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Comparison Between the Immediate Effect of Neural Sliders Vs. Neural Tensioners on Hamstring Flexibility in Knee Osteoarthritis Patients- An Experimental Study.

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Abstract

Objective- Osteoarthritis (OA) is a progressive condition of the joints, which begins in the cartilage but also affects adjacent tissues such as bone and fluid within the synovial membrane. The increased activity of the hamstring muscles in OA is a compensation for weakness in the quadriceps, which leads to hamstring tightness. The neurodynamic approach, which targets neural tissue rather than muscle, has emerged as an alternative to traditional stretching for managing this tightness. The objective of the study was to study and compare the immediate effect of neural sliders vs. neural tensioners on hamstring flexibility in knee osteoarthritis patients using passive knee extension angle. Additionally, it examined the carryover effect of these interventions after 24 hours.

Material and Methods- This study was conducted on 72 subjects between age group of 45 to 65 having knee osteoarthritis. Participants fulfilling the inclusion criteria were enrolled and divided into two groups, Group A received neural sliders and Group B received neural tensioners. Pre and Post intervention hamstring flexibility was assessed by Passive knee extension angle(PKET). Carryover effect was seen 24hrs after intervention.

Results- Results showed significant improvement in hamstring flexibility immediately after intervention in both groups ($p < 0.0001$). However, there was no significant difference between the effectiveness of neural sliders and neural tensioners ($p = 0.967$). While seeing the carryover effect 24hrs post intervention revealed a significant decrease in flexibility for both groups ($p < 0.0001$), with no significant difference between the two techniques ($p = 0.65$).

Conclusion- The study concluded that both neural tensioners and neural sliders are equally effective in improving hamstring flexibility in Knee Osteoarthritis patients. It can also be concluded that both don't have a carryover effect 24hrs after the intervention.

***Keywords**: Carryover effect, Hamstrings Flexibility, Neurodynamic Slider, Neurodynamic Tensioners, OA Knees*

1. Introduction

Osteoarthritis (OA) is a degenerative joint condition that progresses gradually, initially affecting the cartilage and eventually involving surrounding structures like the bone, synovial fluid, and soft tissues. It is commonly identified in elderly patients, especially affecting the large weight-bearing joints of the body, such as the knees and hips. The presenting symptoms like joint pains with limited mobility, along with muscle weakness.[1]

The hamstring group plays an essential role in maintaining posture upright while standing[2]. Flexibility in these muscles contributes to overall movement efficiency, and tightness can compromise trunk stability and balance, perhaps because of the altered coordination with muscles such as the gluteus maximus and abdominals.[3]

Hamstring flexibility can be influenced by a number of variables, including neurodynamics and the viscoelastic characteristics of muscle stretch tolerance. Restriction of knee extension range motion may be the consequence of these factor's physiological adaptations.[4][5][6][7][8]

The gliding of nerves through the mobilization and placement of different joints to reduce nerve tension is known as neurodynamics.[9]

Certain theories suggest that neurodynamic mobilization increases nerve mobility by encouraging a gliding movement between nerves and neighbouring tissues. This can assist in intraneural fluid distribution, which might reduce symptoms.[10]

Furthermore, neurodynamics can result in improvements to blood flow and nerve transmission, as noted by Shacklock et al.[11] Neurodynamics was proven to be statistically significant in increasing knee range of motion in healthy women by Herrington et al.[12] and in improving pain and self-efficacy in rheumatoid arthritis patients by Lau et al.[13]

In clinical practice, neurodynamic techniques are used to mobilize peripheral nerves and adjacent structures.[11] Recently, these methods have been suggested as an alternative to traditional muscle stretching for managing hamstring tightness, as they address neural restrictions without directly elongating the muscle.[14][15]

A neurodynamic approach known as the slider nerve technique makes the neural structures slide with respect to the surrounding tissues. As a result, the tension and compression can be more evenly distributed throughout the nervous system as opposed to building up to one particular location. They are called Neurodynamic Sliders (NS).[16] Using synchronous joint movements, the second type of neural mobilization is known as Neurodynamic Tensioner (NT), which stretches the nerve bed and applies a tensile load to the nerve components. By applying stress to neural structures while operating within the tissue's elastic limit, the tensioner works similarly to a neurodynamic test.[16]

The use of neurodynamic technique will cause less stretch pain than the conventional static hamstring stretching given in OA knee treatment and can be actively done by the patients, making them less dependent. Rather than targeting hamstring muscle alone, it will also target the neural component responsible for hamstring tightness. The immediate effect by this intervention on hamstring flexibility, might improve quality of movement and early normalization of movement in knee osteoarthritis patients with hamstring tightness.

