Efficacy of Neural Mobilization in Treatment of Low Back Dysfunctions

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Abstract: The study was conducted to investigate the effect of lumbar mobilization techniques and neural mobilization technique on sciatic pain, functional disabilities, centralization of symptoms in patients, latency of Hoffmann reflex, and of degree of nerve root compromise in chronic low back dysfunction (LBD). Pre-test post-test group design has been used. Sixty patients with chronic (LBD) from both sexes were involved, aged between 30 – 60 years. They were divided into two equal groups, Group (A) received lumbar spine mobilization and exercise intervention and Group (B) received Straight leg raising stretching (SLR) in addition to lumbar mobilization and exercise. Self-report measures included a body diagram to assess the distribution of symptoms, numeric pain rating scale (NPRS), modified Oswestry Disability Index (ODI), Patients recorded the location of their symptoms on the body diagram to determine the extent to which centralization occurred after treatment, The results of study revealed that: there was a significant difference between both groups on pain ($p = 0.006$), functional disabilities improvement (0.001), location of symptoms ($p = 0.083$) and sciatic nerve root compression ($p = 0.035$). However there is no significant Differences in H-reflex latency ($p = 0.873$) between group A and group B (post test). It is concluded that straight leg raising (SLR) stretching may be beneficial in the management of patients with LBD. SLR stretching in addition to lumbar spine mobilization and exercise was beneficial in improving pain, reducing short-term disability and promoting centralization of symptoms in this group of patients.

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Key words: Chronic low back dysfunction, Straight leg raising (SLR) stretching, lumbar mobilization, H-reflex latency.

Introduction

Lumbar-spine disorders rank fifth among disease categories in the cost of hospital care and account for higher costs resulting in absent from work and disability than any other category [(1)]. Disability associated with low back dysfunction (LBD) continues to rise, contributing to a substantial economic burden that exceeds nearly 50 billion annually in the United States alone. Health care expenditures among individuals with LBD are also 60% greater than those without LBD with 37% of the costs a direct increase of physical therapy services [(2)]. Physical therapists utilize a wide range of interventions in the management of LBD; however, evidence for the effectiveness of these interventions is limited [(3)]. Intervention in patients with a disease requires that the intervention has to be more beneficial, safer, and cost-effective compared with the untreated natural history. Intervention should occur after accurate diagnosis and consideration of prognostic findings. This dilemma is particularly important in patients with low back dysfunction (LBD) with or without radiculopathy [(4)].

The SLR test is frequently used in the assessment of patients presenting with lumbar spine dysfunction and is one of the few indicators that has been shown to identify the degree of impairment from LBD" Furthermore, it has been suggested that improving the range of SLR has a beneficial effect in restoring normal movement and reducing the degree of impairment due to low back dysfunction [(5)]. Unfortunately, there is no research evidence to support these conjectures. The movement of SLR induces posterior pelvic rotation and thereby flexion of the lumbar spine as well as flexion of the hip. The study was conducted to investigate the effect of lumbar mobilization techniques and neural mobilization technique (SLR stretch) and on sciatic pain, functional disabilities, centralization of symptoms in patients, latency of Hoffmann reflex, and of degree of nerve root compromise in chronic LBP with lumbar radiculopathy (sciatica).

Subjects

Sixty patients with chronic (LBD) from both sexes were involved, aged between 30 – 60 years. They were divided into two equal groups, Group (A) received lumbar spine mobilization and exercise intervention and Group (B) received Straight leg raising stretching (SLR) in addition to lumbar mobilization and exercise. Patients were required to have symptoms that referred distal to the buttocks, reproduction of the patient's symptoms with straight leg raise testing, no change in symptoms with lumbar flexion or extension, and a baseline Oswestry score greater than 10%. Patients with ‘‘red flags’’ for a serious spinal condition (e.g. infection, tumors, osteoporosis, spinal fracture, etc.) were excluded. Also patients who were pregnant, has a history of spinal surgery, positive neurologic signs or symptoms suggestive of nerve root involvement (diminished upper or lower extremity reflexes, sensation to sharp and dull, or strength), osteoporosis, or exhibited a straight leg raise (SLR) test of less than 45° were also excluded.

