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EFFECT OF MUSCLE ENERGY TECHNIQUE ON FLEXIBILITY OF HAMSTRING AND CALF MUSCLES AND SPRINTING PERFORMANCE IN SPRINTERS

[1]M. Prasad Naik
[2]Dr. A. Viswanath Reddy, M.P.T(Sports),PhD
[3]Dr. K. Madhavi M.P.T(CT),PhD,FIAP

ABSTRACT

Background: Muscle energy technique is used for restoring normal tone in hypertonic muscles, strengthening weak muscles, preparing muscle for subsequent stretching, one of the main uses of this method is to normalize joint range which may help in increase flexibility and performance in sprinters. The aim of the study is to evaluate the effect of muscle energy technique on flexibility of hamstrings and calf muscles and sprinting performance in sprinters. The objective of the study is to determine the muscle energy technique on hamstrings and calf muscle flexibility and sprinting performance in sprinters by using goniometer and timing of sprinting performance.

Method: The study design is an experimental study in which 30 male sprinters were recruited in this study. The study sample included all male healthy sprinters, aged between 15 -30 years. All subjects received warm up, muscle energy technique and cool down exercises daily for a period of 6weeks.The outcome measures are 90˚-90˚popliteal angle for assessing hamstring flexibility and ROM of ankle joint for calf muscles by universal goniometer and sprinting performance time by using stopwatch.

Results: Independent t-test and paired t- test are used to analyse the data. A significant difference was found between pre and post values of hamstring and calf muscle flexibility and sprinting performance after the analysis in this study.

Conclusion: This study shows that there was a significant effect of MET on hamstring and calf muscle flexibility and sprinting performance.

Keywords: Muscle energy technique, 90˚-90˚poplitealangle, flexibility, Range of motion, Sprinting.

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[2]Associate Professor, College of Physiotherapy, Sri Venkateswara Institute of Medical Sciences, Tirupathi.
[3]professor& Principal, College of Physiotherapy, Sri Venkateswara Institute of Medical Sciences, Tirupathi.

CORRESPONDING AUTHOR

[1]M. Prasad Naik

M.P.T College Of Physiotherapy, Sri Venkateswara Institute Of Medical Sciences, Tirupathi.

INTRODUCTION

100 meter sprinting is a track and field event with a shortest common outdoor running distance. It is one of the most popular and prestigious events in the sports of athletics.

The core and upper body muscles are involved in sprinting, it is the collection of lower body muscles that drive against the ground by explosively extending hip, knee and ankle joints that propel body forward.

The muscle groups involved in performing these actions include the gluteus maximus and hamstrings, which handle hip extension, quadriceps, which extend knee joint. Calf muscles located at the back of lower leg.

Together, they plantar flex or straighten ankle joint, push off the ground during sprinting and contract to straighten ankle and assist in propelling forward.[1]During maximal sprinting hamstrings are highly active in the terminal swing phase as they work eccentrically to decelerate the swinging tibia and control (gastrocnemius) extension of the knee. The hamstrings are active in the initial stance phase, whereby they work concentrically as an extensor of the hip joint.[1]

Definition of Muscle Energy:
Procedure that involves voluntary contraction of a patients muscle in a precisely controlled direction, at varying levels of intensity.[2]

Two types of muscle energy techniques

Isometric muscle energy techniques: An isometric contraction is one in which a muscle or group of muscles, or a joint or region of the body, is contracted or moved in a specified direction, and in which the effort is matched by the therapist's effort, so that no movement is allowed to take place. [3]

Isotonic muscle energy techniques: An isotonic contraction is one in which movement does take place, in that the counterforce offered by the therapist is either less than that of the patient, or is greater.[3]

Any changes in joint arthrokinematics, muscular balance and muscular control affect the functioning of the entire kinetic chain, that leading to abnormal compensation and adaptation[3]. If a particular joint has lost its normal arthrokinematics, the muscles around that joint attempt to minimize the stress at that involved segment.[4]

To prevent additional joint translation certain muscles become tight and hypertonic its leads to neuromusculoskeletal dysfunction.[4]

When muscle in a force couple becomes tight or hypertonic, it alters the normal arthrokinematics of the involved joint and length-tension relationships. This affects the synergistic function of the entire kinetic chain, which leads to abnormal joint stress, soft tissue dysfunction, neural compromise and vascular/lymphatic's stasis.[4]

