CASE REPORT

An avulsion fracture of the calcaneal tuberosity: delay of treatment causes the 'Achilles heel' of optimal recovery

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SUMMARY

A 72-year-old woman was diagnosed with an avulsion fracture of the tuberosity of the calcaneus. The fracture was planned for elective fixation 12 days after the accident. The planned open reduction and internal fixation was not possible due to a decubital wound on the Achilles heel as a result of pressure on the skin of the fractured tuberosity. Closed reduction and internal fixation was performed, leading to an acceptable outcome. Avulsion fractures of the tuberosity of the calcaneus are rare injuries, and delay in treatment should be avoided as it may lead to preventable complications.

BACKGROUND

Avulsion fractures of the tuberosity of the calcaneus are rare injuries. Delay in treatment may lead to decubital wounds due to increased pressure of the fractured bone on the skin. The current case underlines that the fracture should be fixated as soon as possible to prevent such complications.

CASE PRESENTATION

A 72-year-old woman was referred to the emergency department, late in the evening, after a fall at home. She was not able to walk or weight bear on her right foot. Her medical history consisted only of hypertension. Physical examination showed a moderately swollen ankle with tenderness over the distal calcaneus. The Thompson test¹ was positive as it did not lead to plantar flexion of the foot.

INVESTIGATIONS

Owing to the tenderness and swelling over the calcaneus, a plain radiograph was acquired, showing an avulsion fracture of the tuberosity of the calcaneus (figure 1A, B), Beavis type II.² An additional CT scan was made to exclude articular involvement (figure 1C).

TREATMENT

The lower leg was immobilised with a lower leg cast and the patient was able to return home. The trauma surgeon in our hospital was consulted and the decision was made to fix the fracture surgically. Owing to regional agreements on centralisation of calcaneal fractures, the patient was referred to a tertiary centre. She was seen in the outpatient clinic 2 days after the accident, and was planned for open reduction and internal fixation (ORIF) 10 days later (12 days after the fall).

Figure 1 Lateral (A) and anteroposterior (B) view on conventional X-ray showing an avulsion of the tuberosity of the calcaneus. CT scan (C) showing lack of articular involvement.

In the operating theatre, the cast was removed, showing a decubital wound on the heel (figure 2A). Owing to the potential risk of wound infection and infection of the osteosynthesis, the initial plan of ORIF was changed to a less invasive treatment modality. A closed reduction was performed with a percutaneous fixation of two crossing thick Kirschner (k) wires (figure 2B, C). Wound debridement was performed and the wound was partly closed using a Bioguard gauze sponge (Bioguard, Derma Sciences, Princeton, USA), and the lower leg was immobilised by a cast for 6 weeks.

OUTCOME AND FOLLOW-UP

The recovery of the fracture and the wound was followed in the outpatient clinic. After 60 days, the fracture showed signs of consolidation (figure 2D) and the k wires could be removed. After 100 days, the fracture was fully consolidated (figure 2E) and the wound was fully healed (figure 2F). The patient was able to bear weight and wear normal shoes;

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Figure 2 Owing to delay in treatment, the fractured tuberosity led to a decubitus wound (A). Closed reduction and internal fixation with two k wires was performed (B and C). Consolidation was seen after 60 days (D) and 100 days (E). The wound recovered fully (F).

however, dorsiflexion and plantar flexion of the foot was still limited without functional impairment. After 1 year, the patient was free of pain, and she had a 10° limitation of dorsiflexion and plantar flexion, compared to the contralateral side. She was released from follow-up.