Improvement in hamstring flexibility will also improve knee range of motion. Researches have been conducted on effectiveness of neural sliders and neural tensioners on improving hamstring flexibility in normal healthy individuals but which among the neural sliders and tensioners is better in improving hamstring flexibility both immediately and 24hrs post intervention in knee osteoarthritis patients with hamstring tightness is not yet explored.

2. Material and Methodology:

Ethical clearance was obtained from the Ethical Committee. Subjects were screened for inclusion-exclusion criteria. Informed consent were taken from the included subjects. Included subjects were allocated randomly into two groups A and B by lottery method. Before intervention the passive knee extension test (PKET) of participants was done.

Group A, the participants was given neural sliders (NS) and Group B was given neural tensioners (NT). Post intervention hamstring flexibility was assessed by doing passive knee extension test (PKET). Hamstring flexibility was measured 24 hrs after the intervention to see the carryover effect of neural sliders and neural tensioners.

Study design- Experimental study

Year-2024, Period of the study- 1 year.

Participants were selected based on the following inclusion and exclusion criteria:

Inclusion Criteria:

Male and female participants aged between 45 and 65 years undergoing physiotherapy treatment for knee osteoarthritis were included. Participants diagnosed with Grade 2 or Grade 3 knee osteoarthritis according to the Kellgren and Lawrence classification system [17], either unilateral or bilateral, were considered eligible. Only individuals reporting a Visual Analogue Scale (VAS) score of ≤3 and demonstrating moderate hamstring tightness, defined by a knee extension angle between 31° and 40° [18], were included in the study.

Exclusion Criteria:

Participants were excluded if they had any orthopaedic, surgical, or neurological conditions affecting the lower limbs; any other knee injuries or deformities; a history of fracture in the affected limb within the past six months; or complaints of low back pain. Individuals who were hesitant to participate, had recent ankle injuries, had external lower limb implants, or had a hamstring strain or injury were also disqualified.

Intervention

Neurodynamic Slider (NS) involves a way of mobilization of neurologic tissues through the lengthening of one end of the nerve pathway while the other is simultaneously being shortened creating a sliding motion across adjacent tissues.[19] The neural mobilization technique was carried out in a side lying position, with the side to be treated always on top. A pillow was placed under the patient's head and between the lower limbs to maintain proper alignment and comfort. Stabilization of the thigh by one hand of the therapist was performed, while movement of the lower leg was guided by the other hand. Hip positioning was maintained in SLR, i.e., a sustained position of hip flexion throughout the intervention. During knee flexion, the ankle was kept in plantarflexion, while during knee extension, the ankle was simultaneously mobilized into dorsiflexion.

The second kind of neural mobilization is the **Neurodynamic Tensioner (NT),** which delivers a tensile load to the nerve structures by lengthening the nerve bed through synchronous joint movements.[6]. This is set to be carried out in a similar position to that of the neural slider. The intervention exercise is set to be carried out with the patient in a side-lying position, with the side to be treated on top. The pillow is supported under the head as well as between the lower limbs for patient comfort. The patient’s thigh is fixed with one hand, with the other on the ankle used for the mobilization. The hip is set to be positioned in a straight leg raise (SLR), i.e. hip flexion and maintained throughout the intervention. Knee is extended and stabilized by the therapist. The mobilization of the ankle joint is set to be carried out by alternately performing plantarflexion and dorsiflexion movements, which takes a rhythmic form.

Dosage of neural mobilization-

The application of neural mobilization (slider and tensioner) techniques was executed progressively over three sets. In the sets, there were 10, 15, and 20 reps, respectively, as per clinical standards.[11] This gradual progression reduced any negative reactions and improved participant tolerance. During or after the intervention, participants were asked to rate any symptoms, such as pain, tingling, or discomfort, on a scale of 0 to 10.[20]

3. Outcome Measures:

Passive knee extension test:

The participants were placed in a supine position on a plinth. The contralateral limb was fixed in a state of full extension with the use of a strap fastened around the mid-thigh area. The hip on the side of the tested limb was passively flexed to 90° by the therapist, with the thigh fixed in a vertical position. The knee on the tested side was fixed in a position of 90° flexion.

