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Relationship of Ankle Dorsiflexion and Gastrocnemius Tightness and Posterior Talar Glide

It has been reported that gastrocnemius tightness and posterior talar glide are crucial factors influencing ankle dorsiflexion. However, the relationship of ankle dorsiflexion and these factors is not identified in previous studies. The purpose of this study was to identify the relationship of ankle dorsiflexion passive range of motion and gastrocnemius tightness and posterior talar glide. Twenty-five male subjects participated in this study. Bilateral weight-bearing ankle dorsiflexion passive range of motion and amount posterior talar glide of participants were measured using an inclinometer. Change in myotendinous junction of medial gastrocnemius was measured using ultrasonography to identify gastrocnemius tightness. Pearson product moment correlations were performed to examine correlations between ankle dorsiflexion passive range of motion and gastrocnemius tightness and posterior talar glide. Present findings revealed significant correlation between ankle dorsiflexion passive range of motion and gastrocnemius tightness ($p=0.017$, $r=0.336$). Also, ankle dorsiflexion passive range of motion was correlated with posterior talar glide ($p=0.001$, $r=0.470$). The present findings provide experimental evidence for factors influencing weight-bearing ankle dorsiflexion.

Key words: *Dorsiflexion, Gastrocnemius, Talar glide*

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INTRODUCTION

Foot and ankle injuries, including Achilles tendonitis, ankle sprain, plantar faciitis, are often observed in the clinical setting. Although foot and ankle injuries are caused by various factors, insufficient ankle dorsiflexion (DF) could be one of the possible causes [1-3]. It has been stated that insufficient ankle DF movements induce unnecessary DF of midtarsal joint and to early heel-off during gait, increasing stress on midfoot and forefoot, and consequently contributing to foot and ankle injuries [4,5].

Calf muscle tightness has been suggested as the most important factor of limited ankle DF. Gastrocnemius, among calf muscles, limits ankle DF in the knee-extended posture, that leads to early heel-off during mid-stance phase of gait [5,6]. Considering that gait is the most frequently performed daily activity, limited ankle DF caused by gastrocnemius tightness could be crucial risk factor of foot and ankle injuries.

Amount of posterior talar glide could be another possible contributing factor of limited ankle DF. Based on normal arthrokinematics of ankle joint, regardless of knee-flexed and extended posture, posterior talar glide should be accompanied by ankle DF movements [7]. It was demonstrated that increased posterior talar glide facilitates greater ankle DF movements [8].

Previous studies revealed that ankle DF passive range of motion (PROM) increased after gastrocnemius stretching [9,10]. Also, it was demonstrated that mobilization technique for posterior talar glide increases ankle DF [8]. Although it was demonstrated that gastrocnemius tightness and amount of posterior talar glide could influence ankle DF PROM [8-10], to our knowledge, only the relationship of ankle DF PROM and passive ankle DF stiffness was investigated in the previous study [11]. There is no study investigating the relationship of ankle DF PROM and gastrocnemius tightness and amount of posterior talar glide. So, the purpose of this study was to demonstrate correlations of ankle DF PROM and gastrocnemius tightness and amount of posterior talar glide.

METHODS

Subjects

In total, 25 healthy male university students (age = 22.20±1.78; height = 175.28±5.49 cm; body weight = 70.40±7.23 kg) were recruited in this study. Potential participants with foot and ankle surgery and fracture and complained of pain during measurements of ankle DF PROM were excluded. All participants provided an explanation of procedures and agreed to participate.

Measures of ankle dorsiflexion passive range of motion

Bilateral ankle DF PROMs of participants were measured in weight-bearing position. Participants were asked to stand in front of a wall. They assumed a lunge posture, so that examined leg was placed behind the other leg with a step-width. The second toe and heel of the examined leg were placed in a straight line. Participants were instructed to place both arms on the wall and then lean forward until maximum tolerable stretch of gastrocnemius on the examined leg was encountered [12]. While leaning forward, participants maintained knee extension and heel contact on the floor in the examined leg. When maximum tolerable stretch of gastrocnemius on the examined leg was encountered, an examiner placed an inclinometer on the middle of anterior tibia and recorded ankle DF PROM.

Measures of gastrocnemius tightness

To measure gastrocnemius tightness, we examined change in the myotendinous junction (MTJ) of the gastrocnemius during ankle DF using ultrasonography (MyLabOne; Esaote SpA, Via Siffredi, Italy). Linear probe with 7.5-MHz of ultrasonography was placed on the medial gastrocnemius according to the previous study by Kang et al. [13]. MTJ, the junction wherein superficial and deep aponeuroses of medial gastrocnemius are met, was measured at 0° and 20° of ankle DF in standing position. Change of MTJ of medial gastrocnemius was calculated by displacement of MTJ from 0° of ankle DF to 20° of ankle DF [13].

