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Research Article

"A Study on the Comparative Effectiveness of Muscle Energy Technique and Instrument-Assisted Soft Tissue Mobilization for Hamstring Tightness in Student Populations"

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Abstract
Background: Flexibility is a crucial attribute achievable through various techniques, with the hamstring muscle group commonly presenting issues of shortening. This study aims to assess the effectiveness of muscle energy technique in comparison to instrument-assisted soft tissue mobilization among students experiencing hamstring tightness.
Materials and Methods: Thirty male and female subjects with hamstring tightness were randomly assigned to two groups. Group A received muscle energy technique, while Group B underwent instrument-assisted soft tissue mobilization. The treatment protocol spanned two weeks, with sessions conducted thrice weekly. The primary outcome was evaluated using the active knee extension test, with baseline and post-intervention measurements recorded.
Results: Both muscle energy technique and instrument-assisted soft tissue mobilization demonstrated significant improvements in hamstring extensibility. However, the enhancement observed in instrument-assisted soft tissue mobilization was notably more significant ($p > 0.01$) than that in the muscle energy technique group ($p > 0.107$).
Conclusion: This study concludes that both muscle energy technique and instrument-assisted soft tissue mobilization effectively enhance hamstring flexibility in healthy young adults.

Keywords: IASTM, MET, Soft tissue mobilization, hamstring Tightness, Physiotherapy

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Introduction

Flexibility is widely recognized as a crucial component of overall fitness, playing a pivotal role in maintaining normal biomechanical function within the body. It is essential for various musculoskeletal functions, influencing an individual's capacity to move effortlessly [1]. Hamstrings, positioned in the posterior compartment of the thigh, are categorized as bi-articular muscles due to their connection to two joints, namely the hip and knee. Comprising the semitendinosus, semimembranosus, and the long and short heads of the biceps femoris, the hamstrings play a vital role in maintaining posture and facilitating movement [2].

The prevalence of hamstring tightness is often attributed to prolonged sitting, causing the muscles to contract and increase tension actively or passively. Active causes include muscle spasms or contractions, while passive causes are associated with poor posture or postural adaptations [3]. Hamstring tightness, defined when the knee extension angle exceeds 20 degrees, can lead to various musculoskeletal conditions. It restricts anterior pelvic tilt, contributing to decreased lumbar lordosis and influencing the lumbo-pelvic rhythm. Studies have indicated a positive correlation between hamstring tightness and low back pain, making it a significant factor in movement dysfunction affecting the lumbar, pelvic, and lower limb regions [4].

Measuring hamstring tightness traditionally involves tests such as the active knee extension test and passive unilateral straight leg raise (SLR) test, with the former being considered more reliable. These assessments serve as gold standard tests for evaluating tightness and are integral in understanding the associated musculoskeletal conditions [5].

Various interventions have been explored to address hamstring tightness, and their success depends on both clinical and experimental contexts. Treatment selection often hinges on the therapist's specialization in hamstring lengthening techniques.[6]

One such technique is Muscle Energy Technique (MET), which has its roots in osteopathic procedures pioneered by practitioners like T.J. Ruddy (1961). Evolving from the concept of 'resistive duction,' MET was further developed by osteopathic physicians Fred Mitchell Sr. and Fred Mitchell Jr. MET involves manual treatment where the subject contracts the muscle in a controlled position and direction, with the therapist applying counterforce. [7]

This method, rooted in neurophysiology, aims to relax overactive muscles by incorporating manually applied stretching techniques. The principle underlying MET emphasizes the importance of relaxing or inhibiting neuromuscular components before attempting a stretch [8]

This paper delves into a comparative analysis of the effectiveness of MET and another intervention, Instrument-Assisted Soft Tissue Mobilization (IASTM), in addressing hamstring tightness among student populations.[9]

Different Terms in MET:

1. Isometric Contraction: Isometric contraction involves moving a muscle, group of muscles, joint, or body region in a specified direction where the participant's effort matches that of the therapist. During this movement, no visible change in muscle length occurs.

