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IMMEDIATE EFFECT OF NEURODYNAMIC SLIDING TECHNIQUE VERSUS MULLIGAN BENT LEG RAISE TECHNIQUE ON HAMSTRING FLEXIBILITY IN ASYMPTOMATIC INDIVIDUALS

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ABSTRACT

Background: Neurodynamics sliding technique (NDST) and Mulligan bent leg raise technique (MBLR) both have been individually advocated for increasing hamstring flexibility but comparison of these techniques have not been found in studies. The purpose of the study was to find immediate effect of neurodynamic sliding technique versus mulligan bent leg raise technique on hamstring flexibility in asymptomatic individuals.

Method: An Experimental study designs, with two group 80 asymptomatic normal subjects were randomized 40 subjects into each NDST group and MBLR group. NDST group received Neurodynamic sliding technique and MBLR group received Mulligan bent leg raise technique; passive straight leg raise was taken as outcome measure pre and post intervention.

Results: When means of post intervention were compared there is statistically significant difference in means of passive SLR ROM within the groups but there is no statistically significant difference in post intervention means between the groups.

Conclusion: It is concluded that both NDST and MBLR technique are effective on improving hamstring flexibility for asymptomatic individuals with limited SLR ROM. However there is no significant difference in improvement in hamstring flexibility between the groups.

Key words: Neurodynamic sliding technique, Mulligan bent leg raise technique, straight leg raise test, range of motion, muscle tightness, Hamstring flexibility.

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INTRODUCTION

Flexibility is defined as the range of motion around the joint or the group of joints and reflects the ability of muscle tendon unit to elongate.[1] The hamstrings are examples of muscle group that have a tendency to get shorten.[2] Inability to extend the knee completely when the hip is flexed accompanied by discomfort or pain along the posterior thigh and/or knee is usually attributed to hamstrings muscle tightness and this is found in asymptomatic normal individuals.[3] Since this tightness has been associated with pain and injury, it is important to assess the flexibility of the hamstrings before doing any physical activity. Low back muscles and hamstring flexibility is needed for doing everyday tasks such as bending over and sitting.[4]

There are studies found that various stretching techniques such as static, Proprioceptive neuromuscular facilitation, Muscle energy technique (MET), Mulligan bent leg raise (MBLR) technique and Neurodynamic slider technique (NDST) to improve hamstring flexibility.[5-8]

In a recent study concluded that subjects who perceived they had tight hamstrings were unlikely to have reduced hamstring length or extensibility. It was postulated that neural mechanosensitivity may play a significant role in explaining 'perceived hamstring tightness'.[3] It is stated from the studies that increases in tissue extensibility is only because of mechanical properties of the muscle being stretched but it also results from changes in the individual's perception of stretch or pain. This is known as the 'sensory theory' and it proposes that increases in muscle extensibility after stretching are due to modified sensation.[9] With this view in mind, it can be hypothesized that exercises thought to target the neural mobility or the neurodynamics system would be better methods of treating 'perceived hamstrings tightness'.[3]

Neurodynamics is the term used to describe the integration of the morphology, biomechanics and physiology of the nervous system.[3,10,11] An individual with decreased hamstring extensibility may demonstrate limited range in the passive straight leg raise test (SLR) because of altered neurodynamics affecting the sciatic, tibial and common fibular nerves. Abnormal posterior lower extremity neurodynamics may influence resting muscle length and lead to changes in the perception of stretch or pain.[6] It follows that providing a movement/stretching intervention could alter the neurodynamics and lead to modification of the sensation and ultimately, increased extensibility.

Various treatment strategies have been advocated to improve neurodynamics by targeting different components of the neurodynamics system. Direct nerve mobilization consists of sliders, tensioners and single joint nerve mobilization, addressing the mechanical interface, postural correction and ergonomic adaptations are ways of approaching altered neurodynamics.[12] So use of neurodynamics sliding technique can be useful to alter such sensation and ultimately can improve hamstring flexibility. In these exercises tension is increased at one end and lessened at the opposite end of the nerve, thus improving nerve excursion.[6, 13.]

