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Comparison between efficacy of spinal mobilization with leg movement versus McKenzie technique in patients with lumbar disc herniation

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ABSTRACT

Background: Lumbar disc herniation (LDH) is one of the most common causes of medical consultation in the orthopedic clinics. LDH is believed to be the root cause of 60-80 percent of low back pain cases over a lifetime. **Objective**: The current study aims to evaluate the effectiveness of different dissimilar manual therapy techniques (Mulligan's spinal mobilization with leg movement versus McKenzie technique) in patients with lumbar disc herniation. **Design:** The present study is a randomized control trial in which 45 individuals diagnosed with LDH were recruited as the participants of the study (mean age 48.54 ± 5.8 years). The participants were randomly allocated into three groups, with n=15 in each group. **Intervention:** Participants of the group A (Experimental group A) received Mulligan spinal mobilization with leg movement and T.E.N.S. (Transcutaneous Electrical Nerve Stimulation). Group B (Experimental group B) participants received McKenzie technique. Group C (control group) participants only received T.E.N.S. for four weeks. All patients in the three groups received 3 sessions each week. Pain, functional disability, and the H reflex were the primary outcome measures. The visual analogue scale (VAS) was used to assess pain, the Oswestry disability scale was used to assess functional disability, and electromyography was used to assess the H reflex. **Results:** Significant improvements were seen in the participants of group A, with reduction in the intensity and severity of pain, decreased level of functional disability and improvement in the H reflex, in comparison with other groups. **Conclusion:** Spinal mobilization with leg movement was more effective than McKenzie technique and TENS to reduce pain and functional disability, and to improve the H reflex, in individuals suffering from lumbar disc herniation.

KEYWORDS

H reflex; Lumbar disc herniation; McKenzie; Spinal mobilization with leg movement.

1. INTRODUCTION

Most of the individuals experience low back pain at some point of time in their lives. Low back pain is one of the leading causes of disability. It affects similar proportion of population in all the cultures, affecting their quality of life to a significant extent. One of the most prevelant cause of low back pain is the intervertebral disc injury. The typical clinical picture included initial pain in the low back region and limitation of functional disability and decreasing lumbar range of motion (Carroll et al., 2000).

Lumbar disc herniation (LDH) is prevalent in both middle-ages and adult people (Anderson et al., 2008). It is considered to be one of the most typical clinical diagnoses practiced by orthopedicians (Tarulli & Raynor, 2007). The incidence rate of LDH is significantly high in the individuals falling within the age group of 30 years to 55 years (Atlas et al., 2000). Lumbar disc herniation is described as a localized diffusion of the disc contents just beyond disc area's normal edges resulting in numbness, weakness, and pain in either or both dermatomal and myotomal distributions (Kreiner et al., 2014).

Lumbar disc herniation consists of displacement of the content of the intervertebral disc, i.e. nucleus pulposus, through its external membrane, generally in its posterolateral region compressing the spinal nerve on the ipsilateral side. The most common spinal levels of LDH is L4-L5, L5-S1. Patients frequently complain of back pain which is radiated to lower limb (Koes et al., 2007). Many studies have found that the individuals with lumbar disc protrusions, herniation and annular tears have free symptoms, with only 50% reporting radicular manifestations (Schoenfeld & Weiner, 2010).

Some studies have also reported that intervertebral disc herniation usually causes impingement of multiple spinal systems such as the annulus fibrosus, facet joints, ligaments, paravertebral muscles, and neural structures like nerve roots which cause pain (Airaksinen et al., 2006). However, pain is most common cause of medical consultation among the affected population. The pain is caused by the neural compression, leading to mechanical, chemical, and functional changes with in peripheral nervous system and different stages in central nervous system over time (Sertpoyraz et al., 2009).

Variety of laboratory and radiological investigations are used for making diagnosis of LDH. Electro diagnostic studies have been found to be helpful in making the diagnosis of LDH. Hoffmann reflex (H-reflex) (Beyaz & Akyuz, 2009), is also an important procedure for assessment of radiculopathy particularly when electrophysiological and clinical signs of motor root affection are lacking (Mazzocchio et al., 2001).

There is pool of conservative methods of treatment that may help in relieving the symptoms of LDH. These methods include physical therapy, osteopathy, steroidal anti - inflammatory medication and epidural injections (Shen et al., 2006). A huge amount of literature is available on the beneficial effects of manual therapy in LDH in terms of improvement in the functional outcomes and severity of pain with or without neural manifestations (Schäfer et al., 2011).

