

“Comparative Effectiveness of Mulligan’s Traction Straight Leg Raise and Bent Leg Raise in Low Back Ache with Radiculopathy” – A Randomized Clinical Trial

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Abstract: *Background and Objectives: Lumbar spondylosis and prolapsed inter vertebral disc can cause low back pain with or without radiculopathy. Mulligan has described the traction straight leg raise (TSLR) and bent leg raise (BLR) techniques, which are said to improve range of motion of hip flexion in patients with low back pain. The objectives of the present study were to compare the effectiveness of Mulligan’s Traction Straight Leg Raise and Bent Leg Raise in low back ache with radiculopathy. Materials and Methods: 40 participants with clinical diagnosis and radiological evidence of Lumbar spondylosis with radiation or low back pain (LBP) with radiculopathy, with limitation of Straight Leg Raise angle between 30° to 70° were recruited. Participants were randomly assigned into two groups of 20 each. Physical therapy treatment protocol which included Mulligan’s TSLR and BLR techniques with common treatment of Transcutaneous Electrical Nerve Stimulation (TENS) were given for 6 days. Conclusion and Interpretation: The randomized clinical trial provided evidence to support the use of Mulligan’s TSLR and BLR techniques in relieving pain, improving hip flexion (SLR) range of motion and improving functional well being. In addition Mulligan’s Bent Leg Raise can be of great value in improving physical function in LBP with radiculopathy.*

Keywords: Low back ache; Radiculopathy; Mulligan’s Traction Straight Leg Raise; Mulligan’s Bent Leg Raise; Straight Leg Raise.

1. Introduction

Back pain was once known as an ancient curse is now known as a modern international epidemic. In India incidence of low back pain has been reported to be 23.09% and has a lifetime prevalence of 60- 85%.^{1,2} Low back pain affects men and women equally, with onset most often between the ages 30 to 50 years. It is most common cause of disability in individuals under 45 years of age and third most common cause in the age group of 45 to 65 years. It has been reported that 37% of health care costs associated with low back pain are a direct result of physical therapy services. The incidence of low back pain decreases after the age of 55. The incidence of degenerative changes on x-ray, however, increases throughout a lifetime.^{3,4,5}

In young adults, intervertebral discs are so strong that it first damages the adjacent bone after a traumatic injury. It is impossible to damage a healthy disc except by forcible flexion. After the second decade however degenerative changes in discs may result in necrosis, sequestration of the nucleus pulposus, softening and weakening of the annulus fibrosis. Then comparatively minor strains may cause either internal derangement with eccentric displacement of the nucleus pulposus or external derangement; the nucleus pulposus then bulges or bursts through the annulus fibrosis, usually posterolaterally. In degenerative disc joint diseases the narrowing of the disc space and osteophytes may encroach the spinal nerve root resulting in sciatica. Such derangements are usually in the lower lumbar region, especially at the lumbosacral joint region.^{6,7}

2. Literature Survey

Brian Mulligan has developed a most ingenious compilation of manual techniques. Unlike the other mobilization procedures, Mulligan performed while patients were moving, either actively or passively, or while they were performing a resisted muscle contraction. This technique is performed in symptom free range of motion a factor that probably makes it, safer than many other manual therapy approaches.⁸

Mulligan has described the traction straight leg raise (TSLR) and bent leg raise (BLR) techniques, which are said to improve range of motion of hip flexion in patients with low back pain. Indications for use of Mulligan’s Traction Straight Leg Raise and Bent Leg Raise techniques are limited range of motion of hip flexion together with low back pain with or without referred leg pain. The Traction Straight Leg Raise and Bent Leg Raise techniques are painless interventions that are said to have immediate benefits.⁹

The straight leg raise sign is frequently used in the assessment of patients presenting with lumbar spine dysfunction and is one of the few indicators that has been shown to identify the degree of impairment from low back pain. Reduced straight leg raise may be due to pathology of somatic structures or neural tissues, and it is important to assess these factors when investigating straight leg raise. Furthermore, it has been suggested that improving the range of hip flexion has a beneficial effect in restoring normal movement and reducing the degree of impairment due to low back dysfunction.¹⁰

Very little has been published about the effectiveness of Mulligan's traction straight leg raise and bent leg raise on symptomatic subjects. When patients with low back pain report to physiotherapy, it is important from physiotherapeutic point of view to give diminution of low back discomfort so as to get patients belief and confidence in the treatment. Studies have shown immediate efficacy of traction straight leg raise and bent leg raise techniques individually, but there are no comparative studies between these two techniques done.

