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COMPARISON BETWEEN POST ISOMETRIC RELAXATION AND RECIPROCAL INHIBITION MANUEVERS ON HAMSTRING FLEXIBILITY IN YOUNG HEALTHY ADULTS: RANDOMIZED CLINICAL TRIAL

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ABSTRACT

Background & Purpose: Variations in the application of muscle energy technique (MET) for increasing the extensibility of muscles have been advocated, but little evidence exists to support the relative merit of a particular approach. This study investigated two types of muscle energy techniques that have been advocated in the osteopathic literature that differ primarily in the muscle group targeted. **Aim:** To compare the efficacy of Post Isometric Relaxation (PIR) and Reciprocal Inhibition (RI) on hamstring length in young healthy adults **Methodology:** Randomized clinical trial 100 college students aged between 18-25 years were included. The subjects were randomly assigned to PIR and RI group. Each group consisted of 50 subjects (25 male, 25 female). Knee extension limitation was measured by using active knee extension test (AKET) pre & post-intervention, i.e. after 3 weeks of stretching regimen, with the help of universal full circle goniometer. **Results:** There was significant improvement in hamstrings flexibility (p=0.000) in both PIR and RI groups. Statistical comparison of the results of both the technique showed that PIR group had greater improvement than the RI group (p=0.000) **Conclusion:** PIR and RI were both found to be effective in improving hamstring flexibility but, PIR is more effective therapeutic maneuver.

INTRODUCTION

Flexibility is considered as an essential element of normal biomechanical functioning. Flexibility including improves athletic performance, reduced injury risk, prevention or reduction of post exercise soreness and improved co-ordination[1].

The hamstring tightness has also been shown to significantly correlate to back pain. This can be well understood by alteration in the Lumbar-pelvic rhythm as explained by Cailliet [2]. Lewit k suggested that the shortened muscles are source of altered proprioceptive information to central nervous system which affects the muscle and joint. [3]

Tight hamstring muscle also can increase the patellofemoral compressive force because of the increased passive resistance during the swing phase of ambulation and running.[4]

Hamstring muscles injuries are one of the most common musculotendinous injuries in the lower extremity. They occur primarily during high speed or high intensity exercises and have a high rate of recurrence. Worrel et al stated that a "lack of hamstring flexibility is the single most important characteristic of hamstring injuries in athletes[2, 5,6].

Hamstring flexibility can be assessed using active knee extension test (AKET). AKET is the reliable method of testing the hamstring tightness .The reliability coefficient for test and retest measurements were 0.99 for both extrimities[7-11].

There are many successful ways of treating hamstring tightness, for e.g. Mechanical[12], ice and stretch [13], soft tissue massage14.

There are several stretching techniques used to increase joint range of motion, they are static, ballistic, active-assisted stretching. There are a variety of active assisted techniques like the proprioceptive neuromuscular facilitation technique (PNF), muscle energy technique (MET), active isolated stretching or facilitated stretching .

Muscle energy technique (MET) is a manual technique developed by osteopaths that is now used in many different manual therapy professions. MET has been relatively unexplored, with only a few published studies supporting its use.

Two forms of muscle energy techniques are post isometric relaxation and reciprocal inhibition.[15]

Post isometric relaxation (PIR) exercise helps in lengthening of tight hamstring by its contraction and relaxation method .The term PIR refers to the subsequent reduction in tone of the agonist muscle after isometric contraction. This occurs due to stretch receptors called Golgi tendon organs that are located in the tendon of agonist muscle.[16]

Reciprocal inhibition (RI) refers to the inhibition of the antagonist muscle when isometric contraction occurs in

the agonist. This happens due to stretch receptor within the agonist muscle fibers-muscle spindle.[16]

Muscle energy technique was proved as an effective technique in rehabilitation for elongating shortened muscle tissue, there are only limited studies comparing the effectiveness of these techniques and still meager study done on Indian population. Hence in this study an attempt is made to find out the effectiveness of muscle energy techniques on hamstring tightness by comparing PIR and RI.

