

Comparison of lumbar repositioning error according to different lumbar angles in a flexion pattern (FP) subgroup of patients with non-specific chronic low back pain

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Abstract. [Purpose] This study determined the change in lumbar position sense according to lumbar angles in a flexion pattern (FP) subgroup of patients with non-specific chronic low back pain (NSCLBP). [Subjects] Thirteen subjects with FP low back pain participated. [Methods] The lumbar repositioning error (RE) of subjects was measured between a neutral starting position and re-position phases at three angles, in sitting and standing upright positions. [Results] Lumbar RE was significantly greater during lumbar flexion at a 30° angle in the sitting position than in the other tasks. [Conclusion] In the flexion-related subgroup, the lumbar RE measurement may be a more sensitive evaluation method using a lumbar flexion angle of 30° while in the sitting position, compared with other angles in sitting or standing positions.

Key words: Flexion pattern, Low back pain, Repositioning error

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INTRODUCTION

We compared the lumbar repositioning error (RE) according to different lumbar angles in a flexion pattern (FP) subgroup of patients with non-specific chronic low back pain (NSCLBP). Approximately 85% of this population was classified as having NSCLBP, with no radiological change between the 12th rib and the inferior gluteal fold¹⁾. The management approach has been the use of subgroups classified on the basis of pain-provoking postures and movements in NSCLBP²⁾. Repositioning error (RE) is defined as proprioceptive impairment, known to result in poor spinal stability³⁾. Impaired proprioception in positions such as sitting and standing can be related to LBP. In particular, it is associated with flexion direction in the subgroup with pain provoked by lumbar flexion⁴⁾. However, few studies have examined RE in subjects with flexion-related LBP during the performance of different lumbar flexion angles, as in extension on sitting and standing upright postures. Thus, the purpose of this study was to compare changes in lumbar RE at different angles while standing and re-standing and sitting and re-sitting in a subgroup of FP subjects with NSCLBP.

SUBJECTS AND METHODS

Thirteen subjects with FP were selected from among 23 individuals with NSCLBP. The FP subgroup was classified using O'Sullivan's system^{5, 6)} and was defined as subjects with pain provoked by postures and movement-related flexion of the lumbar spine. In the FP subgroup, symptoms were relieved by movement associated with extension, lordosis of lumbar segments, and the loss of a neutral spine posture due to a flexed spine^{5, 6)}. The subjects were aged 44.7±8.2 years (mean ± SD) with a height of 165.4±5.1 cm, a body weight of 62.3±7.2 kg, a Korean Oswestry Disability Index (ODI) of 30.0±4.0%, and a visual analog scale (VAS) score of 5.5±1.2. Ethical approval was obtained from the Inje University Faculty of Health Science Human Ethics Committee. The patients provided written informed consent prior to participation in the study. We used a dual inclinometer (Acumar, Lafayette Instrument Co., Lafayette, USA) to measure the lumbar RE at the main and companion parts (L1 and sacrum). Intra-test reliability of the dual inclinometer was 0.90, and the inter-test reliability was 0.85. The subjects were required to stand upright for 5 s and to hold lumbar flexion angles of 30° and 15° and a lumbar extension angle of 15° for 5 s, followed by return to the starting position. They performed three trials for the three tasks. In the sitting position, each task was performed similarly to when standing. The RE of the lumbar spine was defined as the difference in the mean sagittal angles between neutral sitting and re-sitting phases and between the standing and re-standing phases of the task. The SPSS software (ver. 12.0; SPSS, Chicago, IL, USA) was

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used for all analyses, and the level of statistical significance was set at 0.05. One-way repeated-measures analysis of variance and the least significant difference (LSD) test as a *post hoc* pair-wise comparison were used to determine significant RE differences among the six tasks.

RESULTS

The lumbar RE increased significantly with flexion at 30° during sitting. Upon sitting upright, the lumbar RE between sitting and re-sitting was significantly greater with a flexion of 30° ($5.1 \pm 3.7^\circ$) than 15° ($2.0 \pm 3.7^\circ$) or with an extension of 15° ($1.5 \pm 1.9^\circ$) ($p < 0.05$). In addition, RE while sitting with a flexion of 30° was significantly greater than that between the standing and re-standing positions during flexions of 30° ($1.9 \pm 1.5^\circ$) and 15° ($0.7 \pm 0.6^\circ$) and an extension of 15° ($0.8 \pm 0.6^\circ$) ($p < 0.05$). Upon standing upright, the lumbar RE between the standing and re-standing positions during a flexion of 30° was significantly greater than during a flexion of 15° or extension of 15° ($p < 0.05$).

DISCUSSION

In our study, lumbar spine RE increased in a specific direction while in the sitting position in the FP subgroup. In accordance with previous research^{5, 6}, the FP subgroup in this study had a deficit in flexed-toward status while sitting, but this was not apparent while standing. However, while the previous study used lumbar full flexion in the standing position, our study used a flexion angle of 30°. The neutral RE from 30° of flexion was greater than those from 15° of flexion or 15° of extension while standing, and less than that from 30° of flexion while sitting. The standing position would have added proprioceptive input from other distant receptors, while the adoption of a seated position would minimize other proprioceptive inputs by immobilizing the lower legs and the pelvis^{7, 8}. Furthermore, this may be due to characteristics of the FP group, where pain is provoked during sitting, whereas the pain tended to be relieved upon standing². The results of this study revealed the highest displacement changes between sitting and re-sitting on flexion of 30° of the lumbar spine from the upright sitting posture. When spinal structures, such as passive ligaments or active muscles are stretched or flexed during sitting, reflexive muscle activity may be reduced, passive structures may be lengthened, and their tension may be reduced due to unsuitable stretching stimulation from the central nervous system⁹.

Dolan and Green¹⁰ reported significantly increased lumbar RE following 5 min in a slouched posture, but not following a 3-s duration. Our study showed increased RE immediately while sitting at a flexion angle of 30°. We suggest that a higher lumbar flexion angle may have a negative impact on lumbar positioning sense while in the sitting posture than in the standing posture in FP subjects with NSLBP. We also suggest that the measurement method for lumbar REs would be more effective while sitting using a flexion angle of 30° in FP subjects.

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