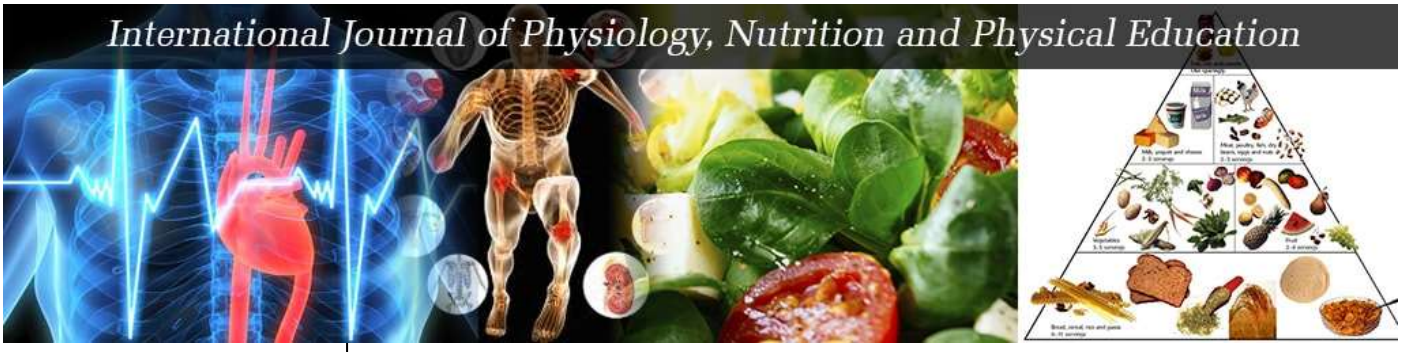

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The immediate effect of muscle energy technique versus doming of diaphragm of hamstring muscle in male cricketers with hamstring muscle tightness: A comparative study

Dr. Amit S Patel

Abstract
Background: Cricket is a sport which demands great strength and flexibility. Due to hamstring tightness strain may occur which is common nowadays. Poor posture, lack of flexibility, lack of warm up, dehydration, poor body biomechanics and poor training are major cause of this issue. Muscle energy technique and Doming of diaphragm are two techniques which were proven to improve the flexibility of the muscle on immediate basis.
Methods: A comparative study is being conducted on 104 subjects of professional cricketers of various academics of South Gujarat region divided into two group of 52 each for MET and DD. Subject were included on the basis of inclusion and exclusion criteria. Outcome measure of the study were Active knee extension test, lift and raise test, and sit and reach test.
Results: The study was done on 104 cricketers who completed the full protocol, of whom 52 underwent the Muscle Energy Technique and the balance 52 underwent the Doming of Diaphragm. The hamstring flexibility was measured by Active knee extension test, Lift and raise test, and Sit and reach test. All these tests were measured before and after the intervention. Pre and Post values were calculated to check the improvement in hamstring muscle flexibility. There was an improvement in hamstring flexibility in AKE, LRT and SRT tests in the MET group and DD group. When pre and post intervention was analyzed.
Conclusion: Among the two techniques, a comparison was made, and there was a higher improvement observed in Muscle Energy Technique.

Keywords: Professional cricketers, hamstring flexibility, MET, DD

Introduction
Cricket is the world's second-most popular spectator sport after football and has captivated people of every age, sex, background, and ability for more than 400 years. It is now being played in 105 member countries of the International Cricket Council [1]. Cricket requires a combination of physical fitness, skill, and strategy. It is surely a non- contact sport but, overuse and impact injuries are common since players engage in a wide range of physical activities, including running, throwing, batting, bowling, catching, and diving [5].
In addition, there are very different physical demands involved in different types of cricket, which has meant a cricketer need high performance. So, often the players need performance related skills which is important in cricket like flexibility, agility is needed in the infield [3].
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 Patellar tendinopathy and Patellofemoral pain, hamstring strain injury. They occur primarily during high speed or high intensity exercises and have a high rate of recurrence due to hamstring tightness. Poor posture, lack of flexibility, lack of stretching, dehydration, poor body biomechanics are the causes of muscle tightness [8].
In cricket, the repetitive twisting, extension and rotation of knee and hip joint at same time as absorption of large ground reaction forces over a short period of time.

