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Effects of Sciatic Nerve Mobilization on Pain and Lower Back Isometric Muscle Strength in Female Patients in their 40s with Lumbar Radiculopathy

The Purpose of this study was to determine the effects of sciatic nerve mobilization on pain and lower back muscle strength in female patients in their 40s who have been diagnosed with lumbar radiculopathy. Using a simple blinded method, 20 female patients with neuropathy in the nerve segments between L4-S1 were randomly divided into one group (n=10) that would undergo sciatic nerve mobilization, and another group (n=10) that would perform lower back segment stabilization exercises. The two groups attended 3 sessions per week, with each session taking 30 minutes, for a duration of 4 weeks. In the preliminary examinations, the pain index as well as the isometric muscle strength of the lower back extensor and flexor muscles were measured. After the passing of 4 weeks. The same method of measurement was used for the concluding examinations. Comparison of the pain indices in the two groups revealed that they both experienced a statistically significant decrease, and further inspection revealed that the there was a more substantial difference in the sciatic nerve mobilization group. Results of comparing changes in the Isometric Muscle Strength lower back muscle and bending muscle by group, In comparison between groups, the isometric strength of the lower back extensor showed a more significant difference in the sciatic nerve mobilization group (p <.05). Conclulsion, it can be inferred that application of sciatic nerve mobilization has a positive effect on the pain index and isometric muscle strength of the lower back in female patients with lumbar radiculopathy in their 40s.

Key words: *Sciatic Nerve Mobilization; Pain; Lower Back; Muscle Strength; Lumbar Radiculopathy*

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INTRODUCTION

80% of the total population experiences lower back pain at least once in their lifetime and it remains one of the most common reasons for hospital visitation. Lower back pain often begins through herniation of the nucleus pulposus in the lumbar vertebrae, which eventually leads to radiating pain in the lower appendages and other similar symptoms [1]. Whilst there is research being conducted on the diagnosis of anatomical mutation and effective treatments relating to the origin of radiating pain in the lower appendages that result from herniation of the lumbar nucleus pulposus, there still remain many patients who suffer from such pain. From an industrial society's perspective, the decline in quality of life, exceeding expenditure on medical fees due to prolonged hospital visits, absence from work, and functional disability are leading to the emergence of crucial socio-economic problems [2,3]. Investigation of previous research reveals that pain resulting from spinal disorders occur in the form of physical problems such as radiating pain in the lower appendages, pain during rest following exercise, reduction in muscle strength and joint range of motion, as well as muscle asymmetry on both the left and right sides [4]. When comparing a patient with lower back pain with a healthy individual, reduced use of the gluteus muscles are observed during performance of hip balancing exercises whilst standing [5]. Also, postural imperfections lead to difficulty in adjustment during changing circumstances, inducing further imbalance in the body [6]. Furthermore, in the addition of body weight, the burden on the ankle region is increased [7]. It has been reported that if these symptoms are prolonged for a length of time, muscle strength in the lower appendages will weaken, ability to walk will become reduced, balance will become poor, grip strength will decline, sensory functions such as eyesight will fade, and proprioceptive control will also decrease [9]. If shortened muscle is sustained for a significant time period due to such postural imbalance, muscle atrophy, sectional reduction, sarcomere reduction, accumulation of connective tissue, increased accumulation of fat in the tendons, multiplication of connective tissue within the joints, adhesion of the joint surface to the connective tissue, reduction of cartilage, and misalignment of ligaments is reported to occur [10]. The resulting abnormal stiffness in the joints and musculoskeletal mutation such as restricted joint range of motion, presents restraints not only to the movement of the joints but also to the functional movement of the patient [10]. The mechanical effect appearing in the peripheral nerves also influence the central nervous system and as such, the mechanosensitivity of the nerves can be reduced, whilst the nerve compliance is heightened in order to enhance mechanical adaptiveness for the purpose of decreasing pain and increasing the joint range of motion [11]. The therapeutic mechanism behind nerve mobilization lies in enhancing the axonal transport systems, through which there is stimulation of the nerve conduction velocity as well as reduction in pressure within the nerve which also increases blood circulation to the nerve; this suggests a close relationship with the restoration of the soft tissue including the muscle and nerve as well as a direct correlation between the reduction of pain to the decrease in scar tissue within the nerve tissue [12]. In accordance, Maitland reported effective alleviation in inflammation of the nerve tissue and functional disability of the nerve fibers that transmit pain [13]. As such, this study aims to identify the effects of sciatic nerve mobilization on the pain index and isometric muscle strength of the lower back in female patients with lumbar radiculopathy.