It is also found that mulligan mobilization techniques are effective in improving straight leg raise (SLR) range.[7,14] There are different schools of thought for improvement in SLR range with the use of Mulligan bent leg raise technique (MBLR) technique but might be due to change in stretch tolerance of hamstring that is change in "perceived hamstrings tightness" with triggering neurophysiological responses with use of BLR technique.[7,15] Mobilization of nervous tissue has been postulated as one of the causes for improvements seen post BLR.[3]

The SLR test is a useful measure, in this regard, because immediate effects of treatment can be determined.[16] It is a common neurodynamic test which is used to examine the mechano sensitivity of lower limb nervous system.[16, 17] To measure the range of motion of this SLR test goniometer is used as its reliability value is high.[18, 19]

Yolanda castellote and his companions studied the effect of neurodynamic sliding technique on hamstring flexibility. They found that NDST can increase hamstring flexibility.[6] Toby hall and his companions studied the effect of mulligan BLR technique for hamstring flexibility. They found that mulligan BLR gives significant increase in SLR range.[7] As there are no studies found in the literature, there is a need to find the comparative effect of NDST and mulligan BLR technique on hamstring flexibility. Finding the comparative effect will clinically provide a guiding stone for therapists in the management of hamstring tightness, on the usage of neurodynamic sliding and mulligan BLR as well as the effectiveness of each as compared to one another and to make evidence based decisions on the proper use of either mode of treatment for the management of hamstring tightness.

Therefore, the Study with research question, Does there is a difference in immediate effect on improving hamstring flexibility following neurodynamic sliding technique versus mulligan

bent leg raise technique in asymptomatic subjects? Therefore, the purpose of the study is to find the comparative effect of NDST versus mulligan BLR technique on immediate effect on improving hamstring flexibility in asymptomatic individuals. It was null hypothesized that will be no statistically significant difference between neurodynamic sliding technique versus mulligan bent leg raise technique on immediate effect of improving hamstring flexibility in asymptomatic individuals.

METHODOLOGY

An experimental study design with two groups, neurodynamic sliding technique (NDST) group and mulligan bent leg raise (MBLR) group. As this study involved human subjects the Ethical Clearance was obtained from the Ethical Committee of KTG College of Physiotherapy and K.T.G. Hospital, Bangalore as per the ethical guidelines of Bio-medical research on human subjects. This study was registered under Rajiv Gandhi University of Health Sciences for subjects for registration for dissertation with registration number 09_T031_47137. Subjects included in the study were normal asymptomatic subjects with no symptoms of hamstring tightness, both male and female subjects,[7] age group between 18 to 40 years,[7] subjects with limited SLR ROM less than 75 degrees, who was willing to participate and sign a consent form,[6-7]. Subjects were excluded with with low back pain,[6] history of hamstring injury in past years,[6] history of neurological disease or peripheral neuropathy,[6] history of orthopedic disorder affecting lower limb (e.g. femoral fracture, meniscal injury etc.)[6]

Subjects were recruited from KTG Group of Institutions, Bangalore. The study was conducted at KTG Hospital, Bangalore. Subjects who meet inclusion criteria were recruited by Simple random sampling method using closed envelops, randomly allocated subjects into two groups. Subjects who meet inclusion criteria were informed about the study and a written informed consent was taken. Total 80 Subject (n=80), 40 in each group participated in the study.

Procedure of stretching for NDST group:[6]

In this group subjects were treated with neurodynamic sliding technique. The neurodynamic sliding technique consists of 'seated straight leg slider'. These neurodynamic sliders are maneuvers performed in order to produce a sliding movement of neural structures relative to their adjacent tissues.[6-10] Sliders involve application of movement/stress to the nervous system proximally while releasing movement/stress distally, and then reversing the sequence. Research has shown that sliders actually result in greater excursion than simply stretching the nerve.[12] Subject sat with their trunk in thoracic flexion (slump) and while maintaining that

Figure-1: NDST technique-knee flexion/ankle planter flexion and cervical flexion.

