EFFECT OF MUSCLE ENERGY TECHNIQUE VERSUS DYNAMIC STRETCHING ON HAMSTRING FLEXIBILITY IN CRICKETERS-A COMPARATIVE STUDY

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Abstract: This study has been undertaken to investigate the “Effect of muscle energy technique versus dynamic stretching on hamstring flexibility in cricketers is a comparative study.” Tightness in hamstring muscles leads to hamstring injuries and hamstring injuries are the most common type of injury among athletes. Adequate hamstring flexibility is required in cricketers to prevent injury and improve performance. The objective of the study was to compare the effectiveness of muscle energy technique and dynamic stretching on hamstring flexibility in cricketers. Study included 60 cricketers with age group between 13-19 years. Subjects were divided into 3 groups. The AKE and BSSR test were used as criterion measurements for hamstring muscle flexibility. Before and after intervention, Subject were taken in Group A (n=20) MET was given, in Group B (n=20) Dynamic stretching was given, and in Group C (n=20) i.e control Group and post treatment measurement in three groups were taken again by above mentioned tests immediately after an intervention 4 weeks. So the Result indicates that MET is significantly improving the hamstring flexibility (range of motion) in cricketers.

Keywords - Muscle energy technique, dynamic stretching, flexibility, hamstring muscle.

I. INTRODUCTION

Crickets is a dynamic sport that involves many skills and movements. To enhance these skills and movements, many players ensure that their bodies are kept fit and strong.1 2 3 There are three unique aspects of the game (bowling, batting and fielding) which are associated with risk of injury.4

Injuries in cricket are common, particularly to fast bowlers. Often these injuries are due to overuse and tend to present gradually over time. Injury prevalence rates in fast bowlers have been recorded at 18%, which is significantly higher than other disciplines: batsmen (7%), spin bowlers (6%) and wicket-keepers (4%).5 There is 39% prevalence of musculoskeletal injuries in cricket players. Lower limb is the most commonly injured body part6. The three elements make up the game of cricket (batting, bowling and fielding), each carry associated risk of injury. Injuries may be either of an acute or chronic nature, the latter resulting from overuse. The repetitive nature of the game combined with long periods of play on the field produce wide range of injuries which may involve nearly any part of the body. Indirect injuries include muscle, ligament and tendon damage sustained during play6.

Lower limb injuries include muscle strain and tears (commonly in the hamstring and quadriceps) are the most common injuries in athletes. Some studies have shown that decreased hamstring extensibility is the risk factor for the development of patella tendinopathy and patellofemoral pain, hamstring strain injury6 7. They occur primarily during high speed or high intensity exercises and have a high rate of recurrence due to hamstring tightness6 7 10. Poor posture, lack of flexibility, lack of stretching, dehydration, poor body biomechanics are the causes of muscle tightness2.

Flexibility is the ability to move a joint and the surrounding muscle through a full range of motion. It is critical in cricket because of the joint stress association with dynamic multi joint movement like batting and bowling. Lack range of motion (ROM) can lead to injury and reduction in speed, agility, strength and endurance potential8. Improved flexibility may enhance performance in aerobic training and muscular conditioning as well as in sport. And the benefits of increasing flexibility include a decrease in injury rate and increase in athletic performance. It is needed to perform everyday activities with relative ease9.

Literature reports a number of associated benefits of flexibility including improved athletic performance, reduced injury risk, prevention or reduction of post exercise soreness, and improved coordination10 11. There are many successful ways of treating hamstring tightness like mechanical, thermal, ice, stretch and spray, ultrasound soft tissue massage, short wave diathermy, dynamic stretching, myofascial release therapy and muscle energy technique12. Most flexibility exercises focus on improving the extensibility of muscle and associated tissues, by muscle energy technique (MET) and dynamic stretching (DS).
Muscle energy technique (MET) is a manual procedure that uses controlled, voluntary isometric contraction of a target muscle group and is widely advocated by authors in the field of osteopathy that is now used in many different manual therapy professions. Muscle energy technique (MET) is claimed to be useful for lengthening a shortened muscle, improving range of motion at a joint and increasing drainage of fluid from peripheral regions. This approach which targets primarily the soft tissue is also known as active muscular relaxation. Effectiveness of MET in hamstring flexibility muscle to lengthen and the tone is altered by muscle contraction and improve the biomechanics.

