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Original Article

Effects of kinesio taping on lumbopelvic-hip complex kinematics during forward bending

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Abstract. [Purpose] The aim of this study was to investigate the effect of kinesio taping (KT) on the kinematics of the lumbo-pelvic-hip complex during forward bending by individuals with reduced hamstring extensibility. [Subjects] Eighteen males with reduced hamstring extensibility were randomly assigned to one of two groups:, the hamstring KT group (n=9), or the sham KT group (n=9). [Methods] The kinematics of the lumbopelvic-hip complex during lumbar forward bending was measured using a motion capture system before and after applying KT. [Results] The angle of lumbar flexion during late lumbar forward bending increased significantly post-KT compared to pre-KT measurements in the hamstring KT group. [Conclusion] These findings suggest that KT does not directly affect an individual's movement during lumbar forward bending.
Key words: Kinematics, Kinesio taping, Lumbar forward bending

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INTRODUCTION

Specific postures and movements required in sports, as well as improper training, can negatively affect the hamstring extensibility of athletes[1)]. Hamstring extensibility may subsequently affect pelvic movement, and posture, and sagittal curvature during lumbopelvic bending[2)]. Because the hamstring muscles originate at the pelvic ischial tuberosity, and the pelvis is regarded as the root of the spine[3)], reduced hamstring extensibility can cause changes in lumbo-pelvic rhythm[4)]. Accordingly, hamstring-stretching programs are recommended for maintaining and improving hamstring extensibility[5)].

Of the various hamstring-stretching programs available, Kinesio taping (KT) has been investigated as a means of improving hamstring extensibility. Akbaş et al. demonstrated that hamstring extensibility increased significantly after implementing KT in comparison with conventional exercise program for patients with patellofemoral pain syndrome[6)]. Furthermore, KT increased the range of motion (ROM) in the passive straight leg raise (SLR) test and increased knee extension angle[7)]. However, few studies have investigated the effect of KT on movement patterns, especially that of lumbo-pelvic rhythm. Although, Lemos et al. showed that application of KT increased the lumbar flexion angle of healthy subjects[8)], and Lee et al. showed that application of KT increased the anterior inclination of the pelvis on both sides in healthy subjects[9)], these studies only investigated the movement of one joint. Therefore, our aim was to investigate the effect of KT on the kinematics of the lumbopelvic-hip complex during lumbar forward bending. We hypothesized that KT would reduce lumbar flexion, and increase pelvic anterior tilt and hip flexion during lumbar forward bending.

SUBJECTS AND METHODS

Eighteen males with reduced hamstring extensibility on the right side were randomly assigned to one of two groups: the hamstring KT group (n=9; mean age: 23.55 ± 4.00 years; mean height: 172.55 ± 4.97 cm; mean weight: 66.22 ± 7.01 kg) or the sham KT group (n=9; mean age: 21.00 ± 1.73 years; mean height: 176.11 ± 7.00 cm; mean weight: 73.11 ± 15.28 kg). The inclusion criteria were as follows: 1) reduced hamstring extensibility (angle of active knee extension (AKE) ≤ 160°), and 2) the ability to maintain full extension during lumbar forward bending[10, 11)]. The exclusion criteria included a history of knee, hip, or low back pain, or scoliosis, or surgery of the lower extremities or low back in the previous 6 months. Prior to participation, all subjects read and signed an informed consent form approved by the Inje University Ethics Committee for Human Investigations.

Kinematic measurements of the lumbopelvic-hip complex in the sagittal plane during lumbar forward bending were obtained using a VICON MX-T20 motion capture

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Table 1. Angles of the lumbar, pelvic and hip joints with hamstring KT and sham KT during lumbar forward bending (°)

Variable	Groups	Pre-KT	Post-KT
		Mean ± SD	Mean ± SD
Early LF	Hamstring KT	9.38 ± 6.69	10.36 ± 6.51
	Sham KT	12.46 ± 4.15	12.12 ± 6.72
Early PAT	Hamstring KT	29.15 ± 5.43	29.22 ± 5.91
	Sham KT	27.75 ± 8.08	28.22 ± 9.34
Early HF	Hamstring KT	38.87 ± 9.38	37.83 ± 7.99
	Sham KT	36.22 ± 9.81	36.24 ± 11.21
Late LF	Hamstring KT	32.85 ± 8.37	34.59 ± 7.72*
	Sham KT	34.72 ± 9.83	35.56 ± 9.31
Late PAT	Hamstring KT	55.47 ± 10.06	56.22 ± 9.58
	Sham KT	54.14 ± 14.49	57.09 ± 13.01
Late HF	Hamstring KT	67.70 ± 10.51	68.01 ± 9.01
	Sham KT	64.82 ± 12.82	67.63 ± 11.62

*$p < 0.05$. LF: lumbar flexion; PAT: pelvic anterior tilt; HF: hip flexion; KT: kinesio taping

system (Vicon Motion Systems Ltd., Oxford, UK). Sixteen reflective markers were attached to landmarks, consistent with the VICON Plug-in-Gait model[12]. Four additional reflective markers were added to assess the kinematics of the lumbar spine; These were attached to the first and second lumbar spinous processes, and to both sides of the second lumbar spinous process[10].