Figure-2: subject receiving mulligan bent leg raise technique.

Figure-3: Measuring passive SLR ROM

posture, they performed alternating movements of knee extension/ankle dorsiflexion with cervical extension, and knee flexion/ankle plantar flexion with cervical flexion. Subjects performed these active movements for approximately 60 seconds and repeated them for 5 times. At present, there is no research evidence on the appropriate dosage for active neurodynamic sliders. [11-21.] However, in this

study 60 seconds and 5 repetitions were used that was found from a pilot study conducted prior to this study.

Procedure of stretching for MBLR group:
In this group subjects were treated with BLR technique. Subjects were in supine position. Therapist placed one hand under subject's knee and clasped under subject's heel with other hand. Therapist flexed subject's hip as far as possible keeping subject's knee flexed. The heel was off the bed and then therapist asked the patient to push his leg down to the bed against therapist's resistance and then relax. At this point therapist raised the leg gently as far as therapist can lift the leg from the bed, with maintaining or increasing knee flexion therapist perform slightly hip abduction at the same time with three repetition of isometric contraction of hamstring and it was held for pain free 5 seconds followed by stretch applied and procedure was performed in five progressive greater position of hip flexion.[7-15]

Outcome Measurements:
Hamstring flexibility was measured by measuring passive SLR ROM using Goniometer before and immediately after the application of technique.

The passive SLR test was used to determine changes in hamstring muscle extensibility. With the subject in the supine position, the lateral condyle of the femur was pinpointed with a marker, as were the head of the fibula and the fibular malleolus. The axis of a goniometer was placed on the projection of the greater trochanter of the femur. One of the arms of the goniometer was placed parallel to the table (checking with a level). The knee and ankle were kept in the extension position. Holding the talus and without rotating the hip, flexion of the hip was gradually increased, lifting the subjects' lower limb until they first complained of pain in the region of the posterior thigh. The point of first onset of pain has traditionally been referred to as P1.[6] Care was taken to ensure that they did not bend their knee, or begin to swing the pelvis in retroversion. At that moment, the other arm of the goniometer was placed in the direction of the line between the head of the fibula and the fibular malleolus, and the degree of elevation of the straight leg was noted. One therapist was performing the passive SLR to P1, while the other therapist was taking the goniometric measurement.[6]

Passive SLR test is valid test to measure hamstring flexibility and goniometer was used to measure ROM which is a valid tool to measure range of the all joints of body. This measurement has been shown to have high reliability and validity in various studies. Its intra-rater reliability ICCs to be 0.95-0.98; the standard error of measurement (SEM) was between 0.54 degree and 1.22 degree; and minimal detectable change was between 1.50 degree and 3.41 degree. Substantial agreement was found between SLR and slump test interpretation (kappa = 0.69) and good correlation in ROM between the two tests (r = 0.64). Measurements were taken before the intervention and re-evaluated after the intervention.[6, 16, 17.]

Statistical Methods
Descriptive statistical analysis was carried out in the present study. Out Come measurements analyzed are presented as mean ± SD. Significance is assessed at 5 % level of significance with p value was set at 0.05 less than this is considered as statistically significant difference. Paired 't' test as a parametric and Wilcoxon signed rank test as a non-parametric test have been used to analysis the variables pre-intervention to post-intervention with calculation of percentage of change. Independent 't' test as a parametric and Mann Whitney U test as a non-parametric test have been used to compare the means of variables between two groups with calculation of percentage of difference between the means. The Statistical software namely SPSS 16.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

The study was conducted on 80 subjects (Table-1) in MBLR Group there were 40 subjects with mean age of 27.88 years and there were 17 males and 23 female subjects were included in the study. In NDST Group there were 16 subjects with mean age 26.03 years and there were 16 males and 24 female subjects were included in the study. There is no significant difference (p = 0.168 (NS)) in mean ages between the groups.

