European Journal of Scientific Research
ISSN 1450-216X / 1450-202X Vol. 131 No 1 April, 2015, pp.122-132
http://www.europeanjournalofscientificresearch.com

Effect of Neural Mobilization Versus Spinal Manipulation in Patients with Radicular Chronic Low Back Pain

Waleed Salah El-din Mahmoud
Assistant Professor of Physical Therapy and Health Rehabilitation Department
College of Applied Medical Science, Prince Sattam bin Abdulaziz University
(Formerly Salman bin Abdulaziz University), Saudi Arabia
E-mail: waleeds306@yahoo.com

Abstract

Objective: to investigate the effects of neural mobilization and lumbar manipulation techniques on leg pain, functional disabilities, and degree of nerve root compression of chronic low back pain (CLBP) patients with sciatica resulted from lumbar disc herniation at L5-S1 level and also to determine which treatment was more effective than the other. Design: Randomized clinical trial. Materials and methods: Sixty patients with confirmed unilateral lumbosacral radiculopathy due to L5–S1 disc herniation from both sexes were involved, aged between 30 – 50 years. They were randomly divided into two equal groups, (group A) received neural mobilization techniques and (group B) received lumbar manipulation techniques. Main outcome measures: Visual analogue scale (VAS), Oswestry Disability Index (ODI), and degree of nerve root compression by grading system were measured for all patients before treatment, after 6 weeks of treatment. Results: There was a positive significant effect of both types of treatment on all outcome measures, however there was a significant difference between the (group B) and (group A) adjusted to baseline values and at 6 weeks post treatment in respect to: leg pain (P=0.006), Oswestry Disability Index (P =0.001), and degree of nerve root compression (P=0.037). Conclusion: The lumbar manipulation was more effective than neural mobilization; this may be due to direct influence of lumbar manipulation techniques on reduction of nerve root compression than neural mobilization techniques.

Keywords: Chronic low back pain, neural mobilization, lumbar manipulation.

Introduction

Chronic low back pain (CLBP) represents a significant health care burden resulting in substantial costs to society. It has been estimated that the 1-year prevalence for LBP ranges from 22% to 65%. A recent study found that the prevalence of LBP has remained consistent over the years in Spain suggesting that a better understanding for proper management of this condition is needed (**Garcia et al., 2014**). Sciatica is characterized by radiating pain in an area of the leg typically served by one nerve root in the lumbar or sacral spine; it is sometimes also associated with sensory and motor deficits. The most common cause of sciatica is a herniated disk. The estimated annual incidence of sciatica in Western countries is 5 cases per 1000 adults. The economic effect of lumbar-spine disorders is great. 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 (**Wilco et al., 2007**).

Management options for sciatica include analgesic medications, manipulation, surgical decompression, bed rest, and a variety of interventions provided by physical therapists. Physical

therapy interventions include therapeutic exercise; functional training; manual therapy techniques, including mobilization and manipulation, electrotherapeutic modalities, mechanical modalities, and physical agents (**Dianne, and Daniel, 2005**). Conservative treatment for sciatica is primarily aimed at pain reduction, either by analgesics or by reducing pressure on the nerve root. Strong evidence of effectiveness is lacking for most of the available interventions. The previous systematic review reported that active physical therapy (exercises) seemed not to be better than inactive (bed rest) treatment and other conservative treatments, such as traction, manipulation, hot packs, or corsets (**Koes et al., 2007**).

Although early surgery roughly doubled the speed of recovery from sciatica compared with prolonged conservative care; outcomes at one and two years were similar for both treatment groups (surgical group and conservative manipulative group) (**Wilco et al., 2008**). Spinal manipulative therapy is used by a number of healthcare professions, including physical therapists, chiropractors, osteopathic physicians, and medical physicians. Spinal manipulation has been advocated in clinical practice guidelines for low back pain, with evidence that exists to support the use of spinal manipulation for improvement of pain and function in patients with acute low back pain (LBP) and sciatica (**Kuczynski et al., 2012**). Spinal manipulation and exercise are important modalities that play a central role in the treatment of chronic low back pain (CLBP) with sciatica (**Merepeza, 2014**).

