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Effect of Mulligan Bent Leg Raise Technique on Patients with Discogenic Sciatica

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Abstract

Background: Mulligan bent Leg raise (MBLR) is thought to have a positive therapeutic effect on pain, restricted straight leg raise (SLR), and affected nerve conduction in the patients with discogenic sciatica, due to altered neurodynamics and tightness of hamstring muscle, but there is not sufficient evidence to support that effectiveness.

Aim of Study: Was to investigate the effect of Mulligan bent leg raise on Pain intensity, Straight Leg Raise ROM, and Hoffmann reflex Latency in the patients with discogenic sciatica.

Patients and Methods: Thirty patients with chronic LBP with unilateral discogenic sciatica from both genders (12 females and 18 males) with ages ranged from 30 to 40 years old participated in this study. Randomly, participants were divided into two equal groups. Each group had fifteen patients and received three sessions per week for four weeks: (Study Group) (A): Was treated by Mulligan Bent Leg Raise Technique in addition to (Core Stabilization Exercises). (Control Group) (B): Was treated by Core Stabilization Exercises only. Three outcome measures (Visual Analog Scale, Straight Leg Raise ROM, and H-Reflex latency) were assessed pre and post treatment for both groups.

Results: There was a significant decrease in VAS and H reflex latency and a significant increase in SLR ROM in both groups compared with pretreatment ($p<0.001$). There was a significant decrease in VAS and H reflex latency and a significant increase in SLR ROM of study group compared with that of control group ($p<0.01$).

Conclusion: Adding Mulligan Bent Leg Raise to Core Stabilization Exercises has a significant effect in decreasing VAS and H reflex latency and increasing SLR ROM compared with Core Stabilization Exercises alone in the patients with discogenic sciatica.

Key Words: *Low Back Pain – Sciatica – Mulligan bent leg raise – Core Stabilization Exercises – Visual Analogue Scale – Straight Leg Raise – H-Reflex.*

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Introduction

LOW back pain (LBP) is a terrible health problem that is widely known. It is ranked top in the burden of musculoskeletal diseases globally. LBP is the main contributor to disability in both developing and developed countries, affecting people of all ages and genders **[1]**. More than half of the world's population has experienced LBP at least once in their lifetime, which highlights the severity of the issue **[2]**.

"Sciatica" is neuropathic leg pain that radiates below the knee and into the foot and toes **[3]**. This neuropathic leg pain is primarily caused by spinal pathology such as a herniated disc with resultant lumbosacral nerve root compression or spondylosis **[4,5]**.

The Visual Analog Scale (VAS), a recognized ratio measure of pain, is employed to measure the pain intensity. The 0-10 numeric version of VAS is a tool that is frequently used in in clinical research and therapeutic settings, due to its simplicity of administration **[6]**.

Straight Leg Raise (SLR) test is the most often performed physical test to assess nerve root irritation in the lumbosacral for those who report low back pain with or without radicular discomfort **[3,7,8]**. The passive straight leg raise (SLR) is extremely useful in determining hamstring flexibility, the hip joint range of motion other than the integrity of the sciatic nerve roots and analyzing low back pain **[9]**.

Hoffmann's reflex is a helpful electrophysiological test for detecting radiculopathy at the level of the lumbosacral spine in chronic low back pain patients, it is important to establish whether or not radiculopathy is present [10]. In individuals with radiculopathy, H-reflex latency prolongation or side-to-side changes likely suggest neural demyelination with severe damage to large diameter nerve axons. However, in the absence of significant demyelination, a lack of or reduced amplitude on the affected side is likely a sign of nerve conduction block [11].

Physical therapy is one of most important non-invasive treatment approaches for treatment of LBP patient with radiating pain. The frequent physical therapy interventions like TENS, short wave diathermy (SWD), low-level LASER therapy, and manual therapy such as Mulligan Bent Leg Raise [1,2].

Mulligan Bent Leg Raise technique was developed to treat hamstring tightness by increasing muscle stretching, hence increasing SLR ROM, reducing functional impairment, and alleviating the radiating pain to the knee [2]. MBLR is a useful method for releasing adhesions between the gluteus maximus, hamstring, and sciatic nerve. As a result, the sciatic nerve will be mobilized relative to these muscles without the nerve being stretched [12].

