



Short Term Effects of Neurodynamic Stretching and Static Stretching Techniques on Hamstring Muscle Flexibility in Healthy Male Subjects

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ABSTRACT

Flexibility is a key component of rehabilitation and inadequate muscle extensibility remains a commonly accepted factor for musculoskeletal disorders. Studies on the most optimal technique for improving muscle flexibility are a widely debated. The aim of the study was to compare the effectiveness of neurodynamic and static stretching techniques on hamstring flexibility in healthy male subjects. This study was a randomized experimental trial; forty healthy male subjects with hamstring tightness were randomly divided into two equal groups: The neurodynamic group and the static stretching group. Treatment was given for 5 consecutive days and the outcomes were measured using Active knee Extension Test and Straight Leg Raising. There was a significant improvement in hamstring flexibility following application of both neurodynamic and static stretching but the improvement in the neurodynamic group ($p < 0.001$) was better than that of the static group ($p < 0.02$). Results suggest that a neurodynamic stretching could increase hamstring flexibility to a greater extent than static stretching in healthy male subjects with a tight hamstring.

Key words: neurodynamic, static stretching, flexibility, hamstring muscle.

INTRODUCTION

Flexibility is an important factor in physical fitness that enables smoothly and safety movement.^[1] Hamstring muscles have an important role in the performance of daily activities such as controlled trunk movement, walking, and jumping.^[2] The hamstrings flexibility have been successfully prescribed for relief of low back pain which was found to be increased in subjects' with hamstring tightness.^[3] Poor hamstring flexibility appears to be one accepted factor causes of hamstring injuries,^[4] musculoskeletal disorders and reduction in physical performance.^[5] Hamstring muscle injuries are one of the most common musculoskeletal tendinous injuries in the lower extremity.^[6]

Stretching exercise is the most therapeutic technique used to improve and maintain muscle length.^[7] Several stretching methods have been used to improve muscle flexibility, including the static stretching, contract-relax stretching, ballistic stretching and neurodynamic.^[8-10] Each of these interventions has demonstrated clinical and experimental success; no agreement has been reached on a standard protocol for treatment. It is believed that static stretching is the most frequent, effective and safest method of stretching.^[11] Static stretching is done in a static state without any additional movement other than the motion of the muscle stretch, it works to improve the viscoelastic properties and stretch tolerance of the muscle.^[12] It was demonstrated that the optimal time for a static stretch is 30 seconds one time per day.^[13]

Neural tissues involvement to hamstring flexibility has been studied in the literature.^[14,15] During daily activities, the sciatic nerve which innervates the hamstrings is exposed to constant pressure during prolonged sitting, standing and other activities resulting in hamstring tightness.^[16] Nerve adhesions in the hamstring may alter neurodynamics

causing abnormal mechanosensitivity of the sciatic nerve; which could influence hamstring flexibility.^[17] This mechanosensitivity of the neural tissue could limit hamstring length in normal healthy individuals.^[18]

Neurodynamic is a manual method of stretching in which force is applying to nerve structures through posture and multi-joint movement^[19], aiming to produce a sliding movement of neural structures relative to their adjacent tissues.^[20] Neurodynamic is thought to decrease neural mechanosensitivity and can be a beneficial technique in the management of hamstring flexibility.^[21]

However, studies compare between the effects of neurodynamic and static stretching techniques on hamstring flexibility are rare. The aim of this study is to investigate the short effects of neurodynamics and static stretching techniques in healthy male subjects with decreased hamstring fallibility.

MATERIALS AND METHODS

This study was a randomized experimental trial. Approval to conduct the study was obtained from the scientific research committee of the university. Informed consent was received prior to the intervention from each subject. Forty healthy male subjects were selected to the study, which was conducted at the outpatient clinic of physical therapy, faculty of Applied Medical Science, Prince Sattam bin Abdulaziz University, AL Kharj, Saudi Arabia between December 2015 and March 2016.

The inclusion criteria: subjects were included in the study if their age ranged between 18 and 26 years with hamstring tightness of 20° (inability to achieve greater than 160° of knee extension with hip at 90° of flexion)^[22] and also inability to reach 70 degree hip flexion in a Straight Leg Raise (SLR).^[23]

The exclusion criteria: subjects were excluded if they had any neurological or orthopedic diseases affecting their lower extremity, hamstring injury, acute or chronic low back pain, or who already involved in any exercise programs for lower extremity in the last three months.

