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ORIGINAL ARTICLE

The Immediate Effect of Posteroanterior Mobilization on Reducing Back Pain and the Stiffness of the Lumbar Spine

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Abstract

Objective: To study the immediate effect of posteroanterior mobilization on back pain and the associated biomechanical changes in the lumbar spine.

Design: An experimental between-group study.

Setting: A biomechanics laboratory.

Participants: Subjects with low back pain (n=19) and healthy subjects (n=20).

Interventions: Grade III posteroanterior mobilization (3 cycles of 60s) was applied at the L4 level in people with or without back pain on 1 occasion.

Main Outcome Measures: Pain intensity, active lumbar range of motion, the magnitude of the posteroanterior mobilization loads, bending stiffness of the lumbar spine, and the lordotic curvature of the lumbar spine before and after 3 cycles of posteroanterior mobilization.

Results: The magnitude of pain of the patients was found to decrease significantly after posteroanterior mobilization treatment. There was also a significant decrease in the bending stiffness of the lumbar spine of the patients, which was derived from the posteroanterior load and the associated change in spine curvature. The stiffness was restored to a level that was similar to that of the asymptomatic subjects. A strong correlation was found between the magnitude of pain and the bending stiffness of the spine before (r=.89) and after posteroanterior mobilization (r=.98).

Conclusions: Posteroanterior mobilization was found to bring about immediate desirable effects in reducing spinal stiffness and the magnitude of back pain. The restoration of the mechanical properties of the spine may be a possible mechanism that explains the improvement in pain after manual therapy.

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About 80% of people will experience low back pain (LBP) at some stages in their lives.[1] Back pain constitutes a significant epidemiologic and economic problem, with health care costs in the United Kingdom reported to be £1632 million.[2] Subjects with LBP are commonly reported to have decreases in spinal mobility and changes in the loading patterns of the spine.[3-8] Manual therapy is widely used in the treatment of back pain, and 1 popular technique involves the application of oscillatory posteroanterior (PA) mobilization forces to the lumbar spine. Various clinical studies have showed that such manual technique is clinically effective in bringing about short-term pain relief.[9,10] Previous studies demonstrated that mobilization elicited viscoelastic responses such as preconditioning and creep in normative asymptomatic subjects.[11-13] However, the mechanisms underlying the change in pain have not been previously studied.

Previous research frequently showed that the mobility of the lumbar spine was significantly lower in people with LBP.[14-16] These studies provided preliminary evidence that there was a possible relation between pain and stiffness. Most previous studies used a mechanical device to measure the PA force applied and the resulting vertical displacement of the spine at the point of force application. Stiffness was then defined by the ratio of force to the absolute displacement. This definition of stiffness is unacceptable because the recorded spine displacement can be

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influenced by many confounding variables, such as the padding of the plinth and rib cage size, leading to a large error in stiffness calculation.[17,18]

A method of defining PA stiffness has been proposed to address the above limitations so that the mechanism of pain can be appropriately studied.[11,12,19,20] The lumbar spine is considered to be a flexible beam that is subjected to 3-point bending under the application of PA mobilization loads.[11,12,19,20] *Stiffness* is defined as the resistance of this beam to the bending deformation caused by PA mobilization. This definition is consistent with that used in the conventional engineering method,[21] and with previous experimental observation that PA mobilization produced a significant bending of the spine.[19,22] This study examined the immediate effect of PA mobilization on back pain and spine stiffness and the relation between bending stiffness and pain relief after mobilization.

The purpose of this study was to study the pain response of the lumbar spine after the application of PA mobilization load in people with back pain and to examine the relation between the pain response and the bending stiffness of the spine.

Methods

Subjects

Twenty asymptomatic volunteers were recruited from the local community, and 19 subjects with LBP were recruited from a local hospital over a 6-month period. The characteristics of the subjects are summarized in table 1. Symptomatic subjects had back pain as the primary complaint, the pain being of sufficient severity to require medical attention or treatment, but not warranting complete bed rest or hospitalization. They had suffered from LBP for >1 week but <12 weeks. None of the symptomatic participants has reported radicular or referred symptoms in the lower limb.

All asymptomatic subjects recruited had no history of significant LBP or leg pain that might be attributed to the back that had required medical or physical treatment. Subjects were excluded from the study if they had any known contraindication to PA mobilization or had any history of back surgery, fracture, dislocation or any structural defect of vertebral structures, malignancy, or inflammatory or infectious diseases of the spine. The study was approved by the Ethics Committee of the University. Subjects were informed about the experimental procedure and any potential risks prior to the attainment of a written consent form.

Instrumentation

A plinth was mounted onto a nonconductive force plate[a] (4060-NC). Subject received PA treatment while lying prone on this plinth, and this allowed us to measure the PA loads applied to the L4 spinous process of the spine. The motions of the lumbar spine were measured with an electromagnetic tracking system.[b] Sensors were attached to the skin overlying the L1 spinous process and sacrum. The reliability of this measurement system has been reported elsewhere.[20]

List of abbreviations:

CI	**confidence interval**
ICC	**intraclass correlation coefficient**
LBP	**low back pain**
PA	**posteroanterior**

Table 1 Subject characteristics of the asymptomatic and LBP group

Characteristics	Asymptomatic Group	LBP Group
Sample size	20	19
Sex		
Male	13	10
Female	7	9
Mean age (y)	33.4±5.11	39.05±7.39
Mean height (m)	1.66±0.08	1.67±0.09
Mean body weight (kg)	60.0±9.1	63.0±11.5
Mean onset of pain (wk)	NA	5.2±1.8
Mean Roland Morris Questionnaire score	NA	9.5±3.4
Lumbar spine length (from L1 to S2) (m)	0.134±0.024	0.138±0.032
Waist (m)	0.913±0.068	0.945±0.081

NOTE. Values are mean ± SD unless otherwise indicated.
Abbreviation: NA, not applicable.

A pain switch, made of a simple signal pulse generation box, was tailor-made for this study to record the onset of pain. Each subject was instructed to press the button of the pain switch to record any increase in the back and/or leg pain symptoms during the application of the PA load. A signal pulse would then be generated and transmitted to the computer for recording the time of pain occurrence. Because measurements of load, movement, and pain occurrence signals were synchronized, the amount of PA load applied and the corresponding spinal movement at the point of pain increase could then be determined.

Assessment

Subjects with LBP were asked to rate their severity of pain at rest before the PA assessment using a visual analog scale. For all subjects, the active flexion and extension ranges of motion of the subject were assessed in a standing position with the electromagnetic sensors attached before they were requested to lie on the plinth for PA assessment. The lordotic curvature of extension in prone lying was then recorded.

Subjects were then assessed by a single application of the PA load up to a maximum of 250N. This magnitude of force was chosen because our pilot study showed that this was the force that can be tolerated by subjects with LBP. The software developed for this study provided instantaneous display of the force and deformation data on the computer display, and so the physiotherapist was able to precisely control the force applied. Subjects with LBP exhibited the most comparable symptoms when the PA load was applied at the L4 spinous process. Those with other symptomatic spinal levels were excluded from this study. The L4 spinal level was also assessed for the asymptomatic subject. The PA load applied, the lumbar lordotic motions induced, and the occurrence of pain were recorded before, during, and after PA mobilization application. Subjects were instructed to hold breathing and be relaxed during the single PA load application.

Treatment

PA mobilization treatment was given at the L4 level. It was similar to a typical clinical session, involving 3 cycles of large amplitude of