Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(3), 1345-1351 | ISSN:2251-6727

Impact of Suboccipital Muscle Inhibition on Hamstring Flexibility: Integrating Neuro-Myofascial Connections in Modern Physiotherapy

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(Received: 16 March 2025 Revised: 20 April 2025 Accepted: 01 May2025)

KEYWORDS

Hamstring muscle, semitendinosus, semimembranosus or biceps femoris, muscle inhibition, suboccipital muscle inhibition, flexibility or joint range of motion, physical therapy or physiotherapy and rehabilitation.

ABSTRACT:

Introduction: Hamstring tightness is prevalent among individuals between 18–27, often leading to reduced flexibility, discomfort, and an increased risk of musculoskeletal injuries. Various manual therapy techniques have been explored to improve hamstring flexibility, one of which is the suboccipital muscle inhibition (SMI) technique. The SMI technique focuses on reducing tension and myofascial restrictions in the suboccipital region. It is commonly used in physiotherapy to promote muscle relaxation and enhance overall flexibility.

Objectives: This review aims to assess the effectiveness of the suboccipital muscle inhibition (SMI) technique in enhancing hamstring flexibility. It analyses the immediate and short-term effects of SMI on hamstring mobility and explores its clinical relevance in the management of hamstring tightness.

Methods: A comprehensive literature review in accordance to PRISMA-ScR was conducted in PubMed, Google Scholar, ScienceDirect and Research gate, focusing on full-text articles from 2014 to 2024.

Results: A total of 570 studies were retrieved, and after removing duplicates and those not meeting inclusion criteria, 13 studies conducted between 2014 and 2024 were included, comprising RCTs, comparative, interventional, quasi-experimental, and experimental designs The findings suggest that SMI technique leads to an immediate improvement in hamstring flexibility.

Conclusions: SMI technique an effective therapy in enhancing hamstring flexibility. studies reported a significant and immediate increase in Hamstring flexibility following its application. It can be effectively incorporated into pre-exercise routines and rehabilitation programs to address hamstring tightness in clinical settings.

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1. Introduction

Hamstring tightness is a common musculoskeletal issue that adversely affects mobility, posture, and overall physical performance. It is frequently observed not only in athletes and physically active individuals but also in healthy young adults between 18-27 years. [1,2] Limited hamstring flexibility can restrict joint range of motion (ROM), contributing to postural deviations, impaired gait mechanics, and increased susceptibility to muscle strains and related injuries. [3] Traditional physiotherapy approaches often rely on localized stretching techniques to improve hamstring flexibility. However, recent developments in neuro-myofascial research have drawn attention to the significance of holistic body systems, particularly the interconnectedness of fascial and neural networks. The **superficial back line**, a fascial pathway, links the suboccipital region at the base of the skull to the posterior chain, including the hamstrings, thereby offering a potential explanation for remote influences on muscle flexibility[4]. The suboccipital muscles are small and deep muscles that stabilize the upper cervical spine that are essential for controlling head posture and facilitating upper spinal movement. They play a primary role in postural alignment. The **Suboccipital Muscle Inhibition (SMI)** technique, a manual therapy intervention, aims to reduce myofascial tension in this region[5]. It is theorized that relaxation of these muscles may produce a downstream effect on hamstring tone via neuromyofascial pathways, promoting improved flexibility[6]. This review critically examines the effectiveness of the SMI technique in enhancing hamstring flexibility, with a focus on both immediate and short-term outcomes. It further explores how the concept of neuro-myofascial connectivity can be integrated into modern physiotherapy to offer a more comprehensive approach in managing hamstring tightness.

2. Objectives

This review aims to assess the effectiveness of the suboccipital muscle inhibition (SMI) technique in enhancing hamstring flexibility. It analyses the immediate and short-term effects of SMI on hamstring mobility and explores its clinical relevance in the management of hamstring tightness.

3. Methods

Literature Search Strategy: A comprehensive literature search was conducted using electronic databases in PubMed, Google Scholar, ScienceDirect and Research gate. The search focused on full-text articles published in English between 2014 till 2024 January. Relevant keywords used in the search included: “hamstring muscle”, “semitendinosus”, “semimembranosus” or “biceps femoris”,“muscle inhibition”, “suboccipital muscle inhibition”, “flexibility” or “joint range of motion”, “physical therapy” or “physiotherapy” and “rehabilitation”.