Core stabilization exercises (CSE) emphasize the co-activation of the transversus abdominis (TrA) and multifidus muscles. These deep stabilizing muscles give the spine segmental stability by attaching to the thoracolumbar fascia and raising intra-abdominal pressure, which stiffens the lumbar spine. In individuals with LBP, stabilization exercises may successfully modify postural deficits, reduce pain and disability, increase proprioception, and therefore raise the stability index [13].

Patients and Methods

This study was conducted in the Outpatient Clinic of Neurology, Faculty of Physical Therapy, Cairo University, Egypt from Feb. 2022 to Aug. 2022. Thirty patients of both genders (12 females and 18 males). Their ages ranged from 30 to 40 years old. They were divided randomly into two groups of equal size. The study Group (A) was treated by Mulligan Bent Leg Raise technique in addition (Core Stabilization Exercises). Control Group (B) was treated by Core Stabilization Exercises only. Both groups received 4 weeks of treatment (12 sessions, 3 sessions per week) every other day.

Inclusion criteria:

Age between 30 and 40 years old, a BMI of less than 30, chronic low back pain (for more than 3 months) diagnosed by MRI as having a lumbar disc bulge at the l5/S 1 level with nerve root entrapment and unilateral sciatica, and Limited SLR test after 30 degrees, they were eligible.

Exclusion criteria:

Patients with Red flags for a serious spinal condition (infection, tumors secondary metastases, osteoporosis, and spinal fracture) and Piriformis Syndrome. LBP caused by systemic or organic diseases, cancers, or psychiatric disorders, central nervous system involvement as upper motor neuron lesion. Participants were also excluded if they had any systemic disease as diabetes or neurological condition that alters the function of the nervous system. Patients who had nerve lesions of the lower limb. Hip or knee or ankle joints pathology causing limitation of movement. Pregnant females.

Instrumentation:

Instrumentation for assessment:

a- EMG Equipment was used to measure H-reflex Latency.

b- Visual Analogue Scale was used to measure Pain Intensity.

c- Goniometer was used to measure SLR ROM.

Instrumentation for treatment:

a- Mulligan Bent Leg Raise:

The Mulligan bent leg raise (BLR) technique is a useful way in people with LBP and/or referred thigh pain for alleviating pain, reducing disability and increasing range of motion in low back pain patients with radiculopathy. It was accomplished by extending the hamstrings further, which reduces the excessive stresses on the painful lumbar tissues and, as a result, permits more posterior pelvic rotation, which in turn increases lumbar mobility and lumbar flexion range of motion [14].

b- Core Stability Exercises:

Core stability was employed to strengthen the muscles in the abdominal, lumbar, and pelvic areas, as these muscles are crucial for stability and managing the lumbar posture by engaging tonic or postural muscles during full-body exercises [15]. Core stability may have significant therapeutic benefits in patients with non-specific chronic low back pain by reducing pain intensity, functional impairment, and enhancing quality of life, core muscle activation, and thickness [16].

Procedures:

Three outcome measures (Visual Analog Scale, Straight Leg Raising ROM, and H-Reflex latency) were assessed before and after one month of treatment for all participants in both groups.

Assessment Procedures:

a- H-Reflex:

The skin overlaying the locations of the recording electrodes on the rear portion of the leg was shaved to minimize skin impedance; the skin was first softly scrubbed with sandpaper to remove surface then alcohol. The patient lay on a comfortable bed in a prone laying position.

The head kept its place in the middle. The inspected leg was flexed at 20 degrees with the knee flexed halfway between abduction and adduction at the hip joint. A small cushion was placed beneath the leg to relax the gastrocnemius and lessen any potential depressing effects on the H-reflex [17].

The posterior tibial nerve was stimulated at the middle of popliteal fossa little bit to lateral aspect by applying extremely low stimulus intensities by a using percutaneous stimulation electrodes and placing the cathode proximal to the anode [17,18]. The recording was from Soleus muscle. Approximately two fingerbreadths distal to where the soleus meets the gastrocnemius's two bellies was the active recording electrode (R1). Reference electrode (R2) was placed over the Achilles tendon. The therapist used the adhesive plaster to adhere recording electrodes to the skin. The ground electrode (G) was positioned halfway between the stimulating electrode and the recording electrode [17].