Dynamic stretching (DS) is the available ROM during active movement and therefore require voluntary muscular action to produce the movement through the ROM. There are two types of dynamic stretching that is active stretching and ballistic stretching. Dynamic stretching develops active ROM through the process of reciprocal inhibition, where the agonist muscle is contracting while the antagonist or opposite muscle is carried through the lengthening process. When performed correctly, dynamic stretching warms up the joints, maintains current flexibility, and reduces muscle tension. The exercise begins at a slow pace and gradually increases in speed and intensity. To increase the ROM, blood and oxygen flow and improve the sprint performance, agility performance and power. There is also disagreement on how long the effect of dynamic stretching last, although the gain in flexibility is believed to increase relatively slowly, despite some evidence that those with a previous hamstring injury are significantly less flexible in this training athletes. Mohd. Waseem et al; suggested that the MET is improving hamstring flexibility. The mechanism behind the gained flexibility in muscle after MET may be due to biomechanical or neuro-physiological changes or an increase in tolerance to stretch.

Adel Rashad Ahmed; suggested that the probably mechanism of increasing muscle extensibility involves both neurophysiological (including changes to stretch tolerance) and mechanical factors (such as viscoelastic and plastic changes in the connective tissue elements of the muscle).

Yuichi Nishikawa et al; suggested that the improvement in hamstring flexibility in the active stretching group i.e. dynamic stretching was less than that of the passive stretching group. The reason for this difference may be the posture of the active stretching group during the stretch. When holding the stretch position the excitatory spinal motor neurons overcome γ inhibitory neuron impulses.

So the aim of this study is to see the effect of muscle energy technique versus dynamic stretching on hamstring flexibility in cricketers.

II. AIMS AND OBJECTIVE

To study the effect of Muscle Energy Technique (MET) versus Dynamic Stretching (DS) on hamstring flexibility in cricketers and the objective is to evaluate the effect of MET on hamstring flexibility in cricketers. To evaluate the effect DS on hamstring flexibility in cricketers and To Compare the effect of MET and DS on hamstring flexibility in cricketers.

III. HYPOTHESIS

1. Null Hypothesis (H0): There is NO SIGNIFICANT EFFECT OF MUSCLE ENERGY TECHNIQUE (MET) ON HAMSTRING FLEXIBILITY IN CRICKETERS.

2. Null Hypothesis (H01): There is NO SIGNIFICANT EFFECT OF DYNAMIC STRETCHING (DS) ON HAMSTRING FLEXIBILITY IN CRICKETERS.

3. Null hypothesis (H02): There is no significant difference between the effect of muscle energy technique and dynamic stretching (DS) on hamstring flexibility in cricketers.

4. Alternative hypothesis (H1): There is significant effect of muscle energy technique (MET) on hamstring flexibility in cricketers.

5. Alternative hypothesis (H11): There is significant effect of dynamic stretching (DS) on hamstring flexibility in cricketers.

6. Alternative hypothesis (H12): There is significant difference between muscle energy technique (MET) and dynamic stretching (DS) on hamstring flexibility in cricketers.

RESEARCH METHODOLOGY

Study Design: Quasi experimental study. Study Setting: Various school from Ahmedabad

Duration of study: Study was completed over a period of 1 year. Sample technique: Convenient random sampling Sample selection: For this study convenient random sample data will be collected from athletes who were playing at school level cricket game at Ahmedabad. All of them took part in study on voluntary basis after giving written consent. Sample size: Group A - 20, Group B - 20, Group C - 20, Age group - 13 to 19 years, Gender - Male (60)

Criteria: Inclusion criteria: Aged between 13-19 years of age; Normal Male healthy Cricket player at school level; Tight hamstring (inability to achieve greater than 160 of knee extension with hip at 90 of flexion). Exclusion criteria: Any history of lower extremity injury in past 3 months; Other musculoskeletal problem (especially lower limb fractures and soft tissue injuries); Acute and chronic hamstring strain injury; Limb length discrepancy; Unrecovered injury or surgery of Spine and lower extremity; Any impaired sensation, bleeding disorders, neurologic condition; Any malignancy or tumor of lower extremity; Venous thrombosis and arterial disease; Metal implant.

