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Comparison of Immediate and Long Term Effects of Neurodynamic Sliding, PNF Stretching and Static Stretching on Hamstring Flexibility in Young Adults with Hamstring Tightness

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ABSTRACT

Hamstring flexibility is reduced due to postural adaptations and this can cause limitations in joint range of motion and muscular imbalance and can affect physical performance of a person. The Neurodynamic sliding technique, PNF stretching and Static stretching are three different techniques that have shown improvement on Hamstring flexibility. The aim of the present study is to compare the short term and long term effects of Neurodynamic sliding, PNF stretching and Static stretching on Hamstring flexibility in young subjects with hamstring tightness. A comparative study was conducted on 63 subjects, who were divided into 3 groups, A, B and C. Group A received Neurodynamic sliding, Group B received Static stretching and Group C received PNF Stretching. The intervention was given 3 times per week for 4 weeks, Pre and post test of Hamstring flexibility were assessed using passive knee extension test, Straight Leg Raise and Active Knee Extension test. Follow up values were taken after one month. The results from all three outcome measures suggest that Group B has greater short term effects when compared to other groups ($p<0.05$), whereas, group A have greater long term effect than group B and group C ($p<0.05$). The study concluded that both interventions significantly improved Hamstring flexibility, but Static stretching has greater immediate effect in improving Hamstring flexibility than other two types of stretching, whereas, Neurodynamic sliding have more long term effect. PNF stretching has immediate effects but was less significant than static stretching and their effects where not carried to long term.

KEYWORDS: Hamstring flexibility, hamstring tightness, Neurodynamic sliding, PNF stretching, Static stretching, Active knee extension, Straight leg raise, passive knee extension

INTRODUCTION

Hamstring muscle has a very important role in performance of daily activities such as controlled trunk movements, walking, jumping.[1] Flexibility of hamstring muscle is reduced due to many reasons such as

postural adaptations, scarring, muscle spasm and contraction. Prolonged sitting keeps hamstring in shortened position for a longer period of time which makes it one of the major reasons of reduced hamstring flexibility. Decreased flexibility of a muscle can cause limitation in joint range of motion and muscular imbalance.[2] Reduced hamstring flexibility may lead to hamstring muscle injuries, musculoskeletal disorders like hamstring strains, low back pain, plantar fasciitis and patella femoral pain syndrome and thereby reduces the physical performance of a person.[3]

Hamstring flexibility is improved using various techniques. Static stretching, PNF stretching and Neuro dynamic sliding are three such techniques. Static stretching is the method of stretching a muscle into a position of maximum length and holding for certain time without additional movement to improve the viscoelastic properties of a muscle.[4] Neurodynamic sliding is another manual method of stretching the nerve. In this method, a force is applied to nerve structures through posture and multijoint movement.[5]

Reduced hamstring flexibility may lead to muscle injuries, musculoskeletal disorders and reduction in physical performance in individuals. Different techniques have been proved effective in improving hamstring flexibility, but there is paucity in literature in determining the most effective method in improving hamstring flexibility. The study aims at comparing long and short term effects of Static stretching and Neurodynamic sliding to improve the hamstring flexibility in normal individuals.

MATERIALS AND METHODS

The present pre post experimental study was conducted on 63 subjects who fulfilled the inclusion criteria. Ethical approval was obtained from institutional ethical committee and all subjects gave their written informed consent. The included subjects were within the age group of 18 to 25 were recruited from the physiotherapy college where the study was performed. The study included both males and females with knee extension <160 degree checked by active knee extension test (AKE). All subjects with injury to hamstring within past 1 year, history of neurological /orthopedic disorders, lumbar radiculopathy, neurovascular, cardiovascular disorders, low back pain in past 6 months, recent fracture of spine or lower limb subjects and taking part in regular stretching exercise were excluded from the study. Name, age and gender of each subject was recorded before the study.

Hamstring flexibility was assessed using Active knee extension test, passive knee extension test and straight leg raising test. Pre-test scores were taken before intervention. The intervention is given with 5 sets in one session for 3 times per week for the duration of 4 weeks. Group A received neurodynamic sliding exercises, group B received static stretching and group C received PNF stretching.

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS for Windows 10.0 (SPSS Inc.). Baseline differences between the treatment and control groups were compared using the Mann-Whitney test for continuous variables as appropriate. The within-group differences were investigated using Repeated measures of baseline, post intervention. An alpha level of 0.05 was used to test for statistical significance and all tests were two-tailed. When the pre and post means were compared among three groups, statistically significant difference was obtained for all the outcome measures. Subjects in all three groups showed significant improvement in values of Active knee extension test, passive knee extension test and straight leg raising test.

RESULTS

65 subjects who fulfilled the inclusion criteria were included in the study. There were 2 drop outs in following which, the data of 63 subjects were considered for data analysis. The characteristics of the subjects

at baseline were normally distributed and are presented in Table 1.

When outcomes were compared at different time intervals using linear repeated measures of ANOVA model, significant improvements and statistically significant difference was proved for all the outcome measures. Subjects showed significant improvement in values of AKE, PKE and SLR in all the three groups ($p<0.05$). The same difference was seen on the follow up values of all three groups.

Statistical analysis between groups was projected in terms of change score and the p value was calculated among 3 groups with time as the changing factor. When post values were compared between the groups, mean difference in group B was more significant compared to other 2 groups ($p<0.05$). When follow up values were compared among the groups, group A showed more significant values compared to group B and C ($p<0.05$).

The study showed that all three groups showed statistically significant improvement in Hamstring flexibility. Group B showed more significant short term improvement compared to group A and group B, whereas Group A showed significant long term improvement than group B and C.