The spinal manipulation is a manual form of treatment aimed mainly at reducing spinal (and other joint) pain and increasing range of motion. It often involves a high velocity thrust, a technique in which the joints are adjusted rapidly, often accompanied by popping or snapping sounds. The technique results in transient stretching of joint capsules and is believed to reset the position of the spinal cord and nerves, allowing the nervous system to function optimally and improve the body's biomechanical efficiency (**Stevinson and Ernst, 2002**). The effectiveness of spinal manipulation remains controversial among family physicians (**Licciardone et al., 2013**). Studies evaluating spinal manipulation for lumbar disk herniation have had conflicting results. Although one systematic review concludes that manipulation can be safely incorporated as a component of conservative management, later meta-analyses have found no benefit of manipulation over other conservative therapies (**Gregory et al., 2008**). Cassidy and colleagues reported a clinical improvement in 50% of their study sample in a case series of patients with chronic sciatica treated with manipulation (**McMorland et al., 2010**).

Some studies have found that the treatment of CLBP with spinal manipulative therapy may significantly decrease pain and improve function. There have been many studies assessing the benefits of either treatment on patients with CLBP with sciatica; however the majority of these studies have focused on investigating each treatment on their own. There are significantly fewer studies that have investigated and compared both treatments head-to-head in the treatment of CLBP with sciatica (**Merepeza, 2014**).

There has been an emergence in physical therapy of evaluation and intervention based on neurodynamics (ND). Knowledge of the normal cellular structure and biomechanical properties of peripheral nerves and the responses of nerves to physical stresses assist physiotherapist in making diagnoses and decisions regarding interventions. Physical therapy intervention should focus on reduction of inflammation, improvement in blood flow, and enhancement of the capacity of the nerve for strain and excursion along its full length in an effort to reduce the physical stress on the compressed region (**Kimberly and Benjamin, 2006)**. Peripheral nerve compression may disrupt the ability of the nerve to stretch and slide. Prolonged compression creates sequelae of intraneural events that may ultimately lead to impaired nerve sliding (**Carroll et al., 2012**).

Responses to neurodynamic sequencing first proposed and practiced by Maitland (1985) though claimed by Shacklock (2005), may simply be due to the attention placed on the first of a combination of movements. In central sensitivity, there is still a place for neural mobilization, as a sliding technique should allow mechanically non-aggressive large range novel movements which could be therapeutic for central mechanisms on the basis of threat reduction (**Butler and Coppieters, 2007**). Neural mobilization exercises, derived from neurodynamic tests, such as the slump test or straight leg raise

test, have been advocated in clinical texts and as a result of published clinical trials. There are many theories that have been postulated for neural mobilization techniques, including physiological effects (removal of intraneural edema, central effects as reduction of dorsal horn and supraspinal sensitization, and mechanical effects in enhanced nerve excursion) (Ellis et al., 2012).

It is important to evaluate possible nonsurgical interventions for patients with chronic low back patients with sciatica using appropriate patient-based outcome measures. It was therefore the purpose of this study to compare the effectiveness of lower limb neural mobilization and lumbar manipulation techniques. Comparisons between groups were made for patient-reported pain severity, function, and degree of nerve root compression at L5-S1 disc level. Therefore, the null hypothesis was that there would be no significant difference in all outcome measures of patients experiencing unilateral lumbosacral radiculopathy due to L5–S1 disc herniation regardless of whether they have been treated with lower limb neural mobilization or lumbar manipulation techniques.

Methods

Subjects

60 patients aged from 30 to 50 years old suffering from chronic low pain (CLBP) with sciatica resulted from L5-S1 disc herniation. All of the patients were conveniently selected from outpatient clinic of faculty of medicine, Cairo University. Patients were randomly assigned into two groups. Written informed consent was obtained from all patients prior to data collection.

To be included in the study, the patients needed to be diagnosed by magnetic resonance imaging (MRI) confirming lumbar disc herniation (postero-lateral herniation) at L5-S1 disc level by a physician (neurologist, orthopedist). The patients also had to suffer from unilateral radiculopathy at L5-S1 disc level more than 3 months. The patients were excluded if they had any pathology of hip, knee, and ankle joints as well as inflammatory diseases of spine column or spinal disorders (rheumatoid disease, anklosing spondylitis, spondylolisthesis) or had sever spondylotic osteophytes that compressing or lacerating lumbar nerve root and leading to sciatica. Also patients were excluded if they had radiculopathy or root pain after spinal surgery (post laminectomy syndrome) diabetic neuropathy, intermittent claudication and osteoporosis.

Group A

30 patients suffered from chronic LBP with unilateral radiculopathy at L5-S1 disc level received neural mobilization techniques three days/week for 6 weeks.

