International Journal of Research and Review
DOI: https://doi.org/10.52403/ijrr.20211208
Vol.8; Issue: 12; December 2021
Website: www.ijrrjournal.com
E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

Comparison of Effectiveness of Passive Hamstring Stretching Technique and Neurodynamic Sciatic Nerve Sliding Technique in Low Back Pain

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ABSTRACT

Objective: Low back pain (LBP) is a very common health problem worldwide having global point prevalence of 9.4%. Correlations have been found between decreased length of the hamstrings and LBP. It was found that improving the flexibility of hamstrings can significantly reduce chronic LBP. This study compared the effectiveness of two techniques i.e. passive hamstring stretching technique (PHS) and neurodynamic sciatic nerve sliding technique (NDS) on hamstring flexibility and pain in non-radiating LBP patients.
Methods: 26 patients between the age group of 25-45 years having non-radiating LBP were recruited in the study. Group A (n=13) were given passive hamstring stretching while Group B (n=13) performed neurodynamic sciatic nerve sliding technique under guidance of the researcher. Baseline data were obtained for hamstring length and pain before and after intervention. Pain was assessed using 'visual analogue scale' and hamstring length was measured using 'passive knee extension test'. Intervention was performed on alternate days for three sessions with 48 hours rest period in between each session.
Results: Data were analysed for hamstring length and pain between both the groups using 'unpaired t' test. NDS technique was statistically significantly more effective in improving pain (p =0.03 at 95%CI= -2.07 to -0.09). There was no statistically significant difference in the effectiveness of both techniques in improving hamstring length (p =0.08 at 95%CI= -3.4 to 0.25).
Conclusions: Both the techniques are equally effective in improving hamstring length, however NDS was more effective in improving pain in low back pain patients as compared to PHS.

Keywords: Low back pain; Neural sliders; Static hamstring stretch; Hamstring flexibility

INTRODUCTION

Low back pain (LBP) is a very common health problem worldwide and a major cause of disability affecting performance at work and general well-being having a prevalence of 23.09% in Indian population [1]. It is the leading cause of activity limitation and work absence worldwide. It can impose a high economic burden on individuals, families, communities, industry, and governments [1,2]. It affects people of all ages, from children to elderly. Prevalence increases and peaks between the ages of 35 to 55 [1]. LBP can be acute, sub-acute, or chronic. According to the Global Burden of Disease 2010 Study, LBP is ranked highest in terms of disability, and sixth in terms of overall burden. The global point prevalence of LBP was 9.4% [3].

LBP can have a significant effect on musculoskeletal, physiological, and neuromuscular characteristics [4]. Individuals with a history of LBP have deficits in trunk strength, hamstring strength, and reduced flexibility and range of motion of the trunk, hip, and knee [4].

Tafazzoli and Lamontagne (1996) reported that the amount of hamstring tightness was significantly higher in individuals with LBP when compared to those without LBP [5]. Improving the flexibility of the lumbar spine and hamstrings can significantly reduce chronic LBP by 18.5%–58% [6]. It was found that, more the tightness, higher the severity of LBP that patient experiences [5]. If the normal lumbo-pelvic rhythm is disturbed because of shortening of hamstrings, more stress might occur at the lumbar spine during movement [7]. Lengthening the hamstrings may allow greater motion to occur at the hips and therefore may reduce stress on the lumbar spine [7].

Stretching exercise is one of the therapeutic techniques used to improve and maintain muscle length [8]. Several stretching techniques have been used to improve muscle flexibility, including the static stretching, contract-relax stretching, ballistic stretching, PNF and neurodynamic stretching [8]. Static stretching increases ROM more than two times that of dynamic stretching, thus it is more effective in enhancing flexibility but if neural tissue is involved as a cause of limited ROM then neural mobilization may be a better treatment option [9]. Randomized controlled trial of hamstring stretching concluded that straight leg raise (SLR) passive stretch group had the greatest improvement in hamstring length [10].

