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Case Report

Entrapment of the Flexor Hallucis Longus Tendon: A rare complication of Calcaneal Fractures

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Abstract

Flexor hallucis longus tendon entrapment between fracture fragments of the calcaneum is a rare complication. Only six other cases have reported this complication in the literature. In these cases, surgical stabilisation was carried out for the calcaneal fractures and the flexor hallucis longus tendon entrapment was only identified post-operatively leading to a second procedure for the patient.

Whereas, in our case the calcaneal fracture was treated conservatively throughout. The flexor hallucis longus tendon entrapment by a piece of callous between the anteromedial and posterolateral fragments was identified at the 2 weeks review due to limited and painful motion of the hallux. The patient underwent flexor hallucis longus tendon release using a medial approach and continued with conservative management of the calcaneal fracture, which resulted in complete recovery and full function within 4 months of the initial injury.

This case report emphasises the importance of thorough physical examination of the entire foot and ankle and a comprehensive review of imaging in calcaneal fractures.

Keywords: Foot, Calcaneum, Fractures, Flexor hallucis longus, Entrapment

Introduction

A calcaneal fracture is a relatively uncommon injury, with an incidence of 11.5 per 100,000 population per year but it is the most frequently fractured bone in the hindfoot [1]. These fractures are associated with soft tissue complications such as fracture blisters, full-thickness skin necrosis, compartment syndrome and tendon pathology [2].

Entrapment of the flexor hallucis longus (FHL) tendon following a calcaneal fracture is a rare but important complication to identify and treat in order to improve patient outcome. There have only been six other cases that have reported this complication in the literature, where the entrapped flexor hallucis longus tendon was not identified during pre-operative planning. In three of the cases, this complication was identified after surgical fixation of the calcaneum and in the other three cases it was identified intra-operatively during surgical stabilisation of the calcaneal fractures [3-6].

In our case report, we describe the timely diagnosis and surgical release of the entrapped flexor hallucis longus tendon and non-operative management of the calcaneal fracture.

Case History

A 40- year-old male builder with no significant past medical history presented to our emergency department following a road traffic accident. He had a fall from his motorbike and was complaining of pain and inability to weight bear on his right foot. The initial examination revealed an isolated, closed injury of the right foot with normal vascular and sensory neurological findings. Radiographs demonstrated a calcaneal fracture. Computerised topography (CT) scan revealed a type 2C intra-articular calcaneal fracture (Figure 1-3), according to the Sanders classification system.

After considering patient factors and the minimally displaced fracture pattern, a decision to manage this patient non- operatively was made at the trauma multidisciplinary team meeting. Treatment with a non- weight bearing below knee cast was initiated. After 2 weeks of immobilisation in the cast, the patient returned to the senior author's foot and ankle fracture clinic for review. Physical examination revealed limited range of motion and severe pain on passive dorsiflexion of the great toe. Passive dorsiflexion of the ankle also caused severe pain along the medial aspect of the foot but did not cause a flexion deformity of the great toe as described by the checkrein deformity.

Our examination findings were suggestive of FHL tendon pathology. The CT scan was re- examined and demonstrated entrapment of the FHL tendon in the primary fracture line, between the anteromedial and posterolateral fracture fragments of the calcaneum. Surgical and non- surgical options were provided to the patient and the patient elected to undergo surgical treatment to release the FHL tendon. The senior author decided to continue non- operative management of the calcaneal fracture as it was a minimally displaced fracture with height, width and length of the calcaneum and subtalar joint clinically and radiologically maintained.

Surgery was performed with the patient positioned supine. A medial longitudinal incision, posterior to the medial malleolus with a curve anteriorly was made along the course of the FHL tendon. The flexor digitorum longus (FDL) tendon and the neurovascular bundle were identified and protected throughout the procedure. The FHL tendon was identified and was found to be tethered by a fragment of callous within the primary fracture line (Figure 4).The fragment of callous was carefully removed allowing full excursion of the FHL tendon using the cotton tape looped around the tendon (Figure 5). There was also free movement of the tendon on flexion and extension of the great toe. An adhesion control barrier gel (Adcon Gel) was placed around the FHL and FDL tendons to prevent further tethering or entrapment of the tendons by scar tissue or callous (Figure 6).

Post- operatively, active and passive range of motion of the great toe was not limited or painful with full dorsiflexion and plantarflexion of the ankle. Radiographs revealed adequate fracture position. Patient was discharged from hospital 3 days after surgery. At his 4 month outpatient clinic review, his fracture had healed completely, and he regained full function.