Group B

30 patients suffered from chronic LBP with unilateral radiculopathy at L5-S1 disc level received lumbar manipulation techniques three days/week for 6 weeks

Instrumentation

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. The grading system was used in this study as shown in figure 1, enables discrimination between grades of nerve root compromise in the lumbar spine with sufficient reliability for both research and clinical purposes (**Christian et al., 2004**). The grading system was:

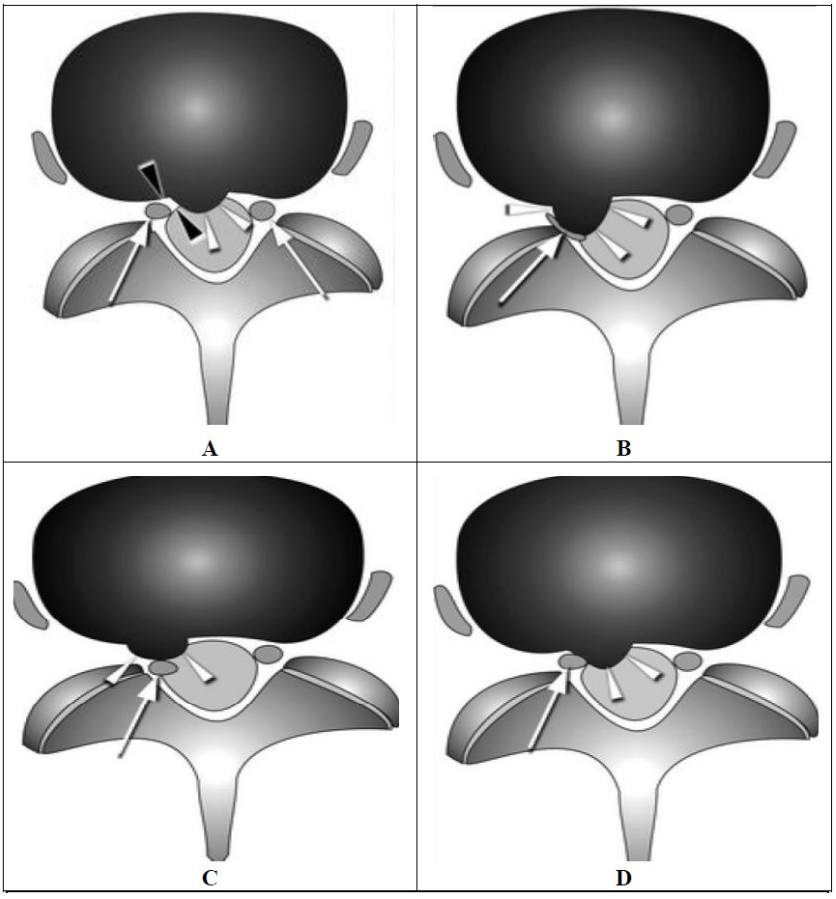
- Grade 0 (normal): No compromise of the nerve root is seen. There is no evident contact of disk material with the nerve root, and the epidural fat layer between the nerve root and the disk material.
- Grade 1 (contact): There is visible contact of disk material with the nerve root, and the normal epidural 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.

Procedures

A. Evaluative Procedure

Health scale device used to measure the weight and the height for each patient. Measurement of degree of nerve root compromise by magnetic resonance imaging (MRI) using the MR image–based grading system done by one radiologist all over the study. Then Patient was asked to place a mark along the line to determine their level of pain on the visual analogue scale (VAS) (**Sadovsky, 2002**). The functional disability of each patient was assessed by Oswestry disability index (ODI) (**Davidson and Keating, 2002**).

Figure 1: Degree of nerve root compression. (A) Grade 0 means no compppromise of the nerve root, (B) grade 1 means visible contact of disk material with the nerve root, (C) grade 2 means the nerve root is displaced dorsally by disk material, (D) grade 3 means the nerve root is compressed between disk material, and may appear flattened.



B. Treatment Procedure

A. Neural Mobilization Techniques

Neural mobilization techniques were applied to (group A) as follow:

1. Straight leg Raising (SLR)

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 limp 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 and hip adduction and medial rotation (**Butler, and Jones, 1991**).