METHODS

Subjects

This subjects of this study involved female patients that were in their 40s suffering from neuropathy in the lower back between L4-S1. Participation required the full understanding of the nature of the research as well as written consent. Further details regarding the clinical requirements included the following: a medical diagnosis of at least 3 months, suffering from severe pain (Visual Analogue Scale of 3~7 points), a middle range in the Oswestry Disability Index (21%~40%) [14], a 20~60° range in the straight leg test, no medical history of spinal surgery or surgical intervention on the joints of the lower appendages, and no growth or mutation in the joints of the lower appendages. After conducting the preliminary examinations, 10 individuals were randomly assigned to the sciatic nerve mobilization group and another 10 individuals were assigned to the lower back segmental stabilization exercise group for a total number of 20 participating subjects. This study excluded patients with psychological, radial, nervous, peripheral blood vessel, and cervical disorders. The physical characteristics of the subjects are displayed in 〈Table 1〉.

Table 1. The general characteristics of the subjects

	SNMG(10 people)	LBSSG(10 people)	t	p
Age(yrs)	45.87 ± 6.94	45.93 ± 5.66	-.029	.977
Height(cm)	168.33 ± 7.17	168.60 ± 6.61	.374	.711
Weight(kg)	68.80 ± 8.80	68.40 ± 8.11	.129	.898
BMI	23.40 ± 2.67	23.44 ± 2.38	-.039	.969

SNMG : Sciatic nerve mobilization group, LBSSG : Lower back segmental stabilization exercise group, BMI : Body mass index

Experiment Design

In order to analyze the effects of sciatic nerve mobilization on pain and isometric muscle strength in the lower back muscles before and after the intervention, the experiment design included 20 female patients in their 40s with lumbar radiculopathy residing in the Ulsan region. The sciatic nerve mobilization group acted as the control group and consisted of 10 subjects. The single blinded method was used and the study lasted for a duration of 4 weeks with the frequency of 3 sessions per week and each session lasting 30 minutes. Concluding examinations took place after 4 weeks in an identical manner to the preliminary examinations.

Experiment Procedure and Measurement Method

Pain Index

A modified Visual Analogue Scale was used in order to ensure a clinical analysis of the degree of pain and increase the reliability as well as objectivity of the measurement of the pain index [15]. Notation of the pain felt by the patient on an unmarked straight line, 10 cm in length, was used and the distance from the starting point was measured. The length was then converted into a point system of 0 to 10, where 0 signified the absence of pain and 10 signified severe pain. As this method allowed subjects to express their pain with a high degree of conformity, the reliability of the method of pain measurement was r=.76–.84 [16].

Isometric Muscle Strength of Lower Back

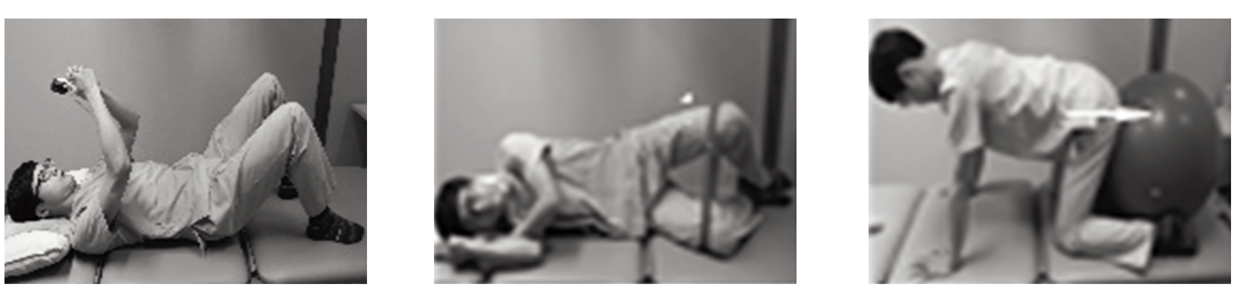
The M3 Muscle Strength Measurement Device (Schnell, Germany) was used in order to evaluate the isometric muscle strength of the flexor and extensor muscles in the lower back. Subjects were made to sit on the chair of the M3 Muscle Strength Measurement Device while the pelvis and legs were strapped down to eliminate movement, ensuring measurement of the isometric muscle strength occurring purely at the flexor and extensor muscles in the lower back for a duration of 5 seconds. All tests consisted of a 1 minute resting period after a measurement, for a total of 3 measurements, from which an average value was extracted for use.

