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EFFICACY OF MODIFIED PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION STRETCHING WITH CRYOTHERAPY OVER MANUAL PASSIVE STRETCHING WITH CRYOTHERAPY ON HAMSTRING FLEXIBILITY

¹Dr. Shamik Bhattacharjee (PT)²Dr. Masih Muhammad Khan (PT)³Dr. Pritam Deka (PT)^{*4}Dr. Abhijit Dutta (PT)

ABSTRACT

Background: Healthy individuals, to ease and accomplish their activities of daily living they need flexible body without any tightness in the muscles, particularly those used for a definite function. Cooling soft tissues in a lengthened position after stretching has been shown to promote more lasting increases in soft tissue length and minimize post stretch muscle soreness. There are less documented studies which compared modified proprioceptive neuromuscular facilitation (PNF) stretch over passive manual stretch with cold application commonly after the interventions.

Methods: Thirty high school going healthy students were divided into two groups- Group I received Passive Manual stretching (n=15) and Group II received modified PNF stretching (n=15) and both groups received cold application after the interventions for 10 minutes commonly for 5 days. ROM was taken on day 1, day 5 and day 7.

Results: After day 7, Group II with Modified PNF stretching along with cold application showed a significant increase in range of motion tested with active knee extension test (AKET).

Conclusion: Modified PNF stretching is considered to be the effective intervention in increasing and maintaining ROM in AKET over passive manual stretching with cold applications commonly after the interventions.

Keywords: AKET, modified PNF, passive manual stretching, cold application, hamstring flexibility etc.

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¹Co-Founder And Consultant ,
Vardaan Doctor's Plus Physiotherapy Care,
Guwahati, Assam

²Ex-Principal,
Krupanidhi College of Physiotherapy, Bangalore
Physiotherapist at Tender Touch Rehab Services,
Brooklyn, New York

³Assistant Prof. Assam Down Town University
Panikhaiti, Guwahati, Assam.
Co-Founder and Consultant,
Vardaan Doctor's Plus Physiotherapy Care,
Guwahati, Assam.

CORRESPONDING AUTHOR

^{*4}Dr. Abhijit Dutta (PT)

Author cum Corresponding Author,
Associate Prof, HOD dept. of Physiotherapy,
Assam down town University, Panikhaiti,
Guwahati, Assam.

INTRODUCTION

Flexibility has been an important factor both to physical therapy treatments and to sports practice. It is known that the flexibility exercises are likely to provide physical, postural and mental improvements [1]. Their aims usually include reducing the risks of injuries, minimizing late-occurring muscle pain and improving general muscle performance [2]. On the other hand, loss of muscle flexibility is revealed through reduced capacity of a muscle to be deformed, thus resulting in reduced ROM [3]. Chandler defined flexibility as “the ability of the joint to perform movement in a range of movement (ROM) without stress on the tendon-muscle unit” [4]. Adequate flexibility is an important characteristic of physical fitness. There continues to be debate regarding the optimal technique(s) for stretching and flexibility training [5]. Flexibility exercises are designed to increase tissue elasticity, thereby increasing range of motion (ROM) of specific joints. Increased ROM is believed to both enhance athletic performance [6] and decrease the severity and frequency of injuries. Several stretching techniques are used to increase joint range of motion (ROM) [7].

Stretching is a general term used to describe any therapeutic manoeuvre designed to increase the extensibility of soft tissues, thereby improving flexibility by elongating (lengthening) structures that have adaptively shortened and have become hypomobile over time [8]. Different types of stretching techniques which are used are static, ballistic, passive manual stretching and proprioceptive neuromuscular facilitation (PNF) stretching. Various studies in the past shows that application of ice may provide enhanced short-term improvements in hamstring flexibility over heat or stretching alone. Studies also suggested that modified PNF stretching alone or in conjunction with heat or cold resulted in significant increase in hamstring length in uninjured, normal, healthy individuals, which includes student population (age group-16 to 35 years) and also that modified PNF stretching is better than passive stretching in improving hamstring flexibility. But in all studies, cryotherapy has been used before or during stretching. Thus, the proposed study intends to find the efficacy of cold application post passive stretching versus cold application post modified PNF stretching in improving and maintaining hamstring flexibility in normal young healthy high school students.

