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TECHNICAL NOTE

Temporary external fixation facilitates open reduction and internal fixation of intra-articular calcaneal fractures

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Management of intra-articular calcaneal fractures during the past years has ranged from the nihilistic approach of no active treatment to open reduction and internal fixation or even to early subtalar arthrodesis. Operative treatment presents the surgeon with many challenges. Good results require atraumatic exposure, anatomic reduction, rigid fixation and early mobilization.

We describe the use of a temporary external fixator as an intraoperative aid in the open reduction and internal fixation of intra-articular calcaneal fractures. We propose this operative strategy as an option for the treatment of calcaneal fractures. The controlled distractive force provides numerous benefits. These include improved exposure of the subtalar joint, correction of angulation and maintenance of temporary stability prior to definitive fixation. We have found this technique applicable and easily reproducible.

Keywords : calcaneal fractures ; external fixator ; ORIF.

INTRODUCTION

Surgical management of calcaneal fractures is difficult and often requires a steep learning curve to achieve consistent results. They usually occur in young individuals with intensive labour occupations and are associated with major complications (*11*).

A better understanding of the comminution of the joint surface has been possible with computed tomography (*10*).

Non-operative treatment often leads to broadening of the heel, muscle imbalance, loss of motion, peroneal impingement, impaired gait, intractable pain, and early development of subtalar osteoarthritis (*3*).

Open reduction and internal fixation methods have been associated with partial skin flap necrosis, deep infection, delay of rehabilitation and sometimes catastrophic failure (*7*).

We describe a technique of open reduction and internal fixation through an extended lateral approach utilizing a temporary external fixator intraoperatively. The fixator allows ample access and easy reduction of the articular fragments. Preoperative management includes limb elevation and computed tomography scan (Fig 1). Surgery is performed 10-14 days after injury to allow swelling to subside.

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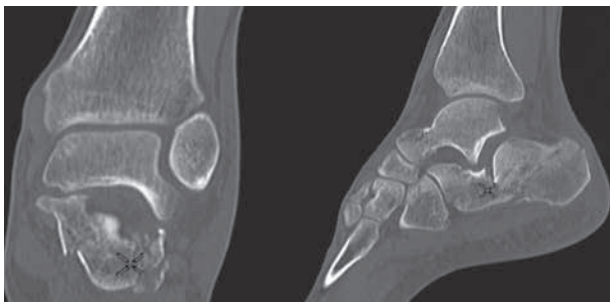

Fig. 1. — Preoperative CT scan showing a Sanders 3AC calcaneal fracture.

SURGICAL TECHNIQUE

The calcaneus is approached through a modified obtuse lateral incision as described by Freeman *et al* (*4*). This approach minimizes the sequelae of peroneal tendinitis, devascularization of the posterolateral skin and preserves the sural nerve (*4*). Two straight cuts meet at the lateral side of the heel at an angle of not less than 100°. The distal arm starts over the base of the 5th metatarsal and passes directly posteriorly to meet the proximal arm. The proximal part of the incision begins in the posterior midline, at about 12 cm above the level of the sole and passes in a straight line distally and anteriorly to meet the distal arm about 2 cm anterior to the line of the heel. The incision is carried directly through the deep fascia with no undermining of skin, followed by subperiosteal dissection of the lateral wall. The flap elevated includes the peroneal tendons proximally, sural nerve, posterior peroneal artery and the detached calcaneofibular ligament (*4*). It is held retracted by two Kirschner wires which are passed obliquely to come underneath the peroneal tendons and are secured into the lateral malleolus anteriorly and body of the talus posteriorly. To allow access to the calcaneocuboid joint, the peroneal tendons distally need to be separated from the flap and from each other. The full "inverted J" aspect of the superior calcaneocuboid joint can be easily visualized in this manner.

The first 5 mm Steinmann pin of the external fixator is inserted at the junction of its upper and middle third of the lateral cortex of the tibia, the second across the posterior plantar calcaneal fragment from lateral to medial (taking care to avoid medial neurovascular structures). A unilateral external fixator frame is applied, followed by locking the frame in place at the desired tension (Fig. 2)

Fig. 2. — Temporary external fixator in place and distraction applied.

