National University of

Medical Science, Spain (NUMSS)

The effect of a muscle energy session on increasing knee extension in People with shortness of knee posterior muscles

A Thesis Submitted to National University of Medical Science, Spain (NUMSS), in fulfillment of the requirement for the degree of Doctor of physical Therapy (DPT)

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INTRODUCTION

Due to the fact that many people in functional positions are more in positions where the knee is bent, the hamstring muscle tends to shorten. As well as aging and lack of proper exercise, this process increases, so that the shortness of this muscle directly affects the function of the knee and indirectly affects the function of the hip and ankle joints.[1]

Flexibility is an important physiological component of physical fitness. Decreased flexibility can cause inefficiency in the workplace and is also a risk factor for conditions such as low back pain, plantar fasciitis, etc. and muscle stiffness affects a person's static and dynamic balance.[2]

Hamstrings contribute to posture stabilization and the control of the pelvis region. Hamstring muscles have the ability to generate high forces rapidly through their eccentric and concentric contractions due to their high composition of type 2 muscle fibers. A hamstring muscle's length can change by up to one third as a result of eccentric or concentric contraction and is subject to high forces in closed and open kinetic chain activities.[3] Of the three hamstring muscles, the bicep femoris has the greatest muscle-tendon length and is stretched the most during sprinting, hence being the most frequently injured muscle. The hamstrings act to decelerate knee extension distally while proximally assisting hip extension in the later stage of swing phase while running. During the eccentric contraction of the hamstrings at the end of the swing phase, the muscle reaches maximal length, and it is suggested this is when strain injury is most likely to occur just before heel strike.[3] The causes of hamstring injuries have been attributed to a lack of strength in the hamstrings, lack of hamstring flexibility as well as imbalance or lack of strength between the lower extremities in quadriceps and hamstring muscle.[1] Tightness and Decreased flexibility in hamstring muscles leads to hamstring muscle injury so to decrease the number of injuries preventive programs are highly recommended. Stretching is important for reducing injuries and improving performance in sports and overall fitness. Muscle energy technique (MET) is a procedure that involves voluntary contraction of a patient's muscle in a precisely controlled direction, at varying levels of intensity. It is unique in its application as the client provides the initial effort while the practitioner facilitates the process. The benefits of MET include: Restoring normal tone in hypertonic muscles, strengthening weak muscles, preparing the muscle for subsequent stretching,

improved joint mobility. It includes two techniques post isometric relaxation technique and reciprocal inhibition. Hamstring tightness is a common problem faced by the general population as well as sports players. The MET is a widely accepted method for treating hamstring.[4, 5]

By doing treatment, the movements are done more easily and with more coordination and from creation injuries such as sudden muscle strain are prevented and the risk of injury after exercise and muscle fatigue is reduced.[7] Muscle stretching is done actively and passively in several ways such as static and ballistic stretching, PNF techniques and muscle energy techniques for muscle flexibility.[6, 7]

Study by Richa Mahajan et al. shows that MET was superior to static and ballistic stretching in decreasing pain intensity and increasing active cervical range of motion in patient with sub-acute neck pain.[8, 9] Research on the effectiveness of each of these methods has shown different results. This is especially true of muscle energy techniques, both in terms of novelty and performance characteristics. While basically some researchers in their studies do not differentiate between PNF techniques and muscle energy techniques and refer to all of them as active muscle stretching.[10, 11, 12]

Worrell et al. (1994) investigated the effects of active stretching (PNF) and static stretching techniques on hamstring muscle flexibility by examining the maximum isokinetic torque criterion.[13] In this study, although there was an increase in flexibility in both stretching techniques, no significant difference was observed between the two methods. Davis et al. (2005) In their study, found that only the static traction group had significant changes in muscle flexibility compared to the control group, while the changes in the active stretching group were not significant.[14] DePino G. et al. (2000), McMillian D. et al. (2006) and O'Sullivan et al. (2009) also showed that static traction increases hamstring flexibility, whereas in dynamic traction this flexibility does not occur.[15, 16, 17]

In contrast, Saddy et al. (1982) examined the effects of different stretching techniques on muscle flexibility in three treatment groups. In group one, PNF technique, in group 2, static stretch and in group 3, ballistic stretch was given .According to the results, only PNF technique was able to significantly increase muscle flexibility compared to the control group.[18] But the study of Lucas et al. (1984) did not show any significant difference in the effectiveness of the three techniques of static, dynamic and PNF traction.[19]

