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Original Article

The effects of self-mobilization techniques for the sciatic nerves on physical functions and health of low back pain patients with lower limb radiating pain

Ui-Cheol Jeong, MS[1)], Cheol-Yong Kim, PT, PhD[2)], Young-Han Park, PT, PhD[3)], Gak Hwang-Bo, PhD[1)], Chan-Woo Nam, PT, MS[1)*]

[1)] *Department of Physical Therapy, College of Rehabilitation Science, Daegu University: 201 Daegudae-ro, Gyeongsan-si, Gyeongsangbuk-do, Republic of Korea*
[2)] *Department of Physical Therapy, Ulsan College, Republic of Korea*
[3)] *Department of Physical Therapy, Korea National University of Transportation, Republic of Korea*

Abstract. [Purpose] This study aimed to examine the effects of self-mobilization techniques for the sciatic nerves on the quality of life in patients with chronic low back pain in the lower limbs accompanied by radiating pain. [Subjects and Methods] The subjects were divided into two groups: a group receiving of lumbar segmental stabilization exercise training including sciatic nerve mobilization techniques, which included 8 males and 7 females, and a group receiving lumbar segmental stabilization exercise training, which included 8 males and 7 females. [Results] There were statistically significant differences in comparison of measurement results between the groups before and after the intervention. [Conclusion] Application of mobilization techniques for the sciatic nerves may promote healing of the soft tissues by stimulating the functions of the nervous system to improve nervous system adaptability and decrease sensitivity, helping to alleviate the symptoms.

Key words: Self-mobilization, Sciatic nerves, Low back pain

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INTRODUCTION

Low back pain is experienced by 80% of the population at least once and is one of the most common causes of visiting a hospital. Such low back pain triggers symptoms of the lower limbs such as radiating pain[1)], and is associated with decrease in strength and flexibility of the lumbar and lower limb muscles[2)]. What is important is that such pain distorts normal signal input into muscles and sensory organs and disturbs postural balance performance, triggers damage to balance maintenance ability, and causes abnormal posture, resulting in an increase in biodynamic stress of the musculoskeletal system[3)]. Previous research reported that low back pain weakened muscle strength of the lower limbs, decreased gait ability, balance ability, and squeeze; triggered sensory decline such as in visual sense; and decreased sensory motor adjustment[4)].

The 4th and 5th lumbar vertebrae and 1st sacral vertebra, where low back pain largely occurs, are neurologically areas where peripheral nerves of the lower limbs pass, and dynamic problems of this area trigger weakening of the muscles of the hip and knee joints due to neurological disability; when this occurs over a long period of time, it triggers changes in vertebrae posture, decreasing joint range of motion and causing joint degeneration, and in order to prevent this, maintenance of appropriate posture and of range of motion through normal muscle tone is important. When muscle are shortened for a long period of time, they trigger muscle atrophy, a reduction in cross-sectional area, a decrease in myomeres, accumulation of connective tissues, and an increase accumulation of fat in the tendons and bring about proliferation of connective tissues within

*Corresponding author. Chan-Woo Nam (E-mail: somamir99@naver.com)

the articular capsule, union between to cartilage surface and connective tissues, atrophy of the cartilage, and malalignment of the ligaments[5], and the resultant abnormal stiffness of the joints and musculoskeletal changes such as restricted range of motion restrict patients' functional movement and movement of the joints[3].

Nerve mobilization techniques have been recently used as a method to adjust radiating pain related to disk disease, and in particular, mobilization techniques for the sciatic nerves improve mobility of the sciatic nerves, decrease mechanosensitivity of the nervous system, and heighten compliance of nerve tissues, relieving low back pain[6]. Through such mobilization techniques, damages to the sciatic nerves may be removed, pain may be alleviated, and range of motion may be increased, and dynamic adaptability of the nervous system may be heightened, helping to patients to use their bodies without resistance. When tension is applied to the nervous system during the mobilization techniques for the sciatic nerves, the cross section of the nerves decreases, and therefore small blood vessels that cross the epineurium are obstructed, thereby adjusting the amount of blood to the nerve fibers. This affects the axonal transport system, and increased flexibility of the shortened nerves and surrounding joint structures leads to increased muscle strength, as improved flexibility of the sciatic nerves decreases mechanosensitivity of the nervous system, which in turn heightens compliance of the nerve tissues[6].