Aim: To compare the efficacy of Post Isometric Relaxation and Reciprocal Inhibition on hamstring length in young healthy adults

Objectives: (A) To determine efficacy of Post Isometric Relaxation on Hamstring length. (B) To determine efficacy of Reciprocal Inhibition on Hamstring length.

METHODOLOGY

Study design: The study design is a Randomized clinical trial.

Ethical approval: Permission and approval was taken to carry out the research work was obtained from the institutional ethical committee and the head of institute. Participation of the subjects was confirmed by obtaining written informed consent from each subject

Sample size & Study duration: Total 100 subjects were selected by sample of convenience .The study was conducted at outpatient department of V.S.P.M.'s College of Physiotherapy for 18 months.

Inclusion criteria: Subjects were included in the study if they aged between 18-25 years (both gender) with bilateral hamstring tightness. (>15- 30 degrees loss of knee extension as measured with the thigh held at 90 degrees of hip flexion)[2,4,7].

Exclusion criteria: Subjects were excluded if they gave history of trauma(acute or chronic) of lumbar spine, pelvis, hip and knee, recent history of infective arthropathy at hip or knee joint, presence of tumors that can restrict range of motion at hip or knee joint, Lumbar radiculopathy, Unilateral hamstrings tightness

Grouping: Subjects fulfilling inclusion criteria were randomly assigned into two groups.

Group A- Post Isometric Relaxation (PIR) and Group B- Reciprocal Inhibition (RI) with equal numbers of subjects in each group (25 female, 25 males).

Methodology:

From the participating subjects demographic data obtained. Active knee extension test was performed on all the subjects before and after intervention.

Standard active knee extension test Procedure [11] was performed in the following manner. Subject was taken in supine lying position. An adjustable cross bar was fixed an inch proximal to the hip joint. Subject's pelvis and the non test leg was stabilized using a stabilizing belt.(as shown in Fig. 1.)

A universal full circle goniometer was strapped to the outer side of the test leg. The fulcrum of the goniometer coincided with the axis of the knee joint16

Subject was asked to flex the hip of test leg to 90 degrees so that the distal thigh of the test leg is in contact with the cross bar. The height of the cross bar can be adjusted according to the length of the thigh of the subject.

Then the subject was asked to extend the knee joint to their maximum available range by maintaining the contact with the cross bar. The available range of motion was measured, and was deducted from 180 degrees to record the total extension limitation. The average of three repetitions was calculated with one minute rest period between two consecutive repetitions.

Fig 1: Standard Knee extension test starting & end position

Post isometric relaxation: [15]

Subject in supine lying with contralateral hip and knee semi flexed position. Therapist standing on the intervention side of the subject, facing the head end of the plinth. The leg to be treated was fully flexed at hip and knee, and then was extended until the restriction barrier was identified. The calf of the treated leg was placed on the shoulder of the therapist for e.g. right leg on right shoulder. The subject was instructed to gently bend the knee against the resistance (here the counterforce was given by the therapist's shoulder) starting slowly and using only sub maximal strength. Inhale, and slowly built up an isometric contraction; hold the breath during the 7-10 sec of contraction. Release the breath as slowly cease the contraction. Inhale and exhale fully once more following cessation of all efforts. During the second exhalation leg was straightened at the knee towards its new barrier. Procedure was repeated two more times and thrice weekly.

Fig. 3 Post isometric relaxation

Reciprocal inhibition [15]

Subject and therapist position are same as above except that the subject was instructed to extend the knee using sub maximal strength against the resistance given by therapist (therapist with the right hand placed anteriorly on the lower leg). Inhale, and slowly built up an isometric contraction, hold the breath during the 7-10 sec of contraction. Inhale and exhale fully once more, following cessation of all efforts. During the second exhalation leg was straightened at the knee towards its new barrier. Procedure was repeated two more times. This whole procedure was repeated thrice weekly.

Post intervention measurement was recorded in same manner as the pre intervention at the end of every week till three weeks. Collected data was documented for statistical analysis.