MATERIALS AND METHODS

Subjects fulfilling the selection criteria like tight hamstring muscles (the inability to achieve greater than 160 degrees of knee extension with the hip at 90 degree of flexion)^o, healthy subjects who had not indulged in any sports activity or any kind of physical exercise program were recruited, no history of endocrine or thermoregulatory disorders, arthritic conditions, or musculoskeletal injuries were included in the study. Subjects with previous lower back or hamstring injury, bony block limiting joint motion, metal pins, plates or screws in the pelvis/ femur/ tib-

ia/ fibula, recent fracture, and bony union is incomplete, evidence of an acute inflammatory or infectious process (heat and swelling), sharp, acute pain with joint movement or muscle elongation, hematoma or other indication of tissue trauma is observed, hypermobility already existing, subjects with an athletic profile. The study setting was B. K. Bajoria school in Shillong and the main study was in schools in and around Bangalore. Subjects were male students of class 10, 11 and 12 aged between 16-20 years. A total of 30 subjects were selected from a population of 82 and divided into 2 groups of 15 subjects each by simple randomization.

Group I was given manual passive stretching followed by cryotherapy and Group II was given modified PNF stretching followed by cryotherapy. Pre-test and post-test data for active ROM was collected before and after intervention.

PROCEDURE

The study was carried out in three stages (A) Pre-intervention measurement (B) Intervention (C) Post-intervention measurement.

A) Pre-intervention measurement:

Measurement of supine active knee extension to check the hamstring flexibility for both the groups was taken. Subjects were instructed to assume a supine position, with the hip and knee flexed at 90 degree, verified with goniometric measurements. Each subject's pelvis was secured to the couch with a strap over the anterior superior iliac spines. Another strap was placed over the mid-thigh of the contra lateral limb to secure it to the table. While maintaining 90° of hip flexion, subjects were asked to actively extend the knee as far as possible. Once they could no longer extend the knee, or the hip began to lose the 90° angle as determined by the goniometer, the angle of knee flexion was then obtained. (B) Intervention: The testing occurred over a 1 week period, with each subject in groups 1 and 2 receiving respective interventions one time a day. The subjects were tested at approximately same time each day. During this period, the subjects were asked to refrain from any kind of sports activity or exercise. Pre-test measurement was taken on 1st day and intervention was carried out for 5 days in the week with post-test measurement taken on 5th day. 6th day was a resting day and on the 7th day measurement was taken to check maintenance of gained ROM.

Group I (Manual passive stretching followed by cryotherapy):

The subjects were positioned supine. With the subject's knee fully extended, the lower leg of the subject was supported with my shoulder, and the opposite extremity along the anterior aspect of the thigh was stabilized with a strap. Now, hip was flexed as far as possible. The stretched position was held for 30 seconds. Sequence was repeated 4 times [10]. At the end of fourth repetition cold pack was applied over the hamstrings (posterior aspect of thigh) for 10 minutes with the subject in prone position. Bags filled with crushed ice was used as cold pack.

Group II (Modified PNF stretching (HR-AC) followed by cryotherapy):

The subjects were positioned supine. The technique was performed without hip rotation. The therapist (i. e: myself) passively stretched the hamstrings until the subject felt mild stretch, then asked the patient to isometrically contract the hamstrings by attempting to push his leg back against resistance of my shoulder for 10 seconds. Then the subject was let to relax for 5 seconds. Then the subject performed a concentric contraction of the agonist (quadriceps) by doing active knee extension. The subject actively moved the extremity through the increased range [11]. This procedure was repeated 4 times. At the end of 4th repetition, cold pack (bags filled with crushed ice) was applied over the hamstrings for 10 minutes with the subject in prone position.

(c) Post- intervention measurement

Post-stretch measurement was taken in the same manner as the pre-stretch measurement, i. e; by using active knee extension test, and data collected by the same therapist (i. e: myself) at the end of intervention on the 5th day. 6th day was a resting day for the subjects and on the 7th day measurement was taken to check the maintenance of gained ROM.