Research on nerve mobilization techniques aimed at treating low back pain in patients with radiating pain has been lacking. Therefore, this study aimed to examine the effects of self-mobilization techniques for the sciatic nerves on the quality of life of patients with chronic low back pain in the lower limbs accompanied by radiating pain.

SUBJECTS AND METHODS

The subjects of this study were patients with low back pain accompanied by radiating pain who were between 30 and 50 years of age and visited J oriental medicine hospital and S hospital. Their pain indexes were three points or higher, Oswestry Disability indexes were more than 20%, and straight leg raise test (SLR) results were between 30 and 70 degrees. They also had no history of surgery in the vertebrae and lower limb joints and no contracture or modification in the lower limb joints. Those who had a history of mental disease, neurological problems other than radiating pain, problems with peripheral blood vessels, and a pathological history of the cervical spine were excluded. Prior to the experiment, a sufficient explanation on the experimental procedures was provided, and all subjects provided written consent to participate in this study. This study was approved by the Institutional Review Board of Daegu University. The subjects were divided into two groups: a group receiving lumbar segmental stabilization exercise training including sciatic nerve mobilization techniques, which included 8 males and 7 females, and a group receiving lumbar segmental stabilization exercise training, which included 8 males and 7 females.

In order to evaluate physical functions and health, the Short-Form 36 Health Survey (SF-36) was used to evaluate the subjects twice, once before the intervention and once six weeks after the intervention. In the 2000s, the SF-36 was used as an inclusive measure of disability including damage to physical function and structure, limitation of activities, and restriction of participation in activities, and recently, it was expanded to use as a measure of a diverse and subjective sense of satisfaction felt by patients.

Therefore, it was expanded to a complex and pluralistic concept of the quality of life, and although there is no agreement on its concept, it is the most frequently used term to express a subjective sense of satisfaction. At present, research on changes in quality of life resulting from treatment and development of scales to evaluate quality of life in relation to a diverse range of diseases is actively being pursued[7]. As a contraction test for health, the SF-36 test of physical and mental symptoms devised by Ware and Sherbourne was recently modified, and eight items and 36 questions are employed in the new version[8].

In the modified version of the SF-36, Physical functions, role limitation-physical, bodily pain, and general perception of physical health are classified into physical health, and social functioning, role limitation-emotion, mental health, and vitality are classified into mental health. The higher the score is, the higher the health level is. The SF-36 has been used in many clinical studies to evaluate treatment effects as a means of measuring the quality of life related to health. In this study, the Korean version of the SF-36 translated and used by Han, Lee, Iwaya, and Kataoka and Kohzuki was utilized[9].

The selected subjects were randomly and equally assigned to the group performing lumbar segmental stabilization exercise including the sciatic nerve mobilization technique (n=15) or the group performing lumbar segmental stabilization exercise (n=15). Treatment was conducted three times per week for six weeks. Based on the fact that the lumbar region segmental stabilization exercise used in this study was effective for coordinated contraction of the multifidus and the transverse abdominis, the training was composed of one exercise using a pressure biofeedback unit, two bridging exercises, and two exercises in a quadrupled position[10], and the neural mobilization technique for relaxation of the sciatic nerves was additionally applied using the three-step methods used by Butler. The patients conducted the exercises by themselves under the supervision of a therapist who was skilled in application of the treatment techniques.

(1) Lumbar Segmental Stabilization Exercise. The patient flexed the hip and knee joints, placed the pressure biofeedback unit under the lumbar vertebra, lied completely relaxed, adjusted the pressure gauge to 20 mmHg, and induced coordinated contraction of the multifidus and transverse abdominis. They increased the pressure to 30 mmHg, held it there while continuing to breathe for 10 seconds, and then decreased the pressure to 20 mmHg and rested for 10 seconds. The patient repeated this motion 20 times.

(2) Sensomotoric exercise 1. The patient got into a quadruped position in which they maintained the neutrality of the

lumbar region and induced coordinated contraction of the multifidus and transverse abdominis. They then triggered retroversion of the pelvis and slightly pushed on a ball.

(3) Bridge 1. The patient flexed the knee joint to 90 degrees and, in a prone position, placed both hands on the abdomen, maintained a neutral position of the lumbar region, and raised the pelvis from the floor.

