Sport and Fitness Journal
E-ISSN: 2654-9182 Volume 11, No.2, May 2023: 116-121

NEURODYNAMIC STRETCHING, SHORT HAMSTRING SYNDROME, AND NEURAL TENSION DYSFUNCTION IN THE LOWER LIMBS

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ABSTRACT

Hamstring muscles are vital for movements, but changes can cause joint dysfunction. Stretching helps sensory adaptation, and neural tension dysfunction limits flexibility. This study examines the relationship between neural tension dysfunction and short hamstring syndrome and the effectiveness of neurodynamic stretching. The research method used was a literature study of 5 articles using that were accessed from journal databases like PubMed Central (PMC), NCBI, and Google Scholar. Keyword search approach for "neural tension dysfunction", "short hamstring syndrome", and "neurodynamic". It has been demonstrated that therapies that target brain structures, such as delivering neurodynamic stretching, are more successful in enhancing flexibility in SHS when compared to other intervention modalities. This is brought on by modifications to the neural system, such as the nerves' capacity to withstand tension loading brought on by adjustments to the length of the hamstring muscles on the SHS. Additionally, one of the primary causes of the restriction of motion in SHS is increased mechanosensitivity brought on by neuronal tension dysfunction. According to the literature study, there is a relation between neurodynamic stretching on short hamstring syndrome incidence in a healthy population and neuronal tension dysfunction in the lower limbs.
Keywords: neurodynamic; short hamstring syndrome; neural tension dysfunction

INTRODUCTION

Hamstring muscles are involved in a variety of functional human movements, including walking, running, and jumping[1]. Hamstring extensibility is commonly observed in both general and athletic populations. Although the exact cause of hamstring injury is unidentified, it could be due to a lack of hamstring extensibility[2]. Changes in hamstring extensibility can cause joint dysfunction and have been associated with a variety of orthopedic conditions, including low back pain and patellofemoral syndrome[2]. Maintaining a normal joint range of motion (ROM), which can be achieved through hamstring stretching, may therefore reduce the risk of an orthopedic problem [1,2].

Short hamstring syndrome and neural tension dysfunction are related but distinct disorders. The symptoms of neural tension dysfunction, which include pain, numbness, tingling, and weakness in the affected location, are caused by increased tension or irritation of the peripheral nerves[3]. Numerous things, such as trauma, repetitive motions, or postural imbalances, might contribute to this tension. On the other side, short hamstring syndrome is a condition where the hamstrings (the muscles in the rear of the leg) are short and tight. Numerous symptoms, including low back pain, hip discomfort, and knee pain, may result from this. Numerous things, such as postural imbalances, muscular imbalances, and repetitive activities that put stress on the hamstrings, might contribute to it[4]. Although they are sometimes related, short hamstring syndrome and neural tension dysfunction are not the same things. It is conceivable for someone to have short hamstring syndrome without also having neural tension dysfunction[4,5].

Neural Tension Dysfunction refers to a change in the mechanical properties of nerves, causing symptoms with tension loading. The mechanical interface plays a role in producing normal movement. Short hamstring syndrome limits hip and knee movement and increases the risk of injury during exercise. It is caused by reduced hamstring muscle flexibility, but the primary causes are unknown. Hamstring injuries are common in sports and work-related activities and are influenced by factors such as poor flexibility, muscle imbalance, fatigue, and previous injuries. However, there is no significant evidence linking decreased hamstring flexibility to injury[6].

[7,8]Poor hamstring extensibility can be found in people who are either healthy or who have strained hamstrings with aberrant mechanosensitivity[9]. It's essential to keep hamstrings flexible to maintain healthy joints and avoid joint dysfunction. It is essential for carrying out basic human motions including walking, running, and jumping. Changes in hamstring extensibility have been linked to various orthopedic conditions such as patellofemoral syndrome and low back pain, which can lead to joint dysfunction and hinder physical activity[7].

The Neurodynamic Stretching (NDS) technique generates sliding movements of the neural structure relative to its mechanical interface. Through joint motion, this technique applies tension to the targeted nerve structures proximally while increasing nerve tension distally[6,9]. Additionally, it's believed that the acute stretching's high afferent input can affect sensory adaptation by lowering the impulse rate of mechanoreceptors and proprioceptors. Mechanical changes in the nervous structure in accepting the load also cause a decrease in joint ROM in short hamstring syndrome. This is commonly known as neural tension dysfunction[6]

The majority of studies evaluate the efficacy of static stretching for hamstring tightness or flexibility, and many studies are carried out on populations of people who report experiencing hamstring pain. Due to the unavailability of sufficient studies that have shown a significant increase in hamstring flexibility after NDS administration[7,10] therefore, this study aims to describe the relationship between neural tension dysfunction and indications of the occurrence of short hamstring syndrome in a healthy population, and how NDS interventions can effectively increase hamstring flexibility in order to prevent someone to have neural tension dysfunction. The purpose of this literature study is to ascertain the relationship between neurodynamic stretching in short hamstring syndrome and neural tension dysfunction in lower limb conditions.