Mobilization with movement (MWM) technique, developed by Mulligan is one of the commonest manual therapy techniques applied for relieving the symptoms of LDH. The effectiveness of MWM is related to fault position principle, which arises as result of an injury that causes joint mal-tracking and is usually accompanied with pain, stiffness, or weakness (Mulligan, 2004).

This technique is effective by causing immediate improvement by increasing the movement of facet joints (Mulligan,1993). Furthermore, Vincenzino confirmed that Mulligan techniques aid in the improvement of patients' manifestations through the neurophysiologic mechanism of slight fault position correction (Vincenzino et al., 2007). However, more investigation is needed to validate and generalize the results on all lumbar disc herniation patients.

On the other side, Robin McKenzie reported other options for management of patients with spinal dysfunctions. McKenzie exercises can be passive or active in the trunk's flexion, extension, and with side bending known as slide gliding at the beginning, middle, and end range of spinal movement. McKenzie defined three different types of mechanical dysfunctions i.e. postural, dysfunctional, and derangement (McKenzie & May,1989). To reduce the derangement, centralization can be achieved, then pain disappears with full range and pain free movement can be regained (McKenzie & May, 2003).

Mulligan has proved his techniques and its effectiveness in reducing the symptoms of disc herniation, as well as Mackenzie, who could reduce the derangement through achieving the centralization of pain. Thus, the present research compared the effects of Mulligan spinal mobilization with leg movement versus McKenzie technique on functional limitations, pain severity, and H-reflex on lumbar disc herniation patients.

2. METHODS

2.1. Design

The present study had an experimental design (randomized, active control, parallel group trial) conducted in the outpatient clinic of the department of physical therapy at El Kaser El Aini hospital. The study was conducted to compare the efficacy of Mulligan spinal mobilization with leg movement versus Mckenzie technique on patients with lumbar disc herniation.

2.2. Participants

A total of 45 patients diagnosed with lumbar disc herniation, both male and female were recruited as participants of the study. Participants were identified and recruited over 4-month period 70 patients clinically diagnosed with LDH were screened for the study. A total of 45 patients fulfilled the selection criteria. A total of 45 patients (18 males and 27 females), diagnosed with lumbar disc herniation, both male and female were recruited as participants of the study. A written informed consent was obtained from each participant prior to the commencement of the study. Participants were randomly allocated into three groups, with n=15 in each group using block randomization method. Participants of the group A (Experimental group A) received Mulligan spinal mobilization with leg movement and T.E.N.S (Transcutaneous Electrical Nerve Stimulation). Group B (Experimental group B) participants received McKenzie and T.E.N.S. Group C (control group) participants received only TENS. The inclusion criteria for the present study was: patients falling under age group of 25 years to 50 years, both male and females, diagnosed with lumbar disc herniation with unilateral symptoms manifesting below the knee for at least 3 months ago. The exclusion criteria of the study was: individuals who were suffering from any cardiopulmonary disease having low endurance, with the history of post laminectomy syndrome or any previous back surgery, vertebral compression fracture, lumbar instability, spondylolisthesis, any spinal deformities, or pregnant women.

2.3. Sample size calculation

To eliminate type II error, a preliminary power analysis was performed [power (1 −α error P) = 0.95, = 0.05, effect size = 1.33] in this study. A sample size of 28 was determined for the 3 groups (15 subjects in each group) using the suggested sample size. This effect size was determined based on a pilot test study of 15 volunteers, every group contains 5 volunteers, with the H- reflex latency serving as the primary outcome. The power analysis was carried out by G*Power 3.1.9.2 software, using t- test family and statistical test difference between independent means (3 groups).

2.4. Randomization

Forty-five patients of both genders with lumbar disc herniation volunteered to participate and were allocated randomly into three equal groups of fifteen (15) patients in each, using block randomization.

2.5. Intervention

Group (A) Spinal mobilization with leg movement (SMWLM): Participants of the group A (Experimental group A) received Mulligan spinal mobilization with leg movement and T.E.N.S. The participant was positioned in side lying on the unaffected side with the upper leg positioned with hip adduction, in way that he or she was facing towards the therapist. Upper side of the lower extremity was positioned with hip abducted to 10º. Researcher stood facing the patient keeping his thumb on affected side of the L5 spinous process simultaneously pushing it in the downward direction. This pressure was sustained. Participant was asked to do Straight Leg Raise (SLR) test from supine position, in order to ensure that there was no pain. This technique was applied from three times to 10 times per session, 3 times per week, during 1 month. As patient improves, the assistant can apply overpressure (Mulligan, 2006).