Fig 1. Application program by groups

Sciatic nerve mobilization group

Step 1 | Step 2 | Step 3

Lower back segmental stabilization exercise group



PBUE | GME | ECE

Exercise Program

The sciatic nerve mobilization technique used in this study consisted of a 3 step method in which the patient self performed under the direction of a physiotherapist [11]. Continuance from level 1 to level 3 increased the tension on the sciatic nerve with the performance of neck flexion in level 3 maximizing the tension all levels were applied to the lower appendages where there was radial pain [17]. Used during the lower back stabilization exercise based on evidence of the effectiveness of the co-contraction of the multifidus and transversus abdominis the pressure biofeedback unit (PBUE) [18,19], the cooperative exercise (FCE) from the quadruped posture, as well as the gluteus medius muscle (GME) endurance exercise are all displayed in 〈Fig 1〉. All programs lasted for a duration of 4 weeks with 3 session taking place per week.

Data processing

The SPSS Statistics 20.0 software was used to calculate the average as well as standard deviation of the physical characteristics and variables of each group. The Kolmogorov-Smirnov test was employed for the normality test of the collected data and the independent t-test was used in order to assess the homogeneity of the physical characteristics for each group. For the pain indices within both groups, the Wilcoxon signed rank test was applied to analyze differences according to the time period before and after intervention in each group. The differences in pain indices between the two groups was analyzed using the Mann-Whithey U-test. After normal distribution, analysis of the difference in isometric muscle strength of the back muscles before and after the intervention for each group was done using the corresponding sample t-test while the independent sample t-test was used to analyze the differences between the two groups. Furthermore, the magnitude of the effect was calculated for each group before and after the intervention. All statistical significance levels were set to $p<.05$.

RESULTS

Changes in the Visual Analogue Scale

The results of the groups before and after the intervention appear as follows in 〈Table 3〉. In the experimental group, the pain scale value was 5.20 ±1.27 before the intervention and after 4 weeks, decreased to 2.07±0.45, while in the control group, the pre-intervention value was 5.00±1.07 and the post-intervention value was 3.93±1.06. Both groups showed statistically significant changes ($p<.05$). Furthermore, 〈Table 4〉 displays the comparison of the two groups with the experimental group exhibiting a large difference of 3.1 ±1.25. Both groups displayed a statistically significant change ($p<.05$).

Table 2. Comparison of VAS between pre and post value for the two groups

Group	Pre-intervention	Post-intervention	Z	p	effect size
SNMG	5.20 ± 1.27	2.07 ± 0.45	-4.142	.000*	0.85
LBSSG	5.00 ± 1.07	3.93 ± 1.06	-3.535	.000*	0.44

* : Wilcoxon signed rank test, p<.05 SNMG : Sciatic nerve mobilization group, LBSSG : Lower back segmental stabilization exercise group

Table 3. Comparison of VAS within pre and post value difference in each groups

	SNMG	LBSSG	Z	p
VAS	-3.13 ± 1.25	-1.07 ± 0.88	-4.779	.000*

* : Mann-whitney U-test, p<.05 SNMG : Sciatic nerve mobilization group, LBSSG : Lower back segmental stabilization exercise group

Changes in the Isometric Muscle Strength of Lower Back

The results of the two groups before and after the intervention are as appears in 〈Table 5〉. The flexor muscles in the experimental group were found to be 61.23±22.68 pre-intervention and 88.36±34.67 after the 4 weeks demonstrating a statistically significant difference (p〈.05). In the control group, the flexor muscles before the intervention were 60.27±19.07 and 90.55±23.40 after the 4 weeks, displaying a statistically significant difference (p〈.05). The extensor muscles in the control group pre-intervention were 75.86±16.08 and 104.23±35.58 post-intervention displaying a statistically significant difference (p〈.05).

Furthermore 〈Table 6〉 depicts the comparison between the groups, with the flexor muscles in the experimental group displaying a difference of 46.50±28.19, both groups displaying statistically significant changes (p〈.05), and the results of the comparison of the flexor muscles between the two groups failing to display a statistically significant difference (p〉.05).

Table 4. Comparison of IMS between pre and post value for the two groups

Group		Pre-intervention	Post-intervention	t	p	effect size
SNMG	Flexor Muscle	61.23 ± 22.68	88.36 ± 34.67	-3.652	.000*	-0.42
	Extensor Muscle	75.00 ± 20.28	121.50 ± 40.51	-7.736	000*	-0.58
LBSSG	Flexor Muscle	60.27 ± 19.07	90.55 ± 23.40	-4.579	.000*	-0.57
	Extensor Muscle	75.86 ± 16.08	104.23 ± 35.58	-4.854	000*	-0.45

* : p〈.05, SNMG : Sciatic nerve mobilization group, LBSSG : Lower back segmental stabilization exercise group

