Original Research Article

Effect of muscle energy techniques on hamstring tightness in normal females

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Abstract

Background: Muscle stretching and flexibility is an important aspect of normal human body function. Hamstring injury is frequently postulated as an intrinsic risk factor for the development of frustrating muscle injury commonly in the females, accompanied by pain, cramping, and discomfort. Hence the current study aims to compare the effectiveness of muscle energy techniques (Post Isometric Relaxation (PIR) and Reciprocal Inhibition (RI)) on overstretching in the tight hamstring muscle. **Methodology:** The study was conducted on 60 female participants, who were divided into three groups (n=20). Among the three groups, Group A received the PIR technique, Group B received the RI technique, and Group C received both PIR and RI techniques. The test was performed as pre and post to determine the active knee extension range of motion (ROM) and modified sit and reach test length. **Result:** The result showed a significant improvement in active knee extension ROM and modified sit and reach test length ($p<0.0001$). The results had shown that PIR and RI have equal effectiveness in normal females, which further suggests having a beneficial effect on the treatment of tight hamstring muscle. **Conclusion:** The current study identified PIR and RI to play a critical role in the management of hamstring injury and suggested to have an equal effect in improving the tightness in the hamstring muscles in normal female individuals.
Keywords: Hamstring Muscles, Muscular Diseases, Muscle Cramp, Post isometric relaxation

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INTRODUCTION

Injury is an incident happening to the body during the physical activities caused by an external force.[1] Muscle tightness is frequently postulated as an intrinsic risk factor for the development of frustrating muscle injury commonly observed in females, characterized by pain, cramping, and discomfort; leading to the development of hamstring strain injury (musculotendinous injuries). It accounts for 12% to 16% of injuries and the most common non-contact injury experienced during exercise or physical activities, with a high rate of reoccurrence (22% to 34%).[2,3] Jogging, dancing, using weights, doing push-ups, doing squats, decreased flexibility and fatigue, the previous injury, and increasing age are the most common causes for the development.[4] Hamstring strain injury account for 37% of muscle injuries in professional woman sports players.[5] Numerous studies indicated that one-third of hamstring injuries relapse and that many of these relapses take place within the first two weeks after returning to sport.[5-6] Many researchers have been demonstrated the crucial role of hamstring in different forms of lumbar intervertebral disc pathology and reported to cause the posterior pelvic tilting, reduced lumbar lordosis and exacerbation of existing pain in patients with low back pain.[7] However, prevention of these early interventions is the primary goal of the therapy. There are numerous effective methods, medical examination and approaches for relieving and treating the hamstring injury are available, but not every time everything is given to every patient and it is difficult to decide which one is better. Therefore, the common treatment program is followed most of the time which may not show results or delays the recovery.[8] Muscle Energy

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Technique (MET) is a more effective and beneficial tool utilized to relieve hypertonic musculature.[9] Researchers demonstrated that the post isometric relaxation (PIR) and reciprocal inhibition (RI) as a two common form of muscle energy techniques commonly used by osteopaths, utilized for the treatment of musculoskel*et al.* disorders such as muscle shortening, muscle spasm, and pain associated with a hamstring injury.[9, 10, 11, 12] PIR is the subsequent reduction in agonist muscle tone after an isometric contraction in stretch receptors of Golgi tendon organs. Stretch receptors react to overstretching of muscle by inhibiting further muscle contraction. This is naturally a protective reaction, preventing rupture and has a lengthening effect due to the sudden relaxation of the entire muscle under stretch.[12] IR is the key function of stretch receptors called Golgi tendon organs with the single or group of muscle which is responsible for the subsequent reduction of muscle after submaximal isometric contraction within the muscles.[13] RI utilizes an antagonist contractual phase followed by a gentle stretch.[14] RI refers to the manner of muscle tissues on one side of a joint relaxing to accommodate contraction at the other side of that joint.[15] The osteopaths suggested PIR and RI as a potential technique to avoid the direct pain that occurred in the muscle, but there is a little paucity of literature and scientific evidence of a difference in the therapeutic comfort or relative effectiveness between these two. Hence, the current study aims to compare the effectiveness of the post isomeric relaxation and reciprocal inhibition muscle techniques overstretching in the tight hamstring muscle.

MATERIAL AND METHODS

Upon obtaining ethical clearance the experimental study was performed on randomly selected 60 female patients of hamstring muscle tightness. Patients of 18 to 40 years of age and had hamstring muscle tightness (AKE test 115 to 130 degrees) were included in the study. Whereas, male patients and patients with AKE test above 140 degrees were excluded from the study. Informed consent was obtained before the initiation of the study. The patients were divided into 3 groups such as groups A, B and C consisted of 20 subjects in each group. Patients of group A received PIR whereas, group B received RI and group C patients were treated with both PIR and RI.

