EFFICACY OF MUSCLE ENERGY TECHNIQUE ON QUADRICEPS STRENGTH AND HAMSTRING FLEXIBILITY IN FENCERS

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ABSTRACT

Introduction: Fencing is a dynamic and intense combat sport. The sport demands a high level of agility, requiring athletes to execute rapid accelerations, decelerations, sudden direction changes, lunges, jumps, and slides. As such, fencing places considerable strain on the lower body, particularly the hamstrings and quadriceps, which are the muscles most susceptible to injury. These injuries typically require extensive rehabilitation, as the muscles have a strong tendency to shorten, increasing the likelihood of recurrence. The nature of fencing, with its explosive movements and frequent high-impact maneuvers, further contributes to the risk of muscle strain. Athletes must adopt preventative strategies and employ appropriate recovery protocols to reduce the incidence of these injuries and maintain optimal performance. **Methodology**- The participants underwent a 5-day treatment regimen over the course of 3 weeks targeting the hamstring and quadriceps muscle groups to improve both strength and flexibility. The strength and flexibility of these muscles were assessed using the sit-and-reach test and a quadriceps strength test. Pre-treatment and post-treatment measurements were taken and compared to determine the outcomes. **Result:** The increase in Hamstring length and Quadriceps strength following a 5-Day MET treatment for 3weeks protocol proved to be statistically significant when compared to presession (Hamstring: 59.42, Quadriceps: 28.51) and post-session (Hamstring: 63.31, Quadriceps: 40.1) values.

Conclusion: The present study concluded that Muscle Energy Technique improves Hamstring flexibility and Quadriceps strength of Fencers and hence can help in injury prevention and enhance their performance.

Keywords: Muscle Energy Technique, Fencers, sit and reach test, Quadriceps strength and Hamstring flexibility.

INTRODUCTION

Fencing is the art of making the right decision in split second". Fencing is a combat sport in which two athletes use sword to attack and defend against one another with the aim of striking their opponent in order to score points. Fencing is one of the oldest known sports and is one of only four sports that has been included in every modern Olympic Games. Modern competitive fencing has spread far from its traditional European roots. Almost 130 countries are currently affiliated with the Federation Internationale d'Escrime (FIE), the international governing body of fencing. In the USA, the United States Fencing Association (USFA) sponsors national competitions for male and female participants according to skill level (Division I-III) or age (from Y-10 for those 8-10 years old, to Veterans 60+ for those aged 60 and older) in individual and team events, able-bodied and wheelchair, in all three disciplines foil, epee and sabre. Fencing is also a sanctioned National Collegiate Athletic Association (NCAA) and interschool's sport, and a popular activity in summer camps and Parks and Recreation programs, among other venues. Fencing in India started with the foundation of the fencing association of India in 1974. It was recognized by government in 1997. It is affiliated with Indian Olympic association, fencing confederation of Asia, Common wealth fencing Federation and federation d'escrime. There are about 30 state association and two services association of India [(1)].

Possible Injuries in Fencing:

There is a lack of well-designed epidemiological studies focused on acute injuries in fencing. A time-loss injury is one that forces an athlete to withdraw from competition. Two studies conducted in Italy in the late 1980s found injury rates of 0.00 to 0.22 per 1,000 athlete-exposures in regional competitions with youth and elite fencers. Most acute time-loss injuries in fencing seem to stem from the dynamic movements of the sport, such as strains and sprains, rather than injuries caused by fencing equipment, like punctures or lacerations [(1)]. The knee is the most common injury site, making up 19.6% of all time-loss injuries, with a variety of conditions such as meniscal tears, ACL and MCL ruptures, patellar tendon pain, patellar subluxation or dislocation, and non-specific knee pain. Thigh strains and ankle sprains are the most common specific injuries, accounting for 14% and 12.5% of all reported injuries, respectively. Among upper extremity injuries, finger injuries (such as sprains, contusions, fractures, and subluxations) are the most common (7.6%), followed by hand and shoulder injuries (3% each). Low back issues, such as sprains, strains, and spasms, make up 9% of time-loss injuries. The repetitive and asymmetrical movements required in fencing impact both the weight-bearing and non-dominant legs, regardless of weapon type. Female fencers, in particular, should be closely monitored as they tend to experience more hip and knee injuries that affect joint function. While sports generally offer many benefits, they also carry inherent risks for injuries at all performance levels. Overuse injuries, typically seen in the shoulders, back, knee joints, and pelvic girdle, are common in fencing due to its repetitive nature. Major knee injuries can have significant short-term consequences, similar to the impact of an interrupted soccer career. At the 2012 London Summer Olympics, 18.7% of the 246 fencing athletes (124 women and 122 men) were injured, with 4.1% missing more than one day and 0.8% missing more than seven