Table 5. Comparison of IMS within pre and post value difference in each groups

	SNMG	LBSSG	t	p
Flexor Muscle	27.81 ± 18.33	22.86 ± 11.49	1.074	.876
Extensor Muscle	46.50 ± 28.19	28.36 ± 27.40	2.167	.036*

* : p〈.05, SNMG : Sciatic nerve mobilization group, LBSSG : Lower back segmental stabilization exercise group

DISCUSSION

According to O'Sullivan, lower back pain is a direct result of the human body's endless adaption to reacting against gravity, and as such this disorder is frequently encountered in the clinical setting which accounts for tremendous expenditure of time and resources relating to examinations, management, and treatment [20]. Such cases of lower back pain leads to reduced endurance, decreased flexibility, and limitation in the range of motion of the waist [21]. Furthermore, the inflow of normal signals from the muscles and other sensory organs become distorted, inhibiting balancing capabilities [4], and damage to the intervertebral discs in the spinal column cause neuralgia, leading to symptoms such as the weakening of muscles as well as loss of sensation in the dermatome [22]. As such, limitations are brought to performing functional and professional activities which not only reduce the quality of life but causes socioeconomic loss, making the prevention of back pain through appropriate interventions a societal problem of importance [23]. Furthermore, pain, structural damage, and suppression of reflexive muscle contractions reduces the overall activity of the body; the prolonged inactivity and disuse leads to muscle atrophy and muscle reduction causing further severity in lower back pain, secondary damage to the spinal column, as well as disability [24]. Conservative methods of physiotherapy for treatment of lower back pain using instruments has included bedding stability, heat, ultrasound therapy, and electrical stimulation while other methods have included traction therapy, joint mobilization, manual adjustment, massage, and exercise therapy [25]. The primary treatment goal for patients who have radiating pain accompanying their lower back pain is through the initial recovery of everyday life by improving the loss of dermatome sensation and the weakness in muscle caused by pressure damage to the peripheral nerves resulting from damage to the intervertebral disc [4]. If radiating pain persists for a significant length of time, the weight distribution of the affected lower limb, which is symptomatic, is reduced along with the protective side of the vertebrae, resulting in a change in the weight distribution due to the lowering of the body balance ability of the lower limbs and causing problems to the gait [22]. Nerve mobilization is a part of manual therapy which restores the mobility of the joints and consequently facilitates the smooth supply of nutrition as well as preventing symptoms from easily recurring [26]. As a rehabilitative treatment, nerve mobilization is also applied with the aim of reducing pain which utilizes the proprioceptive senses from joint movement to stimulate the normal firing of nerve impulses, which then precede the recognition of harmful stimuli [26]. There are safe and effective approaches to address issues that may result from before or after intervertebral disc surgery such as adhesion of the nerve to the intervertebral disc, adhesion of the nerve to other tissues, compression, nerve sensitization, nerve conduction problems, nerve entrapment syndrome, narrowing of the intervertebral foramen, as well as muscle weakness caused by nerve ischemia and as such, many physiotherapists throughout the globe have implemented traditional lower back pain treatments that emphasize stabilization through training that promotes muscle function and exercises that benefit neuromuscular control [27]. While the subjects were not alike to those in this study, recent nerve mobilization techniques have been introduced as an effective treatment method for improving pain and joint range of motion by enhancing the plasticity and mechanical adaptability of the peripheral nerve tissue [11]. In a study that examines the increase in range of motion within the nervous system through application of manual elongation conducted by Akalin et al. patients with carpal tunnel syndrome were reported to have experienced pain relief, as well as improvement in function after having been treated with splints and performing elongation self-exercises at home [28]. Ekstrom and Hodden also reported a 30% decrease in the necessity of carpal tunnel surgery in patients with lateral pain in the elbow after implementing nerve mobilization techniques [29]. Effective pain alleviation has also been reported in pain resulting from nerve tube syndrome of the ulnar, radial, and sciatic nerve [30]. This study divides 20 female patients with lumbar radiculopathy in their 40s into a sciatic nerve mobilization group and a lower back stabilization exercise group, in order to ascertain the effects on the visual analogue scale as well as the isometric muscle strength of the flexor and extensor muscles of the back. A comparative analysis was performed on the changes that each group experienced before and after the intervention.

Inspection of previous studies such as Jeong et al. indicated a statistically significant improvement in the quality of life for 30 patients with chronic lower back pain that received sciatic nerve mobilization techniques for a 6 week period [3]. Gile et al. also reported a statistically significant decrease in the visual analogue scale as a result of spinal manual therapy on patients with chronic lower back pain [30]. Similarly, Lee In Hak as well reported a statistically significant decrease from patients with acute lower back pain in all groups – the joint mobilization group, transcutaneous electrical nerve stimulation group, and the active elongation exercise group – with the joint mobilization group displaying the most prominence in effectiveness [31].