Sciatic nerve which innervates the hamstrings is exposed to constant pressure during prolonged sitting, standing and other daily activities resulting in hamstring tightness [8]. Nerve adhesions in the hamstring may alter neuro-dynamics causing abnormal mechano-sensitivity of the sciatic nerve; which could influence hamstring flexibility [8]. Neurodynamic mobilization is a manual method of stretching in which force is applied to nerve structures through posture and multi-joint movement, aiming to produce a sliding movement of neural structures relative to their adjacent tissues [8]. Studies have shown that it can be a beneficial technique to improve hamstring flexibility [8,9].

Though literature has shown the effects of passive stretching and neurodynamic sciatic nerve sliding technique on hamstring length, there is dearth of studies comparing both the techniques. Therefore, research question emerged was “Whether there was difference in the effectiveness of passive hamstring stretching technique (PHS) and neurodynamic sciatic nerve sliding technique (NDS) on hamstring flexibility and pain in low back pain patients?” which led to design the present study.

MATERIALS AND METHOD

Participants

The study was conducted at physiotherapy OPD of a tertiary care hospital. Experimental two groups pre-post study design was used. A convenience sample of twenty-six participants having axial and non-radiating back pain on the posterior aspect of body from the lower border of twelfth rib to the lower gluteal folds were included in the study. Males and females between age group of 25-45 years, having more than 4 weeks of onset of LBP and presenting with bilateral hamstring tightness were selected for the study. However, those participants with radiating pain in lower limb or having acute exacerbation of LBP were excluded from the study. Patients with neuromuscular conditions involving lower quadrant, seronegative arthropathies, congenital/ traumatic/ acquired spinal conditions or pathological/ infective spinal conditions were also excluded. An informed written consent was taken. Study had received approval from the Institutional Review Board and Institutional Ethics committee.

Study procedure

Data record sheet was filled after the initial physical assessment. The participants underwent Pre-intervention assessment. The outcome measures in the study were Passive knee extension test [9] for the assessment of hamstring muscle length bilaterally and Visual Analogue Scale (r=0.97) [11,12] for the assessment of pain.

In Passive knee extension test the participants were asked to lie supine on a plinth. The contralateral leg remained extended with the help of a strap at the mid-thigh region. The therapist passively flexed the hip to 90° until the thigh was vertical and maintained it throughout the test. The knee was initially kept at 90°. A goniometer was used to measure the knee extension angle. The moving arm of the goniometer pointed towards the lateral malleolus and the stationary arm pointed towards the greater trochanter, with its axis placed over the lateral knee joint line. The examiner then passively extended the patients test knee as far as possible while maintaining the thigh in vertical position. The angle of knee extension was read off the goniometer and recorded as hamstring muscle length. Measure the angle of knee flexion from vertical, with the thigh in vertical position. The measurement unit is degrees. Any degree of flexion will be recorded as positive number, e.g.10,20 degrees, etc. It is depicted in Figure.1

Figure 1: PASSIVE KNEE EXTENSION TEST

Participants were allocated randomly into two groups A and B by chit method. In Group A (PHS group), the participants were given passive hamstring stretch [13]. While in Group B (NDS group), the participants performed neurodynamic sciatic nerve sliding technique [14].

Passive hamstring stretching technique: Participants were in supine position. The contralateral leg was kept extended with the help of a strap. In the passive stretching group the examiner stabilized the subject's hip at 90° of flexion while extending their knee. Each stretch was held for 30 seconds at the point where tightness in the hamstring muscles was felt, and then the leg was slowly lowered. This stretch was repeated on the other leg. Stretching exercises were given for 3 sets bilaterally.