days. Injuries in fencing are predominantly located in the lower extremities, particularly in the ankle and knee. The risk of developing knee osteoarthritis (OA) at a young age, potentially leading to lifelong disability, is a notable concern. Fencers must maintain proper posture and stance with their weapon for long periods during training, which can contribute to the risk of musculoskeletal injuries [4].

Tissue injuries may result from such repetitive chronic micro trauma. An imbalance between the two opposing muscles could cause excessive stress on the joint and musculoskeletal pain. Therefore, the body position can easily become distorted and the lumbosacral spine structures overloaded. Athletes may work out for hours in a week and ignoring the effects and side effects of knee osteoarthritis may cause life-long difficulties. More than 50% of subjects of this study implied to have problem with fully bending their knee and many of them- as was mentioned in exact numbers- complain about difficulties such as going up or down stairs, sitting and rising from sitting and even getting on/off toilet as personal activities. Fencers must continually adapt to changing scenarios during competition, executing dynamic, repetitive movements like Attack, Riposte, Feint, and Lunge (offensive), and Parry and Circle parry (defensive). Among these, the Lunge is particularly significant, forming the foundation for many offensive actions and placing substantial stress on various body parts, especially the knees. This movement exposes fencers to potential impact forces. Similar to challenging personal activities, the lunge requires the knee to be fully bent. When observing the knee muscles during a lunge, it is evident that the forward knee extensors undergo eccentric contraction, while the posterior muscles contract concentrically to decelerate the body. The frequent occurrence of this lunge motion in fencing leads to imbalances between the upper and lower limbs. However, knee musculoskeletal osteoarthritis can be prevented, especially at a young age, by correcting movement patterns. Research has suggested solutions to reduce knee risks, particularly during the lunge. A study with the national fencing team of the Republic of Korea showed that a 12-week muscle imbalance training program significantly improved mediolateral sway and balance in the non-dominant lower limb. Additionally, a cinematic analysis comparing elite fencers (Iran Sharif University) and novice fencers (Iranian national team) emphasized the importance of strengthening the quadriceps and hamstring muscles and closely monitoring lower limb motion patterns to achieve a longer, more effective lunge [1, 6,4].

Considering all, it can be concluded that despite the prevalence of knee problems and pain among fencing athletes of Iran that was proved in the study, there are solutions to inhibit its spread. As the results showed, fully bended knee position is the most affecting posture that should be addressed intently, which is held in common with Lunge motion, as well as personal activities that the participants of this study had mentioned as the most difficulties due to their knees [1,4].

Physiotherapy Interventions:

In the context of enhancing hamstring flexibility and quadriceps strength several physiotherapy interventions are paramount. Stretching techniques such as static, dynamic, and proprioceptive neuromuscular facilitation (PNF) stretching can be employed to increase hamstring flexibility, improving range of motion and reducing injury risk. For quadriceps strength, eccentric strengthening exercises, such as Nordic hamstring curls or squats, can effectively target muscle development while minimizing stress on the joints. Additionally, manual

therapy, including deep tissue massage and myofascial release, can alleviate muscle tightness, improving both flexibility and strength. Incorporating sport-specific movement patterns, such as lunges or plyometric drills, further augments functional strength and agility, ensuring the athlete's readiness for competitive demands.

Muscle Energy Technique:

What is Muscle Energy Technique? Muscle Energy Technique is a form of osteopathic manipulative diagnosis and treatment in which the patient's muscles are actively used on request, form a precisely controlled position, in a specific direction, and against a distinctly executed physician counterforce. Muscle energy technique is used to treat somatic dysfunction especially decreased range of motion, muscular hypertonicity and pain. 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 [(8)].

