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CONTRIBUTION TO THE ANATOMICAL DESCRIPTION OF TIBIOFIBULAR SYNDESMOSIS

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Abstract
Introduction/Objectives
The distal tibiofibular joint is a syndesmosis that joins the distal ends of the tibia and fibula. Its primary function is to maintain congruency at the tibio-talar interface, thereby ensuring stability of the ankle joint.
Understanding the exact anatomy of the bony and ligamentous structures is important for better management of syndesmosis injuries, hence the interest of this study.
Materials and methods
Our work was based on the dissection of twenty-four ankles, between fresh and embalmed, taken from anatomical subjects.
Results
The articular surfaces were devoid of articular cartilage on all the parts studied and a synovial fold prevents direct contact between them. The anterior and distal tibiofibular ligament (ADTFL) had two bundles: proximal and distal, and the accessory ligament was found in 100% of the cases studied. The distal posterior tibiofibular ligament (LFTPD) had two bundles; superficial and deep in 100% of the dissected specimens.
Conclusion
The anatomical description of the distal tibiofibular joint is brief in the classic anatomy treatises. However, it is currently of great interest given the important role it plays in ankle stability, particularly after osteo-ligamentary injuries. Restoration of congruence of the tibio-fibular joint is the guarantee of a good functional result.

Introduction

Studied by Pol Le Coeur in 1938, the distal tibiofibular joint unites the distal ends of the tibia and fibula and is bounded laterally by the two medial and lateral malleolus [1].

Its anatomical landmarks begin at the origin of the distal tibiofibular ligaments, which extend from the tibia and terminate at the lateral malleolus [2].

In standard anatomy textbooks, it is described as an arthrodesis, usually without cartilage and capsule [3-4-5].

It consists of two articular surfaces, one concave tibial, the other convex fibular, covered at the bottom by a very thin layer of encrusting cartilage, following that of the tibio-tarsal joint. A synovial fold, constantly found, insinuates itself between the distal ends of the two articular surfaces, preventing any direct contact. However, an anatomical study has shown that in three quarters of cases, the connection of the distal end of the tibia and fibula is not a simple syndesmosis but a true synovial joint [3].

Although there is a bony congruence between the joint surfaces, the stability of the syndesmosis depends mainly on its ligamentous system, which prevents the two bones from spreading apart [1].

This system consists of three ligaments: the distal anterior tibiofibular (LTFDA), the distal posterior tibiofibular (LTFDP) and the interosseous ligament. A fourth ligament, the inferior transverse tibiofibular ligament, is congruent with the LTFDP, but is sometimes considered a separate ligament [2].

The syndesmosis complex forms the tibiofibular clamp, and contributes to the transmission of talocrural stresses during gait, thus providing stability to the ankle.

Little is known about syndesmotic ligament injuries. It accounts for less than 15% of ankle ligament injuries and is found in particular in sports with "rigid footwear" (alpine skiing, ice hockey) or contact sports (American football, rugby) [6-7].

Rarely isolated, it is often accompanied by a fracture as part of a multifocal lesion. The mechanism of injury is most often dorsal

hyperflexion and/or lateral hyper rotation of the foot.
Ligament rupture leads to diastasis, which can be a source of instability with resulting osteoarthritis [2].
The management of isolated injuries in this region is controversial, hence the importance of knowing its anatomy.

Materials and methods
We worked on twenty-four specimens distributed as follows:
- Six fresh pelvic limb specimens, amputated at the union of the upper two thirds and the lower third of the leg.
- Eighteen pelvic limb specimens embalmed and preserved in formalin.
- The equipment used was a basic dissection kit (forceps, scalpel, fine scissors, scalpels...), a millimetre scale, a camera.
To observe the elements of our study, we first marked the incision lines of the instep region with a dermographic pencil, then limited the distal tibiofibular joint by a circular plane passing two cm from the apex of the medial malleolus (Fig. 1), and then cleaned the region of all enveloping structures, from surface to depth.
However, we went beyond the upper limit to the lower quarter of the leg to better expose the interosseous membrane.

Fig. 1. Lateral view of the ankle showing incision lines and anatomical landmarks.
1-Proximal horizontal line, 2-Distal horizontal line, 3-Vertical line, 4-Line along the lateral edge of the plantar surface, 5-Line along the lateral edge of the calcaneal tendon, 6-Lateral malleolus.

After incising the skin and folding back the skin flaps, we revealed the superficial subcutaneous plane and the superficial vascular and neural elements. We then continued the dissection plane by plane down to the bone plane of the distal tibiofibular joint. After locating the ligaments, we separate the tibiofibular mortise from the talus to study the deep insertions and the synovium (Fig. 2).

