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Effectiveness of muscle energy technique (MET) and proprioceptive neuromuscular facilitation (PNF) stretching on hamstring flexibility

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Abstract
Background: Hamstring muscle complex is an important hip extensor and knee flexor. Hamstring tightness is an extremely common problem which causes low back pain and pain in posterior thigh. Muscular tightness is postulated as an intrinsic risk factor for development of muscle injury. Keeping these muscles flexible is important. So the study is carried out using the two techniques, Muscle Energy Technique (MET) and Proprioceptive Neuromuscular Facilitation (PNF) stretching technique so as to improve the hamstring muscle flexibility and compare its effects on muscle flexibility.
Objective: This study aims to compare the effectiveness of Muscle Energy Technique (MET) and Proprioceptive Neuromuscular Facilitation (PNF) stretching technique on hamstring flexibility.
Methodology: fifty subjects having hamstring tightness were selected by simple random convenient sampling and divided into two equal groups randomly. One group received MET and other group received PNF stretching technique. And study was carried out for 4 weeks.
Outcome measures: Sit and reach test and ROM (active knee extension test)
Results: Study suggests that ROM of Muscle Energy Technique (MET) of right and left side mean and standard deviation pre interpretation value is 33.84±5.382, 32.48±5.838 respectively and post interpretation value is 41.96±5.037, 39.92±4.838 respectively. Sit and reach test after MET mean and standard deviation pre interpretation value is 23.16±2.461 and post interpretation value is 19.8±2.661. ROM of Proprioceptive Neuromuscular Facilitation (PNF) contract relax stretching technique of right and left side mean and standard deviation pre interpretation value is 34.36±4.358, 31.76±5.060 respectively and post interpretation value is 34.68±4.394, 32.04±5.111 respectively. Sit and reach test after PNF mean and standard deviation pre interpretation value is 21.48±2.162 and post interpretation value is 21.2±2.179**.**
Conclusion: Study concluded that the effect of muscle energy technique (MET) is more on the hamstring flexibility than PNF stretching technique.

Keywords: hamstring tightness, muscle energy technique (met), proprioceptive neuromuscular facilitation (PNF) stretching

1. Introduction

The hamstring muscle complex consists of biceps femoris, semitendinosus and semimembranosus muscle. Some anatomists consider even the adductor magnus is the part of the hamstring muscle complex. The hamstring muscle is a hip extensor and knee flexor. The primary function of the hamstring muscle is to contract eccentrically, thereby absorbing the kinetic energy to protect the hip and knee joint. The eccentric contraction occurs when a muscle contracts while being stretches passively [1]. The hamstring muscle group has a tendency to shorten. Hamstring tightness causes increased patella femoral compressive force which leads to patella femoral syndrome [2]. Shortening of hamstring also causes the postural changes and walking ability in spastic children [3]. Muscle tightness is caused by a decrease in the ability of a muscle to deform which results in decrease in ROM at the joint on which it acts. Prevalence of hamstring tightness is present at significantly higher rates among the athletes who are engaged in the contact sports [4]. Long distance runners are more prone to have hamstring muscle tightness [5]. Flexibility is an integral component in any conditioning program. It is defined as the ability of a muscle to lengthen and allows one or more joint to move through range of motion (ROM). Flexibility is a physical fitness attribute and is evaluated from joint range of motion [6]. Limited flexibility has been shown to predispose a person to several musculoskeletal injuries and significantly affects the person's level of function [7].

Muscle Energy Technique (MET) is a manual technique used in many different manual therapy professions. It is effective for variety of purposes like lengthening of shortened muscles, increasing the range of motion [6]. It is one of the osteopathic manipulative treatment in which the patient uses his muscles actively, from precisely controlled position in a specific direction, against a specific executed counterforce [8]. To maintain the traditional muscle length, regular stretching is required to prevent muscle stiffness and benefit from the decreased risk of musculoskeletal injuries and enhance physical performance. Stretching is used as a part of warm up to increase the flexibility or to increase the range of motion (ROM) [7]. Three types of stretching techniques have been defined in an effort to increase flexibility are ballistic stretching, proprioceptive neuromuscular facilitation, static stretching. Proprioceptive neuromuscular facilitation involves the use of isometric contractions of the muscle to be stretched before statically stretching the muscle [9].