Group (B) McKenzie exercise: Participants of the group b received McKenzie and T.E.N.S. All patients were identified with the derangement syndrome. The goal was to produce centralization of symptoms. The aim of McKenzie technique was to decrease derangement, sustain reduction, restore function, and avoid the re-occurrence. Prior to the start of McKenzie exercise program, the posture of the participant must be corrected in sitting position. Participant was asked to lie down in prone lying position with the head turned to one side and arms positioned besides the body. Followed by this, the participant was asked to lift the upper trunk with an active support of the elbows, attaining prone on elbow position. Under the same sequence, the participant was then asked to raise the trunk off the plinth by extending his/ her both elbows, thereby attaining prone of hands position. In the above sequence of events, pelvic stability was maintained by a belt attached to the bed to avoid the pelvic lifting in the course of exercises. The exercises were performed in the three sets, with each set having 10 repetition. All participants were instructed to perform the treatment program at home, in 5 cycles, each cycle having 15 repetetions (McKenzie & May, 2003).

Group (C) control group: Participants of the group C received treatment using TENS. A paraspinal cable was located just above the origin of the sciatic nerve and a second cable was placed on posterior thigh as site of referred pain. For 30 minutes, the device was set at a frequency of 100 Hz and 150s pulse durations (Facci et al., 2011).

2.6. Outcome measures

Participant assessment was done at baseline, i.e. on day 0, and at the end of the course. The following items were included in the assessment procedures. The outcome measures used in the present study included a visual analogue scale for pain assessment, Oswestery disability index for assessment of functional disability, and electromyography to assess the H reflex.

Assessment of pain severity: Pain assessment was done using a , a visual analogue scale was used (VAS). VAS is a full data assessment scale that employs a 10 cm row from 0 to 10. In Vas, 0 indicates “no pain” and 10 indicates “ worst pain”. The participants were directed to tell their level of discomfort by indicating on the row (Marc, 2001).

Functional disability: The Oswestery disability design was used to measure the level of functional disability. Oswestery disability design is a reliable (Davidson & Keating, 2002) and valid tool (Fair bank & Pynsent, 2000). for assessment of functional disability. It contains a set of ten questions regarding back pain. Each participant was asked to select one statement out of six based on his status of disability. The higher score indicates high level of disability.

Electromyography: In the present study electromyographic assessment was done using four channel Neuropak MEB- 9200G/K EP/ EMG monitoring device (Neuropak M1), version is 08.11 from Nihon Kohden. Initially, the raise was limited to 25 V for each longitudinal division. The recording time had to be 0.2 seconds. Bandpass was 0.1- 50 Hz (value of minimum and maximum changes respectively). The prevalent frequency tone was 2 kHz, with first intensity of 75 decibels. The frequency of the rare tone was 8 Khz, with intensity of 75 dB.

H-Reflex measurement: The theory of H-reflex, stating that electrical stimulation of tibial nerve which found at the popliteal fossa causes activation of reflex action to transfer to the S1 dorsal root ganglion. Motor response may become late or non-existent if S1 conduction is disrupted (Stretanski, 2004). H reflex assessment was initiated by asking the participant to lie down comfortably in prone lying position with their arms by the side of their body and head kept on one side. The testing leg was placed in the elevated position. The area between soleus and poplitial fossa was sensitized with alcohol in order to reduce the skin resistance (Stretanski, 2004). Surface bar electrode covered by coupling gel was placed over the popliteal fossa. The cathode was placed anterior to anode electrode and connected to the posterior tibial nerve. he recording electrode was placed 3 cm just above gastrocnemius muscle tendon insertion over the soleus muscle. Ground surface metal electrodes were placed midway between the stimulation and recording sites. All the electrodes were securely fastened with adhesive tape to maximize the skin-electrode contact (Tucker & Türker, 2005).

The stimulation parameters were as follows: the pulse duration was 1.0 ms, frequency was 0.2 pps as 0.2 pulses per second, intensity that produces the highest H-maximum while producing the least stable M-response. 3-minute training test of evoked H-reflex latency were achieved to familiarize the participants with the H-reflex stimulation and recordings. Followed by this , the highest H-reflex latency value from the affected side was monitored five times and the average value was computed (Tucker & Türker, 2005).