Figure 2: PASSIVE HAMSTRING STRETCHING TECHNIQUE

Neurodynamic sciatic nerve sliding technique: Participants were sitting at the edge of the plinth. They were asked to actively perform cervical and thoracic flexion, along with bilateral knee flexion and ankle plantar flexion. Then they were asked to perform cervical and thoracic extension with bilateral knee extension with ankle dorsiflexion. They alternatively performed these movements for 60 s and repeated them for 5 sets with a rest pause of 30 seconds in between each set. Each of the participants in the intervention group were treated with the neurodynamic sliders for 3 sessions on alternate days over 1 week.

After intervention, hamstring length and pain were re-evaluated immediately and after the third consecutive session. The participants were followed up on alternate days with 48 hours rest period in between for 3 consecutive sessions. All the participants from both the groups underwent a common back care program which consisted of core strengthening, bridging exercise, isometric abdominal and back extensor exercises, pelvic tilting exercises and strengthening of hip abductors and extensors.

Figure 3: NEURODYNAMIC SCIATIC NERVE SLIDING TECHNIQUE

Statistical methods

The data analysis was performed using GraphPad Prism (version 8.4.3) software for Windows. Level of significance was set at 5%. Data was tested for normality distribution using Kolmogorov Smirnov Test [15]. All the data were found to be normally distributed. Data analysis was performed to find the statistical significance of the difference in the effectiveness of Neurodynamic Sciatic Nerve Sliding technique and Passive Hamstring Stretching technique on hamstring length and pain using Unpaired ‘t’ test.

RESULT

Twenty-six participants were included in the study. There were 18 males (69.23%) and 8 females (30.77%). Mean age in the PHS group was 39 years while in NDS Group was 36 years.

Data were normally distributed; hence analysis was done using Unpaired 't' test. Table 1 represents the summary of inferential statistics to compare the change in the hamstring length between both the groups.

TABLE 1. Summary of inferential statistics for change in hamstring length between PHS and NDS groups

Groups	Mean±SD	Df	Diff of μ	‘t’ Crit	‘t’ table 0.05	CI 95%	‘p’ value	Significance
PHS (n=13)	2.86±0.86	19.41	1.09	2.29	2.06	-2.07, -0.09	0.03	Yes
NDS (n=13)	3.95±1.47							

PHS Group*=Passive Hamstring Stretching Group,* ***NDS Group****=Neurodynamic Sciatic Nerve Sliding Group,* ***df****=degree of freedom,* ***Diff of μ****=Difference of mean,* ***'t' crit****=Critical 't' value,* ***CI****=Confidence Interval.*

Study findings showed that difference of mean in hamstring length scores between both the groups (PHS group= 7.62±2.11; NDS group=9.19±2.39) was not statistically significant [Critical 't' value (1.78) < 't' table value (2.06) at 0.05]. The calculated 'p' value was 0.08 at 95% CI= -3.4 to 0.25. There was no significant difference in the effectiveness of both techniques.

TABLE 2. Summary of inferential statistics for pain between PHS and NDS groups

Groups	Mean ±SD	df	Diff of μ	‘t’ crit	‘t’ table 0.05	CI 95%	‘p’ value	Significance
PHS (n=13)	7.62 ±2.11	24	1.58	1.78	2.06	-3.40, 0.25	0.08	NS
NDS (n=13)	9.19 ±2.39							

PHS Group*=Passive Hamstring Stretching Group,* ***NDS Group****=Neurodynamic Sciatic Nerve Sliding Group,* ***df****=degree of freedom,* ***Diff of μ****=Difference of mean,* ***'t' crit****=Critical 't' value,* ***CI****= Confidence Interval.*

Table 2 represents the summary of inferential statistics to compare pain between both the groups. Data were normally distributed but the variance of both the groups was different [as measured by ANOVA test which was significant (p value=0.03)], hence analysis for the significance of difference of mean between both the groups was done by Unpaired 't' test using Welch's correction. Inferential statistics is summarised in Table 2.

The result from the analysis showed that mean scores of VAS was more in the NDS group (3.95±1.47) than in the PHS Group (2.86±0.86) [Critical 't' value (2.29) > 't' table value (2.06) at 0.05]. The calculated 'p' value was 0.03 at 95% CI= -2.07 to -0.09. Difference of mean in VAS scores between both the groups was found to be statistically significant. Therefore, NDS was significantly more effective than PHS in relieving Pain.

