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ORIGINAL RESEARCH

Effect of spinal mobilization with leg movement as an adjunct to neural mobilization and conventional therapy in patients with lumbar radiculopathy: Randomized controlled trial

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Abstract

Background: The purpose of the study was to find out whether spinal mobilization with leg movement as an adjunct to neural mobilization and conventional therapy could bring better outcome in patients when compared to conventional therapy or neural mobilization and conventional therapy.

Methods: 90 patients were selected randomly with lumbar radiculopathy. Duration of the study was for six weeks. The study included 3 groups, control group received back extension exercises and hot pack, experimental group 1 received neural mobilisation and conventional physiotherapy and experimental group 2 received SMWLM along with neural mobilisation and conventional physiotherapy. The outcomes included NPRS, SLR using goniometry and MOLBPQ which were assessed at day 1 and 2, 4, 6 week. ANOVA was done for inter group analysis and paired t-test was done for intra group analysis.

Results: All the groups showed significant difference (P -0.000 < 0.05) at 2, 4, 6 weeks of NPRS, MOLBPQ and SLR. The mean difference and paired t-test values of experimental group 2 was more when compared to experimental group 1 and control group at the end of 6 weeks.

Conclusion: All the three groups showed improvement in pain, functional disability and straight leg raise (SLR). SMWLM as an adjunct to neural mobilization and conventional therapy showed significantly better outcomes in pain, functional disability and SLR when compared to conventional therapy or neural mobilization and conventional therapy.

Keywords: lumbar radiculopathy; spinal mobilization; leg movement; neural mobilization; conventional therapy

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Introduction

Lumbar radiculopathy can be described as low back pain radiating to one or both lower extremity. The level of spinal nerve root involvement indicates specific dermatomes affected. Radicular pain and nerve root pain can occur as a single symptom (pain) that can arise from one or more spinal nerve roots [1]. Lumbar disc herniation contributes 60-80% of lifetime incidence of low back pain in general population [2]. Lumbar radiculopathy has an incidence of 23.09% in India [3, 4]. Many physical therapy interventions have been used to treat low back pain due to lumbar radiculopathy including traction, stretching, strengthening exercises, warm water fermentation, modalities like IFT but with varying degrees of success [5-7]. Though there are numerous treatments for lumbar radiculopathy, no single intervention has been proven to be most efficient. Brian Mulligan's principle is based on "positional fault" [8]. In Mulligan's spinal mobilization with limb movements (SMWLM's) three therapist technique a sustained transverse glide is applied to the spinous process of specific spine while the restricted lower extremity movement is done simultaneously actively or passively.

Due to peripheral nerve compression the ability of the nerve to stretch and slide may be disrupted. Prolonged compression creates sequelae of intraneural events that may ultimately lead to impaired nerve sliding [9]. Neural mobilisation uses the Sliding Principle which was introduced by Shacklock, which consists of alteration of combined movements of two joints. These techniques aim to restore neural plasticity and lengthen the nerve bed by sliding the nerve. Neural tissue mobilization targets breaking adhesions in the structures present along the course of the nerve at the mechanical interface while the Mulligan concept corrects the positional fault at the spine. The effectiveness of these technique and clinical appropriateness is immediate reduction in pain and increase in mobility [10]. Studies have been conducted measuring the efficacy of Shacklock neural tissue mobilization and mulligan's spinal mobilization with leg movement separately. No studies have been conducted combining both the techniques.

Methods and study design

90 subjects were recruited from Physiotherapy out-patient department, Nizam's Institute of Medical Sciences, Hyderabad, India. Subjects with subacute and chronic low back pain with unilateral lumbar radiculopathy who were diagnosed with disc bulge, protruded/ prolapsed intervertebral disc were included in the study.

Inclusion criteria: Age of 20-55 years of both sexes, unilateral radiculopathy in the distribution of specific nerve with positive straight leg raise (SLR), positive slump test of specific nerve bias of lumbar region, positive prone knee bend test, mild to moderate pain on a scale of NPRS < 7, hypaesthesia in specific dermatome of unilateral lower limb and impaired deep tendon reflex (knee jerk, ankle jerk).