Researchers such as Funk, Spemoga, and Feland also emphasize the effectiveness of active stretching techniques in relieving muscle shortening.[20, 21, 22]

There is no consensus among different experts on how to perform muscle energy techniques (type of technique, duration of hold time and intensity of muscle contraction). In various sources and studies, regarding the hold time of contraction, several times are observed between 3 to 10 seconds.[23, 24, 25]

Rowlands et al. (2003) showed that if the duration of isometric contraction increases, the effectiveness of traction increases. Also, the intensity of contraction between 20% to 100% of the maximum contraction is recommended. Therefore, it seems that conducting detailed studies by controlling the above parameters can guide clinical decision making.[26]

The aim of this study was to evaluate the effectiveness of a specific type of muscle energy technique with specific holding time and contractile strength in increasing the flexibility of shortened hamstring muscles.

Material and Method

In this study, the target population was defined as men 30-40 years old with hamstring shortening. To determine the sample size, using the relevant formula and previous studies, the researcher selected 30 people from the 100 men who had the entry and exit criteria specified in the plan.

Inclusion criteria: the presence of hamstring muscle shortness of 30 degrees and more (using the Passive Knee Extension Test by Dellitto (1983)).[27, 28]

Exclusion criteria: having continuous exercise before the test or a history of trauma, fracture, pelvic and lower extremity surgery, or back pain in the past year.

To determine the shortness of the hamstring by the Dellitto method, each of the 100 volunteers slept in a supine position so that the flexion of the opposite thigh was prevented by closing the sling. The thigh was then flexed up to 90 degrees and fixed to the frame above the person's head by sling and rope. The knee of the same foot was then passively moved to the extension. This move was made to the point of initial resistance. The degree of knee extension was then recorded with a goniometer so that the fixed axis of the goniometer was along the longitudinal axis of the femur and its moving axis was parallel to the tibia and the vertex of the goniometer was on the external condyle of the femur. In this study, if the knee extension limit was 30 degrees or more using a goniometer, it was selected as a short hamstring sample and entered the study. To perform the muscle energy technique, the person would lie on their back and the thigh on the side of the treatment would be fixed at 90

degrees flexion, and the knee would be passively extended to reach the initial resistance point. At this point, the therapist took an isometric contraction with a force of 50% of the voluntary contraction of the patient in the direction of knee flexion with a hold time of 10 seconds. The person was then instructed to rest and the knee was passively extended by the therapist to a wider range and placed on the new range for 10 seconds.

To determine 50% of isometric contraction, the method was performed by first asking the person to consider all the strength of his muscle and then perform isometric contraction with half of it. Also, due to the fact that the contraction took place against the resistance force of the therapist, she was also decisive and helpful in controlling the intensity of the contraction. This method was used to design the study exactly the same as the actual conditions in the clinic. Hold time was also measured with a stopwatch. This technique was repeated three times in one treatment session and at the end of the treatment session, the knee extension angle was recorded by performing a Passive Knee Extension Test. Finally, the obtained results were analyzed using SPSS (ver.18).

RESULTS

After confirming the normal distribution of the data obtained by Kolmogorov-Smirnov test, Paired-samples T test showed a significant increase ($P<0.05$) in the range of motion of knee extensions after a single application of MET.

The results of this study showed that the application of a session of muscle energy therapy (MET) has been able to significantly improve the range of motion of the knee compared to before treatment and be effective in hamstring muscle flexibility.

DISCUSSION

This study demonstrated that a significant increase in hamstring extensibility (measured as ROM at the knee following PKE) occurred following MET. To evaluate the effectiveness of muscle energy technique in increasing knee extension, 30 healthy men with hamstring shortness were studied. The results showed that the muscle energy technique could significantly improve the range of motion of the knee.

In the present study, sub-maximal muscle contraction (MVIC 50%) and a hold time of 10 seconds were used to perform the muscle energy technique.