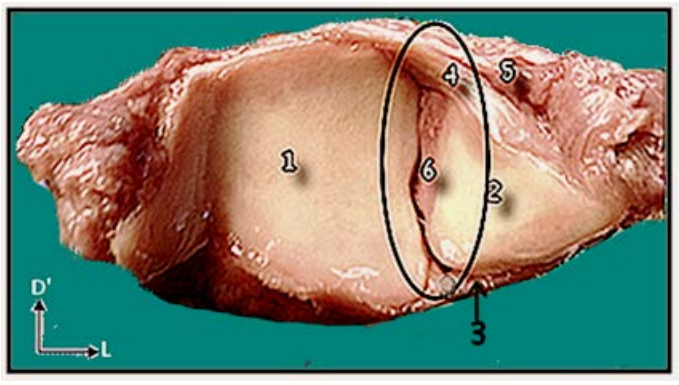

Fig.2 Caudal view of the distal tibiofibular joint
1- Distal articular surface of the tibia
2- Articular surface of the lateral malleolus
3- Distal bundle of the anterior tibiofibular ligament
4- Deep bundle of the posterior tibiofibular ligament
5- Superficial bundle of the severed posterior tibiofibular ligament
6- Synovial fringe

The main points on which our work was based were: the location of the distal anterior and posterior tibiofibular ligaments and the interosseous ligament, the precision of the areas of insertion, the location of the bundles, the study of the relationships with the neighbouring structures, the search for anatomical variability, and the study of the articular surfaces.

Results

1- Ligaments of the tibiofibular syndesmosis

- The distal anterior tibiofibular ligament

On the ventral surface of the distal tibiofibular joint, there is a wide, thick, quadrilateral, multifascial ligament, stretched obliquely from top to bottom and from inside to outside from the ventral edge of the tibial pilon to the ventral edge of the lateral malleolus, extending five mm beyond the articular surfaces (fig. 3).

In all the ankles studied, we were able to identify two bundles: one proximal, which is wider and thicker, and the other inferior or distal, which is thinner and more oblique towards the bottom, and whose termination on the lateral malleolus seems to be confused with the origin of the anterior bundle of the lateral collateral ligament(ATFL) (fig. 3).

The accessory ligament (distal bundle of Basset) is found in 100% of the cases studied. Its prevalence in the literature is 20-90%. The two bundles are separated by vascular spaces (fig.3).

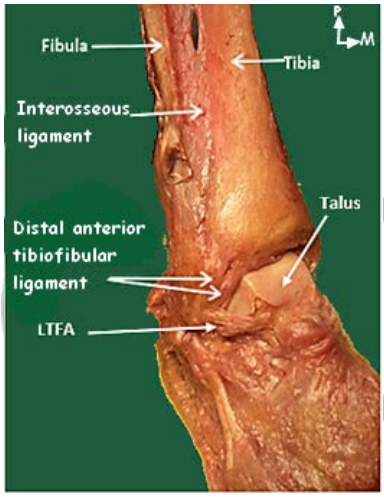

Fig.3 Ventro-lateral view of the ankle joint showing the anterior distal tibio-fibular ligament with its two bundles, and the interosseous ligament.

- The distal posterior tibiofibular ligament.

Dorsally, the tendons of the fibular muscles obscure the distal tibiofibular ligament. Its multiple fibres are thicker and stronger than anteriorly, running slightly obliquely downwards and outwards from the lateral and dorsal part of the tibial pilon to the lateral malleolus, along the dorsal edge of the tibiofibular mortise (Fig. 2). Two bundles, superficial and deep, are present in 100% of the dissected specimens. The deep bundle is shorter and thinner and attaches to the lateral malleolar fossa and to the dorsal edge of the tibial pilon behind the cartilage covering (Fig. 2).

The distal bundles of the anterior and posterior tibiofibular ligaments round the angles between the lateral malleolus and the ventral and dorsal edges of the fibular incision of the tibia.

- The interosseous tibiofibular ligament (Fig. 3)

The ligament consists of short, dense ligament fibres and fatty tissue, originating from the interosseous membrane. The fibres run from the lateral border of the tibia to the interosseous crest of the fibula stopping a few mm above the articular surfaces. The fibular artery perforates it inferiorly. The ventral side of this ligament attaches to the tibialis anterior and extensor digitorum longus muscles, and the dorsal side to the tibialis posterior and flexor hallucis longus muscles.