(4) Sensomotoric exercise 2. The patient induced coordinated contraction of the multifidus and transverse abdominis while maintaining neutrality of the lumbar region in a quadruped position, triggered retroversion of the pelvis, and slightly raised both knees.

(5) Bridge 2. The patient completely flexed one knee and the hip joint and maintained them toward the chest and held the other knee with both hands, lied in a supine position, maintained neutral posture of the lumbar region, raised the pelvis from the floor with the other hip and knee joints flexed at 90 degrees.

(6) Raising the opposite arm and leg in a quadruped posture. In a quadruped position, the patient slowly raised the opposite arm and leg with the neutrality of the lumbar region maintained. For exercise (2) to (6), the patient maintained respiration constant for six seconds and then took a rest for 10 seconds. The patient repeated this motion 15 times. These five exercises were repeated in a circular form for a total of three sets.

Mobilization techniques to relax the sciatic nerves were performed by the patient on his/her own under the supervision of the therapist. The first step was for the patient to extend the knee joint only to the range of pain. The second step was for the patient to extend the knee joint to the range of no pain and to flex the top of the foot within the range of no pain. The third step was for the patient to extend the knee joint to the range of no pain and to flex the top of the foot within the range of no pain and flex the neck. As the steps progressed, the tension of the sciatic nerves heightened, and the neck flexion in the third step was used as a method to induce maximal tone of the nerves; all the steps were applied to the lower limb with radiating pain[11].

Statistical analysis of all the data collected in this study was performed with PASW Statistics for Windows, Version 18.0. For the subjects' general characteristics, means and standard deviations were calculated using descriptive statistics, and as normality tests, the Kolmogorov-Smirnov test and Shapiro-Wilk test were performed. According to the results of the normality tests, physical functioning (PF) and general health (GH) were normally distributed, and in order to analyze differences between the groups according to group homogeneity and exercise, the independent t-test was used; differences in each group according to period were analyzed with the paired t-test.

RESULTS

The general characteristics of the subjects were shown in Table 1. The results of measuring PF of the group that received lumbar segmental stabilization exercise including self-mobilization techniques for the sciatic nerves showed that PF was 17.7±3.5 before the intervention and 25.1±3.3 after the intervention and that GH was 12.6±3.0 before the intervention and 19.0±4.1 after the intervention, and the differences were significant ($p<0.05$). In the lumbar segmental stabilization exercise group, the results showed that PF was 17.3±5.3 before the intervention and 20.3±6.5 after the intervention and that GH was 15.8±2.8 before the intervention and 16.6±3.4 after the intervention, and the differences were significant ($p<0.05$) (Table 2). There was a statistically significant difference in measurement results between the groups before and after the intervention ($p<0.05$) (Table 3).

DISCUSSION

This study was conducted to determine if additional application of self-mobilization techniques for the sciatic nerves has positive effects on pain and physical and mental activities in low back pain patients. The results showed was that physical health indicators such as physical functioning, physical role restriction, general health, and physical and mental health indicators such as physical role restriction, social functions, vitality, and mental health were statistically significantly higher in the group to which mobilization technique for the sciatic nerves were applied than in the classical lumbar segmental stabilization group.

This is the result of pain transmission nerve fibers related to nerve tissue inflammation and functional disability being relieved, adaptability of peripheral nerves being increased, and nerve pressure, excessive friction, and tone being alleviated[12]. The increase in adaptability of peripheral nerves led to a decrease in hypoxia by edema within the nerves[13] and alleviation of scar tissues compression in the nervous tissues, directly decreasing pain[14]. This result is consistent with the results of a study by Cleland et al.[11] on chronic low back pain patients, in which the subjects were divided into a lumbar spine mobilization and exercise group and a lumbar spine mobilization, exercise, and slump stretching group and there were positive outcomes in numeric pain rating scale (NPRS), Oswestry Disability Index (ODI), and centralization of symptoms. It is also consistent with the results of a study by Kavlak & Uyaur[15], who applied a nerve mobilization technique to carpal tunnel syndrome patients and obtained positive outcomes in pain, range of motion, and a sensory test.