2. Isotonic Contraction: Isotonic contraction allows movement during muscle contraction, with the therapist applying counterforce either less or greater than the patient's effort. This contraction results in the approximation of the muscle's origin and insertion and can have a tonic effect, known as concentric isotonic contraction, enhancing muscle strength, particularly beneficial for weakened musculature.

3. Isolytic Contraction: Isolytic contraction, a type of isotonic contraction, involves eccentric movement where the muscle is stretched during contraction. The therapist applies a greater counterforce to the shortened muscle rapidly. This technique is useful in cases with marked fibrotic changes, aiming to stretch and alter the tissue, controlling microtrauma for improved elasticity and circulation. [10]

MET Principles:

- **Post-Isometric Relaxation:**

• Indications: Over restricted joints, before manipulation, acute muscle spasms.

• Isometric contraction is applied to the affected muscle, with the therapist applying counterforce (20-30% of patient strength) for 7-10 seconds. The muscle is then relaxed, and the process is repeated 3-5 times.

• **Reciprocal Inhibition:**

• The therapist applies force to the antagonist muscle during controlled movement. The patient resists, applying force back to the therapist (20-30% of patient strength). This technique is repeated for 3-5 times with a 7-10 second hold. [11]

When to Apply MET:

• Shortened musculature due to joint restriction.
• Areas with myofascial trigger points or palpable fibrosis.
• Tight muscles requiring stretching.
• Cases of muscle imbalance to reduce hypertonicity.

Various studies suggest that MET immediately increases knee extension in individuals with hamstring tightness. [12]

IASTM: Instrument-Assisted Soft Tissue Mobilization (IASTM) is a manual therapy concept based on James Cyriax's rationale. It utilizes specially designed instruments for soft tissue mobilization, rapidly gaining popularity due to its effectiveness. IASTM improves range of motion, removes muscle scarring, and reduces pain caused by muscular tightness.

IASTM promotes connective tissue remodeling by releasing adhesions, eliciting local inflammatory responses, and impacting local circulation and temperature. Standard guidelines for best practice include proper hygiene protocols for both therapists and instruments. According to CDC, IASTM falls into the non-critical item group.[13]

Hygienic Protocol for IASTM:

1. Handwashing before and after treatment, with therapists wearing appropriate PPE.
2. Patient's skin cleaned with a low-level sanitizer before treatment.
3. IASTM tool delivered with lubricant and PPE procedures.
4. Monitoring changes in the skin, such as color, during treatment.
5. Post-treatment cleansing of the region with sanitizer.
6. Post-treatment, therapists follow hand hygiene, instrument cleansing, and PPE removal.[13]

Individual studies suggest that both MET and IASTM decrease hamstring tightness and improve flexibility. The study aims to compare the effects of MET and IASTM in improving hamstring flexibility by reducing tightness in individuals with hamstring tightness.[14]

While various studies have explored the effectiveness of Muscle Energy Technique (MET) and Instrument-Assisted Soft Tissue Mobilization (IASTM) in addressing hamstring tightness and improving flexibility, there exists a notable research gap that necessitates further investigation. The current literature lacks a direct and comprehensive comparison between MET and IASTM in terms of their impact on hamstring flexibility in individuals with hamstring tightness.[15]

While individual studies have independently highlighted the positive effects of both MET and IASTM on hamstring flexibility, a comparative analysis is essential to discern the nuances and potential advantages of one technique over the other. Additionally, the existing body of research primarily focuses on the immediate effects of these interventions, leaving room for a deeper understanding of their long-term efficacy and sustainability.[16]

Moreover, the studies available often lack standardized protocols for the application of MET and IASTM, making it challenging to draw conclusive insights into the comparative effectiveness of these interventions. A research gap exists in establishing a standardized approach for implementing MET and IASTM, considering factors such as treatment duration, frequency, and specific techniques employed.[17]

Furthermore, the current literature primarily emphasizes the physiological outcomes of these interventions, with limited attention given to patient preferences, adherence, and the overall patient experience. A holistic understanding of the impact of MET and IASTM should encompass not only biomechanical changes but also patient-reported outcomes and preferences.[18]