Materials used in the study: Pencil, eraser, consent form and data sheet, Universal goniometer, Measure tape, Sit and reach box, Straps, Active knee extension bar, Weighing machine, Wrist watch, Height scale, Mat
Outcome measures

- Active knee extension test (AKE)
- Back saver sit and reach test (BSSR)

Effects of interventions in both groups were assessed by above mentioned tests immediately after intervention.

Active Knee Extension Test /popliteal angle

**Method:** Measurement of active knee extension test of lower extremity was taken over two different time interval (pre-treatment & immediately after treatment application) in both groups. The subject was in supine position with hips flexed 120° and knee flexed. A 120° hip fixator was used to maintain the proper position of hip and thigh. The testing was done on the lower extremity in both groups and leg was strapped for stabilization and control on accessory movements. Landmarks used to measure hip and knee range of motion were greater trochanter, lateral condyle of 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 fixed arm secured along the femur using greater trochanter as a reference. The movable arm was aligned with the lower leg using the lateral malleolus as a reference. The knee of the extremity being tested were placed into 90° flexion with the posterior aspect of thigh in contact with the horizontal 120° hip fixator frame at all times to maintain hip in 120° flexion. The subject was then asked to extend the lower extremity as far as possible until a mild stretch sensation was felt. A half circle (180 degree) 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 active knee extension test.\(^{19}\)
Back Saver Sit and Reach Test

Method: Measurement of BSSR of affected lower extremity was taken over 2 different time interval (pre-treatment & immediately after treatment application) in both groups. The proper manner of this test is by protective “Hamstring stretch”. The beginning position for doing this test is long sitting with opposite leg flexed, with that foot on the ground and the heel near buttocks. The tested leg to be stretched is held extended. Slow gradual forward body flexion with bending at the hips and reaching toes with bilateral forward hands which is top on another, stretching the hamstring of the extended tested leg. The flexed leg protects the low back by avoiding excessive flexion of the lumbar sacral spine. While maintaining this position, measure the distance between middle fingers of hands to great toe of the right foot. 

Procedure of study: Subject who fulfilled all inclusion criteria were selected for study. The procedure was explained to all subjects. Number of cricket player signed consent form and were allocated randomly to either group A or group B and group C. Subjects were divided in to 3 groups. Group A (n=20) was treated with MET and Group B (n=20) was treated with DS alone and Group C (n=20) was treated with warm up and training. AKE and BSSR were used as outcome measurements, before intervention measurements were taken. Then intervention was given to the lower extremity in both groups. And again measurements were taken immediately after intervention. The 2 tests were completed on one occasion by taking average of three trials. Both 3 groups were treated 6 days per week for 4 weeks and pre & post treatment outcome measure were taken for after 6 day session.

PROCEDURE: Ethical clearance was taken from the ethical committee for the present study. Nature and purpose of the study was explained to the subjects, Subjects fulfilling inclusion and exclusion criteria were selected for study after obtaining informed written consent form.

GROUP-A: In addition to general regular training attending Muscle energy technique in the school cricket player, Ahmedabad. Position: The subject was in supine position. Application: Muscle energy technique was applied using post isometric relaxation. While the subject was lying in supine position, the subject's hip was passively flexed and the leg extended until tension was sensed by the researcher and the subject reported a moderate stretching sensation. The subject provided a moderate knee flexion isometric contraction (approximately 50% of maximal contraction), by pressing his ankle joint against the top of the researcher's shoulder for 7–10 s. This was followed by 2–3 s of relaxation, and then the leg was passively stretched by the researcher to the palpated barrier and/or tolerance to stretch and held for 30 s. The leg was then lowered to the table for a short resting period (approximately 10 s). This procedure was repeated two more times.

GROUP-B: In addition to general regular training attending Dynamic Stretching in the school cricket player, Ahmedabad. Position: Subject is in standing position. Application: Subject in this group was instructed to actively swing the leg to be stretched forward into hip flexion until a stretch was felt in the posterior thigh muscles keeping their knee extended and their ankle planter-flexed. The leg was then allowed to swing back into slight hip extension. This was repeated for 30 seconds, such that the dynamic stretch consisted of repeated hip flexion/extension.