Design of the study:

The design of study was pre-test post-test group design with dependant variables were pain level, functional disabilities, amplitude of Hoffmann reflex, and degree of nerve root decompression, The independent variables were neurodynamic techniques, and lumbar mobilization.

Instrumentation

1- Magnetic resonance imaging (MRI):

Magnetic resonance imaging (MRI) was used to measure degree of nerve root compression by disc herniation using grading system. The system was used in grading compromise of the intraspinal extradural lumbar nerve root consists of four grade categories. Grade 0 (normal): No compromise of the nerve root is seen. There is no evident contact of disk material with the nerve root, and the epidural fat layer between the nerve root and the disk material is preserved. Grade 1 (contact): There is visible contact of disk material with the nerve root, and the normal epidural fat layer between the two is not evident. The nerve root has a normal position, and there is no dorsal deviation. Grade 2(deviation): The nerve root is displaced dorsally by disk material. Grade 3(compression): The nerve root is compressed between disk material and the wall of the spinal canal; it may appear flattened or be indistinguishable from disk material [(6)].

The main reason for MRI referral of patients with chronic radicular pain below the knee without a history of neoplasm, infections, or other rare abnormalities is to distinguish between patients with and without herniated disks. This distinction requires accurate imaging because small herniations can be difficult to detect. The accuracy of MRI for predicting the presence of disk herniations at surgery is relatively high (varying from 76% to 96%), and thus it has become the investigation of choice for patients suspected of lumbar disk herniations [(7)].

2- NeuroScreen plus Electromyography:

NeuroScreen plus Electromyography system was designed to measure electromyography and electroneurography parameters. In this study latency of Hoffmann reflex (H-reflex) was measured. Essentially the Neuroscreen plus system consists of the following components: Computer-incl. A/D converter and control board, 4 channels AC amplifier (floating), Tele panel (control panel), Ink-jet printer. Programmable neuroscreen plus software, and Neuroscreen plus kit: Composed of the following accessories: Cotton, alcohol, scissors, adhesive plaster, and medical gel, Recording, referencing, stimulating, and grounding electrodes with grounding strap.

Procedures:

A- Evaluative procedure

Patients completed a variety of self-report measures, followed by a standardized history and physical examination performed by a physical therapist. Self-report measures included a body diagram to assess the distribution of symptoms, numeric pain rating scale (NPRS), modified Oswestry Disability Index (ODI), Patients recorded the location of their symptoms on the body diagram to determine the extent to which centralization occurred after treatment, which was determined according to the procedures described by Werneke *et al* [(8)].

The standardized history consisted of demographic information including age, gender, past medical history, location and nature of symptoms, relieving/aggravating activities, prior episodes, occupation and leisure activities. The standardized physical examination included measurements of active lumbar range of motion, passive posteroanterior mobility of the lumbar spine [(9)], myotomal testing, sensory examination to sharp and dull, muscle stretch reflex testing, the SLR test [(10)]. The evaluative instruments included:

1-Health scale device:

Health scale device used to measure the weight and the height for each patient

2- Pain assessment

The 11-point NPRS ranges from 0 (''no pain'') to 10 (''worst pain imaginable'') and was used to indicate the intensity of current pain and at its best and worst level over the last 24 h [(11)]. These 3 ratings were averaged to arrive at an overall pain score. The scale has been shown to have adequate reliability, validity, and responsiveness in patients with LBP when the 3 scores are averaged [(12)].

3- Functional disability

The functional disability of each patient was assessed by Oswestry disability questionnaire. It consists of 10 multiple-choice questions of LBP included disability in daily function and leisure time activities, for each question the patient select one sentence out of six that best describe his disability. For each section of six statements the total score is 5, if the first statement is marked, the score is zero, if the last is marked the score is 5. The final score calculated as follow: Total score= (5x number of questions answered) x 100%. The test–retest reliability of the modified ODI has been shown to be high (ICC ¼ .90) [13].