These movements, if performed incorrectly or too frequently, can lead to many injuries every year, particularly in elite and high-level cricketers [5]. The most common injury was the hamstring strain (incidence 8.7%). The hamstring strain has emerged from being one of many common injuries in elite cricket a decade ago to being clearly the most common injury in the sport at the elite level. Other common injuries are abdominal strains (6.1%), wrist and hand fractures (4.7%), groin injuries (4.5%), lumbar stress fracture (4.0 %) shin foot and ankle injuries (3.2%), calf and quadriceps strains (2.9%), ankle sprains (2.7%) *et al*. [5]. Hamstring is a group of muscles located in posterior compartment of thigh. It consists of Biceps femoris, Semitendinosus and Semimembranosus [5]. Anatomically, the hamstring muscle is composed of two parts. The long head and the short head, is involved in knee flexion. Consequently, the hamstring has a biomechanical function in the complex movement of the hip, pelvic joint, and spine [9]. Being the antigravity muscle, hamstring muscle aid in maintaining body posture, holding position of pelvis and performing trunk movements in relation with lower extremity. The long nature of hamstring tendons leads to a greater "spring" effect that enhances athletic performance but increases injury risk [5].

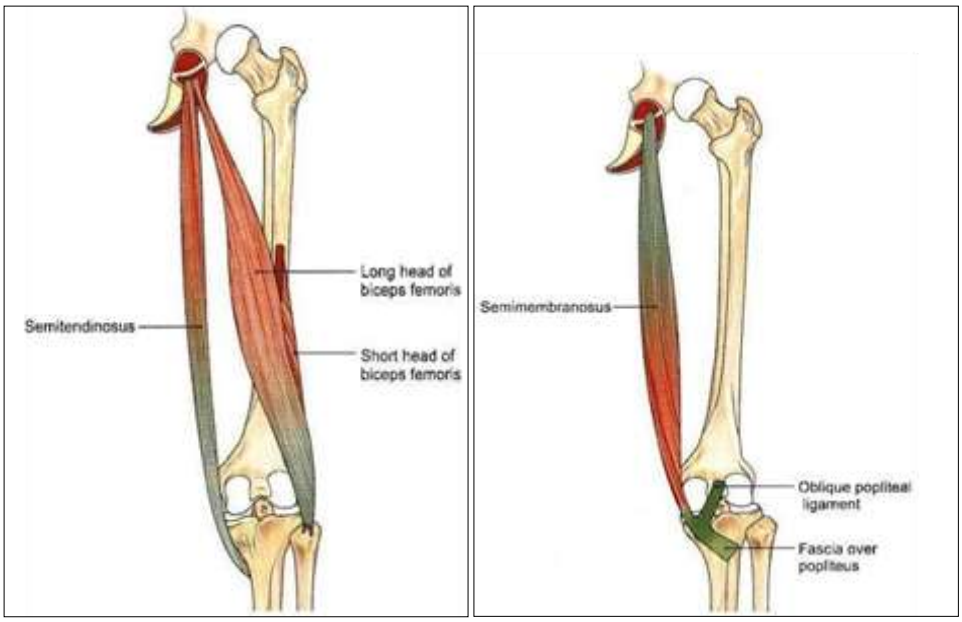


Fig 1: Hamstring muscle [7]

Uneven muscle strength, non-flexibility and overstretching caused during improper running form as primary causes leading to hamstring strain [3].

The risk factors for hamstring strains in cricketers includes. Muscle weakness (particularly the hamstrings or gluteal), muscle tightness (particularly the hamstrings, quadriceps and hip flexor muscles), inadequate conditioning of the hamstring muscles inappropriate training or technique excessive training or activity inadequate recovery periods from sport or activity, poor biomechanics, fatigue, inadequate warm up, poor core stability, inadequate rehabilitation following a previous hamstring strain, muscle imbalances [7].

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 of range of motion (ROM) can lead to injury and reduction in speed, agility, strength and endurance potential [8]. Through muscle flexibility, the body can prevent unnecessary energy expenditure during activity and increase the accuracy of movements, strength activity, and coordination to ensure the range of motion of muscles and joints [9].

