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Original Article

Effect of modified hold-relax stretching and static stretching on hamstring muscle flexibility

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Abstract. [Purpose] The aim of present study was to compare the effectiveness of modified hold-relax stretching and static stretching in improving the hamstring muscle flexibility. [Subjects and Methods] Forty-five male subjects with hamstring tightness were included in this study. The subjects were randomly placed into three groups: the modified hold-relax stretching, static stretching and control groups. The modified hold-relax stretching group performed 7 seconds of isometric contraction and then relaxed for 5 seconds, and this was repeated five times daily for five consecutive days. The static stretching group received 10 minutes of static stretching with the help of a pulley and weight system for five consecutive days. The control group received only moist heat for 20 minutes for five consecutive days. A baseline reading of passive knee extension (PKE) was taken prior to the intervention; rest measurements were taken immediate post intervention on day 1, day 3, day 5, and after a 1 week follow-up, i.e., at the 12th day. [Results] On comparing the baseline readings of passive knee extension (PKE), there was no difference noted between the three groups. On comparing the posttest readings on day 5 between the 3 groups, a significant difference was noted. However, post hoc analysis revealed an insignificant difference between the modified hold-relax stretching and static stretching groups. There was a significant difference between the static stretching and control groups and between the modified hold-relax stretching and control groups. [Conclusion] The results of this study indicate that both the modified hold-relax stretching technique and static stretching are equally effective, as there was no significant difference in improving the hamstring muscle flexibility between the two groups.

Key words: Modified hold-relax stretching technique, Static stretching, Flexibility

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INTRODUCTION

Flexibility is a vital component of a physical conditioning programme that allows the tissue to accommodate easily to stress, to dissipate shock impact, and to improve efficiency of movement, thus minimizing or preventing injury[1)]. A previous study reported that flexibility is important to general health and physical fitness, and hamstring flexibility exercise has been successfully prescribed for relief of low back pain[2)]. The prevalence of low back pain was found to be increased in subjects having tight musculature in the lower spine as well as the hamstring muscles[3, 4)].

Various treatment methods have been used to improve flexibility such as the spray and stretch technique, soft tissue mobilization technique, stretching (static, ballistic, and proprioceptive neuromuscular facilitation) technique, and muscle energy technique[2, 5, 6)].

The most widely used method for increasing muscle flexibility is stretching[7)]. Apart from static stretching, modified hold-relax stretching is now used in many different manual therapy professions. These exercises are designed to enhance the neuromuscular response of the proprioceptors. They have been found to be effective in a variety of conditions, such as in increasing the length of shortened muscle, strengthening weak muscles, increasing lymphatic or venous return to aid the drainage of fluid or blood, and increasing the joint range of motion (ROM) of a restricted joint[8)].

Several researchers have examined the effect of contract-relax techniques (similar to modified hold-relax stretching) on hamstring flexibility and found that these techniques produced increased muscle flexibility[9–11)]. Handel et al. reported significant increases in hamstring flexibility along with an increase in passive torque of muscle after a contract-relax exercise program. Similarly, Wallin et al. reported that the contract-relax technique was more effective than ballistic stretching for improving muscle flexibility over a 30-day period, whereas other researchers have reported no difference between the two techniques[9, 11)].

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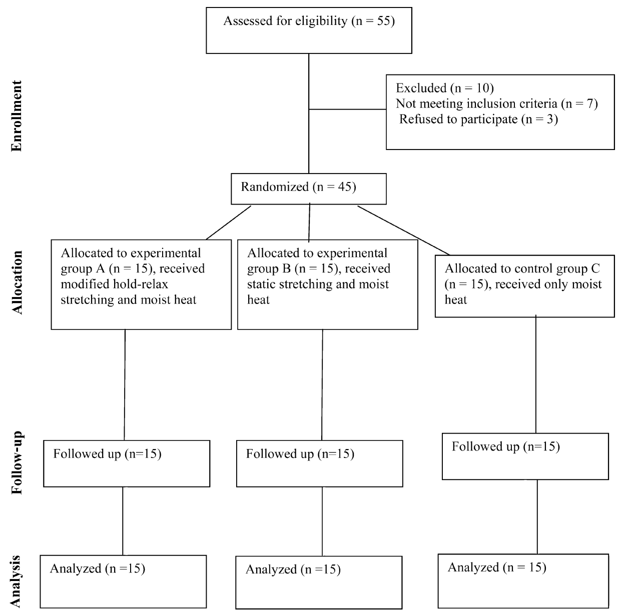