4- Location of the symptoms:

The most distal extent of symptoms were coded as occurring in the low back, buttock/thigh, or distal to the knee by placing a transparent overlay of the scoring grid over the patient's body diagram. A score of (0) was given if there was no identification of symptoms, (1) if pain was isolated to the central low back, (2) if pain was indicated in the lateral low back, (3) if pain was located in the buttocks, (4) if pain was located in the upper leg, (5) if pain was located in the lower leg, and (6) if pain was located in the foot. This procedure has been shown to exhibit excellent reliability [8].

5- Measurement of H-reflex:

Preparation of the skin

In order to reduce the skin impedance, the skin overlying the sites of the recording electrodes were shaved if necessary, the skin was rubbed lightly with sand paper to desquamate the surface and finally was rubbed with alcohol.

Position of the electrodes and their application

The recording electrodes consist of R1 placed over the soleus and R2, the reference electrode, placed over the Achilles tendon. Although the H-reflex can be recorded over any portion of gastrocnemius and soleus muscles, the optimal location that yields the largest H-reflex was two or three fingerbreadth distal to where the soleus meets the two bellies of the gastrocnemius. The tibial nerve was stimulated in the popliteal fossa, with cathode placed proximal to anode and beginning at very low stimulus intensities. Ground electrode (G) placed at half distance between stimulating and recording electrodes Silver chloride surface electrodes were used and the recording electrodes will be fixed to the skin by adhesive plaster, which must not be so tight as to impair contraction or the circulation of the muscles as shown in figure (1) [14, 15].

Position of the patient during recording:

The H-reflex latency was recorded while the patient was laid down in a prone lying position in a quiet room on a comfortably bed. The head maintained in mid position to control the possible effects of asymmetrical tonic reflex. The examined leg was placed mid-way between abduction and adduction at hip joint. The knees was slightly flexed 20° degrees by placing a small cushion under the knee to relax the gastrocnemius to reduce any depressive influence on the H-reflex and ankle was freely positioned in planterflexion outside the plinth [14,15].

Stimulation:

The H-reflex was elicited by stimulation of the posterior tibial nerve at the popliteal fossa little bit to lateral aspect by stimulating electrode as shown in figure (1).

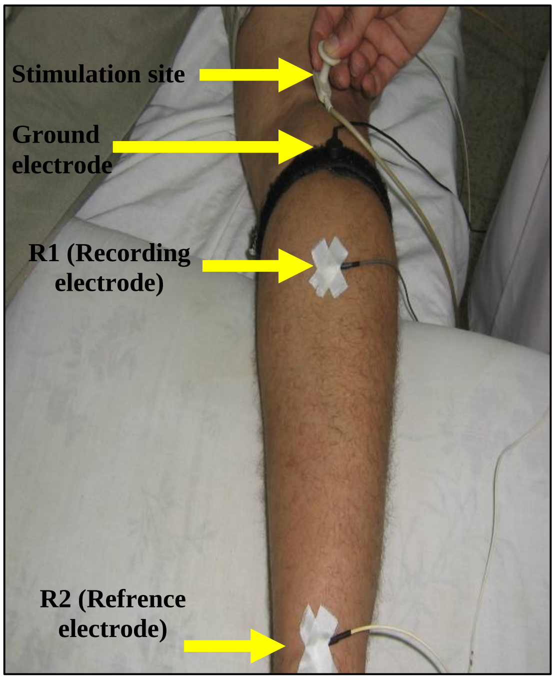

Figure (1): Stimulation site for tibial nerve (Posterior view)

Recording site:

Soleus muscle: Posterior calf with recording electrode (R1) placed one to two fingerbreadths distal to where the soleus meets the two bellies of the gastrocnemius. Reference electrode (R2) placed over the Achilles tendon. The Stimulator pulse duration should be set at (1 ms) to more selectively activate the Ia sensory fibers. H reflex occurs with low stimulation intensities.

6- Measurement of degree of nerve root compromise.