DISCUSSION

The tuberosity of the calcaneus primarily consists of cancellous bone with a thin cortex. It normally acts as a lever to increase the power of the gastrocnemius–soleus complex, which inserts on the tuberosity. Of all tarsal fractures, the calcaneus is the most frequently fractured.³ In 70% of calcaneus fractures, the fracture is intra-articular.⁴ However, avulsion fractures of the posterior tuberosity are rare and account for 1–3%.^{2–5} Several risk factors have been described: diabetes mellitus, osteoporosis, osteomalacia, peripheral neuropathy and long-term use of immunosuppressives.^{3 6 7} Peak incidence occurs at around 70 years of age, and women are more often affected than men.³ The first tuberosity avulsion fracture was described by Hippocrates.⁴

Several trauma mechanisms have been described in the literature. The most referred to theory is that the foot is in plantar flexion with a loaded Achilles tendon when in expectation of a fall, and that the sudden impact and the sudden forceful dorsiflexion of the foot leads to an avulsion of the bone.^{3 4 6–8} In some cases, there has been no trauma at all; in these cases, there was often peripheral neuropathy due to diabetes.⁴ It is suggested that these patients did not notice the microtrauma, due to decreased pain sensation and decreased proprioception.^{3 7} Also, direct penetrating or blunt trauma to the tuberosity has been described.⁷

Physical examination consists of inspection, palpation, functional testing and the Thompson test.¹ Inspection may show pale skin or non-blanching of the skin, which is a sign of increased pressure of the fragment on the skin, potentially leading to decubitus and necrosis of the skin.³ Patients may not be able to plantar flex the foot fully and the Thompson test will often be positive.⁷

As stated above, the biggest challenge of these fractures is soft tissue problems.^{3 9} The tuberosity is pulled cranial by the Achilles tendon, after which the sharp fractured end of the tuberosity can press against the skin (figure 1A), leading to increased pressure and, eventually, decubitus (figure 2A) and necrosis of the skin.^{3 6 7 10} To prevent these skin complications, operative treatment on the day of trauma may be indicated.

Non-operative treatment often leads to misshaped heels, leading to footwear problems after long and slow healing, and impaired dorsiflexion, leading to problems with climbing stairs.^{3 11} Schepers *et al*⁴ showed, in a review of the literature, including 66 cases of tuberosity avulsion cases, that in conservatively treated patients, 66% reached a satisfactory result, while 88% of the operatively treated patients reached a satisfactory result. Also, the patients had an earlier return to daily activities after surgical treatment.⁴ It should be noted that there is no randomised controlled trial on this subject, and Schepers' review of literature is the best evidence available at the moment.

Different surgical strategies have been described as treatment option for calcaneal avulsions.³ Techniques have been described in which corkscrew suture anchors were inserted in the calcaneus, after which the sutures were run through the fracture fragment and to the Achilles tendon using the Kessler or Krakow technique.^{2 3 5 12} Banerjee *et al*⁹ used suture fixation without suture anchors by running fiberwire sutures through 2.0 drill-holes, sometimes aided by fixation with one or two (cannulated) screws. Nagura *et al*,¹³ described a modified style of tension band wiring in three patients, with good 1 year results. Some reports show fixation with lag screws through the plantar cortex,^{7 8} although this may prove difficult in many cases as the avulsed fragment is often small and the bone is osteoporotic.³ In a cadaver model, Khazen *et al* showed that the use of suture anchors fixating the Achilles tendon, in addition to lag screws over the fracture, led to a higher load of failure. Disadvantage of such a technique is that an extensive approach is necessary, leading to extra-trauma on frail skin.¹⁴

An avulsion fracture of the tuberosity of the calcaneus is a rare injury that needs to be operated on, preferably on the day of the injury. Patients older than 70 years are more at risk of

these fractures and especially for their skin complications. These fractures should be treated in a timely fashion, especially in older individuals. The current case highlights skin problems that can take place (figure 2A) if treatment is delayed. Clinicians challenged with these fractures should be aware of the potential complications.

Learning points

- ▶ Avulsion fractures of the tuberosity of the calcaneus are rare injuries.
- ▶ Trauma mechanisms consist of sudden dorsiflexion after falling from a height or neuropathic fractures in patients with diabetes.
- ▶ Avulsion fractures of the tuberosity of the calcaneus should be fixated as soon as possible and minimally invasively when feasible, especially in older individuals.
- ▶ Delay in treatment may lead to decubital wounds as the fractured tuberosity presses on the skin.

Competing interests None declared.

Patient consent Obtained.

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