Assessment: TART (Chase 2009)

Tissue textures a normality Are the tissues hot, cold, tense, flabby, oedematous, fibrotic, indurated, in spasm, hypertrophied, etc?

Asymmetry: Is there any obvious difference compared with contralateral tissues?

Range of motion abnormality: What is the degree (and quality) of pliability, mobility, stability, extensibility, range of motion, compared with normal? Hyper- or Hypomobile? Does the quality of end feel offer additional useful information?

Tenderness: Are these unnaturally sensitive, tender, painful (or numb), etc, on applies pressure or when actively or passively moved?

Although it has not yet been found about the effectiveness of muscle energy technique on quadriceps strength and hamstring muscle flexibility in fencers of adult age group, we believe that many fencers suffer from this condition, specifically because of the repetitive fente motion which is an offensive movement consisting of retraction of the rear leg combined with the projection of the front leg just like lunging. Elite athletes who are participating fully in training and competition with mild to moderate quadriceps muscle pain comprise a large portion of those who suffer from muscle strain. We are aware of that no previous study that has evaluated the effects of muscle energy technique on quadriceps strength and Hamstring flexibility in competitive fencers. Therefore, this experimental study is to investigate the efficacy of Muscle Energy Technique on Quadriceps muscle strength and Hamstring muscle flexibility. Hence evaluating their performance [(8,2)].

METHODOLOGY

The Interventional study, quasi Experimental study, Simple Random Sampling done on practicing Fencers at Fencers Academy for a duration of 1year Sample size: 30 Materials**:** Plinth or bed, weight cuffs, measuring tape and ruler, weight cuffs (3kgs).

Participants fulfilling inclusion and exclusion were selected for the study. Inclusion criteria: Fencers of age between 18 to 25 years, all genders, practising Fencers with experience of minimum 5 years. Exclusion criteria: history of surgery over lower extremity, subject having any trauma over anterior or posterior aspect of thigh, any past or recent history of fracture of knee or femur.

PROCEDURE:

The study protocol was presented for approval in front of institutional ethical committee and protocol committee of D. Y. Patil Education Society, Kolhapur. After the approval from committee field work was started. Efficacy of Muscle Energy Technique on Quadriceps muscle strength and Hamstring muscle flexibility in fencers is an interventional study which was performed accordingly. All the competitive fencers including all genders of adult age group was explained about the procedure and the whole research. A written consent form was taken from the participants that they are willing to participate in this study. Participants for study were selected based on the inclusion criteria and exclusion criteria. Participants were first provided with the data collection sheet including their personal details, sport profile and study related questioner. A total of 30 individuals were randomized into a group, according to inclusive and exclusive criteria. Participants of the group received a 3-week protocol of Muscle Energy Technique on Quadriceps and Hamstring muscle group. Afterwards the effectiveness was assessed through 2 special tests.

Muscle Energy Technique (MET) for hamstring flexibility.

Isometric contraction will be held for 10 seconds and then slight stretch for 30 seconds will be applied. 4 contractions per treatment with 3 seconds rest between each contraction.

5 days/week, 3weeks protocol, conventional Treatment: Static quadriceps exercise, vastus Medialis obliques exercise, straight leg raising. Test the participant for hamstring tightness. Patient lies in supine position either on the bed or plinth. The supine patient fully flexes the hip and on the affected side. The flexed knee is extended by the therapist to the point of initial resistance (identifying the barrier). The calf of the treated leg is placed on the shoulder of the therapist, who stands facing the head of the table on the side of the treated leg.

If the right leg of the patient is being treated, the calf will rest on the therapist's right shoulder, and the therapist's right hand stabilises the patient's extended unaffected leg against the table.

The practitioner's left hand holds the treated leg at the thigh to both maintain stability and to palpate for bind when the barrier is being assessed.

The patient is asked to attempt to straighten the lower leg (i.e. extend the knee) utilising the antagonists to the hamstrings, employing ~20% of the strength in the quadriceps. This is resisted by the therapist for 5 to 7 seconds. Appropriate breathing instructions were given to the participant. Inhale as they slowly build up an isometric contraction. Hold the breath during the 5 to 7 second contraction, and release the breath as the contraction is slowly released. Inhale and exhale fully once more, following cessation of all effort, as the patient is requested to 'let go completely'. The leg is then extended at knee to its new hamstring limit and the procedure is repeated.