In summary, there is a clear research gap in the comparative analysis of MET and IASTM concerning their efficacy, long-term effects, and standardized application protocols in addressing hamstring tightness among individuals. Additionally, a more comprehensive investigation that considers both physiological and patient-centred outcomes is essential for guiding evidence-based clinical practices and optimizing rehabilitation strategies for individuals with hamstring tightness.[19]

The Primary Aims was to camper the immediate effects of Muscle Energy technique and Instrument-Assisted Soft Tissue Mobilisation on hamstring flexibility in individuals with hamstring tightness. [20]

Secondary Aim was to Assess long-term effect and established standardised protocol for considering factors such as treatment duration, Frequency, and specific Techniques. And was to Investigate Patient-Cantered Outcomes including preferences, adherence, and overall patient experience, following MET and IASTM interventions.[21]

The objectives of the study were Comparative Analysis of Immediate Effects Conduct a direct comparison of the immediate effects of MET and IASTM on hamstring flexibility, utilizing measurements such as active knee extension and other relevant clinical assessments.

Methodology

This study employs a comparative research design to investigate the effectiveness of two therapeutic interventions—Muscle Energy Technique (MET) and Instrument-Assisted Soft Tissue Mobilization (IASTM)—in alleviating hamstring tightness among students. The study is set within a student population, utilizing a convenient sampling method to select 30 participants aged 18 to 25 years, encompassing both genders, experiencing hamstring tightness. The research unfolds over a two-week period, during which participants are randomly assigned to either the MET or IASTM intervention group. Ethical considerations include obtaining informed consent and ensuring the confidentiality and privacy of participants.

The intervention protocol involves treatment sessions three times a week for both groups, adhering to standardized protocols. The primary outcome measure is hamstring flexibility, assessed through the active knee extension test, with measurements recorded at baseline and post-intervention. Data analysis encompasses descriptive statistics for participant characteristics and inferential statistics, such as t-tests or Mann-Whitney U tests, to compare the efficacy of MET and IASTM. A significance level of 0.05 is set to determine statistical significance.

Inclusion Criteria:

This study includes both male and female participants who are students at NIMS University, aged between 18 and 25 years. The specific focus is on individuals exhibiting hamstring tightness, defined as a decrease in knee extension of 15 degrees when the hip is held in 90 degrees of flexion. By targeting this age group within the university context, the study aims to explore the effectiveness of interventions for hamstring tightness in a relevant and representative population.

Exclusion Criteria:

Individuals with certain conditions are excluded from participation in this study. Exclusion criteria encompass those experiencing acute or chronic low back pain, individuals with a history of acute or chronic hamstring injuries, those with recent fractures, and individuals with soft tissue injuries around the knee. These exclusion criteria are implemented to ensure a more homogeneous study population and to mitigate potential confounding factors that could impact the outcomes related to hamstring tightness.

Outcome Measure: Active Knee Extension Test

The Active Knee Extension Test serves as a pivotal outcome measure in assessing hamstring tightness within the study. During this evaluation, the subject assumes a supine position on the examination table with both lower extremities fully extended. [22] Palpation is performed on the anterior superior iliac spine, and the vertical bar of the assessment apparatus is aligned accordingly. The participant is then instructed to flex the hip until the thigh makes contact with the horizontal bar. While maintaining this contact, the participant is directed to extend the knee as much as possible, with the foot positioned neutrally, holding the extended position for a duration of 5 seconds.[23]

The measurement process involves the use of a standard universal goniometer. The fulcrum is placed over the lateral epicondyle, the movable arm is aligned parallel to the leg and points toward the lateral malleolus, and the stationary arm is parallel to the thigh, pointing toward the greater trochanter. [24]

This test is conducted three times, and the mean angle of the three trials is calculated for subsequent analysis. The resulting angle represents the degree of knee flexion from terminal knee extension, providing a quantitative measure of hamstring flexibility and, by extension, the effectiveness of interventions such as Muscle Energy Technique and Instrument-Assisted Soft Tissue Mobilization.[25]

Procedure:

The participant selection process commenced with the identification of students within the age range of 18 to 25 years from the NIMS University physiotherapy department. Initial assessments were conducted based on predefined inclusion and exclusion criteria. A comprehensive explanation of the nature and purpose of the study was provided to potential participants. Subsequently, participants expressed their understanding and willingness to partake in the study by signing the informed consent form.

