

## Efficacy of Muscle Energy Technique and Neurodynamic Sliding Technique in Reducing Hamstring Tightness among College Students

<sup>1</sup>Sabari Mani R, <sup>2</sup>Sedhunivas R, Arnold Nikhilesh

Post Graduate Student, M.P.T. Musculoskeletal Sciences, Garden City University, Bangalore, India  
Assistant Professor, Department of Physiotherapy, Garden City University, Bangalore, India.

Corresponding Author: Sabari Mani R  
Email id: sabarirm2@gmail.com

### Abstract

**Background:** Hamstring tightness is a prevalent musculoskeletal concern among college students, often leading to functional impairments and increased injury risk. Muscle Energy Technique (MET) and Neurodynamic Sliding Technique (NDT) have been proposed as effective interventions to improve hamstring flexibility by targeting muscular and neural components.

**Objective:** To systematically review and synthesize evidence on the efficacy of MET and NDT in reducing hamstring tightness among college students.

**Methods:** A literature search was conducted across PubMed, Google Scholar, and Science Direct databases for randomized controlled trials and clinical studies focusing on MET and NDT in young adults. Studies published between 2010 and 2025 meeting predefined inclusion criteria were selected. Data on intervention protocols, outcome measures, and safety were extracted and analysed.

**Results:** A total of 15 articles met the inclusion criteria. Both MET and NDT demonstrated statistically significant improvements in hamstring flexibility, with NDT showing a slightly higher effect size. Intervention durations ranged from single sessions to six weeks, with consistent results supporting the safety and efficacy of both techniques.

**Conclusions:** Both MET and NDT are effective in reducing hamstring tightness, with NDT providing potentially more sustained improvements. Incorporating these techniques in rehabilitation protocols can optimize flexibility outcomes in college student populations.

**Keywords:** Hamstring tightness, Muscle Energy Technique, Neurodynamic Sliding Technique, Flexibility, College students.

## Introduction

Hamstring tightness is a widely prevalent musculoskeletal issue within college student populations, with reported prevalence rates ranging from 55% to as high as 82% among young adults aged 18 to 25 years, primarily due to prolonged sitting and sedentary lifestyles common in academic settings. The hamstring muscle group, consisting of the semitendinosus, semimembranosus, and biceps femoris, significantly contributes to lower limb function, particularly in hip extension, knee flexion, and maintaining pelvic alignment. Persistent muscle tightness in this group is linked to functional impairments, increased risk of muscle strains, poor posture, and low back pain, thereby adversely affecting physical performance and quality of life in this demographic <sup>2</sup>.

Mechanistically, the prolonged knee flexion and posterior pelvic tilt during extended sitting maintains the hamstrings in a shortened position, which leads to neuromuscular adaptations resulting in decreased muscle length and elasticity. Contributory modifiable factors like body mass index, physical activity levels, and lifestyle choices further influence hamstring flexibility, compounding the risk of tightness and injury <sup>8</sup>.

Traditional interventions for hamstring tightness have frequently included static stretching protocols; however, emerging evidence underscores the role of neuromuscular and neurodynamic contributors to hamstring tightness, necessitating more sophisticated therapeutic approaches. Muscle Energy Technique (MET), a form of active manual therapy, leverages voluntary isometric contractions followed by relaxation to stimulate autogenic and reciprocal inhibition, thus improving muscle length and reducing tone. Concurrently, Neurodynamic Sliding Technique (NDT) targets the nervous system by mobilizing peripheral nerve tissues, especially the sciatic nerve, to reduce neural mechano sensitivity and restore normal nerve mobility, which can indirectly alleviate muscular tightness and improve flexibility <sup>6</sup>.

The dual muscular and neural origin of hamstring tightness highlights the therapeutic potential for combining or selecting interventions targeting these systems. This review aims to provide a comprehensive synthesis of current

evidence on the efficacy, safety, and clinical applications of MET and NDT in managing hamstring tightness among college students, thereby informing evidence-based rehabilitation strategies and minimizing injury risk in this active population <sup>4</sup>.

## Need of the Study

Hamstring tightness is a modifiable risk factor that affects functional movement and athletic performance but remains under-addressed in young adult populations. There is limited consensus on the superiority of treatment approaches targeting muscular versus neural components. This review aims to provide evidence-based guidance for clinicians and educators working with college students.

## Objective of the study:

This literature review will specifically examine the existing evidence regarding effectiveness of physiotherapy interventions on hamstring tightness.