Procedure for Quadriceps Muscle strength:

Test and assess the participant for Quadriceps muscle group. Patient lies prone on bed or plinth with the leg being treated flexed at the knee joint. The therapist uses passive joint range movement to position the muscle just short of bind. The participant is then asked to move the heel gently towards the buttocks while an equal resistance force is applied by the therapist, and the hamstring isometrically contracts for about 5-7 seconds. After the contraction the therapist stretches the soft tissues of the anterior thigh by easing the foot towards the buttocks. The contraction of the antagonists to the shortened Quadriceps would result in an improved ability to stretch the anterior thigh. Appropriate breathing instructions should be given as per mentioned above during hamstring procedure.

RESULTS

The interventional study on the effectiveness of Muscle Energy Technique (MET) for improving quadriceps strength and hamstring flexibility in fencers showed significant improvements in both quadriceps' strength and hamstring flexibility among participants. The study found a notable increase in hamstring muscle length measured by sit and reach test, as well as an increase in the number of repetitions performed during the active knee extension test with weights, which showed improvement in Quadriceps muscle strength.

A. GENDER DISTRIBUTION

Gender	Frequency	Percentage
Male	30	85.71%
Female	5	14.29%
Total	35	100.00%

Table no. 1

The gender distribution of the study participants is presented in Table no.1 and Figure no.1. The total sample size consists of 35 participants with 5 female (14.29%) and 30 male (85.71%). This distribution indicates that there is predominance of male participants in the study as the number of female participants (age group 18-25) appearing for state level fencing competitions were less.

B. AGE GROUP

Age	
Mean	21.17
S.D.	1.71

Table no. 2

The average age of the study population is shown in Table 2. The sample comprised 35 participants, with the majority being 21 years old (mean age: 21.17). The standard deviation was calculated to be 1.71.

C. PRE AND POST INTERPRETATION OF SIT AND REACH TEST FOR HAMSTRING MUSCLE.

The Hamstring Sit and Reach flexibility test was employed to assess the pre- and post-test outcomes regarding hamstring flexibility. The results are summarized in Table 3 and depicted in Figure 2, showing the average values before and after the intervention. The bars represent the pre-test and post-test results. The notable increase in the measurements indicates that the training intervention had a positive impact on the participants' flexibility. These findings suggest that the applied technique significantly enhanced hamstring flexibility, as evidenced by the statistically significant test results.

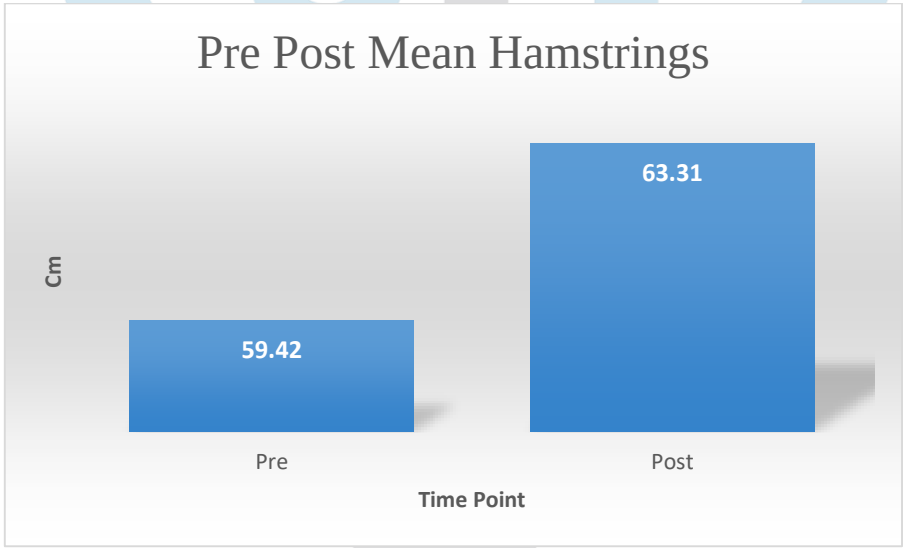

Figure no.1 Pre and post Sit and reach test results.

