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Closed reduction and percutaneous cannulated screws fixation of displaced intra-articular calcaneus fractures

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ABSTRACT

Background: Displaced intra-articular calcaneal fractures remain a therapeutic challenge due to fracture complexity and different treatment options. One of the adverse effects of operative treatment is secondary damage to soft tissues. To avoid soft tissue complications, several less invasive procedures have been introduced. The most frequently used minimally invasive technique is closed reduction of fracture and percutaneous cannulated screws fixation.

Method: This study evaluates the medium-term outcome of a new technique of percutaneous treatment in 60 cases operated in Al-Razi orthopedic hospital in Kuwait in the period from 2007 to 2009. The described technique applies the principle of closed manipulation with new reduction method using a medial subperiosteal tunnel to manipulate the fragments. The technique involves new method of distribution of screws required to fix the fracture.

Results: According to the American Orthopedic Foot and Ankle Society Hind foot Score, 38.3% of all cases (22 cases) had excellent results, 41% good (25 cases), fair results in 15% (9 cases), and poor results in 5% (4 cases). The overall satisfactory results (excellent and good) were 79.3%.

Conclusion: The technique is suitable for most types of intra-articular fractures especially in patients with compromised soft tissues in which open reduction and internal fixation is contraindicated.

1. Introduction

The frequency of calcaneal fractures has been presumed to be around 2% of all fractures and the proportion of intra-articular calcaneal fractures with involvement of the posterior subtalar joint is approximately 75% of calcaneal fractures. Intra-articular fractures carry a high morbidity; approximately 20% are not able to return to work within a year, rendering intra-articular calcaneal fractures costly on a socio-economic aspect [1].

Classifications of calcaneal fractures can be divided into those based on plain radiographs and those based on C.T.-scans. Over twenty different classifications have been described based on plain radiographs since that time. The Essex-Lopresti classification is the most frequently used classification system. It is relatively simple and reproducible. Two types of intra-articular calcaneal fractures, based upon the direction of the secondary fracture line: the 'Joint-depression' and the 'Tongue' type), are described (Fig. 1) [2].

More than ten different classification systems have been described based on computed tomographic scans of intra-articular calcaneal fractures. The most frequently applied classification system was proposed by Sander (Fig. 2) [2].

This classification uses the (semi-) coronal reconstruction images, where the posterior subtalar joint is at its widest and the sustentaculum tali is visible, and is based on the number of fracture lines with more than 2 mm displacement [3].

Treatment of displaced intra-articular calcaneal fractures can be divided into conservative and operative management. The latter comprises both the open reduction and internal fixation (ORIF) and percutaneous reduction and internal fixation. Open reduction and internal fixation is considered the gold standard treatment for displaced intra-articular fractures of the calcaneus by most experts, as it generally provides overall good to excellent results and the ability to anatomically restore the subtalar joint. Its main disadvantages are wound dehiscence and infection, which may occur in up to 30% of patients (Fig. 3).

In an attempt to lower the complication rates encountered with ORIF, various minimal invasive techniques were introduced to reduce and fix displaced fragments. At present, there is a limited amount of data available on the outcome after percutaneous reduction and Percutaneous cannulated screws fixation of calcaneal fractures [4].

The aim of this study is to evaluate the results of treatment of displaced intra-articular calcaneal fractures using new technique

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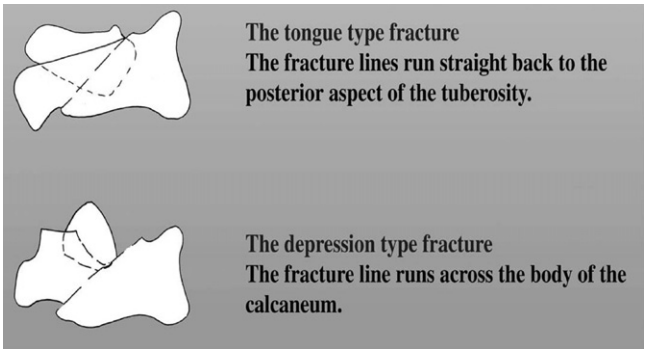

Fig. 1. Essex Lopersti classification [2].

