Original Article

# EFFECTIVENESS OF SPINAL MOBILIZATION WITH LEG MOVEMENT (SMWLM) IN PATIENTS WITH LUMBAR RADICULOPATHY (L5 / S1 NERVE ROOT) IN LUMBAR DISC HERNIATION

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## ABSTRACT

**Background**: Various manual therapy techniques are known to treat discogenic pain. Research is limited and controversial in the effectiveness of manual therapy for treatment of lumbar radiculopathy due to lumbar disc disease. In manual therapy, Mulligan has described spinal mobilisation with leg movement technique, for improvement in lumbar lesion resulting in pain and other signs below knee.

**Purpose of the study:** To find out if Mulligan's Spinal Mobilisation with Leg Movement technique (SMWLM) in conjunction with conventional treatment is better than conventional treatment alone in improving leg pain intensity (VAS), localization of leg pain (body diagram by Donelson), back specific disability (RMQ) in patients with lumbar radiculopathy ($L_5$/ $S_1$ nerve root) in lumbar disc herniation.

**Methods:** The study is a randomized controlled trial performed on 30 patients with lumbar radiculopathy. Both the groups received back extension exercises, hot pack, precautions and ergonomic advice. The experimental group received SMWLM technique in addition to the conventional treatment. Outcomes included leg pain intensity, Roland Morris Questionnaire and body diagram by Donelson.

**Results:** There was significant improvement in VAS (p=0.000), body diagram (p=0.000 for experimental group and p=0.003 for conventional group) and Roland Morris Questionnaire score (p=0.000) within the groups. Between group analysis showed significant improvement in VAS (p=0.000), body diagram score (p=0.000). Although there was significant improvement in Roland Morris Questionnaire score within the groups but there is no significant difference between the group (p=0.070).

**Conclusion:** Spinal Mobilization with Leg Movement technique in addition to conventional physical therapy produced significant improvement in leg pain intensity, location of pain and back specific disability in patients with lumbar radiculopathy in lumbar disc herniation.

**KEYWORDS:** Lumbar disc herniation, Lumbar radiculopathy, Manual therapy, physical therapy, Spinal Mobilization with Leg Movement.

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## INTRODUCTION

Low back pain is the second leading reason why primary care consultation is sought [1] and one of the most common reason for low back pain is herniation of intervertebral disc in spinal canal [2]. Lumbar disc herniation is believed to be a major contributor to the estimated 60-80% of lifetime incidence of low back pain in general population. [3] The annual incidence of lumbar disc herniation has been estimated to be 1% of the total population.[2,4]

Cost of treatment of low back pain in United States is estimated to be approximately 31 billion dollars per year and disc related disorders of

spine are estimated to comprise a high percentage of low back pain population.[5] Symptomatic lumbar disc disease is responsible for tremendous cost to society. Lumbar disc herniation is among the most common causes of sciatica.[2] More than 90% of these radicular lesions are protruded intervertebral discs.[6] Patients with lumbar radiculopathy represent large segment of population who consume care costs related to lumbar disc disease. [3]

Various operative and non-operative treatment strategies have been tried for lumbar disc herniation with varying degrees of success. Treatment often involves patient education, physical therapy, alternative medicine options, and pharmacotherapy. During the past several decades, the pendulum regarding the best treatment with which to treat lumbar disc herniation has shifted between surgery and physical therapy. [2]

Non operative treatment has been demonstrated to be beneficial in more than 50% of patients with sciatica.[7] Weber found that a period of 3 months was necessary to decide whether nonoperative therapy would provide satisfactory results. If no or little improvement occurred during this period, then the patient would be a good candidate for surgical intervention.[2]

Physiotherapy is one of the major components of non operative treatment. Literature is available for beneficial effect of physical therapy in management of lumbar disc herniation. It not only reduces pain but it also limit days off from work. [2]

Manual therapy is widely used in the treatment of back disorders. Despite the widespread use of manual therapy in clinical setting, very little is known about the efficacy of these procedures.

Various manual therapy techniques are believed to treat discogenic pain. Research is limited and controversial in the effectiveness of manual therapy for treatment of lumbar radiculopathy in lumbar disc herniation.