The results of this study exhibited a statistically significant decrease of the visual analogue scale in both groups after the intervention and comparison of the two groups revealed that the sciatic nerve mobilization group had a more positive effect as evidenced by a higher statistical significance in change. This result is similar to that of the research conducted by Jeong Han Seok, which involved patients with chronic lower back pain treated with manual spinal correction for 4 weeks [32], as well as the research conducted by Jo Sung Hak which applied lower back stabilization exercises and manual therapy for a duration of 4 weeks to 48 patients with chronic lower back pain [33] While according to Johannsen et al. humans consist of a relatively equal distribution of both type I and type II muscles, much anatomical research on the bones of the pelvis and back attest a rather high ratio of type I fibers in the multifidus and erector spinae muscles [34]. Recent research conducted by Yoshihara et al. compared the living tissue of the multifidus muscle on both sides of the spine between the L4~L5 region in patients with herniation of the intervertebral disc in the lower back, which revealed that the average size of the type I and type II muscle fibers were significantly smaller on the injured side of the vertebral level than the uninjured side [35]. Furthermore, McGill concluded that the weakening of the muscles around the spinal column, causes exercise levels to fall and muscle size to shrink [36]. This disuse of muscle due to pain causes atrophy and even without pain, muscle atrophy could emerge due to the suppression of the α motor neuron activity, which commands the muscle, caused by afferent stimulus to the damaged area as a result of the suppression of reflexive muscle contractions [36]. Examination of a study conducted on patients with chronic lower back pain by Lee Jung Min reported that, after dividing 14 patients with herniated intervertebral discs into a lower back stabilization exercise group and a sling exercise group for a duration of 8 weeks, the muscle strength of the extensor muscles of the lower back had increased with statistical significance, resulting in effectively reducing the restrictions on everyday life [37]. Lee Jwa Geun divided 40 patients with herniated intervertebral discs into an isotonic exercise group and a combined exercise group for a duration of 12 weeks, with the post-intervention results revealing that the muscle strength of the extensor muscles had increased with statistical significance at a total of 7 different angles of hip flexion – 0°, 12°, 24°, 36°, 48°, 60°, and 72° [38]

In the results of this study, both groups displayed a statistically significant increase in the isometric muscle strength of the flexor muscles in the lower back after the intervention. Comparison between the groups revealed that there was no statistically significant difference in the isometric muscle strength of the flexor muscles in the lower back, however, the sciatic nerve mobilization group did demonstrate a relatively higher statistical change. While there was no statistically significant change in the isometric muscle strength of the flexor muscles of the lower back, since the sciatic nerve mobilization group still experienced a greater increase in muscle strength, it can be inferred that the sciatic nerve mobilization group had a more positive effect in increasing isometric muscle strength. As such, it is thought that the application of direct treatment methods such as nerve mobilization – which obtains mobility through improving joint and nerve system limitations – improves abnormal movement of the nerves within the vertebral joints, effectively reducing pain with more positive effect. Similar research regarding the management of pain and use of stabilizing exercises is necessary.

This study remains limited in its ability to popularize the results of the research due to the insufficient number of subjects recruited into the experiment. Furthermore, restrictions on the personal physical training activities and other sought out treatments of the subjects were not able to be placed on an individual basis.

CONCLUSIONS

This study was conducted in order to identify the effects of sciatic nerve mobilization on pain and the lower back isometric muscle strength in female patients with lumbar radiculopathy in their 40s.

Combining the results of this study, both groups displayed a statistically significant decrease in the visual analogue scale after the intervention, and upon further comparison between the two groups, the sciatic nerve mobilization group displayed an even more notable difference. Examination of the changes regarding the isometric muscle strength of the flexor and extensor muscles of the lower back within each group displayed a statistically significant increase. Comparison between the two groups indicated that while the sciatic nerve mobilization group experienced a more notable change in the isometric muscle strength of the extensor muscles, there was no statistically significant change observed between both groups regarding the isometric muscle strength of the flexor muscles. However, the sciatic nerve mobilization group did experience a substantial increase in muscle strength of the flexors.

Based on these results, it can be inferred that application of sciatic nerve mobilization has a positive effect on the pain index and isometric muscle strength of the lower back in female patients with lumbar radiculopathy in their 40s. As such, sciatic nerve mobilization may contribute to the establishment of a treatment model that can provide a swift recovery towards everyday life and economic activity, which in turn positively affects the improvement of quality of life.

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