Proprioceptive Neuromuscular Facilitation (PNF) stretching technique is an advanced form of flexibility training program that involves both stretching and contraction of the targeted muscle group. This technique facilitates the muscular inhibition [10]. Proprioceptive neuromuscular facilitation (PNF) techniques are used to induce muscle relaxation and increase range of motion [11]. One of the PNF stretching technique is contract-relax technique which includes the concentric contraction of the shortened muscle [12]. As the hamstring tightness is very common problem, the present study is to find out which of these techniques exhibit the profound outcome. This study is conducted to compare the effects of MET and PNF stretching on hamstring flexibility.

2. Methodology

2.1 Source of Data

The source of data will be collected form the students having hamstring tightness from Dr. APJAK college of physiotherapy, loni, Maharashtra.

2.2 Method of collection of data

Type of Data: Data will be primary collected by the principal investigator
Study Design: Comparative study
Sample size: 50
Participants: Patients in the age group of 18 to 30 years of age having hamstring tightness, both males and females who all are willing to participate are included.
Sampling Method: Convenient sampling.
Study Duration: 4 weeks

3. Procedure

The ethical clearance form registration no. BPT/INT/2018/06 50 subjects were taken having hamstring tightness and allocated randomly and equally in two study groups: group A- Muscle Energy Technique (MET) and Group B- Proprioceptive Neuromuscular Facilitation (PNF) contract and relax stretching technique. Subjects were assessed for hamstring tightness by measuring the hamstring popliteal angle (active knee extension test) with the universal goniometer. Subjects lay supine with hip and knee flexed to 90º. Then, in that position ask the patient to extend the knee until the mild stretch is felt. Do not stretch to the point of pain or beyond the limit. If the angle between the leg and perfect right angle (vertical line) is more than 20º, then hamstring muscles are tight.

Sit and reach test was used to measure the hamstring flexibility before and after the treatment. Participant's shoes should be removed. Place a box in front of the patient. Heels of both the legs should touch the right angle line which is marked the box. The subject should slowly reach forward with both hands (one hand on another) as far as possible, holding this position for approximately 2 seconds. Be sure that the participant keeps the hands parallel and does not lift the knees. The distance between the box and the patient's hands is recorded by measuring tape. Best of 3 should be recorded. Group A (n=25) was given MET for hamstring muscles. The subject was lying in supine position, the subject's hip is passively flexed until the mild stretch is felt with the knee extended. The therapist will sit in front of the patient. The subject's leg was placed on the therapist's shoulder and the opposite leg is stabilised. Then the subject was asked to apply the pressure over the therapist's shoulder for 7-10 seconds. Then during the relaxation phase, the therapist passively takes the leg into further flexion and hold it for 30 seconds. Then subject's leg is lowered on the treatment table for the short resting period with duration of approximately 10 seconds. This procedure is repeated for 2-3 times.

Group B (n=25) was given PNF stretching in which contract relax technique is being used on antagonist muscle group (quadriceps). Subjects were in sitting position at the edge of the bed. The therapist was at the side of the patient. Ask the subject to perform the dynamic quads and the therapist will apply the resistance while subject is moving the limb and allow the muscle to relax after the contraction. Repeat the procedure until knee is extended for 3 times.

Both the techniques were given 3 days per week for 4 weeks. Sit and reach test and ROM was measured again at the end of the 4 weeks. And then it is compared that which technique is better than the other to improve hamstring flexibility.

Fig 1: Initial position to assess the Hamstring tightness

Fig 2: Measurement of Range of motion (ROM)

Fig 3: Application of MET

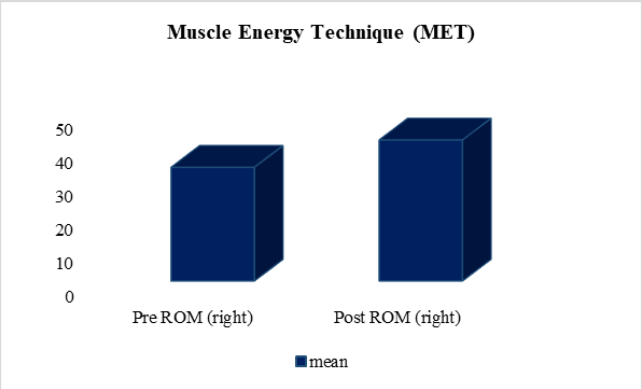
Fig 4: Application of contract relax technique of PNF