Thirty students from the NIMS University physiotherapy department were then purposively selected and divided into two groups: Group A (N=15) received Muscle Energy Technique (MET), while Group B (N=15) underwent Instrument-Assisted Soft Tissue Mobilization (IASTM).

The assessment of hamstring tightness was carried out using the Active Knee Extension Test, and the length of the hamstring muscle was evaluated through the Passive Unilateral Straight Leg Raise (SLR) Test. Participants were briefed on the study procedures.

Following the pre-test measurements, the intervention phase commenced. The training sessions for each group were detailed as follows:

Group A (MET): Participants in this group underwent Muscle Energy Technique sessions.

Group B (IASTM): Participants in this group received sessions involving Instrument-Assisted Soft Tissue Mobilization.

Throughout the training sessions, ongoing assessments and measurements were conducted to monitor changes in hamstring tightness and length. The procedural details are further outlined in Table 1.1.

This structured procedure ensures a systematic and ethical approach to participant selection, informed consent, and the administration of interventions, facilitating a robust examination of the comparative effectiveness of Muscle Energy Technique and Instrument-Assisted Soft Tissue Mobilization on hamstring tightness among the selected student population.

Table 1: Muscle Energy Technique (MET) Protocol

Group A: MET Protocol	
Duration of MET Session:	6 sessions
Frequency:	3 sessions per week
Total Duration:	2 weeks
Duration of One MET Session:	2 minutes

Table 2: Instrument Assisted Soft Tissue Mobilization (IASTM) Protocol

Group B: IASTM Protocol	
Duration of IASTM Session:	6 sessions
Frequency:	3 sessions per week
Total Duration:	2 weeks
Duration of One IASTM Session:	2 minutes

These tables outline the detailed protocols for both Group A (Muscle Energy Technique) and Group B (Instrument Assisted Soft Tissue Mobilization) interventions. The sessions are conducted over a span of 2 weeks, with a frequency of 3 sessions per week for each group. Each session, whether MET or IASTM, has a duration of 2 minutes. This structured protocol ensures consistency in the application of interventions and facilitates a systematic comparison of their effectiveness in addressing hamstring tightness among the study participants.

Table No 3

S. No	Treatment	Patient Position	Procedure	Dosages
1	Muscle Energy Technique	Supine lying	The therapist flexes the hip up to 90 degrees and then extends the knee. The posterior part of the leg rests on the therapist's shoulder, and the subject performs knee extension while applying downward pressure against the shoulder with the back of the lower leg. Simultaneously, the therapist resists the pressure, causing an isometric contraction of the hamstring.	Repetition - 5 times
2	Instrument-Assisted Soft Tissue Mobilization	Prone Lying	The therapist instructs the patient to lie down in a prone position. Application of emollient over the posterior aspect of the thigh is done to reduce friction between the skin and the tool. The IASTM is applied in the longitudinal vertical direction from top to bottom and then reversed from bottom to top, based on the direction and shape of the hamstring muscle fibers.	Duration - 2 mins

Figure 1 Muscle Energy

Figure 2- Muscle Energy

Figure 3- Application of

Figure 4 The Emollient

Figure 5 The Emollient

Data Analysis:
Due to the unequal distribution of the data, non-parametric tests of comparison were employed in the analysis. Nonparametric within-group tests were conducted to compare all parameters, utilizing the paired sample t-test. A statistical significance level was set at a p-value of < 0.05. The data analysis was executed using SPSS version 24, ensuring robust statistical evaluation and interpretation of the outcomes. This approach was chosen to appropriately handle the specific characteristics of the dataset and derive meaningful insights from the study results.

Result
Participant's Flow Chart: A total of 120 students from NIMS College of Physiotherapy and Occupational Therapy were initially screened. Ultimately, 30 students met the inclusion criteria and were included in the study.

