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Original Article

# The treatment effect of hamstring stretching and nerve mobilization for patients with radicular lower back pain

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**Abstract.** [Purpose] In this paper, hamstring stretching and nerve mobilization are conducted on patients with radicular lower back pain, and changes to pain levels, pressure thresholds, angles of knee joint extension, and disorder levels of lower back pain were studied. [Subjects and Methods] The subjects were divided into two groups: one group conducted hamstring stretches and was comprised of 6 male and 5 female subjects, and the other group received nerve mobilization treatment and was comprised of 5 male and 6 female subjects. [Results] Pain level and the disorder index of lower back pain were significantly alleviated after the intervention in both groups. Pressure threshold and angles of knee extension were significantly increased after the intervention in both groups. Comparing the two groups, the alleviation of pain was more significant in the nerve mobilization group. [Conclusion] Patients with radicular lower back pain showed significant differences in pain level, pressure threshold, knee extension angle, and disorder index of lower back pain for both the hamstring stretching group and nerve mobilization group after the treatment. Hamstring stretching and nerve mobilization can be usefully applied for the therapy of patients with radicular lower back pain.

**Key words:** Radicular lower back pain, Hamstring stretching, Nerve mobilization

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## INTRODUCTION

There are various causes of lower back pain, such as innate, traumatic, inflammatory, degenerative, oncotic, metabolic, and organic pain[1)]. In addition, changes to body alignment and continuous movement are acknowledged as general risks of lower back pain[2)]. Changes to muscle flexibility directly affect epidemiologically connected functions of other joints, and decreases of the range of joint movement cause epidemiologic changes that result in disorders of joint functions[3)]. When muscle changes and posture are imbalanced, forward pelvic tilting frequently occurs during the transposition of the pelvis due to the weakened or slack hamstring muscle[4)]. The increase of lumbar curvature while the body bends forward raises the shearing force on the front part of the spine and increases the risk of spinal injury. Decreases of flexibility in hamstring muscles raise the risk of injury because of the epidemiological stress put on the spine during the bending posture[5)]. Since the occurrence of lower back pain increases when lower spine muscles and hamstring muscles contract[6)], hamstring flexibility exercises are good treatment options to alleviate lower back pain[7)].

Neuromuscular status is sensitive to any damage of the vertebral column, and it can especially cause damage to the neck bone or thoracic vertebrae[8)]. The first option of treatment for most patients with lower back pain is typically physical therapy. Rest, medical treatment, injections, nerve blocks, traction therapy, execution of Williams exercise, focused abdominal training, and muscle stretching lead to the alleviation of such pain[9)]. Major causes of pressure on the spine are herniated discs, facet joints, uncovertebral joint osteophytes, and contraction of the spinal nerve hall, which delays blood circulation of neural

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muscles[10]. In general, pain occurs as a result of microvascular change, which is caused by the positive feedback of inflammation in response to pressure[11]. Acute or sub-acute neuromuscular pressure increases neural conduction block, edema in nerves, epidemiologic sensitivity, and sodium channel density[12]. However, Bertolini et al. explained that nerve mobilization decreased adhesion between the edema and the nerve with recovery of neuroepidemiologic sensitivity in their experiments on animals[13].

Clinical viewpoint, nerve mobilization is effective for various musculoskeletal diseases, such as carpal tunnel syndrome, brachial nerve pain in the neck, and lateral epicondylitis[14]; it is therefore being actively researched. In the research of Kim et al., median NM of upper limbs improved the fatigue and pain threshold of biceps[15]. Also, Ha et al. explained that the application of median nerve mobilization of the arms by a therapist led to greater increases in nerve conduction velocity than nerve mobilization that was performed by the patient[16]. In addition, Cha et al. illustrated that nerve mobilization of the lower limbs in stroke patients was more effective for improving lower leg functions than other forms of non-operative physical therapy[17].