2. Slump Technique

The patient sat well back on the end of a plinth with thighs fully supported and knees together. The patient's hands were linked gently behind his back. The examiner stands beside and close to the patient. The patient was asked to slump or sag while examiner maintains cervical spine in neutral position. Overpressure was applied to the lumbar and thoracic flexion in attempt to bow the spine rather than the hips. With spinal flexion position maintained, the patient was asked to bend his chin to chest and then overpressure in the same direction was added. The patient was asked to extend his knee actively. The patient was asked to dorsiflex his ankle. The therapist was maintaining the ankle dorsiflexion as a progression for technique. 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 reproduced, or it was taken to a point where resistance of the movement was encountered. As the pain was relieved, the therapist increased the range of motion until reaching the maximum range of slump position with pain free (**Butler and Jones, 1991**).

B. Lumbar Manipulation

All spinal manipulative techniques were provided by a single physiotherapist. The standardized intake history and physical examination was repeated at the initial visit to ensure there were no contraindications to treatment. Each position of manipulation will be repeated 3 to 4 times and time interval between each time ranged from 30 to 60 seconds. Mobilization techniques may be used before manipulation technique as a preparation and hold at the end for 30 seconds. Lumbar manipulation techniques were applied to (group B) as follow:

1. Posterior Anterior Central Vertebral Pressure

The position was taken up by moving the therapist's body weight forward more directly over the patient's vertebral column, and exert a downward pressure on the spinous process of the vertebra to move the joint through the full physiological range of motion. Once the end of the physiological range was reached, high velocity thrust by therapist's hand was applied exerting a force on the vertebra (**Maitland et al., 2001**).

2. Lumbar Rotation

When the position of full rotation had been reached, the physiotherapist stretched further by increasing the pressure against the patient' shoulder and pelvis, then a sudden downward and rotary thrust was applied to the pelvis and strong counter-pressure at the shoulder. The all important factor was that the

direction of movement should produce rotation of the pelvis and not adduction of the hip. This rotation was done with lumbar spine in flexion or extension by positioning the underneath leg and altering the angle of hip flexion used for the leg, which was acted as the lever (**Maitland et al., 2001**).

3 Rotation with Straight Leg Raising

The physiotherapist provided a holding action with his left hand against the patient's shoulder and performed the rotation with his right hand against patient's femur then a sudden downward and rotary thrust was applied to the femur and strong counter pressure at the shoulder. At the same time as physiotherapist applied rotation to patient's lumbar spine, physiotherapist also increased the tension in the straight leg raising by pivoting on his feet both maintaining knee extension and increased the angle of hip flexion (**Maitland et al., 2001**).

Data Analysis

SPSS version 16.0 for Windows (SPSS Inc) was used for the statistical analyses. Two-tailed Paired t-test was used to evaluate pain and functional scores pre- and post treatment in one group. Two-tailed Independent t-test was used to evaluate pain and functional scores pre- and post treatment between two groups. Differences between groups for degree of nerve root compression were compared using Mann-Whitney test while the differences in one group concerning degree of nerve root compression were compared using Wilcoxon sign rank test (alpha set at 0.05 for each test).

Results

Eighty patients were assessed for eligibility. Sixty patients underwent randomization. 30 patients were allocated to each group. All of them completed 6 weeks of treatment. The demographic features of the patients for (group A) and (group B) were similar with regard to age, height, weight and presented in Table 1. Specific measurements of the study (leg pain, Oswestry Low Back Disability index, and degree of nerve root compression) were also well balanced between the groups at baseline ($P > 0.05$ for all variables).

Table 1. Characteristics of the Study Participants

Groups / Variables	(Group A)	(Group B)	p value
Age (Years)	44.2±6.16	42.93±5.73	0.413
Weight (Kilograms)	84.05±10.73	86.1±9.67	0.440
Height (Centimeters)	165.2±7.30	167.5±7.07	0.220

A. Effect of Neural Mobilization and Lumbar Manipulation on Pain Level

There was a significant decrease of pain level for group A, pre treatment was (7.96±1.42) and post treatment was (3.03±1.88) and $P<0.05$. For group B there was a significant decrease of pain level, pre treatment was (8±1.08) and post treatment was (1.83±1.31) and $P<0.05$ as shown in table 2.

Table 2: Influence of Neural Mobilization and Lumbar Manipulation on Pain

Group	Pain level		p value
	Pre	Post	
Group A (Neural mobilization)	7.96 ±1.42	3.03 ±1.88	0.000*
Group B (Lumbar manipulation)	8±.1.08	1.83±1.31	0.000*

* Significance level ≤ 0.05

B. Effect of Neural Mobilization and Lumbar Manipulation on Functional Disabilities:

There was a significant improvement of function abilities (OSI) for group A, pre treatment was (42.7±4.94) and post treatment was (23.9±4.97) and P<0.05. For group B there was a significant improvement of functional abilities, pre treatment was (40.6±4.5) and post treatment was (18.46±6.87) and P<0.05 as shown in table 3.