In general, cold/thermal therapy, massage, electrotherapy, stretching, active release technique, myofascial release, and dynamic soft tissue mobilization or muscle energy technique (MET) have been applied to enhance muscle flexibility [9]. In this study following two techniques were used.

Muscle Energy Technique (MET)

The post isometric relaxation type of MET is one of the manual therapies using voluntary isometric contractions in a target muscle group and is mainly used in osteopathic medicine. It is a manual therapy approach commonly used to improve flexibility and range of motion in tight musculature [10].

Repeated applications of the MET have been shown to significantly improve hamstring flexibility in both athletic and non-athletic populations. This makes MET a valuable technique for clinical and therapist seeking to acutely increase hamstring range of motion in sports medicine setting, such as with cricketers [10].

Fig 2: MET Technique

Doming of diaphragm

The diaphragm being central muscle in the body is muscle with a trefoil-shaped tendon that blends superiorly with the fibrous pericardium. Kinetic-chain approaches are based on movement patterns; the body works as a dynamic unit rather than an isolated segments. Therefore, the biomechanical relationship between the diaphragm and other structures indicates that a diaphragm technique can have a repercussion in other distant structures such as hamstring muscle. The shortening of a muscle creates compensation in adjacent and also in distinct muscles [13].

The doming of the diaphragm technique involves using the abdominal muscles to pull the diaphragm superiorly, creating increased intra-abdominal pressure. This upward movement of the diaphragm is thought to have an indirect, but beneficial effect on the hamstring muscles. The diaphragm shares fascial connections with the psoas muscle, which connects to the femur. When the diaphragm domes superiorly, it creates a lengthening force that is transmitted through the fascial system to the hamstring musculature, facilitating their elongation [13]. This fascial force transmission is believed to override the stretch reflex of the hamstrings, allowing them to be lengthened more effectively than with traditional static stretching alone [13].

The doming of the diaphragm is a technique designed to relax the resting state of the diaphragm, enhancing its contraction and relaxation functions. It is designed to create a greater pressure gradient between the thorax and the abdomen, augmenting the expiration phase [13]. By improving hamstring flexibility in this manner, the doming of the diaphragm technique may help to acutely increase range of motion and reduce the risk of hamstring strains in athletes like cricketers [13].

Fig 3: Doming of Diaphargm

- **Methodology**
- **Study setting:** The Cricket Academies in South Gujarat region.
- **Study Population:** Professional Male Cricket Players.
- **Study Design:** A Comparative Study.
- **Study Duration:** 6 Months
- **Sample Design:** Convenient Sampling
- **Sample Size:** 104 Cricket Players [Time Bound]

Material Used

- A pen.
- A paper.
- A table.
- A 3600 Goniometer.
- A Measurement tape.
- A Mat.
- A Hurdle.
- Cloth Straps.
- Lift and Raise instrument.

- **Selection criteria**
- **Inclusion criteria**
- Professional male cricket players [6].
- Age group - 18-25 years [6].
- Active knee extension test than 20 degrees [16].
- Lift and raise test less than 20 degrees [17].
- Sit and Reach test distance more than 5 cm [19].
- Those who are willing to participate.

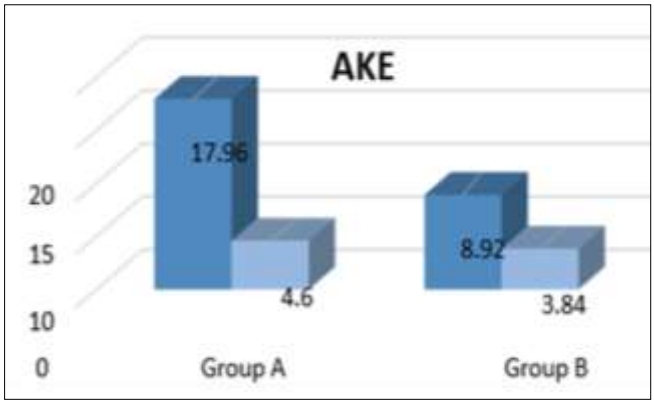
- **Exclusion Criteria**
- Any back injuries or surgeries in previous six years [6].
- Any respiratory illness [13].
- Acute and chronic hamstring strain injury [8].
- Any impaired sensation, bleeding disorders [8].
- Any neurological condition, malignancy or tumour [8].