Fig 4: Reciprocal Inhibition

Data Analysis: Statistical analysis was performed by using Epi info software3.4.3 version and results are calculated using 0.05 level of significance. Student t-test: was used to compare the group A (Post isometric relaxation) and B (Reciprocal inhibition) for different treatment technique and to find their effectiveness and which technique is better for increasing hamstring flexibility in adults. Unpaired t test was used to compare Pre-Post mean Difference scores between group A and group B. Paired t test was used to compare Pre and Post scores within group A and B.

RESULTS:

Table 1: Age wise Distribution in post isometric relaxation (PIR) & reciprocal inhibition (RI) group

Intervention	Age in years	
	Males	Females
Post Isometric Relaxation	19.76±1.6	19.6±1.8
Reciprocal Inhibition	20.04±1.5	19.6±1.4

Table 2: Comparison of Pre & Post Active knee extension limitation ROM in PIR & RI group

Intervention	Gender	Side	Mean±S.D		t value	p value
			Pre	Post		
Post Isometric Relaxation	Female	Right side	28.84±9.11	15.08±8.50	3.95	0.0003
		Left side	32.16±9.23	20.56±8.85		
	Male	Right side	35.04±5.30	22.72±5.97	2.25	0.03
		Left side	37.48±6.36	23.76±6.36		
Reciprocal Inhibition	Female	Right side	29.48±8.48	21.8±8.50	3.95	0.0008
		Left side	32.36±7.43	26.44±7.43		
	Male	Right side	32.20±5.7	28.00±5.63	2.25	0.03
		Left side	35.60±2.62	28.00±5.6	15	0.000

Table 3: Comparison between PIR & RI groups mean difference of Active knee extension limitation ROM in females & Males

Gender		Mean difference		t value	p value
		Post Isometric Relaxation	Reciprocal Inhibition		
Female	Right side	13.08±2.57	7.68±1.08	16.05	0.0000
	Left side	11.60±2.56	5.92±2.6	9.72	0.0000

Table 4: Comparison between PIR & RI groups mean difference of Active knee extension limitation ROM in males

	Mean difference		t value	p value
	Post Isometric Relaxation	Reciprocal Inhibition		
Right side	12.32±2.34	4.2±2.71	16.93	0.0000
Left side	13.72±2.62	7.6±3.18	9.13	0.0000

As seen in Table 2, there is statistical significance (p=0.0000) between pre and post values of AKE limitation in PIR group (both sides) in females as well as males. And also when mean difference was compared between both sides it was statistically significant (p=0.0000). There was decreased AKE limitation in post intervention values which shows increased flexibility of hamstring. Comparison between pre and post values of AKE limitation in PIR group (both sides) in males shows statistically significant difference (p=0.0000). Also when

mean difference is compared between both sides it was statistically significant. (p=0.0000) There was decreased AKE limitation in post intervention values which shows increased flexibility of hamstring. Table 3: Shows statistical significant difference (p=0.0000) between PIR & RI group for AKE limitation (both sides) in females as well as males (Table 4). And also when mean difference was compared between both sides it was statistically significant. (p=0.0000).

There is statistical significance (p=0.0000) between PIR & RI groups (right & left side). And when mean difference of ROM in PIR was compared with RI (both sides) PIR was better than RI group in male as well as in females (Table 2 &4).

Discussion

PIR group showed significant improvement on both right side and left side among males and also in females. This can be correlated with study conducted by Patrick J H which showed significant improvement in the flexibility of hamstrings with PIR [17] and also with another study done by Jisha Thampi who concluded that PIR technique given for 3 weeks significantly improved (P=0.001) hamstring flexibility and increased knee extension range of motion ($17.4^0 \pm 4.4$)[6]

In PIR subject was instructed to perform isometric contraction for 7 to 10 seconds, (Lewit) [15].Study done by Cornelius, W. L Rauschuber, M. R [15] found that an isometric contraction greater than 6 seconds up to 10 seconds was sufficient to produce desired outcome. This is followed by the second phase, where the muscle was held in relaxed position for 7 to 10 seconds and then knee was passively stretched to new barrier and held for 30 seconds. After a phase of isometric contraction, the muscle would show an increased flexibility due to decreased resting tension which was due to the post contraction inhibition of alpha motor neuron and/or by reduced motor neuron excitability. [18]

