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Original Research Article

Effect of Neural Mobilization and PNF Stretching on Hamstring Flexibility in Working Women

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ABSTRACT

Background: Hamstring flexibility is considered as a prerequisite for normal mobility and function as its inflexibility has been related with development of soft tissue and musculoskeletal injuries. There are reports of higher incidence of 'Work-related Musculoskeletal Disorders' (WMSD) in working women and majority of them have been linked to tight muscles, especially, hamstrings. Hence, need arises to find out simple yet efficacious therapeutic intervention that can counter the hamstring tightness and ameliorate its negative effects. Proprioceptive Neuromuscular Facilitation (PNF) stretching and Neural Mobilization (NM) techniques are coming up as promising methods to augment flexibility in athletes. However, effectiveness of these interventions needs to be examined in other population groups.
Objective: To investigate and compare the effectiveness of PNF stretching with combined effects of PNF stretching and Neural Mobilization (NM) on the hamstring flexibility in working females.
Materials and Methods: 24 females aged 25-40 years with hamstrings tightness as demonstrated by 20^o loss in Active Knee Extension (AKE) and Straight Leg Raise (SLR) less than 70^o were included in study and randomly allocated to two groups. Group A (n=12) received PNF stretching only while Group B (n=12) was administered PNF stretching followed by NM to hamstrings muscle. Both the groups received 20 intervention sessions, i.e. 5 days per week for a total period of 4 weeks. AKE and SLR were measured before and after 4 weeks of intervention.
Results: The results revealed that hamstring flexibility significantly improved in both groups after 4 weeks of intervention. Further, between the group comparison demonstrated that non-significant differences existed in improvement scores of AKE (t=1.86,p=0.075) and SLR (t=1.51,p=0.14) indicating that both interventions were equally effective in improving hamstring flexibility in working women.
Conclusion: Finding of present study revealed that neural mobilisation component when applied in combination with PNF stretching did not produced any additional benefits in terms of hamstring flexibility among working women..
Keywords: Proprioceptive neuromuscular facilitation, Neural mobilization, Hamstrings flexibility.

INTRODUCTION

Flexibility is a key component of the physical fitness and held as an important attribute that enable the person to move smoothly and safely. [1] It is an important aspect of normal human function that enhances the skills and motor abilities of an individual. [2] Although the flexibility of all the muscles of the body is essential for normal human function, the flexibility of hamstring muscle is much emphasised. Emerging evidences suggests that hamstring tightness contributes to musculoskeletal dysfunctions such as impaired postural balance, reduced range of motion of the knees and hips, increased risk of musculoskeletal and soft tissue injuries as patella tendinopathy, patellofemoral pain, hamstring strain injury, low back pain, herniated lumbar disc, decreased lumbar lordosis, decreased range of lumbar spine flexion and a higher risk of muscle injury thus causing an inefficiency in the workplace. [1,3-5] The numerous factors influencing the hamstring flexibility includes the age, gender, race, tissue temperature, strength training, stiffness, awkward posture and reduced warm up period during exercise [6] Recent studies show that that people with prolonged hours of chair sitting are prone to develop hamstring tightness as during prolonged sitting hamstring muscle becomes inactive and is consequently held at shortened length. [7]

Employed women are two to five times more likely than men to report musculoskeletal problems and their higher prevalence among the women reflects the accumulation of many factors related to office work load, domestic work load and biological difference. [8] Hence, the working females with sitting jobs of more than 8-10 hours may have preponderance for the development of hamstring tightness which makes them susceptible to various musculoskeletal problems such as low back pain and other musculoskeletal injuries.

The usual therapeutic technique used to improve and maintain muscle length is stretching. [2] Several stretching methods, including the static, ballistic, dynamic stretching have been shown to increase the flexibility, but the research is still divided on which technique is most effective. However, recent studies have shown that the Proprioceptive Neuromuscular Facilitation (PNF) stretching techniques are emerging as effective techniques to counter the hamstring tightness. [2,6,9,10-16] PNF stretching utilizes inhibition techniques, and of these, contract relax, hold- relax and contract - relax antagonist-contract appear to be commonly used. [17] The PNF methods, particularly those involving reciprocal activation such as hold relax (HR), provide the greatest potential for muscle lengthening, under the assumption that greater motor pool inhibition reduces muscle contractibility and therefore allows more muscle compliance. [18]