RESULTS

This study was done to determine the efficacy of modified PNF stretching over manual passive stretching followed by cold application on hamstrings flexibility. 30 normal school going male students between the ages of 16-20 years participated in the study. They were divided into two groups. Each group included 15 male subjects. Group I (N1=15) treated with passive manual stretching and Group II (N2=15) treated with modified PNF stretch followed by cold application. Comparison was done by using Student t-test.

Table: 1.1 Paired ‘t’ test performed with 1st and 5th day values of active knee extension for significance within the groups

	Mean	SD	T value	P value
1 st day AKE of Group I	157.13	2.56	13.440	<0.0001
5 th day AKE Group I	160.2	3.05		
1 st day AKE of Group II	157.06	2.91	1.871	0.0824
5 th day AKE of Group II	163.53	3.77		

INTERPRETATION

The above Table-3.1 shows the value of "t" as 13.440 and 17.795 for group 1 and group 2 respectively for the 1st and 5th day values of Active Knee Extension. When compared to the tabulated value the above "t" values were significant with p < 0.0001. Hence, cold application post manual passive stretch and modified PNF stretch, both were effective in improving hamstrings flexibility for group 1 and group 2 respectively.

Table: 1.2 Paired ‘t’ test performed with 5th and 7th day values of active knee extension for significance within the groups

	Mean	SD	T value	P value
5 th day AKE of Group I	160.2	3.05	1.581	0.1362
7 th day AKE Group I	159.86	2.80		
5 th day AKE of Group II	163.53	3.77	1.871	0.0824
7 th day AKE of Group II	163.13	3.66		

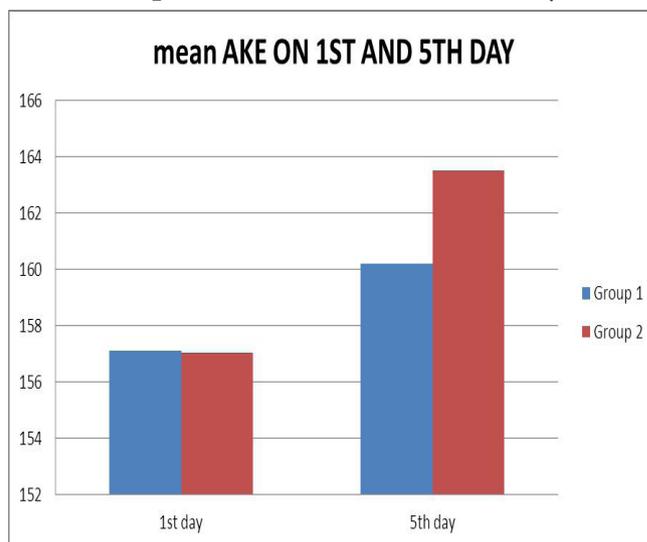
INTERPRETATION

The above Table-3.2 shows the value of ‘t’ as 1.581 and 1.871 for group 1 and group 2 respectively for the 5th and 7th day values of Active Knee Extension. When compared to the tabulated value the above ‘t’ values were significant with p > 0.05.

Hence cold application post manual passive stretch and modified PNF stretch, both were effective in maintaining hamstrings flexibility for group 1 and group 2 respectively.

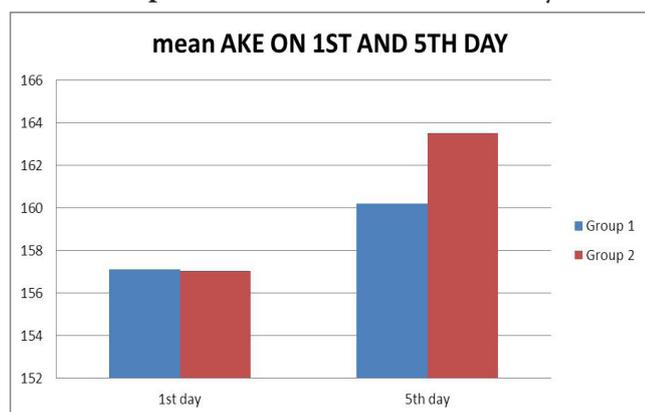
Unpaired ‘t’ test performed with 1st and 5th day values of active knee extension for significance between the groups. Value of ‘t’ = 2.659 for mean active knee extension on 5th day. When compared to the tabulated value the above ‘t’ value was significant with p < 0.05. As the ‘t’ value was significant with p < 0.05, it was concluded that cold application post modified PNF stretching had a superior effect over cold application post manual passive stretching in improving hamstrings flexibility.