In relation to lumbar intervertebral disk diseases, traditional lumbar stabilization training has recently been performed with a main focus on promotion of muscular functions and nerve root adjustment. The techniques to mobilize sciatic nerves have been used as a method to verify dynamic sensitivity of the nerves and whether this is neuritis, and like the study of Cleland et al.[11], there have been many studies that have applied indirect nerve system mobilization to chronic low back pain

Table 1. The general characteristics of the subjects

	SSNMG (n=15)	LSEG (n=15)
Age (yrs)	35.1±6.4	41.6±11.1
Height (cm)	168.6±7.6	166.0±7.2
Weight (kg)	68.6±7.6	61.5±7.3

SSNMG: self-mobilization of the sciatic nerve group; LSEG: lumbar stabilization exercise group

Table 3. Comparison of PF and GH between the groups (unit: score)

	SSNMG	LSEG
PF	−7.4 ± 4.2	−3.0 ± 4.5*
GH	−6.4 ± 3.5	−0.0 ± 1.4*

*p<0.05
SSNMG: self-mobilization of the sciatic nerve group; LSEG: lumbar stabilization exercise group; PF: physical functioning; GH: general health

Table 2. Within-group comparison of PF and GH between before and after the intervention (unit: score)

		Before	After
SSNMG	PF	17.7 ± 3.5	25.1 ± 3.3*
	GH	12.6 ± 3.0	19.0 ± 4.1*
LSEG	PF	17.3 ± 5.3	20.3 ± 6.5*
	GH	15.8 ± 2.8	16.6 ± 3.4*

*p<0.05
SSNMG: self-mobilization of the sciatic nerve group; LSEG: lumbar stabilization exercise group; PF: physical functioning; GH: general health

patients without radiating pain in the lower limbs. However, a few studies have indicated that nerve system mobilization techniques improve adaptability of the nerves and dynamic adaptability and have positive effects that decrease pain and increase range of motion and reported them as methods of treating low back pain. When low back pain continues for longer than six months, it is classified as a disease with restriction of muscle strength, endurance, flexibility, and range of motion and as one with neurological problems that are secondarily expressed[16].

Universally degenerative changes in joints and muscles and musculoskeletal problems occur with agoing, and Pinar et al.[17] noted that functional weakening and sciatic nerves pain in low back pain patients may become a major factor triggering tension of the hamstrings and that the resulting decrease in flexibility of the hamstrings may affect radiating pain. Therefore, this study utilized the SLR as an evaluation index and made efforts to exclude to a maximal extent problems caused by musculoskeletal degeneration. In addition, when mobilization techniques for the sciatic nerves are applied, movement and extension of the hamstrings are triggered, relieving stimulation of the sciatic nerves, reducing radiating pain in the waist and distal part of the lower limbs, and having a positive effect that increases the flexibility and adaptability of the sciatic nerves[18].

Therefore, classical treatment methods and spinal mobilization techniques are important in therapy to decrease the mechanical stress caused by restriction of the range of motion of the hip joint or sacroiliac joint due to an increase in tension of the hamstrings resulting from stimulation of the sciatic nerves, but it is desirable to improve the causes through direct neural mobilization[19]. Therefore, mobilization techniques for the sciatic nerves recommended as a therapeutic method for patients with chronic low back pain accompanied by radiating pain reduce the burden on the waist by increasing flexibility as a result of extension of the hamstrings and triggering good results that reduce oversensitivity and stimulation of the sciatic nerves caused by radiating pain in the lower limbs[20]. These techniques are therapeutically recommended for patients with low back pain accompanied by radiating pain. However, diagnosis of whether radiating pain in the lower limbs is caused by stimulation of the sciatic nerves is important among others, and the effects of radiating pain on functional activity of the body, muscular activity, and physical balance should be studied further.

In conclusion, this study was conducted to examine the effects of application of mobilization techniques for the sciatic nerves for six weeks on PF and GH in low back pain patients. According to the study results, application of the traditional lumbar segmental stabilization exercise with mobilization techniques for the sciatic nerves improved the functions and health of the subjects. Application for the mobilization techniques of the sciatic nerves may promote healing of the soft tissues by stimulating the functions of the nervous system to improve nervous system adaptability and decrease sensitivity, helping to alleviate symptoms. This method may be selectively recommended for patients with low back pain accompanied by radiating pain.

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