Mulligan has described a mobilization technique, spinal mobilisation with leg movement, for improvement in lumbar lesion resulting in pain and other signs below knee.[8] Efficacy of mulligan technique is theorized. There is paucity of research evidence supporting its efficacy and are dominated by case report publication. There has been no randomized controlled trial to see its effect on lumbar radiculopathy in lumbar disc herniation which is the purpose of the present study.

## MATERIALS AND METHODS

We recruited 30 subjects from Indian Spinal Injury Centre, New Delhi and Bara Hindu Rao Hospital, Delhi. Subjects with subacute low back pain with lumbar radiculopathy who were diagnosed with prolapsed intervertebral disc by an orthopaedician were included in the study.

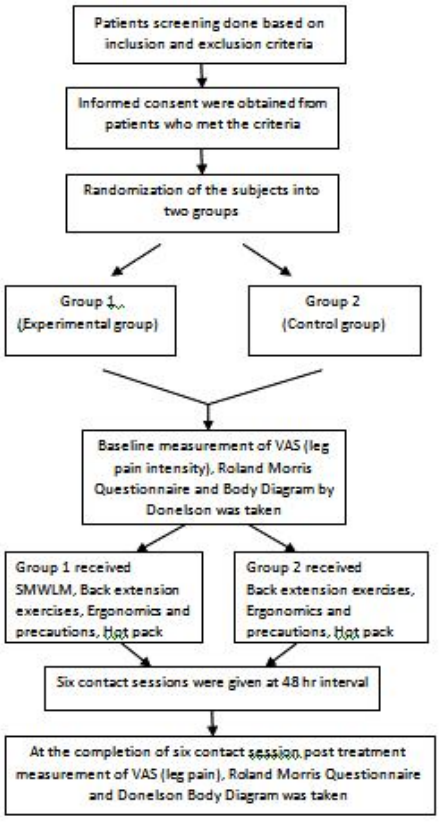
Criteria for inclusion were age of 20-50 years, unilateral radiculopathy, pain in distribution of specific nerve also without provocation of SLR, able to read and understand english. Pain was accepted as evidence of $L_5$ root compression when distributed to anterolateral aspect of calf and to dorsum of foot and as evidence to $S_1$ root compression when distributed to posterior aspect of calf extending to the heel and lateral aspect of the foot. [9] If pain did not extend below the ankle, at least one additional neurological sign was demanded for the patient to be included [9]. These signs were for the $L_5$ root: Hypaesthesia in the dorsum of the foot, weakness of dorsiflexion of foot or first toe, impaired medial hamstring reflex. For the $S_1$ roots the signs were: Hypaesthesia at the lateral aspect of the foot, weakness of the plantarflexion of the foot or first toe, impaired achilles tendon reflex.

Exclusion criteria included subjects diagnosed with rapidly progressing neurological symptoms, dementia or other cognitive impairment, bladder or bowel disturbances, inflammatory or other specific disorders of spine such as ankylosing spondylitis, paget's, vertebral collapse, rheumatoid arthritis, stenosis, spondylolisthesis, osteoporosis, previous spinal surgery. Subjects with known pregnancy, severe pain (VAS > 74mm), more than one nerve root involvement, and prescence of red flags (History of significant trauma, cancer, constitutional symptoms (Fever, malaise, weight loss), recent infection, bladder and/or bowel dysfunction, saddle anaesthesia, unremitting pain ). [2]

The subjects were randomly assigned in the treatment group with every odd subject assigned to the SMWLM therapy group (group 1), every even subject assigned to the conventional therapy group (group 2). Baseline measurements for leg pain intensity (VAS), back specific disability (Roland Morris Questionnaire) and localization of leg pain (Body diagram by Donelson) were taken for every patient.

Patients received treatment protocol as per the group assigned to them. Group 1 included SMWLM technique, back extension exercises, precautions and ergonomic advice and hot pack. Prior to the application of the technique patients were warned to report against any increase in pain with the treatment. At the end of the session, the subjects were assessed for any increase in pain. If, no adverse response was reported, further sessions were carried out. Six sessions of SMWLM were given with 48 hour interval between each session. After six contact sessions, final readings of all outcome measures were taken for both the groups.

