# Effectiveness of Muscle Energy Technique and Other Treatment Modalities in Improving Hamstring Flexibility: A Comprehensive Literature Review

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**ABSTRACT**

Flexibility in the hamstring is important for correct movement, better sports skills and for avoiding injuries. Having reduced hamstring flexibility can raise the risk of strains and strains tend to happen again and may strongly interfere with playing sports. This review attempts to highlight the available alternatives for improving hamstring flexibility. Literature dating from 2000 to 2024 was found in PubMed, PEDro and Google Scholar, by using "hamstring strain," "hamstring flexibility," and "muscle energy technique" as keywords. Studies matching our standards were examined. Muscle Energy Technique (MET) was found to be the most successful way to increase both knee range of motion and hamstring flexibility compared to proprioceptive neuromuscular facilitation (PNF), static stretching, myofascial release and foam rolling. The reason MET is effective is due in part to its physiological responses, particularly reciprocal inhibition and post-isometric relaxation. Some techniques were shown to be moderately helpful and might be applied together with primary rehabilitation treatments. Based on this review, it is suggested to apply MET in clinics to relieve hamstring tightness and to carry out more extensive randomized controlled trials to study long-term results.

**CONTRIBUTION OF THE PAPER**

1. This review highlights MET as a key method for enhancing hamstring flexibility, yielding better outcomes than static stretching and PNF.
2. It compiles findings from twenty years (2000-2024), providing healthcare professionals with a useful overview for making treatment choices.
3. The study emphasizes the need for additional high-quality RCTs and the standardization of protocols in clinical settings

**Keywords:** Hamstring flexibility, Muscle Energy Technique, Stretching, Physiotherapy, Musculoskeletal rehabilitation, Hamstring strain

**INTRODUCTION**

Posterior to the thigh, hamstring muscle consist of the semitendinosus, the ischial head of the adductor magnus and long head of the biceps femoris. Such muscles are essential for moving the hip forward and bending the knee and support a range of movements such as walking, running and jumping. How flexible the hamstring muscles plays a role in the proper working of biomechanics in both sports and daily life (Kisner & Kolby, 2012; Gleim & McHugh, 1997).

Not having enough flex in the hamstrings is a common cause of torn and strained muscles. Among the most common injuries affecting the muscles and tendons of athletes are hamstring strains, found in soccer, rugby, dance and water skiing (Heiderscheit et al., 2010; Orchard & Seward, 2002). Hamstring injuries often occur and are repeated and some research found that nearly a third of them sometimes occur once more within the first two weeks of playing again (Sherry & Best, 2004; Askling et al., 2007). Because of this, sports rehabilitation teams must look for effective ways to improve muscle flexibility and prevent injuries.

Many methods have been used to help increase hamstring flexibility. Examples of these techniques are MET, PNF, stretching, myofascial release (MFR), foam rolling, Kinesio-taping and exercises that focus on strengthening muscles (eccentric exercises) (Chaitow & Crenshaw, 2001; Pope et al., 2000; Sullivan et al., 1992). It's well-known among therapists that MET works because it helps people become more flexible by having their muscles contract and then relax, producing reciprocal inhibition and post-isometric relaxation (Hutson, 1996; Kisner & Kolby, 2012).

Because there are many treatment methods, doctors need to regularly assess the evidence to help their decision-making. Our objective is to study and review various ways to improve hamstring flexibility based on papers between 2000 and 2024, pick out the best approaches and help design new research and rehabilitation plans (McHugh et al., 1999; Knapik et al., 1991; Hawkins et al., 2001).

## METHODS

A search of the literature was done to discover studies reviewing various treatment interventions designed to improve hamstring flexibility. Among the databases we searched were PubMed, Physiotherapy Evidence Database (PEDro), ScienceDirect, ResearchGate and Google Scholar. The articles looked at publications from January 2000 all the way up to December 2024. Ultimately, 31 studies were incorporated following the application of inclusion and exclusion criteria (Figure 1)

Words used in the search with MeSH (Medical subject headings) included: "hamstring injury," "hamstring strain," "hamstring flexibility," "muscle energy technique," "stretching exercises," and "physiotherapy treatment." The studies chosen were those written in English between the designated dates, including people with hamstring tightness or injury and dealing with conservative physiotherapy aimed at improving hamstring flexibility. The Active Knee Extension (AKE) test, Sit and Reach Test (SRT) and knee Range of Motion (ROM) were reported as outcome measures by selected studies and were all available in full-text form through the databases. We did not include in our review surgical intervention studies, study protocols, surveys, short communications, abstracts without full articles and non-English articles. The Centre for Evidence-Based Medicine guidelines from the Oxford Centre were used to independently grade the studies, starting at Level 1 (systematic reviews and randomized controlled trials) and ending at Level 5 (reports from experts or studies done on animals).