Measures of posterior talar glide

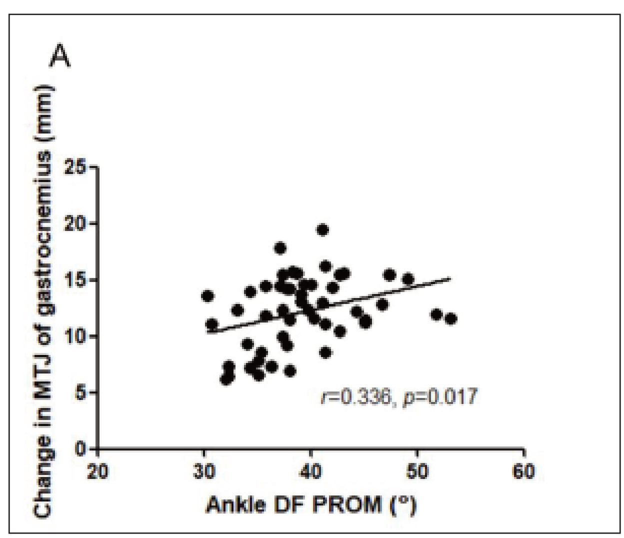
Amount of posterior talar glide was measured in sitting position. Participants sat on the end of a table with thigh support. Examined foot was aligned with subtalar neutral position while parallel to the floor. An examiner placed both thumbs on the anterior talus and pushed the talus posteriorly. [8,13,14]. During posterior displacement of talus, alignment of foot was maintained to parallel to floor. When the firm end-feel was encountered, an inclinometer was placed on the just inferior to tibial tuberosity [13]. The inclination of tibia was measured to record amount of posterior talar glide.

Statistical analysis

All dependent variables were measured bilaterally, and measurements of each variable were repeated three times. Mean value of three trials was used for data analysis. Descriptive statistics were performed to calculate mean and standard deviation of variables. To identify the relationship between ankle DF PROM and gastrocnemius tightness and posterior talar glide, Pearson product moment correlations were performed. All data were analyzed using PASW Statistics 18 (SPSS Inc, Chicago, Illinois) with a level of $p<.05$.

RESULTS

The mean±standard deviations of ankle DF PROM, gastrocnemius tightness, and posterior talar glide were 39.09±5.05°, 12.13±3.18 mm, and 15.39±3.73°, respectively. Ankle DF PROM was significantly correlated with gastrocnemius tightness (p=.017, r=.336; Fig. 1A) and posterior talar glide (p=.001, r=.470; Fig. 1B)



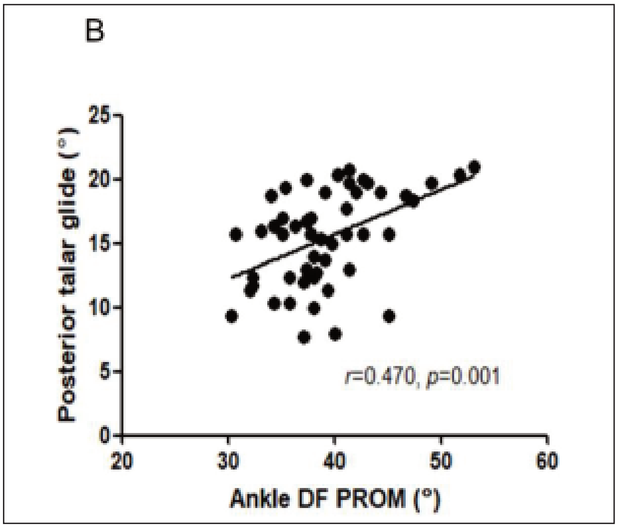


Fig. 1. Correlation of ankle dorsiflexion passive range of motion and gastrocnemius tightness (A) and posterior talar gldie (B)

DISCUSSION

Our findings demonstrate that ankle DF PROM is fairly correlated to gastrocnemius tightness and posterior talar glide.

This study revealed that relatively weak correlation between ankle DF PROM and gastrocnemius tightness (r=.336), although gastrocnemius muscle length is the most crucial factor for ankle DF movements. Gastrocnemius stretching was frequently performed to alleviate gastrocnemius tightness in the clinical setting [9,10]; In the previous studies, ankle DF during mid-stance phase of gait was unchanged, while ankle DF PROM increased after stretching exercises [10,15]. It has been reported that stretching exercises contribute to increase in gastrocnemius muscle length as well as weaker adjacent soft tissues, including ligaments, fascia, and capsule [16]. Findings indicate gastrocnemius tightness could influence ankle DF; however, ankle DF is also influenced by tightness of soft tissue and/or other factors. So, GCM length as well as various other factors may affect the ankle DF PROM, that contributes to a relatively weak correlation of ankle DF PROM and gastrocnemius tightness in this study.

Amount of posterior talar glide may be one of the other factors influencing ankle DF based on findings that revealed fair correlation between ankle DF PROM and posterior talar glide (r=.470). The previous study by Kang et al. [13] that revealed increased ankle DF without significant change in displacement of MTJ after intervention supports our findings. Another previous study demonstrated that ankle DF could be increased by intervention for increasing posterior talar gldie without gastrocnemius stretching [8]. Based on previous and present findings, it is demonstrated that posterior talar glide is a crucial factor influencing ankle DF movements.

Findings of this study revealed correlation of ankle DF PROM and gastrocnemius tightness and posterior talar glide, that provide experimental evidence for causes of limited ankle DF. Also, our findings could be an evidence that gastrocnemius stretching and posterior talar glide mobilization are appropriate intervention for increasing ankle DF.

There are limitations in this study. First, only young male subjects participated in this study. Second, only gastrocnemius and posterior talar glide were measured, while other soft tissues may influence ankle DF PROM. So, future studies must include female subjects and examine the relationship ankle DF and tightness of other soft tissues.

CONCLUSION

This study demonstrates significant correlation between ankle DF PROM and gastrocnemius tightness and posterior talar glide. Also, greater relationship was found between ankle DF PROM and posterior talar glide than between ankle DF PROM and gastrocnemius. These findings suggest experimental evidence for factors influencing ankle DF.

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