Exclusion criteria: Subjects diagnosed with rapidly progressing neurological symptoms, extruded disc, dementia or other cognitive impairment, inflammatory or other specific disorders of spine such as ankylosing spondylitis, paget's disease, vertebral collapse, rheumatoid arthritis, spondylolisthesis, severe osteoporosis, Tb spine, intermittent claudication, diabetic neuropathy, stenosis, sacroiliac joint pathology, previous spinal surgery, previous spinal injury causing radiculopathy, pathology of hip, knee and ankle and patient with known pregnancy and severe pain (NPRS > 7). More than one nerve root involvement, muscular involvement such as Piriformis syndrome, Red flags such as trauma, cancer, constitutional symptoms (fever, malaise, weight loss), recent infection, mental retardation, hemiparesis / hemiplegia.

The subjects were randomly assigned into three groups by lottery method who met the inclusion and exclusion criteria. Institutional Ethical Committee approval was taken. The allocations were concealed from the principal investigator. The outcome measures were single blinded and were taken by a physical therapist who was trained in taking the outcome measures. Informed consent was obtained from patient who met the criteria. Outcome measurements were Numeric Pain Rating Scale (NPRS) for pain intensity [11-13], Hip ROM during SLR- Universal Goniometer [14], back specific disability scores-Modified Oswestry Low Back Pain Questionnaire (MOLBPQ) [15]. Pre-treatment evaluation was done at the first day as baseline measurement. Group 1 included conventional therapy, Group 2 included neural tissue mobilization (NTM) and conventional therapy, Group 3 included

Spinal mobilization with leg movement (SMWLM) three therapist techniques along with NTM and conventional therapy (Figure 1). At the end of session (zero day), the subjects were assessed for any increase in pain. If, no, adverse response was reported, further sessions were carried out. There were four dropouts. At six weeks final readings of all outcome measures were taken and data analysis was done for final results.

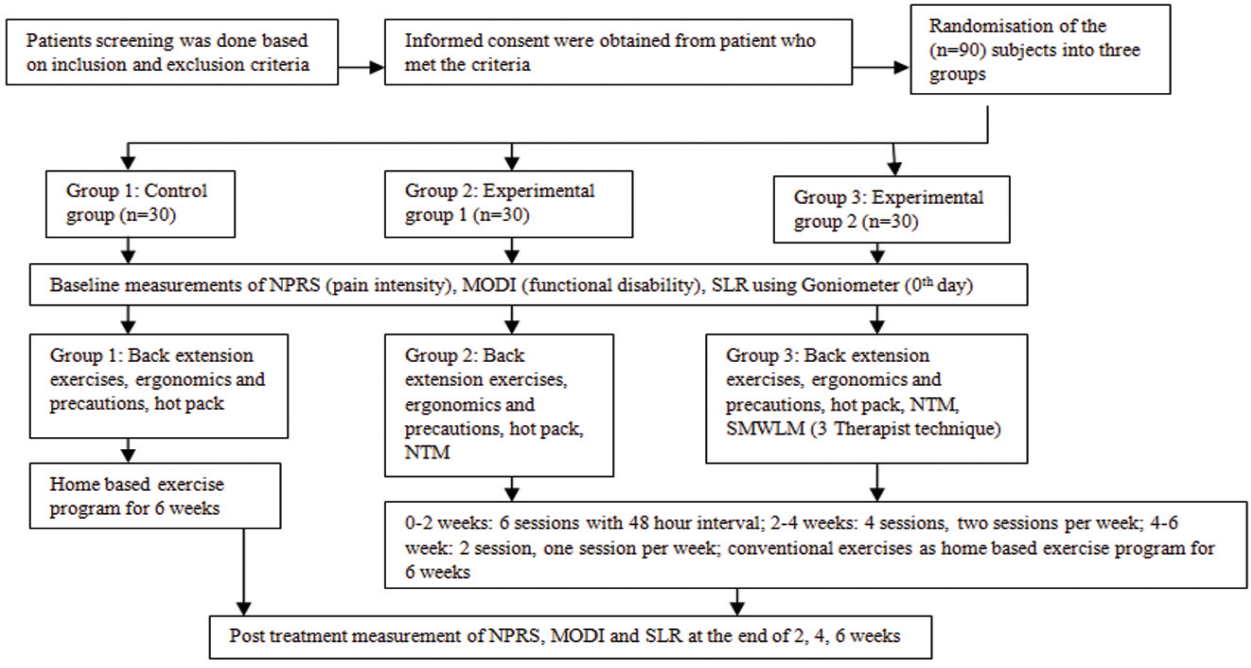

Figure 1: Consort flow chart of study.

