, if necessary, also with a bone screw (Figure 1). In all but three patients, reduction was checked with radiographs on the operating table using the Brodén (1949) projection I which in four cases caused the surgeon to change the reduction or the length and position of the screw; it is difficult to determine the reduction and the position of the screw because of the limited exposure.The skin was sutured over a subcutaneous drainage tube.

A plaster of Paris or compression bandage was used for 2 weeks. Motion exercises were then started and after 6–8 weeks weight bearing was permitted.

## Follow-up

At the follow-up all patients were interviewed according to a specially designed protocol and clinically examined by the independent author (U.J.). The subtalar motion was recorded according to Widén (1954). A radiographic examination was made with a standard lateral projection and oblique projections according to Brodén (1949).

## Radiographic examination

All fractures were Grade II according to Soeur & Remy (1975). In this type of fracture the posterior articular facet is rotated forwards on a transverse axis passing through the calcaneus behind and below the posterior articular facet. This rotation was recorded at the follow-up, as were steps in the posterior articular facet and the Böhler angle. Osteoarthrosis was defined as a considerable narrowing of the joint space and sclerosis of the subchondral bone.

# Results

## Clinical findings

At the follow-up the majority of patients in both groups had moderate pain and disability, partially limited work capacity, and limited recreational activity (Table 1). Three patients

*Table 1. Clinical findings in calcaneal fractures at follow-up*

| Pain and function | Non-operated n=19 | Operated n=20 |
|---|---|---|
| Negligible pain or restrictions of activity | 2 | 3 |
| Light pain at activity, no restriction of work or recreational activity | 3 | 5 |
| Moderate pain; partial restriction of work or recreational activity; occasional pain at rest | 11 | 9 |
| Pronounced disability or pain | 3 | 3 |
| Walking ability on even/uneven surface. (Patient's own estimation) | | |
| < 100 m | 0/6 | 0/1 |
| 100 – 500 m | 1/5 | 0/3 |
| 500 –1000 m | 3/2 | 2/5 |
| 1000–3000 m | 5/2 | 4/4 |
| >3000 m | 10/4 | 14/7 |
| Normal gait | 14 | 16 |
| Jumps ten times on injured foot | 8 | 15 |
| Can run | 5 | 11 |

in both groups rated the result as poor. Three operated and two non-operated patients considered the result excellent with almost no disability. There was no difference between the groups as regards the mean calf atrophy (1 cm), broadening of the heel (1 cm) and reduced ankle motion (10 per cent). The mean hospital stay for the operated group was 9 days compared to 4 days in the non-operated group. The mean sick-leave time was 43 weeks in the operated group and 28 weeks in the non-operated group. If cases with multiple injuries were excluded, the mean sick-leave time was 32 and 28 weeks in the two groups, respectively. The operated group had on average retained half of the normal subtalar motion compared to only one fifth in the non-operated group ($p < 0.001$). There was also a corresponding difference with regard to the ability to jump ten times on the injured foot and to the ability to run. The patients' estimation of their maximal walking distance on an even surface was almost equal in both groups. However, on an uneven surface the non-operated group seemed to have more problems (Table 1). Eight patients in the operated and four in the non-operated group were unable to return to their preinjury occupation. Four of the eight operated patients considered the calcaneal fracture only partially responsible for their reduced working capacity. Four non-operated and seven operated patients used analgetics occasionally; one patient in both groups used analgetics regularly.

## Radiographic findings

There was little or no difference in the two groups regarding the rotation of the posterior articular facet, the Böhler angle, or the step seen in the fracture on the primary radiographs (Table 2). The step was reduced after the operation and at the follow-up the step was smaller in the operated group than in the non-operated group. At the follow-up nine operated