When means of SLR ROM was analyzed within the group (Table-2) shows that there is a statistically significant change in means when means were analyzed from pre-stretch to post-stretch within the groups with positive percentage of change showing that there is increase in post means and negative percentage of change showing there is decrease in post means.

When means of SLR ROM was compared between the groups (Table-3) there is a statistically significant difference in means of SLR ROM between the groups.

Table 1: Basic Characteristics of the subjects studied

Basic Characteristics of the subjects the studied		MBLR Group	NDST Group	Between the groups Significance[a]
Number of subjects studied		40	40	--
Age in years (Mean ± SD)		27.88 ± 5.96 (18-38)	26.03 ± 5.75 (18-40)	p = 0.168 (NS)
Gender	Males	n = 17	n = 16	
	Females	n = 23	n = 24	
	Significance[b]	0.000**	0.000**	
Side	Right	n = 19	n = 20	
	Left	n = 21	n = 20	
	Significance[b]	0.000**	0.000**	

a. Pearson Chi-Square; b. Fisher's Exact Test

Table 2: Analysis of SLR ROM within MBLR and NDST Groups (Pre to post test analysis)

	Pre-stretch (Mean ± SD) min-max	Post-stretch (Mean ± SD) min-max	Z value[a] (Non parametric) [a]	t value[b] (parametric) [b]	Parametric Significance P value[b]	Percentage of change	Effect size r	95%Confidence interval of the difference	
								Lower	Upper
MBLR Group	55.68 ± 9.03 (38- 70)	67.97 ± 8.99 (50 -83)	-5.519 p = 0.000 **	-27.398	p = 0.000 **	22.07%	+ 0.56 (Large)	-13.208	-11.392
NDST Group	54.60 ± 9.45 (36 - 71)	64.03 ± 9.99 (44 - 82)	-5.525 p = 0.000 **	-25.825	p = 0.000 **	1%	+ 0.43 (Large)	-10.163	-8.687

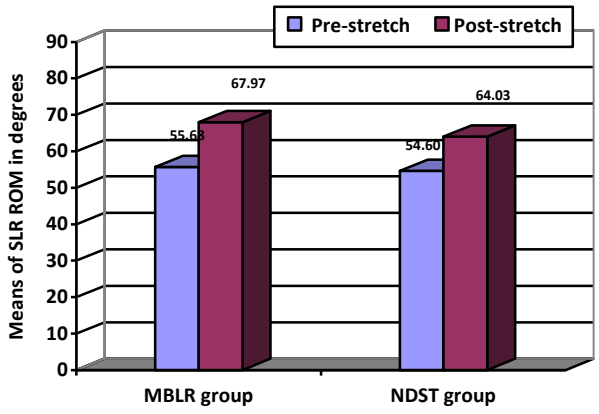
** Statistically Significant difference p < 0.05; NS- Not significant; a. Wilcoxon Signed Ranks Test. b. Paried t test.

Table 3: Comparison of means of SLR ROM between MBLR and NDST Groups

	Percentage of difference	Effect size	Z value[a] (Non Parametric)	t value[b] (Parametric) [b]	Significance (1-tailed) P value [b]	95%Confidence interval of the difference	
						Lower	Upper
Pre-Stretch	-1.95%	+ 0.05 (Small)	-.555 P = 0.579	0.520	p = 0.605 (NS)	-3.042	5.192
Post-Stretch	-6.15%	+ 0.20 (Small)	-1.724 P = 0.085	1.857	p = 0.067(NS)	-0.284	8.184

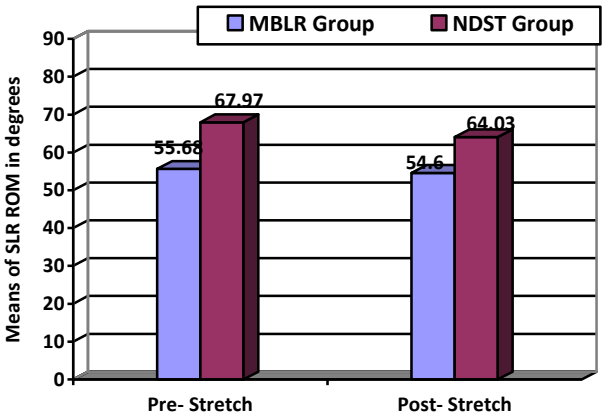
** Statistically Significant difference p < 0.05; NS- Not significant a. Mann-Whitney Test; b. independent t test.