Table 3: Influence of Neural Mobilization and Lumbar Manipulation on Functional Disabilities

Group	Functional disabilities (OSI)		p value
	Pre	Post	
Group A (Neural mobilization)	42.7±4.94	23.9±4.97	0.000*
Group B (lumbar manipulation)	40.6±4.5	18.46±6.87	0.000*

* Significance level ≤ 0.05

C. Effect of Neural Mobilization and Lumbar Manipulation on the Degree of Sciatic Nerve Root Compression:

There was a significant reduction of nerve rot compression for group A, pre treatment was (1.4±0.674) and post treatment was (0.533±0.507) and P<0.05. For group B there was a significant reduction of nerve root compression, pre treatment was (1.5±0.572) and post treatment was (0.266±0.499) and P<0.05 as shown in table 4.

Table 4: Influence of Neural Mobilization and Lumbar Manipulation on the Degree of L5-S1 Nerve Root Compression

Group	Degree of L5-S1 nerve root compression		p value
	Pre	Post	
Group A (Neural mobilization)	1.4±.674	.533±.507	0.005*
Group B (lumbar manipulation)	1.5±.572	.266±.499	0.004*

* Significance level ≤ 0.05

D. Comparison Between Neural Mobilization and Lumbar Manipulation on Measured Variables

There was more significant decrease of pain level, functional disabilities, and degree of nerve root compression in group B treated by lumbar manipulation techniques than group A treated by neural mobilization techniques as shown in table 5.

Table 5: The Difference between Neural Mobilization and Lumbar Manipulation Techniques (Post Treatment)

Variable	Group A (Neural mobilization)	Group B (lumbar manipulation)	P value
Pain level	3.03±1.88	1.83±1.31	0.006*
Functional disabilities	23.9±4.9	18.4±6.87	0.001*
Degree of nerve root compression	.533±.507	.266±.449	0.037*

* Significance level ≤ 0.05

Discussion

This study was designed to investigate the efficacy of therapeutic exercises including neural mobilization and lumbar manipulation techniques on patients having sciatica resulted from posterolateral prolapse of L5-S1 intervertebral disc; the criteria which investigated were the leg pain, functional disabilities, and degree of sciatic nerve root compression. A subsidiary aim was to determine

whether the neural mobilization techniques or manipulation has a greater effect on pain, functional disabilities, and degree of sciatic nerve root compression.

It was proved that neural mobilization techniques and manipulation have a role in treatment of chronic low back pain and radiculopathy. This comes in agreement with (**Burns and Hangee, 2008**) who investigated the use of thrust, non-thrust mobilization/manipulation coupled with 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 neural mobilization techniques. A combination of thrust and non-thrust mobilization/manipulation and lower extremity neural mobilization techniques may be helpful in patients with chronic recurrent low back pain with radicular symptoms.

It was clear that neural mobilization techniques have a great role in management of sciatica resulted from herniated disc concerning pain and restoring mobility of nerve root in our study. This comes agreement with (**Gladson et al., 2009**) who mention 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, neural mobilization 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 neural mobilization technique seems to be a better form of treatment when compared to passive stretching alone.

It was assumed that the neural mobilization techniques induced nerve movement by elongation of the nerve bed (the tract formed by the structures that surround the nerve). There is ample evidence to support the notion that neurodynamic tests elongate the nerve bed and that this elongation is associated with nerve gliding. Lengthening of the nerve bed may also elongate the nerve, which may result in an increase in tension and intraneural pressure (**Coppieters et al., 2009**). The principle of neural mobilization is that changes in the mechanics or the physiology of the nervous system can result in other system dysfunctions or dysfunctions of the musculoskeletal structures that receive its innervations. The neural mobilization technique is used to regain the movement and elasticity of the nervous system, with the objective of improving neurodynamics and reestablishing axoplasmic flow, thus restoring nerve tissue homeostasis, which promotes the return to its normal functions. The technique is also used to regain joint flexibility (**Gladson et al., 2009**).