2.7. Data analysis

In the present study, statistical analysis of data was done using SPSS software program. In the evaluation of research data, descriptive statistical methods which contains standard deviation and mean values were calculated. Homogenicity of the data was tested using Kolmogorov–Smirnov distribution test The quantitative analysis was done using one way ANOVA. Tukey's Post hoc analysis was performed to identify the group that was responsible for the difference. For intragroup comparisons, the paired samples t-test was applied with 95 percent confidence interval, at 0.05 significance level.

3. RESULTS

No single drop out was reported in the present study and no adverse effects were encountered by the participants of any group during the course of intervention. A total of 45 participants were recruited for the present study. Participants were allocated into three groups with n=15 in each group. In group A the mean weight and height of the participants was 76.84.92 kg and 168.876.05 cm. In group B the mean weight and height of the participants was 76.84.92 kg and 168.876.05 cm. In group C the mean weight and height of the participants was 78.87 ± 5.13 kg and 169.60 ± 6.71 cm, as shown in Table 1. Also, the use of one-way ANOVA showed that there were no significant differences between the baseline characteristics of the participants between all the groups (Table 1).

Within-group analysis demonstrated a statistically significant improvement ($p < .05$) for pain level, functional disability and latency of H-reflex in the three studied groups. Post hoc test used to compare the results among the three tested groups revealed that there was a significant improvement ($p < .05$) in the post-test mean values of pain level, functional disability and H-reflex in the experimental group A and group B, compared with the control group (C). There was significant improvement ($p < .05$) in the post-test mean values of all measured variables between the two experimental groups (A and B) in favor of group A, as shown in Tables 2 and 3.

Table 1. Clinical and demographic characteristics of participants in all groups.

Variables	**Group A (N=15)**	**Group B (N=15)**	**Group C (N=15)**	***F*-value**	***P*-value**
Age (year)	34.75 ± 2.44	34.60 ± 1.46	24.35 ± 2.92	0.147	0.864
Weight (kg)	76.8 ± 4.92	79.67± 9.36	78.87 ± 5.13	0.051	0.950
Height (cm)	168.87 ± 6.05	169.27± 6.15	169.60 ± 6.71	0.713	0.496
BMI (Kg /m^2)	26.94 ± 1.47	27.82 ± 3.14	27.45 ± 1.82	0.563	0.574

Table 2. ANOVA design for all dependent variables (pain level, functional disability, and H- reflex latency) at different measuring periods among groups.

Dependent variables		Group A (SMWLM)	Group B (Mackenzie)	Group C (Control)	P value*
Pain level	Pre-treatment	7.84±.89	7.54±.98	7.7±.63	0.646
	Post-treatment	3.22±1.27	3.33±1.50	5.59±.63	**0.0001**
	P value**	**0.000**	**0.000**	**0.000**	
Functional Disability	Pre-treatment	62.07±14.38	57.48±12.197	56.4±4.33	0.425
	Post-treatment	26.70±9.66	29.93±9.91	43.4±4.45	**0.0001**
	P value**	**0.0001**	**0.0001**	**0.0001**	
H-reflex Latency	Pre-treatment	34.35±1.67	34.17±1.39	33.12±1.27	0.361
	Post-treatment	28.81±0.98	28.54±1.167	30.84±1.21	**0.001**
	P value**	**0.0001**	**0.0001**	**0.0001**	

** Inter-group comparison; ** Intra-group comparison of the results pre- and post-treatment. P < 0.05*

Table 3. Pairwise comparison between test groups for all dependent variables

Dependent variables		Group A Versus Group B	Group B Versus Group C	Group A Versus Group C
Pain level	Post-treatment	0.999	0.0001*	0.0001*
Functional Disability	Post-treatment	0.691	0.002*	0.0001*
H-reflex Latency	Post-treatment	0.998	0.0001*	0.001*

** P < 0.05*

4. DISCUSSION

Lumbar disc herniation (LDH) has been identified as one of the most widely known reasons that cause back dysfunction. Spinal mobilization with leg movement (SMWLM) and McKenzie technique were reported to be helpful in management of individuals suffering from back pain. The objective of this research was to see how SMWLM and McKenzie affected lumbar disc herniation. The findings of the present study revealed that more improvement in the symptoms with respect to pain, functional status and H-reflex latency was observed in the participants of group A than in the participants of group B and group C.