3. Problem Definition

Hence this study is designed to determine the effectiveness of two forms of manual therapy interventions such as Traction Straight Leg Raise and Bent Leg Raise techniques on range of hip flexion (straight leg raise) and pain in participants with low back pain with radiculopathy.

4. Methodology

The sample size for this research study was forty (40). It was calculated on the basis of past physiotherapy records. The study sample included male and female individuals with low back ache with radiculopathy. The sampling design was a random sampling method. A simple random method was used for assigning patients in to two groups (Envelope method).

Both male and female participants with clinical diagnosis and radiological evidence of Lumbar spondylosis with radiation or low back pain (LBP) with radiculopathy, with limitation of Straight Leg Raise angle between 300 to 700 who were referred to physiotherapy department and willing to take treatment for 6 consecutive sessions were recruited for the study. The method of data collection employed for the present study was a primary method.

Data was collected from physiotherapy OPD of KLES Dr. Prabhakar Kore Hospital and medical Research Centre, Belgaum and from KLES Ayurvedic Hospital and Research Centre, Belgaum.

Participants were included in the study if they meet following criteria:(1)Both male and female participants with clinical diagnosis and radiological evidence of lumbar spondylosis with radiation or low back pain with radiculopathy.(2)Age group between 22-73 years.(3)All subjects with symptoms for a duration of more than 6 weeks.(4)Limitation of straight leg raise angle between 30⁰ to 70⁰, due to pain.(5)All subjects with unilateral or bilateral radiation of pain in the sciatic nerve distribution.(6)Participants willing to participate in the study.

Participants were excluded if :(1)History of spinal surgery in previous 6 months.(2)Knee and ankle pathology causing limitation of movement.(3)Clinical conditions such as oversensitive skin, patients with cardiac pacemakers, pregnancy etc. where application of transcutaneous electrical nerve stimulation (TENS) is contraindicated.(4)Subjects with psychological low back pain.(5)

Spondyloarthropathies.(6) Altered deep tendon reflexes.(7)Motor weakness.(8)Subjects with mental disorders.(9)Tumours / malignancies.(10)Any other major illness.

5. Interventions

The demographic data including age, gender, height, weight, side affection and duration of symptom were collected through data collection sheet. Initial evaluation of pain intensity was done using visual analogue scale (VAS). Passive hip flexion range of motion (Straight Leg Raise angle) was measured by Universal Goniometer and Physical Function Outcome was scored using Quebec Back Pain Disability Scale as an interventional scale as an interventional The demographic data including age, gender, height, weight, side affection and duration of symptom outcome measures.

6. Procedure

Prior to the commencement of the procedure, informed written consent was taken from the participants. The forty (40) subjects were randomly allocated to two groups of twenty (20) each. For both groups, Transcutaneous Electrical Nerve Stimulation (TENS) was given in common as a part of the conventional treatment.

- **Application of Transcutaneous Electrical Nerve Stimulation (TENS):** Participants were positioned in prone lying and were treated with high frequency, short pulse, high intensity–Burst TENS using pad electrodes for 30 minutes per day per sitting.
- **Group A:** Group A received Mulligan's Traction Straight Leg Raise technique to the affected limb immediately following Transcutaneous Electrical Nerve Stimulation (TENS) for 30 minutes. Three repetitions of Mulligan's Traction Straight Leg Raise were done with 7 seconds hold and 5 seconds relax time. The pain free Straight Leg Raise traction was given for 3 repetitions.
- **Group B:** Group B received Mulligan's Bent Leg Raise technique to the affected limb immediately following Transcutaneous Electrical Nerve Stimulation (TENS) for 30 minutes. Three repetitions of Mulligan's Bent Leg Raise were done with 7 seconds hold and 5 seconds relax time.
- The above procedures were given for 6 consecutive days. The post-interventional responses were recorded on 6th day of treatment in the form of visual analogue scale (VAS), hip flexion ROM and Quebec Back Pain Disability scale (QBPDs). The hip flexion (Straight Leg Raise) range of motion was measured by Universal goniometer. Therapist passively took participant's hip into flexion and passive range of hip flexion was noted. Quebec back pain disability scale for all the 20 activities of daily living was done by asking the participant's to mark his/her ability to perform each of the 20 activities of daily living to rate their score out of six grades of severity.

