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Lateral approach to the ankle and distal leg

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Fractures of the distal tibia are usually high-energy injuries and are well known for their soft tissue complications after surgery. Various factors have been studied regarding the possibility of them reducing the incidence of such damage, including timing of surgery, staged surgery, fixation method, and surgical approach. Less invasive surgical techniques with vascularity preserving approaches were proposed as reasonable solutions to this problem. The aim of this study was to investigate the presence of minor vascular structures, which can be preserved during anterolateral approach, possibly contributing to the success of the approach. Lateral approach for the distal tibia was performed in 22 cadaver feet. The mean distance between the lateral malleolus and the superficial peroneal nerve was 12.2 cm. Two different vascular pedicles, from peroneal vessels to muscles of the anterior compartment, were 4.3 and 8.2 cm away from the lateral malleolus, respectively. We conclude that preserving greater vascularity was possible in the lateral approach for the distal tibia, placing the plate in a completely submuscular plane. (Folia Morphol 2011; 70, 2: 91–94)

Key words: distal tibial fractures, anatomy, peroneal vessels

INTRODUCTION

Distal tibial fractures are well known as a significant treatment challenge to most orthopaedic surgeons [8, 15]. The minimal soft tissue envelope around the distal tibia and ankle is prone to loose its integrity in such high-energy injuries historically named as explosion fractures of the distal tibia [3, 12, 16]. Wound complications including superficial skin necrosis at suture line, full thickness skin loss, and deep infection ranging from 30% to 68% [2, 4, 8] may lead to a delay in ankle motion in simple superficial problems and secondary surgery such as debridement and soft tissue coverage.

The degree of initial soft tissue injury seems to play a major role in the development of these complications. Timing, methods of stabilisation, and staged surgery are surgeon dependent factors that have been studied extensively in the literature [3, 13]. A surgical approach to pilon fractures recently gained popularity because of its importance in avoiding wound healing problems. Most tibial pilon fractures are traditionally approached anteromedially, passing through the thin part of the soft tissue envelope covering the distal tibia. An anterolateral approach to these fractures offers reduced wound complications associated with surgery [11]. Theoretically, the thick muscle coverage on the anterolateral side shorten wound recovery time and also with this approach excellent visualisation of the distal tibia and submuscular plating of extra-articular fractures will be possible.

The aim of this study was to evaluate the risk of minor vascular injury, including perforating branches in the anterolateral approach, which may interfere with the expected advantages of this approach by determining the relationship with incision lines.

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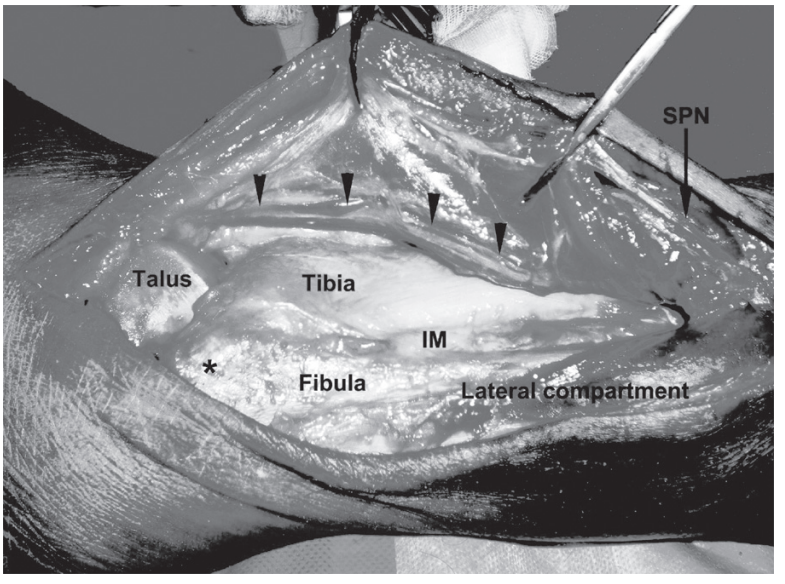

Figure 1. Lateral approach to the left distal leg; asterisk — lateral malleolus; IM — interosseous membrane of the leg; SPN — retracted superficial peroneal nerve; arrow heads — anterior tibial vessels and deep peroneal nerve package, which were covered with deep fascia of the anterior compartment muscles.

MATERIAL AND METHODS

Dissections were performed on 16 formalin fixed and 6 fresh frozen feet. The materials had no foot and ankle surgery or trauma history. The superficial peroneal nerve and branches were identified in all specimens for description of a safe skin incision line. This line started from the tip of the lateral malleolus and extended to the cranial following the anterolateral border of the fibula. The intersection point between the superficial peroneal nerve and anterolateral border of the fibula was described with the aim of preventing nerve injury. After the incision, we reached the interosseous membrane of the leg with carefully blunt dissection over the fibula. Then, further blunt dissection passed over the interosseous membrane under the deep fascia of the muscles of the anterior compartment to reach the medial border of the tibia. The branches of the posterior tibial and fibular arteries, which pinched the interosseous membrane and reached the anterior compartment of the leg, were defined. All measurements were performed with digital callipers (0.1 mm).

RESULTS

The distance between the tip of the lateral malleolus and the intersection point where the superficial peroneal nerve crossed the fibula had a mean distance of 12.2 cm (range 10.3–13.1 cm). The anterior tibial vessels and deep peroneal nerve were covered with deep fascia, as well as the muscles of the anterior compartment, in all specimens (Fig. 1). We did not find any remarkable branches of the anterior tibial vessels or deep peroneal nerve at the dissection area. However, we found two different vascular pedicles from the peroneal vessels to the muscles of the anterior compartment via penetration of the interosseous membrane (Fig. 2). The distal one was more prominent than the proximal one and was called the anterior perforated branch of the peroneal artery. We observed distal vascular pedicles in all feet, although the proximal pedicle existed only in 17 (77.3%) feet. The mean distances between the distal and proximal pedicles to the tip of the lateral malleolus were 4.3 cm (range 3.8–4.7 cm) and 8.2 cm (range 7.8––8.5 cm), respectively.