Discussion

Entrapment of the FHL tendon in calcaneal fractures is a very rare complication but it is an important complication to identify to ensure adequate patient recovery and outcome.

The FHL tendon begins in the posteromedial groove of the distal

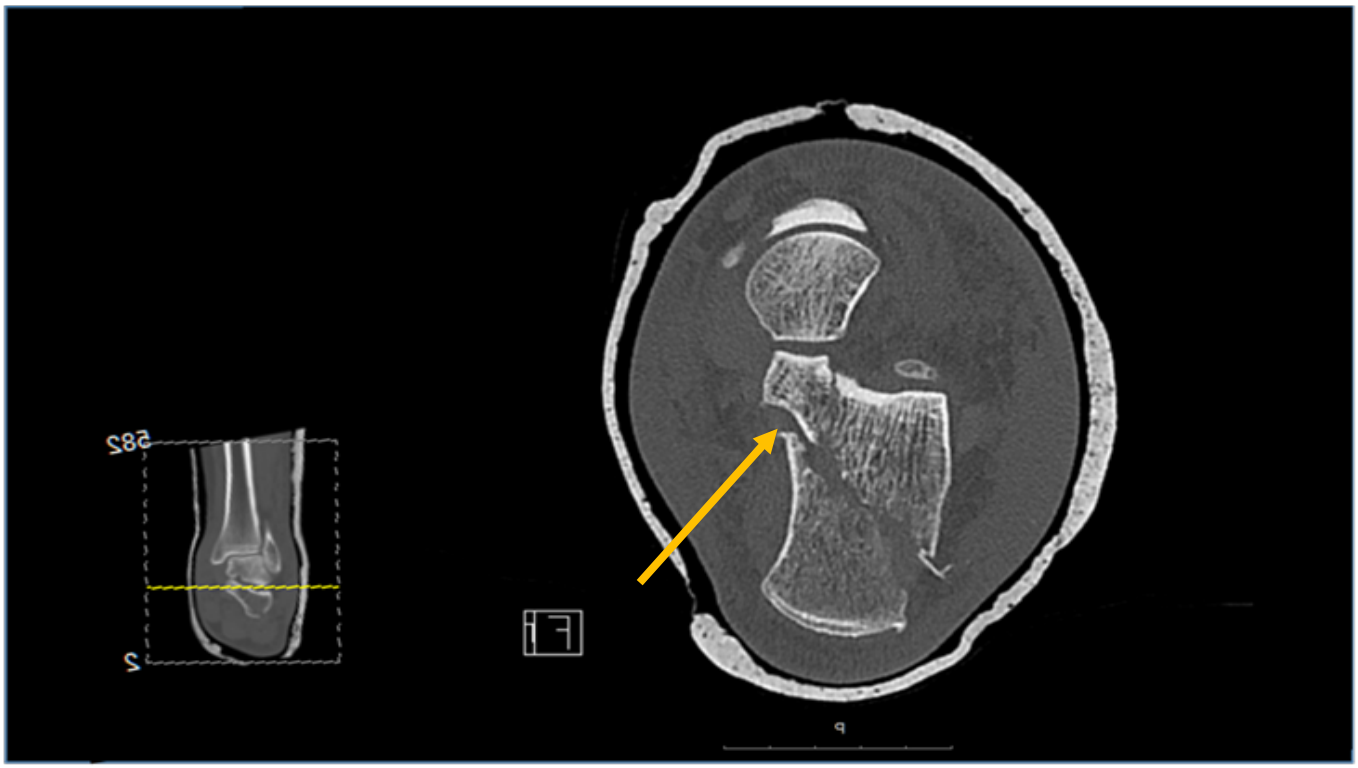

Figure 1: Axial CT image showing the primary fracture line with the area of FHL tendon entrapment marked (yellow arrow). Secondary fracture line is also shown exiting inferior to the sustentaculum, closure to the course of FHL.