7. Results

Statistical analysis of the study was done manually as well as using the SPSS 13 version software so as to verify the results.

a) Demographic Profile:

- **Age Distribution:** Age of the participants in the study was between 25 to 73 years. The difference in mean age of two groups was statistically not significant ($p=0.65$).
- **Sex Distribution:** The gender ratio of Group A was 9:11 (9 males and 11 females) and Group B was 6:14 (6 males and 14 females) and was statistically not significant ($p=0.5136$). Therefore both the groups are matched with respect to age and gender.

b) Anthropometric Measurements:

- **Body Weight, Height and Body Mass Index:** The difference in mean of body weight, height and BMI of two groups were statistically not significant with $p=0.0696$, $p=0.6764$, $p=0.0849$ respectively.

c) Outcome Measurements:

- **Visual Analog Scale (cms) Score:** In the Group A and B, the mean VAS scores on pre session on the first day were reduced after 6 sessions of treatment on 6th day. The p value by paired 't' test was found to be <0.0001 which is statistically significant. (Table no. 1) On comparing the pre session and post session values, the results between the two groups using unpaired 't' test revealed that there was no statistically significant difference seen with p values of 0.88 and 0.75 respectively. (Table no. 1)
- **Quebec Back Pain Disability Scale (QBPDS):** The p value by paired 't' test for group A and B were found to be <0.0001 which is statistically significant. (Table no.2) On comparing the pre session and post session values, the results between the two groups using unpaired 't' test revealed that there was statistically significant difference seen with p values 0.0632 and 1.15 between group A and B indicating that there was improvement in physical function of both the groups with better improvement seen in subjects of group B. (Table no. 2)
- **Straight Leg Raise Angle (SLR):** The mean straight leg raise angle prior to the intervention in group A was $41.55^{\circ} \pm 9.84^{\circ}$. Following 6 sessions of treatment SLR angle in Group A improved to $71.7^{\circ} \pm 11.16^{\circ}$. In the group B, the mean straight leg raise angle prior to the treatment was $45.3^{\circ} \pm 11.97^{\circ}$. Following 6 sessions of intervention it improved to $77.1^{\circ} \pm 12.37^{\circ}$. (Table no.3)
On comparing the pre session and post session values, the results between the two groups using unpaired 't' test revealed that there was no statistically significant difference seen with p values of 0.285 and 0.155 respectively. (Table no. 3)
- **Radiation of Pain:** Out of the total 40 participants included in the study 19 had radiation to left side lower extremity while 21 had radiation to the right side lower extremity.

Table 1: Visual analog scale (VAS) score (in centimeters)

Groups	Pre-interventional	Post-interventional	Paired 't' test P value	Unpaired 't' test P value
Group (A)	7.48 \pm 1.66	3.10 \pm 1.31	<0.0001*	0.88
Group (B)	7.41 \pm 1.48	2.97 \pm 1.36	<0.0001*	0.75

* Statically significant

Table 2: Quebec Back Pain Disability Scale (QBPDS)

Groups	Pre-interventional	Post-interventional	Paired 't' test P value	Unpaired 't' test P value
Group (A)	63.3 \pm 10	36.95 \pm 9.74	<0.0001*	0.0632
Group (B)	57.15 \pm 10.32	24 \pm 6.07	<0.0001*	1.15

* Statically significant

Table 3: Hip flexion range of motion (ROM) in degrees

Groups	Pre-interventional	Post-interventional	Paired 't' test P value	Unpaired 't' test P value
Group (A)	41.55 $^{\circ}$ \pm 9.84 $^{\circ}$	71.7 $^{\circ}$ \pm 11.16 $^{\circ}$	<0.0001*	0.285
Group (B)	45.3 $^{\circ}$ \pm 11.97 $^{\circ}$	77.1 $^{\circ}$ \pm 12.37 $^{\circ}$	<0.0001*	0.155

* Statically significant

8. Discussion

Significant relief of pain was noted in both groups over sessions for 6 days. It is important to note that all participants were given transcutaneous electrical nerve stimulation (TENS) as a common mode conventional method. TENS is a noninvasive technique of electrical stimulation of the peripheral nervous system. It has recently emerged as a distinct therapeutic modality in the control of both acute and chronic pain.¹¹

In this study, the age group of the participants was in between 25 to 71 years. Subjects above 40 years of age were prone for this condition simply because of the process of aging. The findings of this study correlated with above reference since maximum number of subjects were in the age group of 40 to 70 years. Aging factor plays a role to provable cellular dysfunctions, which sets the platform for discal changes. It has been reported that reduction in the disc height, causes compression and bulging with dimensional changes of the spine.^{12,13,14}

In the present study reduction in pain level, as quantified by the VAS, with the application of both Mulligan's traction straight leg raise and bent leg raise⁹ is consistent with the findings of previous studies indicating Mulligan's traction straight leg raise and bent leg raise techniques reduced low back pain.