Nerve mobilization utilizes methods of imposing tension and utilizing slipping to treat lower back pain[18], and this therapy alleviates and disperses the tension on the nerve[19]. However, few studies have been conducted on its effects in treating radicular lower back pain. Therefore, in this paper, hamstring stretching and nerve mobilization are conducted on patients with radicular lower back pain, and changes to pain levels, pressure thresholds, angles of knee joint extension, and disorder levels of lower back pain were studied.

## SUBJECTS AND METHODS

This research targeted outpatients who were diagnosed with radicular lower back pain at K-Hospital located in Andong-si of Gyeongsangbuk-do under the agreement of their participation in the experiment. Selection criteria was patients between the ages of 20 and 50 who had sought treatment for pain or paresthesia of the lower limbs or pelvis due to a diagnosis of radicular lower back pain. Patients who had surgery or therapy for lower back pain with an active period of pain over three months, as well as patients with other musculoskeletal disorders causing pain, injury, or neurological symptoms, were excluded. A total of 22 subjects participated in the research, and they were randomly assigned to two subject groups. One group conducted hamstring stretches and was comprised of 6 male and 5 female subjects, and the other group received nerve mobilization treatment and was comprised of 5 male and 6 female subjects. Both groups executed basic physical therapy, which included superficial thermal treatment for 20 minutes and interference wave treatment for 15 minutes, before the intervention. All subjects were informed of the purpose and methods of the study, and their consent was approved by the Institutional Review Board of Daegu University (1040621-201702-HR-012-02).

Subjects in the hamstring stretching group bent the hip joint to its maximum range in the lying position and fixed it with a belt; the knee joint was then straightened to as far as the shortened muscle allowed; they maintained these positions for 10 seconds each. The muscle was then stretched to its maximum range for 10 seconds, the subjects were ordered to move into the direction of the stretch, and antagonist muscle stimulation was conducted for 10 seconds. The sets took a total of 40 seconds each and five sets were executed for a subject. After a set, a break of 20 seconds was given, and another set was then executed[20].

Subjects in the nerve mobilization group used the slider method, in which they fixed a side of the head using the sling device while lying on their side. In the starting posture, the neck joint was bent in its normal range without pain, and the hip and ankle joints were then bent. After then the knee and neck joints were straightened generously, the whole process was repeated. The bending was executed in a range that did not cause pain; the patients instead felt a slight pulling. A single rep was set to be 2 seconds, and 20 reps for 40 seconds was defined as a set. After the execution of a set, a break of 20 seconds was given, and 5 sets were executed in total[21]. In addition, the nerve mobilization technique was performed by two physiotherapists qualified with MT or more who were trained in the kaltenborn-evjenth concept. These interventions were conducted three times a week for three weeks for both groups.

To evaluate the effect of the therapy in each group, the visual analogue scale, digital sense, angle of straightened knee, and the index of backache disorder were compared before and after therapy. To measure the level of pain, the visual analogue scale was been applied. On the level of pain for each subject, a painless status was defined as ‘0,’ while unbearable pain was defined as ’10.’ These pain levels were marked by the patients themselves[22]. The change in pain level was reviewed by comparing the pain status before and after executing three weeks of interventions.

The experimental pressure threshold on the gluteus medius caused by radicular lower back pain was measured by the digital algometer in the unit of N/cm$^2$ (JTECH medical Industries Inc., UT, USA). When the pressure was indicated on the screen of the digital algometer, it was numerically marked. The measurement index was 1 cm$^2$, and it was applied on the pressure spot of the gluteus medius. The subjects were lying face down in a relaxed position, and they said “Ah,” when they felt pain during the experiment. The pressure at which subjects felt pain was measured three times, and an interval of a minute was given. The spot was marked to ensure consistency for the next measurement, and the result was concealed to subjects. The measurement reliability of the digital algometer using the interclass correlation coefficient in subject groups was 0.90[23].