All subjects were screened according to the inclusion and exclusion criteria, and randomly assigned into two equal groups (20 each); the neurodynamic group and static stretching groups.

Methods

Demographic data were obtained from all subjects at the beginning of the study. Measurements for both groups were taken as a baseline on the 1st day and posttest in the 5th day. Assessment would be done approximately at the same time in the day by trained senior physiotherapist. The treatment would be given as one treatment session in a day for 5 consecutive days.

Outcome measurement

Measurements of hamstring flexibility were obtained using the Active Knee Extension (AKE) test and Active Straight Leg Raise (SLR).

The active knee extension is a measure of hamstring flexibility; it was performed while the subject lies supine on the examination table wearing shorts or underwear.^[24] With the dominant (tested) hip and knee flexed to 90° degrees, held in position by a wooden box, and the non-tested lower extremity secured to the table by Velcro strap across the middle of the thigh. While the subject maintaining a relaxed foot position, he was asked to extend his knee as far as he is comfortably able, keeping the posterior aspect of the thigh in contact with box and stop at the point where he first felt the stretch sensation in the posterior thigh area. The angle of the knee extension was measured using a universal full circle goniometer (Enraf Nonius, Netherlands) by measuring the angle between a line drawn from the mark just distal to the greater trochanter and the mark on the femoral condyle, with other line drawn from the mark on the fibular head to a mark just proximal to the lateral malleolus. A total of 3 measurements were recorded and a mean angle of the extension will be recorded for analysis. AKE was found to be valid and reliable for measuring of hamstring muscle length.^[25]

The Straight Leg Raise (SLR) is used to measure hamstring flexibility, while the subject lying supine on the examination table with the other limb secured by a velcro strap. The subject is asked to lift his lower extremity up, maintain his knee extended, to the point where he first felt a stretch in the posterior thigh. The measurement was

taken of the straight leg to the horizontal angle between the horizontal and the line between the mark just distal to the greater trochanter and the mark just proximal to the lateral malleolus. SLR was found to be a valid and reliable test for measuring the hamstring flexibility.^[26]

Intervention

The Neurodynamic group was received neurodynamic sliding stretching for the sciatic nerve. While subjects in lying supine and their neck and thoracic spine supported in a forward flexed position. Concurrent hip and knee flexion were alternated dynamically with concurrent hip and knee extension. The therapist alternated the combination of movement depending on the tissue resistance level. This combination of movements was performed for 180 seconds on their dominant lower extremity.^[27]

The Static group was received stretching of the hamstring muscles in their dominant leg. While subjects in lying supine, the dominant lower extremity would passively position into SLR position (hip in flexion, knee in extension, and ankle in neutral) without pain/discomfort to the point where resistance to the movement was first noted. This position was then maintained for 30 seconds and repeated further 5 times. During the 30 second stretches, the therapist monitored the subjects to ensure they did not make any compensation that could modify the stretching position. Each subject had a total of 180 seconds of stretching on their lower extremity.^[28]

Data Analysis

The data were calculated using the Statistical Package for Social Sciences (SPSS) version 20, a *t-test* was used to compare the effectiveness of both types of stretching. The Paired *t*-test was used to compare pre and post values within both groups. The unpaired *t*-test was used to compare pre-post mean difference values between neurodynamic and static groups. The level of significance was set at a *p*-value 0.05.

RESULTS

The physical characteristics (mean age, height and weight) values showed non-significant differences in both groups $P > 0.05$ (table 1).

Table1. The physical characteristics (Age, height and weight) of neurodynamic group and static group

| Group | Age (years) Mean \pm SD | Height (cm) Mean \pm SD | Weight (kg) Mean \pm SD |
|--------------------|------------------------------|------------------------------|------------------------------|
| Neurodynamic group | 22.0 \pm 2.4 | 167.2 \pm 4.5 | 68.7 \pm 5.1 |
| Static group | 22.3 \pm 1.8 | 168.8 \pm 3.2 | 67.5 \pm 4.9 |
| P. value | 0.805 | 0.804 | 0.787 |

The difference between AKE and SLR of the neurodynamic and static group before treatment were calculated. The differences were non-significant for both groups $P > 0.05$, as shown in the table (table 2 and 3).