Group 1 conventional therapy

Subjects received exercises which included back extension exercises: hyper extension of back (prone), hyper extension of back and flexion (kneel), extension opposite arm and leg [16], transverse abdominus contraction with pelvic floor muscle activation, superficial moist heat (hot pack) for 10 min, precaution and ergonomic advice [17]. These exercises were given as home programme to the subjects.

Dosage: 5 sets × 10 repetition with 2 min rest between each set for six weeks [18].

Group 2 neural tissue mobilisation and conventional therapy

Neural tissue mobilization was performed according to the norms/ guidelines by NDS, Australia [19]. Step 1- Sliders: Using unaffected joint (remote sequence, remote sliders). Affected joint is placed in neutral or symptom free position. Step 2- Sliders: Using unaffected joint (remote sequence, remote slider). Affected joint if placed some ROM but with or without minimal symptoms. Step 3- Sliders: (remote sequence, local sliders). Move affected area and any other area but with or without minimum symptoms.

Dosage: 30 sec to 2 min × 5 sets. Three days per week for two weeks. Two days per week from 2-4 weeks. One day per week from 4-6 weeks. Conventional therapy was given as home program to patients.

Group 3 SMWLM – 3 therapist technique, NTM & conventional therapy

SMWLM was performed according to norms/ guidelines by Mulligan's concept.

Dosage: Three set × 7 to 10 reps three days per week for two week. Two days per week from 2-4 weeks. One day per week from 4-6 weeks. Neural tissue mobilisation and conventional therapy was given as home program.

Results

Pain

There was no significant difference among control group, experimental group 1 and experimental group

2 on day 1 since f-value is 0.220 and P- value 0.803 is more than 0.05 (Table 1) (Figure 2). A significant difference exists among control group, group 1 and group 2 at week 2, 4, 6 since P-value 0.000 is less than 0.05. Since the paired t-test values of day 1 versus week 6 in control group, experimental group 1 and experimental group 2 are 12.776, 19.501 and 33.899 respectively and mean difference is more in experimental group 2 (Table 2). Hence there is significant improvement in pain reduction in the experimental group 2 when compared to experimental group 1 and control group.

Table 1: ANOVA test is used to test the significant mean difference between the groups of NPRS.

		Sum of squares	*df*	*Mean square*	*F*	*Significance*
NPRS day 1						
	Between groups	0.309	2	0.154	0.220	0.803
	Within groups	58.215	83	0.701		
	Total	58.523	85			
NPRS 2nd week						
	Between groups	195.419	2	97.709	76.820	0.000
	Within groups	105.569	83	1.272		
	Total	300.988	85			
NPRS 4th week						
	Between groups	159.845	2	79.923	87.521	0.000
	Within groups	75.794	83	0.913		
	Total	235.64	85			
NPRS 6th week						
	Between groups	97.635	2	48.818	63.630	0.000
	Within groups	63.679	83	0.767		
	Total	161.314	85			