Graph 1: Mean AKE on 1st and 5th day

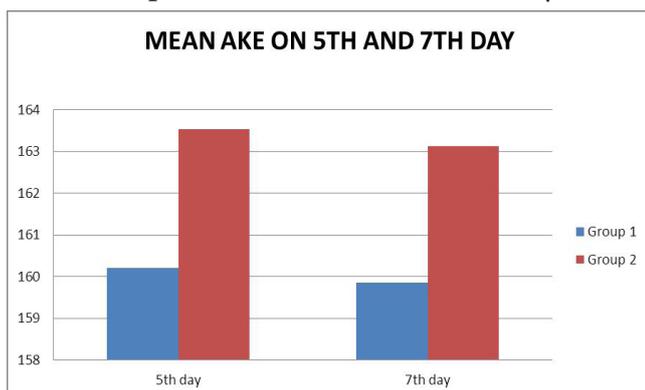


Unpaired ‘t’ test performed with 5th and 7th day values of active knee extension for significance between the groups. The value of ‘t’ = 2.745 for mean active knee extension on 7th day. When compared to the tabulated value the above ‘t’ value was significant with p<0.05. As the ‘t’ value was significant with p<0.05, it was concluded that Group-2 treated with modified PNF had a superior effect over the Group-1 treated by manual passive stretching in maintaining hamstrings flexibility.

Graph 1: Mean AKE on 1st and 5th day



Graph 2: Mean AKE on 1st and 7th day



DISCUSSION

In this study, totally 30 normal school going male students were included and assigned randomly into two groups. Each group had 15 subjects. Subjects in group 1 received cold application post manual passive stretching and group 2 received cold application post modified PNF stretching. Active Knee Extension (in degrees) was the parameter considered for hamstrings flexibility and was measured by using standard universal goniometer. Measurements were recorded on 1st, 5th and 7th day. The mean was calculated and the statistical analysis of the values showed significant difference in improving and maintaining the mean AKE (in degrees) for Group 2 than Group 1. This proved that the subjects who received cold application post modified PNF stretch had a better outcome than cold application post manual passive stretch.

There is significant difference between effects of cold application post modified PNF stretching over cold application post passive stretching on maintenance of hamstring flexibility. This study was detailed and tailored to find the efficacy of modified PNF stretch over manual passive stretch for improving and maintaining hamstring flexibility. The analysis of mean by 't' test showed that cold application post modified PNF stretch is more effective way of improving hamstrings flexibility than cold application post manual passive stretch. The basis for modified PNF stretching is theorized to be through neural inhibition of the muscle group being stretched. The proposed neural inhibition reduces reflex activity, which then promotes greater relaxation and decreased resistance to stretch, and hence greater range of movement Hutton [12]. These results were

significant at $p < 0.05$ and strongly support the earlier findings of Melanie J. Sharman et al (2006) that modified PNF is the most effective means to increase ROM by way of stretching, particularly in respect to short-term gains and Darren G. Burke et al [13] also supports the result of this study that modified PNF flexibility training alone or in conjunction with heat or cold thermal agents resulted in significant increases in hamstring length. Studies done by Ian Shrier and Kav Gossal [14] also support the result that modified PNF stretching has resulted in greater increases in range of motion compared with static or ballistic stretching. This study also showed that cold application post modified PNF stretch is more effective way of maintaining hamstrings flexibility than cold application post manual passive stretch and this is supported by Scott G. Sperrnoga et al (2001).

CONCLUSION

This study has shown that modified PNF with cold application for 10 minutes for continuous 5 day of treatment on a specific time of the day on high school going healthy students is more effective over passive manual stretching followed by cold application for 10 minutes in increasing the Hamstring flexibility. There was a significant increase and maintained ROM in AKET in the group treated with modified PNF and cold.

Hence, modified PNF is a better technique over passive manual stretch with cold commonly applied after the interventions for increasing and maintaining the hamstring flexibility.

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