J. Phys. Ther. Sci. 29: 93–94, 2017

The Journal of Physical Therapy Science

Original Article

Effect of a pelvic wedge and belt on the medial and lateral hamstring muscles during knee flexion

Won-gyu Yoo[1)]

[1)] *Department of Physical Therapy, College of Biomedical Science and Engineering, Inje University: 607 Obangdong, Gimhae, Gyeongsangnam-do 621-749, Republic of Korea*

Abstract. [Purpose] This study developed a pelvic wedge and belt and investigated their effects on the selective activation of medial and lateral hamstring muscles during knee flexion. [Subjects and Methods] Nine adults were enrolled. The participants performed exercises without and with the pelvic wedge and belt, and the electromyographic activities of the medial and lateral hamstring muscles were recorded. [Results] The activity of the medial hamstring was increased significantly when using the pelvic wedge and belt, while the activity of the lateral hamstring did not differ significantly. [Conclusion] The pelvic wedge and belt provide a self-locked position during knee flexion in the prone position. Prone knee flexion in this position is an effective self-exercise for balanced strengthening of the medial hamstring.

Key words: Electromyography, Medial hamstring, Strengthening exercise

(This article was submitted Sep. 6, 2016, and was accepted Oct. 5, 2016)

INTRODUCTION

The hamstring muscles contribute to hip extension and knee flexion, and connect the pelvis, tibia, and fibula via the hip and knee joints. Researchers have investigated several exercises and instruments for activating hamstring-associated hip motion[1)]. A therapeutic exercise was studied to quantify the pattern and rate of activation of each hamstring muscle[2)]. The hamstrings are involved in two joint motions and show various rates of muscle activation with varying parameters[1, 2)]. Croisier et al. compared various maximal voluntary isometric contraction methods for the hamstring and investigated hamstring muscle electromyographic activity and torque in four different hip positions[3)]. Mohamed et al. examined the hamstring muscles during maximally resisted knee flexion with neutral, medial, and lateral rotation of the tibia[4)]. Onishi et al. tested the difference in activity among three hamstring muscles during isometric knee flexion exercises and isokinetic knee flexion exercises[5)]. Based on previous studies, this study developed a pelvic wedge and belt and investigated their effects on selective activation of the medial hamstring (MH) and lateral hamstring (LH) muscles during knee flexion.

SUBJECTS AND METHODS

The study enrolled nine males (mean age 26.3 ± 2.2 years, mean height 175.4 ± 4.2 cm, mean weight 67.3 ± 4.0 kg) with no history of musculoskeletal or neurological disorders. The study purpose and methods were explained to the subjects, who provided informed consent according to the principles of the Declaration of Helsinki before participating. A Trigno wireless system (Delsys, Boston, MA, USA) was used to measure electromyographic signals. EMG data were normalized using the maximum voluntary isometric contraction (MVC) of each muscle, which was measured using the manual muscle test. Surface electrodes were placed on the right side of the MH, 50% of the distance from the ischial tuberosity to the medial joint

Corresponding author. Won-gyu Yoo (E-mail: won7y@inje.ac.kr)

line of the knee, and on the LH 50% of the distance from the ischial tuberosity to the fibula head. Participants performed an isometric exercise with knee flexion at 90° in the prone position on a table without pelvic control (exercise 1) or with pelvic control using the pelvic wedge and belt (exercise 2). Pelvic control was applied by placing the pelvic wedge on the anterior superior iliac spine with the subject in a prone position and then fixing it to the table by wrapping the pelvic belt around the posterior sacroiliac joints. Muscle activation was recorded for 5 s during each exercise. The data were analyzed using SPSS for Windows ver. 20.0 (IBM Corp., Armonk, NY, USA). The paired t-test was used to assess differences in muscle activity during the exercises, with the significance level set at $\alpha=0.05$.

RESULTS

The activity of the MH in exercise 2 (120.5 ± 15.1%MVC) was significantly increased compared with exercise 1 (93.0 ± 19.6%MVC) ($p<0.05$). The activity of the LH was not significantly different between exercises 1 (93.4 ± 21.5%MVC) and 2 (85.7 ± 19.3%MVC) ($p>0.05$).

DISCUSSION

In a previous study, the activity of the MH was greater than that of the LH at 90° of knee flexion[5]. A previous research estimated the force and moment generation capacities with a computer model and demonstrated that the MH has a thicker moment arm than the LH during knee flexion, which may contribute to greater MH activation during knee flexion[6]. However, in our study, the mean activity of the MH was lower than that of the LH during the exercise without pelvic control. During prone knee bending, the therapist has to palpate the right sacroiliac joint and note whether the innominate rotates anteriorly as the patient bends the ipsilateral knee[7]. Optimally, the pelvic girdle should remain stable and should not unlock during this task[7]. For this, this study was applied by placing the pelvic wedge on the anterior superior iliac spine with the subject in a prone position and then fixing it to the table by wrapping the pelvic belt around the posterior sacroiliac joints. The subjects felt comfortable by pelvic wedge and pelvic belt. MH activity was significantly increased with pelvic control using the pelvic wedge and belt, which provide a self-locked position during knee flexion in the prone position. Finally, prone knee flexion exercise in the self-locked position is an effective self-exercise for balanced strengthening between MH and LH.

REFERENCES

1) McAllister MJ, Hammond KG, Schilling BK, et al.: Muscle activation during various hamstring exercises. J Strength Cond Res, 2014, 28: 1573–1580. [Medline] [CrossRef]
2) Lewis CL, Sahrmann SA: Muscle activation and movement patterns during prone hip extension exercise in women. J Athl Train, 2009, 44: 238–248. [Medline] [CrossRef]
3) Croisier JL, Malnati M, Reichard LB, et al.: Quadriceps and hamstring isokinetic strength and electromyographic activity measured at different ranges of motion: a reproducibility study. J Electromyogr Kinesiol, 2007, 17: 484–492. [Medline] [CrossRef]
4) Mohamed O, Perry J, Hislop H: Synergy of medial and lateral hamstrings at three positions of tibial rotation during maximum isometric knee flexion. Knee, 2003, 10: 277–281. [Medline] [CrossRef]
5) Onishi H, Yagi R, Oyama M, et al.: EMG-angle relationship of the hamstring muscles during maximum knee flexion. J Electromyogr Kinesiol, 2002, 12: 399–406. [Medline] [CrossRef]
6) Arnold EM, Ward SR, Lieber RL, et al.: A model of the lower limb for analysis of human movement. Ann Biomed Eng, 2010, 38: 269–279. [Medline] [CrossRef]
7) Neumann DA: Kinesiology of the musculoskeletal system: foundations for physical rehabilitation, 1st ed. St Louis: Mosby, 2002.