Several authors have demonstrated specific movement system imbalance in patients with altered neuromuscular control secondary to muscle imbalance. Increased neural drive in the tight or hyperactive muscle and decreased neural drive in the inhibited or hypoactive muscles. Several factors can lead to the development of muscle imbalance and soft tissue dysfunction including postural stress, poor neuromuscular efficiency, pattern overload, overtraining and poor technical efficiency.[4]

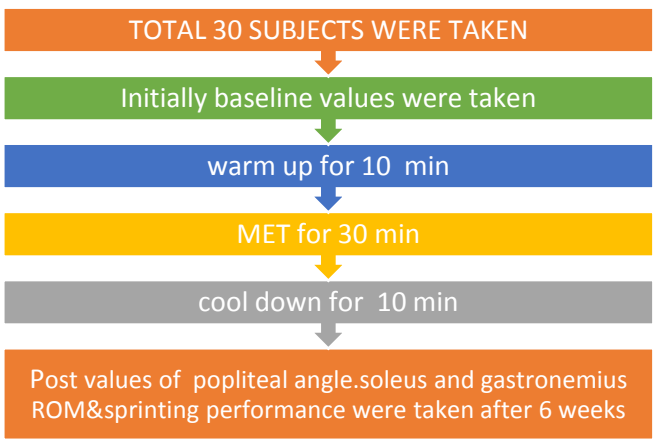
MET have the ability to relax overactive muscles or stretch tight muscles and their associated fascial components when connective tissue or viscoelastic changes have occurred. When using MET, it is important to relax/inhibit the neuromuscular component before attempting to stretch the involved musculature. Two fundamental neurophysiologic principles accounts for neuromuscular inhibition that occurs with MET.[4]

The first principle is neurophysiologic of MET is post contraction inhibition (autogenic inhibition). After a muscle contracts it is automatically in a relaxed state for brief latent period. The second neurophysiologic principle that MET uses are the principle of reciprocal inhibition.[4]

Sprinters need muscle flexibility to improve their performance and lack of flexibility may lead to injuries. Muscle energy technique (MET) is the one which lengthens the muscle, increases the ROM and relaxes over active muscles or stretch tight muscles.

METHODOLOGY

STUDY ALGORITHM



Materials

The materials used in the study are measuring tape, weighing machine, goniometer, stop watch, one high couch, Welcro Strap ,written informed consent, data collection tool. The variables and tests used are 90-90 popliteal angle test for assessing hamstring muscle flexibility, ankle joint ROM for calf muscle flexibility by using universal goniometer and sprinting time by using stop watch.

The primary data was collected from Siddhartha college of Physical education, Gollapalli, Thirupati and SVIMS University, Thirupati. The study duration was from January to March 2015. The study design was an experimental study without control group with a purposive sampling design. The participants are male athletes who are willing to take part in the study for 6 weeks were recruited for the study. The sample size for this research study was thirty (30). The study sample included male athletes, aged between 15-30 years, female athletes, any associated neuromuscular conditions and musculoskeletal injuries, lower limbs injuries, and recent surgery were excluded.

Procedure

This is an experimental study of pre test - post test design. Prior to the commencement of the procedure, informed written consent was taken from the participants. Those willing to take intervention daily for six weeks were recruited for the study.

Interventions

All subjects received warm up for 10minuets, muscle energy techniques for 30minutes and cool down exercises for 10 minutes.

Measurement procedure for hamstring 90˚/ 90˚[8]

Hamstring muscle measurement data on popliteal angle was collected from all the participants.[8] Participants were assessed for hamstring tightness using the Active Knee Extension test (Popliteal angle). The participant is supine position with hips and knee flexed to 90˚. To maintain the proper position of hip and thigh a cross bar is used at the level of knee. Testing procedure was done on right then left lower extremity alternatively. Either left or right lower extremity or the pelvis is strapped to the table for stabilization and control of any substitutions movements. Greater trochanter, lateral condyle of femur and the lateral malleolus are the landmarks which have been used to measure hip and knee range of motion.

The goniometer fulcrum centered over the lateral condyle of the femur with the proximal arm strapped along the femur using greater trochanter as a reference. The distal arm is directed with the lower leg using the lateral malleolus as a reference point. The hip and knee of the tested lower extremity were placed into 90˚ flexion with the anterior aspect of thigh in contact with the horizontal cross bar frame at all times to keep hip in 90˚ flexion. The participant was instructed to extend the tested lower extremity as much as until a mild stretch sensation is felt .A standard goniometer is then used to measure the angle of knee flexion. An average of the three repetitions is taken as the final reading for popliteal angle.

