

Biomechanical Study about Lateral Ankle Laxity

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Abstract

The objective of this paper is to study the contribution of the anterior talofibular ligament to ankle laxity at 18 cadaver ankles. For this, there was made an original, bipolar transoseus system, in a monitorized test stand Mx-500N Schmidt with a digital force gauge Imada. It was measured the motion response for applied antero-posterior force, inversion-eversion moment and internal-external rotary torque, in three positions of flexion of the ankle, with an intact anterior talofibular ligament and after it's sectioning. The results showed a significant increases in laxity in plantar flexion for the inversion and internal rotary torque, this mechanism coresponding with common modes of injury.

1. Introduction.

Almost 20% of the patients who suffered an ankle injury by inversion will be have a persistent simptomatology, wich is characteristic to ankle instability, like is related in most of the raports. [4] Anterior talofibular ligament and calcaneofibular

ligament are the most frecvent ligaments involved in the mechanism of the lesion.

The object of this experiment is to measure the structural motion response of tibio-talar joint to specific forces like in ankle sprain, before and after sectioning the anterior talofibular ligament.

2. Material and method

Eighteen cadaver specimen ankles from Anatomopathology of Couty Hospital Targu Mures, with the mean age of 62 years (range 35 to 70 years) were fixed in an original, bipolar transoseus system, made for this study.(Figure 1)

The trapping system is made by two horseshoe, like thouse used for transoseus continue extension of the fractures, each of them with a double frontal system, a Steimann pin (4,5mm) and a Kirschner wire (3mm). One of the horseshoe is fixed, at the distal metaphisys, bicortical, through tibia and fibula. The other one is mobile, at the level of anterior foot, through metatarsian I-V.

The complex system ankle specimen-traction device was mounted in a testing machine Mx-500N Schmidt with a digital force gauge Imada, model DPS-50R (0-490N).

Keywords: *biomechanical, study, ankle*



Figure 1

The transosseus traction device mounted in the testing machine

On the anterior horseshoe, mounted transmetatarsian, there was applied anterior-posterior forces about 150 N, in testing machine. The movements of the cross-head and the forces were noted in tables and a x-y system axes. The rate of cross-head was 3 mm/sec. The tests were made for each specimen in three positions: neutral, in dorsoflexion and plantar flexion. There were made three kind of tests: with anterior-posterior force, inversion-eversion moment and internal-external rotary torque. The last two movements were made at a rotation rate at 4 degrees per second, at a load cell force to a maximum value of $\pm 2,5$ Nm

Then, we continued with the second part of the experiment. It consisted from the same three type of tests after the dissection and sectioning the anterior talofibular ligament.

For this test, laxity is defined as the total displacement of the foot in tibio-talar joint in

response to anterior-posterior, inversion-eversion and internal-external rotation forces. Laxity may therefore be determined from the load-displacement curve as the displacement, measured along the horizontal axis at a given level anterior-posterior force. We used the paired t test to analysed the data obtained.

3. Results

Each one of the curves was obtain by averaging the displacement of eighteen individual specimens at five equal incremence of force in each loadin direction.

All kind of tests show us that there was an important increase of laxity after sectioning the anterior talofibular ligament. Anterior-posterior, the greatest increase in laxity was found with ankle in dorsoflexion, with an average of 4,4 mm(97%). In inversion-eversion movements, the plantar flexion was the position of greatest change in laxity, by 5,8 degree(51%). In internal-external rotation torque, the mean increase was by 11 degree (90%), also in plantar flexion. (Figure 2)

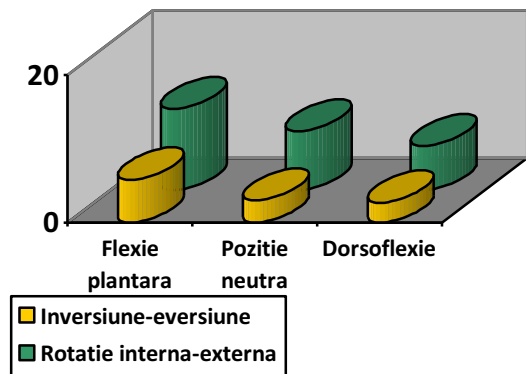


Figure 2

The laxity after sectioning anterior talofibular ligament in inversio-eversion and internal-external rotary torque for all three type of ankle positions

4. Discusion

Our results are in agreement with previously reported observation of other authors, who used other traction device of specimens. [1, 5, 7]

Preservation of the tendons, muscles and the skin specimens and using a traction device that work from distance about the ankle, make us to believe that we are almost like „in vivo”

5. Conclusion

The greatest increase in laxity after sectioning the anterior talofibular ligament, were recorded in inversion and internal rotation of the foot in plantar flexion, positions and loads that correspond to common modes of lateral ankle sprain.

Dorsoflexion was the position with the least amount of laxity, wich may be related to the fact that in dorsoflexion the wider diameter anterior of the talus is flush with the distal tibiofibular syndesmosis.

Our results establish the importance of anterior talofibular ligament in all position of flexion for all modes of loading. The ability of this ligament to contribute to the control of laxity can be explained by its changing orientation with the degree of ankle flexion. In neutral and dorsoflexion its fiber orientation is transvers to the long axis of the tibia, but in plantar flexion the orientation becomes more parallel to the tibia.

The results contribute to a better understanding of ankle biomechanics and show the importance of the anterior talofibular ligament in ankle laxity.

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