The effect of neural mobilization techniques in exploration of sciatic nerve root from compression of disc herniation explained by (**McGill, 2007**) who stated that if the nerve root is impinged and cannot slide, instead of moving, the pain was elicited along the nerve trunk. Further, tension on such a nerve can be increased from the cranial end with simultaneous cervical flexion because the entire spinal cord moves slightly with cervical flexion and thus pulling at the nerve roots all alongits length. This was the basis for action of straight leg raising test and slump (maneuver). It was suggested that nerves has the ability to create their own pathways as long as they can move. They seem to have some chemically based ability to dissolve over time impinging them. Thus, by working the nerves back and forth in whatever limited range they can manage in spite of impingement, it was facilitating the dissolving of the impingement and the gradual release of the nerve to once again move freely. This helped in chronic sciatica resolution; it can also cause an acute onset.

The results of this study showed that spinal manipulation has an effect on reduction of disc compression on sciatic nerve root. This comes in agreement with study done by (**Hoke, 2007**) who applied rotatory manipulation with the painful side uppermost and the top hip being taken forward and the shoulders backwards. Strong traction was always applied before the manipulative thrust and it was considered that the disc in dysfunction would be the one reduced by the manipulation and that other (normal) joint and discs would be unaffected. The results revealed that manipulation succeeds in a few sessions or not at all; one to four sessions suffice.

Mechanical forces which applied from lumbar manipulation to specific vertebral regions may alter segmental biomechanics by releasing trapped meniscoid lesions, releasing adhesions, or reducing distortions of the annulus fibrosus (**De Oliveira et al., 2013**). In recent study revealed that a large percentage of acute and importantly chronic lumbar disc herniation patients treated with high-velocity, low-amplitude side posture SMT reported clinically relevant "improvement" with no serious adverse events (**Leemann et al., 2014**).

Findings of our study revealed that lumbar manipulation techniques were useful in treatment of sciatica resulted from herniated disc of lumbar spine concerning pain intensity and functional disabilities. This comes in agreement with a recent pilot study compared outcomes of chronic lumbar disk herniation patients (radiculopathy for over 3 months) who had failed 3 months of nonoperative and non SMT treatment after randomly assigning them to receive SMT or microdiscectomy. They found that 60% of these patients benefited from SMT to the same degree as those having surgical intervention. However, it is hard to determine precisely what was considered "benefit" in this study (**Peterson et al., 2013**).

Although the neural mobilization and lumbar manipulation have an effect on decreasing compression on sciatic nerve root, however; the lumbar manipulation showed better results than neural manipulation. This may be due to the great effect of manipulation on size of disc bulge even if the manipulation reduced it by small amount. It supported by (**Bulbulian et al., 2002**) who reported that the exact mechanisms for LBP symptom reduction caused by Spinal manipulation is still unknown despite significant strides toward better understanding the treatment of LBP. A series of clinical observations have detailed additional possible mechanisms related to positive outcomes for treatment of LBP in one case study in which a patient has significant pain reduction where discal bulging was reduced by 14%. In a follow-up study, the same investigators reported reduced L5-S1 disk protrusion after spinal flexion-distraction (FD) therapy, which was demonstrated by repeated computed tomography scanning.

It could be also attributed to clear effect of lumbar manipulative techniques that produced significantly greater hypoalgesia than other exercises. It was hypothesized that manipulative techniques inhibit pain at the dorsal horn of the spinal cord through alterations of neuroplastic changes consistent with central sensitization. Manipulation may provide a novel stimulus that acts as a counter-irritant to C fibre-mediated pain. From a clinical perspective, most therapists reason that placing the symptomatic side uppermost will theoretically 'open' or 'gap' the dysfunctional intervertebral foramen with the rotatory manipulative technique and hypothetically 'release' impinged structures and augment healing through restoration of movement (through joint cavitation) and improved local motor control of the dysfunctional segment (**Perry et al., 2011**).

It was suggested that spinal manipulation has an effect on blood perfusion of segmental spinal origin and on lower limb and may be contributing in improvement of discogenic patient, (**Karason and Drysdale, 2003**) stated that the major vasomotor effects following an high-velocity low-amplitude thrust (HVLAT) manipulation are due to local segmental effects rather than to global ones. Similarly, it has been shown that vascular perfusion abnormalities may occur in the lower limb of patients with sciatica secondary to disk herniation.

