

FUNCTIONAL OUTCOME AFTER OPEN REDUCTION AND INTERNAL FIXATION (ORIF) OF INTRA-ARTICULAR CALCANEAL FRACTURES-TWO CASE REPORTS

Oliver Arsovski^{1,3}, Stefan Krstevski^{2,3}, Dino Hajradinovikj^{1,3}, Antonio Andonovski^{1,3}, Dimitar Petrevski^{1,3}, Igor Kaftandziev^{1,3}

¹PHI University Clinic for Traumatology, Orthopaedic Diseases, Anaesthesia, Reanimation, Intensive Care and Emergency Centre – Department of Traumatology, Skopje, North Macedonia

² PHI University Clinic for Traumatology, Orthopaedic Diseases, Anaesthesia, Reanimation, Intensive Care and Emergency Centre – Emergency Centre, Skopje, North Macedonia

³Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, North Macedonia

Abstract

Unique and simple parameters have not yet been established according to which we can evaluate the surgical reduction and assume the functional outcomes in calcaneal fractures. The classic radiological Bohler's angle is considered a sensitive parameter for assessing the quality of the reduction but not so adequate in the functional outcome assessment. In this paper we report two cases of Open Reduction and Internal Fixation (ORIF) of calcaneal fractures using already established methodology.

Patients were treated according to the standard procedure using lateral approach, open reduction and osteosynthesis with anatomic locking plate. Postoperative Bohler's angle was measured on postoperative radiographs compared to contralateral healthy leg.

Functional outcomes were assessed one year after injury using the American Orthopaedics Foot and Ankle Society (AOFAS) scale.

Case report 1: A 39-year-old man, injured in a traffic accident as a car driver sustained right calcaneal fracture and a fracture of the facial bones suitable for conservative treatment. The preoperative Bohler's angle was 15°. Surgery was done on the eleventh day post-injury. Postoperatively Bohler's angle was 37° compared to the uninjured leg where it was 32°. The functional outcome one year after the injury was 89 points according to AOFAS scale.

Case report 2: A 51-year-old woman injured by fall from a height of 1.5 meters sustained an isolated left calcaneal fracture. On the initial radiographs Bohler's angle was 13°. Surgery was done on the eighth day post-injury. Bohler's angle measured on postoperative radiographs was 29° compared to the uninjured calcaneus - 31°. Superficial wound infection occurred postoperatively, which was managed with local treatment. Functional outcome using AOFAS scale was 91 points.

A good reduction was achieved in both presented cases which correlated to good functional outcome at one year after injury. In determining the true value of this radiological parameter as a predictor of functional outcome we suggest studies on large patient samples with extensive analysis of multiple factors that may influence.

Keywords: calcaneus, Bohler's angle, fracture, outcome

Introduction

Fractures of the calcaneus are the most common fractures of the foot. They represent 2% of all fractures and 75% of foot fractures[1,2].

Of these, 10% are bilateral, 10% are accompanied with other injuries and even 75% have an intra-articular component, therefore they represent intra-articular fractures[3].

Dislocated intra-articular fractures of the calcaneus are the main challenge regarding the treatment of this injury [4,5].

The choice of treatment of calcaneal fractures in regards to open reduction and osteosynthesis *versus* conservative treatment is still being debated in the world literature [6].

Conservative treatment for a longer period is accompanied by numerous complications among which are pain, limitation of movements in the subtalar and ankle joint, increased morbidity, prolonged healing, heel deformities, subfibular impingement causing peroneal stenosis or tendinitis [7,8].

Open reduction and osteosynthesis of intra-articular calcaneal fractures is technically demanding procedure and in order to achieve good results there is a necessity to comply with the strict principles of surgical management of these injuries.

Although there has been progress in the treatment during the last decades, not a single nor simple parameters have been defined according to which we can evaluate the reduction and assume the functional outcome.

The classic radiological Bohler's angle is considered a sensitive parameter for assessing the quality of the reduction but not so adequate in the functional outcome assessment [9,10].

Taking into consideration these findings, in this paper we report two cases of Open Reduction and Internal Fixation (ORIF) of calcaneal fractures using already established methodology.

Materials and Methods

The two patients being presented in this paper were admitted immediately after the accident that had led to the injury. The fracture was diagnosed using lateral and axial radiographs of the calcaneus followed by Bohler's angle measurement and consequent indication for ORIF.

Bohler's angle is formed by the intersection of the line connecting the tip of the posterior tubercle with the posterior facet and the line connecting the tip of the posterior facet and the anterior process of the calcaneus. Although population studies indicate variability in this radiological parameter, it is thought to be between 25° and 40° taken on a true lateral view of the calcaneus.

Using this radiological parameter, we can evaluate the height or inclination of the calcaneus and the degree of depression of subtalar joint. The patients were treated using lateral approach to the calcaneus with ORIF and anatomic locking plate.

The ORIF was done according to the established and well-known AO principles (Arbeitsgemeinschaft für Osteosynthesefragen) group.

With this approach the patient is placed on the operating table in a lateral decubitus position on the uninjured leg.

