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Original Article

Effects of a good posture belt on buttock pressure during cross-legged sitting

Youngje Woo, PT[1)], Ilsub Jun, PhD, PT[2)*], Woomin Je, MSc, PT[1)]

[1)] *Department of Physical Therapy, Daegu University, Republic of Korea*
[2)] *Center of Physical Therapy, Kimjun's Orthopaedic Clinic: 77-1 Seomoonro 1 street, Jung-gu, Daegu 700-251, Republic of Korea*

Abstract. [Purpose] The purpose of the present study was to examine the effects of wearing a good posture belt on buttock pressure during cross-legged sitting. [Subjects] The study subjects were 34 adults who were divided into a good posture belt group (7 men, and 10 women) and a control group (7 men, and 10 women), with 17 subjects each. [Methods] Sensor mats were used to measure buttock pressure and changes in the total travel distance of the center of pressure, maximum pressure, and mean pressure. [Results] The good posture belt group showed smaller increments in center of pressure, maximum pressure, and mean pressure than the control group. [Conclusion] The use of the good posture belt during cross-legged sitting is considered to control the increment of buttock pressure, thereby greatly helping the maintenance of efficient postures.
Key words: Good posture belt, Buttock pressure, Cross-legged sitting

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INTRODUCTION

Inadequate sitting postures maintained for long periods are the major cause of back pain[1)]. Moreover, because the spine and pelvis are anatomically composed of the spine-pelvic complex, the position of the pelvis in sitting postures greatly affects the spine[2)].

Cross-legged sitting (CLS), also called "tailor sitting" entails movements that accompany hip joint flexion, abduction, external rotation, knee joint flexion and internal rotation, and ankle plantar flexion. In particular, as CLS includes complex lower limb movements, increases pelvic posterior rotation, and reduces lumbar lordotic curves, it may cause back pain[3)]. Ultimately, the basis of proper sitting postures is the pelvis, and maintaining the pelvis in its neutral position is greatly important in securing postural stability[4)].

A method frequently used when analyzing sitting positions is the measurement of buttock pressure (BP). As a basal area should be prepared through the pelvis in stable sitting postures, even weight distribution can help maintain proper postures. Generally, in sitting positions, BP increases over time[5)], and foam[6)] and good posture belts (GPB) are most frequently used to slow down increases in BP. Whereas use of foam has been extensively studied as a preventive method for bedsores[5–7)], the effects of GPBs during CLS have not been studied.

CLS causes more slumped postures compared to upright sitting postures on a chair. Therefore, finding and preventing the factors that contribute to slumped postures during CLS is greatly important. To this end, the present study was intended to examine the effects of wearing a GPB on BP during CLS.

SUBJECTS AND METHODS

In the present study, 34 male and female college students were selected and randomly assigned to a good posture belt group (GPBG) with 17 participants (7 men, and 10 women) who would wear a GPB during CLS and a control group (CG) with

*Corresponding author. Ilsub Jun (E-mail: sub7475@hanmail.net)

17 participants (7 men, and 10 women) who would not wear any GPB during CLS. The criterion for selection of the study participants was individuals who had no muscular, skeletal, or neurological problems. Those who felt pain or were restricted in movement during CLS were excluded. The present study was approved by the institutional review board of Korea Daegu University (1040621-201507-HR-001-02), and the participants provided voluntary written agreement for their participation in the study after sufficiently understanding the overall contents regarding the purpose of the study and the experiment.

The general characteristics of the participants were as follows (in mean±standard deviation): age, 21.41±2.09 years; height, 165.94±8.31 cm; and weight, 59.42±7.92 kg in the GPBG, and 22.47±3.21 years, 168.29±8.33 cm, and 61.29±8.45 kg, respectively in the CG. To assess the characteristics of the two groups, the sexes were analyzed by using chi-squared tests, and the age, height, and weight were analyzed by using independent t-tests. According to the results, the two groups had no significant differences ($p>0.05$), so their homogeneity could be assumed for comparison of the test results.