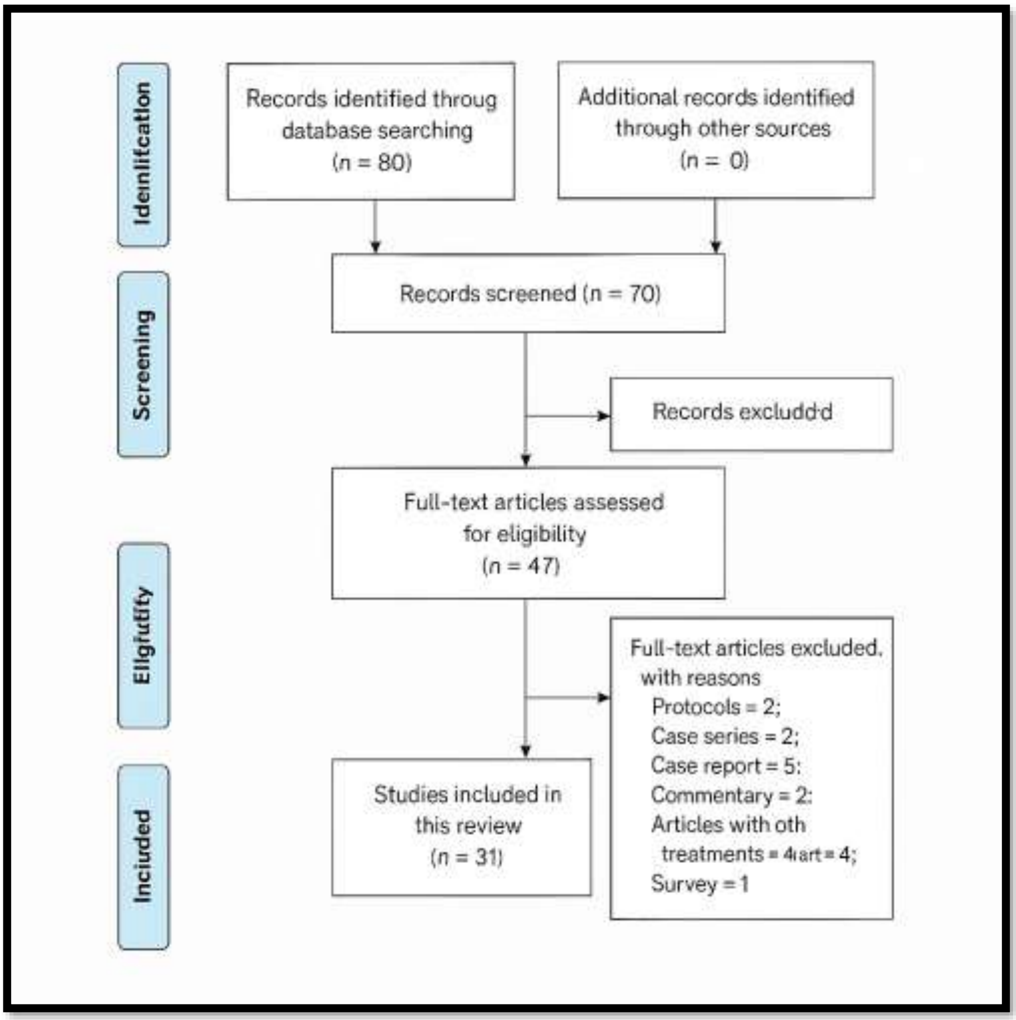


**Figure 1: PRISMA Flowchart**
Source: Self-developed

**RESULTS**

A total of 31 studies published between 2000 and 2024 met the predefined inclusion and exclusion criteria and were included in this review and their key findings is provided in Table 1. These studies primarily evaluated various conservative physiotherapy interventions aimed at improving flexibility of hamstring and range of motion in both healthy individuals and athletes.

The majority of the studies focused on several key treatment modalities. Muscle Energy Technique (MET), assessed in 11 studies, consistently demonstrated significant improvements in hamstring flexibility and active knee extension range of motion. For instance, studies by Sailor et al. (2019), Biswas et al. (2018), and Adkitte et al. (2016) reported superior outcomes with MET compared to other methods such as static stretching and positional release therapy. MET's mechanism involves patient-generated isometric contractions against therapist resistance, facilitating post-isometric relaxation and reciprocal inhibition O'Hara et.al (2011).