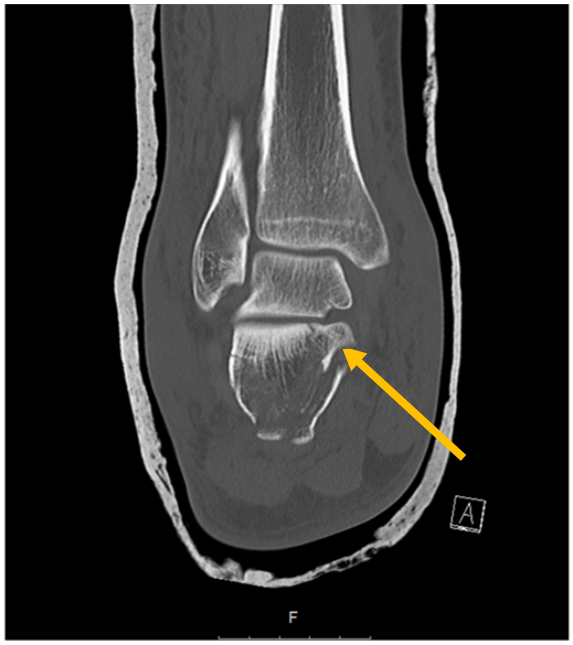

Figure 2: Coronal CT image showing the primary fracture line with the area of Flexor Hallucis Longus(FHL) tendon entrapment marked (yellow arrow). Secondary fracture line is also shown exiting inferior to the sustentaculum, closure to the course of FHL.

tibia and travels between the medial and lateral tubercles of the posterior talus [6]. Distally, the tendon then passes beneath the sustentaculum tali to the knot of Henry before inserting onto the base of the distal phalanx of the great toe on the plantar surface [7]. The primary function of the flexor hallucis longus muscle is to flex the great toe. Other functions include plantarflexion of the ankle and supporting the medial longitudinal arch of the foot [8].

Entrapment of the FHL tendon is associated with fractures of the foot and ankle. The FHL tendon can be trapped anywhere along its course and may result in a checkrein deformity. McKeever [9] described the checkrein deformity of the great toe as tethering of the FHL tendon after a fracture of the distal third of the tibia. It is described as a dynamic flexion deformity of the great toe where the FHL tendon adheres to the scar tissue or callous at the fracture site and forms a bowstring between this point and the site of its insertion onto the great toe. Therefore, when the ankle is passively dorsiflexed, the flexion deformity of the great toe is prominent but when the ankle is passively plantarflexed the flexion deformity is corrected completely [9]. The checkrein deformity was noted in

