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Effect of muscle energy technique v/s static stretching on tight hamstring muscles length and pelvic inclination amongst asymptomatic adults

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Abstract
Aim of this study was to compare the effect of Muscle Energy Technique (MET) and static stretching on length of hamstring muscle and pelvic inclination.
Method: 60 individuals with tight hamstrings including both males and females participated in study with age 19 to 25 years. 30 individuals received static stretching and 30 individuals received post isometric relaxation technique of MET for 20 sessions. Angle of SLR, Passive Knee Extension (PKE) and Pelvic Inclination (PI) recorded and compared in both groups pre and post treatment. Statistical significance of SLR, PKE and PI calculated in both study groups and also between the groups.
Result: Study showed that there was significant difference between pre and post values of outcome measures in both thegroups, whereas no significant difference in both experimental and control group results as evident from mean change in control group and experimental group in SLR 4.88 to 6.15 (p=0.20), PKE 4.01 to 4.6 (p=0.55), PI 1.21 to 1.66 (p=0.25.)
Conclusion: Both static stretching and muscle energy technique are equally effective in treating tight hamstrings muscles in asymptomatic adults.

Keywords: hamstrings tightness, pelvic inclination, passive knee extension, met, static stretching

1. Introduction
Flexibility is defined as "the range of motion available in a joint or a group of joints that is influenced by muscles, tendons, ligaments, and bones" - Anderson and Burke [1]. It is one of the important characteristics of muscles and is often a concern of physical therapists and rehabilitation specialists, as well as physical educators and coaches. It is also claimed that maintenance of muscle flexibility with help of stretching activities can be of great help in reducing incidence of musculotendinous injuries, thus improving athletic performance. Lack of flexibility can also lead to disturbance in posture leading to various changes in mechanics of human movement [2].
Muscle tightness is caused by a decrease in the ability of the muscle to elongate, resulting in a decrease in the range of motion at the joint on which it acts. Hamstrings muscles have tendency to get shortened and can lead to changes in human mechanics. Hamstring tightness leads to hamstring injuries. These injuries are slow to recover, increase health expenditure and decrease the performance level of the individual [3].
Hamstrings are also considered the important postural muscles. Postural muscles act predominantly to sustain the posture in the gravity field. These muscles contain mostly slow-twitch muscle fibres and have a greater capacity for sustained work. They are prone to hyperactivity [4].
Inability to achieve greater than 160° of knee extension with hip at 90° of flexion is considered as hamstring tightness. Hamstring tightness leads to hamstring injuries and hamstring strain injuries are the most common type of injury among athletes. These injuries are slow to recover, increase health expenditure and decrease the performance level of the athlete [3].
As described by Janda and Jull, Hamstring muscles play an important role in maintaining normal angle of pelvic inclination [5]. If the hamstrings are tight and short, they prevent anterior pelvic tilting, influencing sacroiliac and lumbar spine dysfunction [3]. In healthy individuals it is estimated that 7 to 30% of individuals show mild to moderate hamstring tightness with high recurrence rate of 18 to 41% [3].
There are various techniques of stretching used to increase and maintain the flexibility of muscles such as static stretching, ballistic stretching, proprioceptive neuromuscular facilitation (PNF) technique etc [6]. Muscle energy technique (MET) is considered to be an advanced stretching technique [7].
Muscle energy techniques are the class of soft tissue osteopathic (originally) manipulation methods that incorporate precisely directed and controlled, patient initiated, isometric and/or isotonic contractions, designed to improve musculoskeletal function and reduce pain – Chaitow [7].
Karen L. Lerehan stated the effectiveness of MET in increasing gross trunk ROM [8]. *Fiona Ballantyne* studied effect of MET on hamstring extensibility and stated it to be effective in improving range of knee extension, but found no evidence of visco-elastic change [9]. *Roshan Adkitte* also suggested post isometric relaxation technique of MET to be effective in increasing hamstring flexibility in Indian national football players [10]. however *Azadeh Shadmehr* reported MET and passive stretching to be equally effective in increasing hamstring extensibility of adult females [11].
Thus purpose of this study was to compare the effect of MET and static stretching on hamstrings muscle flexibility.