The flexibility can not only be influenced by muscle elasticity but also by the nervous tissue extensibility. [6] The tight hamstring has also been attributed to altered neural tissue mobility also referred to as altered neurodynamics resulting in enhanced neural mechanosensitivity. Thus decreased hamstring flexibility as evidenced by limited range could be due to altered neurodynamics affecting the sciatic and tibial nerve. Neurodynamic interventions, termed as Neural Mobilization (NM) or Nerve Glide Stretches are active stretches in which the nervous system is made taut and then slack and are thought to decrease neural mechanosensitivity by providing movement that lead to changes in the neurodynamics and modification of sensation, and help to explain the observed increase in flexibility. [19] The primary effect of neural mobilisation is to restore the dynamic balance between the relative movement of neural tissues and surrounding mechanical interfaces, thereby allowing reduced intrinsic pressures on the neural tissues and promoting optimum physiologic function [20] and it is assumed possible that inclusion of these techniques in the management of hamstring flexibility could prove to be more beneficial.

Thus, the present study aims to compares the efficacy of adding neural mobilization component to the proprioceptive neuromuscular facilitation over the proprioceptive neuromuscular facilitation (HR) stretch alone on enhancing the hamstring flexibility of the working females population having sitting clerical jobs of more than 8-10 hours.

MATERIALS AND METHODS

Sample: 24 females aged between 25 to 40 years exhibiting hamstring tightness were recruited in study by convenience sampling. Females having sitting jobs of at least 8 to 10 hours a day and having minimum of 20^0 loss of Active Knee Extension(AKE) measured with femur held at 90^0 of hip flexion [5] and also having inability to reach 70 degree hip flexion in a Straight Leg Raise(SLR) [16] were included in study. Individuals with acute or chronic low back pain, hamstring injury, history of surgery of the knee, hip or lumbosacral region, current pregnancy, neurological abnormality, inability to extend the knee fully in sitting position and person having hypermobility were excluded. Approval was obtained from Institution Ethics Committee (IEC) of Punjabi University, Patiala (No.46/DLS/HG) and informed written consent was obtained from all the participants.

Procedure: Participants recruited in study were randomly and equally allocated into two groups, i.e. Group A (n=12) and Group B (n=12) respectively. Informed written consent was obtained from all the participants Demographic details of participants are presented in Table.1.

Intervention: Subjects assigned to Group A were given PNF (Hold-Relax) stretching to hamstring muscle while subjects of Group B received PNF (Hold-Relax) stretching and neural mobilization (NM). Both the interventions were given for 4 weeks, 5 days per week.

Proprioceptive neuromuscular facilitation (PNF) Hold-Relax.

Group a received PNF (Hold-Relax) intervention only. The subject was made to lie supine on the examination table with the left leg secured with a strap. The right leg was used for the intervention in all the subjects. The leg was taken to the point where the subject first felt the tightness or 'mild discomfort' in the posterior thigh. Once the point of discomfort was reached, the position was held for 7 seconds. Next, the subject was made to isometrically contract the hamstrings for 7 seconds. After the contraction, the subject was made to relax for 5 seconds and the leg was passively stretched into the new range until the mild stretch sensation in hamstrings was reported by the subject. This was repeated five times. The AKE and SLR measurement was recorded prior to and after every intervention. This intervention was administered for 4 weeks/ 5 days a week/ one session a day and one session comprised of five repetition of PNF (Hold-Relax) technique.

PNF and Neural Mobilization:

Group B received two interventions, i.e. PNF and Neural mobilization

PNF (Hold-Relax) stretching was also applied to subjects of Group B, thereafter, they also received neural mobilisation (NM). NM was applied by placing subject's leg on researcher's shoulder and lifting the leg with knee kept in extension to a point where subject felt mild stretch in hamstrings. At this point, researcher rotated hip medially and dorsiflexed the foot for 3 secs, [21] this sequence was repeated 5 times in a session. Frequency of this intervention was same as in Group A. In Group B one session comprised of application of Hold-Relax with five repetitions followed by five repetitions of nerve mobilisation.

Outcome Measures: Outcome measures of study included, 1) Active Knee Extension (AKE) test and 2) Straight Leg Raise (SLR).The active knee extension test designed and studied by Gajdosik and Lusin [22] is a method of measuring the hamstring musculotendinous length. It is a test that measures hamstring tightness by the angle of knee flexion after active knee extension while the hip is stabilized at 90 degrees flexion. For performing the AKE test, the patient lies supine on the examination table, and the lower extremity not to be tested is secured to the table with a cloth or Velcro strap across the middle of the thigh. A plastic frame is attached to the examination table to help the patient accurately maintain the hip flexed to 90^0 throughout the test. The subjects are told to extend their knee and stop at the point where they first felt the stretch sensation at the posterior thigh area. The knee flexion angle is determined by measuring the angle between a line drawn from the mark just distal to the greater trochanter and the mark on the femoral condyle, with other line drawn from the mark on the fibular head to a mark just proximal to the lateral malleolus. Intratester reliability of AKE was found to be very high (r = 0.99) for both the right and the left extremity) [22] and inter-tester reliability of the AKE as determined by Norris and Mathews revealed an intra-class coefficient (ICC) of 0.761, hence it is a reliable measure of hamstring muscle length. [23]