Each participant's average soleus H-reflex latency to deflection was calculated from the biggest five typical traces recorded on both sides [10]. In determining the severity of a unilateral lesion, comparison with the other side is more helpful [19].

b- Straight Leg Raise ROM Test:

Participants lay on a table in a supine position, and an assistant passively raised their ipsilateral lower limb off the couch by flexing their hip, extending their knee, and maintaining their ankle in a neutral position [20]. When the SLR provokes pain spreading between 30 and 70 degrees of hip angle below the knee and along the sciatic nerve's route, it was considered positive [21]. Leg elevation was stopped when individuals experienced back or leg pain or paresthesia in the lower limb. The examiner then used a goniometer to measure the hip flexion degree. Over the greater trochanter, the fulcrum of goniometer was positioned, the fixed arm of the instrument placed horizontal to the table, whereas the moving arm of the instrument placed along the midline of the lateral aspect of the thigh. For data analysis, an average of three measurements was taken [22]. To enhance the test's sensitivity, additional maneuvers were described, such as foot dorsiflexion to increase the pain while the examiner had completed the leg raise [20].

c- Visual Analogue Scale:

The numeric visual analogue scale (VAS) allowed respondents to choose a whole number (0-10 integers) to indicate the intensity of their suffering. The 11-point numeric scale runs from "0," which represents the least amount of pain (for example, "no pain") to number "10," that denotes the greatest amount of pain. Respondents were asked to report either the average or degree of their pain [23].

Treatment Procedures:

a- Mulligan Bent Leg Raise:

Patient lay supine close to the edge of treatment table. The therapist supported the patient's flexed hip and knee of the injured side on his shoulder. The patient pushed down with their hip into progressively more flexed postures while the therapist applied resistance with their shoulder for a 5 second submaximal isometric contraction of the hamstrings. The therapist applied traction through the femur to help gain range between contractions. After that, the patient relaxed, and the hip was passively moved to a new point in range [24].

The process was repeated until maximal hip flexion range is achieved. Holding the position at the end of the range for 20 seconds, and then bringing the leg back to the beginning position. In the first session, repeat the procedure three times. 1 minute rest between each stretch. At the end the examiner reassessed the SLR in supine [25].

b- Core Stability Exercises:

The participants in both groups received Core Stability Exercises program for treatment [26-28]. It is consisted of: Abdominal brace exercise, abdominal bracing with heel slide, abdominal bracing with leg left, abdominal bracing with bridging, prone leg lift, cat and camel Exercise, and quadruped legs lift with abdominal brace.

At the session number 9, the examiner added the following exercises: Half bridge, star Exercise, superman Exercise, and forearm planks. These exercises were done for 1 set with 8 repetitions.

Statistical analysis:

Unpaired *t*-test was conducted for comparison of subject characteristics between groups. Chi squared test was conducted for comparison of sex and affected side distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Mixed MANOVA was conducted to investigate the effect of treatment on VAS, H reflex latency and SLR ROM. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. The level of significance for all statistical tests was set at $p<0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

Results

Subject characteristics:

Table (1) showed the subject characteristics of study and control groups. There was no significant difference between groups in age, BMI, sex and affected side distribution ($p>0.05$).

Table (1): Comparison of subject characteristics between study and control groups.

	Study group Mean ± SD	Control group Mean ± SD	MD	*t*-value	*p*-value
Age (years)	36.06±4.62	33.93±5.33	2.13	1.17	0.25
BMI (kg/m^2)	26.91±3.06	26.73±2.84	0.18	0.17	0.86
Sex, n (%):	165.06±9.84	166.22±7.95	–1.16	–0.39	0.69
Females	5 (33%)	7 (47%)		(χ^2=0.55)	0.45
Males	10 (67%)	8 (53%)			
Affected side, n (%):					
Right	9 (60%)	10 (67%)		(χ^2=0.14)	0.71
Left	6 (40%)	5 (33%)			

SD : Standard deviation.
MD: Mean difference.
$\chi 2$: Chi squared value.
p-value: Probability value.