2. Materials and Methods

The study was approved by institutional ethics committee prior to commencement. It was a cross-sectional study carried out at tertiary health care center over a period of 12 months on 60 subjects. Sample size was calculated from the pilot study using open epi software. Asymptomatic individuals in age group of 19-35 years, both males and females, having hamstring tightness (angle of SLR $\leq 80^{\circ}$) were included in the study. Individuals with severe hamstrings tightness, any pathology of spine or lower limbs, metabolic, endocrine, rheumatic, infective, malignant diseases, surgery or trauma affecting lower limbs and pregnant females were excluded from the study.

Study included 3 repetitions of static stretch with 30 sec hold for 20 settings over period of 20 days for control group, Post isometric relaxation technique of MET 3 repetitions for 20 settings over period of 20 days.

2.1 Procedure

Subjects fulfilling the inclusion and exclusion criteria and willing to participate in the study were selected. The purpose of the study was explained to them and their written consent was obtained. History was taken, followed by a brief evaluation. Measurements for Hamstring tightness, Angle of passive SLR, PKE and PI were then recorded by taking three readings and average value was considered as final reading.

1. Angle of passive SLR (Straight Leg Raise) [3, 7.] Figure 1.

The SLR was performed passively by examiner with individual completely relaxed. It is one of the most common tests used in lower limbs. Each leg is tested individually while other leg is completely rested on plinth/ground. With the patient in supine position the hip medially rotated and abducted, and the knee extended, greater trochanter is considered as fulcrum, stationary arm is fixed parallel to plinth along the trunk line and movable arm is directed towards lateral condyle. Examiner then flexes the limb until patient feels the pain or tightness in back of leg and angle of hip flexion is noted.

Fig 1: Passive SLR

2. Angle of PKE (Passive Knee Extension) [12, 13, 14, 15.] Figure 2

This test is commonly used to evaluate the hamstring muscle tightness. Individual is positioned supine with the lumbar spine flat on the table, with contra lateral leg extended and relaxed and the ipsilateral hip and knee is flexed at 90˚. Hip is maintained in neutral position (allowing no rotation at hip). Knee is then passively extended and the angle of extension is measured in order to detect the hamstrings tightness, until the mild stretch is felt by individual, where knee joint axis is fulcrum, femur serves as stationary arm, and tibia as movable arm.

Fig 2: Passive knee extension

3. Angle of PI (Pelvic Inclination) [13] Figure 3

Pelvic inclination was measured with the help of hand held pelvic inclinometer. Individual stands in normal resting stance and examiner applies one tip of the calliper to the anterior superior iliac spine (ASIS) and the other tip to the posterior superior iliac spine (PSIS), both on the same side of pelvis, and finally brings the closed end of the callipers to a position such that the pendulum hangs free over the protractor. In this position, the plane of the protractor is perpendicular to the floor and the therapist can thus measure the angle of inclination of that ilium from the protractor scale.

Fig 3: Measurement of Pelvic Inclination

Study included 3 repetitions of static stretch with 30 sec hold for 20 settings over period of 20 days for control group, Post isometric relaxation technique of MET 3 repetitions for 20 settings over period of 20 days.

2.2 Statistical analysis
The data was entered using Microsoft Office 2013 and analyzed using GraphPad InStat software version 3.1. Normality was assessed using the One-Sample Kolmogorov-Smirnov Test, when the data passed the normality (mention where it came normal) and Wilcoxon matched pairs test was used when the data did not pass normality (mention where it came). A p-value of less than 0.05 was considered statistically significant.