Results

Table 1: Comparison of AKE test between group A and group B

AKE TEST			
Column 1	**Group A**	**Group B**	**Difference**
Mean	17.96	8.92	9.04
SD	4.6	3.83	0.23

Table 1, The AKE test scores were compared between Group A and Group B. Group A had a mean score of 17.96 with a standard deviation of 4.6, while Group B had a mean score of 8.92 with a standard deviation of 3.83.



Graph 1: Comparison of AKE test between group A and group B

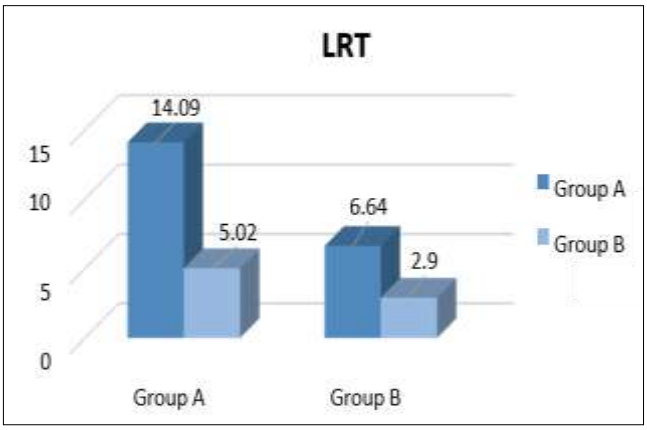
Graph 1, comparison between Group A and Group B was conducted based on their AKE test scores. Group A exhibited an average score of 17.96, accompanied by a standard deviation of 4.6, whereas Group B showed a mean score of 8.92, with a standard deviation of 3.83

Table 2: Comparison of LRT test between group A and group B

LRT Test		
Column1	**Group A**	**Group B**
Mean	14.09	6.64
SD	5.02	2.9

Table 2, the LRT test scores were analysed for both Group A and Group B. Group A had a mean score of 14.09, with a standard deviation of 5.02, while Group B had a mean score

of 6.64, with a standard deviation of 2.9.



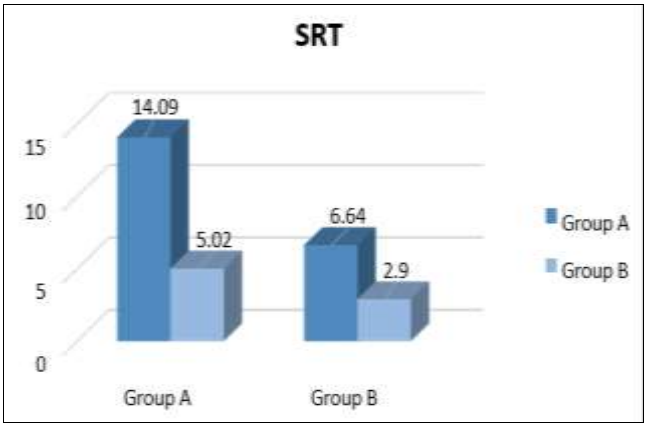
Graph 2: Comparison of LRT test between group A and group B

Graph 2, the performance on the LRT test was compared between Group A and Group B. Group A achieved an average score of 14.09, with a standard deviation of 5.02, whereas Group B obtained a mean score of 6.64, with a standard deviation of 2.9

Table 3: Comparison of SRT test between group A and group B

SRT Test		
Column 1	**Group A**	**Group B**
Mean	14.1	6.47
SD	0.22	0.99

Table 3, in the SRT test, the performance of participants in Group A and Group B was examined. Group A demonstrated a mean score of 14.1, with a standard deviation of 0.22, while Group B displayed a mean score of 6.47, with a standard deviation of 0.99.



Graph 3: Comparison of SRT test between group A and group B

Graph 3, in the SRT assessment, the proficiency of individuals in both Group A and Group B was assessed. Group A exhibited an average score of 14.1, with a standard deviation of 0.22, whereas Group B showcased a mean score of 6.47, with a standard deviation of 0.99.