Fig 5: Sit and reach test

Fig 6: Measurement of Sit and reach test

4. Results

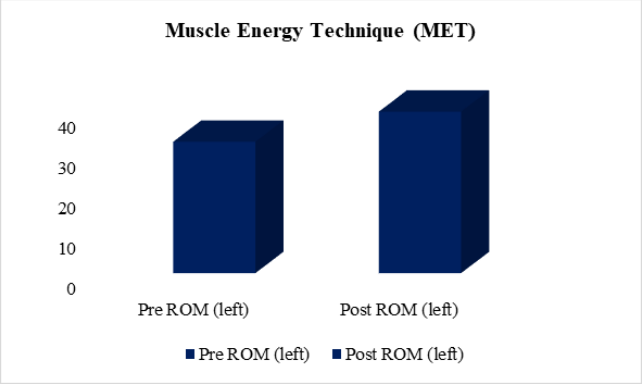
Various statistical measures such as mean, standard deviation (SD) and tests of significance such as paired t test and unpaired t test were used to analyse the data.



Graph 1: ROM (right) Pre and post MET in degrees

Table 1: Data Presentation of ROM (right) Pre and Post MET

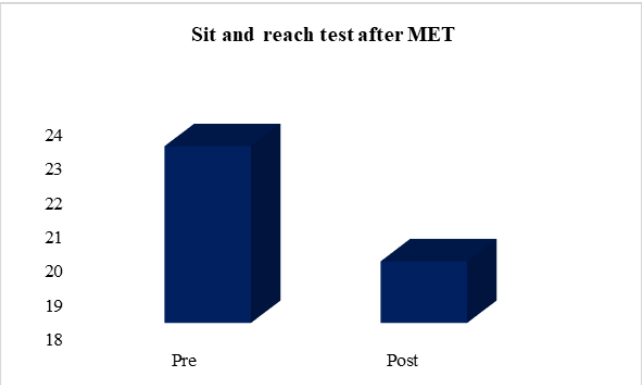
Parameter	Pre (mean±sd)	Post (mean±sd)	T value	P value
rom(right) (degrees)	33.84±5.383	41.96±5.037	12.368	<0.0001



Graph 2: ROM (left) Pre and Post MET in degrees

Table 2: Data Presentation of ROM (left) Pre and Post MET

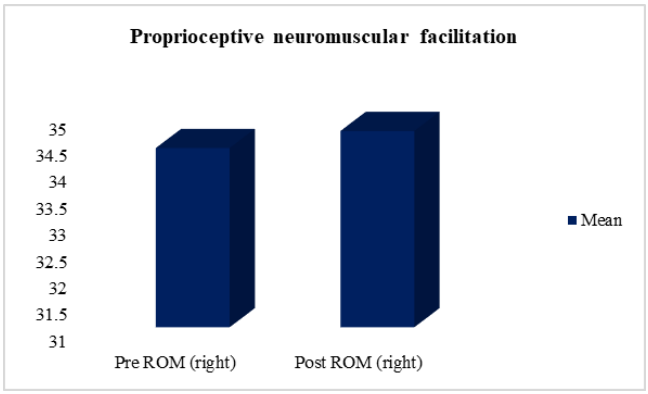
Parameter	Pre (mean±sd)	Post (mean±sd)	T value	P value
ROM (left) (degrees)	32.48±5.839	39.92±4.838	12.065	<0.0001



Graph 3: Sit and reach test after MET in cm

Table 3: Data Presentation of Sit and Reach test after MET

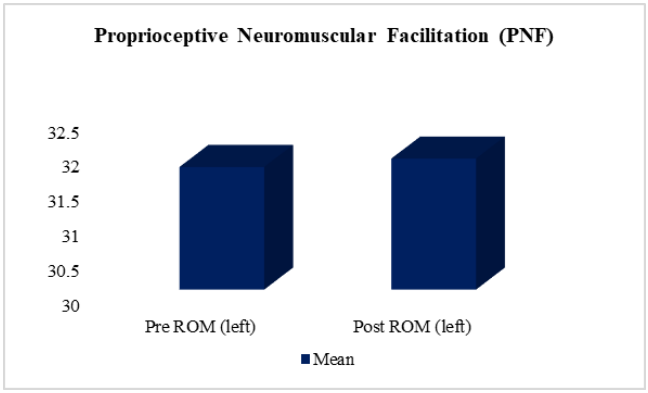
Parameter	Pre (mean±sd)	Post (mean±sd)	T value	P value
Sit and Reach Test after MET (cm)	23.16±2.461	19.8±2.661	22.187	<0.0001