Goniometer:

Extension of the knee joint was measured with a goniometer. The mobile part of the goniometer was set parallel to the lateral malleolus, while the fixed part of the goniometer was directed towards the greater trochanter, with the fulcrum over the lateral joint line of the knee.[21]

4. Results and Statistics

Descriptive statistics were used to calculate the mean and standard deviation for the outcome variables. The Shapiro-Wilk test was applied to assess the normality of the data, with a significance level set at $p < 0.05$. Parametric tests were employed for normally distributed data, while non-parametric tests were used for data that did not follow a normal distribution. Within-group comparisons of pre-intervention, immediate post-intervention, and 24-hour post-intervention values for the Passive Knee Extension (PKE) test in Group A and Group B were analyzed using the paired *t*-test, as the data were normally distributed. For between-group comparisons, the Mann–Whitney *U* test was applied, as the data did not meet the assumptions of normality.

Table 1: Data of inter group comparison of PKET values.

PKET	**DIFFERENCE OF GROUP A AND B**	
	Group A	**Group B**
Mean	12.694	13.806
Mean difference	1.1	
SD	2.54	2.35
P value	0.967	

Table 2: Data of inter group comparison of PKET values 24hrs after intervention.

PKET	**DIFFERENCE OF GROUP A AND B after 24hrs**	
	Group A	**Group B**
Mean	4.56	4.75
Mean difference	0.19	
SD	0.91	1.76
P value	0.65	

The results revealed that 72 subjects having OA knee, 34 were male and 38 were females. With the mean age 54.19 ± 5.24 of subjects. When comparing the pre and post values of PKET in group A (NS group). There was extremely significant changes in hamstring flexibility with a mean difference of 12.83, and a p value <0.0001, but while seeing the carryover effect there was a significant decrease in the hamstring flexibility with a mean difference of -4.69, with p value <0.0001.
When comparing the pre and post values of PKET in group B (NT group). There was extremely significant changes in hamstring flexibility with a mean difference of 13.62, with p value <0.0001, but

while seeing the carryover effect there was a significant decrease in the hamstring flexibility with a mean difference of -4.42, with p value <0.0001. When comparing the mean difference of both the groups there was no statistically significant difference with a mean difference of 1.1, and p value = 0.967. Similarly, when comparing the inter group difference of mean PKET 24hrs after intervention there was no statistically significant difference with a mean difference of 0.19, with p value = 0.65.

5. Discussion:

Osteoarthritis (OA) is considered a significant public health concern, according to World Health Organization reports. It is one of the main factors contributing to reduced function and lower quality of life (QOL) globally. [22]

The quadriceps and hamstrings, which are the two main muscles involved in knee joint movements, help with precise and efficient ambulation. The correlation between OA Knee and tight hamstrings is crucial because tight hamstrings may contribute to increased knee joint stress, which may limit knee range of motion, and result in compensatory movements that exacerbate the disorder and make the condition worse.[23]

There was a significant improvement in hamstring flexibility post intervention in group A, that were subjects who were given neural sliders. This effect may be attributed to a reduction in the mechanosensitivity of neural tissue, which subsequently decreases tension within the extraneural interface. As a result, it may help prevent the formation of adhesions between the nerve and adjacent tissues, while also enhancing the viscoelastic properties of the tissue—factors that collectively contribute to improved flexibility. [24]

Similar findings were found on the immediate impact of sciatic nerve sliders on hamstring length and lumbar flexion range of motion in sedentary desk workers. According to the author’s hypothesis ,the neurodynamic sliders should have reduced the intrameningeal sensitivity. The authors state that a positive neural tension sign has been clinically demonstrated to indicate the importance of intrameningeal mechanosensitivity in the etiology of hamstring injury. [24]

In a study comparing the effects of sciatic nerve gliding and lower extremity dynamic stretch on athlete’s hamstring flexibility, the researcher found that sciatic nerve gliding increased hamstring flexibility in football players more effectively than dynamic stretching.[25]

The study revealed that the flexibility seems to decrease after 24 hrs when seeing the carryover effect of neural sliders in group A. Similar results were seen in a 2023 double-blind randomized control study that was conducted to examine the immediate and long-term effects of neurodynamics on straight leg raise ranges in acute prolapsed intervertebral disc patients. The results indicated that the VAS score, PSC score, and SLR ranges were not maintained 72 hours after the intervention.[26]

