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Original Article

The influence of gastrocnemius stretching combined with joint mobilization on weight-bearing ankle dorsiflexion passive range of motion

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Abstract. [Purpose] The purpose of this study was to investigate the effect of gastrocnemius stretching combined with talocrural joint mobilization on weight-bearing ankle dorsiflexion passive range of motion. [Subjects] Eleven male subjects with bilateral limited ankle dorsiflexion passive range of motion with knee extended participated in this study. [Methods] All subjects received talocrural joint mobilization while performing gastrocnemius stretching. Ankle dorsiflexion passive range of motion was measured using an inclinometer under weight-bearing conditions before and immediately after intervention. A paired t-test was used to analyze the difference between weight-bearing ankle dorsiflexion passive range of motion pre- and post-intervention. [Results] A significant increase in weight-bearing ankle dorsiflexion passive range of motion was found post-intervention compared with pre-intervention. [Conclusion] These findings demonstrate that gastrocnemius stretching combined with joint mobilization is effective for increasing weight-bearing ankle dorsiflexion passive range of motion.
Key words: Gastrocnemius stretching, Talocrural joint mobilization, Weight-bearing ankle dorsiflexion

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INTRODUCTION

Ankle dorsiflexion passive range of motion (DF PROM) measurements are performed in the field of physical therapy to estimate ankle motion during functional activities[1)] and to prevent lower extremity injuries[2)]. Although in the clinical setting, ankle DF PROM is frequently measured under non-weight-bearing (non-WB) conditions[1, 3, 4)], many researchers have stated that the WB position is more appropriate for estimating the amount of ankle DF motion during functional activities[5, 6)]. Therefore, WB ankle DF PROM should be measured during interventions focused on increasing ankle DF PROM.

Limited ankle DF PROM with knee extended may result from gastrocnemius tightness and insufficient posterior talar glide[7)]. Thus, gastrocnemius stretching and talocrural joint mobilization have been performed as intervention strategies to increase ankle DF PROM[3, 8, 9)]. Previous studies have reported a significant increase in ankle DF PROM after these interventions[3, 8, 9)]; however, to our knowledge, no study has demonstrated the combined effect of both interventions on WB ankle DF PROM. Therefore, the aim of the present study was to examine the influence of gastrocnemius stretching combined with joint mobilization on WB ankle DF PROM.

SUBJECTS AND METHODS

In total, 11 male subjects with bilateral limited non-WB ankle DF PROM with knee extended (mean age, 22.82 ± 3.09 years; mean height, 175.91 ± 3.39 cm; mean weight, 69.55 ± 3.78 kg; mean non-WB ankle DF PROM, 4.17 ± 2.48°) participated in this study. Inclusion criteria were 1) ankle DF PROM with knee extension < 10°; 2) ankle DF PROM with knee flexion > 10°; and 3) > 5° difference in ankle DF PROM between knee extension and knee flexion conditions on bilateral sides in non-WB positions[3)]. Subjects with a history of surgery on the lower extremity, fracture, or neurological diseases were excluded from this study. All participants signed an informed consent form approved by the Institutional Research Review Committee of Inje University prior to participation in this study. The study protocol of this study complies with the ethical standard of the declaration of Helsinki.

WB ankle DF PROM with knee extended was measured

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following the procedures suggested by Munteanu et al[10]. Subjects stood in front of a wall and placed the leg being tested behind the contralateral leg in a lunge posture. Subjects were asked to place both hands on the wall and then lean forward without heel-off and knee flexion until maximum stretch was felt in the gastrocnemius on the tested leg. The force applied to the tested leg was maintained at 60 ± 5% of the subject's weight using scales[11]. An examiner determined the maximum tibial inclination using an inclinometer to measure the WB ankle DF PROM with knee extended. Measurements of WB ankle DF PROM were repeated 3 times for each ankle under pre- and post-intervention conditions. The mean value of 3 trials was used for data analysis.

For gastrocnemius stretching combined with joint mobilization, subjects leaned forward against the wall in the same lunge posture as that during measurement of WB ankle DF PROM with knee extended until the maximum gastrocnemius stretch was felt. Subjects held the end-range posture while an examiner provided the talus of the tested leg with sustained anterior-to-posterior gliding force. An intervention trial was performed for 30 s, and 10 trials were repeated with 30-s rest periods for each ankle.

The difference in WB ankle DF PROM with knee extended between pre- and post-intervention conditions was analyzed using a paired t-test. PASW Statistics software (ver. 18.0; SPSS, Inc., Chicago, IL, USA) was used for statistical analysis.

RESULTS

WB ankle DF PROM with knee extended was significantly increased in post-intervention compared with pre-intervention conditions (42.60 ± 5.49° versus 38.24 ± 4.69°, $p < 0.001$).

DISCUSSION

Our findings demonstrate that gastrocnemius stretching combined with joint mobilization significantly increases WB ankle DF PROM with knee extended. Stretching exercises increase tolerance, resulting in increased ROM[12]. Additionally, increased displacement of the myotendinous junction (MTJ) after gastrocnemius stretching for 5 min was found in a previous study[13]. Therefore, the change in tolerance and/or increase in MTJ displacement might have influenced our findings. The addition of talocrural joint mobilization to gastrocnemius stretching is another possible explanation for our findings. Previous research by Dinh et al.[3] showed a 4.25° increase in WB ankle DF PROM with knee extended after gastrocnemius stretching alone for 3 weeks. Although gastrocnemius stretching combined with joint mobilization was applied for 5 min in the present study, the amount of increase in WB ankle DF PROM after intervention (i.e., 4.36°) was similar to that found previously. Considering this outcome, despite the relatively short period of intervention in the present study, it may be inferred that the addition of talocrural joint mobilization might maximize the effects of general gastrocnemius stretching. Talocrural joint mobilization improves posterior talar glide, which increases ankle DF[9]. Thus, we conclude that gastrocnemius stretching combined with joint mobilization might decrease gastrocnemius tightness and increase posterior talar gliding movement, which effectively increases WB ankle DF PROM with the knee extended.

The present study had several limitations. First, although non-WB ankle DF PROM was used as an inclusion criterion, changes in non-WB ankle DF PROM after intervention were not measured. However, we believe that WB ankle DF PROM is clinically more important because most functional activities are performed under the WB condition. Second, our study included only male subjects, and the results cannot be generalized to women. Lastly, long-term evaluation should be performed in a future study.

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