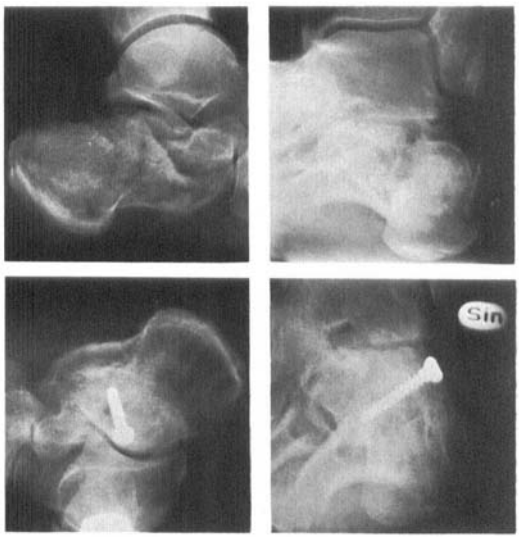


Figure 2. Before the operation there was a 3 mm step and 25 degrees forward rotation of the lateral part of the posterior articular facet, and the Böhler angle was 0 degrees. At follow-up there was no step or rotation, and the Böhler angle was now 15 degrees.

*Table 2. Radiographic findings in calcaneal fractures*

| | Non-operated N=19 | | Operated N=20 | |
|---|---|---|---|---|
| | Initially | At follow-up | Initially | At follow-up |
| Rotation [a] (degrees) | | | | |
| <10 | 6 | 7 | 5 | 16 |
| 10–35 | 6 | 5 | 7 | 4 |
| >35 | 7 | 7 | 6 | 0 |
| Böhler angle (degrees) | | | | |
| Mean (Range) | +2 (−10–+20) | −1 (−20–+20) | +2 (−40–+35) | +6 (−20–+40) |
| Step in fracture[b] (mm) | | | | |
| Mean (Range) | 2.5 (0–15) | 3.6 (0–12) | 4.4 (0–14) | 1.2 (0–6) |
| Osteoarthrosis | 8 | | 9 | |

[a] Forward rotation of lateral part of posterior articular facet.
[b] As measured in Brodén (1949) projection I.

Note: Not all radiographs were sufficient for determining the amount of rotation and height of step in the fracture.

and eight non-operated patients had radiographic signs of osteoarthrosis; one of these patients had no disability while five of the six patients with a subjective rating of poor had osteoarthrosis. Seven of the eight non-operated patients with signs of osteoarthrosis had a step in the posterior articular surface exceeding 2 mm. In the operated group the size of the step had no significance for the development of osteoarthrosis. Examples of preoperative radiographs and radiographs taken at follow-up are shown in Figure 2.

The normal Böhler angle varies between 25 and 40 degrees (Tanke 1982). This angle was only slightly improved at the follow-up in the operated group; the best radiographic improvement after surgery was the reduction of the rotation of the lateral part of the posterior articular facet.

### Complications

There were two superficial infections and two lesions of superficial nerve branches causing paraesthesia in the operated group. There were no complications in the non-operated group.

## Discussion

Our operated patients had better preservation of subtalar motion with better ability to walk on uneven surfaces and to jump on the injured foot; this confirms the results of Palmer (1948) and Soeur & Remy (1975). However, the subjective rating in the operated group did not differ from that of the non-operated group. Three patients in both groups had marked residual symptoms and almost equally many had no symptoms at the follow-up.

After surgery the rotation of the lateral fragment of the posterior joint facet was reduced but the Böhler angle was only partially restored and the joint was not always congruent. It is difficult to obtain a perfect reduction; all patients were operated by an experienced surgeon.

Widén (1954) and McReynolds (1982) have pointed out that the medial part of the posterior joint may also be displaced in relation to the talus and the inferior part of the calcaneus. This may be the reason for the remaining reduction of the Böhler angle in the operated group.

Two patients in the non-operated group and one in the operated group have been offered arthrodesis but none have accepted. Tanke (1982) advocated postponing arthrodesis as long as possible since it does not eliminate all the pain. Causes for pain other than osteoarthrosis might be a change in foot load because of loss of the longitudinal plantar arc, plantar spurs, impingement of the peroneal tendons, and loss of the architecture of the fat pad of the heel (McLaughlin 1963).

Tanke (1982) reported that non-operative treatment is better than operative, but also thought that operation could be attempted in cases with little fracture comminution and great dislocation, where it is possible to obtain an osteosynthesis resulting in a stability allowing exercise. Our results only partly confirm this statement. In our study the results after operation with early postoperative mobilisation and non-operative treatment were almost the same. Surgery, even by an experienced surgeon, can only slightly improve the subtalar motion and function. However, complications after surgery are not uncommon and the patients' pain and disability do not seem to improve with this type of operation.

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