Measurement procedure for calf muscles:

Gastrocnemius muscle:[4]

Participant in supine position with knee extension to measure dorsiflexion through the goniometer. The fulcrum is placed over the lateral malleolus of the tibia, fixed arm strapped with lower leg .The participant is instructed to do the dorsiflexion of the ankle until a mild stretch sensation is felt then the dorsiflexion is measured and average of the three repetition was taken.

Soleus muscle:[11]

Participant in supine position with knee flexed to 30˚, the dorsiflexion is measured through the goniometer, fulcrum over the lateral malleolus of the tibia fixed arm strapped with lower leg. The participant is instructed to do the dorsiflexion of the ankle until a mild stretch sensation is felt then measure the dorsiflexion is measured and average of the three repetitions was taken.

Technique of MET

Isometric- Autogenic Inhibition[3]

Participant attempts to push through the barrier of restriction then autogenic inhibition of the target muscle occurs.

Frequency: 10reps

Intensity: Therapist and patient's forces are matched. Patient provides the effort at 20% of their strength increasing to not more than 50% subsequent contractions.

Duration: 4-10 seconds initially, increasing up to 30 seconds in subsequent contractions.

Isometric- Reciprocal Inhibition[3]

Therapist attempts to reciprocal inhibition which causes relaxation of the target muscle.

Frequency: 10 reps

Intensity: Therapist and patient's forces are matched. Patient provides an effort at 20% of their strength increasing to not more than 50% subsequent contractions.

Duration: 4-10 seconds initially, increasing up to 30 seconds in subsequent contractions.

Isotonic Concentric- Utilizing Autogenic Inhibition[3]

Target muscle is allowed to contract with some resistance from the therapist. This technique utilizes autogenic inhibition of the target muscle.

Frequency: 5-7 reps

Intensity: Participant force is greater than therapist resistance. Participant utilizes maximal effort and force is built but not suddenly.

Duration: 3-4 seconds

Isotonic Eccentric- Utilizing Reciprocal Inhibition[3]

Target muscle is prevented from contracting by superior operator force, utilizing reciprocal inhibition which causes relaxation of the target muscle.

Frequency: 3-5 reps as long as tolerable

Intensity: Therapist force is greater than patient's force. Patient utilizes less than maximal force initially and subsequent contractions build towards participant maximal force.

Duration: 2-4 seconds

RESULTS

After 6weeks intervention period of MET, the post values are increased and sprinting time is reduced in the study group (table no1)and statistical comparison of the experimental group of pre and post mean value significant changes seen in this study (table no 1). Statistics were performed by using IBM SPSS Inc20.0 version. Results were calculated by using ($p < 0.05$) level of significance.

Statistical analysis

Statistical analysis has been carried out to analyze the significant impact of the treatment issued to the subjects of study group by using muscle energy technique. All 30 subjects completed the entire study protocol as defined by 6 weeks in the training sessions. Statistical tools such as independent sample t-test and paired sample t-test has been applied to the outcome measures- range of motion for hamstring, gastrocnemius and soleus muscles and sprinting time.

Table: 1

Analysis of hamstring, gastrocnemius and soleus muscle flexibility with pre and post intervention of MET (muscle energy technique)

Parameter (pre-post)	Side	N	Mean		Standard Deviation		t-value	Df	p-value
			Pre	Post	Pre	post			
Hamstring	Right	30	57.36	70.13	5.64	4.16	24.33	29	0.00*
	Left	30	59.166	70.333	5.200	4.037	19.203	29	0.00*
Gastrocnemius	Right	30	17.166	23.633	2.085	1.564	17.598	29	0.00*
	Left	30	18.1	23.9	2.040	1.241	16.872	29	0.00*
Soleus	Right	30	18.766	24.333	1.851	1.093	18.913	29	0.00*
	Left	30	13.156	12.466	2.492	0.971	18.913	29	0.00*
Sprinting time		30	13.156	12.466	0.989	0.681	7.282	29	0.00*

The above table consists of pre and post values for the right and left hamstring, gastrocnemius, soleus muscles flexibility scores and sprinting time in study group. The mean, standard deviation, t-test, degrees of freedom and p-values for independent sample observations have been utilized. It is observed that the post values of study group have shown significant changes in the subjects.