Effect of treatment on VAS, H reflex latency and SLR ROM:

Mixed MANOVA revealed a significant interaction effect of treatment and time (F = 7.24, p = 0.001, Partial eta-squared = 0.45). There was a significant main effect of treatment (F = 3.5 7, p = 0.02, Partial eta-squared = 0.29). There was a significant main effect time (F = 173.46, p = 0.001, Partial eta-squared = 0.95).

Within group comparison:

There was a significant decrease in VAS and H reflex latency post treatment in both groups compared with that pretreatment ($p>0.001$). The percent of change in VAS and H reflex latency of study group was 74.44 and 17.07% respectively and that in control group was 54.32 and 7.15% respectively. (Table 2).

There was a significant increase in SLR ROM post treatment in both groups compared with that pretreatment ($p>0.001$). The percent of change in SLR ROM of study group was 54.59% and that in control group was 25.67%. (Table 2).

Between group comparison:

There was no significant difference between groups pretreatment ($p>0.05$). Comparison between groups post treatment revealed a significant decrease in VAS and H reflex latency and a significant increase in SLR ROM of study group compared with that of control group ($p<0.01$) (Table 2).

Table (2): Mean VAS, H reflex latency and SLR ROM pre and post treatment of study and control groups.

	Pre treatment Mean ± SD	Post treatment Mean ± SD	MD (95%CI)	*p*-value
VAS:				
Study group	6.26±0.88	1.6±0.82	4.66 (4.17: 5.16)	0.001
Control group	6.13±0.74	2.8±1.01	3.33 (2.83: 3.83)	0.001
MD (95%CI)	0.13 (–0.47: 0.74) *p*=0.65	–1.2 (–1.89: –0.51) *p*=0.001		
H reflex latency (ms):				
Study group	34.09±5.87	28.27±3.24	5.82 (3.92: 7.71)	0.001
Control group	33.7±3.03	31.29±3.26	2.41 (0.52: 4.3)	0.01
MD (95%CI)	0.39 (–3.11: 3.89) *p*=0.82	–3.02 (–5.44: –0.57) *p*=0.01		
SLR ROM (degrees):				
Study group	53.6±11.53	82.86±12.83	–29.26 (–35.29: –23.23)	0.001
Control group	52.2±12.21	65.6±10.8	–13.4 (–19.43: –7.36)	0.001
MD (95%CI)	1.4 (–7.48: 10.28) *p*=0.74	17.26 (8.39: 26.13) *p*=0.001		

SD : Standard deviation. CI: Confidence interval.
MD: Mean difference. *p*-value: Probability value.

Discussion

The purpose of this study was to investigate the effect of Mulligan bent leg raise on Pain intensity and SLR ROM, and Hoffmann reflex in patients with discogenic Sciatica at L5/S 1 level. The present study found that both the study and the control groups had a significant improvement to enhance pain level, straight leg raise ROM, and H-reflex latency in LBP patients with discogenic Sciatica at L5/S 1 level after 4 weeks of treatment. But the study group who received Mulligan Bent Leg Raise technique proved to be superior and more effective than the control group.

The reduction in the latency of the H-reflex after the application of Mulligan Bent Leg Raise may be attributed to that the neural mobilization restored the neurophysiological and mechanical functioning of the nerve. When the connective tissues around the nerve roots are stretched, the sensory fibers in the dorsal root are stimulated. This results in a summation of Ia afferent inputs in the spinal cord, which increases the response of the alpha motoneuron. As a result, there was an improvement in nerve conduction, which reduced the latency **[29]**.

There are a variety of opinions about the effectiveness of the Mulligan bent leg raise technique (MBLR) to reduce the pain intensity and increase SLR ROM. One explanation could be that these improvements result from the mobilization of highly sensitive, intense neural tissues, enhanced sciatic nerve mobility, stretching of myofascial structures, reduced mechanosensitivity of neural structures, and improved lumbar mobility, which reduces pain and increases PSLR ROM in patients with LBP who have restricted SLR ROM **[30-32]**.