According to Favio¹⁵, neural manipulation would stretch and provoke the nerve and hence not be useful in pain reduction. However in the present study traction straight leg raise, which would stretch and mobilize the sciatic nerve did produce pain relief. Definitely no neural symptoms were worsened or provoked by straight leg raise traction.

Study done to compare the effectiveness of Mulligan's straight leg raise traction and bent leg raise on hamstring flexibility suggested possible mechanism for pain relief can be due to static stretching that increases flexibility of

muscles. In straight leg raise static stretching with traction was given in which the muscle is slowly elongated to tolerance and the position held with the muscle in its greatest tolerated length.¹⁶ Traction has shown to improve painfully restricted straight leg raise in previous studies by Larsson¹⁷ and Pal¹⁸. Also a recent study by C. Beyerlein¹⁹, found that straight leg raise traction technique significantly improved the SLR angle with similar explanation for the cause of improvement of range. This strongly supports the previous studies that the Mulligan's traction straight leg raise can be used successfully in low back ache with radiculopathy in reducing pain and improving range of straight leg raise.

Another method used in this research was Mulligan's bent leg raise method which is contract-relax stretch method. "Brian Mulligan" has advocated the use of bent leg raise for stretching hamstring to improve flexibility by increasing the range of motion. This intervention consists of contract relax cycles applied to hamstrings that provide peripheral somatic input by the way of contracting muscles and the cutaneous contact of the therapist. Changes in alpha and gamma motor neuron activity (influencing the hamstring muscles) at a segmental level are likely following this technique that are similar to those effects observed following the implementation of proprioceptive neuromuscular facilitation (PNF) techniques and this may affect the subject's perception of their straight leg raise (SLR) limit.¹⁶ This strongly supports the evidence that, Mulligan's bent leg raise technique is a painless technique, when indicated and can be tried on any patient who has limited or painful SLR.^{9,20}

All subjects had reduced straight leg raise prior to the treatment in either group. It is assumed that, this could be because straight leg raise caused more compression of sciatic nerve root, due to the pain the subjects were protective towards the straight leg raise or due to apprehension of exaggerating their low back pain and leg pain due to the maneuver of straight leg raising.

The results of this study found that there was significant improvement in straight leg raise (SLR) angle within groups pre and post intervention. However there was no significant difference was seen on comparing the pre session and post session values between the groups, which suggests that both Mulligan's traction straight leg raise and bent leg raise techniques are effective in improving range of SLR and can be used in the treatment of low back pain with radiculopathy due to prolapsed intervertebral disc (PIVD) and or lumbar spondylosis (L.S.). This could have been due to relief of pain, increase in extensibility of soft tissues, increased sciatic nerve mobility, stretching of myofascial structures as well as increased lumbar mobility and decreased mechanosensitivity of neural structures.²¹

The Quebec back pain disability scale (QBPDS) is one of the most commonly used questionnaire for assessing disability in people with low back pain. The QBPDS has shown greater reliability and has sufficient width scale to reliably detect improvement or worsening in most subjects. For these reasons, the QBPDS appears to be the one of most commonly reported measure of health status in patients with low back pain.^{22,23,24}

In the present study, when the means of Quebec back pain disability scale (QBPDS) were analyzed intra groups statistically significant improvement was found in both groups and has shown reduced QBPDS scores which represent an improvement in pain, range of motion and functional activities. When intergroup analysis was done, results have shown the statistically significant difference between group A and group B, with group B showing better improvement in QBPDS scores. Thus it can be concluded that Mulligan's bent leg raise technique is more effective in improving physical function outcome in patients with low back ache with radiculopathy.

Low back pain presents a serious health care problem and produces a huge burden on society. Simple, safe, physical treatment procedures such as Mulligan's traction straight leg raise and bent leg raise combined with other simple noninvasive intervention such as transcutaneous electrical nerve stimulation (TENS) could be of great value. This provides a low cost, easy means of treatment in subjects with low back ache with radiculopathy.

9. Future Scope

- 1) Studies with longer duration and larger sample size are recommended with longer follow-up period to assess long term benefits.
- 2) The study can be conducted by using bubble goniometer or electro-goniometer to measure pelvic tilt motions along with SLR
- 3) Future studies could be done taking up a homogenous sample with either male or female subjects separately.
- 4) Further prospective study with comparable subject variables with emphasis on anthropometric as well as ergometric variables, other than the clinical alone should be done.
- 5) Quality of life can be assessed by using Modified Oswestry Low Back Pain Disability Index.
- 6) Future studies could be conducted to know the effect of these techniques on strength and flexibility of thigh musculature.

