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The effects of lumbo-pelvic postural taping on gait parameters in patients with lumbar spinal stenosis

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ABSTRACT

Background: Altered gait patterns with lumbar-flexed posture threaten the quality of life in patients with lumbar spinal stenosis; however, few studies have developed management strategies to improve gait patterns and lumbo-pelvic posture. The present study investigated the effects of lumbo-pelvic postural taping on pelvic tilt, spatiotemporal gait parameters, and pain during walking in patients with lumbar spinal stenosis.
Methods: The pelvic tilt and gait parameters were assessed in 20 patients with lumbar spinal stenosis before sustained walking using a palpation meter and GAITRite system, respectively. Next, the participants were asked to walk on the ground for 20 min or until they complained of symptoms of neurogenic claudication. Pelvic tilt and gait parameters were measured immediately after the manifestation of neurogenic claudication followed by the application of lumbo-pelvic postural taping. The participants rated the pain intensity using a visual analog scale. Changes in dependent variables among the conditions were analyzed using a one-way repeated-measures analysis of variance.
Findings: The results show a decreased pelvic anterior tilt, walking velocity, and step and stride lengths, as well as an increased base of support and pain after severe symptoms of neurogenic claudication ($P < 0.05$). However, a greater pelvic anterior tilt, faster walking velocity with a longer step and stride length, and decreased base of support and pain were found after the application of postural taping ($P \leq 0.001$).
Interpretation: These findings suggest that lumbo-pelvic postural taping can provide beneficial management for improving gait patterns and lumbo-pelvic posture in patients with lumbar spinal stenosis.

1. Introduction

Lumbar spinal stenosis (LSS) is defined as narrowing of the spinal canal and/or spinal nerve foramen due to degenerative changes, including thickening of the ligamentum flavum, facet joint osteophytes, and disk herniation (Katz and Harris, 2008; Spivak, 1998). Degenerative changes in the lumbar spine induce symptoms of neurogenic claudication, which is characterized by pain, weakness, paresthesia, and cramping of the lower extremities that is aggravated during lumbar extension, standing, and walking in patients with LSS (Tong et al., 2007). Symptoms of neurogenic claudication disturb functional activities, especially walking, worsening the gait pattern and lumbo-pelvic posture during walking in patients with LSS (Katz et al., 1995; Lim et al., 2007; Suda et al., 2002).

Katz et al. (1995) showed that a wide-based gait, a key clinical finding, is strongly associated with LSS. Additionally, patients with LSS exhibit characteristics of a lumbar-flexed posture (Lim et al., 2007), as evidenced by a forward inclination of the trunk with a loss of typical lumbar lordosis (Hirose et al., 2004; Saha et al., 2008). The gait of patients with LSS is often performed with a lumbar-flexed posture (e.g., stooped gait) to reduce neurogenic claudication (Lim et al., 2007; Takahashi et al., 1995).

Although a lumbar-flexed posture decreases epidural pressure and consequently alleviates neurogenic claudication symptoms (Takahashi et al., 1995), changes in lumbo-pelvic posture can worsen gait performance. Hirose et al. (2004) showed that elderly subjects with a lumbar-flexed posture had shorter step and stride lengths as well as slower walking speeds compared to elderly subjects with an upright lumbo-pelvic posture. Furthermore, a lumbar-flexed posture during walking increases the low-back load, an important factor in the worsening gait performance in patients with LSS (Leteneur et al., 2009; Oğuz et al., 2007). In light of previous findings, an altered gait pattern can be attributed not only to symptoms of neurogenic claudication but also to a lumbar-flexed posture in patients with LSS.

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To improve gait pattern, a novel management strategy leading to a neutral lumbo-pelvic posture is needed for patients with LSS. The application of non-elastic tape (i.e., postural taping) has been recommended as a safe and cost-effective approach to correct altered posture (Greig et al., 2008; Holtzman and Harris-Hayes, 2012; Vaughn and Nitsch, 2008). Postural taping has been applied to decrease pain and correct the altered posture of body segments by passive mechanical support provided by non-elastic tape (Greig et al., 2008; Kang et al., 2013). A previous study suggested the application of non-elastic tape as a useful conservative management for restraining altered pelvic tilt alignment (Vaughn and Nitsch, 2008). Kang et al. (2013) demonstrated that postural taping could increase pelvic anterior tilt and decrease lumbar flexion through kinematic linkage of the lumbo-pelvic complex. Additionally, the optimal posture acquired by postural taping to the lumbo-pelvic area may reduce the low-back load (Greig et al., 2008; Kang et al., 2013; Leteneur et al., 2009).