The fracture line at the level of the angle of Gissane is identified and the thin lateral wall is lifted gently and retracted inferiorly to expose the articular fragments buried within the body of the calcaneus. The fragments are usually depressed and rotated inferiorly. The depression of the posterior facet joint is reduced using a lamina spreader. If inferior bone is soft or fragmented, a smooth metal instrument such as a metal ruler is used to protect the inferior fragments from the point loading of the lamina spreader. The talar articular facet is used as a reduction reference. A Macdonald retractor is used to gently palpate the surface of the anterior and posterior aspects of the subtalar joint. A temporary 1.6 mm Kirschner wire is passed just beneath the articular surface aiming towards the sustentaculum.

Valgus heel alignment is restored by controlling the amount and direction of distraction using the

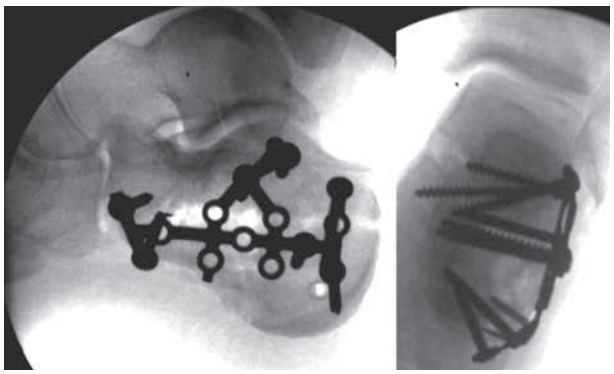

Fig. 3. — Intraoperative assessment of reduction

multiaxial distractor. The "constant" medial sustentacular fragment is then fixed by a 3.5 mm partially threaded cancellous lag screw. After exposure of the calcaneocuboid joint, a calcaneal locked plate is applied from the anterior process to the most posterior aspect of the tuberosity to maintain tuber-sustentacular alignment. Reduction is then verified using fluoroscopy (Fig. 3). The external fixator and half pins are then removed and the wound is closed in layers.

DISCUSSION

Calcaneal fractures are disabling injuries, which represent more than 2% of all fractures and approximately 60% of all tarsal injuries. The articular surfaces are displaced in 65% to 70% of cases. Motor vehicle collisions and falls are the major causes of these large force compression injuries, causing widening of the heel, loss of heel height, and articular surface displacement (*2*).

The main goal of treatment for displaced fractures of the calcaneus should be the restoration of the three dimensional structure, with emphasis on correct alignment in the coronal and axial planes and the height of the calcaneal body. A correlation has been shown between restoration of normal anatomy and satisfactory functional outcome (*6,9*).

Overall, there is insufficient high quality evidence relating to current practice to establish whether surgical or conservative treatment is better for adults with displaced intra-articular calcaneal fracture. Evidence from adequately powered randomised, multi-centre controlled trials, assessing patient-centred and clinically relevant outcomes is required (*2,12*).

The described technique permits manipulation and easier reduction of the subtalar joint in open reduction and internal fixation. The Böhler calcaneal traction pin represents one of the earliest uses of this concept. It has been widely incorporated in various treatment schemes for calcaneal fractures (*1*). The use of temporary external fixator in intra-articular calcaneal fractures has been useful to obtain exposure of subtalar joint and minimize the amount of soft tissue dissection incurred from surgery. Intra-operatively the external fixator is versatile because it has potential for angular adjustment that can then be "locked in".

We found this technique to be safe and useful to aid in treatment of intra-articular calcaneal fractures. We have had no instance of bone failure at pin insertion site or soft tissue injury. Although pin sites represent stress risers, no stress fractures have been observed.

To the best of our knowledge this technique has not been described before. The external fixator has been described as definitive method of fixation rather than a temporary tool to aid open reduction and internal fixation (*5*). The advantage over fixed traction and traction bow is that length, angulation, and manipulation of the limb for X-ray control are all easily possible without the need for assistance, which dramatically reduces operative time.

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