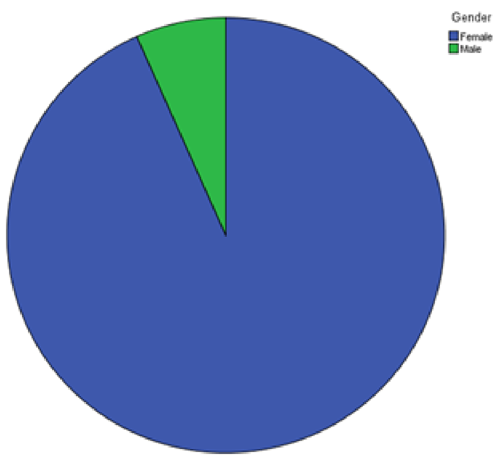
Demographic Characteristics of Participants: Participants were recruited based on age and gender, without specific selection criteria related to health conditions. The distribution of participants according to hamstring tightness and gender is presented in the following table.

Table No 4

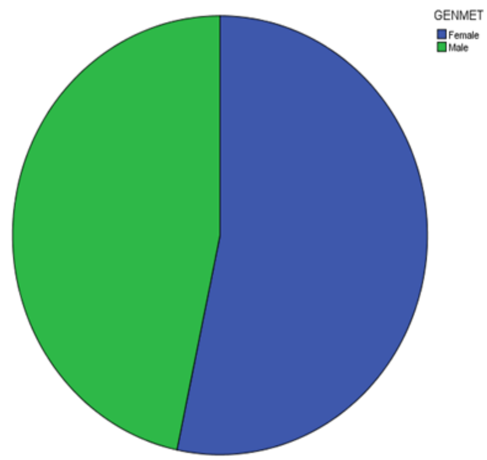
Demographic Characteristic	Participants	Male	Female
Hamstring Tightness	30	8	22

This table 4 outlines the demographic characteristics of the study participants, categorizing them based on hamstring tightness and gender. Among the 30 participants, 8 were male, and 22 were female. The following analyses focus on the effectiveness of interventions on hamstring tightness in this diverse participant group.

PARTICIPANTS CHARETERISTICS



Gender wise distribution in MET Fig 5



Gender wise distribution in IASTM **Fig 6**

Mean Age of Participants by Intervention

Table No 5

Intervention	Age (Years) Mean ± SD
Muscle Energy Technique	21.73 ± 2.21
Instrument Assisted Soft Tissue Mobilization	22.66 ± 2.16

Interpretation:
The table 5 presents the mean age of participants stratified by the intervention they received. Participants in the Muscle Energy Technique (MET) group had a mean age of 21.73 years with a standard deviation of 2.21, while those in the Instrument Assisted Soft Tissue Mobilization (IASTM) group had a slightly higher mean age of 22.66 years with a standard deviation of 2.16.

The minimal difference in mean ages between the two intervention groups suggests that the study achieved comparable age distribution, contributing to the validity of the subsequent analyses. The narrow standard deviations indicate relatively homogeneous age groups within each intervention, enhancing the precision of age-related comparisons during the study.

Paired Samples Statistics for Active Knee Extension (AKE) and Muscle Energy Technique (MET) Groups

Table No 6

Pair	Measurement	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AKE Pre	13.3333	15	4.70056	1.21368
	AKE Post	35.9333	15	7.86009	2.02947
Pair 2	MET AKE Pre	13.0667	15	2.60403	0.67236
	MET AKE Post	23.4667	15	2.69568	0.69602

Interpretation:
The table6 provides paired samples statistics for two different measurements—Active Knee Extension (AKE) and Muscle Energy Technique (MET) groups. Here's an interpretation of the data.

Table 7 Correlation Analysis for Active Knee Extension (AKE) and Muscle Energy Technique (MET) Groups

Pair	Measurement Pair	N	Correlation	Sig.
Pair 1	AKE Pre & AKE Post	15	0.786	0.001
Pair 2	MET AKE Pre & MET AKE Post	15	0.433	0.107

Interpretation: table 7
These correlation results provide insights into the associations between pre and post-intervention measurements in both the AKE and MET groups, contributing to the understanding of the relationship between the variables under investigation.