Study by Mohd.Wesim et al. (2009) and Roshan Adkitte et al. (2016), Shows that MET is effective in improving hamstring flexibility (range of motion) and it can prevent the injuries and improves their performance [29, 30, 31]

In terms of isometric contraction, Feland et al. (2004) studied the effect of Contract Relax PNF technique on three different intensities of maximum voluntary isometric contraction (MVIC 20%, 60%, 100%). According to the results of this study, hamstring muscle flexibility increased significantly in all three groups, but no significant difference was observed between the effectiveness of 20% and 60% contraction with 100% maximum voluntary isometric contraction. In other words, these researchers proposed sub-maximal isometric contraction with an intensity of 20% of maximum voluntary isometric contraction to increase muscle flexibility.[24]

Schmitt et al. (1999) and Ballantyne et al. (2003) suggested the use of sub-maximal contractions (MVIC 75%) in the implementation of the PNF technique.[35,36] According to Schmitt et al. in this type of stretch, the soft tissue is neurologically reset and lengthens instead of sustaining deformation.

In the present study, to use the neurophysiological properties of muscle energy techniques, 50% sub-maximal contractions were used and positive clinical effects were observed. It seems that in terms of ease of clinical estimation of contraction percentage and high error rate in estimation of 20% contraction, as well as ease of performing the technique for the patient, 50% contractions are appropriate.

In fact, one of the main differences between muscle energy technique and PNF techniques is the use of sub-maximal contractions in muscle energy technique. The main reasons for using sub-maximal isometric contractions are as follows: Sub-maximal isometric contractions are safe for the patient and in addition cause post-isometric relaxation, thus facilitating stretching.

This maximal neurophysiological facilitation does not occur if maximal contractions are used. On the other hand, in contractions of more than 70%, blood flow is reduced and the amount of O2 is reduced, which prevents muscle relaxation. This increases the likelihood of uncomfortable cramps and prevents increased flexibility. As a result, it is easier for the therapist to control sub-maximal contractions than stronger contractions, which makes it easier to apply the muscle energy technique.

In the present study, 10-second hold time was used in isometric contraction. Lewit (1984) also considers the hold time of 7 to 10 seconds to be desirable in his study.[34] Feland et al. 2001 consider a 6-second hold time and Green Man 1996 a 3-to-7-second hold time.[24, 35]

Bonnar et al. (2004) Compared hold time of 3, 6, and 10 seconds. They found no significant difference between the three times in terms of increased muscle flexibility.[17] According to the results, it seems that using the average hold time (about 6 seconds) is more appropriate. In this study, the mean trend of changes in knee extension angle showed that these people achieved the most increase in range of motion, and this can mean that the maximum increase in length can be achieved by using the muscle energy technique. Overall, there is limited evidence for theories that explain the mechanism of action of muscle energy techniques in increasing muscle flexibility. Some researchers suggest neurophysiological mechanisms for the effectiveness of muscle energy techniques. Kuchera (1992) considers the inhibition of Golgi tendon reflex due to the performance of muscle energy techniques to be effective.[30] Also Ruparlia et al. (2019) in their study, which sought to find an effective treatment to increase flexibility and improve Y-Balance test performance between MET and PRT, concluded that both groups show improvement in flexibility and Y-Balance test. But when compared between the two groups, MET is better than PRT for Y Balance test performance.[29] The effects of the MET component to increase ROM can be explained by the physiological mechanisms of changes in muscle extensibility - reflex relaxation, biomechanical event, neurophysiological changes, and changes in stretch tolerance.[2, 36]

CONCLUSION

This study found that Muscle energy technique has been shown to be an effective technique in increasing the flexibility of hamstring muscle and a single application of MET produced an increase in passive stretch of the hamstring muscle. This suggested that a single application of MET produced no biomechanical change to the muscle, but created a change in tolerance to stretch as there was no evidence of viscoelastic change.

STUDY LIMITATIONS

One limitation of this trial was that we only conducted a short-term follow up. We do not know if these effects would be maintained for longer periods.

SUGGESTION

It seems that all the methods used to eliminate the shortness of this muscle can have positive results and depend on the patient's condition and her cooperation and the choice of appropriate treatment method. Thus, it is suggested that studies be performed in more diverse groups in terms of gender, diseases associated with muscle shortening, and in controlled conditions, the effect of muscle energy techniques with other techniques be examined.

In this case, it may be possible to obtain more specific clinical guidelines for muscle flexibility.

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