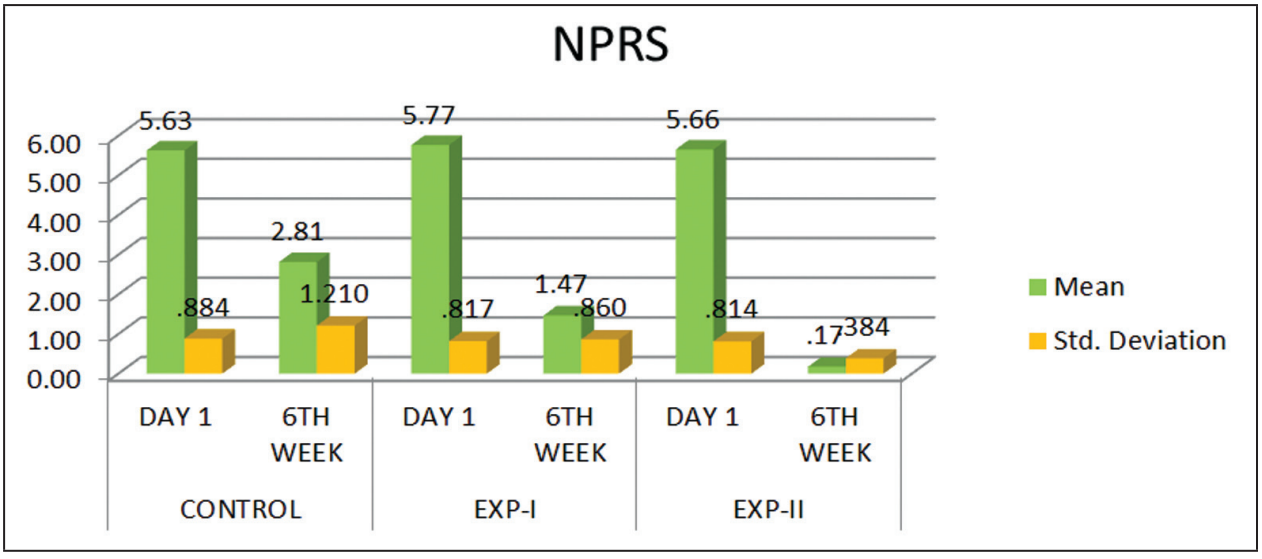

Figure 2: Paired t-test is used to test the significance mean difference in each group.

Modified oswestry low back pain questionnaire

There was no significant difference among control group, experimental group 1 and experimental group 2 on day 1 since F-value is 1.517 and its P-value 0.225 is more than 0.05 (Table 3) (Figure 3). A significant difference exists among control group, group 1 and group 2 at week 2, 4, 6 since P-value 0.000 is less than 0.05. Since the paired t-test values of day 1 versus week 6 in control group, experimental group 1 and experimental group 2 are

Table 2: Paired t-test is used to test the effectiveness of day 1 *vs* week 6 significance mean difference in each group like control, Experimental-1 and Experimental-2 of NPRS.

Group		*Mean*	*N*	*Standard deviation*	*Standard error mean*
Control	NPRS day 1	5.63	27	0.884	0.170
	NPRS 6th week	2.81	27	1.210	0.233
Experimental 1	NPRS day 1	5.77	30	0.817	0.149
	NPRS 6th week	1.47	30	0.860	0.157
Experimental 2	NPRS day 1	5.66	29	0.814	0.151
	NPRS 6th week	0.17	29	0.384	0.071

Group		*Paired differences mean*	*t*	*Df*	*Significant (2-tailed)*
Control	NPRS day 1 - NPRS 6th week	2.815	12.776	26.000	0.000
Experimental 1	NPRS day 1 - NPRS 6th week	4.300	19.501	29.000	0.000
Experimental 2	NPRS day 1 - NPRS 6th week	5.483	33.899	28.000	0.000

Table 3: ANOVA test is used to test the significant mean difference between the groups of MOLBPQ.

		Sum of squares	*df*	*Mean square*	*F*	*Significance*
MOLBPQ day 1						
	Between groups	232.838	2	116.419	1.517	0.225
	Within groups	6371.499	83	76.765		
	Total	6604.337	85			
MOLBPQ 2nd week						
	Between groups	866.921	2	433.461	7.361	0.001
	Within groups	4887.834	83	58.890		
	Total	5754.756	85			
MOLBPQ 4th week						
	Between groups	1140.277	2	570.139	12.987	0.000
	Within groups	3643.862	83	43.902		
	Total	4784.14	85			
MOLBPQ 6th week						
	Between groups	1781.062	2	890.531	25.470	0.000
	Within groups	2901.972	83	34.964		
	Total	4683.035	85			

9.421, 14.960 and 21.495 respectively and mean difference is more in experimental group 2 (Table 4). Hence there is significant improvement in MOLBPQ in the experimental group 2 when compared to experimental group 1 and control group.