The angle of the extension knee, which was influenced by radicular lower back pain, was measured by the goniometer on the spot right above the ankle while subjects lied on their back, maintained the thigh perpendicularly to the ground, and extension the knee[24]. When the lower leg was perpendicular to the ground, the degree of the angle of the bent knee was

Table 1. The general characteristics of the subjects

| | HSG (n=11) | NMG (n=11) |
|---|---|---|
| Age (yrs) | 37.6 ± 4.4 | 36.8 ± 5.6 |
| Height (cm) | 166.2 ± 9.3 | 167.6 ± 8.0 |
| Weight (kg) | 63.4 ± 11.1 | 065.5 ± 15.1 |

Mean ± SD. HSG: hamsring stretching group; NMG: nerve mobilization group

Table 2. Comparison of within and between two group (unit=score)

| Group | | Before | After | Change |
|---|---|---|---|---|
| HSG | VAS | 5.4 ± 0.8 | 2.1 ± 0.7* | –3.3 ± 0.5 |
| | PPT | 14.6 ± 2.9 | 17.3 ± 3.1* | 2.6 ± 1.3 |
| | KEA | 46.3 ± 8.9 | 51.6 ± 9.7* | 5.4 ± 2.1 |
| | ODI | 29.7 ± 8.9 | 17.8 ± 5.1* | –11.9 ± 4.6 |
| NMG | VAS | 5.6 ± 1.0 | 1.4 ± 0.8* | –4.2 ± 0.6† |
| | PPT | 14.5 ± 4.6 | 18.4 ± 3.9* | 3.9 ± 1.4 |
| | KEA | 49.4 ± 10.7 | 55.8 ± 10.2* | 6.5 ± 1.6 |
| | ODI | 26.4 ± 4.9 | 14.2 ± 3.8* | –12.2 ± 2.9 |

Mean ± SD. *$p<0.05$, †Significant difference between groups ($p<0.05$) HSG: hamstring stretching group; NMG: nerve mobilization group; VAS: visual analogue scale; PPT: pain pressure threshold; KEA: knee extension angle; ODI: Oswestry disability index

perpendicular in the beginning posture. As the knee was straightened, the angle increased, and the angle at which subjects could not straighten any more was measured three times. The average value of the measurements was used.

To measure the functional disorder level, the Oswestry Disability Index (ODI) was used. The ODI is composed of 10 items that gauge the pain caused by backache, lifting, sitting, sleeping, social life, personal management, walking, standing, sexual life, and traveling. The painless status is defined as the '0' point, and the worst status of pain is marked by '5' points. Lower points can be analyzed as less influential, and the higher point mean that the pain is more disruptive to daily life. According to the research, the test-retest reliability of the ODI is 0.99, which is very reliable[25)]. Before and after the intervention during the three weeks, a break of 30 minutes was given before the measurement to minimize the influence of fatigue.

The collected data of this research was analyzed by the statistics program SPSS Version 18.0 for Windows (SPSS Inc., Chicago, IL, USA). The differences between before and after intervention were compared with Wicoxon signed-rank tests and differences within a group before and baseline score, change score of dependent variable of were tested using the Mann-Whitney U test. A $p<0.05$ was considered to indicate significance for all analyses.

The significance level ($\alpha$) was set to be 0.05.

## RESULTS

Table 1 shows the general characteristics of the subjects.

Pain level and the disorder index of lower back pain were significantly alleviated after the intervention in both groups. Pressure threshold and angles of knee extension were significantly increased after the intervention in both groups. Comparing the two groups, the alleviation of pain was more significant in the nerve mobilization group; however, the pressure threshold, angle of knee straightening, and the disorder index of lower back pain were not notably different (Table 2).

## DISCUSSION

The most common symptom of targeted patients in this research with radicular lower back pain was a decrease in lower subluxation, which is the angle of knee straightening caused by pain in the pelvis or leg. The original purpose of this research was to compare the influence of hamstring stretching that is generally applied in clinics to the influence of nerve mobilization, which is being newly implemented. Also, the research intended to review the influence of two treatments and the degrees of change in pain levels, knee stretching angle, and disorder index of lower back pain.