Measures

The active knee extension test and modified sit and reach test[10,16] were measured. First, participants were assessed for hamstring tightness using the active knee extension test (Popliteal angle). In this test pre-post and follow up measurement data on popliteal angles were collected. Initially, the participants were kept supine position with hips flexed at 90° and knee flexed. A crossbar was used to uphold the correct position of the thigh and hip. The test was done on the right lower extremity and subsequently, the left lower extremity and the pelvis were strapped down to the table for stabilization and control on accessory movements. Landmarks were used to measure hip and knee range of motion were greater trochanter, lateral condyle of the femur and the lateral malleolus which were marked by a skin permanent marker. The fulcrum of the goniometer was centered over the lateral condyle of the femur with the proximal arm secured along the femur using greater trochanter as a reference. The distal arm was aligned with the lower leg using the lateral malleolus as a reference. The hip and knee of the extremity being tested were placed into 90° flexion with the anterior aspect of the thigh in contact with the horizontal crossbar frame at all times to maintain hip in 90° flexion. The subject was then asked to extend the right lower extremity as far as possible until a mild stretch sensation was felt. A full circle goniometer was then used to measure the angle of knee flexion. Three repetitions were performed and an average of the three was taken as the final reading for Popliteal Angle. For the modified sit and reach test[17], each participant was asked to sit on the floor with the back and head against the wall, legs fully extended with the bottom of the feet against the seat and reach the box. While keeping the head and back against the wall, the participants were asked to place the hands on the top of each other by stretching the arms forward. The distance from the fingertips to the box edge with a ruler was measured. This point is considered as the zero or starting point. Further, participants were told to bend slowly to reach forward as far as possible through sliding the fingers along the ruler. Finally, participants were told to hold the position for two seconds and recorded the distance reached.

Procedure

Post isometric relaxation[18]

Initially, the tested leg was flexed at both the hip and knee and then straightened by the practitioner until the restriction barrier is identified. Further, depending upon an acute and chronic problem, the isometric contraction against resistance is introduced as a bind barrier (if acute) or a little short of it (if chronic). During this the instruction to the participants such as “try to gently bend your knee, against my resistance, starting slowly and using only a quarter of your strength”. In this test, during isometric contractions in this region not more than 25% of the patient’s strength should ever be used. Following the 7-10 seconds of contraction followed by complete relaxation, the leg should be straightened at the knee towards its new barrier. This stretch should be held for up to 30 seconds.

Reciprocal inhibition technique

The participants were asked to flex the hip on the affected side and the flexed knee is extended by the practitioner to the resistance. The calf of the tested leg was placed on the

shoulder of the practitioner. Further, the practitioner holds the treated leg thigh using the left hand to maintain both stability and to palpate for bind when the barrier was being assessed. Next, the participant is told to straighten/extend the lower leg/knee by utilizing the antagonists to the hamstrings which employ 20% of the strength in the quadriceps. Further, this was resisted by the practitioner for 7-10 seconds. In case of an acute problem, the practitioner extends the knee to its new limit or stretched slightly if chronic. The test procedure is repeated after relaxation.

Statistics: Data were analyzed using SPSS software. Categorical variables were expressed in Mean ± SD. The difference between the group was determined using the student's paired t-test. The difference between the group was considered significant (probability level) at the degree of freedom at 0.05. ANOVA test was used to find effectiveness in between A, B and C groups.

RESULTS

Post isometric relaxation technique- Active knee extension test and modified sit and reach test

The mean pre and post-test score of active knee extension (right and left knee) and modified sit and reach test score is described in table 1. On comparing pre and post-test scores, both groups showed significant different active knee extensions and modified sit and reach test scores (P<0.0001).

Table 1: Post isometric relaxation techniques scores (Active knee extension test and modified sit and reach test)

	Active knee extension test		
	Pre-test score (cm) (Mean±SD)	Post-test (cm) (Mean±SD)	P-value
Right knee	123.91±4.35	138.57±5.7	P<0.0001
Left knee	125.21±4.06	140.34±4.98	P<0.0001
	Modified sit and reach test		
Score	11.58±1.57	6.01±1.54	P<0.0001

Reciprocal inhibition technique- Active knee extension test and modified sit and reach test

Using reciprocal inhibition technique, active knee extension (right and left knee) and modified sit and reach test scores are described in table no. 2. A significant difference was observed between pre and post-test scores of both groups (P<0.0001) (table 2.)

Table 2: Reciprocal inhibition technique: Active knee extension test and modified sit and reach test

	Active knee extension test		
	Pre-test score (cm) (Mean±SD)	Post-test (cm) (Mean±SD)	P-value
Right knee	122.67±3.02	136.67±5.04	P<0.0001
Left knee	124.45±3.35	139.05±5.64	P<0.0001
	Modified sit and reach test		
Score	12.3±2.93	6.79±2.96	P<0.0001

Post Isometric Relaxation and Reciprocal Inhibition Technique- Active knee extension test and modified sit and reach test

The mean of pre and a post-test active score of knee extension test score (right and left knee) and modified sit and reach test using post isometric relaxation and reciprocal inhibition technique is illustrated in table no 3. A significant difference was observed between pre and post-test scores of both groups (P<0.0001).