By using magnetic resonance imaging (MRI), One observer (Radiologist) interpreted the MRI finding (degree of sciatic nerve root compression) pre and post treatment. The observer

(Radiologist) was blinded about selection of patients and type of treatment during the reading of MRI. Before MRI exam, remove all accessories including hair pins, jewelry, eyeglasses, hearing aids, wigs and dentures. During the exam, these metal objects may interfere with the magnetic field, affecting the quality of the MRI images taken. Depending on how many images are needed, the exam generally takes 15 to 45 minutes. However, very detailed studies may take longer. Patient must lie down on a sliding table and be comfortably positioned. Even though the technologist must leave the room, Patient was asked to remain still during the actual imaging process; however, between sequences, which last between 2-15 minutes, slight movements were allowed. Luckily during the scans, there was no pain; however, some patients find the loud knocking and tapping sounds to be bothersome. Ear plugs were provided to avoid such annoyances.

B. Treatment procedure:

Mobilization and exercise group (Group A):

The lumbar spine mobilization and exercise intervention group performed a 5-min exercise warm-up at the beginning of each treatment. Following the warm-up patients received lumbar spine mobilization and completed a standardized exercise regimen since a combination of manual therapy and exercise have been shown to be effective in reducing disability in patients with chronic LBP [16]. The physical therapist performed posteroanterior mobilizations to hypomobile lumbar spine vertebrae segments as determined on the initial evaluation. Grades III–IV mobilizations were selected based upon the patient response and the physical therapist's clinical reasoning [9]. Patients also completed a standardized exercise program consisting of pelvic tilts, bridging, wall squats, quadruped alternate arms/legs activities as described by Childs *et al* [12], which has been shown to result in clinically meaningful improvements in disability. Patients were asked to perform 2 sets of 10 repetitions of each exercise. The physical therapist progressed the patient's exercise routine according to the patient's symptoms.

SLR stretching group (Group B)

Patients in the SLR-stretching group completed the identical warm-up followed by lumbar spine mobilization and the identical standardized stabilization exercise program, but also received SLR-stretching exercises that were provided by the physical therapist. One investigator performed SLR on all the subjects. The SLR test was performed as described by Butler, and Jones [17]. The patient was supine and relaxed in the center of the bed, with one pillow under the head. The trunk and pelvis should were in neutral position. While the therapist was standing beside the affected side, he began to raise the affected side perpendicular to the bed in standard SLR test with one hand placed under the ankle joint and the other hand placed above the knee joints until either pain in the back or referred pain to the leg restricted the movement. Then the lower limb was taken down few degrees from this symptomatic point. The therapist started to stretch (mobilize) the sciatic nerve by a sequence of gentle oscillations toward ankle dorsiflexion and then reassessed the effect. The number of these sequences was repeated several times, through which the amplitude of the technique was increased according to the patient response. The technique was progressed to a point where symptoms were reproduced, or it was taken to a point where resistance of the movement was encountered. The technique was repeated with sciatic nerve was more tensed through variations as: Ankle planter flexion and inversion. Hip adduction and medial rotation. As the pain was relieved, the therapist increased the range of motion until reaching the maximum range of SLR with pain frees [18]**.** The position was held for 30 s. A total of 5 repetitions were completed. The time spent performing the SLR stretching added only 3–4 min to the total treatment time, thus the potential for an attention effect to exist is extremely low. The decision to use a treatment procedure that reproduced the patient's symptoms was based on a case series reported by George [19]. In this study patients exhibiting a positive SLR test in the absence of radicular symptoms were subjected to SLR stretching following a brief warm-up, as a treatment protocol. A decrease in symptom intensity was observed following 5–12 treatment sessions.

Follow-up

At the completion of 6 physical therapy sessions (3 weeks), an assistant who was unaware of group assignment or the nature of the study re-administered the self-report questionnaires. The potential for rater bias is further minimized based on the use of patient completed outcome measures.

Statistical design and data analysis:

Sample size calculations were performed using SPSS statistical software (SPSS Inc., Chicago, IL). The independent variable was group (mobilization and exercise vs. SLR stretching), and the primary dependent variable was perceived disability as recorded by the ODI. Secondary dependent variables included centralization of symptoms and pain. Separate independent t-tests were used to assess differences between groups at discharge. The a-level was divided equally between dependent variables to maintain the family-wise a-level equal to .05.