After appropriate preparation of the surgical field, a fasciocutaneous flap is created which extends to the subtalar joint. In this act the peroneal tendons should be carefully dissected from the peroneal tubercle.

After their preparation the tendons are gently mobilized and protected within the flap. To achieve a good view of the injured subtalar joint, two Kirchner wires are introduced into the lateral part of the talus so that the soft-tissue flap can be kept cranially while gaining better access to the operative field. The anterior process and calcaneocuboid joint are visualized anteriorly with the peroneal tendons and the sural nerve plantarly.

In analogy to the subtalar joint, the skin flap can be held away from the calcaneocuboid joint with one or two Kirchner wires inserted into the cuboid bone. The next step is introducing a 6.5 mm cancellous screw through punctate incision into the tuber calcanei from posterior or lateral side. The protruding lateral wall of the calcaneus is folded and retracted inferiorly secured with a suture.

To gain access to the entire subtalar joint, fragments of the anterior process that are dislocated cranially must be temporarily held at Gissane's angle.

The subtalar joint is gradually repositioned from medial to lateral. The reduction begins with the sustentacular fragment, which is either medially or fractured in 42% of intra-articular fractures.

The sustentacular fragment is repositioned to the medial facet of the talus if displaced, and may be fixed with a 2.0 mm Kirchner wire placed plantarly if this fragment is unstable. In cases of comminuted fractures of the sustentaculum tali, an additional direct approach is performed so that anatomical reduction of the medial facet is achieved.

For further reconstruction of the medial wall and anatomic reduction of the articular fragments the tuberos fragment is retracted downward and medially below the sustentacular fragment.

Intra-operative control of the reduction of the subtalar joint is an imperative in the surgical treatment of displaced intra-articular fractures.

For visual conformation of the joint congruity all the Kirschner wires passing through the subtalar joint should be removed and the heel should be brought into a slight varus position.

The reconstructed subtalar joint is repositioned to the tuberosity fragment. The anteromedial facet of the subtalar joint (if fractured) and the calcaneocuboid articular surface are visualized through the anterior part of the approach. With the remaining incongruities, especially depressed articular fragments in the calcaneocuboid joint, the articular surfaces are reduced starting from medial to lateral using the articular aspect of the cuboid.

Then, a temporary fixation of the reduced fragments with Kirschner wires placed in subchondral bone is made in a way that they will not interfere with the subsequent positioning of the plate. Following the procedure, immobilization is applied for the next 10-14 days during which the sutures are removed and swelling subsides. After this period, physical therapy is initiated, which includes active and passive exercises for ankle, subtalar and metatarsal joints mobilization starting from the second postoperative day. Passive mobilization of the subtalar joint is continued consequently.

Postoperative Bohler's angle is measured on the first postoperative radiographs and compared to the contralateral healthy leg. Functional outcome is assessed one year after injury using the AOFAS scale. This scoring system includes nine questions related to three components: pain (one question - 40 points), function (seven questions - 50 points) and axis (1 question - 10 points). T

he total number of points is 100. Questions about the axis are answered by the researcher based on the clinical examination and radiographs. The remaining questions are answered by the patient.

Case presentation

Case report 1: A 39-year-old man, injured in a traffic accident as a car driver sustained right calcaneal fracture and a fracture of the facial bones suitable for conservative treatment. Local swelling of the right heel was evident and local treatment was being done. The preoperative Bohler's angle was 15°. Surgery was done on the eleventh day post-injury. Postoperatively Bohler's angle was 37° compared to the uninjured leg where it was 32°. The functional outcome one year after the injury was 89 points according to AOFAS scale.

Case report 2: A 51-year-old woman injured by fall from a height of 1.5 meters sustained isolated left calcaneal fracture. On the initial radiographs Bohler's angle was 13°. Surgery was done on the eighth day post-injury. Bohler's angle measured on postoperative radiographs was 29° compared to the uninjured calcaneus - 31°. Superficial wound infection occurred postoperatively, which was managed with local treatment. Functional outcome using AOFAS scale was 91 points.



Figure 1. Axial view of calcaneal fracture ORIF



Figure 2. Lateral view of calcaneal fracture ORIF. **Figure 3.** Anatomical locking plate *in situ* intraoperatively.

Discussion and conclusion

The modern orthopaedic trauma is increasingly focused on the patient's, i.e., subjective evaluation of functional outcomes after injury. The classic radiological Bohler's angle is considered a sensitive parameter for assessing the quality of the reduction but not so adequate in the functional outcome assessment [11,12].

In both presented cases, a good reduction of the calcaneal fracture was done, which correlated with good functional outcome achieved one year after injury.

In determining the true value of this radiological parameter as a predictor of functional outcome, we suggest studies on large patient samples with extensive analysis of multiple factors that may influence. In conclusion, open reduction and internal fixation with anatomic locking plate of the calcaneus results in good functional outcome, which is manifested through anatomical reconstruction of the height, width, Bohler's and Gissiane's angles of the calcaneus.

It further allows early mobilization if the surgical principles are appreciated, adequate patient selection and timing of the surgery, appropriate skin-flap formation and adequate postoperative protocol [13].

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