



Original Article

The effects of a pelvic belt on trunk and lower extremity muscles in the bridge position

HYUN-GYU CHA, PT, PhD¹⁾, YAN-TING WU²⁾, MYOUNG-KWON KIM, PT, PhD^{2)*}

¹⁾ Department of Physical Therapy, College of Kyungbuk, Republic of Korea

²⁾ Department of Physical Therapy, College of Rehabilitation Sciences, Daegu University: Jillyang, Gyeongsan, Gyeongbuk 712-714, Republic of Korea

Abstract. [Purpose] The purpose of this study was to investigate the effects of a pelvic belt on the activities of trunk and lower extremity muscles in normal adults. [Subjects and Methods] The subjects were 20 normal individuals without a history of orthopedic problems. The pelvic compression belt (The Com-Pressor, OPTP, Minneapolis, MN, USA) was an adjustable body belt with four elastic compression bands that provide stabilizing pressure and was designed to adjust the amount of force applied and to alter sites of compression. The body belt was placed below the anterior superior iliac spine, and stabilizing pressure was applied to the belt using the elastic compression bands in the bridge position after confirming the site of compression. [Results] The subjects showed a significant decrease in muscle activation in the erector spinae, oblique internus abdominis, rectus femoris, and biceps femoris while wearing the pelvic belt. [Conclusion] The use of a pelvic compression belt with external pelvic compression might improve pelvic joint stability and alter neuromotor control of the lumbopelvic and thigh muscles.

Key words: Electromyography, Bridge position, Pelvic compression belt

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INTRODUCTION

Computers now play an increasingly important role in our daily lives, and their use is associated with lower back pain. The sacroiliac joint (SIJ) is a widely described source of low back pain. Therapeutic approaches to relieve this pain include the application of a pelvic compression belt (PCB)¹⁾. Researchers have suggested that functional exercises conducted using a PCB have a beneficial effect associated with muscle strengthening²⁾. PCB are effective for stabilizing pelvic articulation and enable exercises that address coordination and stabilization³⁾. Furthermore, evidence shows that application of a PCB can relieve pain and facilitate neuromuscular performance during rehabilitation exercises in patients with lumbopelvic problems⁴⁾. In particular, PCBs effectively alter the activation patterns of hip extensor muscles in females with chronic low back pain during prone hip extension⁵⁾. Moreover, PCBs offer a conservative measure for the treatment of sacroiliac joint pain and are cheap and considered to be without any adverse side effects⁶⁾. In addition, it has been shown that use of a PCB significantly improves health-related quality of life and possibly decreases sacroiliac joint-related pain⁶⁾. Hammer et al.⁷⁾ suggested that PCB application is accompanied by altered rectus femoris activity when walking. Furthermore, PCB improve postural steadiness⁷⁾. However, it is unknown whether PCB alter trunk and lower-extremity muscle activities in healthy adults. Therefore, the purpose of this study was to investigate the effects of a PCB on these muscle activities in normal healthy adults.

SUBJECTS AND METHODS

Twenty individuals without a history of orthopedic problems were enrolled in the study. All were given comprehensive information on the study, and all provided written informed consent according to the ethical standards of the Declaration of

*Corresponding author. Myoung-Kwon Kim (E-mail: skybird-98@hanmail.net)

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Table 1. Pre- and post-intervention electromyography values of subjects wearing or not wearing a pelvic compression belt (units: %MVIC)

	Without pelvic compression belt	With pelvic compression belt	Change value
Erector spinae*	101.7 ± 8.8	80.9 ± 5.6	20.8 ± 10.9
Oblique internus abdominis*	107.8 ± 20.4	87.0 ± 12.4	20.8 ± 11.7
Rectus femoris*	93.7 ± 15.9	77.8 ± 8.0	15.8 ± 17.7
Long head of the Biceps femoris*	94.7 ± 17.3	83.6 ± 11.0	11.1 ± 13.2

Mean ± SD.

*Significant intergroup difference between the gains achieved ($p < 0.05$)

Helsinki prior to participation and agreed to participate in the study (Table 1). Their average ages, heights, and weights were 21.60 ± 1.08 years, 171.20 ± 6.23 cm, and 71.23 ± 8.64 kg, respectively.

