



Original Article

The effects of sitting with the right leg crossed on the trunk length and pelvic torsion of healthy individuals

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Abstract. [Purpose] The purpose of this study was to determine the effects on the trunk length and pelvic torsion of healthy individuals that arise from crossing the right leg while sitting. [Subjects and Methods] The subjects in this study were 30 healthy individuals consisting of 18 males and 12 females. The subjects were instructed to sit on a chair, the height of which was adjustable, so that their knee and hip joints were bent at 90°. For the study, they sat stripped to the waist, with the back and hips bare. They were then instructed to perform a one-leg-crossed sitting posture by placing the right leg on the top of the left knee. A spinal posture test was performed to measure the subjects' trunk length and pelvic torsion by using a three-dimensional image-based spinal diagnostic system. [Results] The results of the three-dimensional spine examination showed statistically significant decreases in trunk length and pelvic torsion after the one-leg-crossed sitting posture. [Conclusion] In this study, the right leg-crossed sitting posture led to a decrease in the right trunk length with time and, in terms of pelvic torsion, increased the posterior rotation of the right pelvis when compared with the left pelvis.

Key words: Pelvic torsion, Trunk length, Vertebra

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INTRODUCTION

The spine consists of the cervical, thoracic, and lumbar regions, and it forms an interactive, complex biodynamic system connected to the pelvis¹⁾. In addition, as the spine is comprised of disks, muscles, and ligaments, it facilitates shock absorption and trunk stability during walking. Owing to these structural characteristics, the spine always supports body weight and is under continuous tension and pressure. Therefore, unstable postures can cause spinal deformities²⁾. With the popularization of computers and the generalization of computer-related tasks, individuals are using computers at both home and work for increasingly long hours, which also results in their working for long hours in a sitting position³⁾. A one-leg-crossed sitting posture is commonly observed regardless of age or gender. The one-leg-crossed sitting posture can reduce muscle fatigue by reducing muscle activity in the abdominal internal and external oblique muscles, and can adjust the height of the two sides of the pelvis for better alignment should the individual's two legs be of different lengths. In addition, it can provide stability to the sacro-iliac joint of individuals who have instability in that joint by generating adduction of the hip joint⁴⁾. However, crossing one leg while sitting can also create multiple risks for the body. For example, it can cause trunk asymmetry due to an asymmetrical use of the abdominal internal oblique muscles on the two sides⁵⁾ and can increase the rotation of the spine in individuals with a limited range of hip joint motion by rotating the pelvis⁶⁾. In addition, while the spine is strong enough to resist stress applied vertically, it is vulnerable to stress resulting from rotation or bending, and this can cause back pain⁷⁾.

In recent years, a number of studies have been conducted to analyze the spines of workers who perform repetitive jobs that

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generate excessive loading of the lumbar spine. Previous studies have focused on the asymmetry of the trunk muscles when subjects sit with one leg crossed and the ankle of that leg placed on top of the opposite knee^{4, 5}. These studies reported the importance of avoiding unstable postures in reducing musculoskeletal disease. However, few studies have investigated spinal deformities resulting from unstable postures. Therefore, the purpose of this study was to determine the effects on the trunk length and pelvic torsion of healthy individuals that arise from crossing the right leg while sitting.

SUBJECTS AND METHODS

The subjects in this study were 30 healthy individuals consisting of 18 males and 12 females. The selection criteria were as follows: subjects had not undergone orthopedic surgery on the spine or lower limbs, subjects had not taken medicine for neurological problems, and subjects had no musculoskeletal diseases. The subjects' mean age, height, and weight were 20.42 ± 0.98 years, 172 ± 4.23 cm, and 68.28 ± 6.32 kg, respectively. Following the ethical standards of the Declaration of Helsinki, an explanation of the intent and purpose of the study was provided to all the subjects prior to their participation, and written informed voluntary consent to participate in the study was obtained from all the subjects.

