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Review

MANAGEMENT OF POSTERIOR MALLEOLUS IN ANKLE FRACTURES.

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ABSTRACT

The fractures of the posterior malleolus are isolated or in association with the fracture of the fibula and the medial malleolus. Recently, a particular emphasis was given to the treatment of posterior malleolus fracture for the role of this structure in ankle ligament stability. Numerous techniques and types of surgical access are reported in literature, but there is currently no consensus among the orthopaedics on the correct management of this fracture. The aim of this work is to review the management of the posterior malleolus fractures.

1. Introduction

Ankle fractures are due to low energy trauma and have an annual incidence of 122-184 / 100,000 people (1). The posterior malleolus is involved in about 7-44% of all ankle fractures, with dimensions and morphology ranging from the simple avulsion of a posterolateral portion to the detachment of a large fragment (2, 3). The term "posterior malleolus" was first introduced by Cooper and Earle in 1822. In 1933, Henderson introduced the term "trimalleolar fractures", which differ from tibial pylon fractures in that they involve the supra-articular metaphyseal region with a variable degree of joint comminution (4). Fracture of the posterior malleolus occurs frequently following rotational trauma and negatively affects the prognosis in ankle fractures. The association of rotational and axial forces produces the variant of the "posterior pylon" characterized by the presence of a postero-medial fragment and by the bone comminution. The treatment of fractures of the posterior malleolus is now controversial and a subject of debate.

2. Anatomy and biomechanics

The joint stability of the ankle is based on the integrity of the bone and ligament structures. Among the osseous structures, the posterior malleolus plays a fundamental role as it allows a joint congruity and a homogeneous distribution of the load forces between the tibia and talus.This structure also allows a posterior stability to the talus and permits a rotational stability to the ankle. In addition, the posterior malleolus forms the posterior part of the incisura tibiae (notch fibularis) which receives the distal fibula. Among the ligamentous structures, the tibio-peronal syndesmosis is particularly involved in joint stability. This structure consists of the anterior tibio-fibular ligament (AITFL), the posterior tibio-fibular ligament (PITFL), and the interosseous membrane. The PITFL has a trapezoidal shape with superior fibers that fit into the tubercle of the posterior malleolus and lower fibers that originate from the articular surface of the distal tibia. The PITFL provides 42% of the mechanical resistance of the syndesmosis, 35% from AITFL and 22% from the interosseous membrana (5.6). According to the Danis-Weber classification, in type B fractures -the most frequent ankle fractures - the PITFL remains intact attached to the posterior malleolus (7). Therefore, a fracture of the posterior malleolus not onlyinfluencesthe load distribution between the tibia and talus, but the ligament stability of the syndesmosis as well. A bone or ligament instability of the ankle predisposes to joint degenerative processes. The biomechanical studies of the 1990s stated that the 50% resection of the posterior articular surface of the distal tibia does not alter the joint stability nor does it increase the tibio-talar mechanical pressures, but only a reduction of the contact surface (8,9). Subsequently, studies have shown that the posterior malleolus fracture alters the distribution of mechanical forces on the articular cartilage between the tibia and the talus, with an increase in the antero-medial region in particular, producing post-traumatic arthrosis (10).

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Moreover, the integrity of the lateral and medial ligament structures influences the ankle stability more than the extension of the contact surface between the tibia and talus (11,12). Therefore, ligamentous structures play a more relevant role in ankle stability than the bone component.

3. Radiographic assessment

X-ray examination in standard projections (true anteroposterior, mortise with 15 ° internal rotation, lateral views) is sufficient to diagnose the posterior malleolus fracture, particularly in the lateral view. For several years, the size of the posterior malleolus fragment has been evaluated proportionally to the percentage of involvement of the articular surface of the tibial plafond. In the variant of the "posterior pylon", the sign of the "double contour" or "spur sign" of the medial malleolus in the antero-posterior view is indicative of the presence of a posterior malleolus fracture with medial extension (4). However, several authors agree that radiographic examination is not sufficient to evaluate the extent of the fracture, comminution, degree of joint involvement and injury of syndesmosis (3.13). Performing a preoperative CT scan is useful for identifying the size and shape of the fragment and the degree of involvement of the fibular notch of the tibia, and is therefore considered essential before performing surgical treatment (14,15).

4. Classification

Most of the classifications on the posterior malleolus were based on an x-ray assessment of the fracture. The first classification, formulated by Grondahl, dates back to 1913, and includes three groups: fractures of the posterior lip, fractures of the posterolateral corner of the distal tibia, and cortical avulsion from the dorsal surface of the tibia (16). Only in 2015 did Rammelt divide the fractures of the posterior malleolus into 4 groups through an evaluation performed by CT scan: extraincisural fragment with an intact fibular notch; intraincisural posterolateral fragment involving 1/3 - 1/4 of the fibular notch; intraincisural posteromedial fragment involving the fibula notch and the medial malleolus; large posterolateral fragment carrying the posterior half of the fibular notch (17). This need arises from the fact that it is difficult to correctly evaluate both the shape and the size of the fracture of the posterior malleolus due to the obliquity of the margins and the involvement of the fibular notch through a simple radiographic examination. The CT scan also allows evaluation of the fracture comminution, the degree of joint involvement, and a possible injury of the anterior component of the syndesmosis.

