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Original Research Article

COMPARISON OF IMMEDIATE EFFECT ON HAMSTRING FLEXIBILITY USING NON BALLISTIC ACTIVE KNEE EXTENSION IN NEURAL SLUMP POSITION AND STATIC STRETCH TECHNIQUE

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ABSTRACT

Background: Amongst all of the biarticular muscles of the human body hamstring have a greater tendency to shorten. Increased tension in the neural structures has also been shown to be one of the most important causative factor for the hamstring tightness for which mobilisation of the nervous system has emerged as a significant adjunct apart from routine stretching techniques. There are lots of studies available which has proven the effect of stretching on the hamstring flexibility, but only after giving the multiple sessions. Thus the aim of this study was to determine whether a single session of hamstring stretching by neural slump and static stretch technique improves hamstring flexibility or not.

Materials and Methods: 60 healthy individuals between the age groups of 18-30 as per the inclusion and exclusion criterion were enrolled for the study. Hamstring tightness was measured using knee flexion angle. Subjects were asked to actively extend their knee from 90-90 hip knee flexion in supine position, individuals having knee flexion angle more than 15 degrees were assumed to have hamstring tightness and were randomly allocated and divided into 2 groups, group A was given static stretch in modified Hurdler's position and group B was given neural slump stretch, having 30 subjects in each group.

Result: Data was collected and statistically analyzed using the appropriate statistical tests. Results showed significant reduction in hamstring tightness in both the groups and on comparison, group B (Neural slump stretch) was found to be more effective than group A (Static stretch).

Conclusion: Neural slump stretch was found to be more effective in immediately improving the hamstring flexibility as compared to static stretch.

KEY WORDS: Hamstring, Neural slump stretch, Flexibility, Static stretch.

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INTRODUCTION

The ability of an individual to move smoothly depends on his flexibility which is the ability to move a single joint or series of joints smoothly and easily through an unrestricted pain free range of motion [1,2].

Limited flexibility i.e.,tightness has shown to be a major risk factor for the muscle strain injuries [3]. Tightness is the adaptive shortening of the contractile and non contractile elements of the muscles which usually occurs in muscle groups in set pattern, with the biarticular muscles showing the greater tendency to shorten [2,4]. The hamstring are the group of muscles that have a tendency to shorten even among young, healthy individuals and in recreational athletes [5].

Most of the patients coming to physiotherapy department have hamstring tightness which may lead to several musculoskeletal problems such as low back pain due to decreased lumbar lordosis, Erector spinae fatigue , increased forward trunk lean, and knee pain due to increased patellofemoral compression force [6].

Apart from the musculoskeletal causes, hamstring has also been shown to get tight due to increased tension in the neural structures. Gajdosik, pointed out that along with the hamstrings, the deep fascia of the lower limb and the soft tissues of the pelvis, including neurological tissues, can limit a straight leg raise test. In the same way these noncontractile tissues can come under tension during passive or active movements of hip flexion or knee extension. If tension of non contractile tissues limit indirect measures of hamstring flexibility i.e. straight leg raise or active knee extension test, then use of stretching technique that emphasizes these neural tissues along with the hamstrings may be justified [7] **.**

Studies have shown that incorporating neural mobilisation technique such as slump mobilis ation into the treatment program can be an effective method of restoring normal neural tension and mechanics of the nervous system [8].

Conventionally, the stretching excercises such as static stretching and dynamic stretching targeting the hamstrings muscles extensibility are employed to treat hamstrings tightness. There is a paucity of literature assessing the effectiveness of exercises targeting neural tissue mobility or neurodynamics as opposed to conventional hamstrings stretching exercises [9].

Slump Stretch: Slump stretch is a neurodynamic test used to evaluate the dynamics of the neural structures of the central and peripheral nervous system from head, along the spinal cord, and sciatic nerve tract and its extension in the foot. These tests consist of a series of passive movements designed to assess the mechanics and physiology of neural tissue. Maitland, Shacklock, Butler and Kuilart have proposed the use of the Slump test in clinical examination for differentiation between neural mechano sensitivity and hamstring extensibility.