D. PRE AND POST INTERPRETATION OF ACTIVE KNEE EXTENSIO TEST FOR QUADRICEPS MUSCLE

The Active Knee Extension test was employed to assess the pre- and post-test outcomes regarding Quadriceps strength. The results are summarized in Table 4 and depicted in Figure3 showing the average values before and after the intervention. The bars represent the pre-test and post-test results. The notable increase in the measurements indicates that the training intervention had a positive impact on the participants' strength. These

findings suggest that the applied technique significantly enhanced Quadriceps strength, as evidenced by the statistically significant test results.

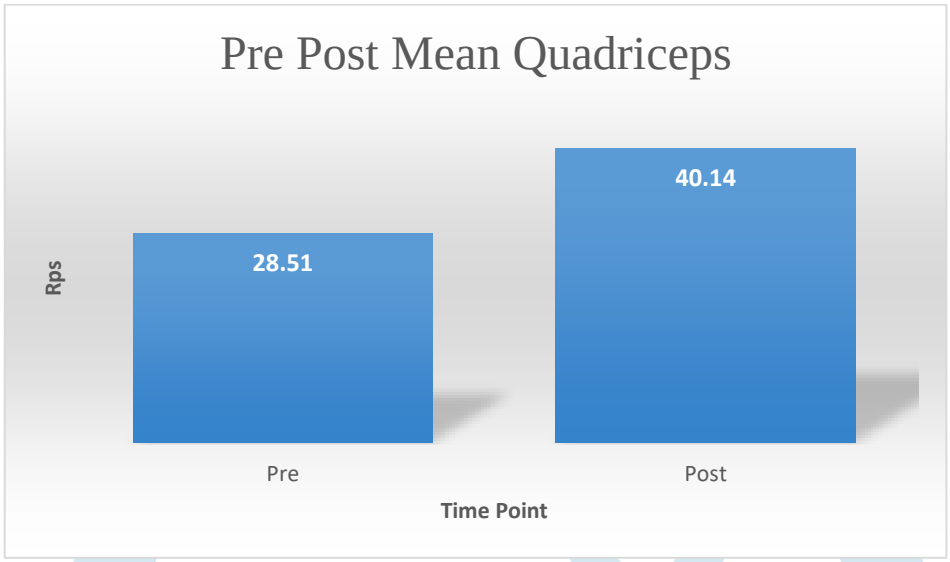

Figure no. 2 Pre and post results of active knee extension test.

DISCUSSION:

This study aims to evaluate the effectiveness of Muscle Energy Technique (MET) on improving hamstring flexibility and quadriceps strength in fencers. A total of 35 participants, aged between 18 and 25 years, were included in the study. All participants followed a MET protocol focused on the hamstrings and quadriceps for 15 to 20 minutes, five days a week, over a span of three weeks. The study predominantly consisted of male participants, as there were fewer female fencers attending state-level competitions. Additionally, the majority of participants were in the 21-22-year age group. The results showed a significant improvement in both hamstring flexibility and quadriceps strength in the fencers. The age group of 21 years stood out as particularly relevant, as it represents a critical period of physical development and performance in athletes.

Adkitte, Roshan; Rane et al. (2016) evaluated the effectiveness of Muscle energy technique on Hamstring flexibility in national level football players. The players were given 6 days Muscle Energy Technique on Hamstring muscle to improve its flexibility. This improvement is particularly relevant to football players, where flexibility is critical for their performance. The study concluded that Muscle Energy technique increases the flexibility of Hamstring muscle in Indian football players and hence it can prevent injuries and improves their performance.

D. Dinesh, S. Sudhankar from department of musculoskeletal and sports physiotherapy (2022) investigated the effects of Muscle Energy Technique and proprioceptive neuromuscular facilitation on hamstring muscle flexibility in recreational athletes. It was a pre-test and post-test comparative experimental study aimed to compare the effects of Muscle Energy Technique and Proprioceptive Neuromuscular facilitation among the athletes. 30 athletes were divided into two groups MET and PNF and a protocol was practised for 4 weeks- 5 sessions/week. The modified Back Savers sit and reach test was the outcome measure. The analysis was based

on the fact that PNF stretch technique yields a significant reduction of Hamstring tightness and improves flexibility but study concluded that the mean value of group given Muscle Energy Technique was higher than the other group who received PNF stretch technique. Hence, was a significant improvement in flexibility of hamstring in group which underwent the 4-week Muscle Energy Technique protocol.