Results: Subject characteristics

Mobilization and exercise group (Group A):

Thirty subjects were included in this group 10 male and 20 female. The mean of the age of males was 47 ±3.35 years. The mean value of their weight was 87.7 ± 5.9 kg and the mean value of their height was 174.3 ±4.3 centimeters. The mean of the age of females was 43 ± 6.7 years. The mean value of their weight was 82.4 ± 4.5 kg, and the mean value of their height was 161.2 ±4.03 cm.

SLR stretching group (Group B)

Thirty subjects were included in this group 12 male and 18 female. The mean of the age of males was 43.8 ±3.8 years. The mean value of their weight was 94.9 ± 6.69 kg and the mean value of their height was 175.4 ±3.1 cm. The mean age of females was 42.5 ±6.5 years and the mean value of their weight was 81.7 ±7.7 kg, and the mean value of their height was 163.5 ± 4.7 cm.

Table (1): Demographic data of all subjects

Groups / Variables	Mobilization and exercise group (Group A)	SLR stretching group (Group B)	t- value	P value
Age (years)	44.2±6.16	42.93±5.73	.0824	0.413
Weight (kg)	84.05±10.73	86.1±9.67	0.777	0.440
Height(cm)	165.2±7.30	167.5±7.07	1.239	0.220

* Significance level ≤ 0.05

Table (2) Self-report variables for both treatment groups (post test)

Variable	Mobilization and exercise group (n = 30)	SLR stretching group (n=30)	t value	P value
Numeric pain rating score	3.03±1.88	1.83±1.83	2.86	0.006*
Oswestry Disability Index	28.4±6.87	23.9±4.9	3.54	0.001*
Location of symptoms	4.3 ± 0.83	3.9±0.77	3.22	0.083

Table (3): Differences in H-reflex latency between group A and group B (post test)

H-reflex latency	Mobilization and exercise group (n = 30)	SLR stretching group (n=30)	t value	P value
	28.82±3.02	28.93±2.42	.160	.873

Table (4): Differences in degree of sciatic nerve root compression between group A and group B (post test)

Sciatic nerve root compression	Mobilization and exercise group (n = 30)	SLR stretching group (n=30)	t value	P value
	533±.5.07	266±.4.49	2.154	.035*

* Significance level ≤ 0.05

Discussion:

The results of study confirm hypotheses that strait leg raising (SLR) stretching may be beneficial in the management of patients with LBD. SLR stretching in addition to lumbar spine mobilization and exercise was beneficial in improving pain, reducing short-term disability and promoting centralization of symptoms in this group of patients. This study was limited by several factors. First, the measurement of pain was limited to the available Numeric pain scale. Second, the effect of noise and any external waves may interfere with accuracy of Hoffmann reflex (Latency) in E.M.G lap. There is a significant difference in pain reduction in the mobilization and exercise group compared to the SLR stretching group. It has been reported that reductions in the Oswestry of 6 points or greater are considered clinically meaningful [13]. The change scores for both groups in our study confirm this clinically meaningful level (18.4±6.87 in the mobilization and exercise group and 23.9±4.9 in the SLR stretching group).

Centralization of symptoms in patients with LBP indicates a favorable prognosis [20, 21] and is typically used to guide treatment in patients with low back and lower extremity symptoms. However, the SLR stretching technique used in this study was designed to reproduce the patient's symptoms, which sometimes resulted in a peripheralization of their symptoms. The decision to proceed with treatment despite the peripheralization of symptoms in this group is consistent with the treatment approach used by George [19]. In this study, SLR stretching resulted in significant improvements in disability and pain and centralization of symptoms compared to a lumbar spine mobilization and exercise program without SLR stretching. Therefore, perhaps centralization is not prognostic for a favorable outcome among all subgroups of patients with LBD. A few studies [18, 22, 23, 24] have investigated the effects of neural mobilization techniques on patients with LBD and lower extremity symptoms. Scrimshaw and Maher [24] investigated the effects of neural mobilization following lumbar dissection, fusion, or laminectomy. The results of a 12-month follow-up demonstrated that neural mobilization did not provide additional benefits to traditional postoperative care. However, the patients in this study exhibited a straight leg raise range of motion that was within normal limits suggesting that perhaps performing neural mobilizations on patients with a normal straight leg raise may not be beneficial in decreasing pain and disability.