Straight leg raise

There was no significant difference among control group, experimental group 1 and experimental group 2 on day 1 Since F-value is 2.733 and its P-value 0.071 is more than 0.05 (Table 5) (Figure 4). A significant

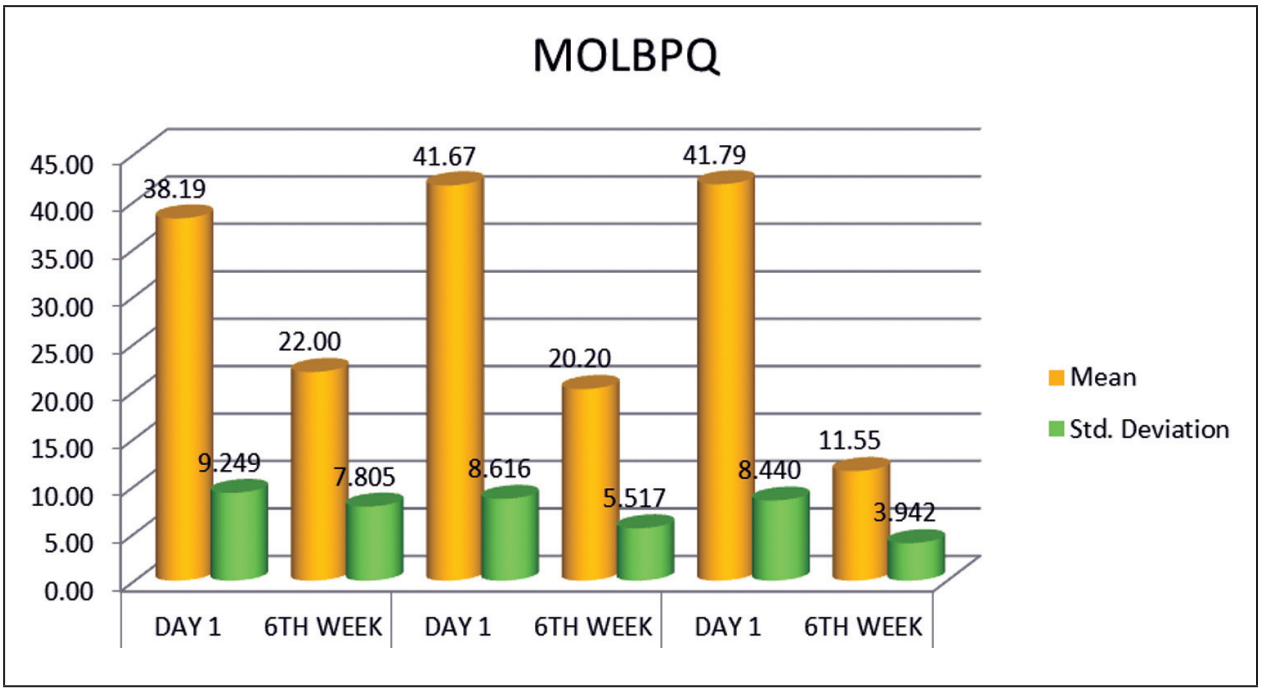

Figure 3: Paired t-test is used to test the significance mean difference in each group.

Table 4: Paired t-test is used to test the effectiveness of day1 Vs week 6 significance mean difference in each group like control, Experimental-1 and Experimental-2 MOLBPQ.

Group		*Mean*	*N*	*Standard Deviation*	*Standard Error mean*
Control	MOLBPQ day 1	38.19	27	9.249	1.78
	MOLBPQ 6th week	22	27	7.805	1.502
Experimental 1	MOLBPQ day 1	41.67	30	8.616	1.573
	MOLBPQ 6th week	20.2	30	5.517	1.007
Experimental 2	MOLBPQ DAY 1	41.79	29	8.44	1.567
	MOLBPQ 6th week	11.55	29	3.942	0.732

Group		*Paired differences mean*	*t*	*df*	*Significant (2-tailed)*
Control	MOLBPQ day 1 - MOLBPQ 6th week	16.185	9.421	26	0.000
Experimental 1	MOLBPQ day 1 - MOLBPQ 6th week	21.467	14.960	29	0.000
Experimental 2	MOLBPQ day 1 - MOLBPQ 6th week	30.241	21.495	28	0.000

difference exists among control group, group 1 and group 2 at week 2, 4, 6 since P-value 0.000 is less than 0.05. Since the paired t-test values of day 1 versus week 6 in control group, experimental group 1 and experimental group 2 are -12.126, -13.102 and -20.810 respectively and mean difference is more in experimental group 2 (Table 6). Hence there is significant improvement in SLR in the experimental group 2 when compared to experimental group 1 and control group.