Graph 4: ROM (right) Pre and Post PNF in degrees

Table 4: Data Presentation of ROM (right) Pre and Post PNF

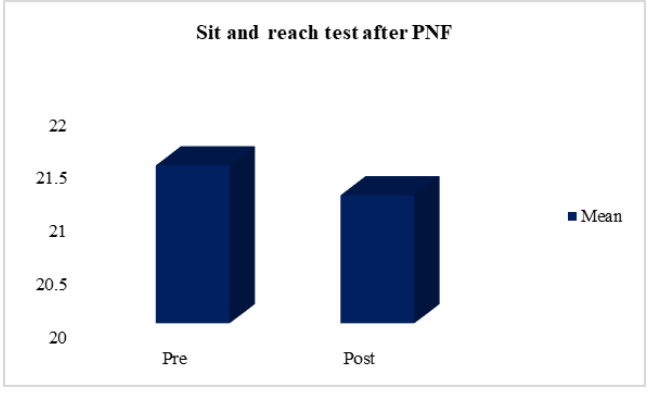
Parameter	Pre (mean±sd)	Post (mean±sd)	T value	P value
Rom (right) (degrees)	34.36±4.358	34.68±4.394	3.361	0.0026



Graph 5: ROM (left) Pre and Post PNF in degrees

Table 5: Data Presentation of ROM (left) Pre and Post PNF

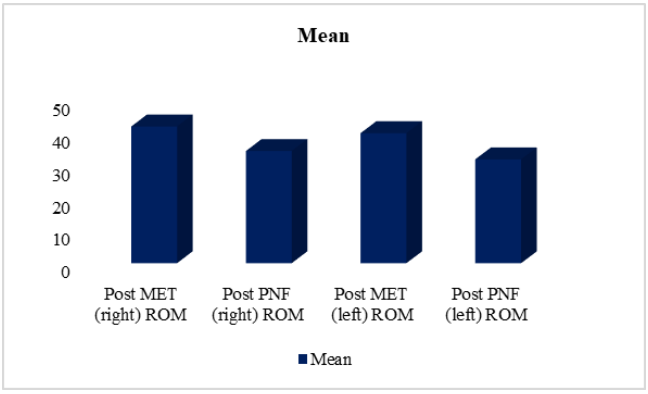
Parameter	Pre (mean±sd)	Post (mean±sd)	T value	P value
Rom (left) (degrees)	31.76±5.060	32.04±5.111	3.055	0.0054



Graph 6: Sit and reach test after PNF in cm

Table 6: Data Presentation of Sit and Reach test after PNF

Parameter	Pre (mean±sd)	Post (mean±sd)	T value	P value
Sit and reach test after PNF (cm)	21.48±2.163	21.2±2.179	3.055	0.0054



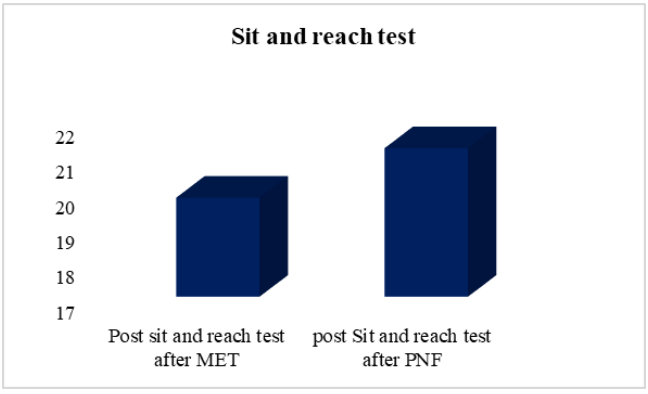
Graph 7: ROM (right, left) post MET and PNF in degrees

Table 7: Data Presentation of ROM Post MET (right) and Post PNF (right)

Parameter	Post MET (mean±sd)	Post PNF (mean±sd)	T value	P value
Rom (right) (degrees)	41.96±5.037	34.68±4.394	5.445	<0.0001

Table 8: Data Presentation of ROM Post MET (left) and Post PNF (left)

Parameter	Post MET (mean±sd)	Post PNF (mean±sd)	T value	P value
Rom (left) (degrees)	39.92±4.838	32.04±5.111	5.598	<0.0001



Graph 8: Sit and reach test post MET and PNF in cm

Table 9: Data Presentation of Sit and Reach test Post MET and Post PNF

Parameter	Post MET (mean±sd)	Post PNF (mean±sd)	T value	P value
Sit and reach test (cm)	19.8±2.661	21.2±2.179	2.035	0.0474

Table no.1: Represents the comparison of pre and post range of motion of right side after MET. The t value is 12.368 and p value is <0.0001 by using paired t test which shows it is extremely significant.