Graph - 2: Analysis of of SLR ROM within MBLR and NDST Groups (Pre to post test analysis)



The above graph shows that there is a statistically significant change in means of SLR ROM when means were analyzed between pre-stretch to post-stretch within the groups

Graph - 3: Comparison of means of Score between Group MBLR and Group NDST



The above graph shows that there is no statistically significant difference in pre- stretchand post-stretch SLR ROM means compared between the groups with small effect size.

DISCUSSION

The present study found that there is no statistically and clinically significant difference between NDST group, who received Neurodynamic sliding technique and MBLR group who received Mulligan bent leg raise technique on increasing hamstring flexibility. However there is a significant difference in improvement within the group.

In NDST group, who received Neurodynamic sliding technique showed that there is a statistically significant change in means of passive SLR ROM, when means were analysed from pre intervention to post intervention measurements within the group with positive percentage of change showing there is increase in post means. There is a clinical significant effect with large effect size. This could be due to neurodynamics sliding technique, when tension is applied to the nervous system while applying neurodynamics, it causes reduction in cross-sectional area and increase in pressure in the nerve that results in extension and movement of the sciatic nerve together with the hamstring and this compliance of the nerve, results in increased flexibility. When applying neurodynamics, tension that occurs in the nervous system and pressure within the nerve increases due to the decrease in cross-sectional area, and the axonal transport system lengthens the sciatic nerve after shortening because of the influence of the surrounding related structures and hamstring flexibility.[20]

The observed changes may have been secondary to decreasing neuromeningeal sensitivity or may be that the neurodynamic sliders led to a modification of sensation such that the individual's perceptions of stretch or pain were altered.[6] A study examined the immediate effect of a suboccipital muscle inhibition (SMI) technique on hamstring flexibility that measured by the forward flexion distance test; straight leg raise test; and popliteal angle test and pressure pain threshold (PPT) over myofascial trigger points (MTrPs) in the hamstring musculature. Results in their study demonstrated that the SMI technique modified the flexibility of the hamstring muscles on all outcome measures, and furthermore, there was a significant difference in pressure algometry (PPT) for MTrPs in the right semimembranosus following the SMI (p ¼ .021) but not the left semimembranosus (p ¼ .079).[21] The fact that such a distant technique (suboccipital region) can have an immediate effect on the flexibility and pressure pain thresholds in the hamstrings may lend support to the 'sensory theory' proposed by Weppler and Magnusson (2010). It appears reasonable to suggest that the observed increases in hamstring tissue extensibility following the SMI would have more likely come from changes in the subjects' perceptions of stretch or pain associated with the flexibility and pressure pain testing.[6,9,21]

Although our study does not provide information about the mechanism of action or change, it does suggest that neurodynamics treatment can significantly increase hamstring flexibility in asymptomatic individuals.

In MBLR group, who received Mulligan bent leg raise technique showed that there is a statistically significant change in means of passive SLR ROM, when means were analyzed from pre intervention to post intervention measurements within the group with positive percentage of change showing there is increase in post means. There is a clinical significant effect with large effect size.