Static stretching (SS), often used as a control or comparator, showed moderate efficacy in increasing hamstring range of motion across several studies. Research by Ahmed et al. (2011), Askling et al. Orchard (2005) Hora et al. (2011) demonstrated that while static stretching improved flexibility, it was frequently less effective than MET or proprioceptive neuromuscular facilitation (PNF) stretching. PNF techniques, including hold-relax and irradiation, assessed in studies such as Yu et al. (2019) and Hill et al. (2016), yielded greater flexibility improvements than static stretching, likely due to mechanisms involving autogenic inhibition and increased stretch tolerance.

Myofascial release (MFR) and self-myofascial release (SMFR), including foam rolling, were reported to improve hamstring flexibility and reduce myofascial pain in studies by Ajimsha et al. (2014) and Jung et al. (2017). However, evidence regarding the magnitude and duration of these effects was mixed. Eccentric training and neuromuscular electrical stimulation (NMES), studied by Kaur et al. (2013) and Kumar et al. (2015), were suggested to complement stretching techniques by enhancing muscle length and function, particularly in tendinopathy cases. Additional modalities such as kinesiotaping combined with stretching Demir & Yagci and dynamic soft tissue mobilization (Abbas et al., 2017) also showed potential benefits in improving hamstring flexibility, although supporting evidence remains limited.

Most studies utilized the Active Knee Extension (AKE) test or the Sit and Reach Test (SRT) to quantify flexibility improvements. MET consistently demonstrated faster and greater improvements, with significant changes observed as early as one-week post-intervention. Combining MET with other techniques, such as soft tissue massage, was found to enhance gains in passive knee extension. While static stretching and PNF were effective, these methods generally required longer or repeated treatment sessions to achieve comparable results. Evidence supporting MFR and SMFR was promising but less consistent across studies. Meanwhile, eccentric exercises and NMES were primarily focused on improving muscle strength and functional recovery rather than directly enhancing flexibility.

Many of the studies measured how flexible people got by using either the Active Knee Extension test or the Sit and Reach test. Many significant changes were detected in MET as early as one week after starting. When we combine MET with soft tissue massage, the results in gaining passive knee extension are much greater. Even though both static stretching and PNF were helpful, they generally took either more time or several repeat visits to produce the same results. Findings about MFR and SMFR were favorable but did not show strong consistency in most studies. The main purpose of eccentric training and NMES was to help people recover muscle strength and function, while flexibility was developed indirectly.

**Table 1. Summary of Included Studies on Treatments for Increasing Hamstring Flexibility**

| Author (Year) | Study Design | Sample Size | Intervention(s) | Outcome Measures | Duration & Sessions | Key Findings |
|---|---|---|---|---|---|---|
| Sailor et al. (2019) [20] | Comparative RCT | 24 | MET vs Positional Release Tech | AKE, SLR | 10 min/session, 2 weeks | MET improved flexibility more than PRT |
| Yu et al. (2019) [21] | Comparative RCT | 51 | Static Stretching, PNF hold-relax, PNF irradiation | AKE | Single session | PNF irradiation improved ROM similarly to other techniques |

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| Biswas et al. (2018) (18) | Experimental | 60 | MET vs Static Stretching | ROM, SRT | Once daily, 4 weeks | MET more effective than static stretching |
| Lokesh & Yogeshwaran (2018) (22) | Comparative | 56 | Self-MFR vs Static Stretching | AKE | 4 weeks | Both effective; combined better |
| Demir & Yagci (23) | Experimental | 30 | PNF + Kinesiotaping vs PNF alone | AKE, Modified SRT | 4 weeks | KT increased effect of stretching exercises |
| Abbas et al. (2017) (24) | Comparative | 120 | Dynamic Soft Tissue Mobilization vs Passive Stretching | AKE | 5 days/week, 1 week | DSTM superior to passive stretching |
| Jung et al. (2017) (25) | Cross-sectional | 22 | Self-MFR | SRT, AROM, PROM | 3 days | Self-MFR significantly improved flexibility |
| Joshi et al. (2017) (26) | RCT | 39 | Pulsed MET vs Isolytic MET | AKE, Hamstring contracture test | Single session | Both MET techniques equally effective |
| Mason et al. (2016) (27) | RCT | 39 | Dry Needling + Stretching vs Sham | AKE, ASLR | Single session + 7 days | Dry needling not superior to sham |
| Adkitte et al. (2016) (28) | Experimental | 30 | MET | SRT | 6 days | MET significantly increased flexibility |
| Hill et al. (2016) (29) | Review | 165 | PNF vs Static Stretching | AKE, Knee ROM | Up to 8 weeks | Both increased ROM; no significant difference |
| Morton et al. (2016) (30) | Experimental | 19 | Self-MFR + SS vs SS alone | Passive ROM, Hamstring stiffness | Twice daily, 4 weeks | SS alone effective; addition of SMFR no extra benefit |