An altered gait pattern is a serious health-related problem in patients with LSS (Tomkins-Lane et al., 2012); however, few studies have investigated management strategies for improving the gait pattern of patients with LSS. Although various approaches such as surgical management and body weight-supported treadmill walking have been studied (Suda et al., 2002; Whitman et al., 2006), patients with LSS were dissatisfied with the surgical outcome over time (Katz et al., 1996), and body weight-supported treadmill walking cannot be applied during functional activities of daily living. Furthermore, most studies have overlooked the influences of a lumbar-flexed posture on the altered gait pattern in patients with LSS. Based on previous findings, clinicians should consider conservative management for correcting lumbo-pelvic posture, including postural taping, to improve the gait pattern of patients with LSS.

The aim of this study was to investigate whether lumbo-pelvic postural taping changes pelvic tilt, spatiotemporal gait parameters, and pain intensity during walking in patients with LSS. We hypothesized that the pelvic anterior tilt, walking velocity, and stride and step lengths of the patients would increase significantly, while the heel-to-heel base of support and pain would decrease significantly after the application of lumbo-pelvic postural taping.

2. Methods

2.1. Participants

Community-dwelling older people who had participated in a health promotion program at a community health center in Pusan, South Korea, were contacted by telephone. A total of 20 subjects (18 females and 2 males) diagnosed with LSS were recruited for this study. All participants were previously diagnosed by a surgeon as having degenerative LSS using computed tomography (CT) or magnetic resonance imaging (MRI). The inclusion criteria were: (1) >55 and <80 years of age, (2) CT or MRI findings of lumbar spinal nerve root compression associated with degenerative changes in the ligamentum flavum, facet joint, or disk, and (3) alleviation of symptoms of neurogenic claudication when sitting or lying. Subjects were excluded if they had undergone surgery within the last year or had chronic obstructive pulmonary disease, cardiovascular disease, severe osteoarthritis, or other diseases that could limit walking. All participants completed the Oswestry Disability Index and Roland–Morris Questionnaire to assess their functional status. Table 1 shows the characteristics of the participants in this study. Ethics approval was obtained from the Inje University Ethics Committee for Human Investigations, and written informed consent was obtained from all participants.

2.2. Pelvic tilt measurement

A palpation meter (PALM; Performance Attainment Associates, St. Paul, MN, USA) was used to measure the pelvic tilt of the participants.

Table 1
Characteristics of the participants.

Variables	Participants with LSS
Age (years)	69.05 (5.38)
Body mass (kg)	56.20 (9.63)
Height (cm)	155.90 (7.19)
Oswestry Disability Index (%)	38.22 (8.21)
Roland–Morris Questionnaire	10.15 (4.45)

All values are mean (standard deviation). Abbreviation: LSS, lumbar spinal stenosis.

After palpating the anterior superior iliac spine (ASIS) and posterior superior iliac spine (PSIS), an examiner attached tape to these bony landmarks. An examiner placed one caliper arm tip of the palpation meter on the ASIS and one caliper arm tip on the PSIS; the red bubble of the inclinometer was used to indicate pelvic tilt (Fig. 1). An intraclass correlation coefficient of 0.92–0.99 in the measurement of pelvic tilt using a palpation meter was reported previously (Krawiec et al., 2003; Preece et al., 2008). Pelvic tilt measurements were performed under each condition with the participants placed in a comfortable standing position.

2.3. Gait assessment

In the present study, spatiotemporal gait parameters were measured using the GAITRite system (CIR Systems Inc., Sparta, NJ, USA). The GAITRite system detects sensor activation, and the spatiotemporal gait parameters are calculated automatically. To compare the spatiotemporal gait parameters of the participants among the experimental conditions, we measured walking velocity, step and stride lengths, and base of support (Hollman et al., 2011) (Table 2). A previous study using the GAITRite system showed good to excellent test–retest reliability in spatiotemporal gait parameter measurements (Van Uden and Besser, 2004). Spatiotemporal parameters were measured three times under each condition, and mean values of the three trials were used for data analysis.

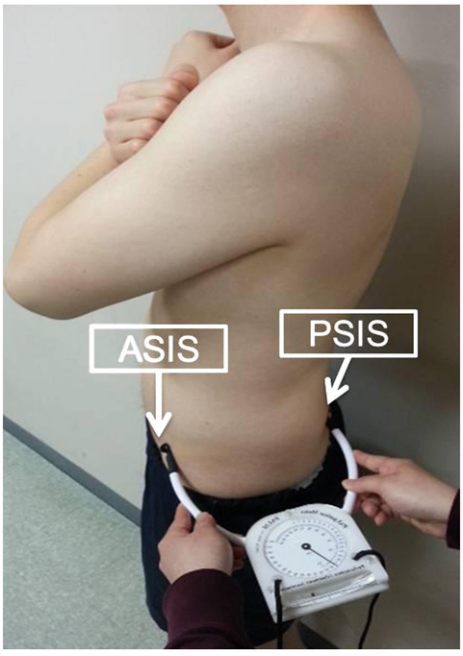

Fig. 1. Measurement of pelvic anterior tilt. Abbreviations: ASIS, anterior superior iliac spine; PSIS, posterior superior iliac spine.