A Romberg and Lew, in a small, uncontrolled study, have suggested that adding the slump maneuver to a treatment regime facilitated an athlete's return to full function after a hamstring strain [9,10]. Butler has shown that 'adverse tension' in the nervous system can impair its mobility and elasticity and painful problems can arise as a result. This can be improved by incorporating neural mobilization technique such as slump mobilization [8].The functions of the nervous system are mechanical and physiologi cal. The primary mechanical functions are tension, movement and compression. The physiological functions are intra neural blood flow, impulse conduction, axonal transport and mechano- sensitivity. Extraneural and intraneural fibrosis due to abnormal neurodynamics can limits the nervous system's ability to move within its nerve bed which may ultimately lead to the onset of pain and adaptive shortening of the nervous system [11,12,13].

MATERIALS AND METHODS

Inclusion Criteria: Healthy individual having right hamstring tightness i.e. knee flexion angle greater than 15 degrees. Subjects willing to participate, young healthy adults between 18-30 years.

Exclusion Criteria: Individuals having knee flexion angle less than 15 degrees. Individuals having previous history of injury to the hamstring muscle.

Materials Used: 1. The universal goniometer. 2 .Measuring tape. 3 .Marker pen. 4 .Stabilizing belt. 5. Stop watch.

Procedure: 6O healthy individuals having hamstring tightness, showing knee flexion angle greater than 15 degrees, defined by screening test were given a written informed consent.

Measurement of Knee Flexion Angle: It was determined by measuring the angle between the intersecting lines of the thigh(tape marks 5 cm distal to greater trochanter and 5 cm proximal to the lateral femoral epicondyle)and leg (tape marks 5 cm proximal to fibular head and 5 cm proximal to the inferior to the lateral malleolus).

SCREENING TEST:

Position of the Patient: Subjects were in supine position with the left lower extremity in zero degree of hip flexion and right extremity was kept in the 90-90 hip knee flexion position stabilized by a stabilizing belt.

Subjects then instructed to actively extend their right knee to its limit, keeping foot relaxed in planter flexion. Goniometer was used to measure the degree from full extension. Subjects who demonstrated knee flexion angle greater than 15 degrees were defined as having hamstring inflexibility and were enrolled in the study.

Subjects were then randomly assigned to two groups.

Group A: Received static hamstring stretching in a modified Hurdler's position. Hot collator packs were applied to posterior aspect of thigh for 10 minutes. Static stretch was given in modified Hurdler's position by flexing forward from the hips and maintaining the spine in the neutral position. Stretch was maintained for 30 seconds until the stretch sensation was felt in the posterior thigh, knee or calf. Three repetitions of static stretch was given with the interval of 5 second in between each stretching session.

Hot packs applied to posterior aspect of thigh

Static stretch in modified Hurdler's position

Group B: Received non ballistic active knee extension in neural slump position.

Hot collator packs were applied to posterior aspect of thigh for 10 minutes. Patients were in sitting position on the table at a height which didn't allow the foot contact with the floor with thighs supported, leg flexed and popliteal fossae touching the table edge, maintaining the cervical and thoracolumbar flexion by interlocking both hands behind the neck.

Patients were then instructed to perform 30 repetitions of active knee extension maintaining the full dorsiflexion, upto the point where the firm resistance or stretch was felt at the posterior thigh, knee or calf and position was held for the self count of one, two, three, four by the patient.

Knee flexion angle was measured in both the groups, postintervention.

RESULTS AND TABLES

Data analysis: After data collecetion, data entry was done in Excel. Data analysis was done with the help of SPSS Software ver 15 and Sigmaplot Ver 11. Shapiro-wilk test was used to check distribution of data whether it is normally distributed or not.