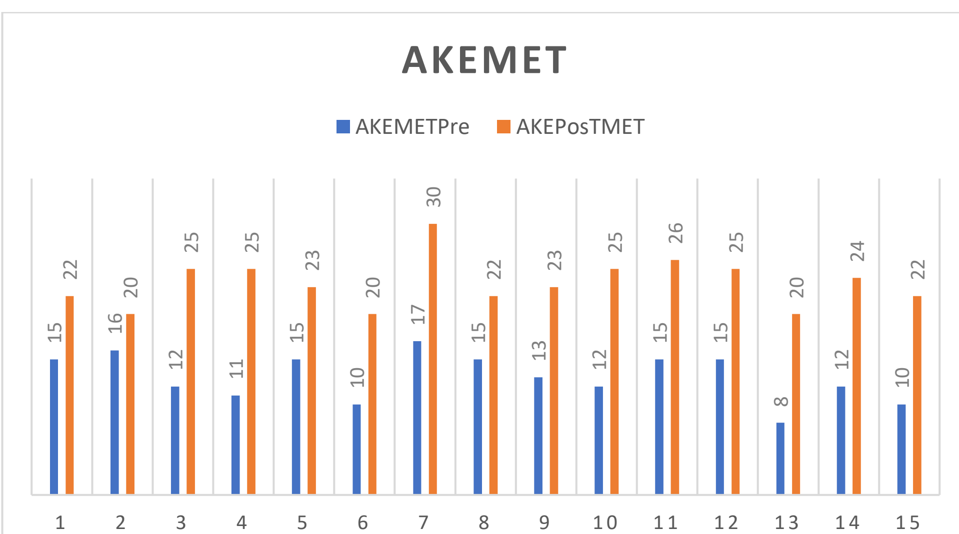
Paired Samples T-Test for Active Knee Extension (AKE) and Muscle Energy Technique (MET) Groups

Table No 8

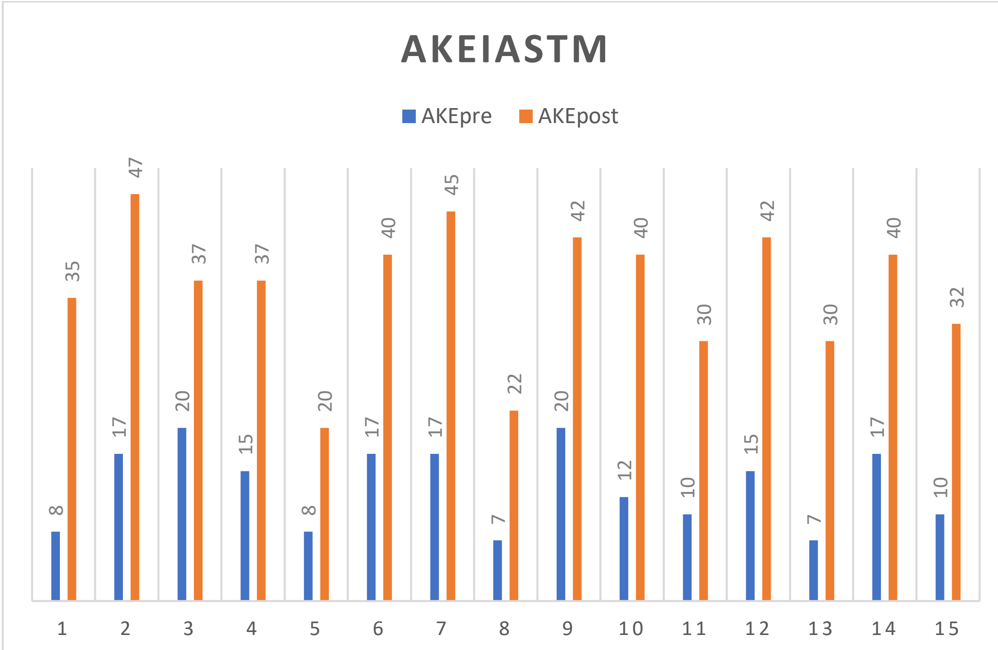
Pair	Measurement Pair	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	T	df	Sig. (2-tailed)
Pair 1	AKE Pre–AKE Post	-22.600	5.08218	1.31221	Lower: -25.41442, Upper: -19.78558	-17.223	14	0.000
Pair 2	MET AKE Pre–MET AKE Post	-10.400	2.82337	0.72899	Lower: -11.96353, Upper: -8.83647	-14.266	14	0.000