Before applying KT, movement analysis was performed. The subjects were asked to perform lumbar forward bending. For early lumbar forward bending, the subjects stood comfortably with their feet shoulder-width apart, and then bent forward slowly until their fingertips reached a crossbar. Subjects maintained this position for 3 s. For late lumbar forward bending, the subjects were asked to bend as far forward as possible and maintain this position for 3 s, followed by a return to the standing position. All subjects performed knee extension and the lumbar forward bending motions three times.

The hamstring KT protocol was similar to that described by Lumbroso et al.[7], and standard 5-cm beige tape was used for all subjects. Hamstring KT was applied with the subject in a standing position with slight lumbar forward bending in order to achieve initial hip flexion. The examiner applied tape from the ischial tuberosity to the lateral popliteal fossa on the lateral hamstring in an I-shape. A second I-shaped taping was applied from the ischial tuberosity to the medial popliteal fossa on the medial hamstring. The tape was stretched to approximately 30% of its maximal stretch during application[13]. In the sham KT group, tape was applied in the same locations as in the hamstring KT group, but without stretching or lumbar forward bending. Immediately after applying KT, lumbar forward bending was repeated in the same manner as in the initial assessment, pre-KT. Kinematic data were recorded three times for each condition during lumbar forward bending, and the mean values of the peak angles were used in the data analysis.

Kinematic data were collected at a sampling data rate of 100 Hz and processed using the Nexus software (version 1.7; Vicon Motion Systems Ltd., Oxford, UK). The angle of lumbar flexion was calculated as the change in the angle of the lumbar spine vector relative to the pelvis. The angle of pelvic anterior tilt was calculated as the absolute motion of the pelvic segment, and the angle of hip flexion was calculated as the change in the angle of the thigh vector relative to the pelvic segment. Lumbar flexion, pelvic anterior tilt, and hip flexion were defined as positive angular values of the lumbar spine, pelvis, and hip, respectively.

All data were analyzed using SPSS version 20.0 (SPSS Software, Chicago, IL, USA). A Two-way repeated ANOVA (within-group factor: time, between-group factor: group) was used to determine the main effects and their interaction for movement of the lumbopelvic-hip complex, with a p-value of < 0.05 indicating statistical significance. A post hoc t-test was also performed, with a statistical significance for level of tests was also set at $\alpha = 0.05$.

RESULTS

A significant main effect was observed for time (pre-KT vs. post-KT) for the angle of lumbar flexion during late lumbar forward bending ($p = 0.035$, Table 1). The lumbar flexion angle increased significantly in the post-KT vs. pre-KT assessments in the hamstring KT group (32.85 ± 8.37° to 34.59 ± 7.72°, respectively; $p = 0.018$). However, the other values showed no significant differences in either groups (Table 1).

DISCUSSION

Our findings indicated that KT did not influence the angle of pelvic anterior tilt or hip flexion. These findings indicate that KT does not directly affect the movement of the lumbopelvic-hip complex. One possible reason for this finding is that lumbar forward bending includes thoracic,

lumbar, pelvic, and hip movements[14], and KT was used to control only one joint connecting with the hamstring muscle, and did not affect the other structures, or their movements. A second possible reason for this finding is that the movement pattern can be influenced by various factors, including ROM, proprioception, and muscles stiffness[15, 16]. Thus, we propose that KT does not immediately influence the movement pattern.

Our results showed that the lumbar flexion angle during late lumbar forward bending increased significantly post-KT compared to pre-KT measurements within the hamstring KT group. The tension provided by KT may have helped to move the muscles, fascia, or the joint into a more desirable position[13]; however, it may also have limited ROM in the taped region. The KT technique used here involves applying the tape after hip flexion has been initiated. Because of this, early lumbar forward bending did not affect the pelvis or hip movements, whereas the hip and pelvis were affected in late lumbar forward bending due to increased KT tension.

This study had several limitations. First, the sample size was small; only 18 subjects with reduced hamstring extensibility were recruited to investigate changes in the lumbopelvic-hip complex. Second, this study investigated only acute or immediate effects. Additional studies are required to investigate the long-term effects of KT on motion of the lumbopelvic-hip complex.

This study investigated the effects of KT on the kinematics of the lumbopelvic-hip complex during lumbar forward bending. Our results indicate that KT does not influence in the angle of pelvic anterior tilt or hip flexion during lumbar forward bending. Thus, KT is not appropriate as an intervention for the improvement of the movement pattern.

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