Clinically, the measurement of hamstring muscle length is used to measure lower back pain[26)], and the correlation between lower back pain and hamstring muscle length has been explained by the report—patients with lower back pain had significantly decreased hamstring muscle length[27)]. In this experiment, the diagnosis of radicular pain significantly decreased in both groups after therapy was performed. In the case of hamstring stretching, the intervention increased the degraded flexibility of patients with lower back pain to finally alleviate the pain[7)]. The nerve mobilization group showed greater effects from therapy than the hamstring stretching group, which suggests that nerve mobilization decreases the nerve adhesion of patients with radicular lower back pain, blocks the diffusion of harmful substances, and expands the nerve blood vessels[28)].

Pressure threshold define as the minimum (force) required to cause pain. pressure threshold measurements are usually performed over areas of muscle tenderness (sometimes referred to as trigger points) Trigger points, fibrositis, myalgic spots, activity of arthritis as well as assessment of sensitivity to pain can be diagnosed by pressure threshold[29)]. In previous research on pressure threshold's role as an indication of the measurement index of pain, nerve mobilization that was conducted on a patient with lateral epicondylitis led to a significant increase in pressure threshold[30)]. In this research, the hamstring stretching group also significantly increased their pressure thresholds, which also increased in the nerve mobilization group after the intervention. However, there was no significant difference between the groups in pressure thresholds. The application of nerve mobilization to patients with lower back pain decreases the pressure on the peripheral nerve and increases the flexibility, which increases blood flow and nerve conduction velocity[31]. Alleviating muscle fatigue also lessens the pain of the patient[15].

For the knee extension angle, the subjects without lower back pain were more flexible than others with lower back pain[27]. Both maintaining positions and relaxing, as well as static stretching methods, were effective for improving the flexibility of the hamstring muscle[32]. In this research, the flexibility of the hamstring muscle improved after the intervention of the stretching. This suggests that static stretching of the hamstring muscle contributed to the viscoelasticity of the muscle and increased the tolerance to stretching; thus, flexibility was improved[33]. Also, applying the nerve slip and tension methods of nerve mobilization, the same effect of improvements to the knee extension angle was observed[34]. Both Bulter's nerve mobilization and Mulligan's bent leg raise methods for lower back pain show significant improvement in the range of leg lifts, as this research showed. Also, this study showed significant differences before and after the intervention of nerve mobilization treatment. This is because nerve mobilization can alleviate the tension and pressure in neighbor muscles, which improves movement[14]. However, there was no significant difference between the two groups.

For the disorder index of lower back pain, the short period of hamstring stretches for patients with lower back pain significantly decreased the index[35]. The self-execution of nerve mobilization for patients with lower back pain promoted the recovery of nervous tissue by stimulating soft tissues, which increased the adaptability of nerves and decreased the sensitivity, thus alleviating the symptom[36]. In this study, both the hamstring stretching group and nerve mobilization group showed improvement after the intervention. However, there was no significant difference between the two groups.

In this research, 22 patients with lower back pain into hamstring stretching and nerve mobilization groups. Therapy was conducted three times a week for three weeks, and the pain level, pressure threshold, knee extension angle, and disorder index of lower back pain were compared before and after intervention. According to the results, patients with lower back pain showed significant differences in pain level, pressure threshold, knee extension angle, and disorder index of lower back pain for both the hamstring stretching group and nerve mobilization group after the treatment. Comparing the two groups, the nerve mobilization group showed more significant changes in pain level. Hamstring stretches and nerve mobilization are effective interventions for patients with lower back pain, and nerve mobilization is superior to hamstring stretching in alleviating lower back pain of patients. Therefore, both hamstring stretching and nerve mobilization can be usefully applied for the therapy of patients with lower back pain.

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