The subjects were instructed to sit on a chair, the height of which was adjustable, so that their knee and hip joints were bent at 90°. For the study, they sat stripped to the waist, with back and hips bare. They were then instructed to perform a one-leg-crossed sitting posture by placing the right leg on the top of the left knee. A spinal posture test was performed to measure the subjects' trunk length and pelvic torsion by using a three-dimensional (3-D) image-based spinal diagnostic system (Formetric III, Germany)⁸. The examiner instructed the subjects not to move while sitting for the spinal analysis and to tie their hair back so that the neck region was exposed for acquiring images. In addition, they were not allowed to wear a watch or necklace to avoid reflections from the metal.

The trunk length refers to the straight-line distance between the vertebra prominens (C7) and the dimple middle (the midpoint between the posterior superior iliac spines on the two sides)⁸. Pelvic torsion refers to the degree of torsion on the two sides of the pelvis when a straight line is drawn from the left to the right posterior superior iliac spine. The anterior and posterior rotations of the right pelvis were indicated as (+) and (-), respectively. During the spinal examination, the distance between a 3-D camera and each subject was 2 m. Measurements were performed three times while the subject was sitting normally with the legs uncrossed and then three times 20 minutes after crossing the leg. The mean of three measurements was obtained for each group.

SPSS 18.0 for Windows was used for the statistical analysis. A repeated-measures analysis of variance was performed to compare the measurements from before the intervention, 20 minutes after the intervention, and again 40 minutes after the intervention. When the differences were significant, the Bonferroni method was used as a post hoc comparison test. The statistical significance level was set at $\alpha=0.05$.

RESULTS

The results of the 3-D spine examination showed statistically significant decreases in trunk length and pelvic torsion after the one-leg-crossed sitting posture ($p<0.05$) (Table 1).

DISCUSSION

In this study, the right leg-crossed sitting posture led to a decline in the right trunk length with time and, in terms of pelvic torsion, increased the posterior rotation of the right pelvis when compared with the left pelvis. In terms of the state of the spinal alignment, this posture generated concavity on the right side and convexity on the left side. In addition, it was analyzed that spinal deformities were caused by the posterior rotation of the right pelvis.

One previous study that had 20 healthy adult men perform a one-leg-crossed sitting posture reported statistically significant differences in the muscle activity of the musculus rectus abdominis, internal oblique, and external oblique muscles after the intervention. This resulted from the one-leg-crossed posture, causing asymmetry of the trunk muscles⁵. Another study

Table 1. Comparison of the changes in the characteristics of the experimental group, with values presented as mean ± standard deviation (n=30)

	Pre	Post
Trunk length VP-DM (mm)	471.2 ± 25.8	459.0 ± 22.4*
Pelvic torsion DL-DR (°)	1.0 ± 1.6	-1.5 ± 2.2*

* $p<0.05$.

VP-DM: from the vertebra prominens (C7) to the dimple middle; DL-DR: from the posterior superior iliac spine (left) to the posterior superior iliac spine (right)

*Significant intergroup difference in the increases achieved ($p<0.05$)

reported that the imbalanced shortening or stiffness of the trunk muscles limited lumbar rotation exercise in one direction and increased the exercise in the opposite direction, thereby causing left-right asymmetry in the trunk⁹).

Many individuals whose lower limbs are of different lengths take up a one-leg-crossed sitting posture to adjust the height of the two sides of their pelvis, thereby improving alignment¹⁰). In most cases, however, people cross a leg while sitting because this posture feels comfortable or has become a habit. This causes left-right asymmetry in the body and increases the rotation of the lumbar spine by rotating the pelvis, following the bending of the hip joint⁶). In individuals with a limited range of hip joint motion, this will increase the pelvic rotation. Therefore, the findings of this study suggest that crossing a leg while sitting can cause scoliosis and spinal deformities.

This study has some limitations regarding the generalization of its results. First, it did not observe the subjects in the one-leg-crossed sitting posture for long hours, and it involved a relatively small number of subjects. Second, it could not identify the effects of the one-leg-crossed sitting posture on trunk stabilizers. Therefore, future studies should be conducted to identify the correlation between unstable postures commonly adopted in daily life and musculoskeletal diseases.

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