The data passed normality test for static stretch group (group a), thus paired t test was used. The data did not pass normality test for neural slump stretch group (group b), thus wilcoxon signed rank test was used. Comparison between study groups was done with the help of Unpaired T test or Mann-Whitney test as per results of Normality test. Quantitative data is presented with the help of Mean, Std Dev, Median and IQR, Qualitative data is presented with the help of Frequency and Percentage table, association among study group is assessed with the help of Chi-Square test. P value less than 0.05 is taken as significant level.

Demographic Data: Table 1&2 shows the demographic characteristics of 60 subjects enrolled for the study. The mean age of the population was 24 years for both the groups and ranged between 18-30 years. Of 60 subjects included in the study, 40% male and 60% female were in the static stretch group ,however neural slump stretch group had 43.3% male and 56.7% female.

Table 1: Showing the demographic characteristics.

Technique	Age group (yrs)	Median age (yrs)
Neural slump stretch	18-30	24
Static stretch	18-30	24

Table 2: Showing the demographic characteristics.

Technique	Total no of Subjects	Male	Female
Neural slump stretch	30	43.30%	56.70%
Static stretch	30	40.00%	60.00%

Table 3: Measurements of Knee Angle in Group A.

	Mean	sd	Median	95% C.I.		IQR	T Value	P value	Diff
				lower	upper				
Pre KFA	34.47	4.216	33	32.89	36.04	8.50	13.813	0	Significant
Post KFA	29.47	4.431	28	27.81	31.12	7.00			

Table 4: Measurements of Knee Angle in Group B.

	Mean	sd	Median	95% C.I.		IQR	T Value	P value	Diff
				lower	upper				
Pre KFA	32.17	6.092	32	29.89	34.44	10.50	4.682	0	Significant
Post KFA	25.03	5.887	25	22.84	27.33	10.00			

Table 5: Difference in Measurement of knee flexion angle between Group A and B.

	Mean	sd	Median	95% C.I.		IQR	T Value	P value	Diff
				lower	upper				
Pre KFA	5	1.983	5	4.26	5.74	2	3.282	0.002	Significant
Post KFA	7.47	3.608	8	6.12	8.81	5			

DISCUSSION

The purpose of our study was to assess the immediate effect on hamstring flexibility using non ballistic active knee extension in neural slump position and static stretch technique and to compare the effectiveness of both the techniques. 60 healthy individuals were enrolled for the study, out of which, 35 (58.3%) were females and 25(41.7%) were males. The mean age of the population was 24.00 years for both the groups and ranged between 18-30 years. At the end of the study, data was collected and analyzed and described as follows:

Table no.3 showed significant immediate improvement in hamstring flexibility which was depicted by reduction in knee flexion angle post static stretch intervention ($p<0.05$). This result of our study is supported by the study done by O'Hora, John et al in june 2011, in which they also found immediate improvement in hamstring flexibility after giving a single static stretch session [14].

Another similar studies conducted by John Cronin in 2008,Puentedura EJ et al in 2011, have also found in their study that static hamstring stretch immediately improved hamstring flexibility on the same day intervention. Rubini EC et al, conducted a study in 2011, in which they found immediate improvement in hip adductor flexibility in female ballet dancer, after giving a single static stretch session [15-17] .The improved range of motion post static stretch intervention could be attributed to the mechanism of Sarcomere Give and Autogenic Inhibition.

Sarcomere Give: When stretch force is applied to the muscle, number of changes occur in the anatomical structure and physiological function of the contractile tissue (Sarcomere). Passive stretch is transmitted to the connective tissue (perimysium and endomusium) via the muscle fibers to lead to an immediate increase in the sarcomere length. Tension rises sharply when fibers are stretched initially in the series elastic (connective tissue) component. The cross bridges of the filaments slides further apart leading to their mechanical disruption which is influenced by neural and biochemical changes and this leads to the abrupt lengthening of the sarcomere, known as Sarcomere Give [3] .