Interpretation:
The table 8 presents the results of the paired samples t-test for two different measurement pairs-Active Knee Extension (AKE) and Muscle Energy Technique (MET) groups. The highly significant p-value (0.000) indicates a significant difference between MET AKE measurements before and after the intervention. The negative mean difference (-10.400) implies an improvement in AKE measurements following the MET intervention.These results affirm the effectiveness of both interventions in enhancing hamstring flexibility, as evidenced by significant differences in AKE measurements before and after the respective interventions.In this study, SPSS version 24 was employed, and the Active Knee Extension test served as the primary outcome measure. Descriptive statistics, including mean and standard deviation, were calculated to characterize the variables. The paired t-test was utilized to assess the differences between the Muscle Energy Technique and Instrument Assisted Soft Tissue Mobilization groups. The statistical analyses were performed at a 95% confidence level, with a significance level set at $p < 0.05$ to establish statistical significance.

Physical characteristics such as age and height for both intervention groups were summarized in Table 1. The results indicated no significant differences between the groups at the study's outset ($p > 0.05$), ensuring a comparable baseline.Table 2 presents the mean changes in knee range of motion at baseline and post-intervention for both groups. Prior to intervention, there were no significant differences in baseline measurements of knee range of motion between the two groups ($p > 0.05$).Both groups exhibited significant improvements post-intervention. However, the comparison revealed that the improvement in Instrument Assisted Soft Tissue Mobilization was statistically superior ($p = 0.01$) compared to Muscle Energy Technique ($p = 0.107$). This suggests that Instrument Assisted Soft Tissue Mobilization may be more effective in enhancing knee range of motion compared to Muscle Energy Technique.
These findings provide valuable insights into the effectiveness of the interventions and underscore the significance of considering specific techniques in rehabilitation protocols for optimizing outcomes in hamstring flexibility.



The above graph shows significant difference between pre and post active knee extension in MET group**. Fig 6**



The above graph shows significant difference between pre and post AKE test in IASTM group. **Fig 7**

Discussion:

The study findings highlight the superior impact of Instrument Assisted Soft Tissue Mobilization (IASTM) on hamstring tightness compared to Muscle Energy Technique (MET) within this specific age group. Hamstring muscles, integral in various sports and athletic activities, are susceptible to injuries. Optimal hamstring flexibility not only reduces the risk of strains but also enhances overall performance. [9] The study's objective was to analyze the effectiveness of MET compared to IASTM among a student population.

Prior research has consistently reported that both MET and IASTM interventions lead to improvements in hamstring extensibility and increased range of motion. In alignment with these findings, the current study demonstrated that both MET (Group A) and IASTM (Group B) significantly improved hamstring flexibility, as evidenced by the active knee extension test measurements.[8,9]

The active knee extension test, conducted using a universal goniometer, served as a reliable measure of hamstring tightness. This method aligns with previous studies, emphasizing its significant inter-rater and intra-rater reliability in assessing hamstring muscle flexibility.[20]

Group A, receiving MET, exhibited a noteworthy change in active knee extension range of motion (ROM) with a p-value of 0.00. This aligns with existing literature, such as Prasad Naik et al.'s conclusion that MET enhances hamstring muscle extensibility over both short and long-term durations. The improvement in active knee extension ROM following MET can be attributed to factors like viscoelastic properties, thirotropic, and neural properties.[22]

The viscoelastic properties of the musculotendinous junction, operating in a viscoelastic manner, contribute to creep and stress relaxation. MET induces a strong contraction against an equal counterforce, activating the Golgi tendon organ and initiating a post-isometric relaxation. This process, involving inhibitory motor neurons, leads to a reduction in muscle tone, resulting in lengthening and relaxation of the agonist muscle.[10]

Comparisons with other studies further support the effectiveness of MET in improving hamstring flexibility. Adel Rashed Ahmed found MET to be superior to dynamic stretching, while Ewan Thomas et al. [18] concluded that MET improves pain and range of motion in both symptomatic and asymptomatic subjects. Sejal Sailor and colleagues suggested that MET is more effective than positional release technique for hamstring tightness in healthy individuals.