In PIR, a strong muscle contraction against equal counterforce triggers the Golgi tendon organ .The afferent nerve impulse from the GTO enters the dorsal root of spinal cord and meets with an inhibitory motor neuron. This stops the discharge of the efferent motor neurons impulse and therefore prevents further contraction, the muscle tone decreases, which in turn results in the agonist relaxing and lengthening.[17]

PIR may principally be a biomechanical event, a combination of viscoelastic creep and plastic change in the parallel and series connective tissue elements of the muscle, above and beyond that obtained by passive stretch.[19]

The RI group also showed improvement in hamstring flexibility. Reciprocal inhibition works on Agonist Contract Relax technique with the use of sub maximal contraction. Study done by Feland and Marin suggested that the use of sub maximal contraction strength is generally thought to reduce the risk of treatment injury or injury aggravation. Feland and Marin recommended the sub maximal contraction intensity was 65% of maximum contraction, and is sufficient to achieve optimal gain in joint ROM and produce desired outcome [15]. Sheared and Paine reported that there is no evidence in the literature to support this sub maximal strength.[15]

The present study also correlates with the study done by M .Nasiri et al. who found that knee extension range of motion increased after the reciprocal inhibition technique .They concluded that after reciprocal inhibition AKE ranges showed highly significant (p=0.0000) increment from $157.10^0 \pm 8.2$ to $168.1^0 \pm 6.7$ [20]

This result can also be correlated with the study conducted by Osternig et al who found that the Agonist Contract Relax (reciprocal inhibition) showed an improvement of 9% to13% (approximately 20^0) in knee joint range of motion than the Contract Relax and static stretch.[15]

In this study stretching intervention was given for three times in a week for 3 weeks. Both the groups showed significant improvement (P=0.0000) in the active knee extension range of motion.

This can be correlated with the study done by A.P.Marques et al [21] who found that stretching exercises performed three times a week were sufficient to improve flexibility and range of motion compared to subjects exercising once a week. The improvement in flexibility and ROM after thrice a week stretching was similar to that of subjects who exercised five times a week. Study conducted by Jisha thampi also showed significant improvement in hamstring muscle length after alternate three weeks of stretching exercises.[6]

In Reciprocal inhibition, the muscle spindles discharge nerve impulses, which excite the afferent nerve fibers of the agonist muscle; they synapse with the excitatory motor neuron of the agonist muscle (in spinal cord) and at the same time inhibit the motor neuron of the antagonist muscle which prevents it from contracting .This results in the relaxation of the antagonist.[17]

Inter group comparison in the present study showed significant improvement in active knee extension range of motion in PIR group. When PIR and RI techniques were compared among females, significant improvement was found in PIR group than RI on both right side (T=16.05, p=0.0000) and left side (T=9.72, p=0.0000). In males post isometric relaxation technique (Table 8) showed better results than RI which was found to be highly significant on right side (t=16.93, p value=0.0000) as well as on left side (T= 9.13, p= 0.0000). When compared both the techniques, in PIR technique there was contraction of hamstring muscle which are the target muscles and in RI technique the hamstring was indirectly relaxed by isometrically contracting the opposite group which was the quadriceps. This indirect action could be the reasons for reciprocal inhibition technique to be less effective as compared to PIR. Feber et al noted that 77% of subjects found ACR to be most uncomfortable procedure than Contract-Relax and static stretching.[15]

Clinical implication: Flexibility is important physiological component of physical fitness, and reduced flexibility can cause insufficiency at the workplace and is also a risk factor for low back pain.From the results of this study it can be helpful for individuals who desire to increase their flexibility in an attempt to decrease risk of injury, enhances performance, as well as for those clinician who

incorporate PIR and RI stretching as a part of their rehabilitation programs.

CONCLUSION

This study concluded that although both PIR and RI are effective techniques to improve hamstring flexibility, PIR is better and effective technique as compared to RI.

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