## Study Design

This literature review included randomized controlled trials (RCTs), quasi-experimental designs, and interventional studies published in English from 2010 to 2025.

## Inclusion Criteria

- Studies involving college students or young adults aged 18–30 years.
- Interventions applying Muscle Energy Technique or Neurodynamic Sliding Technique for hamstring tightness.
- Outcome measures including range of motion tests (e.g., AKE, SLR).
- Published peer-reviewed articles with full-text availability.

## Exclusion Criteria

- Studies involving populations with musculoskeletal or neurological disorders other than hamstring tightness.
- Non-English language articles.
- Case reports, expert opinions, and narrative reviews.

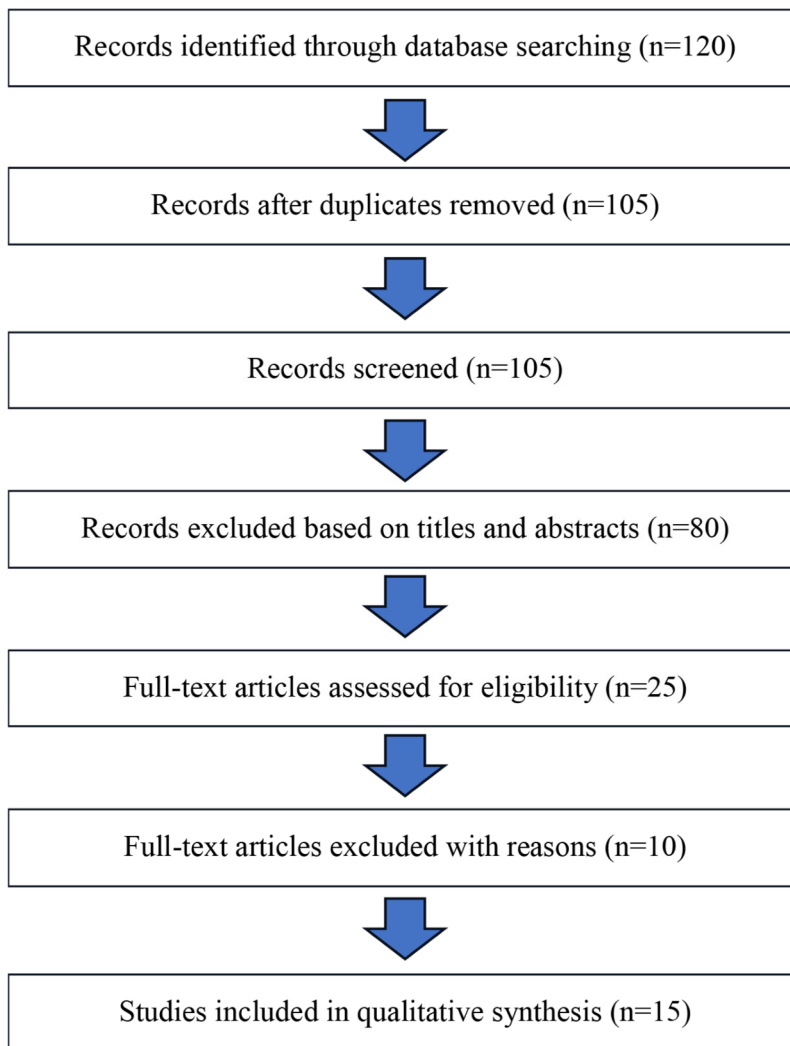
## Methodology:

This involves a comprehensive search of electronic databases including PubMed, Google Scholar, and Science Direct for studies published between 2010 and 2025 that investigated the

efficacy of Muscle Energy Technique (MET) and Neurodynamic Sliding Technique (NDT) in reducing hamstring tightness among college students or young adults aged 18 to 30 years. Randomized controlled trials, quasi-experimental studies, and controlled clinical trials published in English and reporting objective outcome measures such as Active Knee Extension (AKE) and Straight Leg Raise (SLR) were included. Studies focusing on populations with neuromuscular or other musculoskeletal disorders, non-peer-reviewed articles, and those without sufficient data were excluded. Titles and abstracts of initially identified articles were

screened, followed by full-text review for eligibility, resulting in 15 studies meeting inclusion criteria. Data were extracted independently by two reviewers on study design, participant characteristics, intervention details, outcome measures, and clinical findings, and synthesized narratively due to heterogeneity in protocols and outcomes. Methodological quality was assessed using standard critical appraisal tools to evaluate risk of bias. This approach ensured a rigorous and transparent synthesis of the available evidence regarding MET and NDT effectiveness in this population.