3. Results
3.1 Age

Table 1: Comparison of age in both the groups

Group	n	Mean ± SD	Minimum	Maximum	P value	Significance
Control	30	21.36 ± 1.82	19	25	0.5242	Not Significant.
Experimental	30	21.66 ± 1.88	19	25		

3.2 BMI

Table 2: Comparison of BMI in both the groups

	n	Mean ± SD	Minimum	Maximum	P Value	Significance
Control	30	21.75 ± 2.34	17.44	25.56	0.78	Not Significant
Experimental	30	21.94 ± 3.03	16.03	29.38		

3.3 Within the group: Averaged values of left and right sides
Control Group: Static Stretching

Table 3: Comparison of pre and post values of control group

Outcome	N=30	Min	Max	Med	Mean ± SD	P value	Significance
SLR	Pre	60	80	74	73.45 ± 5.96	<0.0001	Significant
	Post	70	90	78	78.93 ± 6.20		
PKE	Pre	64	80	73	73.23 ± 4.79	<0.0001	Significant
	Post	66	90	75	77.58 ± 6.83		
PI	Pre	0	12	4	3.81 ± 2.99	<0.0001	Significant
	Post	0	10	2	2.60 ± 2.78		

Experimental Group: Muscle Energy technique

Table 4: Comparison of pre and post values of experimental group

Outcome	N=30	Min	Max	Med	Mean ± SD	P value	Significance
SLR	Pre	60	80	71	71.05 ± 6.74	<0.05	Significant
	Post	64	90	78	77.20 ± 6.58		
PKE	Pre	60	83	73	72.53 ± 5.71	<0.05	Significant
	Post	66	90	76	77.13 ± 6.63		
PI	Pre	0	16	5	5.53 ± 4.04	<0.05	Significant
	Post	0	12	4	3.86 ± 3.44		

3.4 Between the Groups
Control Group VS Experimental Group

Table 5: Comparison between outcomes of both the study groups

Outcome	N=30	Min	Max	Med	Mean Diff. ± SD	P value	Significance
SLR	Contr	0	11	4	4.88 ± 3.30	>0.05	Not Significant
	Exp	0	15	5	6.15 ± 3.84		
PKE	Contr	0	13	2	4.01 ± 3.94	>0.05	Not Significant
	Exp	0	11	4	4.6 ± 3.08		
PI	Contr	0	4	1	1.21 ± 1.33	>0.05	Not Significant
	Exp	0	5	2	1.66 ± 1.62		

4. Discussion
Main objective of this research was to study the effectiveness of static stretching and muscle energy technique (MET) for the treatment of tight hamstring muscles in asymptomatic adults, and to study the effect of both the treatment on SLR, Passive Knee Extension (PKE) and pelvic inclination.

Study consisted of Control group (n=30) consisted of 4 males and 26 females with mean age of 21.36 ± 1.82 years and mean BMI of 21.75 ± 2.34 kg/m^2. Experimental group (n=30) consisted of 8 males and 22 females with mean age of 21.66 ± 1.88 years and mean BMI of 21.94 ± 3.03 kg/m^2.

Following results were obtained from the study,

- Statistical significance was observed in SLR, PKE and Pelvic Inclination in control group receiving static stretching.
- Statistical significance was observed in SLR, PKE and Pelvic Inclination in experimental group receiving muscle energy technique.
- There was no statistical significance of SLR, PKE and Pelvic Inclination between control and experimental group i.e. Static stretching and muscle energy technique.

Potential sources of stiffness are adhesions, epimysium, perimysium, endomysium, sarcolemma, contractile elements within the muscle fibre, and associated tendons and their insertions. The relative contribution of the contractile elements to resistance to stretch appears to be velocity related, with increased resistance to stretch occurring at higher velocities. The farther the muscle is stretched, the greater is the relative contribution of non-contractile elements.[15]

A stretching activity causes a neural inhibition of muscle group being stretched. The neural inhibition reduces reflex activity which causes greater relaxation and decreased resistance to stretch (Daneshmandi Hassan at el, 2011)[12].This is because the stretching exercise causes plastic stretching which results in irreversible tissue elongation (Turner *et al*, 1988). The range-of-motion improvements in the SLR may be attributed to an increase in stretch tolerance found with static stretching. These improvements also may be attributable to the viscoelastic property changes that occur with ‘‘creep,’’ whereby the tension in the muscle-tendon unit diminishes over time.[17]

Stretching decreases the passive tension in the muscle at a

given length. This reduction in passive tension is due to stress relaxation i.e. decreasing in stress (force per unit area) in a material elongated and held at a constant length. Majority of the stress relaxation in passive stretches occurs in the first 20 seconds that's why holding stretches for 20 to 30 seconds is a good standard. *Kubo et al. (2002b)* studied the acute effect of stretching and contractions on the stiffness of the human Achilles tendon with the help of ultrasound imaging. The acute effect of stretching was to significantly decrease tendon stiffness (8%), but the largest effect of stretching was a 29% reduction in hysteresis i.e. the energy lost when a viscoelastic material is stretched and returns to its normal length [18].