There was no significant difference between post test results of neurodynamic techniques and post test results of mobilization on H-reflex (Latency), where neurodynamic techniques and mobilization have a same effect on H-reflex (Latency) where (p = 0.873), and there was a significant difference between post test results of neurodynamic techniques and post test results of mobilization on the degree of sciatic nerve root compression (p = 0.083), This comes with agreement with study done by Hoke [25], who applied rotatory manipulation with the painful side uppermost and the top hip being taken forward and the shoulders backwards.

It was proved that neurodynamic techniques and mobilization have a role in treatment of chronic low back pain and radiculopathy. This comes in agreement with Burns, and Hangee [26], who investigated the use of thrust, non-thrust mobilization/manipulation coupled with neurodynamic mobilization (neural mobilization) exercises for an individual with recurrent lower back pain. The patients experienced a rapid improvement in pain and functions after non-thrust and thrust manipulation to the lumbar spine and supine lower extremity neurodynamic mobilization (neural mobilization) techniques. A combination of thrust and non-thrust mobilization/manipulation and lower extremity neurodynamic mobilization techniques (neural mobilization) may be helpful in patients with chronic recurrent, low back pain with radicular symptoms.

It was clear that neurodynamic techniques (neurodynamic) has a great role in management of sciatica resulted from herniated disc concerning pain and restoring mobility of nerve root. This comes agreement with Cleland *et al* [27], Gladson *et al* [28], who mentioned that when the nerve root was compressed and microcirculation was compromised; and the pressure received by the nerve will affect the edema and the demyelination, neurodynamic techniques consists of short oscillatory movements and was sufficient to disperse the edema, thus alleviating the hypoxia and reducing the associated symptoms. It could also be directly associated with the immobilization reduction in the neurogenic inflammation. In addition, there is the hypothesis that nerve movement within pain-free variations can help to reduce nerve compression, friction and tension, therefore decreasing its mechanosensitivity. Therefore, a neurodynamic technique seems to be a better form of treatment when compared to passive stretching alone.

A Neurodynamic technique has a great role in management of radiculopathy and low back pain. It supported by McCracking [29], who tested the long-term effects of a neurodynamic treatment technique for a patient with non-specific low back pain (LBP) and lower extremity (LE) pain. The study suggested that neurodynamic treatment (neural mobilization) techniques may be useful in treating patients with low back and lower extremity pain who present with neural tension dysfunction. However, symptoms did not resolve substantially until introduction of a neurodynamic treatment technique. Also, slump stretching, was shown to be effective in the management of patients with non-radicular LBP when combined with lumbar mobilization and exercise.

The effect of neurodynamic techniques in exploration of sciatic nerve root from compression of disc herniation explained by McGill [30], who stated that if the nerve root is impinged and cannot slide, instead of moving, the pain was elicited along the nerve trunk. The concept of nerve gliding plays a major role in formulating a treatment plan for nerve mobilization. Blood circulation and axonal transport, which are necessary for the functional and structural integrity of a neuron, will recover after the removal of the pressure by neurodynamic techniques was performed for reducing pressure caused by intraneural and extraneural fibrosis, increasing vascular and axoplasmic flow, and restoring tissue mobility [31].

Improvement of H-reflex (Latency) post treatment due to mobilization was same to the effect of neural mobilization; this was due to small effect of mobilization on H-reflex latency and unclear clues that mobilization has a obvious effect on H-reflex latency. This comes in agreement with study done by Bulbulian *et al* [32] who investigated the effect of spinal mobilization on H-reflex measures, which revealed that Mean H-reflex amplitude was decreased and the H/M ratio was also decreased. However, Suter *et al* [33] stated that H-reflex responses after spinal manipulation are sensitive to movement/repositioning, and that the H-reflex depressions after manipulation documented in previous studies were movement artifacts rather than treatment effects. The relationship between etiology of low back pain and changes in H-reflex amplitude after spinal manipulation is not clear and needs further investigation.

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