Table no.2: Represents the comparison of pre and post range of motion of left side after MET. The t value is 12.065 and p value is <0.0001 by using paired t test which shows it is extremely significant.
Table no.3: Represents the comparison of pre and post sit and reach test after MET. The t value is 22.187 and p value is <0.0001 by using paired t test which shows it is extremely significant.
Table no.4: Represents the comparison of pre and post range of motion of right side after PNF stretching technique. The t value is 3.361 and p value is 0.0026 by using paired t test which shows it is significant.
Table no.5: Represents the comparison of pre and post range of motion of left side after PNF stretching technique. The t value is 3.055 and p value is 0.0054 by using paired t test which shows it is significant.
Table no.6: Represents the comparison of pre and post sit and reach test after PNF stretching technique. The t value is 3.055 and p value is 0.0054 by using paired t test which shows it is quite significant.
Table no.7: Represents the comparison of post range of motion of right side after MET and post range of motion of right side after PNF stretching technique. The t value is 5.445 and p value is <0.0001 by using unpaired t test which shows it is extremely significant.
Table no.8: Represents the comparison of post range of motion of left side after MET and post range of motion of left side after PNF stretching technique. The t value is 5.598 and p value is <0.0001 by using unpaired t test which shows it is extremely significant.
Table no.9: Represents the comparison of post sit and reach test after MET and post sit and reach test after PNF stretching technique. The t value is 2.035 and p value is 0.0474 by using unpaired t test which shows it is significant.

5. Discussion

The study is to compare the effectiveness of Muscle Energy Technique (MET) and Proprioceptive Neuromuscular Facilitation (PNF) stretching on hamstring flexibility. The sample size was 50. The participants were randomly divided into 2 groups. The participants were assessed on the first day for ROM (active knee extension test) and sit and reach test. Group A was given MET and Group B was given PNF stretching technique. The intervention was for 4 weeks.
Muscle Energy Technique (MET) is a manual technique which targets the soft tissues primarily and it is effective in lengthening of shortened muscles, increasing the joint range of motion. The patient actively uses his muscles, from a precisely controlled position in a specific direction, against a distinctly executed counterforce.
To maintain the normal muscle length, regular stretching is required. Stretching is necessary to prevent muscle stiffness and benefit from the decreased risk of musculoskeletal injuries and enhance physical performance. Proprioceptive neuromuscular facilitation (PNF) involves the use of isometric contractions of the muscle to be stretched before statistically stretching the muscle. It facilitates the muscular inhibition. PNF is a stretching technique used to improve ROM and flexibility. In the contract relax technique the muscle is contracted while moving which is also known as isotonic stretching. BSc. Fiona Ballantyne conducted a study on the effect of muscle energy technique on hamstring extensibility: the mechanism of altered flexibility. The purpose of the study was to investigate the effect of muscle energy technique in increasing passive knee extension and to explore the mechanism behind any observed change. 40 asymptomatic subjects were taken and randomly allocated into 2 groups: control group and experimental group. Subjects lay supine with the hip flexed to 90º and the hamstring muscle stretched to the onset of discomfort by passive knee extension. Knee range of motion was recorded. The experimental group received the muscle energy technique on hamstring muscle, after which the resistance to stretch and range of motion were again measured. A significant increase in range of motion was observed at the knee (p= <0.019) following a single application of MET to the experimental group. No change was observed in the control group. At the end of the study they concluded that muscle energy technique produced an immediate increase in passive knee extension. The observed change in range of motion is possibly due to an increased tolerance to stretch as there is no evidence of visco-elastic change.

6. Conclusion

The effect of muscle energy technique (MET) is more than the proprioceptive neuromuscular facilitation (PNF) stretching technique on hamstring flexibility.

7. Acknowledgement

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