Autogenic Inhibition: When tension develops in the muscle during stretching GTO fires, afferent stimuli are sends via 2B fibers, inhibiting alpha motor neuron activity and thus decreasing tension in the muscle by inhibiting individual muscle fiber and thus relaxing and lengthening the muscle [3].

Table no.4 showed significant immediate improvement in hamstring flexibility which was depicted by reduction in knee flexion angle post neural stretch intervention ($p<0.05$). This result of our study is supported by the study done by Herrington et al in 2006, which states that knee extension range of motion can be improved by adding tensioner technique in slump position [18].

Fidel et al, have examined the effect of a tensioner neural mobilization (knee extension while in a fully slumped position) on lower limb range of motion (ROM) in 27 asymptomatic subjects and found statistically significant increase in knee extension range of motion post intervention [19].

Another study conducted by Castellote-Caballero, Yolanda et al in 2013 states that neurodynamic mobilization can lead to improved range of motion i.e. can improve the hamstring flexibility in male soccer player [20]. Roberto Mendez-Sanchez conducted a study in 2010 and found that neural mobilization lead to an immediate increase in both lumbar and lower quadrant mobility in healthy male soccer player [21].

The probable reason of reduced knee flexion angle post neural stretch can be attributed to the improved physiological functions of nervous system, including improved axoplasmic flow and vascular perfusion and reduced neuromeningeal mechanosensitivity . Mechanosensitivity is the chief mechanism by which the nervous system becomes a source of pain with movements and postures. According to shacklok, Damaged or inflamed nerves leads to increase in mechanosensitivity which is a direct response to mechanical loading of the neural structures [11]. Our hypothesis is supported by the studies done by Roberto Mendez-Sanchez et al in 2010 ,in which they have attributed improved lower quadrant mobility post neurodynamic intervention to the decrease in neural mechano-sensitivity, and states that the subgroup of patients with hamstring strain that have neural tissue involvement , benefit from adding neural mobilization techniques to their rehabilitation and/or prevention program [21]. Herrington et al also in their study attributed the results to the decrease in the sensitivity of the neuromeningeal structures to the mechanical load [18].

Table 5 showed significant improvement in knee flexion angle in neural slump stretch technique as compared to static stretch technique (p=0.002). This result is supported by the study done by yollanda et al in 2013, which states that for immediate improvement in hamstring flexibility, the neurodynamic technique is better than static hamstring stretching [22].

Webright, in his study has found statistically non significant trend for improving active knee extension range in a supine 90^0 hip flexion position favoring tensioner mobilization over static

stretching. In their study, the tensioner mobilization brought about 10.2 degree increase in knee extension range, compared to 8.9 degree for static stretching in asymptomatic subjects [10].

Thus, from the above discussion it can be concluded that, both the neural slump stretch and static stretch immediately improve the hamstring flexibility with neural slump stretch showing the significant improvement. Thus the results supports the alternate hypothesis ,which states that there is immediate effect on hamstring flexibility using non ballistic active knee extension in neural slump position.

Limitations: Since the sample was selected from a single tertiary hospital, the results of the study can't be generalized to the population. Sample size was small.

Suggestions: Further studies can be done to compare the long term effect of improved hamstring flexibility using static stretch and neural slump stretch technique. The study should be carried out in a large sample size.

CONCLUSION

From this study we conclude that, Static stretch technique is effective in immediate improvement in hamstring flexibility. Neural slump stretch technique is effective in immediate improvement in hamstring flexibility. On comparison, neural slump stretch technique is found to be more effective than static stretch technique in immediate improvement in hamstring flexibility.

Clinical Implication: In our study we have found that a single stretching session improves hamstring flexibility. Thus in case of recreational athletes, a single hamstring stretch can be given prior to sport activities to improve the hamstring flexibility and reduce the incidence of injury.

Conflicts of interest: None

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