GROUP-C: In addition to general regular training, warm up, cool down in the school cricket player, Ahmedabad.
IV. RESULTS AND DISCUSSION

Data was analyzed using SPSS 20.00 by IBM. The statistical data was screened for normal distribution level of significance was at 5% with confidence interval 95%. The data does not follow normal distribution. The data was checked for normality using Shapiro Wilk test, so the data was found to be skewed, so non-parametric tests were applied for analysis. For comparison between pre and post values on 4 week follow up measure of Active Knee Extension test and Back Saver Sit and Reach Test. For within group comparison Wilcoxon signed rank test was used and for between group comparison kruskall wallis test was done.

Study included 60 cricketers with age group between 13-19 years. Subjects were divided into 3 groups. The AKE and BSSR test were used as criterion measurements for hamstring muscle flexibility Before and after intervention. Subject were taken in Group A (n-20) MET was given, in Group B (n-20) Dynamic stretching was given, and in Group C (n-20) i.e control Group and post treatment measurement in three groups were taken again by above mentioned tests immediately after an intervention 4.

RESULT

Following table shows the demographic characteristics of three groups

- To analyze the baseline difference in AGE and BMI. Baseline independent test was used.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>15.50</td>
<td>1.40</td>
</tr>
<tr>
<td>B</td>
<td>15.05</td>
<td>1.47</td>
</tr>
<tr>
<td>C</td>
<td>15.95</td>
<td>1.99</td>
</tr>
</tbody>
</table>

Table: 1 Age Distribution

Table 1 and Graph 1 display the Group statistics of age distribution among 60 subjects. Mean age of patients in Group A and Group B and Group C is 15.50±1.40 and 15.05±1.47 and 15.95±1.99 respectively. There was no significance difference found on comparing mean value of AGE.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18.94</td>
<td>2.17</td>
</tr>
<tr>
<td>B</td>
<td>15.56</td>
<td>3.56</td>
</tr>
<tr>
<td>C</td>
<td>18.00</td>
<td>2.14</td>
</tr>
</tbody>
</table>

Table: 2 BMI distribution

Table 2 and Graph 2 shows the BMI distribution of the 60 subjects participated in the study. In Group A (20 subject) and Group B (20 subject) and Group C (20 subject). There was no significance difference found on comparing mean value of BMI.

WITHIN GROUP ANALYSIS

- To analyze difference in AKE and BSSR score after 4 weeks of intervention in Group A.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Z Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP A</td>
<td>AKEPRE 20</td>
<td>50.75</td>
<td>9.15</td>
<td>3.89</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>AKEPOST 20</td>
<td>46.65</td>
<td>9.41</td>
<td>3.66</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>BSSRPRE 20</td>
<td>28.58</td>
<td>3.36</td>
<td>3.93</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>BSSRPOST 20</td>
<td>32.83</td>
<td>2.87</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE : 3 Mean of AKE (º) and BSSR (cm) in group A

There was significance difference found on comparing mean value of AKE (p<0.001) and BSSR (p<0.001)
To analyze difference in AKE and BSSR score after 4 weeks of intervention in **Group B**.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean ± SD</th>
<th>Std. Deviation</th>
<th>Z Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKEPRE</td>
<td>20</td>
<td>52.83</td>
<td>7.82</td>
<td>3.935</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>AKEPOST</td>
<td>20</td>
<td>50.28</td>
<td>8.00</td>
<td>3.935</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BSSRPRE</td>
<td>20</td>
<td>26.53</td>
<td>4.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSSRPOST</td>
<td>20</td>
<td>28.90</td>
<td>3.58</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table : 4 Mean of AKE (º) and BSSR (cm) in Group B

There was significance difference found on comparing mean value of AKE (p<0.001) and BSSR (p<0.001).

To analyze difference in AKE and BSSR score after 4 weeks of intervention in **Group C**.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean ± SD (º)</th>
<th>KW value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.10 ± 2.16</td>
<td>36.64</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>B</td>
<td>2.55 ± 1.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1.95 ± 1.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table: 5 Mean of AKE (º) and BSSR (cm) in Group C

There was significance difference found on comparing mean value of AKE (p<0.002) and BSSR (p<0.001).

**BETWEEN THE GROUP ANALYSIS**

Analysis showed no significant difference between the difference in AKE and BSSR Scores.