Another study supported the effect of manipulation on reduction of disc on nerve root; (**Evans, 2002**) reported that acute cervical or lumbar disk herniation has generally been regarded as a contraindication to high velocity low-amplitude thrust (HVLAT) manipulation of the herniated segment, especially in the presence of severe or progressive neurologic deficit. However, a long-term beneficial effect of manipulation on symptomatic lumber disk herniation has been demonstrated, showing improvements in leg pain, back pain, and self-reported disability, these improvements were due to structural changes to the disk; there have been case reports of apparent reductions of small lumbar disk protrusions after manipulation.

Conclusion

The lumbar manipulation and neural mobilization techniques have a clear effect on chronic low back pain with unilateral lumbosacral radiculopathy due to L5–S1 disc herniation concerning leg pain, functional regaining, and reduction of herniated disc compression at level of L5-S1. The lumbar manipulation techniques were more effective than neural mobilization techniques; this may be due to direct influence of lumbar manipulation techniques on reduction of nerve root compression than neural mobilization techniques.

References

[1] **Bulbulian R, Burke J, and Dishman J. D.** Spinal reflex excitability changes after lumbar spine passive flexion mobilization. *J Manipulative Physiol Ther* 2002; 25(8): 526-532.

[2] **Burns SA, Hangee J:** Use of thrust and non-thrust manipulation in recurrent lumbar radiculopathy. *Journal of Manual & Manipulative Therapy.* 2008; 16(3): 161–181.

[3] **Butler D S, Coppieters M W.** Letter to the Editor. *Manual Therapy* 2007; 12: e7–e8.

[4] **Butler SD, Jones MA:** Mobilization of the nervous system: Tension testing- the lower limbs and trunk. 1991; Churchill Livingstone, Melbourne.

[5] **Carroll M, Yau J, Rome K, Hing W.** Measurement of tibial nerve excursion during ankle joint dorsiflexion in a weight-bearing position with ultrasound imaging. *Journal of Foot and Ankle Research* 2012; 5(5): 1-6.

[6] **Christian W. P, Dora C, Marius R. S, Zanetti M, Hodler J, and Boos N:** MR Image–based Grading of Lumbar Nerve Root Compromise due to Disk Herniation: Reliability Study with Surgical Correlation. *Radiology* 2004; 230: 583-588.

[7] **Coppieters M W, Hough A D, Dilley A.** Different Nerve-Gliding Exercises Induce Different Magnitudes of Median Nerve Longitudinal Excursion: An In Vivo Study Using Dynamic Ultrasound Imaging. *J Orthop Sports Phys Ther* 2009; 39(3):164-171.

[8] **Davidson M, Keating J L:** A Comparison of Five Low Back Disability Questionnaires: Reliability and Responsiveness. *Physical Therapy* 2002; 82(1): 8-24.

[9] **De Oliveira R F, Liebano R E, Costa L C M, Rissato L L, and Pena L O C.** Immediate Effects of Region-Specific and Non-Region-Specific Spinal Manipulative Therapy in Patients With Chronic Low Back Pain: A Randomized Controlled Trial. *Phys Ther* 2013; 93:748-756.

[10] **Dianne V Jewell and Daniel L Riddle:** Interventions That Increase or Decrease the Likelihood of a Meaningful Improvement in Physical Health in Patients with Sciatica. *Phys Ther* 2005; 85(11):1139-1150.

[11] **Ellis R F, Hing W A, Mcnair P J.** Comparison of Longitudinal Sciatic Nerve Movement With Different Mobilization Exercises: An In Vivo Study Utilizing Ultrasound Imaging. *J Orthop Sports Phys Ther* 2012; 42(8): 667-675.

[12] **Evans D W.** Mechanisms and effects of spinal high-velocity, low amplitude thrust manipulation: previous theories. *J Manipulative Physiol Ther* 2002; 25(4): 251-262.

[13] **Garcia M T, Rincon A I L, Moreno J S, Cena M P, Santiago R O, Penas C F.** Neuroscience education in addition to trigger point dry needling for the management of patients with mechanical chronic low back pain: A preliminary clinical trial. *Journal of Bodywork & Movement Therapies* 2014; 1-9.

[14] **Gladson R. B, Taciane S. S, Danilo L. T, Adriano P. C, Alberito R. C:** Neural mobilization and static stretching in an experimental sciatica model: an experimental study. *Revista Brasileira de Fisioterapia* 2009; 13(6): 493-498.

[15] **Gregory D S, Seto C K, Wortley G C, Shugart C M.** Acute Lumbar Disk Pain: Navigating Evaluation and Treatment Choices. *Am Fam Physician.* 2008; 78(7):835-842, 844.