DISCUSSION

There was no significant difference found between NDS and PHS group in improving hamstring length. These findings are in line with the study conducted by Curtis et al. (2016); Machado and Bigolin (2010), and Muragod and Pathania (2017) in chronic LBP patients. However, in present study both the groups were also found to be individually effective in improving it. [9,16,17] These findings are in line with Ahmed and Samhan (2016), who found improvement in hamstring flexibility after the application of both neurodynamic and static stretching. [8] There are various probable mechanisms proposed by researchers for improvement in hamstring length due to NDS. Decrease in neuro-pathomechanics that develops in the nervous system is believed to increase neural tissue mechano-sensitivity causing protective mechanism when stressed and limits flexibility of muscle [8,18]. NDS causes deflection of the sciatic nerve, improves neuro-dynamics and maintains a dynamic balance between neural tissues and surrounding mechanical interfaces, thus decreasing neural tissue mechano-sensitivity, resulting in improvement of hamstring flexibility [8,19,20]. When tension is applied to the nervous system during neuro-dynamics application, there is a reduction in the cross-sectional area and increase in pressure in the nerve which results in movement of the sciatic nerve together in compliance with the hamstring muscle which may result in increased hamstring flexibility or increased tolerance to stretch [8,21].

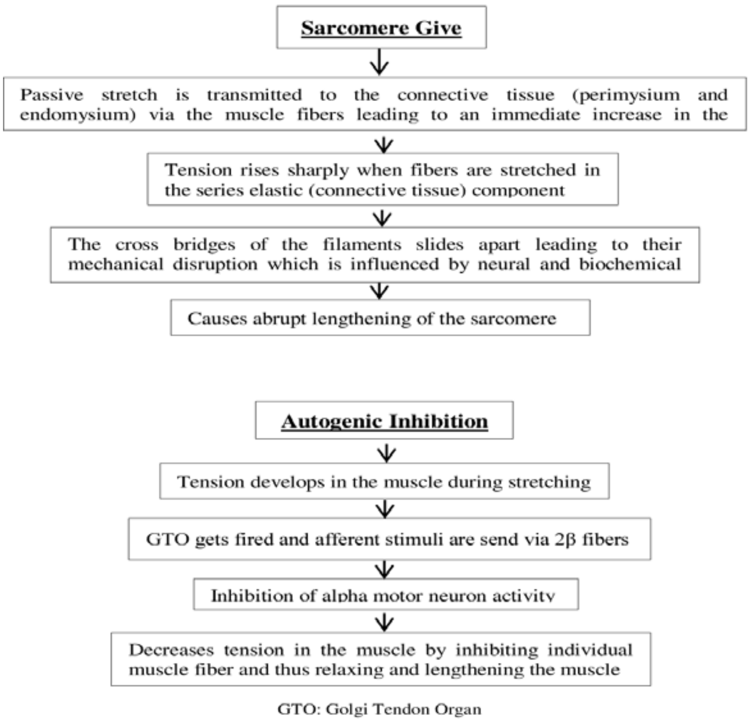

Figure 4: MECHANISM OF SARCOMERE GIVE AND AUTOGENIC INHIBITION

Improvement in hamstring length due to PHS is observed also could be due to increase in the stretch tolerance of the muscle found with static stretching. This could be probably due to changes in the viscoelastic property that occur with “creep”, whereby the tension in the muscle-tendon unit diminishes over time [8,10,20]. The improvement in hamstring length can be explained by two probable mechanisms [22,23]. Those are Sarcomere Give and Autogenic Inhibition. Both the mechanisms are depicted in Figure 4.