METHOD

Methodology

Study design

The research method used was a literature review of articles using secondary data from research journals about the mechanical nature of nerves in the form of tension dysfunction in the nerve structures found in the lower extremities in a healthy population with short hamstring syndrome was the research method used. Journal databases like PubMed Central (PMC), NCBI, and Google Scholar are available for this literature review. Keyword search approach for "neural tension dysfunction", "short hamstring syndrome", and "neurodynamic".

Article selection

The inclusion and exclusion criteria are independently applied by three reviewers. They examined each study's entire text to determine whether it complied with the requirements. The debate is used to settle differences in the consensus if there are any. Inclusion criteria include Journal papers with randomized controlled trials (RCT) or cross-sectional research designs and articles published over the last 15 years (2007–2022). The exclusion criteria include (1) Copies of the same publication; (2) Conference proceedings; (3) Abstracts of theses; (4) Case reports.

Data extraction

Data were extracted by summarizing data on participant descriptions, intervention groups, control/comparison groups, outcome measures, results, and study quality ratings.

RESULTS

There were 35 items found overall after the initial database search. Then, 5 articles were picked based on inclusion and exclusion criteria. The study results included in this analysis are summarized in Table 1.

Table 1. Summary of the study.

Author	Sample	Intervention	Comparison	Outcome Measures	Result
Caballero et al., 2014	N=120 Age range=20-45	Neurodynamic Sliding	1. Hamstring stretching 2. Placebo control	Leg was measured for straight leg raise (SLR) range of motion (ROM) before and after interventions	In healthy subjects with short hamstring syndrome, the findings suggest that a neurodynamic sliding technique will increase hamstring flexibility more than static hamstring stretching
Park et al., 2014	N=24 Age range=20-30	Neurodynamic technique	-	1. Hip joint range of motion (ROM) 2. Balance during one-legged standing using a balance measurement system	The neurodynamic sciatic nerve sliding technique improved the hamstring flexibility and postural balance of healthy adults
Areeudomwong et al., 2016	N=40 Age range=18-25	Neurodynamic Sliding	Control group receiving placebo shortwave intervention.	1. Knee extension angles were measured with the passive knee extension test 2. Maximal voluntary isometric contraction (MVIC) of hamstrings was measured by a surface electromyography	When compared to the control group, Neurodynamic Sliding produced a statistically and clinically significant increase in knee extension angle
Ahmed et al., 2016	N=40 Age range=18-26	Neurodynamic Stretch	Static Stretch	Hamstring flexibility were obtained using the Active Knee Extension (AKE) test and Active Straight Leg Raise (SLR)	Significant improvement in hamstring flexibility following both neurodynamic and static stretching, but the neurodynamic group improved more than the static group
Vakhariya et al., 2016	N=80	Neurodynamic sliding	1. Suboccipital muscle	1. Angle of knee flexion measured	Suboccipital Muscle Inhibition Technique,

	Age range=18-25	inhibition technique 2. Static stretching 3. Control group	with Active Knee Extension test 2. Passive straight leg raise measured with Passive Straight Leg Raising Test 3. Hamstring and lower back flexibility measured with Modified Sit and Reach test	Neurodynamic Sliding, and Static Stretch are all very effective at increasing hamstring flexibility

DISCUSSION

In the body, the nervous system can adapt to mechanical loads that are continuously applied, and thus, the nervous system can change mechanical and physical properties due to dimensional changes in the mechanical interface tissue[11]. Some of the mechanical properties of nervous structures that have been described in several kinds of literature, namely tension, sliding, and compression. The first mechanical function possessed by the nervous system is the ability of the nervous system to generate passive tension. Because the nervous system is attached to both ends of the container, the nervous system will be elongated if the two ends of the container move away from each other. This elongation then produces tension in the nervous system. The perineurium is the main connective tissue that can withstand excessive loads of tension. This tissue helps the peripheral nerve structures withstand a load of 18-22% tension before they finally rupture [12].

The second mechanical function possessed by the nervous system is sliding. Sliding is the movement of a neural structure relative to the surrounding tissue. Sliding can occur longitudinally or transversally and is an essential aspect of the nerve which functions to reduce tension in the nervous system. Sliding can occur when the two ends of the container to which the neural structure is attached do not move away from each other, instead, move in the same direction. When performing the slump test, cervical extension reduces tension on the nerve structures and results in sliding motion in the distal caused by knee extension and ankle dorsiflexion. Compression is the third mechanical function possessed by nerve structures. The structure of the nerve can be distorted in various ways including changing its shape based on the amount of pressure applied to the nerve structure. A clinical example of a compression force occurs on a nerve structure when the patient performs ipsilateral cervical extension and rotation, resulting in narrowing of the intervertebral foramen space thereby increasing pressure on the nerve roots passing through it[12].