4.1. Spinal mobilization with leg movement (SMWLM)

In the present study significant reduction in the severity of pain was observed in the participants of the Group A, followed by Group B and Group C. The reduction in the pain was attributed to the neurophysiologic mechanism of the Mulligan technique, which is similar to the work done by Vincenzino (2007). The authors of the study stated that the immediate pain relief provided by Mulligan's method may be associated with activation of non-narcotic endogenous pain suppression pathways, particularly the descending pain suppression system through the periaqueductal gray region of the midbrain.

In addition to this, authors of this study also stated that Mulligan's technique provides an immediate analgesic effect, but corrects the "positional defects" that do not disturb neural structures. Hence, more detailed investigation is needed for having a better understanding of the mechanism of SMWLM maneuver for treatment of patients with lumbar radiculopathy caused by disc herniation (Bialosky et al., 2009).

In the present study, improvement was observed in the scores of H reflex. The gains of scores of H reflex in the SMWLM group could be due to a small positional fault correction leading to reduction in the pressure of the neural structures, thereby minimizing pain, limitation and decreasing symptoms of radiated pain by the “centralization” mechanism (Mulligan, 2004).

In many studies, SMWLM rotational glide has been effectively used in the treatment of LDH. According to a biomechanical study conducted by Fujiwara et al., axial rotational glide increases the height and area of the intervertebral foramen on the side opposite to the rotation (Fujiwara Atsushi et al., 2001). A similar study was conducted in which authors stated that the rotational glide is reported to increase the intervertebral foramen space, restoring vertebral normal position, and decompressing the nerve root by widening the intervertebral space leading to pain relief (Kumar & Cherian, 2011).

Mulligan reported that hypomobility of facet joints results in the posterior disc bulge during flexion, which might cause pain especially when the posterior layers of the disc are weak. It was demonstrated that the rotation in the lumbar vertebra moves the facet joint also. It tends to increase the space of the facet joint, located in opposite to the side of rotation of vertebra. Hence, it stands to reason that SMWLM would also deal with the hypomobile facet joints and hence contribute to relieve pain (Mulligan, 2006). According to literature review on current concepts on Mulligan's concept, fault position, and relieving pain, the most frequently reported effect after Mulligan's mobilization is immediate effect after accomplishment of a successful session (Vincenzino et al., 2007).

4.2. McKenzie technique

Back extension exercise of McKenzie has been shown to relieve symptoms of sharp and chronically persistent pain among affected individuals. McKenzie technique of exercises is implemented in the prone lying position (Mckenzie, 1981). It is believed that the prone lying position increases the interior movement of the nucleus pulposus away from the compressed nerve root by the effect of the gravitational force (McKenzie & May, 2003) and to correct the lumbar spine alignment at L5-S1 level (Tehranzadeh & Gabriele, 1984). In addition, prone back extension exercises are thought to have a strong impact on shifting disc materials forward from spinal nerve pathways (Beattie et al., 1994).

According to Karas (1997), 73 percent of 126 chronic back pain patients experienced centralized symptoms at early sessions, when managed with directional preference techniques. Besides, Denelson (1990) examined the effect of centralization phenomenon for referred pain evaluation and management by using mechanical treatment. In their study, centralization of the symptoms of pain was reported in most of the participants during the first session, the rest of patients reported improvement over the next two days. Repeated extension maneuver can alleviate pain and reduce compressive loads exerted on the sensitive structures. Repeated extension maneuver works by transferring compressive load from vertebral body to the posterior facet joint to relieve tension on the nucleus (Adams et al., 2000).

However, to the best of the researcher's knowledge, no study has been published evaluating the the impact of back extension exercises on H-reflex in case of sciatica. There are some previous experiments in which authors investigated the H-reflex determination of the radial wrist flexor after neck extension and associated variation in the reflex with the radicular pain. The authors reported that there was reduction of amplitude of H-reflex accompanied with the relief in the intense radicular symptoms. Followed by the repetitive neck extension, the H-reflex amplitude showed great improvement with reduction in the intensity of the pain (Abdulwahab & Sabbahi, 2000).

5. CONCLUSIONS

Based on the findings of the study, the researchers concluded that SMWLM is more successful than McKenzie back extension in pain reduction, improving functional limitation and H reflex in lumbar disc herniation. The main limitations of the present study were: small sample size, no follow up, and focus on the immediate effect of the various techniques. Future research with a higher number of participants should be conducted, and long patient follow-up is advised in future research to determine the prolonged effects of the SMWLM and McKenzie back extension techniques.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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