However, present study findings are contradictory to the findings of systematic review and meta-analysis by López L et al. (2019) who found that neurodynamic treatment was better in hamstrings flexibility than control group (placebo) or other treatments.[24] Similarly, Gadpal and Asgaonkar (2017); Méndez-Sánchez et al. (2010); Ahmed and Samhan (2016) concluded that neurodynamic and static stretching interventions both significantly improved hamstring flexibility, but neurodynamic intervention could improve hamstring flexibility to a greater extent than static stretching. [8,22,25]

The second outcome measure was pain; where the present study found both the groups individually effective in improving pain. However, NDS was found to be significantly more effective than PHS in relieving pain. These findings were in line with the study by Pourahmadi et al. (2019); Cleland et al. (2006). They concluded that slump stretching is beneficial in improving long term disability, pain and centralization of symptoms among non-radicular LBP patients [21,26]. Similar results were also found in the study conducted by Ju-Hyun-Lee and Tae-Ho Kim (2017) on radicular LBP patients [27]. They found that alleviation of pain was more significant in the nerve mobilization group, probably because nerve mobilization decreases the nerve adhesions, blocks the diffusion of harmful substances, expands the nerve blood vessels and also alleviates muscle fatigue [27,28]. Zhimina Devi et al. (2014) concluded that stretching of lower back muscle, hamstring and tensor fascia lata showed significant effects on improving pain, flexibility and functional disability in occupation related chronic mechanical LBP in community nurses. [29]

Coppieters et al. (2007) found that neural sliders cause elongation at one end of the nerve bed, thereby creating tension in the nerve from that end, while simultaneously releasing tension from the other end of the nerve. In doing so, excursion is promoted without increased nerve tension [20,30,31]. This excursion causes intraneural fluid dispersion, reducing intraneural oedema, thus relieving hypoxia and improving axonal transport [32,33,34]. NDS also reduces the pressure caused by intraneural and extra-neural fibrosis, helps in restoring tissue mobility and reduces neural mechano-sensitivity [34]. It reduces antidromic impulses generated in C-fibers at the dysfunctional site, which result in the release of neuropeptides and subsequent tissue inflammation [33]. There is improvement in viscoelastic properties of the nerve, leading to reduction in pain thus reducing disability [33]. NDS reduces thermal and mechanical hyperalgesia, and reverses the increased immune responses following a nerve injury [33].

The present study findings were in contradiction to the study findings of Machado and Bigolin (2010) in chronic LBP patients. They found that when neural mobilization group was compared with muscle stretching group, no statistically significant difference was found for pain reduction, although both the groups showed significant improvement for the reduction of pain within the group [16].

CONCLUSION

The findings of the present study conclude that NDS was more effective in relieving pain as compared to PHS in LBP patients whereas both were equally effective in improving hamstring length. However, both the techniques significantly improved hamstring length and alleviated pain individually. Pain relief helps to reduce disability and improves one's quality of life. During the study the researcher experienced that NDS was easier to administer in patients and was also energy conserving for the therapist. Thus, NDS could be preferred over PHS if the patient has good comprehension and compliance for the treatment.

Limitations

Some limitations of the study should be acknowledged. Study results may not be generalized in different populations of LBP patients e.g.: patients of different age groups, different types of low back pain, etc. No long-term follow-ups were conducted.

Future research can be conducted to determine whether the effects would also be reflected in the functional outcomes of the patients. A future study can be designed compare both the techniques in different subtypes of LBP and also to assess the relationship between low back pain and hamstring length.

Declarations

Acknowledgements

Researchers acknowledge the participants for their participation in the study.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Ethical Approval

The study protocol was approved by Institutional Review Board and Institutional Ethics Committee. All subjects gave their written informed consent for participation in the study.

Conflict of Interest: None

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How to cite this article: Paranjape S, Naik N. Comparison of effectiveness of passive hamstring stretching technique and neurodynamic sciatic nerve sliding technique in low back pain. *International Journal of Research and Review*. 2021; 8(12): 54-62. DOI: *https://doi.org/10.52403/ijrr.20211208*

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