The Straight Leg Raise (SLR) is widely reported as an indicator of hamstring muscle length for measuring the SLR, the subject is made to lie supine on the examination table with the other limb secured with a velcro strap. The subjects are instructed to lift their lower extremity up, keeping the knee extended, to the point where they first felt a stretch in the posterior thigh. The measurement was taken of the straight leg to the horizontal angle between the horizontal and the line between the mark just distal to the greater trochanter and the mark just proximal to the lateral malleolus. Cameron and Bohannon found that the intraclass coefficients for the AKE (.861) and SLR (0.953) tests were good and high and both tests provide an indicator of measuring the hamstring musculotendinous length. [24]

AKE and SLR measurements of each participants were taken on 1st day (baseline) before starting of intervention and then again at the completion of intervention period, i.e. is on 20th day.

Statistical Analysis: Data analysis was performed using Microsoft Office Excel version 2007.The Student's paired t- test was applied to compare pre- intervention and post -intervention- AKE and SLR values for both groups while unpaired t-test was used to compare mean difference values (difference of value at 20th day and baseline values) of AKE and SLR for intra-group comparison. The results were calculated using 0.05 level of significance

RESULTS

Comparison of physical characteristics (mean age, height and weight) and baseline values of AKE and SLR values between of participants of both the group showed non-signicant differences indicating homogeneity of groups. (Table.1; Table.2)

Table 1. Descriptive statistics and comparison of physical characteristics of participants of Group A (PNF group) and Group B (PNF + Neural Mobilization group)

Demographic	Group A	Group B	't' value	p value
Age (years)	28.92±1.98	28.58±2.71	0.350	0.729^NS^
Height (cm)	161.50±4.01	161.25±3.92	0.154	0.870^NS^
Weight (kg)	52.67±4.70	53.17±3.49	0.295	0.770^NS^

NS=Non-significant

Table1 Represents non-significant differences exist between age, height and weight of participants of two groups.

Table 2. Between the group comparison of baseline values of Active Knee Extension (AKE) test and Straight Leg Raise (SLR) tests

Variable	Group A (mean ± SD)	Group B (mean ± SD)	't' value	p value
AKE	144.58 ± 6.64	142.92 ±5.65	0.66	0.513 NS
SLR	57.08 ± 2.47	56.67 ± 1.83	0.46	0.648 NS

*$p \leq 0.05$= significant; NS=Non-significant

Table2 Represents non-significant differences exist between baseline values of AKE and SLR between two groups.

Within the group comparison demonstrated that the AKE and SLR values significantly increased from baseline values on 20th day, in both groups suggesting both interventions were effective in increasing hamstring flexibility (Table 3,Table 4). Between group comparison, however, demonstrated that non-significant differences existed in 20th day values of AKE and SLR (Table 5), suggesting that both interventional programs were equally effective in improving hamstring flexibility.

Table 3. Within group comparison of baseline and Day 20th values of Active Knee Extension (AKE) test for both groups

	Baseline AKE scores (mean ± SD)	Day 20th AKE scores (mean ± SD)	't' value	p value
Group A	144.58 ± 6.64	165 ± 4.47	-8.83	0.00 **
Group B	142.92 ±5.65	166.5 ± 4.6	-10.07	0.00 **

**$p \leq 0.05$=highly significant;

Table3 Represents those highly significant differences exists between of baseline and Day 20th values of Active Knee Extension (AKE) test for both groups.

Table 4. Within group comparison of baseline and Day 20th values of Straight Leg Raise (SLR) tests for both groups.

	Baseline SLR scores (mean ± SD)	Day 20th SLR scores (mean ± SD)	't' value	p value
Group A	57.08 ± 2.47	67.83 ± 1.95	11.83	0.00 **
Group B	56.67 ± 1.83	71.83 ± 2.9	15.31	0.00 **

**$p \leq 0.05$=highly significant;

Table 4 Represents that highly significant differences exists between of baseline and Day 20th values of Straight Leg Raise (SLR) test for both groups

Table 5. Between group comparisons of mean difference values (improvement scores) of Active Knee Extension (AKE) test and Straight Leg Raise (SLR) tests for both groups.