Fig. 1. Consort diagram showing the flow of participants through each stage of the randomized trial

A systemic review of the literature with the aim of uncovering the effect of hamstring stretching on range of motion concluded that it is difficult to confidingly identify the most effective hamstring stretching method[12]. Further, Feland et al. reported that contract-relax and static stretching had similar benefits in improving hamstring flexibility in the elderly population[13]. However, the increase was much greater for their contract-relax proprioceptive neuromuscular facilitation group as compared with their control and static groups. Till recently, no studies have compared modified hold-relax stretching and static stretching with respect to improvement of hamstring flexibility. Therefore, the aim of the present study was to compare the effectiveness of modified hold-relax stretching and static stretching in improving hamstring muscle flexibility.

SUBJECTS AND METHODS

Subjects

A total of 45 subjects with hamstring muscle tightness were included in the study. The criteria for inclusion were healthy male between the ages of 20 and 30 years with hamstring muscle tightness of 20 degrees (inability to achieve greater than 160° of knee extension with hip at 90° of flexion is considered hamstring tightness). Subjects were excluded if they had neurological problem in the lumbar region, any deformity of the knee, hip, and back, history of participation in a stretching or yoga program in the last six months, history of trauma at the hip, knee, or back, or any injury to the hamstring and other muscles in the lower limb. The study received ethical clearance, and informed consent was received prior to the intervention from each subject. All experiments were conducted according to the Declaration of Helsinki. The subjects were screened according to the inclusion criteria. They were randomly allocated through the chit box method into three groups (Fig. 1)[14]. Measurements of the dependent variable were obtained by another therapist who was blinded to group assignment.

Table 1. Subject characteristics

Characteristics	Group A N=15	Group B N=15	Group C N=15
Age (years)	25.1 (2.9)	24.7 (3.5)	25.3 (2.9)
Weight (kg)	65.6 (4.8)	66.3 (3.8)	66.9 (2.5)
Height (m)	1.6 (0.8)	1.6 (0.5)	1.6 (0.1)
BMI (kg/m^2)	24.8 (2.0)	24.6 (1.1)	24.9 (1.3)

Values are means (SD)

Methods

Group A received moist heat and modified hold-relax stretching; Group B received moist heat and static stretching, whereas Group C received only moist heat.

For moist heat, a hot pack (at a temperature of 71 °C) was applied over the posterior aspect of the thigh for 20 minutes for 5 days[15].

For modified hold-relax stretching, each subject in group A was comfortably positioned in a supine lying position on a plinth with the hip fixed at 90 degrees of flexion, and a therapist then stretched the hamstrings passively until the subject felt and reported a mild stretch sensation; that position was held for 7 seconds. The subjects were asked to perform maximal isometric contractions of the hamstrings for 7 seconds by attempting to push their leg back toward the table against the resistance of the therapist[16]. After the contraction, the subjects were instructed to relax for 5 seconds. This sequence was repeated 5 times in each session for 5 consecutive days in this experimental group[16].

For static stretching, each subject in group B was comfortably positioned in a supine lying position on a plinth, and to maintain the knee in as much as extension position, a splint was applied to the anterior aspect of the knee. A pulley and weight system (4.55 kg) was used to apply static traction. This stretched the hamstring muscles while providing a constant stretch torque. The stretch was maintained for 10 minutes in each session for 5 days[16].

The outcome measure selected for this study was passive knee extension range of motion. Measurements were taken at baseline and on, day 1, day 3, day 5, and day 12.

Statistical analysis was performed using the SPSS 15.0 Software (SPSS Inc., Chicago, IL, USA). Repeated measure ANOVA was applied for comparison of passive knee extension within the groups. Further post hoc analysis was done using Bonferroni correction. One-way ANOVA was applied to compare passive knee extension between the groups. The results were taken to be significant at $p<0.05$.