In a study by Ridder et al., neurodynamic sliders were used to increase flexibility in people with tight hamstring syndrome. The neurodynamic group showed a greater carryover effect in flexibility immediately following the intervention when compared to the control group, but both groups experienced a similar loss in flexibility gain during the retention-analysis period after four weeks.[27]

The improvement in hamstring flexibility in group B (NT group) might me due to a similar reason of neural sliders, i.e. Due to release movement of nerve bed increases the flexibility of neural tissue and decreasing sensitivity can be an additive effect for the particular finding. One of the authors proposed that variations in an individual's tolerance for the stretch could be the cause of an increased knee extension angle. Additionally, the acute stretch's strong afferent input may lower the firing rates of mechanoreceptors and proprioceptors, which could influence sensory adaptation, permit increased joint range of motion, and improve PKET values.[28]

The 24-hour reduction in hamstring flexibility observed in Group B may indicate that stretching alters muscle elasticity, affecting Golgi tendon organ sensitivity and allowing prolonged muscle lengthening. This response may occur soon after stretching, as the elastic components of the tendon recoil to a new equilibrium. Thus, proving the reduced hamstring flexibility 24hrs after the intervention.[29]

Findings in line with our study were found in a 2024 study by D'souza et al. that examined the immediate effects of various neural mobilization exercises on hamstring flexibility in recreational soccer players. Specifically, both neural sliding and neural tensioning exercises increase hamstring flexibility. Though this difference was small and might have resulted from measurement inaccuracies participants in the neural tensioning group showed improvement in hamstring flexibility more than those in the neural sliding group.[30]

Neural tensioning and sliding mobilization procedures are known to release movement in the nerve bed clinically, according to a prior study comparing the effects of various sciatic nerve mobilization exercises.[31] This could be one of the causes of the same outcome in both exercise.

In contrast to our findings, a different study found that when it comes to neural mobilization strategies, sliders are superior to tensioners for patients with short hamstring syndrome. Sliders were more comfortable and beneficial for patients, causing them less discomfort because they were less aggressive. The physiological explanation for this is because sliding techniques entail a series of motions that lengthen the nerve bed at one joint while shortening it at a neighbouring joint. These are less forceful than tension techniques and have a biomechanical impact on the nervous system. Here, progress is achieved by gradually increasing both the patient's comfort level and the distance between the two ends of the nerve.[32]

An author conducted a similar study comparing the short- and long-term effects of tensioner and slider neurodynamic techniques on knee extension range of motion and pain in the slump position. The study found that only in the immediate postintervention period did both groups experience a significant improvement in knee extension range and pain intensity. However, after one week and the second day of the intervention, no discernible difference was observed.[33]

The study concluded that both neural tensioners and neural sliders are equally effective in improving hamstring flexibility in knee osteoarthritis patients. It can also be concluded that both neural tensioners and sliders do not have a carryover effect 24hrs after giving the intervention. However, the limitation of the study was that duration of how long the patient has been taking conventional treatment was not regulated. Future research may include studies examining, mild and severe hamstring tightness in OA knee patients, while observing the long term effects of neural sliders and neural tensioners. Additionally, the effect of neural sliders and neural tensioners on pain and improvement in functional activities in OA knee can also be seen. Further studies on comparing the effectiveness of static hamstring stretching vs. neural mobilization of sciatic nerve in improving hamstring flexibility in OA knee patients can be done.

6. Conclusion:

The body of evidence indicates that neural mobilization techniques, including neural sliders and neural tensioners, can enhance hamstring flexibility and may reduce neural mechanosensitivity in various populations. In the context of knee osteoarthritis (OA), this suggests that addressing hamstring tightness through targeted neural mobilization could improve joint range of motion and potentially alleviate compensatory stresses on the knee. Comparative findings show that both sliders and tensioners can yield immediate improvements in flexibility, with some studies reporting similar short-term gains and limited or absent carryover after 24 hours or longer retention periods. The heterogeneity of study designs, populations (athletes, sedentary workers, OA patients), and intervention protocols highlights the need for cautious interpretation and emphasizes that neural mobilization should be considered as part of a multimodal OA management plan rather than a standalone cure.

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