Variable	Group A (mean ± SD)	Group B (mean ± SD)	't' value	p value
AKE	21.42 ± 2.58	23.58 ± 3.07	1.86	0.075NS
SLR	10.75 ± 2.09	12.07 ± 2.18	1.51	0.14 NS

*$p \leq 0.05$= significant; NS=Non-significant

Table 5 represents that non-significant differences existed between improvement scores of AKE and SLR test for both groups.

DISCUSSION

Present study was undertaken with an aim to investigate whether using neural mobilisation as adjunct with PNF stretching would be more beneficial in improving hamstring flexibility in working women with prolonged sitting jobs. Results of present study revealed that though the intervention comprising of combination of nerve mobilisation and PNF stretches was effective in significantly improving hamstring flexibility after 4 weeks of application but it was not more efficacious then PNF stretching alone. Within the group comparison demonstrated that both groups showed significant improvement in hamstring flexibility after 4 weeks of intervention. Further, between the group comparison of improved scores of AKE and SLR demonstrated non- significant differences existed between the groups hence non of intervention was superior over other.

Finding of present study, with regards to effect of PNF stretching on muscle flexibility, is in accord with findings of many previous studies that report PNF stretching is more effective technique of all flexibility exercises in producing immediate and long term gains in muscle flexibility and range of motion. [2, 6, 9, 10-16]

Till so far it has not been possible to demonstrate indisputably which is most efficacious, optimal method or technique for improving muscle flexibility. This could be due to unclear understanding of tissues that are at fault in causing soft tissue restriction. Theorist now view that it is not only contractile tissue but non-contractile tissues such as deep fascia, soft tissues surrounding the joint and even neurological tissues that can limit the range of motion. [14,22] Current evidences suggest altered posterior lower extremity neurodynamics (integrated biomechanical, physiological and morphological functions of nervous system) influence resting muscle length and increase mechanositivity. [20, 25] Nervous tissue is required to be able to adapt to mechanical loads and must undergo distinct mechanical events such as elongation, sliding, cross sectional change, angulation and compression. Neuropathomechanics or adverse neural tesion that develop in nervous system as in present case due to prolonged sitting or faulty postures is believed to increase mechanosensitivity of neural tissue which then induces protective mechanism when stresses are imposed on them and in result limit extensibility of muscle . Neural mobilisation is considered to improve neurodynamics, axoplasmic flow, maintaining dynamic balance between neural tissue and surrounding mechanical interfaces and thus dampening the mechanosensitivity. [20,26] With this conceptual knowledge, using neural mobilisation as an added component to stretching is though attracting much attention of professionals who aim at achieving better results on muscle flexibility, however, only few studies so far have been undertaken to scientifically substantiate the effects of NM on muscle flexibility. [19, 25, 27]

Present study could not demonstrate any additional benefit of using NM with PNF stretching in hamstring flexibility in women. Similar results were reported by Mhatre et al and Webreight et al, [25,27] Mhatre, et al. compared Mulligan's bent leg raise and two leg rotation (neural mobility) versus passive/active hamstring stretches in 56 young female physiotherapy students who reported perceived hamstring tightness. They assessed changes in hamstring tightness in the Active Knee Extension Test and Slump Test. Both groups demonstrated a significant reduction in knee flexion angle, and although the neural mobility group had better results compared to the control group however difference between groups was not statistically significant. [25] Webreight et al. compared the effects of 30 secs of static stretching with 30 secs of active stretching in neural slump position given twice daily for 6 weeks and they found both the interventions improved hamstring flexibility but not were significantly different when compared to each other. [27] In contrary to findings of present study, Castellote-Caballero et al. demonstrated neurodynamic intervention was more effective than static stretching in countering the hamstring restrictions. [19] Present and aforementioned studies varied greatly in respect to sample size, type of participants, methods of neural mobilisation employed and outcome measure used, which makes it difficult to arrive at any definite conclusion. These contradictory findings in literature reflects to the need of conducting more studies using neurodynamic interventions or studies on combination of neural tissue mobility exercises with other flexibility exercises to establish most efficacious therapeutic intervention in improving flexibility of soft tissues.

CONCLUSION

Finding of present study revealed that neural mobilisation component when applied in combination with PNF stretches did not produced additional benefits in terms of hamstring flexibility in working women, however, it is felt that more experimentally well measured validation studies are required to guide evidence based practice about the application of neural mobilisation in clinical settings. Considering the effects of life style and occupational demands on hamstring flexibility and also compliance and limited training time in working class people especially women, need arises to find out simple yet efficacious methods of improving muscle flexibility. Along with PNF stretches, neural mobilisation has shown promising results. Further studies must come forth to give definite evidence of benefits of using these techniques in countering the hamstring inflexibility problems in non active working individuals especially females.

Conflict Of Interest: None

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