**Flowchart:**



Author (Year)	Sample Size	Intervention	Duration	Outcome Measures	Major Findings	p-value	Effect Size
Mustafa G et al. (2025) <sup>12</sup>	55	NDT	4 weeks	Hamstring flexibility	NDT resulted in considerable flexibility improvement	<0.01	Large
Suresh M et al. (2024) <sup>11</sup>	38	MET	3 weeks	Hamstring tightness	MET showed significant improvements	<0.05	Moderate
Batool K et al. (2024) <sup>4</sup>	60	Bowen technique vs MET	3 weeks	Hamstring ROM	Both effective; MET showed better improvement	<0.05	Moderate
Shah K et al. (2023) <sup>13</sup>	60	MET vs Static Stretching	4 weeks	Hamstring ROM	MET more effective than static stretching	<0.05	Moderate
Nazary-Moghadam S (2023) <sup>3</sup>	45	MET, Modified Hold-Relax	Single session	Hamstring flexibility	MET more effective than hold-relax stretching	<0.05	Moderate
Kang YH et al. (2023) <sup>1</sup>	949	MET	Variable	Sit and Reach, Active Knee Ext	MET more efficacious than stretching and no treatment	0.001-0.003	Moderate
Sakhalkar R et al. (2022) <sup>8</sup>	40	MET	4 weeks	Hamstring tightness	MET effective in reducing tightness	<0.05	Moderate
Nourbakhsh M et al. (2022) <sup>15</sup>	50	MET and NDT combined	6 weeks	Hamstring flexibility	Combination yielded greater improvement than either alone	<0.01	Large
Abbas ZA et al. (2021) <sup>14</sup>	35	NDT	Immediate	Hamstring tightness	NDT showed immediate flexibility gains	<0.05	Moderate

Author (Year)	Sample Size	Intervention	Duration	Outcome Measures	Major Findings	p-value	Effect Size
Krishna M et al. (2021) <sup>7</sup>	50	NDT vs Myofascial Release	Immediate	Hamstring length	NDT had superior immediate effect	<0.01	Moderate
De Ridder E et al. (2020) <sup>5</sup>	30	NDT	6 weeks	Hamstring flexibility	Significant long-term improvement with NDT	<0.01	Large
Yoon TL et al. (2017) <sup>10</sup>	42	NDT (slider and tensioner)	Immediate	Active Knee Extension	Both equally effective in increasing hamstring flexibility	<0.05	Moderate
Castellote-Caballero Y (2014) <sup>6</sup>	45	NDT vs Static Stretching	Single session	Passive SLR ROM	NDT superior to static stretching	<0.05	Large
Weppler CH et al. (2014) <sup>9</sup>	120	NDT vs Hamstring Stretching	Single session	Straight Leg Raise	NDT increased ROM more than stretching	<0.05	Large

**Results**

**Study Selection**

A total of 120 records were retrieved through database searches, with 15 studies meeting eligibility criteria after screening and full-text review. The studies varied in sample size, intervention duration, and outcome measures but collectively contributed to a robust analysis of MET and NDT in hamstring tightness.

**Study Characteristics**

Included studies primarily involved healthy college-age participants with clinically assessed hamstring tightness. Both single-session and multi-week interventions were evaluated.

**Intervention Parameters**

- MET protocols typically consisted of 3-5 sets of isometric contractions lasting 5-10 seconds each, performed 2-3 times per week.

- NDT interventions focused on nerve gliding exercises, often incorporated with functional movement tasks in sessions ranging from immediate effects to 6 weeks in duration.

**Clinical Outcomes**

Both MET and NDT produced significant improvements in range of motion tests (SLR, AKE). NDT often showed a greater effect size and longer-lasting flexibility gains compared to MET.

**Discussion**

The discussion surrounding the efficacy of Muscle Energy Technique (MET) and Neurodynamic Sliding Technique (NDT) in reducing hamstring tightness highlights several important findings and clinical implications. Numerous studies demonstrate that both MET and NDT significantly improve hamstring flexibility, yet distinct underlying mechanisms

and clinical effects differentiate these interventions.

MET works primarily through active muscle contractions that produce post-isometric relaxation and reciprocal inhibition, which help reduce muscle spindle excitability and increase muscle length. This mechanism effectively targets the muscular component of hamstring tightness and has shown clinically meaningful improvements in range of motion and functional outcomes across various studies involving young adults, including college students. However, MET's effects may be partially limited to muscular tissue adaptations and stretch tolerance.