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| Balani &Kataria (2015) [31] | Comparative | 60 | Passive Stretching, MET, Combination | AKE | 5 consecutive days | Combination more effective than individual techniques |
| Kumar et al. (2015) [32] | Comparative | 30 | MET, PNF Stretching, Static Stretching | AKE, NPRS | 4 weeks | All showed significant improvement |
| Ajimsha et al. (2014) [34] | Systematic Review | 1288 | MFR | SLR | Various | Mixed evidence; promising for MFR |
| Evans et al. (2014) [33] | Experimental | 10 | Self-MFR | Sit and Reach Test | Single session | SMFR had no significant effect compared to passive rest |
| Jadav & Patel (2015) [34] | Experimental | 50 | Post Facilitation Stretching vs Agonist Contract Relax | AKE, Knee ROM | 6 weeks | Post facilitation stretching more effective |
| Masters et al. (2014) [35] | Experimental | 20 | MET + Soft Tissue Massage vs MET alone | AKE, PKE | Single session | Combination improved passive knee ROM more |
| Kaur et al. (2013) [36] | Experimental | 40 | Eccentric Training vs MET | AKE, SRT | 14 days | MET showed significant improvement |
| Shah et al. (2012) [37] | Experimental | 31 | MFR | Passive SLR | 2 weeks | Significant improvement in passive SLR |
| Ahmed et al. (2011) [38] | Comparative | 20 | MET vs Dynamic Stretching | AKE | 6 days | MET better than dynamic stretching |
| Hora et al. (2011) [38] | Experimental | 45 | Static Stretching vs PNF | Passive Knee Extension | Single session | PNF more effective than static stretching |

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| Sambandham et al. (2011) [39] | Comparative | 60 | MET vs Eccentric Training | AKE | Single session | Both effective; no difference immediate effect |
| Ahmed et al. (2010) [40] | Comparative | 45 | MET vs Static Stretching | Passive Knee Extension | 4 sessions | Both equally effective |
| Waseem et al. (2009) [41] | Experimental | 20 | MET | Popliteal Angle (AKE) | 5 days | MET significantly improved flexibility |
| Smith & Fryer (2008) [42] | Comparative | 40 | MET (different durations) | AKE | 2 sessions | Both durations equally effective |
| Thampi et al. (2007) [43] | Comparative | 40 | Post-Isometric Relaxation vs Static Stretching | AKE | 3 sessions | PIR more effective than static stretching |
| Sokunbi et al. (2006) [44] | Comparative | 45 | Soft Tissue Massage vs Hold Relax + STM | Sit and Reach Test | 6 weeks | Hold Relax + STM better than STM alone |
| Decoster et al. (2005) [45] | Systematic Review | 1338 | Various Stretching Techniques | Knee Extension, SLR | Up to 10 weeks | Various stretching methods increase ROM |
| Kostidis et al. (2004) [46] | Comparative | 63 | MET vs Static Stretching | AKE | Single session | No significant difference; both increased flexibility |
| Anita & Fryer (2003) [47] | Comparative | 162 | MET vs Passive Stretching | AKE | Single session | MET more effective immediately and 1 hour after treatment |

**DISCUSSION**

This comprehensive review systematically examined 31 studies that evaluated a range of treatment alternatives aimed at improving hamstring flexibility, with a primary focus on physiotherapy interventions. The interventions analyzed include Muscle Energy Technique (MET), static stretching (SS), proprioceptive neuromuscular facilitation (PNF), myofascial release (MFR), eccentric training, and adjunctive modalities such as kinesiotaping and neuromuscular electrical stimulation (NMES). Across these various approaches, the evidence consistently highlights MET as a highly effective method for increasing hamstring flexibility and knee range of motion (ROM), often outperforming or at least matching the effectiveness of other commonly used techniques. This positions MET as a particularly promising therapeutic tool in the management of hamstring tightness and related musculoskeletal conditions.

Focusing on the effectiveness of Muscle Energy Technique, several randomized controlled trials, including those conducted by Sailor et al. (2019), Biswas et al. (2018), and Adkitte et al. (2016), reported significant improvements in hamstring flexibility and active knee extension within relatively short intervention periods, ranging from single treatment sessions to a few weeks of therapy. The physiological rationale underpinning MET's success involves by Yu & Shin (2019) neurophysiological mechanisms such as post-isometric relaxation and reciprocal inhibition. These processes facilitate muscle relaxation by using patient-generated isometric contractions performed against therapist-applied resistance, which results in decreased muscle tone and increased extensibility. This mechanism contrasts with static stretching, which predominantly relies on the viscoelastic properties of muscles and connective tissues and typically requires longer duration or repeated sessions to achieve comparable gains in flexibility.