**Procedure:**




**flow chart showing procedure**

**Fig. 1:** SMWLM technique.

**Group 1:** (SMWLM with conventional therapy) received Spinal Mobilization with Leg Movement technique performed in side lying, with the affected leg uppermost. Patient lies facing the therapist, and an assistant therapist supporting his affected leg (Figure 1). Therapist flexes over patient and places one thumb reinforced over other on the spinous process of the chosen vertebra ($L_4/L_5$ vertebra) as palpated with reference to posterior superior iliac crest. The therapist then pushes down on the chosen spinous process. This pressure is sustained and the patient actively performs SLR for the leg supported by the assistant provided there is no pain. If this approach is successful, on subsequent visits, as the patient improves, assistant applies overpressure, provided there is no discomfort. On day one, three repetition are only applied.[8] On subsequent days three sets of six repetition will be applied. Six sessions with 48 hr interval between each were given.

Subjects received back extension exercises. These included hyperextension of the back (prone position), hyperextension of back in kneeling position, flexion of back in kneeling, extension of hip in kneeling, extension opposite arm and leg [10]. Exercises were given in five sets of 10 repetitions with 2 minute rest between each set [5]. Hot pack was given for 15 minutes. Precautions and ergonomic advice were explained to the subjects. [11]

**Group 2:** (conventional therapy group) received back extension exercises, hot pack and precautions and ergonomic advice same as that in group 1. No mobilization (SMWLM) was given to the patients in group 2.

### Data Analysis:

The Statistical Package of Social Sciences (SPSS) for windows version 19.0 was used to analyze the data. Analysis was done for 30 subjects who completed the study. The outcome variables of the study included leg pain intensity on VAS, Body Diagram by Donelson and Roland Morris Questionnaire.

Paired t-test was used for comparing the pre-treatment and post-treatment scores of each variable for both the groups (within group analysis). Independent t-test was performed to check the homogeneity of subjects before intervention and also to compare the effect of both the intervention on the various outcome (between group analysis).

Statistical significance was set at $P < 0.05$. P value $> 0.05$ was considered as non significant difference while P value $\leq 0.05$ was considered to have represented a significant difference. Value of confidence interval was set at 95%.

## RESULTS AND TABLES

The data in the study was normally distributed. Demographic characteristics showed that there was no significant difference in mean scores of age between the groups. Baseline values (pre-treatment) showed no significant difference in leg pain intensity (VAS), body diagram by Donelson and RMQ between the two groups.

Paired t-test for the pre and post test comparisons revealed a significant improvement in VAS-leg pain ($p = 0.000$), RMQ score ($p = 0.000$) and Body diagram scores ($p = 0.000$) in group 1(Table 1, Graph 1). In group 2 there was significant improvement in VAS-leg pain ($p = 0.000$), RMQ score ($p = 0.000$) and Body diagram scores ($p = 0.003$). (Table 2, Graph 2)

**Table 1:** Within group analysis of group 1.

| Groups | | Mean ± S.D | t value | Sig. ( p value) |
|---|---|---|---|---|
| VAS | Pre test | 63.56 ± 6.54 | 12.894 | 0.000* |
| | Post test | 32.73 ± 10.09 | | |
| B.D | Pre test | 4.80 ± .414 | 10.583 | 0.000* |
| | Post test | 3.47 ± .640 | | |
| RMQ | Pre test | 10.40 ± 3.52 | 10.212 | 0.000* |
| | Post test | 5.60 ± 2.69 | | |

**Graph 1:** Within group analysis of group 1.

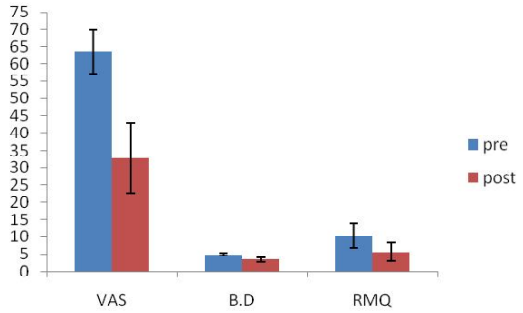
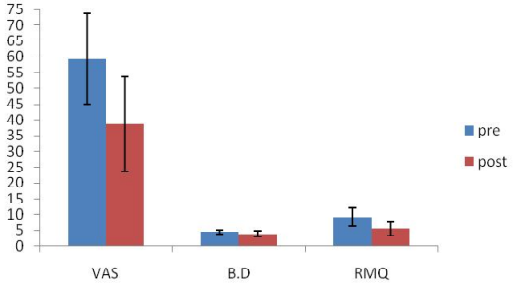