Eligibility criteria

Articles were included if they met the following Inclusion criteria: a) studies involving participants aged 18 to 27 years, b) randomized controlled trials (RCTs), cross-sectional studies, and case studies, c) studies which suboccipital muscle inhibition technique as the primary intervention. Exclusion criteria were: reviews and meta-analyses, books, notes, conference proceedings, theses or dissertations, letters and abstracts. Studies that implemented suboccipital muscle inhibition solely as a passive intervention were excluded. The records retrieved from the search strategy were screened for eligibility by two independent reviewers. The study selection process has followed the PRISMA-SCR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews) flowchart was used to identify relevant studies via databases during the initial phase. A total of 13 articles that met the study criteria, as represented in Fig 1, were selected for this scoping review

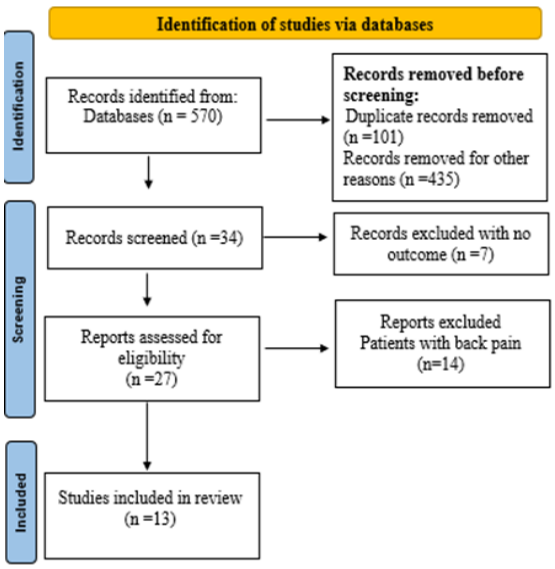

Fig- 1 PRISMA ScR- FLOWCHART

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JCHR (2025) 15(3), 1345-1351 | ISSN:2251-6727

4. Results

The findings from 13 articles demonstrated that Suboccipital Muscle Inhibition (SMI)techniques led to immediate improvements in hamstring flexibility across various outcome measures such as AKE, SRT, PA, FFD, and SLR. While some studies favoured SMI alone, others found combined approaches more effective than SMI alone. Broadly, SMI was shown to be a beneficial, non-invasive technique for enhancing hamstring flexibility in young adults.

5. Discussion

This scoping review explores the impact of Suboccipital Muscle Inhibition on Hamstring Flexibility. Findings suggest that this intervention may contribute to an immediate improvement in flexibility. The study incorporates various outcome measures, including the Active Knee Extension (AKE) test, Popliteal Angle (PA), Forward Flexion Distance (FFD), Straight Leg Raise (SLR), and the Sit and Reach Test (SRT), to assess changes in flexibility. Suboccipital Muscle Energy Techniques (MET) help improve hamstring flexibility instantly by targeting the neuromyofascial connections between the suboccipital muscles and the posterior chain, particularly the hamstrings. The mechanism behind this effect is based on the concept of the superficial back line, a fascial network that links the suboccipital muscles to the hamstrings via the dura mater. When tension in the suboccipital muscles is reduced, it induces a reflexive relaxation in the hamstrings, leading to immediate improvements in flexibility.

Panchal et al. (2023) conducted a single-session comparative study using SMI and reported significant pre- to post-intervention improvements in AKE and SRT, suggesting enhanced flexibility in both the hamstrings and calf muscles[7]. Similarly, a comparative study by Shinde et al. (2021), which involved six sessions over two weeks, found both SMI and static stretching to be effective in improving flexibility, although static stretching yielded more noticeable changes in the popliteal angle[8]. This highlights that while SMI is beneficial, traditional stretching methods may still offer superior results in certain flexibility parameters. In contrast, Sojitra et al. (2020) evaluated SMI against Muscle Energy Technique (MET) and observed that both techniques resulted in statistically significant improvements in AKE values, indicating that SMI can be as effective as MET in enhancing hamstring flexibility[9]. A similar experimental design by Vachhani et al. (2021) found that MET more beneficial than SMI for long-term flexibility gains[10]. Chua et al. (2019) examined the impact of SMI and suboccipital static stretching in a quasi-experimental study involving 54 physiotherapy students. Their results showed that both the interventions positively influenced hamstring flexibility, as measured by PA and FFD, supporting the use of SMI in sedentary adult populations[11]. Mandale et al. (2024) reported in his study that SMI produced superior outcomes that traditional stretching of Hamstring in terms of PA and FFD improvements[12]. Cho et al. (2015) also compared SMI and self-myofascial release (SMFR) and found a greater improvement in FFD, SLR, and PA scores among participants who received SMI, thus supporting its efficacy for immediate gains in flexibility[13]. Panse et al. (2018) and Desai et al. (2019) found SMI effective, with Desai noting it outperformed retro walking[15,16]. Kariya et al. (2021) showed both SMI and cranial cervical flexion are beneficial[17]. Chawla et al. (2021) found the Mulligan bent leg raise more effective than SMI[18]. Dharti (2022) recommended combining SMI with static stretching to enhance flexibility and agility[19]. Researches underscore the effectiveness of Suboccipital Muscle Inhibition (SMI) in addressing hamstring tightness within physiotherapeutic practice. While some studies indicate that SMI alone is as beneficial as conventional methods, others suggest that combining it with traditional techniques enhances its impact. The observed improvements are likely linked to the suboccipital muscle's role in the body's fascial networks, specifically the superficial back line, which connects the cranial region to the posterior lower limb. This supports the theory that neuromyofascial modulation through SMI may trigger reflexive relaxation in the hamstrings, ultimately enhancing flexibility. Findings of this study highlighted the effect of SMI on hamstring flexibility as its non- invasive nature and immediate effect makes it an effective mode of treatment in clinical settings. Hence, SMI can be used as a valuable technique in physiotherapy for individuals with hamstring tightness with its applicability in pre-exercise routine and rehabilitation programs. The summary of included article is mentioned in Table 1.