DISCUSSION

Distal tibia fractures usually developed secondarily to axial or rotational loading, such as high--energy traumas caused by motor vehicles or falls. Fibula fractures can also accompany such traumas. Fibular stabilisation is usually performed as the first step in surgery in order to facilitate the reduction of the tibia and to achieve restoration of fibular length [3]. Open reduction and fixation of the fibular followed by tibial fixation via classic anteromedial open reduction and internal fixation (ORIF) is the traditional approach for these fractures. Usually, an additional lateral incision for fibular stabi-

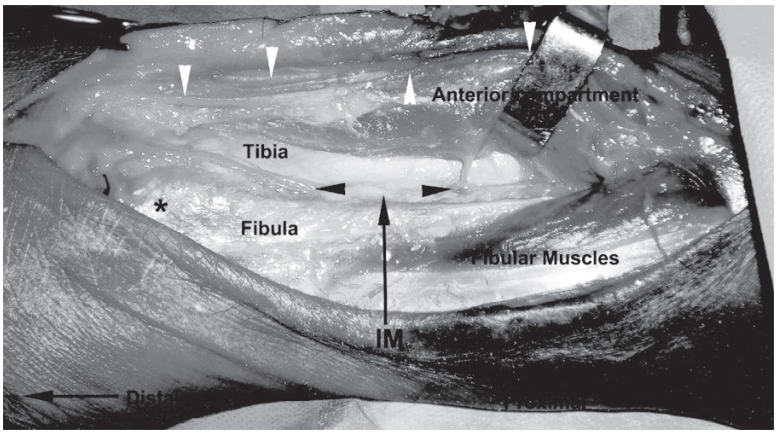

Figure 2. Lateral approach to the left distal leg; asterisk — lateral malleolus; IM — interosseous membrane of the leg; black arrowheads — perforator branches of the peroneal vessels, white arrowheads: retracted superficial peroneal nerve.

lisation is a necessity in such cases [3, 13, 15]. Severe soft tissue injury and the postoperative wound complications which frequently accompany may worsen with two (medial and lateral) incisions [12, 16]. The incidence of wound complications after the traditional ORIF technique has been reported in between 30% and 70% of cases [2, 4, 5, 9]. There are several factors studied, including timing of surgery, staged surgery, and various fixation methods such as external fixation, standard plate osteosynthesis, and minimally invasive osteosynthesis [2, 13].

Surgical approaches for the operative treatment of distal tibial fractures were studied extensively, and alternative approaches to the distal tibia (either anteromedial or posterolateral) were proposed by several authors [1, 6, 10, 11]. The main goal of these alternatives was to create a bipedicle flap with a better knowledge of the angiosomes and vascular anatomy of skin over the ankle [6].

Ideally the incision should preserve the anterior soft tissue vascularity including both skin and muscles. Clinically, Groose et al. [7] stated that the lateral approach has a lower wound complications ratio than the anteromedial approach and explained this result with thicker soft tissue on the lateral side than the medial side. The anterolateral approach provides visualisation of the distal tibia and allows sub-muscular plating for spanning of the metaphyseal comminution. The aim of this study was to highlight the important anatomical structures during the anterolateral surgical approach to the distal tibia to minimise the risk of complications. The mean distance between the tip of the lateral malleolus and the crossing point of the superficial peroneal nerve with the fibula was 12.2 cm. We believe that the incision could safely be extended from the tip of the lateral malleolus to this crossing point. There is some research supporting this assumption in the literature. Manninen et al. [11] suggest that the incision could be extended to the border of the middle and distal third of the tibia where the superficial peroneal nerve crosses the fibula, regarding the level of the fracture. Redfern et al. [14] described painful symptoms following superficial peroneal nerve lesions in 21% of patients treated by ORIF of ankle fractures using a lateral approach to the fibula. Femino and Vaseenon [6] recommended that the superficial peroneal nerve be minimally dissected and preserved within the subcutaneous plane. None of these researchers referred to the morphological characteristics of the intersection point between the superficial peroneal nerve and the anterolateral border of the fibula. We believe that this distance can be important to reduce the complications of the superficial peroneal nerve during surgery.

Additionally, we observed two different vascular pedicles originating from peroneal vessels which perforated interosseous membrane. The peroneal artery and its branches are usually identified and protected in the posterolateral approach for tibial pilon fractures [6, 10]. Grose et al. [7] stated that they make no attempt to identify or protect distal perforating branches of the peroneal artery. We believe that protection of vascularity can only be possible with detailed knowledge about the anatomy and morphometric information. Considering the distances between lateral malleous and perforating

distal and proximal vessels (4.3 and 8.2, respectively) the pro-ximal branch may be protected by strictly placing the plate sub-muscularly. We believe that preserving more vessels will help to decrease the incidence of postoperative complications.

CONCLUSIONS

In conclusion, the anterolateral approach to the ankle offers theoretical advantages of protecting vascularity and decreasing postoperative wound complications. Surgeons should make every effort to preserve blood supply to soft tissues especially in approaches specifically preferred in order to protect vascularity. We suggest protecting perforating branches by placing the plate from the lowest point possible in a strictly sub-muscular plane based on morphometric information about these arteries.

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