After application of post hoc test for AKE significant difference was found between Group A and Group B (p=0.007), Between group A and Group C (<0.001), since mean value of Group A is higher so Group A is better on hamstring flexibility than Group B and Group C.

For applying post hoc test for BSSR significant difference was found between Group A and Group B (<0.001), Between Group A and Group C (<0.001) and Between Group B and Group C (0.040), since mean value of Group A is better on hamstring flexibility than Group B and Group C.

Hence, Hypothesis was accepted and Null hypothesis was rejected. It was concluded that there was significant difference between effectiveness of MET (muscle energy technique) and Dynamic stretching (DS) alone on hamstring muscle flexibility in cricketers. Group A is comparative better than Group B and Group C.
DISCUSSION
The purpose of study was designed to obtained a more through understanding of effect of MET (muscle energy technique) versus DS (dynamic stretching) on hamstring flexibility. Extensibility of the hamstring muscle measured by active knee extension(AKE) and back savar sit and reach (BSSR) test.

Compare the effect of MET and DS and to determine which is better in improving hamstring flexibility. Over time period of 4 weeks interventional comparative study was conducted on healthy young individuals divided into 3 groups i.e. Group A (muscle energy technique), Group B (dynamic stretching) and Group C (warm up, cool down and regular cricket training). It was reported that the application of such as MET, produce greater changes in range of motion and muscle extensibility than active or ballistic stretching that is dynamic stretching.

The effectiveness of MET was attributed to the inhibitory Golgi tendon reflex. This reflex is believed to be activated during isometric contraction of muscle, which is claimed to produce stretch on the golgi tendon organs and a reflex relaxation of the muscle.

Dynamic stretching increases the flexibility of tight muscles while concomitantly improving the function of antagonistic muscles. A contraction by the antagonist muscle causes the joint crossed by the agonist muscle to move through the full ROM. Active stretching is characterized by a reciprocal innervation mechanism used to relax antagonist muscle contraction. Reciprocal inhibition adjusts the contraction of agonist and antagonist muscles to facilitate various movements.

The present study showed that muscle energy technique and dynamic stretching found that both techniques were effective for increasing hamstring flexibility. Results also suggested that a comparision of both muscle energy technique and dynamic stretching will improve hamstring flexibility. Muscle energy technique is better improvement than dynamic stretching on hamstring flexibility.

According to Mohd. Waseem et al, they found that the Muscle Energy Technique and Eccentric Training program improve the Popliteal angle, i.e. hamstring flexibility. Result indicate that MET is maximum improvement as compared to Eccentric Training/contraction on hamstring flexibility. Flexibility increased after MET more, whereas Eccentric Training showed less improvement in hamstring flexibility. The mechanism behind the gained flexibility in muscle after MET may be due to biomechanical or neuro-physiological changes or an increase in tolerance to stretch, which can maintain muscle elongation for this duration, may produce an increase in muscle length by a combination of creep and plastic change in the connective tissue.

According to Shibili Nuhmani, found that the Efficacy of MET on hamstring muscles flexibility in normal Indian collegiate males. Result indicates that MET is significantly improving the hamstring flexibility, which can maintain muscle elongation for this duration, may produce increase in muscle length, an increase in flexibility.

According to Adel Rashad Ahmed, they found that Muscle Energy Technique and Dynamic Stretching on Hamstring Flexibility in Healthy Adults. Result indicates that MET is better improvement as compared to dynamic stretching on hamstring flexibility. MET may produce an increase in muscle length by a combination of creep and plastic change in the connective tissue. Dynamic stretching improve muscle performance measures such as agility, speed and strength. Repeated muscular contraction during dynamic stretch may result in disruption and membrane damage, this could be a cause of less improvement of muscle flexibility in dynamic stretching. So because this reason DS is having produce less improvement then MET which is similar line with present study.

Thus from the above research, the study showed Muscle energy technique is better improvement as compared to dynamic stretching on hamstring flexibility.

IV. ACKNOWLEDGMENT
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immediate effect of muscle energy technique and improvement of hamstring flexibility: a comparison between two conditions after stretching of unexercised and eccentrically exercised human planter flexor muscles, Exp. Brain Res., 2009.