**Table 2:** Within group analysis of group 2.

| Groups | | Mean ± S.D | t value | Sig. (p value) |
|---|---|---|---|---|
| VAS | Pre test | 59.33 + 14.30 | 13.225 | 0.000* |
| | Post test | 38.66 + 15.00 | | |
| B.D | Pre test | 4.47 ± .640 | 3.674 | 0.003* |
| | Post test | 3.87 ± .834 | | |
| RMQ | Pre test | 9.20 ± 2.93 | 9.811 | 0.000* |
| | Post test | 5.53 ± 2.23 | | |

**Graph 2:** Within group analysis of group 2.

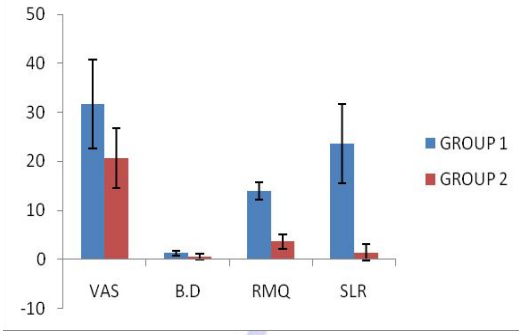



Independent t-test for between group comparisons was done for difference of pre-test and post-test reading between the two groups for each outcome measure. The results revealed significant differences in VAS for leg pain intensity ($p = 0.000$) and Body diagram ($p = 0.001$). There was no significant difference in the RMQ score between the groups ($p = 0.070$). (Table 3, Graph 3).

**Table 3:** Independent t-test for between group analysis.

| Outcome Measure | Mean ± S.D | | t value | Sig. (p value) |
|---|---|---|---|---|
| | Group 1 | Group 2 | | |
| VAS | 31.73 ± 9.04 | 20 ± 6.052 | 3.938 | 0.000* |
| Body Diagram | 1.33 ± 0.48 | 0.600 ± 0.63 | 3.556 | 0.001* |
| RMQ | 4.80 ± 1.82 | 3.66 ± 1.44 | 1.887 | $0.070^{NS}$ |

**Graph 3:** Between group analysis of group 1 & group 2.




The results, thus indicate that both the groups improved in VAS (leg pain), Body diagram score and RMQ score, but, the improvement in SMWLM group was more significant in the VAS and B.D score compared to the conventional group. And, there was no significant difference in RMQ score between the two groups.

## DISCUSSION

In the SMWLM group, there were significant improvements in the VAS score (leg pain intensity), localization of pain, and SLR as compared to the conventional therapy group. Vincenzino proposed that Mulligan techniques helps in improving patient's symptoms by correcting minor positional fault and by neurophysiologic mechanism. [12]

In the present study, improvements in leg pain intensity and location of pain can be attributed to the effects of SMWLM technique. The SMWLM technique might have corrected a small positional fault which frees the pressure off the structures that produce the pain and limitation [13]. This might have relieved the radicular pain caused by the compression of the nerve and may have also reduced the extent of pain by centralization.

The SLR is strongly correlated with the severity of leg pain and thus it also showed improvement, because of mechanical compression of nerve root, especially at dorsal root ganglion that was relieved by the rotation produced manually during application of SMWLM technique. [14]

Rotational glide has been utilized for treatment of lumbar radiculopathy and there are case reports showing the effectiveness of rotational glide in treatment of sciatica due to disc herniation [15]. A biomechanical study by Fujiwara et al has showed that axial rotation increases the intervertebral foramen height and area at the side opposite to the rotation.[16] Thus, reinforcing the fact that the rotational glide might have increased the space of intervertebral foramen. Hence, pain relief could be explained by restoration of vertebral position and decompression of nerve root by opening the intervertebral position. [14]

One of the pain relief models in manipulative therapy states that manipulation improves joint mobility and thus reduces pain.[17] Mulligan has also stated that if the facet joints are hypomobile, when flexion takes place, the disc will bulge posteriorly causing symptoms like pain. And, if there was a weakness in the posterior wall of disc, then even greater problems will arise from facet hypomobility. [18] It has been shown that during rotation of lumbar vertebra, there is movement of facet joint, increasing the gap in facet joint opposite to direction of rotation.[19] Thus, it is logical that SMWLM would also address hypomobility of facet joint and hence contribute in relieving pain.