Mulligan's BLR technique utilizes passive flexion at the hip which results in caudal loading of the lumbosacral nerve roots and sciatic nerve in the pelvis, followed by active hip extension. During hip extension, there is unloading of these neural tissues, and they move in the cranial direction.[22, 23] With hip flexion during BLR, there is obligatory lumbar flexion. With lumbar flexion, the lateral intervertebral foramina and central canal open further facilitating caudal movement of the neural structures. This movement of neural structures could be effective in dispersing intraneuraledema, thus restoring pressure gradients and relieving hypoxia.[4,24,25] Improved mechanics of the neural structures would be one mechanism for improvements noted post BLR. BLR also involves isometric contraction of hip extensors followed by stretch of the same muscles also referred to as 'Post Isometric Relaxation'. Post-isometric relaxation refers to the assumed effect of reduced tone experienced by a muscle or a group of muscles after brief periods following an isometric contraction. Improvements noted in Group B (MBLR group) could also be attributed to the effect of isometric contraction on the connective tissues. Combination of contraction and stretches may be responsible for improving the viscoelasticity which in turn improves tissue extensibility.[4,25, 26]

Another explanation could be that increase in passive SLR ROM with MBLR technique is due to changes in pain responsiveness. The explanations for changes in pain responsiveness have not been well understood. Afferent input from muscles and joints during BLR, may interfere with signals from

nociceptive fibers (stretch discomfort), subsequently inhibiting an individual's perception of pain. This explanation is consistent with the gate control theory of pain.[29] Mulligan's Mobilization with Movement (MWM) is reported to cause pain relief through neurophysiological effects like sympathoexcitation, improvements in motor function and non-opioid hypoalgesia in patients with lateral epicondylalgia. Whether Mulligan's BLR can have similar neurophysiological effects needs to be further evaluated. Alternatively, changes in pain responsiveness may be psychologically mediated. It is possible that participants anticipated the positive effects of BLR, so their perception of pain during passive SLR was dampened. According to the gate control theory, sensations of pain and discomfort are affected by descending modulatory influences from higher centers. Prior motivation, elevated mood and confidence from positive expectations of BLR are all potential psychological contributors explaining the participants' altered perception of discomfort and willingness to tolerate greater stretch over time.[4,30] Harvey et al. (2003) found no increase in hamstring extensibility after 4 weeks of hamstring muscle stretching in patients with spinal cord injuries. It seems reasonable to extrapolate that increase in hamstring extensibility is closely connected to central neurophysiological processing, which is severely impaired in patients with spinal cord injuries. Thus, it might be assumed that the BLR technique triggers neurophysiological responses influencing the muscle stretch tolerance.[8, 28]

This study found that the small effect size with wider range 95% CI between the groups showing no difference between the groups. One reason for no significant difference in hamstring SLR ROM with NDST and MBLR could be that both the technique targets neural tissue mobility/neurodynamics, which is a method to treat "perceived hamstring tightness". Now with an understanding that subjects with "perceived hamstrings" tightness are more likely to be experiencing altered neurodynamics and respond better to exercises targeting neural tissue mobility.[4,6] Hence based on the analysis and findings, the present study found that Neurodynamic sliding technique and Mulligan bent leg raise technique found statistically no significant difference on passive SLR ROM in asymptomatic individuals. Therefore the study accepts null hypothesis.

LIMITATIONS OF THE STUDY

1. Subjects with 18-40 years of age were considered for study thus results cannot be generalized to all age group.
2. Only immediate effect was studied short and long term effects were not studied that would have helped to find the maintenance of the improved outcome measures.
3. Only SLR ROM was measured.
4. Study was done only on normal subjects.

RECCOMENDATION FOR FUTURE RESEARCH

1. Further study on other techniques in combination with NDST and MBLR needed to find the effect for individual with limited hamstring flexibility.
2. Further study are needed to find the effects of these techniques in conditions with secondary hamstring tightness.
3. Further study should needed measuring effect on other outcome measurements.

CONCLUSION

The present study concludes that both NDST and MBLR technique are effective on improving hamstring flexibility for asymptomatic individuals with limited SLR ROM. However there is no significant difference in improvement between the groups. It is recommended clinically that to consider NDST and MBLR technique are effective for patients with limited hamstring flexibility.

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Conflicts of interest: None

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