5. Management

There are no precise guidelines in literature on the treatment of posterior malleolus fractures due to non-standardized clinical studies, limited patient samples and heterogeneous surgical techniques. Historically, the main indication for surgical treatment was the instability of the ankle, subsequently, greater attention was given to the restoration of the congruence of the articular surface.

In 1940, Nelson introduced the "one - third rule", which states: if the fracture affects more than 1/3 of the articular surface in the lateral radiographic view, a surgical procedure is indicated (18); other indications for surgical treatment were the presence of posterior subluxation of the talus and displacement of over 2 mm of the articular surface; the size of the fragment and the joint involvement were the main factors when considering surgical treatment.Although several factors may contribute to the decision such as the comminution of fragments, the articular impaction and the stability of the syndesmosis,nowadays, greater attention has been given to the ligament stability of the ankle and to the reduction of the fibula within the fibular notch (17). Conservative treatment is indicated in the presence of an isolated non-displacement fracture and stable syndesmosis, or in the presence of marginal bone avulsions of posterior malleolus. In consideration of recent biomechanical studies, surgical treatment is recommended in the presence of displacement fragments involving 5/10% of the articular surface (4.19,20,21,22).The objectives of the surgical treatment are: tension of the PITFL, and therefore a greater stability of the syndesmosis, anatomical reconstruction of the fibular notch to prevent the posterior translation of the fibula and restoration of the articular tibio-talar congruence in order to ensure a posterior stability of talus. This can be achieved by indirect reduction of fracture and synthesis with screws or direct reduction and plate and screws fixation.

In biomechanical studies, using a posterolateral approach, the plate fixation demonstrated greater stability and less axial displacement under load forces compared to the anteroposterior screws (23). Clinical studies have better clinical outcomes in patients operated with direct reduction than indirect treatment (24.25).

The indirect osteosynthesis with screws, performed more with the patient supine by anteroposterior approach, is a minimally invasive technique that is based on a reduction of the fracture for ligamentotaxis of the PITFL.This procedure is indicated for large fragments with minimal displacement, it has a low incidence of local complications, it does not allow the removal of the periosteum or interposed fragments and it frequently requires the use of a trans-syndesmotic screw. Using anteroposterior screws may cause injury to the extensor tendons or tibial nerve.

Direct osteosynthesis is performed with the prone patient by posterolateral approach, between the peroneal tendons and the long flexor of the hallux. This technique is indicated in small or large fragments, it allows a reduction of the fracture, the removal of interposed fragments, a visualization of the osteochondral injuries, and provides a lower risk of proximal migration of the bone fragment.Moreover, it allows a better mechanical stability of the syndesmosis, through a greater tension of the PITFL. This technique has shown better functional results, although it is associated with major local complications such as fibrosis, infections, vascular (safena) and nervous (sural nerve) lesions in 4-12%. Posterolateral approach allows a simultaneous synthesis of the fibula through a posterior plate and must be performed following the synthesis of the posterior malleolus in order to allow visualization of the articular surface (1).The synthesis of the medial malleolus is difficult due to the patient's prone position (26). The posteromedial approach, performed posteriorly on the posterior tibial tendon, is useful in the presence of a posteromedial fragment.

According to the classification of Rammelt, the I type does not require a surgical treatment, in the II type the treatment is necessary based on the size of the fragment and the type of fracture of the fibula, the III and IV types always require a surgical treatment with a direct technique. At the end of the surgery, the stability of the syndesmosis must be evaluated through the Hook or extrarotation of ankle tests. The surgical reconstruction of the posterior malleolus allows a greater stability of the syndesmosis compared to the use of the trans-syndesmotic screw. Gardner (15), bystudying a CT scan, observed a bad reduction of the fibula in tibial incision in 52% of cases after using the trans-syndosmotic screw.The same author, through MRI study, reported a restoration of 70% of the stiffness of the syndesmosis after osteosynthesis of the posterior malleolus, compared to 40% after use of the transindesmotic screw. Li (27) notes that after synthesis of the posterior malleolus, the treatment of syndesmosis is necessary in 46% if an indirect reduction with screws is used and unnecessary if a direct reduction with a plate is performed. Therefore, the posterior malleolus plays an important role in the stability of syndesmosis and its synthesis reduces the need for use of trans-syndesmotic screws (26).

The main complication of the posterior malleolus fracture is post-traumatic osteoarthritis, which for many years has been related to the size of the fragment (20). Recently, it has been observed that arthrosis is more frequent in the presence of fragment dispalcement, ankle dislocation, a residual posterior subluxation of the talus and an incongruity of the articular surface > 2mm (12). The risk of post-traumatic arthritis, which occurs after 7 years of the trauma, increases from 4% in bimalleolar fractures to 34% in trimalleolar fractures (14). A failure of the treatment of the posterior malleolus involves a subluxation of the fibula and an instability of the syndesmosis (1)

6. Conclusions

The treatment of the posterior malleolus would allow both the anatomical reconstruction of the fibular notch of the tibia and a greater stability of the syndesmosis, indispensable requisites for obtaining better clinical results and lower incidence of complications. Despite the presence of numerous studies on fractures of the posterior malleolus, to date no consensus has been achieved on the classification and treatment of these traumatic injuries. Performing a preoperative CT scan is useful for identifying the size and shape of the fragment and the degree of involvement of the fibular notch. Indication for surgical treatment should be extended to small fragments and associated with an intraoperative evaluation of the stability of syndesmosis. Clinical trials with broad samples and similar methodologies are necessary in the future for an adequate assessment of clinical outcomes and long-term complications.

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