An improvement noted post-BLR could be the improved mechanics of the neural structures. During BLR, hip flexion causes the pelvis tilts posteriorly and increasing lumbar flexion during end range and further opens the central canal, facet joints, and intervertebral foramina, allowing the neural tissue to travel caudally. As a result, increased blood flow to the intraneural region, axoplasmic flow, and sympathetic activation are observed. Such movements of the neural structure could restore pressure gradients and alleviate neural hypoxia by tissue fluid dispersion and the decrease of intraneural oedema **[29,31,33]**.

Kumar and Mulligan **[12]** and Sanjana et al., **[24]** attributed the improvement of the straight leg raise ROM to release of the adhesion between the gluteus maximus and hamstring, where the sciatic nerve travels through at hip level. Stretching these muscles while keeping the knee in flexed position aids in releasing adhesions between these muscles and the sciatic nerve. Therefore, in relation to these muscles, the sciatic nerve will be mobilized without the nerve being stretched; thereby it improves SLR.

The possible explanation for reduction of the pain perception after MBLR technique may be due to reflexive relaxation of the hamstring muscle caused by the autogenic inhibition **[33]**. Stretch tension activates the Ib afferent fibers within the GTOs. Afferent fibers send information to the spinal cord, and the stimulus causes inhibitory interneurons to fire. The inhibitory stimulation provided by these interneurons to the alpha motor neuron reduces nerve excitability and efferent motor drive of the muscles. These reflexes will allow the musculotendinous unit to relax, reducing pain perception [24,34].

Regarding the Effect of MBLR on the H-Reflex Latency, This study was supported by the study of Vipin et al., [35] that was conducted to detect the effect of neural mobilization (Slider Technique) on monosynaptic reflex on 30 subjects. H-reflex measurements were performed before and after neural mobilization. It was discovered that neural mobilization has a considerable influence on monosynaptic reflexes and nerve conduction. As a result, there is support for using neural mobilizations as a treatment for neurodynamic changes.

The results of H-reflex in the current study also matched with the study of ELDesoky and Abutaleb [29] that examined whether participants who suffer from low back pain with S 1 radiculopathy respond to neural mobilization. According to the study, the neural mobilization group significantly reduced their post-treatment pain level, functional disability, and H-reflex latency compared to the control group.

This study was also in line with the study of Shaker and Abd El-Mageed [36] that was conducted to investigate the effect of neurodynamic mobilization on chronic discogenic sciatica in ten patients It was determined that neurodynamic mobilization helps patients with chronic discogenic sciatica feel better, including an improvement in their ability to raise their legs straight and their H-reflex recovery. According to the study, adding neurodynamic mobilization to conservative therapy for sciatica may enhance outcomes, save costs, and lessen patient impairment.

Moreover, Ibrahiem et al., [37] have conducted a study to examine the impact of three distinct neural mobilization approaches (proximal glide, slider slump, and piriformis) on motor neuron excitability using the H reflex. The findings showed that all three forms of neurodynamic tension treatments reduced the sciatic nerve's H reflex latency, confirming the findings of the current study.

In Terms of the Outcomes of Combination of MBLR Technique with Core Stabilization Exercises, our findings of this investigation were confirmed by the study of Na'ima et al., [38] which aimed to determine the combined effect of core stability exercise and contract relax exercise on hamstring flexibility. It showed that combination of both core stability and contract relax exercises are more effective than core stability exercises alone and on par with contract relax exercises for increasing hamstring flexibility.

Our results were consistent with Elsayyad et al., [39] who compared the effects of adding neural mobilization utilizing straight leg raise with longitudinal traction (NM) against myofascial release (MFR) to stabilization exercises (SE) in patients with lumbar spine fusion (LSF). It was concluded that after LSF, a SE program with either NM or MFR added to it improved disability and pain significantly, in favor of NM; more than a SE program alone.

The results of this study agreed with those of Javadipour et al., [40] on people with chronic nonspecific low back pain who integrated core stability with stretching exercises as a way to reduce pain severity and improve motor function. According to the findings, combining core stability and stretching exercises can improve balance, trunk muscular endurance, and the severity of lumbar lordosis along with improving chronic low back pain.