Table 2. The difference between baseline (1st da) and post (5th day) AKE of the neurodynamic and static group

| | Neurodynamic group | Static group | P. Value |
|-------------------------------|--------------------|-------------------|----------|
| Baseline(1 st day) | 143.49 \pm 5.95 | 142.84 \pm 6.23 | 0.621 |
| Post(5 th day) | 158.6 \pm 4.66 | 152.3 \pm 4.74 | 0.001 |
| P. Value | 0.001 | 0.02 | |

The difference within baseline (1st day) and post (5th day) treatment AKE and SLR values of the neurodynamic and static group were analyzed. The differences were significant in both groups suggesting that both interventions were effective in increasing hamstring flexibility (table2, table3). However, the difference was found more in the neurodynamic group as compared to the static group which was extremely significant, as shown in the table (table 2 and 3).

Table 3. The difference between baseline (1st da) and post (5th day) SLR of the neurodynamic and static group

| | Neurodynamic group | Static group | P. Value |
|-------------------------------|--------------------|------------------|----------|
| Baseline(1 st day) | 57.11 \pm 3.47 | 56.92 \pm 2.75 | 0.623 |
| Post(5 th day) | 69.21 | 65.31 | 0.001 |
| P. Value | 0.001 | 0.02 | |

DISCUSSION

This study was designed to compare between the short term-effect of neurodynamic and static stretching in improving hamstring muscle flexibility. Results revealed that both interventions significantly improve hamstring flexibility, but neurodynamic has a greater short-term effect in improving hamstring flexibility more than static stretching.

Studies on the most optimal technique for improving muscle flexibility are a widely debated. It was concluded that the contractile tissue is not the only cause of soft tissues restriction but also the non-contractile tissues such as deep fascia, soft tissues surrounding the joint and the neurological tissues can limit the range of motion.^[29]

The results of this study showed improvement in hamstring flexibility after the application of both neurodynamic and static stretching which could be the result of an increase tolerance to stretch^[30]. It was stated in the literature that static stretching is the commonest forms of stretching^[31], it results in viscoelastic changes in the muscle connective tissues that may improve muscle flexibility.^[32]

The improvement in hamstring flexibility following neurodynamic stretching came in consistence with previous studies. A significant increase in ROM was demonstrated after a neurodynamic sliding technique to 28 healthy football players using the passive SLR test.^[14]

Also, greater improvement in ROM was observed following application of a neurodynamic sliding technique to the hamstrings of healthy male soccer players, than that after general stretching.^[15] These findings can be explained as following; when tension is applied to the nervous system during neurodynamics application, there is a reduction of the cross-sectional area and increase in pressure in the nerve result in movement of the sciatic nerve together in compliance with the hamstring muscle, resulting in increased flexibility.^[33, 34]

Another possible explanation for the improvement in hamstring flexibility after neurodynamic stretching is related to decrease in neuropathomechanics that develop in the nervous system as a result of prolonged sitting which is believed to increase neural tissue mechanosensitivity causing protective mechanism when stresses and limit extensibility of muscle^[35]. Neurodynamic stretching is said to cause deflection of the sciatic nerve in the posterior thigh^[36] and decrease in the mechanosensitivity of the neural tissues that result in improvement of hamstring flexibility.^[37] Neural mobilization improves neurodynamics, maintaining a dynamic balance between neural tissues and surrounding mechanical interfaces and thus inhibiting the mechanosensitivity.^[38] Neurodynamics increases the activity of muscles more significantly than that observed at rest.^[39]

Limitations of the study

It appears to be difficult to generalize the results of this study due to the small number of subjects. Also, this study determines only the short term effects of neurodynamics and static stretching. In the future, studies on the long-term effects of both techniques including more subjects, both genders should be performed. Also it would be interesting to compare the effect of the two types of stretching used in this study in subjects with a history of hamstring injury and low back pain.

CONCLUSION

It can be concluded that neurodynamic and static stretching are effective in increasing hamstring flexibility in healthy male individuals, but neurodynamic stretching showed a more significant effect as compared to static stretching.

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