However, the current study also revealed that when comparing the two groups, IASTM demonstrated a more significant improvement in hamstring muscle extensibility and knee extension ROM. The mechanism behind this improvement involves the breakdown and release of scar tissue, fascial restriction, and adhesions. IASTM, by increasing skin temperature, altering chronic muscle holding patterns, and modifying spinal reflex activity, promotes enhanced blood flow and cellular activity in the treated area.[17]

Research by Matthew Lambert and Alisha Noreen supports the effectiveness of IASTM, with evidence indicating reduced pain and improved function. Additionally, studies comparing IASTM with other techniques, such as the Graston technique and PNF stretching, have shown significant improvements in hamstring muscle extensibility.[19,20]

The present study underscores the potential of IASTM in reducing therapist effort while improving treatment accuracy. Immediate effects observed in studies emphasize IASTM's capacity to enhance hamstring muscle extensibility in terms of knee extension ROM. Overall, the findings suggest that IASTM, with its physiological impact on skin temperature, reflex activity, and cellular responses, stands out as a promising intervention for addressing hamstring tightness and improving flexibility in the student population.

Conclusion:

In conclusion, this study affirms that both Muscle Energy Technique (MET) and Instrument Assisted Soft Tissue Mobilization (IASTM) are effective in enhancing hamstring muscle extensibility. Notably, Instrument Assisted Soft Tissue Mobilization demonstrated superior improvements when compared to Muscle Energy Technique. The utilization of the IASTM tool emerged as a significant contributor to enhanced hamstring muscle extensibility, suggesting its practical application in clinical settings for optimal results. The findings underscore the potential of IASTM as a valuable technique for addressing and improving hamstring muscle flexibility.

Strengths of the Study:

This study builds upon previous one-day investigations by extending the research duration to two weeks, allowing for a more comprehensive understanding of the comparative effectiveness between Muscle Energy Technique (MET) and Instrument Assisted Soft Tissue Mobilization (IASTM). The inclusion of a specific age group adds depth to the findings, contributing to a more nuanced understanding of how these techniques operate within a targeted demographic. Moreover, the use of the "Myoblaster" IASTM tool, less commonly employed in prior studies, enriches the existing literature by introducing a novel element to the comparative analysis.

Limitations of the Study:

While the study contributes valuable insights, it is essential to acknowledge its limitations. The reliance on a single outcome measure, active knee extension range of motion (ROM), may provide a focused perspective but may not capture the full spectrum of potential effects. Additionally, the uneven distribution of male and female participants introduces a gender-related bias that should be considered in the interpretation of the results.

Future Recommendations:

To enhance the robustness of future studies, several recommendations can be considered

Future studies could benefit from a larger sample size to strengthen the generalizability of the findings. The authors will be conducting long-term follow-ups could offer insights into the sustainability of the observed effects over an extended period. We can Expand the study to include diverse populations may uncover variations in response to MET and IASTM across different demographic groups. Also, we can **Include Quadriceps Strength Analysis** While the current study focused on tightness, future investigations could explore the impact of these techniques on the strength of the quadriceps muscles, providing a more comprehensive assessment of lower limb function.

Author's Contribution

SS and NV jointly conceived and developed the research idea, methodology, and study design. NV supervised data collection, with SS and VN contributing actively. NV conducted data analysis, with PR interpreting findings. SS refined the manuscript, while NV handled review and editing. All authors approved the final manuscript, ensuring its accuracy and integrity.

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Conflict of interest: none

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