2- The articular surfaces

The tibial articular surface (the fibular incisure) is concave, triangular with a distal base and proximal apex. It is devoid of cartilage except for the distal part, which is shaped like a narrow band outlining the distal edge. The cartilage is spread over a few mm (two mm) and continues with that of the mortise (Fig. 4).

The convex fibular articular surface, triangular with a distal base, is narrower than the tibial one, and is completely devoid of

cartilage on all the pieces studied (Fig. 4).

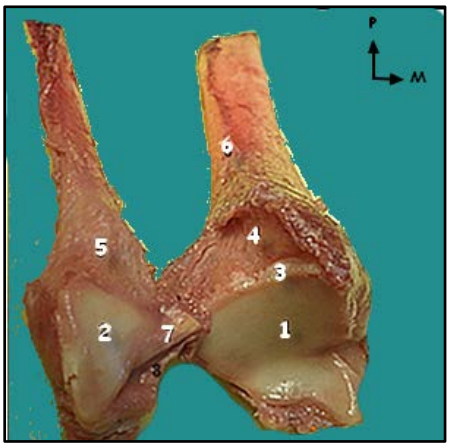

Fig.4 Ventral view of the joint surfaces of the distal tibiofibular syndesmosis
1- Tibial articular cartilage, 2- Fibular articular cartilage, 3- Fibular incisure cartilage, 4- Fibular incisure, 5-Fibular articular surface, 6-Insertion of interosseous ligament, 7-Deep bundle of posterior tibiofibular ligament, 8-Superficial bundle of posterior tibiofibular ligament

Discussion

The anatomical description of the syndesmosis is controversial.
Classical anatomists consider it to be a fibrous joint, lacking cartilage and capsule [8-9-10].
Other more recent studies, such as that of Bartonieck [6], consider it to be a synovial joint. He identified cartilaginous facets on both the tibial and fibular articular surfaces in three quarters of the dissected specimens. This should be reflected in the treatment of ankle dislocation/fracture [3].
Support is provided by three ligaments; the distal anterior tibiofibular, distal posterior tibiofibular and interosseous ligaments, which have anatomical variations
Nikolopoulos et al [11-12] demonstrated that the distal anterior tibiofibular ligament consists of two bundles, whereas Bartonieck [6] identified three. The distal bundle is deeper, and has been identified by many authors; Basset et al [13], Akseki et al [14] as Basset's accessory ligament. It is responsible for anterolateral impingement, and its resection relieves pain in patients with chronic ankle pain after a sprain without causing instability.
The distal anterior tibiofibular ligament is the least resistant [15].
The controversy concerns the posterior transverse ligament: does it belong to the distal posterior tibiofibular ligament or is it an independent structure?
Golano [16] and Bartonieck [6] consider it to be a deep bundle of the posterior tibiofibular ligament. It joins the medial malleolus to the lateral malleolus, forms the dorsal wall of the malleolar mortise, and terminates on the dorsal edge of the lateral malleolus. Because of its strength, it is thought to be responsible for Destot's malleolus tears in ankle fractures. Herman et al. consider it to be a separate ligament [2]. For Testut and Latarget [4], this bundle deserves special attention. It inserts on the base of the fibular malleolus 8 mm in front of the insertion of the other bundles, slightly above the malleolar fossa where the posterior bundle of the lateral collateral ligament attaches, and ends on the posterior edge of the tibia, which it runs along [4].
The posterior transverse ligament plays a role in the stability of the talocrural joint by preventing posterior translation of the talus.
The interosseous ligament has been shown to play an insignificant role by some, while others consider it to be the main structure for ankle stability [16-17].
In our series, the cartilage coating was only observed on the distal part of the fibular incision as a thin band in continuity with the cartilage of the mortise. This is consistent with the results of the classic literature [8-9-10].
The distal anterior tibiofibular ligament is composed of two bundles. The distal bundle is better individualised and is found on all the specimens studied (100%). Nikolopoulos [11-12], in his cadaveric study, observed it on twenty-two specimens out of a total of twenty-four (92%).
The transverse ligament doubling in depth the posterior tibiofibular ligament is found on all our specimens studied.

Conclusion

The most significant results of our study were that the distal tibiofibular joint is a syndesmosis, and the syndesmotic ligaments are uniform in location and morphology.
However, the anatomical description of the distal tibiofibular joint is very limited in classical anatomical treatises, it is still not well known, and deserves more study given the important role it plays in ankle stability.

Conflicts of interest
The authors declare that they have no conflicts of interest

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