10. Conclusion

In conclusion, the present randomized clinical trial provided evidence to support the use of both manual therapy techniques viz Mulligan's traction straight leg raise and bent leg raise techniques in relieving pain, improving range of motion and reducing disability in subjects with low back ache with radiculopathy. In addition, results supported that Mulligan's bent leg raise technique was more effective than traction straight leg raise technique in reducing disability in subjects with low back ache with radiculopathy.

References

- [1] Sharma SC, Singh R, Sharma AK, Mittal R: Incidence of low back pain in workage adults in rural North India, Medical journal of India 2003; 57(4):145-147.
- [2] M.Krismer M.Van Tulder: Low back pain (nonspecific), Best practice and research clinical rheumatology 2007; 21(1):77-91.

- [3] M.A.Hutson: Back pain recognition and management. Butterworth, Heinmann London, England;1993.
- [4] Patricia A Downie (FCSP): Cash's textbook of orthopedics and rheumatology for physiotherapists,1st Indian edition 1993.
- [5] Definitions of Sciatica. www.laser-spine.com/more_information/terms/
- [6] Williams P.L. etal, Gray's anatomy: Churchill Livingstone; 38th ed (International student ed).
- [7] Richard S. Rothman and Frederick A. Simone: The spine, vol.1, WB Saunders Company, Philadelphia; 1975.
- [8] Larsen B, Andreassen E, Urfer A, et al: Patellar Taping: A radiographic examination of the medial glide technique. American Journal of Sports Medicine 1995;23:465-471.
- [9] Mulligan BR.Manual therapy: Nags, Snags, MWMs, etc. 5th edition 2006; 70-73.
- [10] Hall T et al: Mulligan traction straight leg raise, A pilot study to investigate effects on range of motion in patients with low back ache, The journal of manual and manipulative therapy 2006; 14(2): 95-100.
- [11] Rogger Scudds, Bruce Lai. Pain control with Transcutaneous Electrical Nerve Stimulation. The Journal of the Hong Kong Physiotherapy Association 1983; 5.
- [12] Cram R. H.: A sign of sciatic nerve root pressure, J. Bone Joint Surgery: 1953: 35(B): 192-195.
- [13] Mulligan BR.Manual therapy: Nags, Snags, MWMs, etc. 4th edition 1999.
- [14] Howe JF, Loeser J.D, Calvin W.H.: Mechanosensitivity of dorsal root ganglia and chronically injured axons: A physiological basis for the radicular pain of nerve root compression: Pain: 1977: 3: 25-41.
- [15] Richard P. DiFavio: Neural Mobilization: The Impossible: JOSPT: 2001: 31(5): 224-225.
- [16] Neha Jain, G.L. Khanna, Amit Chaudhary: Comparison between straight leg raise and bent leg raise stretching techniques for increasing hamstring flexibility, Indian Journal Of Physiotherapy and Occupational Therapy 2009;3(2)
- [17] Larsson U et al: Autotraction for treatment of Lumbago-Sciatica. Acta Orthopaedica Scandinavia: 1980: 51: 791-798.
- [18] Pal B et al: A controlled trial of lumbar traction in the treatment of back pain and sciatica. British Journal of Rheumatology: 1986: 25: 181-183.
- [19] C. Beyerlein et al: Efficacy of Mulligan traction SLR technique in improving range of pain free SLR in low back and thigh pain: Curtin School of Physiotherapy: Spring Ed: 2001.
- [20] Hall T et.al. : Mulligan bent leg raise technique- a preliminary randomized trial of immediate effects after a single intervention, Manual therapy 2005;11(2): 130-135.
- [21] Eyal Lederman: Fundamentals of manual therapy, physiology, neurology and psychology. Churchill Livingstone.
- [22] Jacek A.K., John M.E. et. al. The Quebec Back Pain Disability Scale: Conceptualization and development. Dep. of Preventive Medicine and Biostatistics, University of Toronto; 1995.
- [23] Kopec JA, Esdaile JM, et. al. The Quebec Back Pain Disability Scale: Measurement properties. Spine; 1995 Oct 1; 20(19): 2169-70.
- [24] Deville WL,Vander Windt DA et.al.: The test of Lasegue, systematic review of the accuracy in diagnosing herniated discs-Spine 2000; 25(9): 1140-7.

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