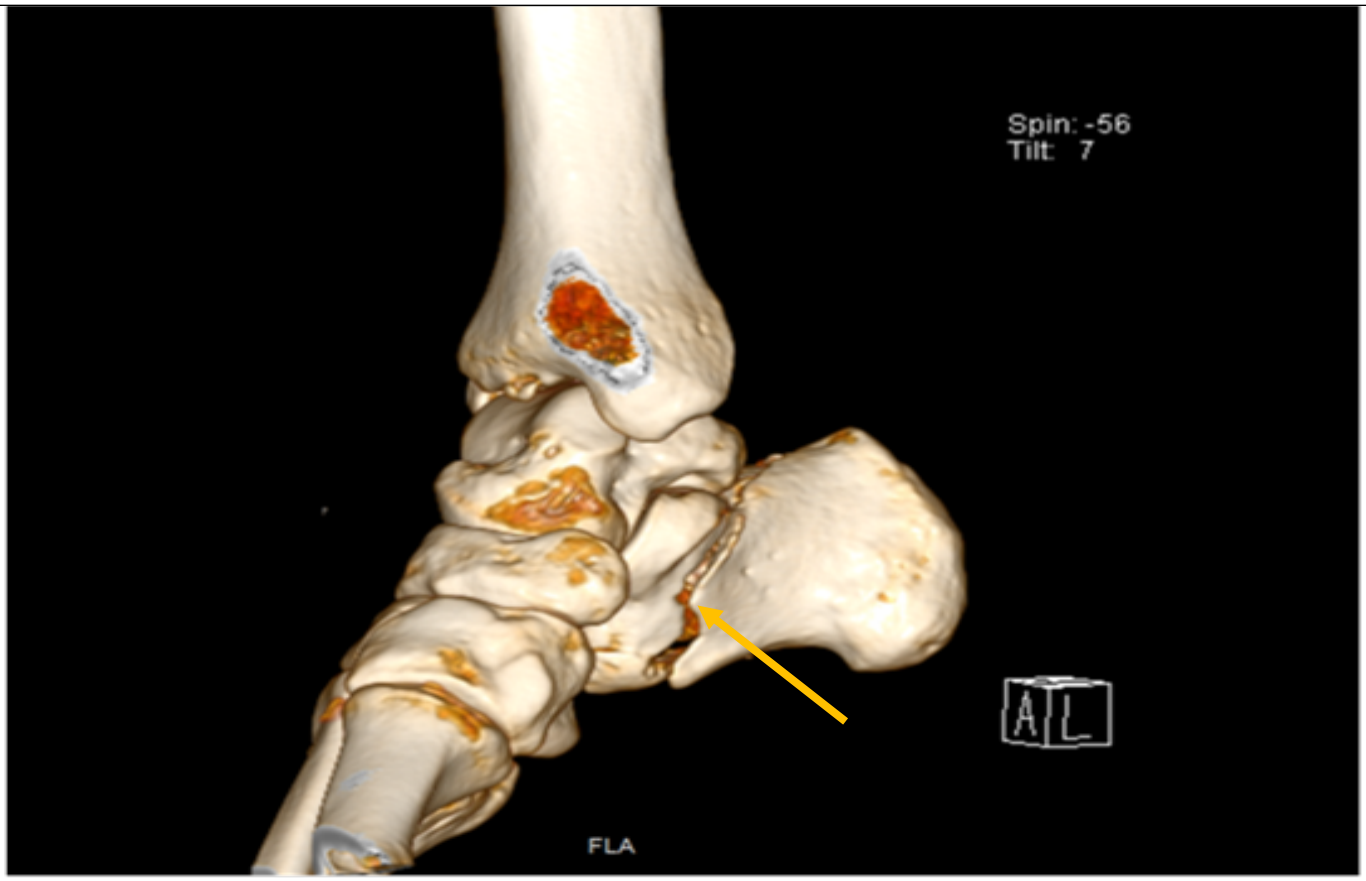

Figure 3: 3D CT rendered reconstruction image showing disruption to the sustentaculum tali, close to the course of Flexor Hallucis Longus. It also shows the point of Flexor Hallucis Longus tendon entrapment (yellow arrow) correlated from the operative findings.

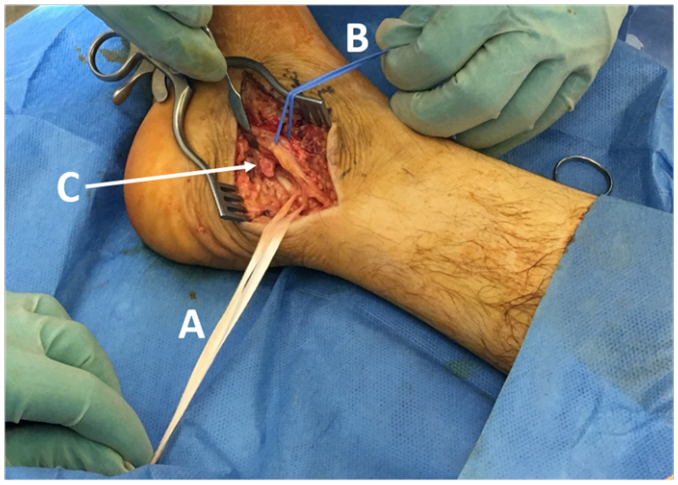

Figure 4: Intra-operative image of surgical release of Flexor Hallucis Tendon. **A**: cotton tape controlling Flexor Hallucis Tendon, no excursion of tendon is possible due to entrapment. **B**: a blue sloop holding Flexor Digitorum Longus and the neurovascular bundle. **C**: A bone spike tethering the Flexor Hallucis Longus tendon.

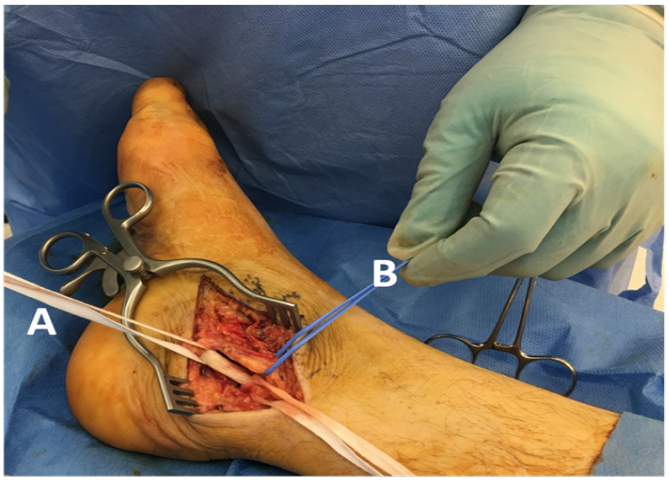

Figure 5: Intra-operative image after surgical release of Flexor Hallucis Tendon. **A**: cotton tape controlling Flexor Hallucis Tendon, excursion of tendon is possible due to release by removal of bony spike. **B**: a blue sloop holding Flexor Digitorum Longus and the neurovascular bundle.

Figure 6: An adhesion control barrier gel (Adcon Gel, aap bio implants) was used to prevent further adhesions and tethering during further healing of the fracture of the calcaneum and of the wound.

cases involving calcaneal fractures [3], intra-articular talus fractures [10], ankle fractures and also after ankle surgery [11-15].