A study conducted Prachi Choksi, Krupa Tank to evaluate the effectiveness of Muscle Energy Technique on Quadriceps strength and Hamstring flexibility in patients with knee osteoarthritis.

A total of 120 patients with unilateral knee osteoarthritis were randomly assigned to two groups based on inclusion and exclusion criteria. Both groups underwent pre and post- test assessments of Hamstring flexibility using Active knee extension test and quadriceps strength test through Delorme boot method. The study found that the MET group showed greater improvement in hamstring flexibility and quadriceps strength compared to the control group. Statistical analysis revealed significant improvements in the MET group for hamstring flexibility ($t=15.66$, $p<0.05$) and quadriceps strength ($t=7.60$, $p<0.05$), compared to conventional treatment. The study concluded that both conventional treatment and MET enhance hamstring flexibility and quadriceps strength, with MET proving to be more effective for improving hamstring flexibility in knee osteoarthritis patients.

A study aimed to compare the effectiveness of Muscle Energy Technique (MET) and static passive stretching in improving hamstring flexibility in healthy college athletes with hamstring tightness. A total of 30 participants were randomly assigned to two groups: Group A ($n=15$) received MET, which involved isometric contraction with post-isometric relaxation, and Group B ($n=15$) received static passive stretching. Both treatments were administered in a single session, and hamstring flexibility was measured using the straight leg raise angle (active range of motion) before and immediately after the intervention. The results, analyzed using a Paired Samples t-Test, revealed that both treatments significantly improved hamstring flexibility ($P=0.000$). However, the Mann-Whitney Test demonstrated that the MET group experienced a significantly greater improvement in flexibility compared to the static passive stretching group. In conclusion, the Muscle Energy Technique was found to be more effective than static passive stretching in enhancing hamstring flexibility in this cohort of athletes.

Anju Harry, A George (2021) conducted a study to evaluate the effect of Muscle Energy Technique on Hamstring muscle flexibility in high school level Kabaddi players. The study took 30 female amateur kabaddi. The participants were assessed based on inclusion and exclusion criteria and were divided into two groups. Group A received Muscle Energy Technique in combination with conventional exercises, while group B received only conventional flexibility exercises for 5 consecutive days. Pre-test and post-test measurements, as well as follow-up assessments of hamstring flexibility, active knee extension test and agility were conducted using a flexometer 90-90 test and agility t-test.

The study concluded that MET effectively improves hamstring muscle flexibility, AKE range, and agility following a 5-day MET program. Therefore, MET is beneficial and can be implemented on-field before sports events to enhance players' performance.

Peter A Harmer did a study on Injury patterns and care in competitive fencing. Fencing is an engaging, challenging physical activity that can be safely practiced by all ages. Research has shown that the risk of significant injury is very low, especially compared to other contact sports such football, basketball, soccer and lacrosse. The majority of time loss injuries are lower extremity strains and sprains, typical of any dynamic activity involving rapid change of direction movements. Although the risk of serious fencing-specific injuries, such as puncture wounds and lacerations, is always present, the conscientious use of approved protective clothing in good condition and adherence to the rules of the sport diminish the low probability of such events. However, medical staff at fencing competitions must be prepared to deal with catastrophic and/or potentially fatal injuries. This study shows that muscle strains and sprains are common in lower extremity in fencers which demands more work load on particular muscle group. Hence it is of utmost importance to maintain good flexibility and strength og lower extremity musculature in Fencers.

Bryant Walrod et al. (2019) performed a prospective cohort study of a college fencing team to analyze the rates and types of injuries that occurred to this team over the course of year. They noted that 75% of those injured had a time loss of less than 2 week. A large percentage of our injuries (88%) were musculoskeletal in nature. There were equal numbers of acute and chronic injuries. Men and women had a similar rate of injury. In the study population, it was noted that most of the injuries occurred in practice over competition (87.5% vs 12.5%, respectively). The data was compared from a small subset population with the current evidence published with respect to fencing injuries. Some similarities and also some differences when comparing certain population were noted.