Conclusion:

The availability of evidences suggests that SMI is an effective intervention for improving hamstring flexibility. Several studies have reported an immediate increase in

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JCHR (2025) 15(3), 1345-1351 | ISSN:2251-6727

hamstring flexibility after the application of SMI. Further studies are needed to confirm its efficacy and long-term effect of SMI on hamstring flexibility and to find its effect on athletic population.

Table 1: Summary of included Article

Ushaben Mahendrakumar Prajapati et al (2020)[14]	52	Interventional study	52 subjects were randomly divided into 2 groups. Group A got SMI and static stretching. Group B received static stretching.	SMI improved the hamstring flexibility in subjects with hamstring tightness.
Namrata Sojitra et al (2020)[9]	40	Interventional study	Total 40 subjects with hamstring tightness were selected for study. Group A: SMI, Group B: (MET)	SMI and MET are equally effective in improving hamstring flexibility in healthy collegiate subjects.
Shrikrishna Shinde et al (2021)[8]	30	Comparative study	30 medical students with hamstring tightness were divided into two groups: one received static stretching, the other SMI, both for 2 weeks, 3 times a week.	The comparison within group shows improvement in popliteal angle and finger to floor test, but when compared between both groups are equally effective
Rooju Vachhani et al (2021)[10]	52	Experimental study	52 subjects were included and divided into two groups Subjects in the experimental group were treated with SMIT and Subjects in control group were treated with MET	SMI and MET both were effective in improving hamstring flexibility but MET was found to be more effective.
Sakshi K Kariya et al (2021)[17]	50	Comparative study	The 50 subjects will be divided in to 2 different groups; each group will have 25 participants. Group A (SMI) and Group B (CCFE)	SMI and cranial cervical technique will be given as an intervention to the participants to improve hamstring flexibility and work efficiently.

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Limitations:

Dr Riya Chawla et al (2021)[18]	48	Comparative study	48 younger individuals divided into two group Group A received SMI and group B received of mulligan BLR technique.	The Mulligan BLR was more effective over SMI
Hingarajia Dharti (2022)[19]	116	Experimental study	116 subjects having hamstring tightness were randomly divided into two groups (58 in each). Group A received SMI and SS and Group B received SS	SMI should be incorporated along with static stretching technique to improve hamstring muscle flexibility and agility in healthy young adults.
Shruti Panchal et al (2023)[7]	60	Comparative study	Subjects were randomly divided into two equal groups. Group A(n=30) received SMI and group B (n=30) received self-stretching of hamstring and calf muscles	The SMI is more effective in relieving tightness from the hamstring and calf group of muscles as compared to the self-stretching technique
Shubhangini Damodar Mandale et al (2024)[12]	100	Comparative Study	A total of 100 subjects of both genders were recruited. Subjects were assigned to two groups; Group A 50 subjects were given SMI Another group 50 subject were given static stretching	Both techniques improve hamstring flexibility, but suboccipital muscle inhibition is more effective than static stretching in healthy individuals with tight hamstrings.

Limitations:

There are very limited research on the long-term effects of SMI on hamstring flexibility. Few studies compared SMI with other flexibility techniques. Differences in sample size, study design, and outcome measures makes it difficult to generalize findings. More large-scale, long-term studies are needed to confirm SMI's effectiveness as a standalone or a complementary treatment.

Ethical information: Since, the study is a literature review, there is no involvement of human or animals, so ethical clearance has not been included in the study.

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JCHR (2025) 15(3), 1345-1351 | ISSN:2251-6727

Author Contribution:

Author 1,2: Maithily, Muhammed Afsal K A: Concept, Literature search, Manuscript preparation

Author 3,4: Subhra Basu, Priyanka Amit Kumar: Manuscript design and editing

Author 5,6: Abdur Rahman, Amir Ahmed: Literature search.

Acknowledgement:

We extend our sincere gratitude to Yenepoya (Deemed to be) University for providing us this opportunity and helping us in this research process.

Conflict of interest: No Conflict of interest.

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