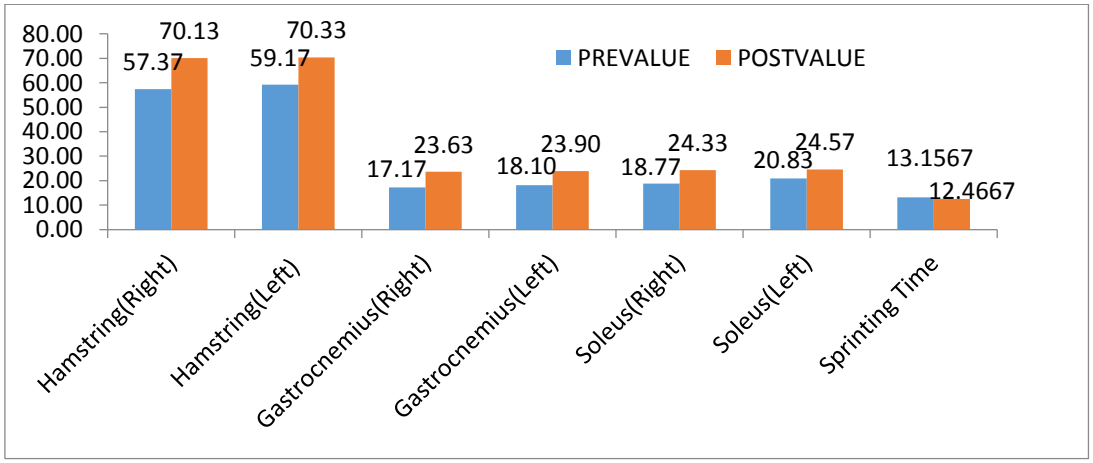


Figure:1 pre & post values of right and left hamstring, gastrocnemius, soleus muscles and sprinting time.

DISCUSSION

This study shows that there is a significant difference between pre and post values of length (90˚-90˚)of right and left hamstring, left gastrocnemius, soleus muscles and sprinting performance at the level of ($p < 0.005$) .

In this study MET has been applied for the subjects of the study group which was proved to be effective. The previous study done by Gandhi hiral et al post isometric relaxation was effective in therapeutic manoeuvre for treating range of motion and flexibility in hamstring individuals.

The study result shows that (table no.1) mean and SD muscle energy technique was very effective in improving hamstring flexibility shows significant change. The previous studies done by Leon Chaitow et.al.2013,[12] on MET appears to increase range of motion of joints and extensibility of muscle.

GARY FRYER.et.al.2009.[5]in his research-informed muscle energy concepts and practice -applications of MET to stretch and increase myofascial tissue extensibility may potentially produce viscoelastic and structural change. Viscoelastic and plastic changes autonomic mediated change in extracellular fluid dynamics and fibroblastic mechanotransduction have been proposed for the therapeutic effect of MET.

According to the study done by Adel Rashad Ahmed et.al.2011.[6]Muscle energy technique and dynamic stretching improving on hamstring flexibility.

According to the study done by Fryer G.et.al.2011.[7]An evidence-informed approach that MET technique is most useful technique variations (such as number of repetitions, strength of contraction, duration of stretch phase), causing frustration for those endeavouring to integrate relevant evidence into practice that demonstrate an increase in the extensibility of muscles and spinal range of motion.

Previous study done by Lee Herrington et.al.2013.[8]Hamstring muscle length significantly change the popliteal angle 90˚-90˚ this is very effective when measuring hamstring muscle length.

In this study statistical results shows (table no1) that mean and SD the sprinting performance was increased. Previous study done by Luis Cunha et.al.2005,[9]which showed that muscular tension depends on the muscle length and joint angle. When a joint angle varies, the strength also changes due to a different tension produced by those muscles and muscle work through different moment arms.

In this study all subjects received warm up and cool down exercises and stretching, previous study done by Pablo B. Costaet.al.2011.[10]Warm-up sessions focus on active or dynamic movements. Cool-down strategies should be developed to enhance the return to basal metabolic levels and aid in post exercise recovery.

In this study results shows that (table no1) Mean and SD of pre and post values of the sprinting time shown significant change. The previous study was done by Takashi Abe et.al.1999.[11]Concluded that fascicle length and lesser pennation angle observed in leg muscles of sprinters runners, compared with distance runners, would appear to favor shortening velocity as required for greater running speed.

CONCLUSION

The present study was conducted to find out the effectiveness of muscle energy technique on hamstring and calf muscle flexibility and sprinting performance in sprinters. All subjects were taken in the study group received muscle energy technique.

All the subjects were assessed initially and after six weeks of intervention, the outcome measures are range of motion of hamstring and calf muscles and sprinting performance time were taken.

On comparing the mean and standard deviation of pre and post values in the present study the post values shows significant improvement in values of outcome measures than the pre values following after intervention.

This study suggest that effect of muscle energy technique on hamstring and calf muscles flexibility shows significant change in sprinting performance when comparing pre and post values of the study group.

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