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Impact of fibular torsion and rotation on chronic ankle instability

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ABSTRACT

Background: The fibula is known not to involve in transmission of weight but known simply as an ankle stabilizer. However, its main function in stabilizing the ankle remains obscure. Since the fibula has an impact on torsion and rotation of the ankle, its effect on lateral ankle instability should be investigated.
Materials and methods: Twenty patients with lateral ankle instability (Group 1) and 19 healthy volunteers (Group 2) were included in the study. The tibiofibular and talofibular relationships were evaluated using MRI images. Fibular torsion and rotation angles were calculated using a new method. Range of motion of the ankle joint was investigated while the knee was at flexion (90°) and extension (0°). The comparisons performed between the 2 groups and independent from the groups were statistically evaluated and, the p value of <0.05 was considered as statistically significant.
Results: A significant difference was found between the two groups for age ($p < 0.05$). There were no statistically significant differences between the right and left sides for all measurements in the group 1 and 2 ($p > 0.05$). There was a statistically significant difference between the two groups in dorsal flexion when the knee is at flexion (90°) and extension (0°) position. There was also a statistically significant difference between the two groups in plantar flexion which was measured while the knee was at extension (0°) position. No statistically significant difference was found between both groups in terms of fibular torsion and rotation. However, independent from the groups when the patients were divided into 2 groups according to whether the fibula localized posteriorly or not, in patients with posteriorly localized fibula it was demonstrated that the fibular torsion and rotation was increased significantly.
Conclusion: We did not detect any relationship between fibular torsion and rotation and ankle instability. However, independent from the groups when the patients were divided into 2 groups according to whether the fibula localized posteriorly or not, we realized that in patients with posteriorly localized fibula, fibular torsion and rotation significantly increased. This finding did not explain the cause of instability. However, it may gain significance with new further studies regarding ankle instability.

1. Introduction

The presence of some predisposition factors such as "proprioceptive deficiencies, peroneal muscle weakness, varus deformity of the foot, and varus deformity of the "tibial plafond" has been shown by the studies in development of ankle instability following ankle injuries. In this clinical problem, not receiving a satisfactory result despite the surgical treatment and the presence of persistent subjective instability and limitation in the range of motion, a consensus has been occurred that some intrinsic factors are effective in development of ankle instability [1–4].

Ongoing studies are present regarding what the intrinsic factors can be in development of instability. The relation between the localization of the fibula in the ankle "mortise" and clinical problems encountered at the ankle region, especially the chronic ankle instability, has been studied by many researchers and the studies made in this regard have put forward that the positional alterations of the fibula in the ankle joint have an effect on the stability of the ankle [1–4].

A study by Scranton et al. [4] revealed that the posterior localization of the fibula is a predisposing factor for the ankle

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instability. Thereafter, clinical and radiological studies by Berkowitz and Kim [2] and Eren et al. [3] have supported this result. However, an absolute understanding of the exact cause and the predisposing factors for ankle instability has not been well documented yet. In the same way, no clear evidence has been proposed regarding how much the effect of the fibula in development of instability and what the mechanism it causes instability.

Therefore, the aim of the present study was to reveal the importance of the morphological and dynamic impact of the fibula in chronic ankle instability.

2. Materials and methods

Twenty patients with chronic lateral ankle instability (Group 1) and 19 healthy volunteers (Group 2) were included in the study. Group 1 had 20 male patients with a mean age of 32 years (min: 24, max: 43 years) and group 2 had 19 males with a mean age of 28 years (min: 20, max: 39 years) without any previous complaints of lower extremity problems.

Range of motion of the ankle joint on both groups was investigated while the knee was at flexion and extension. Zero degree (0°) for extension and ninety degrees (90°) for flexion were accepted to minimize the effect of possible incorrect measurements for flexion and extension degrees on the results and to make more correct, easier measurements. Passive dorsiflexion of the ankle joint was measured with a goniometer according to the recommendations of the American Academy of Orthopedic Surgeons [5]. All subjects were positioned supine on a padded treatment table. The tip of the lateral malleolus was used as the axis. The stationary arm was vertical and parallel to the midshaft of the fibula. The movement arm was brought down so that it was parallel to the fifth metatarsal. This measurement was repeated twice while the knee was at flexion (90°) and extension (0°). All measurements performed at flexion (90°) and extension (0°) were repeated twice by the same observer blinded to the study protocol. Arithmetical averages of all measurements were used for calculations.

