Effect of Pelvic Belt on Gluteal Muscles Activity during Therapeutic Exercise

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Abstract

[Purpose] The aim of this study was to investigate the EMG amplitude of the gluteus maximus (GMax) and medius (GMed) during 6 exercises with and without a pelvic belt. [Subjects] Twenty healthy males were recruited. [Methods] The belt was positioned below the anterior superior iliac spine. Surface EMG was used to measure the GMax and GMed activity of the dominant limb during exercise. The percentage of the EMG amplitude relative to maximal voluntary isometric contraction was analyzed with a mixed within-between subjects analysis of variance (ANOVA). [Results] This study showed significantly increased GMax activity in the pelvic belt condition as a main effect. However, there was no significant effect on GMed activity except with the hip clam. [Conclusion] The pelvic belt significantly improved GMax activity during exercises in contrast to the GMed activity. When treating people with weakness of gluteal muscles, the functional specific exercises with a pelvic belt have the beneficial effect of associated muscle strengthening.

Key words: Pelvic belt, Lower extremity exercise, Gluteus maximus and medius

INTRODUCTION

Weakness of the gluteus medius and maximus may contribute to lower extremity injury by decreasing the stability of the pelvis during functional movement. The force acting by tension of ligaments and activity of core muscles such as the multifidus, erector spinae, latissimus dorsi and gluteus maximus affects the SIJ stability during specific loading situations1–5). The main purpose of the exercises was to recruit muscles and restore the imbalance pattern of postural muscles6, 7). Some studies have also emphasized stretching and strengthening of weak muscles to increase pelvic stabilization. Weight-bearing exercises, especially dynamic single-limb exercises, have been shown to significantly improve muscle strength of the hip8). Various unilateral weight-bearing exercises such as squats, hops and step-ups have been used to help improve gluteal muscle strength in functional activity and prevent injury in rehabilitation programs9, 10). However, previous reviews have focused on muscles recruitment in static positions regardless of prone, standing, or side-lying to verify pelvic belt effects4, 11, 12). Therefore, this study was conducted to compare muscle activity level with and without pelvic belt conditions during common dynamic therapeutic exercises. Based on previous experiments and clinical experiences, we applied the pelvic belt at a high level. Muscle activity was measured by EMG signal amplitude with good correlation, and the frequency was used to assume the muscle strengthening effect12–14).

SUBJECTS AND METHODS

Twenty healthy males (mean age 22.9 ± 2.1 years, mean height 174.4 ± 3.9 cm, mean weight 70.0 ± 6.2 kg) volunteered in this study through the posting of flyers at Gachon University, Republic of Korea. All participants completed an informed consent form that described the purpose and procedures of testing. None of the participants, who were able to perform the exercises without pain, had a history or symptoms of neurological, psychological, musculoskeletal or cardiopulmonary disease. Participants were excluded if they had experienced any injury to the lower back, sacroiliac or lower limbs within the past year. The subjects were individually instructed with regard to 6 different therapeutic exercises by an experienced physical therapist and practiced until they performed each exercise correctly at a comfortable speed: (a) hip clam, (b) side-lying hip abduction, (c) single limb squat, (d) single limb deadlift, (e) frontal planar lunge and (f) frontal planar hop9) (Fig. 1). Each exercise was repeated 3 times with and without a pelvic belt. Participants rested for 3 minutes to prevent muscle fatigue after practicing and recorded 3 repetitions of exercises with and without a pelvic belt. The pelvic belt was placed below the ASIS. This study used a pelvic belt (COM-PRESSOR™, OPTP, Minneapolis MN, USA) that is designed to modify the application site and amount of compression force based on the subjects’ condition. The subjects randomly performed the 6 exercises on the dominant leg, which was defined as the leg used to kick a ball. The GMax and GMed activity was assessed by surface
EMG (MyoSystem1400A, Noraxon USA, Inc., Scottsdale, AZ, USA)\cite{ref15}. A single reference electrode was placed over the tibial tuberosity of the dominant limb. The EMG signal was sampled at 1000 Hz, amplified with an overall gain of 500, filtered to produce a band-pass filter (20–500 Hz) and band-stop filter (60 Hz), and smoothed using a root mean square (RMS) by the Acqknowledge software. We carefully monitored for artifacts and noises. The mean RMS data of each muscle from all 3 trials were normalized by obtaining 1 maximal voluntary isometric contraction (MVIC) value. We calculated the MVIC of each muscle before starting the exercises\cite{ref16}. The normalized mean EMG amplitude data (%MVIC) were analyzed using SPSS version 19.0 and described as the mean ± standard deviation. ANOVA was used to identify differences in normalized mean EMG data, and confidence intervals were used to evaluate for multiple pairwise comparisons with a Bonferroni post hoc t-test. The level of significant was set at p<0.05.

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<th>Exercise Method</th>
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<td><strong>Fig. 1.</strong> Therapeutic exercise</td>
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**RESULTS**

Use of a pelvic belt significantly improved the mean GMax muscle activity in all exercises (F_{1,114}=77.27, p=0.00). However, there was no statistically significant influence on GMed muscle activity when using a pelvic belt condition (F_{1,114}=0.08, p=0.38) except in the case of the hip clam exercise (p=0.00). There were significant interactions between conditions and exercises in both the GMax (F_{5,114}=3.67, p=0.00) and GMed (F_{5,114}=3.05, p=0.01) (Table 1).

**DISCUSSION**

Exercises for a lower extremity, the hip clam, side-lying hip abduction, lunge and hop, can easily be applied in the clinical setting without any equipment. The main finding of the present study was that compression force caused by the
pelvic belt effectively increased the GMax activity during all trials. Also, there was a significant difference between muscle activation and exercise in both the GMax and GMed. However, the normalized mean EMG data for the GMed was not significantly influenced by use of the pelvic belt. The pelvic belt increased the GMax activity and reduced the activities of the transverse and oblique abdominal muscles during treadmill walking and the active straight leg raise, but this study did not investigate various lower extremity exercises. Based on our findings, pelvic support may contribute to lumbopelvic stability by improving GMax activity during therapeutic exercises for the lower extremities. Those exercises which we selected effectively activate the gluteal muscles more than other muscles during weight-bearing motion. In contrast with a previous review, our results showed decreased GMed activity when using the pelvic belt while performing the exercises, except in the case of the hip clam. A possible explanation for this outcome could be limitation of pelvis mobility caused by the pelvic belt, although we do not have kinematic data to support this supposition. GMed activity increased during the hip clam with the pelvic belt because the belt appears to resist movement of the GMed. The present study suggests that the pelvic belt is useful for single-limb balance tasks based on the higher GMax activity found during single-limb squats and deadlifts, which is similar to the findings of Ayotte et al. and Distefano et al. The pelvic belt may have positive effects during performance of functional exercise that stimulate GMax activity in patients with SIJ dysfunction, as our findings and previous research suggest. Pelvis stabilization during a trunk extension exercise using a Roman chair that was performed in a prone position did not affect glutus muscle activity; however, hip extensor activity was reduced depending on hip position according to the length-tension relationship. Further study is needed to investigate kinematic data of pelvic mobility because wearing a pelvic belt should limit pelvic motion in conjunction with a change in muscle recruitment pattern or an increase in muscle activity on lower extremities and the low back.

REFERENCES