Comparatively, proprioceptive neuromuscular facilitation stretching techniques, such as hold-relax and irradiation, also demonstrated substantial improvements in hamstring range of motion. Several studies, including those by Yu et al. (2019) and Hill et al. (2016), have shown that PNF stretching can yield greater flexibility gains than static stretching, likely due to enhanced neuromuscular facilitation and increased stretch tolerance. However, PNF techniques may cause discomfort for some patients and demand considerable therapist expertise, which could limit their routine clinical application. Meanwhile, static stretching remains a widely accepted, low-cost, and easily administered intervention, although its effectiveness tends to develop more gradually and often results in smaller improvements compared to MET or PNF.

The role of myofascial release techniques, encompassing self-myofascial release methods such as foam rolling, presented a more varied and less consistent picture. Some investigations, notably those by Jung et al. (2017) and Ajimsha et al. (2014), reported immediate improvements in hamstring flexibility and reductions in myofascial pain following myofascial release interventions. Conversely, other studies, such as Evans et al. (2014), found no significant differences in flexibility outcomes when comparing self-myofascial release with passive rest, indicating variability that may arise from differences in application technique, duration, pressure applied, and heterogeneity in patient populations. Although self-myofascial release offers a practical and accessible adjunct to other therapies, further rigorous research is necessary to establish standardized protocols and clarify its long-term efficacy.

Additional treatment modalities, including eccentric training and neuromuscular electrical stimulation, demonstrated effectiveness primarily in enhancing muscle strength and functional outcomes, particularly in cases involving tendinopathy. While these approaches indirectly contribute to improved flexibility by addressing muscle performance and tendon health, they are best employed as complementary strategies alongside stretching or manual therapy techniques. Similarly, kinesiotaping and dynamic soft tissue mobilization have shown potential benefits in increasing hamstring flexibility; however, the current evidence base is limited, and further high-quality studies are warranted to fully elucidate their therapeutic roles.

From a clinical perspective, MET offers physiotherapists a valuable and readily integrated intervention that can be applied in rehabilitation programs targeting athletes and individuals experiencing hamstring tightness. The technique's ability to produce rapid improvements in flexibility holds promise for reducing injury risk and facilitating quicker return to functional activities and sport. Additionally, combining MET with adjunctive treatments, such as soft tissue massage or conventional stretching, may amplify therapeutic outcomes. Nonetheless, treatment decisions should be individualized, taking into consideration patient comfort, therapist expertise, and the patient's specific response to intervention.

Despite the encouraging findings regarding MET and other interventions, the overall quality of the included studies varied considerably. Methodological limitations such as small sample sizes, lack of blinding, and short follow-up durations were common and may affect the reliability of conclusions drawn. The heterogeneity of intervention protocols and outcome measures further complicates direct comparisons between studies and highlights the need for standardized methodologies. Future research should prioritize larger, well-designed randomized controlled trials comparing MET with other established techniques, with an emphasis on investigating long-term effects, optimal dosing regimens, and identifying patient subgroups most likely to benefit. Additionally, mechanistic studies exploring the biological and neurophysiological changes induced by these interventions would provide valuable insights into their modes of action and assist in refining clinical protocols for maximum efficacy.

## CONCLUSION

It is highlighted in this review that Muscle Energy Technique enhances the flexibility of hamstrings and knee mobility. It was found, based on several top research studies, that MET produced similar or better results than static stretching, proprioceptive neuromuscular facilitation and myofascial release. Thanks to reciprocal inhibition and post-isometric relaxation , resistance training quickly and effectively works the muscles over a long period.

MET provides unique benefits by making treatments more effective and guaranteeing better outcomes for the patient, compared to static stretching and PNF. While myofascial release, eccentric workouts and neuromuscular electrical stimulation help in some cases, more study is needed to make them standard procedures.

For people with hamstring tightness or injuries, clinicians should try using MET as a regular treatment to increase flexibility, prevent further injury and promote faster recovery. Further research should increase the size of its trials, collect results on long-term outcomes and refine treatment strategies to gain the best patient benefits.

## DECLARATIONS

**Ethical Approval:** This research did not involve any human participants, animal subjects, or the use of personally identifiable or sensitive information. Consequently, ethical approval from an institutional review board or ethics committee was not necessary.

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