RESULTS

Table 1 details the subject's characteristics. Table 2 details the results. The baseline readings of all three groups were not statistically significant ($p=0.568$). Comparison of group A and group B showed that there was no significant difference in baseline readings ($p=0.897$). Similarly, there

Table 2. Comparison of passive knee extension (PKE) between the groups

Variables	Group A	Group B	Group C
Baseline	27.8 (3.8)	29.2 (3.8)	28.3 (2.7)
Day 1	23.1 (3.8)	21.8 (4.1)	27.4 (2.9)†‡
Day 3	21.4 (3.6)	19.6 (4.1)	27.3 (3.1)†‡
Day 5	19.7 (3.7)	17.2 (3.7)	27.2 (2.8)†‡
Day 12	19.7 (3.7)	17.5 (3.7)	27.1 (3.1)†‡
Change	8.1 (0.1)*	11.7 (0.1)*	1.3 (0.4)†‡

Values are means (SD) for range of motion (degrees); * Significant at $p < 0.05$ (ANOVA); †Significant between groups A and C; ‡Significant between groups B and C; Change from baseline to day 12

was no significant difference between group B and group C and between group A and group C (p>0.05).

The post-test readings on day 1 were found to be statistically significant between the three groups (p=0.001). However, post hoc analysis revealed a nonsignificant difference between group A and group B (p>0.05).

Similarly, the post-test readings on day 3 were also found to be statistically significant between the three groups (p=0.001). However, post hoc analysis revealed a nonsignificant difference between group A and group B (p=0.501).

Further, the post-test readings on day 5 were also found to be statistically significant between the three groups (p=0.001). However, post hoc analysis revealed a nonsignificant difference between group A and group B (p=0.171).

Comparison of the final readings, i.e., posttest readings on day 12, using one-way ANOVA revealed a significant difference between the three groups (p=0.001). However, post hoc analysis revealed a nonsignificant difference between group A and group B (p=0.279).

DISCUSSION

This study was designed to compare the effects of modified hold-relax stretching and static stretching in improving hamstring muscle flexibility. The results of our study indicate that both modified hold-relax stretching and static stretching are effective methods to improve hamstring flexibility.

Modified hold-relax stretching improves flexibility through relaxation of the contractile component of the muscles, while static stretching causes an increase in elasticity of the noncontractile viscoelastic component[9]. Thus, our study demonstrated that both of these mechanisms play equal roles in improving the flexibility of the muscles.

The finding of our study concurs with other previous studies that have reported similar results. Feland et al. reported that contract-relax and static stretching had similar benefits in improving flexibility[13]. Similarly, Gribble et al. found that static and hold-relax stretching were equally effective in improving hamstring range of motion[9]. Recently Lim et al. reported similar effects of static and PNF stretching on hamstring muscle extensibility[17].

A possible mechanism for the improvement of hamstring range of motion relies on the effects of autogenic inhibition. Autogenic inhibition is contingent on the function of the Golgi tendon organs, which not only detect changes in length but also changes in tension. Tension is produced in the antagonists with both static and PNF hamstring stretching techniques. Therefore, the presence of autogenic inhibition would not be affected if the measurement technique was an active or passive stretch or if the training method was a static or hold-relax stretch[9].

Another possible mechanism for the increase in range of motion is augmentation of stretch tolerance. This is supported by Halbertsma et al., who reported an increase in hamstring flexibility in their study[16]. Sharma et al. reported stretching along with warming up is an effective way to improve hamstring flexibility[18]. Moreover, their participants reported an increase in pain tolerance at the end of study. They attributed the gains in flexibility to an increase in stretch tolerance.

It would be interesting to compare the effect of modified hold-relax stretching and static stretching in subjects with a history of hamstring injury and low back pain. It is possible that such conditions involve deposition of abnormal fibrous tissue and cross linkages, and may respond differently in healthy muscles. Further research comparing active knee extension and passive knee extension measurements may be useful in determining the best method for testing the effectiveness of modified hold-relax stretching and static stretching in improving hamstring flexibility.

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