Table 3: Post isometric relaxation Technique and reciprocal inhibition technique: Active knee extension test and modified sit and reach test

	Active knee extension test		
	Pre-test score (cm) (Mean±SD)	Post-test (cm) (Mean±SD)	P-value
Right knee	124.54±3.02	139.37±3.71	P<0.0001
Left knee	124.98±3.18	140.35±3.06	P<0.0001
	Modified sit and reach test		
Score	10.81±1.5	5.82±1.52	P<0.0001

DISCUSSION

Hamstring tightness and injuries are common musculotendinous injuries in the lower extremity and major problems in all age groups.[19] Tight hamstring causes lumbosacral nerve impingement, low back pain, gait dysfunctions, tiredness, etc. by reducing muscle flexibility and directly affect epidemiologically connected functions of other joints, and decreases of the range of joint

movement cause epidemiologic changes that result in disorders of joint functions.[20] Therefore, regular stretching is required to enhance physical performance in day to day life and reduce the risk and problems associated with musculoskel*et al.* injuries.[21] PIR and RI are the MET having various advantages in muscle injury such as increased range of motion, lengthen the shortened, contracted or spastic muscles, and strengthen the weakened muscles.[9] However, based on the available literature, no significant data is available on the comparison of PIR and RI in hamstring strain injury. Therefore, the study was undertaken to evaluate the effect of MET in reducing the tightness of hamstring muscles in normal females. In the current study, we first selected sixty female participants and divided them into three groups of 20 in each. Second, among the selected groups, group A was subjected to PIR- active knee extension and modified sit and reach test. The pre-test and post-test of the active knee extension test on the right and left knee were performed. The result obtained from pre and post-test showed a significant increase in active knee extension in the post-test compared to the pre (on right $t=19.32$, $p<0.0001$) and (on left $t=21.94$, $p<0.0001$). The significant difference is obtained in modified sit and reach test for pre and post-test in female participants ($t=14.57$, $p<0.0001$) which suggests improvements in hamstring flexibility. Further, group B was subjected to RI. In RI, initially, the nerve impulses are discharged by the muscle. Further which excites the afferent nerve fibers of the agonist muscle, then in the spinal cord they synapse with the excitatory motor neuron of the agonist muscle and inhibit the motor neuron of the antagonist muscle which prevents it from contracting, further this will cause the relaxation of the antagonist.[22] In the current study, initially, we performed a pre-test followed by the post of right and left knee for RI. The comparison of pre-test with the post-test showed a significant increase in the active knee extension in both the groups (right $t= 11.57$, $p<0.0001$ and left $t=11.6$, $p<0.0001$). The significant difference is obtained in modified sit and reach test for pre and post-test in female participants ($t=8.2$, $p<0.0001$). Previous studies on the effect of MET on hamstring extensibility reported no significant difference between the groups.[23] One of the studies conducted on the efficacy of MET on hamstring muscle flexibility in normal Indian collegiate males showed a significant difference in improving the hamstring flexibility in males.[24] In the current study, group C was subjected to both PIR and RI for active knee extension test and modified sit and reach test. The outcome parameter by considering test as pre and post. The groups were treated separately for 5 days for one week with 3 repetitions. The results were obtained statistically by using the paired t-test and ANOVA test to evaluate individual effects of PIR and RI technique over the active knee extension test and modified sit and reach test. The result showed a significant increase in the active knee extension (on right $t=13.29$, $p<0.0001$ and on left $t=14.68$, $p<0.0001$). The significant difference is obtained in modified sit and reach tests for pre and post-test in female participants ($t=15.42$, $p<0.0001$). Currently, there were few studies were performed on PIR and RI and reported to reduce the problems associated with hamstring muscle tightness.[13, 25, 26, 27] The current study findings significant improvement in active knee extension and modified sit and reach test length, to have equal effectiveness in normal females, which further suggests having a beneficial effect for treatment of tight hamstring muscle. Thus the muscle energy technique is clinically applied in the muscle tightness, after the post immobilization where the joint range is reduced, used to lengthen the shortened muscle, used to strengthen the weakened muscles, used in malpositioning of the bony elements, used to lengthen the contracted muscle. The limitations of the present study were the small sample size and gender-specific. Generalization could be better if the large sample size of both genders is included in the study.

CONCLUSION

Based on the current study result, both PIR and RI techniques have equal effectiveness in improving the hamstring flexibility in healthy female individuals, which plays a critical role in the management of hamstring injury.

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