On the other side, this research's findings did not agree with a study by Scrimshaw and Maher [41] that looked at the impact of neural mobilization in individuals with lumbosacral radiculopathy who had spinal surgery, such as lumbar discectomy or laminectomy. According to the authors, there was no benefit to neuronal mobilization.

This study came in contrast with the study of Adel [17] that determine how lumbar mobilization techniques and neural mobilization technique affect sciatic pain, functional disabilities, patients' centralization of symptoms, Hoffmann reflex latency, and degree of nerve root compromise in chronic low back dysfunction (LBD). Her study revealed that both approaches had the same impact on the reflex (Latency). This was because mobilization had little impact on H-reflex latency and there were no clear signs that mobilization had a noticeable impact on H-reflex.

Our research results also did not correspond to the results of Giovanni et al., [42] that was conducted to assess the effects of neurodynamic treatment in patients with chronic nerve-related leg pain. Conclusion: At two weeks, adding neurodynamic therapy to the recommendation to keep moving did not reduce leg pain or impairment. For the treatment of chronic nerve-related leg pain, neurodynamic therapy should not be advised.

Conclusion:

This study concluded that adding Mulligan Bent Leg Raise to Core Stabilization Exercises has a significant effect in decreasing VAS and H reflex latency and in increasing SLR ROM compared with Core Stabilization Exercises alone in the patients with discogenic sciatica.

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تأثير استخدام أسلوب رفع الساق المثنية لموليجان على حالات الإنزلاق الغضروفى المصاحبة لألام عصب النسا

الخلفية : يُعتقد أن رفع الساق المثنية لموليجان له تأثير علاجى إيجابى على الألم، ومستوى رفع الساق المستقيمة والتوصيل العصبى المتأثر فى المرضى الذين يعانون من عصب النسا الناتج عن الإنزلاق الغضروفى، بسبب الديناميكا العصبية المتغيرة وشد العضلة الخلفية، ولكن لا يوجد دليل كاف لدعم تلك الفاعلية.

الهدف : هو التحقيق فى تأثير تقنية رفع الساق المثنية لموليجان على شدة الألم، ومستوى رفع الساق المستقيمة، وزمن تأخر منعكس هوفمان فى المرضى الذين يعانون من عصب النسا الناتج عن الإنزلاق الغضروفى.

شملت الدراسة ثلاثين مريضاً من كلا الجنسين (١٢ أنثى و ١٨ ذكراً). تراوحت أعمارهم بين ٣٠ و ٤٠ عاماً. تم اختيار المرضى من عيادة العيادات الخارجية لأمراض الأعصاب، كلية العلاج الطبيعى، جامعة القاهرة. تم تقسيمهم بشكل عشوائى إلى مجموعتين متساويتين فى الحجم. تلقت كل مجموعة ٤ أسابيع من العلاج جلسة، جلسات فى الأسبوع يوماً بعد يوم. تم علاج مجموعة الدراسة (أ) بواسطة أسلوب رفع الساق المثنية لموليجان بالإضافة إلى (تمارين الإستقرار الأساسية). تم علاج المجموعة الضابطة (ب) من خلال تمارين الإستقرار الأساسية فقط.

النتائج : كان هناك انخفاض ملحوظ فى قيم الألم على المقياس التناظرى البصرى وزمن تأخر منعكس هوفمان وزيادة كبيرة فى مستوى رفع الساق المستقية فى كلتا المجموعتين مقارنة بالنتائج المسبقة للعلاج كان هناك انخفاض كبير فى قيم الألم على المقياس التناظرى البصرى وزمن تأخر منعكس هوفمان وزيادة كبيرة فى مستوى رفع الساق المستقيمة لمجموعة الدراسة مقارنة بالمجموعة الضابطة (p<0.01).

الخلاصة : أظهرت الدراسة أن إضافة رفع الساق المنحنية إلى تمارين الاستقرار الأساسية له تأثير كبير فى تقلل شدة الألم على المقياس التناظرى البصرى وزمن تأخر منعكس هوفمان وزيادة مستوى رفع الساق المستقيمة مقارنة بتمارين الإستقرار الأساسية وحدها فى المرضى الذين يعانون من عصب النسا الناتج عن الإنزلاق الغضروفى.