Table 5: ANOVA test is used to test the significant mean difference between the groups of SLR.

		Sum of squares	*df*	*Mean square*	*F*	*Significance*
SLR day 1						
	Between groups	422.120	2	211.060	2.733	0.071
	Within groups	6409.275	83	77.220		
	Total	6831.395	85			
SLR 2nd week						
	Between groups	7295.524	2	3647.762	58.871	0.000
	Within groups	5142.848	83	61.962		
	Total	12438.372	85			
SLR 4th week						
	Between groups	3834.521	2	1917.260	35.992	0.000
	Within groups	4421.293	83	53.269		
	Total	8255.814	85			
SLR 6th week						
	Between groups	1124.600	2	562.300	13.361	0.000
	Within groups	3493.132	83	42.086		
	Total	4617.733	85			

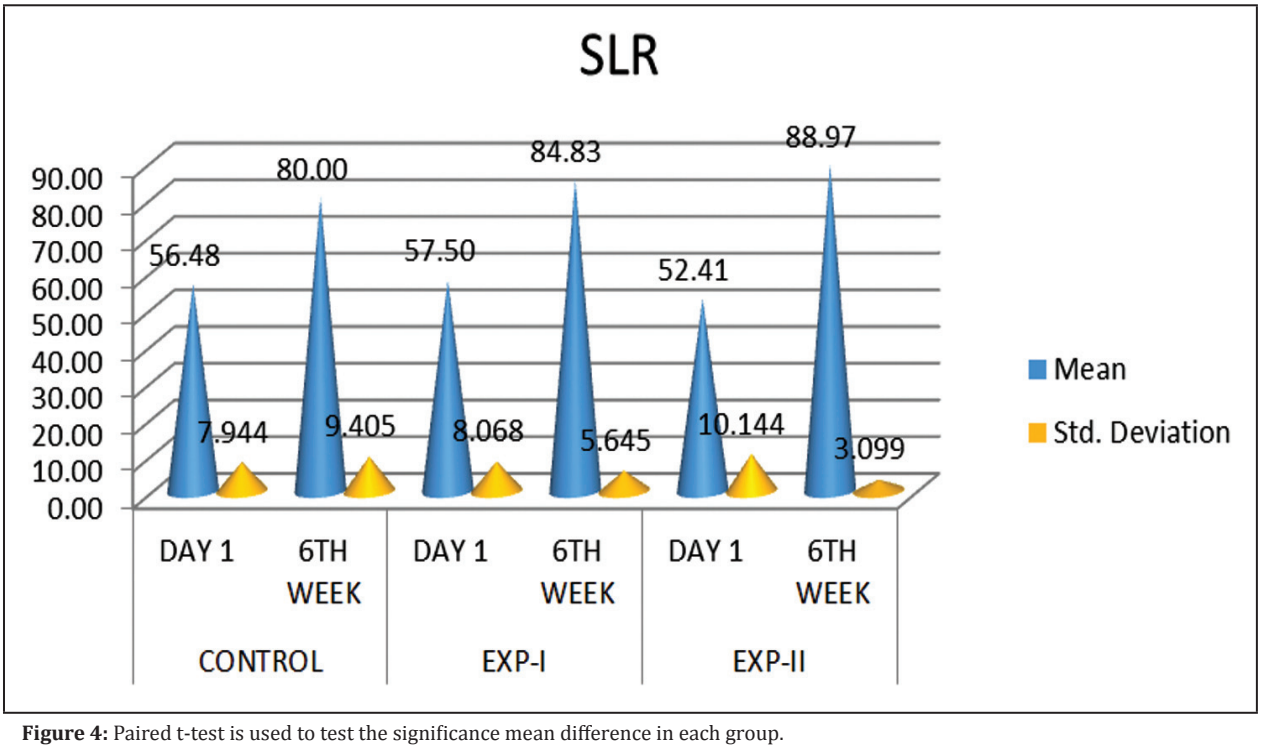

Figure 4: Paired t-test is used to test the significance mean difference in each group.