Our literature search identified 6 cases that reported FHL entrapment following a calcaneal fracture. In 1990, Carr [3] described 2 cases of open calcaneal fractures, where FHL entrapment was only identified after the initial surgery of wound debridement and surgical stabilisation of the calcaneal fractures. Post- operatively, the great toes were noted to have a mild checkrein deformity which Carr [3] described as pathognomonic for FHL entrapment. Both patients were then taken for a second surgery, where the FHL groove was found to be empty. The FHL tendon was entrapped in the fracture site between the large lateral fragment and smaller sustentacular fragment and required relocation via a medial approach.

In the case reported by Anglen and Gehrke [4] in 1996, the entrapped FHL tendon was not identified from the CT scan during pre-operative planning. Instead the FHL tendon was noted to be entrapped between the large medial fragment and the talar facet during surgical fixation of the calcaneal fracture using a posterolateral approach. This approach to fix the calcaneal fracture made it challenging to relocate the FHL tendon but it was accomplished without needing a medial approach.

Similarly, in the case reported by Komiya & Terada [5] in 2014, FHL tendon entrapment was not identified on the pre-operative CT scan despite the presence of a sharp osseous fragment originating near the proximal entrance of the osseofibrous tunnel under the sustentaculum tali. The patient in this case was treated with a closed reduction and percutaneous pinning of the fracture and the diagnosis of FHL entrapment was only made post –operatively when there was limited great toe movement and increasing pain on extension of the great toe but no checkrein deformity was identified. The tendon was released 5 days later at a second surgical procedure using the medial approach.

In 2015, Wong- Chung [6] described a case where closed reduction and percutaneous pinning failed to reduce the calcaneal fracture. This led to the fracture being opened using an extensile lateral approach. The block to reduction was due to the FHL tendon within the fracture site between the tongue- type intra-articular fracture of the calcaneum and small sustentaculum fragment, which was present on pre- operative CT scan but not identified.

In our patient, the FHL tendon was entrapped by a fragment of callous between the anteromedial and posterolateral fracture fragments. Entrapment was by a different mechanism to the other cases described. The case described by Komiya & Terada [5] also described a bony fragment entrapping the FHL tendon but this fragment was present at the entrance of the osseofibrous tunnel under the sustentaculum tali.

The entrapped FHL tendon was identified when our patient was assessed, and initial CT images re-examined at his 2 week routine clinic appointment. But there was no checkrein deformity present as described by Carr [3]. Also, unlike the other cases, the calcaneal fracture in our patient was continued to be treated non- operatively even after the surgical release of the FHL tendon. The goal of calcaneal fracture management is to ensure that the height, width and length of the calcaneum and subtalar joint are clinically and radiologically maintained. In this case, the goals were achieved with non- operative management, as it was a minimally displaced

fracture. But if these goals were unattainable with non- operative treatment then closed reduction with percutaneous fixation should be considered. Non- operative management of the calcaneal fracture after FHL tendon release in our case, resulted in good patient outcome with complete functional recovery. The medial approach was used as described by Carr [3] and Komiya & Terada [5] as it allowed adequate exposure and access to the FHL tendon.

Soft tissue complications especially tendon pathology following calcaneal fractures can be challenging to recognise. Therefore, it is imperative to carry out a careful examination of the entire foot because hindfoot pathology can cause forefoot problems as shown in this case. In the emergency and elective settings, there needs to be a high index of suspicion of FHL tendon entrapment if on physical examination there is limited range of movement of the great toe and severe pain on passive dorsiflexion of the great toe following a calcaneal fracture. It is also important to look out for the presence of checkrein deformity of the great toe (passive dorsiflexion of the ankle, results in the flexion deformity of the great toe to become more prominent but when the ankle is passively plantarflexed the flexion deformity is correctly completely) which is highly suggestive of FHL tendon entrapment. But clinicians should bear in mind that absence of the checkrein deformity does not always rule out entrapment of FHL tendon along its course as demonstrated in this case. Secondly, even though CT scans are indicated for bony pathologies, they can also assist in identifying soft tissue pathologies as shown in the previous case reports which have described FHL tendon entrapment. Thus, it is important to be mindful of FHL tendon entrapment when reviewing CT scans for calcaneal fractures.

Conclusion

In conclusion adequate physical examination [16] and comprehensive review of images will allow timely identification and management of this rare complication so as not to impede patient recovery and outcome.

Conflict of Interest

Authors certify that they have no financial conflict of interest.

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