[16] **Hoke A P:** Acceptance Speech for the John McMillan Mennell Service Award of the American Academy of Orthopaedic Manual Physical Therapy. *The Journal of Manual & Manipulative Therapy* 2007; 15(1):16–19.

[17] **Karason and Drysdale:** Mobilization of the nervous system: Tension testing- the lower limbs and trunk. 2003, Volume 25, Number 4, p: 251-262.

[18] **Kimberly S Topp and Benjamin S Boyd:** Structure and Biomechanics of Peripheral Nerves: Nerve Responses to Physical Stresses and Implications for Physical Therapist Practice. Physical Therapy 2006; 86(1): 92- 109.

[19] **Koes B W, Van Tulder M W, Peul W C.** Diagnosis and treatment of sciatica. *BMJ* 2007; 334: 1313-1317.

[20] **Kuczynski J J, Schwieterman B, Columber K, Knupp D, Shaub L, Cook C E.** Effectiveness of Physical Therapist Administrated Spinal Manipulation for the Treatment of Low Back Pain: A Systematic Review of the Literature. *IJSPT* 2012; 7(6): 647-662.

[21] **Leemann S, Peterson C K, Schmid C, Anklin B, Humphreys B K.** Outcomes of Acute and Chronic Patients with Magnetic Resonance Imaging–Confirmed Symptomatic Lumbar Disc Herniations Receiving High-Velocity, Low-Amplitude, Spinal Manipulative Therapy: A Prospective Observational Cohort Study with One-Year Follow-up. *J Manipulative Physiol Ther* 2014; 37: 155-163.

[22] **Licciardone J, Minotti D E, Gatchel R J, Kearns C M, Singh K P.** Osteopathic Manual Treatment and Ultrasound Therapy for Chronic Low Back Pain: A Randomized Controlled Trial. *Ann Fam Med* 2013; 11:122-129.

[23] **Maitland G, Hengenveld E, Banks K and English K.:** Maitland's vertebral manipulation, Butterworth Heinneman, Oxford 2001, pp: 351-380.

[24] **McGill S.** Low back disorders: Evidence-based prevention and rehabilitation. 2nd edition, 2007. Human kinetics. Ontario.

[25] **McMorland G, Suter E, Casha S, Du Plessis S J, Hurlbert R J.** Manipulation or Microdiskectomy for Sciatica? A Prospective Randomized Clinical Study. *J Manipulative Physiol Ther* 2010; 33: 576-584.

[26] **Merepeza A.** Effects of spinal manipulation versus therapeutic exercise on adults with chronic low back pain: a literature review. *J Can Chiropr Assoc* 2014; 58(4): 456–466.

[27] **Perry J, Green A, Singh S, Watson P.** A preliminary investigation into the magnitude of effect of lumbar extension exercises and a segmental rotatory manipulation on sympathetic nervous system activity. *Manual Therapy* 2011; 16: 190-195.

[28] **Peterson C K, Leemann S, Lechmann M, Pfirrmann C W A, Hodler J, Humphreys B K.** Symptomatic Magnetic Resonance Imaging–Confirmed Lumbar Disk Herniation Patients: A Comparative Effectiveness Prospective Observational Study of 2 Age-and Sex-Matched Cohorts Treated with Either High-Velocity, Low-Amplitude Spinal Manipulative Therapy or Imaging-Guided Lumbar Nerve Root Injections. *J Manipulative Physiol Ther* 2013; 36: 218-225.

[29] **Sadovsky R:** Clinically Important Changes in Pain Severity on VAS. *American Academy of Family Physicians* 2002; 65(9): 1916-1921.

[30] **Stevinson C, Ernst E:** Risks Associated with Spinal Manipulation. The American Journal of Medicine 2002; 112: 566-571.

[31] **Wilco C Peul, Wilbert B van den Hout, Ronald Brand, Ralph T W M Thomeer, Bart W Koes:** Surgery versus Prolonged Conservative Treatment for Sciatica The new England journal of medicine 356(22), 2007, p 2245-2256.

[32] **Wilco C Peul, Wilbert B van den Hout, Ronald Brand, Ralph T W M Thomeer, Bart W Koes:** Prolonged conservative care versus early surgery in patients with sciatica caused by lumbar disc herniation: two year results of a randomised controlled trial. *BMJ* 2008; 336: 1355–1358.