Table 6: Paired t-test is used to test the effectiveness of day 1 Vs week 6 significance mean difference in each group like control, Experimental-1 and Experimental-2 SLR.

Group		*Mean*	*N*	*Standard deviation*	*Standard error mean*
Control	SLR day 1	56.48	27	7.944	1.529
	SLR 6th week	80	27	9.405	1.81
Experimental 1	SLR day 1	57.5	30	8.068	1.473
	SLR 6th week	84.83	30	5.645	1.031
Experimental 2	SLR day 1	52.41	29	10.144	1.884
	SLR 6th week	88.97	29	3.099	0.576
Group		*Paired differences mean*	*t*	*df*	*Significant (2-tailed)*
Control	SLR day 1 - SLR 6th week	-23.519	-12.126	26.000	0.000
Experimental 1	SLR day 1 - SLR 6th week	-27.333	-13.102	29.000	0.000
Experimental 2	SLR day 1 - SLR 6th week	-36.552	-20.810	28.000	0.000

Discussion

The findings of the study indicate that SMWLM three therapist technique as an adjunct to neural mobilization and conventional therapy (experimental group 2) showed significant improvement in pain, functional disability and SLR when compared to neural mobilization with conventional therapy (experimental group 1) and conventional therapy (control group). This supports that both spinal manipulation and neural mobilization techniques have a role in the treatment of lumbar radiculopathy. This is in agreement with Waleed who compared the effect of neural mobilization versus spinal mobilization in patients with radicular chronic low back pain [20]. Spinal mobilization and neural mobilization both were effective in improving the symptoms but spinal mobilization showed an immediate effect. This might be due to correction of positional fault done by SMWLM at the spinal level whereas neural mobilization worked on restoring the mobility of the nerve to its mechanical interface which was compressed due to herniated disc resulting in pain. The minor positional fault might have caused pressure on pain-sensitive structures and nerve roots. In SMWLM, rotation glide was used which might have increased the space of intervertebral for amen by opening intervertebral position and thereby decompressing the nerve roots. This is in agreement with the biomechanical study done by Fujiwara et al. who showed that axial rotation increased intervertebral foramen height and area at the side opposite to the rotation [21]. The neurophysiologic mechanism is another mechanism by which SMWLM has been believed to relieve pain [22].

Experimental group 1 and 2 were treated with neural mobilization technique showed improvement in pain and SLR as neural mobilization has a positive impact on restoring mobility of the nerve and this might have improved neural tissue gliding with respect to its interface [23]. Gladson et al., mentioned that compression of nerve root leads to decreased microcirculation resulting in neural edema and demyelination. The short oscillatory movements in neural mobilization help to reduce neural tissue hypoxia and reduce inflammation. In addition, there is a hypothesis that nerve movement within pain-free variation can help to reduce mechanosensitivity of the nerve [24]. Therefore neural mobilization improves altered circulation to neural tissue and altered axonal transport dynamics by breaking adhesions hence correcting pathophysiology and relieving pain and improving SLR in patients in group 2 and 3.

Although conventional therapy, neural mobilization have an effect in decreasing low back pain, functional disability and improving SLR, however SMWLM as an adjunct to neural mobilization and conventional therapy showed better results than conventional therapy or neural mobilization with

conventional therapy. It could be attributed to clear effect of SMWLM that produced greater hypoalgesia than other exercises. It was hypothesized that manipulation inhibits pain at dorsal horn of spinal cord by altering neuroplasticity of the nerve and central sensitization. Spinal mobilization may provide a stimulus that acts as counter-irritant to C fiber-mediated pain [25].

Conclusion

All the three groups showed improvement in pain, functional disability and SLR. SMWLM as an adjunct to neural mobilization and conventional therapy showed significantly better outcomes and was more effective in improving pain, functional disability and SLR when compared to conventional therapy or neural mobilization and conventional therapy.

Conflicts of interest

Authors declare no conflicts of interest.

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