When external force is applied, the nucleus is capable of deformation in all directions. Rotation of intervertebral segment creates simultaneous tension and approximation in alternate layers of annulus. Theoretically, the mechanical deformation in the lumbar spine is being reduced either by stretching or compressing deformed soft tissue. Rotational movements applied to lumbar spine motion segment can therefore produce favourable therapeutic effects on intervertebral disc. [20] Senthil P. Kumar et al stated that structurally when torque is applied in the form of rotation to lumbar motion segment, the collagenous structures particularly the alternate layers of annulus are stretched. Further if rotation of segment reduces the mechanical deformation of injured annular collagen fibers and their associated nociceptive endings, symptom reduction should follow. [14]

Neurophysiologic mechanism is another mechanism by which MWM has been believed to relieve pain. According to paungmali et al MWM produces a hypoalgesia and concurrent sympathoexcitation.[21] This finding of initial sympathoexcitation was similar to that reported previously with oscillatory manual therapy of cervical spine. It has been previously proposed

that the combination sympathoexcitation, non opioid hypoalgesia and improvement in motor function are indirect signs of possible involvement of endogenous pain inhibitory systems in manual therapy treatment effects. [12]

In one of the case reports by Brian R. Mulligan, SMWLM was given in the side lying position to a subject having bilateral radiculopathy. This study showed that there was significant improvement in leg pain and SLR within two and a half week of physical therapy treatment given on alternate days.[13]

Another case study by Brian R. Mulligan showed the efficacy of SMWLM technique, given in prone lying on a subject with unilateral radiculopathy. After three sessions over a period of six weeks the patient had retained most of her improved SLR and was able to walk with less pain. This modification of doing SMWLM was done as the patient was not able to perform SLR in side lying due to pain. It was stated that this modification should not replace the side lying method as both the technique have their place in the manual therapy. [22]

Results of the case studies by Brian R. Mullian on SMWLM application in patients with lumbar radiculopathy mentioned above and present study are in concordance.

Although there was no statistically significant difference in RMQ score between the groups, the mean score for RMQ in SMWLM group were better than the conventional therapy group. Also, number of patients who could reach the minimal clinically important difference (MCID) were more in the SMWLM group than in the conventionally treated group. The minimal clinically important difference for RMQ is five points. This indicates that clinically meaningful change has occurred when the RMQ scored has changed by 5 points or more. [23,24] In the present study, eight subjects in the SMWLM group reached the MCID as opposed to only five subjects reaching the MCID in the conventionally treated group.

In the present study, no particular order was followed for the application of hot pack. This was done to eliminate the order effect in the study.

**Limitation of the study**:

1. Smaller sample size.

2. No follow up was done. Hence, long term effects of SMWLM technique cannot be commented on.

3. Positional fault could not be measured objectively.

**Recommendation for further research:**

1. Further studies may be done with larger sample size.

2. Long term follow up of the patients is recommended in further studies to see the long term effects of the SMWLM technique.

Further studies can be done to determine the efficacy of the technique in patients with more than one nerve root involvement, applying the technique at more than one level.[3]

## CONCLUSION

In conclusion, SMWLM in conjunction with conventional therapy produced significantly more improvement in leg pain intensity, localization of leg pain and SLR over conventional therapy alone in patients with lumbar radiculopathy in lumbar disc herniation. Although, SMWLM did not produce significant improvement in RMQ score over the conventional therapy group, the mean scores and number of patients reaching MCID were better in SMWLM group. We recommend use of SMWLM technique in patients with lumbar radiculopathy in lumbar disc herniation for a better and more effective treatment of the population mentioned.

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**Conflicts of interest:** None

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