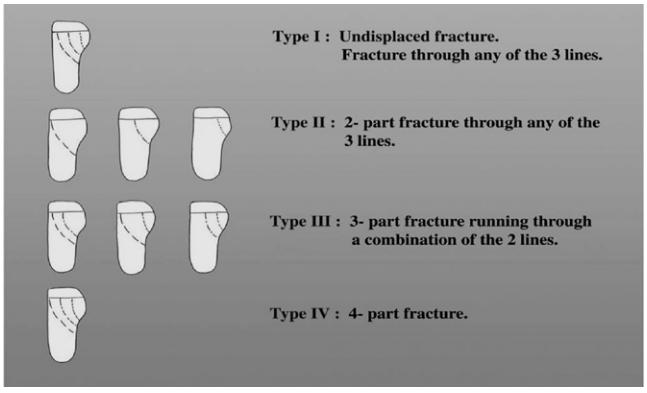

Fig. 2. Sander classification [2].

of closed reduction and percutaneous screw fixation with cannulated screws.

2. Material and methods

Between February 2007 and October 2009, 47 patients (60 cases) with intra-articular fractures of the calcaneus (13 bilateral), were treated by closed reduction and percutaneous screw fixation in the AL-Razi orthopedic hospital in Kuwait. The average follow-up was 29 months (range 16–42 months). The average age at trauma was 34.4 years (range 22–54 years) with 76.5% were males. The right foot was injured in 16 patients, the left foot in 18 and both feet in 13 patients. There were two open fractures. The mechanism of injury was most often a fall from height which accounted for 68.5% (32 patents). Work related injuries comprised 21% (10 patents), motor-vehicle accidents 6% (3 patents) and direct impact injuries 4.5% (2 patents).

Fig. 3. Wound dehiscence and infection.

Table 1
Associated injuries.

Associated injuries	Number of cases
Lumbar spine fractures	5
Lumbar spine and bilateral superior and inferior pubic rami fractures	1
Fracture inferior pubic ramus and sacrum	1
Ankle fracture	2
Contralateral tibial shaft fracture	1
Talar neck fracture and head injury	1
Head injury and pneumothorax	1
Fracture distal radius	1

2.1. Associated injuries

25.5% of the patients (12 cases) presented with other injuries (Table 1).

2.2. Classifications

The Essex Lopersti and Sanders classifications appear to be the most prevalent and best suited for clinical practice and for research purposes. In this study, these two classifications were used in order to assess the fracture preoperatively. Preoperative plain X-ray lateral view was used to classify the fractures into tuberosity and joint depression types according to Essex Lopresti classification and midcoronal C.T. views were used to classify the fractures according to Sander classification. I used an algorism in preoperative planning to choose the suitable method of percutaneous reduction of fractures depending on these two classifications systems (Fig. 4).

2.3. Radiological evaluation

The initial radiographs for a suspected calcaneal fracture consists of anteroposterior, lateral and axial view of the calcaneus. C.T.-scan was performed when the plain X-ray showed a fracture of the calcaneus including axial, coronal and sagittal planes. Postoperatively, the same preoperative plain X-ray views and C.T. scan were taken to assess the reduction. The protocol of radiological evaluation in this study involved measuring 3 angles and 3 distances.

The angles measured were (Fig. 5):

1. *Böhler's tuber joint angle by* is measured using the highest points of the calcaneal tuberosity, the subtalar joint and the anterior process and is taken as a relative measurement of the degree of compression and deformity in calcaneal fractures. Normally, this angle ranges from 25° to 40° [5].
2. *The crucial* angle, as described by Gissane, is the angle formed by the posterior facet and the line from the calcaneal sulcus to the tip of the anterior process of the calcaneus. This angle is normally between 120° and 145° [6].
3. *The posterior facet inclination angle*, as described by Sarrafian, is the angle formed by the two intersecting lines drawn along the surface of the posterior facet and along the upper surface of the calcaneal tuberosity. Normally, this angle measures an average of 65°, with a range of 55–75°.25 [7].

The distances measured were: (in comparison with uninjured side in unilateral fractures only) (Fig. 6).

1. *The length of the calcaneus* is measured on the lateral view from the most posterior point of the tuberosity to the calcaneocuboid joint.
2. *The height of the posterior facet*, as described by Leung et al., is measured by a line perpendicular on the calcaneal axis to the highest point of the posterior facet.