According to Ivan, MET is said to inhibit motor activity via the Golgi tendon organs or the muscle spindles. Post isometric relaxation technique reduces the tone of the muscles in the latency period of approximately 10 sec after the isometric phase. During this period, the movement toward the new position of the joint or muscle can be easier (due to the reduction in tone). According to Zuzana, the changes within the connective tissues display mechanical properties relating to both fluid (viscous) and elastic components. "Creep" represents the temporary elongation of connective tissue during stretch as a result of its viscoelastic properties. Permanent "plastic" changes occur as a result of micro-tearing and remodelling of connective tissue fibers. MET may produce increased muscle length by a combination of creep and plastic changes in the connective tissues.[10]

4.1 Straight Leg Rise (SLR)

There was significant increase in SLR in both the intervention groups when compared pre and post intervention. The improvement in the mean change in control group was observed from 73.45 to 78.93 (p=0.0001) so as in experimental group mean 71.05 to 77.20 (p=0.0001) at the end of intervention.

In accordance with this study Jo m. Fasen, Annie m. O'connor, Susan l. Schwartz *et al* (2009) conducted a randomized controlled trial of hamstring stretching by comparing four different stretching techniques. Stating the result that straight leg raise (SLR) passive stretch group had the greatest improvement in hamstring length [17].

Adel Rashad Ahmed (2011) supported this study by stating that there was significant increase in the hamstrings muscle flexibility after 6 days of consecutive intervention by using MET when compared to dynamic stretching, he also stated that there was no carry over effect of any of the above two techniques on hamstrings when compared the results with 10th day measurements [19].

4.2 Passive Knee Extension

There was significant increase in PKE in both the intervention groups when compared before and after readings. The improvement in the mean of control group 73.23 to 77.58 (p=0.0001), so as in experimental group mean 72.53 increased to 77.13 (p=0.0001) at the end of intervention.

D. Scott davis *et al*. (2005) [20] evaluated the effectiveness of 3 stretching techniques on hamstring flexibility using consistent stretching parameters, knee extension angle was measured before the start of the stretching program, at 2 weeks, and at 4 weeks. These data indicated that static stretching 1 repetition for 30 seconds 3 days per week increased hamstring length in young healthy subjects supporting this study.[20]

Mandeep Kaur, Rajesh Paul, Sandeep Kumar *et al* (2014) [12] in their RCT comparing static stretching and PNF for tight hamstrings treatment showed that static stretching significantly increased the hamstrings flexibility when 3 repetition for 30 sec hold was given 5 days a week for four week.[12]

4.3 Pelvic Inclination

There was significant change in pelvic inclination in both the intervention groups when compared before and after readings. The mean of control group 3.81 decrease after intervention to 2.60, and in experimental group mean 5.53 decreased to 3.86 at the end of treatment.

Felipe Jose et. al. (2015) [21] investigated influence of hamstring tightness in pelvic, lumbar and trunk range of motion in low back pain and asymptomatic volunteers during forward bending. He found the correlation between tight hamstrings and low back pain as pelvic restriction and tight hamstrings to be directly related however author stated that there was positive co relation between the hamstring and pelvic motion but statistically not significant.[21]

Our study showed that there was no significant difference in both experimental and control group results as evident from mean change in control group and experimental group in SLR 4.88 to 6.15 (table 10, graph 10) p=0.20, PKE 4.01 to 4.6 (table 11, Graph 11) p=0.55, PI 1.21 to 1.66 (table 12, graph 12) p=0.25. The outcome measures were assessed for right and left side; and our study showed there is no difference between right and left side analysis.

5. Conclusion

Results of the study showed that both static stretching and muscle energy technique are equally effective in treating tight hamstrings muscles in asymptomatic adults.

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