Muscular flexibility is crucial for normal human function and can be improved through various stretching techniques. However, few studies have compared these techniques. A study aimed to evaluate and compare the effectiveness of Muscle Energy Technique (MET) and Positional Release Technique (PRT) on hamstring flexibility in healthy individuals. Methods: Twenty-four healthy participants who met the inclusion criteria were randomly assigned to two equal groups.

Each group followed a 2-week home-based hamstring stretching protocol, with five 10-minute sessions per week, using either MET or PRT. The range of motion (ROM) for knee extension was measured before and after the program using the Active Knee Extension Test and Active Straight Leg Raise with a universal goniometer. Results: Both MET and PRT showed significant improvements in hamstring flexibility. However, the increase in knee extension ROM was greater with MET compared to PRT. The change in flexibility from the initial assessment to the post-intervention evaluation was also more substantial in the MET group. The results suggested that MET is more effective than PRT in improving hamstring flexibility in healthy individuals with both normal and limited flexibility.

In this study, Hamstring flexibility was evaluated using the Sit and Reach flexibility test, while quadriceps strength was measured through the Active Knee Extension test utilizing Delorme's technique—both of which are well-established methods for assessment. Following a 3-week intervention, significant improvements were observed in both hamstring flexibility and quadriceps strength, as evidenced by increased mean scores in both tests. These results indicate that MET has a positive effect on improving hamstring flexibility and quadriceps strength in fencers. Furthermore, the findings emphasize the potential of Muscle Energy Technique as an effective therapeutic technique, suggesting its application in athletic conditioning programs to enhance performance and reduce injury risks in fencing requiring dynamic flexibility and strength.

The results of this study are consistent with prior research that demonstrates the effectiveness of Muscle Energy Technique (MET), which combines isometric contraction, stretching, and resistance applied at a newly identified movement barrier. These methods, when compared to conventional exercises such as static quadriceps exercises, Vastus Medialis Oblique (VMO) exercises, and straight leg raises, have been shown to significantly improve muscle strength and flexibility. Consequently, these improvements contribute to enhanced overall athletic performance in fencers during their competitive training. The technique specifically targets the hamstring and quadriceps muscles of the lower extremity, as these muscle groups are crucial for maintaining the on-guard or lunging position in fencing. Fencing requires quick, explosive, and alternating movements, including actions like the fleche, lunge, and repetitive forward and backward motions of the dominant leg.

Therefore, maintaining optimal flexibility and strength in the lower extremities is essential for performance. The significant increase in mean values following treatment indicates that MET is particularly effective in enhancing quadriceps strength and hamstring flexibility, thereby supporting the maintenance of the on-guard stance and lunging movements during competition. This research underscores the importance of incorporating MET into training routines to improve functional strength and mobility in key muscle groups, ultimately enhancing performance and reducing the risk of injury in fencers.

The improvement of lower extremity strength and flexibility is essential for athletes, particularly in sports like fencing, where rapid and dynamic movements are required. Enhanced quadriceps strength and hamstring flexibility allow athletes to maintain stability, explosiveness, and agility during competitive training. Stronger quadriceps contribute to more powerful lunges and greater control during directional changes, while improved hamstring flexibility supports a wider range of motion, reducing the risk of injury during quick, forceful movements. In competitive sports, such as fencing, where performance often depends on precise and explosive actions, these improvements can significantly enhance an athlete's ability to execute complex movements with efficiency and power.

The need for MET in similar sports that demand lower extremity strength and flexibility is evident. Whether in sprinting, martial arts, or other contact sports, the ability to generate strength while maintaining flexibility is crucial for peak performance. MET's ability to address muscle imbalances, increase muscle activation, and improve functional range of motion makes it a valuable tool for athletes across various disciplines. As such,

the incorporation of MET into training regimens could help athletes optimize their physical capabilities, reduce the risk of injuries, and improve overall performance during competition.

CONCLUSION:

In conclusion, the study demonstrates that the muscle energy technique notably enhances strength and flexibility in fencers, as measured by the sit and reach test and the active knee extension test. Following a 3-week intervention, participants exhibited an increase in hamstring length, contributing to improved flexibility, as well as greater quadriceps strength. When comparing pre-test and post-test results for each muscle group, significant strength improvements were observed in the quadriceps. Thus, the findings suggest that the muscle energy technique effectively reduces hamstring tightness, enhances flexibility, and results in a notable increase in strength.

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