To examine the effects of GPB on BP during CLS, all the participants were instructed to maintain CLS on BP measuring mats installed on a flat floor. While maintaining CLS, each participant was instructed to put their ischial tuberosity into contact with the center of the mat and maintain a neutral position in order to prevent lumbar lordosis or kyphosis. In addition, each participant was instructed to rest their hands softly on their knees and watch videos on the monitor installed 150 cm in front of them. The position of the monitor was adjusted so that the monitor was placed on the plane horizontal to the eyes of the participant. The participants in the GPBG were instructed to maintain the state of wearing the GPB during CLS. A GPB (Good Posture, Korea) is composed of a non-elastic tension belt, a tension belt connecting ring, a length-adjusting buckle, and elastic knee bands. During CLS, the participants were instructed to wear the GPB by placing the tension belt connecting ring at the center of the GPB on the spinous process at L3, putting the elastic knee bands located at both ends on the knees, and pulling the tension belt to fix it when the waist was in the neutral position.

BP was measured during CLS by using an S2028 pliance sensor mat 448 (Novel Pliance, Germany), which is composed of a pressure sensing mat (448×448 mm) containing 256 (16×16) sensors, a multichannel analyzer, a calibration device, and software that elaborates and standardizes data. The data detected by the sensors enable the computer to analyze BP through the software. In the present study, to analyze BP, maximum pressure (MaxP), mean pressure (MeaP), and total travel distance of the center of pressure (COP) were measured. The average MaxP and MeaP values, and the total travel distance of the COP for 60 sec during 1–2 minutes and during 13–14 minutes, respectively, were used as measured values.

The measured data were analyzed by using the SPSS 18.0 statistical program. Paired t-tests were used to test the significance of changes in individual groups before and after the experiment, and independent t-tests were used to test the significance of the differences between the two groups. The significance level α was set to 0.05.

RESULTS

Changes in COP, MaxP, and MeaP were presented in mean± standard deviation (Table 1). During CLS, COP and MeaP significantly increased in the GPBG ($p<0.05$), and COP, MaxP, and MeaP significantly increased in the CG ($p<0.05$). In the comparison between the GPBG and the CG, significant differences in COP and MeaP were found ($p<0.05$).

DISCUSSION

Spinal alignment mitigates external impacts and forms a central axis of the body to maintain balance[8)]. However, when CLS is maintained for a long period, the pelvic posterior tilt increases and lumbar lordosis decreases[3)], leading to increases in thoracic kyphosis as a compensatory action for the foregoing, thereby increasing muscle fatigue and compression on intervertebral disks, resulting in low back pain[1, 9)]. For this reason, many tools are currently being developed through ergonomic analyses.

In the present study, although COP, MaxP, and MeaP were shown to increase over time in both the GPBG and the CG, increments in COP, MaxP, and MeaP were shown to be smaller in the GPBG than in the CG. In particular, the total travel distance of the COP was shown to be shorter in the GPBG than in the CG. This is considered attributable to the fact that

Table 1. Variation of change in buttock pressure

	Good posture belt group (n=17)		Control group (n=17)	
	Pre	Post	Pre	Post
COP (mm) [b]	706.1±151.4	764.9±149.4[a]	656.3±141.7	784.2±163.3[a]
MaxP (kPa)	15.2±2.9	15.9±3.3[a]	15.2±5.3	16.3±5.4[a]
MeaP (kPa) [b]	2.0±0.3	2.1±0.4	2.4±0.5	2.4±0.5[a]

The presented are expressed as mean±SD. COP: center of pressure; MaxP: maximum pressure; MeaP: mean pressure
[a]Statistically significant difference between pretest and posttest ($p<0.05$)
[b]Statistically significant difference between the group ($p<0.05$)

the use of a GPB supported the lumbar region during CLS so that upright sitting could be maintained for a long time. The shorter travel distance of the COP means that balance was maintained better in the GPB than in the CG during CLS. This is considered the reason why the increments in MaxP and MeaP were smaller in the GPB. Human bodies continuously show minute postural sway when maintaining static balance. The maintenance of balance can be effectively measured by measuring the COP[10]. Balance control requires well-controlled voluntary movements and reflexive muscle movements related to body alignment[11]. In general, larger flexion angles are formed on the lumbar spine to maintain CLS for a long time[12], requiring more effort and energy from the muscles around the spine[13] so that upright sitting cannot be maintained and the travel distance of the COP increases over time.

Ultimately, the use of GPB is considered to support spinal alignment during a long period of CLS, thereby affecting COP, MaxP, and MeaP, and resulting in positive effects on the prevention of low back pain that may occur due to BP.

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