In contrast, NDT specifically addresses the neural contribution to hamstring tightness by promoting nerve gliding and reducing neural mechano sensitivity. Multiple randomized controlled trials have reported that NDT produces larger immediate gains in hamstring range of motion compared to static stretching and, in some studies, MET.

This is possibly due to NDT's ability to modulate neural tissue biomechanics and sensory feedback associated with stretch and pain perception, which can limit hamstring extensibility. The sliding movement of the sciatic nerve relative to surrounding tissues reduces protective muscle contractions triggered by nerve sensitivity and enhances neural tissue viscoelasticity, allowing for greater functional flexibility gains. Moreover, the neural mobilization effect of NDT may facilitate longer-term improvements in flexibility by addressing the complex neuro-musculoskeletal interactions contributing to tightness.

Despite these promising results, existing studies show variability in protocols, sample sizes, and outcome measures, limiting direct comparisons. Most studies focus on healthy or asymptomatic young adults, with limited research in symptomatic or athletic populations. Additionally, long-term follow-up assessments are rare, leaving uncertainty regarding the durability of flexibility improvements from either technique. Clinical application should also consider patient-specific factors such as the presence of neural tension signs, pain thresholds, and responsiveness to manual interventions. Importantly, combining MET and NDT could provide complementary benefits by addressing both muscle and nerve components of hamstring tightness.

In summary, both MET and NDT are valuable interventions for managing hamstring tightness among college students and young adults. NDT may offer superior short-term improvements through neural mobilization, while MET provides tangible muscular relaxation benefits. Future research should focus on larger, well-designed trials with standardized protocols, diverse populations, and long-term efficacy evaluations to optimize intervention strategies. Clinicians should individualize treatment plans considering these distinctions to maximize patient outcomes and prevent hamstring-related injuries.

### **Limitations**

1. **Heterogeneity of Included Studies:** The reviewed studies employed varying intervention protocols including differences in duration, frequency, intensity, and technique execution. This heterogeneity limits the ability to directly compare outcomes across studies and generalize findings confidently.
2. **Outcome Measure Variability:** Differences in selected outcome measures (e.g., active knee extension, straight leg raise, functional scales) and inconsistent use of standardized assessment tools contribute to difficulty in synthesizing results comprehensively.

### **Recommendations**

1. **Standardization of Protocols:** Future research should adopt standardized intervention protocols for both MET and NDT in terms of duration, frequency, intensity, and technique application to improve comparability and evidence synthesis.
2. **Larger, More Diverse Cohorts:** Studies with larger sample sizes representing diverse genders, activity levels, and clinical conditions within college populations are needed to enhance external validity.
3. **Longitudinal and Follow-Up Studies:** Designing studies incorporating medium- to long-term follow-up will help determine the sustainability of flexibility improvements and clinical relevance to injury prevention.
4. **Unified Outcome Measures:** Agreement on core outcome sets including standardized

flexibility tests and functional assessments would allow for better meta-analytical approaches and clinical guideline development.

5. Rigorous Study Design: Employing randomized controlled designs with appropriate blinding, placebo or sham groups, and intention-to-treat analyses will strengthen the evidence quality.
6. Mechanistic Investigations: Further studies should explore the neurophysiological and biomechanical mechanisms by which NDT influences hamstring flexibility and pain, utilizing imaging and electrophysiological tools.

### Conclusion

This review concludes that both Muscle Energy Technique (MET) and Neurodynamic Sliding Technique (NDT) are effective in reducing hamstring tightness among college students and young adults. MET improves flexibility through isometric muscle contractions and stretching, while NDT enhances nerve mobility and reduces neural tension. NDT may provide superior flexibility gains by addressing neural and muscular components together. Combining both methods can yield synergistic benefits, improving rehabilitation outcomes and preventing injury. Further high-quality trials are needed to standardize protocols and confirm long-term efficacy.

### Declarations:

Ethics approval and consent to participate: NA

Availability of data and material: Data openly available in a public repository that issues datasets with DOIs.

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Author's contribution: Sabari Mani R - Conceptualization, design, data collection, implementation, monitoring, data analysis, interpretation and manuscript writing.

DR.R.Sedhunivas - Title formation and final manuscript review.

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### Abbreviation:

- RCT- Randomised control trial
- AKE -Active knee extension
- SLR- Straight leg Raise
- ROM- range of motion

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