The pelvic compression belt (The Com-Pressor, OPTP, Minneapolis, MN, USA) used was an adjustable body belt with four elastic compression bands that provide stabilizing pressure and was designed to allow the amount of compression to be adjusted at targeted compression sites. The PCB was placed below the anterior superior iliac spine (ASIS)⁸, and stabilizing pressure was applied using the elastic compression bands after confirming the location of the compression site.

We collected data using an MP150 electromyography system (BIOPAC Systems Inc., Goleta, CA, USA) to measure muscle activation. Four surface electromyography signals were processed through the MP150 system when subjects were in the bridge position and transformed into digital signals, which were filtered and processed using Acqknowledge software Ver. 3.7.3 (BIOPAC Systems Inc., Goleta, CA, USA) on a personal computer. A 1,000 Hz sampling rate was used for electromyography signals, and their amplified waveform was filtered using a 60–500 Hz band-pass filter and a 60 Hz of notch filter. For quantifying collected signals, we used root mean square values⁹. In addition, the signals collected from each muscle were normalized versus the maximal voluntary isometric contraction (%MVIC).

To measure muscle activation at maximal voluntary isometric contraction, manual muscle testing was used¹⁰. After collection of the data for 5 seconds at maximal voluntary isometric contraction for each muscle, the average electromyographic signals as a percentage of MVIC for 3 of the 5 seconds, excluding the data for 1 second each from the beginning and end, were used.

Muscle activation was measured using electromyogram electrodes fixed to areas of muscle fibers and by pressing on muscle parts and following the direction of muscle texture to find the appropriate positions.

The locations of the surface electrodes were as follows: (1) for the erector spinae, 2 cm lateral to the spinous process at the L4–5 interspace¹⁰; (2) for the oblique internus abdominis (OI), in the center of the triangle formed by a horizontal line between the anterior superior iliac spine of the innominate and the umbilicus, midline, and the inguinal ligament¹¹; (3) for the rectus femoris, the midpoint between the upper margin of the patella and ASIS¹²; and (4) for the long head of the biceps femoris, the midpoint between the gluteal fold and the knee joint¹³.

Intragroup comparisons of variables before and after the intervention were performed using the paired samples t-test. IBM SPSS Statistics ver. 20.0 (IBM Corp, Armonk, NY, USA) was used for statistical analysis, and p values of < 0.05 were considered significant.

RESULTS

The subjects showed a significant decrease in muscle activation in the erector spinae, oblique internus abdominis, rectus femoris, and biceps femoris while wearing the PCB ($p < 0.05$) (Table 1).

DISCUSSION

This study was undertaken to determine how a PCB affects erector spinae (ES), oblique internus abdominis (OI), rectus femoris (RF), and long head of the biceps femoris (BF) muscle activation in healthy adults. We observed reduced ES, OI, RF, and BF activity with a PCB compared with without a PCB in the bridge position. Several possible explanations exist for less muscle activity in abdominal muscles than in core muscles while wearing the PCB. Stabilizing the core is a dynamic process of maintaining balance. Kaushik et al.¹⁴ suggested that the transverse abdominis is the first muscle activated during lower extremity movements, indicating that it is a primary muscle linked to core stability during lower limb movements. In the present study, the decreased OI activity indicated that subjects required less effort to maintain stability when wearing the PCB. Nevertheless, Kim et al.¹⁵ suggested that decreasing the activation of abdominal muscles on an unstable surface using an external support, such as a PCB, is suitable for improving abdominal muscle control and lumbopelvic stability. In a recent study by Hu et al.¹⁶, it was found that transverse and oblique abdominal muscles were less active with a PCB in normal subjects because these coordinated muscles are activated to press the ilia against the sacrum, creating a forced closure, and

the pelvic belt may have substituted for this stabilizing activity. Therefore, it is thought that the use of a PCB with external pelvic compression might have improved pelvic joint stability and altered neuromotor control of the lumbopelvic and thigh muscles.

This study has several limitations. First, the small sample size may have adversely influenced certain variables and impacted results. Second, the compression force of the pelvic belt was not controlled, although the belt was adjusted by a skilled physical therapist. Furthermore, we recruited healthy adults without a history of low back pain or sacroiliac joint pain, and thus, our findings cannot be generalized to other populations. Finally, we measured EMG activity of the trunk and lower extremity, but this is insufficient to represent muscle force directly. Further studies are needed to investigate a more diverse sample of normal healthy subjects.

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