The results of a cross-sectional study conducted by Park et al in 2014, also support this study. In his study, they found that out of 24 healthy subjects who were indicated to have SHS in the dominant leg, it was stated that all had neural tension dysfunction which was confirmed by positive results on the SLR examination and slump test [10]. The same idea was explained by the research by Areeudomwong et al in 2016, on 40 healthy soccer athletes with an age range of 18 to 25 years who are indicated to have SHS in dominant limbs. Through the passive knee extension test, it was found that the intervention of the neurodynamic sliders technique had the most significant results when compared to the control group and the group that received maximal voluntary isometric contraction (MVIC). In this study, they concluded that most athletes who experience limited ROM in SHS are due to changes in individual tolerance resulting from decreased mechanosensitivity that was initially high in neural tension dysfunction following the SHS[13].

Other supporting research was shown in the study conducted by Ahmed and Shaman in 2016, on 40 healthy male subjects who were indicated to have SHS which also found that interventions that targeted the neural tension dysfunction such as neurodynamic stretching provide a more significant increase when compared to conventional stretching that only directs the muscle tissue[3]. Vakhariya et al., 2016, in their study, compared the effectiveness of several interventions that are generally aimed at short hamstring syndrome. Using 80 healthy subjects with an age range of 18 to 25 years, this study showed that interventions involving the neurodynamic tensioner component obtained more significant results when compared to some other interventions such as suboccipital muscle inhibition technique (SMIT) and static stretching. Vakhariya revealed that the occurrence of neural tension dysfunction has a very big role in the symptoms complained about by the subject with SHS[14].

Some of the results of the above studies have described that neurodynamic stretching (NDS) has a more significant result when compared with other intervention approaches in increasing hamstring flexibility in SHS. In their discussion, some of these researchers also explained that there was a change in the components of the neural structure, namely the presence of neural tension dysfunction which underlies the results of the study where NDS tended to have more significant results when compared to static stretching which was directly aimed at the hamstring muscles[5]. Short hamstring syndrome, a condition where the hamstring muscles at the back of the legs seem short and tight, can be brought on by hamstring tightness. Symptoms of this illness may include knee pain, hip discomfort, and lower back pain. Numerous things, such as muscle overuse, bad posture, being overweight, and prior hamstring injuries, might result in a tight hamstring[4,9,15].

In the SHS condition, the hamstring muscle acts as a mechanical interface. The sciatic nerve and its branches will adapt in the form of changes in mechanical properties such as the ability to elongate following a change in the hamstring muscle such as shortening[6]. Short hamstring syndrome itself may not directly cause neural tension dysfunction, but it can potentially contribute to it. Short hamstring syndrome is a condition where the hamstrings are tight and inflexible, which can lead to compensatory movements and postures that may increase tension on the peripheral nerves. This increased tension can then result in neural tension dysfunction, which is characterized by symptoms such as pain, numbness, tingling, and weakness in the affected area. However, it's important to note that not everyone with short hamstring syndrome will necessarily develop neural tension dysfunction, and other factors such as trauma, repetitive motions, or postural imbalances may also contribute to the development of neural tension dysfunction[6,16,17]. Moreover, it is said that increased tightness of the hamstring muscle is likely to generate an increase in compression load on the neural structures that pass underneath the muscle[7]. This then reduces the ability of the neural structures to slide around their container or mechanical interface. This decreased ability of the nerves to move around the container is associated with increased loads of tension generated during limb movement[7].

CONCLUSION

According to a study of five articles in the literature, findings reveal that in healthy patients with short hamstring syndrome, the neurodynamic sliding approach is successful at increasing hamstring flexibility. This inhibits the neuronal structures' ability to move about their container or mechanical interface. This reduced ability of the nerves to travel about the container is linked to increasing tension loads created during limb movement. It can be concluded that there is a connection between neurodynamic stretching on short hamstring syndrome in healthy populations and neural tension dysfunction in the lower limbs.

Comparing the results of neurodynamics in people with a history of hamstring injury and low back pain may also be helpful. This would be useful information about which method is better for easing pain and enhancing flexibility in these particular people. To better understand any potential gender differences in the effects of these stretching techniques, it would be helpful to include both males and females in future research as the current study only included subjects of one gender. Future research can provide more thorough and generalizable results on the effects of neurodynamics on people with various illnesses and backgrounds by addressing these constraints.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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