Then the torsion and rotation of the fibula were evaluated on MR images. For the accuracy of the measurements, a special instrument (Fig. 1a and b) was designed and developed to keep both the lower extremities in neutral and standard positions. All radiological images were obtained by the same radiology specialist blinded to the study protocol. MRI examinations were performed on 1.5 Tesla machine (Siemens Magnetom Symphony Maestro Class, Quantum Gradient, Erlangen, Germany). MRI study included imaging of the crural region in axial plane. Only T2-weighted axial sequence (TR: 3800 ms, TE: 80 ms, FOV: 160 mm × 160 mm, thickness/slice gap: 2 mm/0 mm, matrix: 320 × 256 pixels, average: 2) was obtained.

At the end of filming, all measurements were made with a software which is able to show DICOM views. The measurements of all subjects were performed by a radiologist blinded to the study protocol. In order to assess intra-observer variation, all measurements were repeated two times by the same radiologist, and then mean values were calculated. First of all, on the slice where it seems as widest the joint intervals between the proximal tibia–fibula, distal tibia–fibula and talus–fibula were determined. Later, at the same levels the distance between both posterior tibial–fibular lines and anterior tibial-fibular lines were measured (Fig. 2a–c). Then at these 3 levels the angle between the line drawn tangential to the fibular surface neighboring the joint and horizontal axis was measured. (Fig. 3a–c). Therefore, at tibial level fibular torsion angle was calculated as the difference between the angle measured at proximal tibial level and the angle measured at

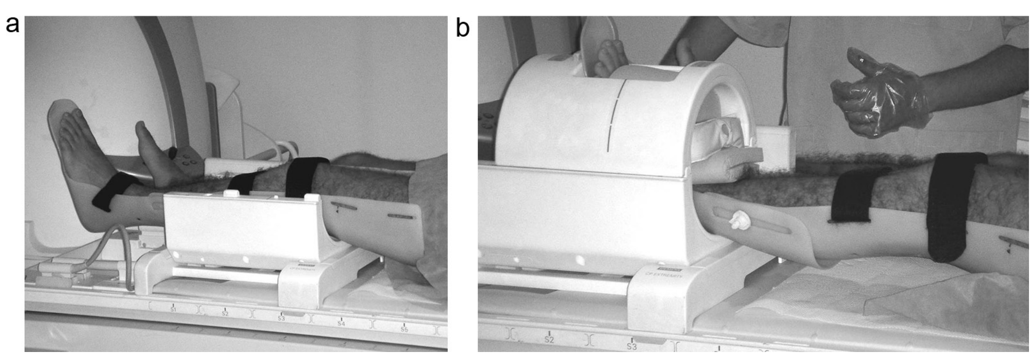

Fig. 1. A special instrument that designed for this study is shown (a and b).

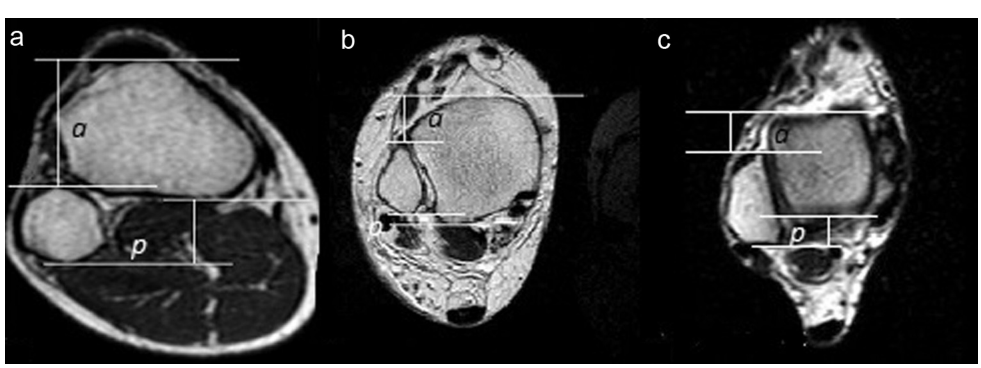

Fig. 2. Axial T2W images of distances between the tibial–fibular and talar-fibular anterior (a) and posterior (*p*) cortices at the level of (a) proximal tibiofibular joint, (b) distal tibiofibular joint, (c) talofibular joint.