Discussion

Cricket, the world's second most popular spectator sport, necessitates a combination of physical fitness, talent, and strategic thinking. Lower limb injuries, among which are hamstring strains and tear, are common in cricket and usually occur during high-speed or high-intensity exercises. With an incidence of 8.7%, hamstring strains are the most frequent injury in cricket. The hamstring muscle, which is found in the thigh's posterior compartment, is essential for knee flexion and maintaining proper posture. Muscle weakness, tightness, inadequate conditioning, inappropriate training, excessive training, insufficient recovery periods, poor biomechanics, fatigue, insufficient warm-up, poor core stability, insufficient rehabilitation after a previous hamstring strain, and muscle imbalances are all risk factors for hamstring strain.

The present study aimed to find out the immediate effect of muscle energy technique of hamstring muscle versus Doming of diaphragm in male cricketers with hamstring muscle tightness in South Gujarat Region. Subject were included based on inclusion and exclusion criteria.

The study has included cricketers of various academies of South Gujarat Region.

Cricketers were having experience of more than 2 years of professional cricket.

The Demographic characteristics of the subjects include Name, Age, Academy name, medical/surgical history, dominance. The Active Knee Extension test, Lift and Raise test and Sit and Reach test were used to find out hamstring tightness respectively.

The main intention of the study was to evaluate the effectiveness of Muscle energy technique of hamstring muscle versus Doming of diaphragm in male cricketers with hamstring muscle tightness in South Gujarat Region.

According to this study done on 104 cricketers, of whom 52 underwent the Muscle Energy Technique and the balance 52 underwent the Doming of Diaphragm. The hamstring flexibility was measured by Active Extension test, Lift and Raise test, and Sit and Reach test. Pre and Post values were calculated to check the improvement in hamstring muscle flexibility. There was an improvement in hamstring flexibility of in AKE, LRT and SRT tests respectively, in the MET group and DD group. When pre and post intervention was analyzed. Among the two techniques, a comparison was made, and there was a higher improvement observed in Muscle Energy Technique.

In this study, after analyzing the results of the Muscle Energy Technique (MET) and Doming of diaphragm (DD), it was found that the outcomes favored MET. These findings closely align with those of Dr. Riddhi Rathod and Dr. Paryushi Rami in 2020, whose study focused on comparing the effects of MET and DD on hamstring flexibility in 60 cricketers aged 13-19. The participants were divided into three groups: Group A received MET, Group B received Dynamic Stretching, and Group C served as the control. The results indicated that MET significantly improved hamstring flexibility among cricketers, which corroborates our findings.

Another study by Sejal Sailor and Yesha Mehta in 2018 aimed to compare the effectiveness of MET and Positional Release Technique (PRT) on hamstring flexibility in healthy individuals. Twenty-four participants meeting the inclusion criteria were randomly assigned to MET and PRT groups. The study revealed that MET produced better improvement compared to PRT, as evidenced by a higher mean difference between pre- and post-treatment data. These results further support our research findings.

The research conducted by Marie Carmen Valenza, Irene Cabrera-Martos, *et al*. in 2015 focused on the effectiveness of diaphragm doming in reducing hamstring muscle tightness. Thirty participants underwent diaphragm doming, leading to significant improvements in flexibility, similar to our study's outcomes. This study strongly reinforces the notion that diaphragm doming enhances hamstring flexibility.

Furthermore, a study by Débora Fortes Marizeiro, *et al*. in 2017 explored the immediate effects of diaphragm doming on physical and functional outcomes in sedentary women, involving a sample size of 75. The findings indicated that diaphragm doming techniques improve flexibility in the posterior chain muscles, mirroring the results obtained in our study.

These finding tells us the importance of MET and DD to understanding of hamstring flexibility, the importance of hamstring flexibility across different parameters such as age, gender, work load, experience, diet, hydration, warm up, cool down and biomechanics of the athlete provide valuable insights for injury prevention strategies and detailed intervention to improve rehabilitation and to prevent hamstring injury and to optimize overall performance in professional cricketer community.

Conclusion

The comparative study among professional cricketers found that MET yielded greater effectiveness compared to DD, as indicated by the data analysis.

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