Table 1: General characteristics of subjects at baseline

	Group A	Group B	Group C
Number of subjects (n)	21	21	21
Gender (male/female)	8/13	10/11	7/14
Age (years)	21.1	21.6	21.3
AKE (degrees)	116.5	119.5	130.5

n = 63, all values expressed in mean, gender in ratio, Baseline homogeneity analysed using Kolmogorov - Smirnov test; AKE- active knee extension test

Table 2: Pre, post and follow up values of outcome measures in Group A, B and C

					p value	
		PRE	POST	FOLLOW UP	Time	Time* group
AKE	GROUP A	116.5±6.68	137±6.65	133±10.59	0.001	0.759
	GROUP B	130.5±9.5	163±9.7	142±9.8	0.000	0.172
	GROUP C	125.5±3.5	134.5±5.7	130±3.9	0.001	0.150
PKE	GROUP A	133.4±7.24	168.44±4.36	162.2±6.4	0.004	.000*
	GROUP B	146.3±5.00	167.5±4.08	151.3±3.3	0.029	0.886
	GROUP C	133.5±3.2	140.5±2.1	136.4±7.3	0.000	0.003
SLR	GROUP A	57.8±8.59	73.4±7.20	67.8±6.51	0.014	0.072
	GROUP B	52.5±7.75	80.2±5.41	61.3±5.68	0.000	0.008
	GROUP C	53.5±5.56	69.2±3.42	59±4.50	0.000	0.085

Values are expressed in mean ± SD; level of significance <0.05; data analysed using linear repeated ANOVA; AKE - active knee extension test; PKE - passive knee extension test; SLR - straight leg raise * shows significance

DISCUSSION

The purpose of the study was to compare the effect of Neurodynamic sliding and Static stretching, and to find the immediate and long term effects of each technique. 63 subjects with hamstring tightness who met the inclusion criteria were selected for the study. Group A received Neurodynamic sliding, Group B received Static stretching and Group C received PNF Stretching for the duration of 4 weeks. The results revealed that all three interventions significantly improved hamstring flexibility but Static stretching has greater immediate effect in improving hamstring flexibility than neurodynamic sliding but the effects of neurodynamic sliding have long term effects than Static stretching. PNF stretching had immediate effects, but was less significant than static stretching and their effects were not carried long term.

Flexibility of hamstring muscle is reduced due to many reasons among which postural adaptation is the most common. This can cause limitation in joint range of motion and leads to muscular imbalance.[2] Contractile tissue is not only the cause of soft tissue restriction, but non contractile tissues such as deep fascia and neurological tissue can limit the range of motion.[16] so hamstring tightness can be caused due to many factors that include contractile tissue contracture, fascia tightness as well as neural tissue restrictions. Therefore, addressing any of the above reason can lead to reduction in hamstring tightness.

All three techniques like static stretching, PNF stretching and neurodynamic sliding exercises are proved to be effective in treating hamstring tightness. Even though the immediate effects of neurodynamic sliding was less, its effects were maintained for a longer period of time, when compared to Static stretching. During daily activities, and other activities like prolonged sitting and standing, the sciatic nerve which innervates the hamstring is exposed to constant pressure,, resulting in hamstring tightness.[17] Nerve adhesions in the hamstrings may alter neurodynamics causing abnormal mechanosensitivity of the sciatic nerve; which could influence hamstring flexibility.[18] Neural mobilization improves neurodynamics, by maintaining dynamic balance between neural tissues and the surrounding mechanism interfaces and thus inhibits the mechanosensitivity.[19] Neurodynamic sliding is said to cause deflection of the sciatic nerve in the posterior thigh and decrease in the mechanosensitivity of the neural tissues that result in improvement of hamstring flexibility.[20]

Another possible explanation in improving the symptoms is the fact that sliding techniques are aimed to induce biomechanical effects that permit to reestablish optimal movement of the nerve and its surrounding tissue.[21] This may be the possible reason due to which effects of neurodynamic sliding was maintained for longer periods.

Meanwhile, the immediate effects of static stretching were significantly high when compared with neurodynamic sliding or PNF stretching, its long term effects were not maintained. Static stretching resulted in changes of viscoelastic properties of muscle and connective tissue that may have improved muscle tightness.[22] But postural adaptations may put the muscle into shortened position again which reverses the viscoelastic properties of muscle due to which the effect was not maintained in long term.

Hold relax technique in PNF stretching works on autogenic inhibition which is the possible mechanism for improvement of the hamstring range of motion. It is the inhibition of the alpha motor neurons of homonymous muscle by the stimulation of the Golgi tendon organ and this inhibitory effect diminishes muscle activity and therefore relaxes the muscle so that the muscle can be stretched further.[23] as auto genic inhibition is a temporary response and it fades off as soon as the tension is relieved, its effects cannot be maintained for long term.

It can be concluded that static stretching has greater immediate effect and neurodynamic sliding have greater long term effects in improving hamstring improving in young adults with hamstring tightness.

CONCLUSION

Hence, the study concluded that all three interventions significantly improved hamstring flexibility both after intervention and after follow up, but Static stretching can be given to achieve immediate effect in improving hamstring flexibility and neurodynamic sliding can be given to maintain the results in long term in young adults with hamstring tightness. PNF stretching can also be given as a treatment to achieve both short term and long term effects but the results are inconclusive.

List Of Abbreviations

PNF - Proprioceptive Neuromuscular Facilitation
AKE- Active Knee Extension
PKE - passive knee extension test
SLR- Straight Leg Raise
ROM- Range of Motion

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