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EFFECT OF STATIC STRETCHING ON STRENGTH OF HAMSTRING MUSCLE

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ABSTRACT

Background: Flexibility is an indisputable component of fitness defined as the ability to move a single joint or series of joints through an unrestricted pain free range of motion. Static stretching consists of stretching a muscle or group of muscle to its farthest point and then maintaining or holding that position. The literature supports that muscles are capable of exerting their greatest strength when they are fully lengthen. Hence this study was conducted to find the effect of static stretching on hamstring muscle.

Methods: The study was experimental study design. 40 samples were selected by purposive sampling method. Flexibility of the hamstring muscle unilaterally right side (arbitrarily chosen) was measured by active knee extension test of all the subjects who met the inclusion criteria of the study. After measuring the flexibility of hamstring muscle, strength was measured by 1RM for the same side (right) hamstring muscle. Static Stretching Protocol was given for 5 days per week for 6 weeks to all the participants. After the 6 weeks of training, knee extension deficiency and 1RM was documented.

Result: Statistical analysis using Paired t-test was done. The t-test showed that there was significant effect of static stretching on 1RM of hamstring muscle ($p < 0.05$) & active knee extension test ($p = 0.000$).

Conclusion: Static stretching showed significant change in pre and post 1RM of hamstring muscle and active knee extension test. There was significant improvement of hamstring muscles flexibility and strength after giving static stretching in female population. So it is possible that females who are unable to participate in traditional strength training activities may be able to experience gains through static stretching.

Keywords: Flexibility, static stretching, Strength, Hamstring, 1RM, Active knee extension test

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INTRODUCTION

Flexibility is an important attribute of a healthy as well as of physically fit muscle therefore stretching exercises is an essential part of preparation for subsequent sporting activities [1]. Flexibility is an indisputable component of fitness defined as the ability to move a single joint or series of joints through an unrestricted pain free range of motion [2]. Flexibility of the muscle has long been a concern of physical therapists and rehabilitation educator and coach [3]. Lack of flexibility has been suggested as a predisposing factor to hamstring strain.

Static stretching is effective for improvement of flexibility according to M. Alter; static stretching consists of stretching a muscle or group of muscle to its farthest point and then maintaining or holding that position [4]. Static stretching offers advantages over the ballistic stretching method. Static stretching exceeding the extensibility of the tissue involved is unlikely, and the technique requires less energy to perform. The most important characteristics of a muscle are its ability to develop tension and to exert a force on the bony lever. When a muscle is stretched, initial lengthening occurs in the series elastic component and tension rises sharply.

Muscle fiber develops maximal isometric tension at optimal sarcomeres length because the thick and thin filaments are positioned so that the maximum number of cross-bridges within the sarcomeres can be formed. Muscles that have large physiologic cross section are capable of producing more tension than muscle that has small cross-sections [5]. Hence muscle physiology suggested that when the muscle is in fully lengthen position it will create tension and strength is directly related to the amount of tension a contracting muscle can produce.

As the literature supports that muscles are capable of exerting their greatest strength when they are fully lengthen. So this study is also investigating the effect of static stretching on the strength of hamstring muscle.

METHODOLOGY

Normal adult females ranging in age from 18 to 30 years with decreased Hamstring muscle flexibility (30 degree loss of knee extension measured with femur held at 90 degree of hip flexion)³. Purposive sampling method used. Participants with significant history of pathology of the hip, Knee, thigh or low back any neurological deficit and medically unstable participants are excluded. Materials Used in the study are Goniometer (full circle), Weight Cuffs, Stopwatch, Plinth Marker .Active knee extension deficiency measured by full circle goniometer [6.7.8]. Strength of hamstring muscle measured by 1 RM [9,10]. Before taking measurements each subject wore a pair of shorts to avoid any restriction to movement in the lower limb. All subjects who met the criteria for inclusion in the study were measured flexibility of the hamstring muscles unilaterally right side (arbitrarily chosen). Hamstring muscle flexibility was measured with a double-armed, full-circle goniometer made up of plastic.

After measurements of hamstring flexibility, strength was measured by 1RM for the same side (right) hamstring muscles. Range of motion of knee extension deficiency and 1RM were documented and from the next day stretching protocol was given to each subject. Subjects statically stretched five times a week for 6 weeks [11]. The subjects performed static stretching of the hamstring muscles by standing erect with the left foot planted on the floor and placed directly forward without hip medial or lateral rotation. The posterior calcaneal aspect of right foot was placed on a plinth (which was comfortable to the subject.). The toes of the right foot directed towards the ceiling, again without hip medial or lateral rotation.

The knee remained fully extended. The arms were flexed to shoulder height with the elbows fully extended. The subject then flexed forward from the hip, maintaining the spine in a neutral position, while reaching the arms forward in this position until a gentle stretch was felt in the posterior thigh [12,13]. Once the subject achieved this position, the static stretch was sustained the assigned amount of time.

Performance of each static stretching session by each subject was supervised and recorded. If a subject missed a scheduled session, she made up the session on another day during the same week. Any subject missing more than 2 days without performing the stretching was eliminated from the study. No warm-up period was given before static stretching.

After the 6 weeks of training, all subjects were retested using the same procedures described for the pre-stretch measurement one day of rest was provided prior to the post-stretch. Range of motion of knee extension deficiency and 1RM was documented

RESULTS

In this study 40 subjects were included for studying the effect of static stretches on flexibility and strength of the hamstring muscle .Primer software used for analysis, Paired t-test was used.

Figure 1: pre and post intervention (mean) change in active knee extension test

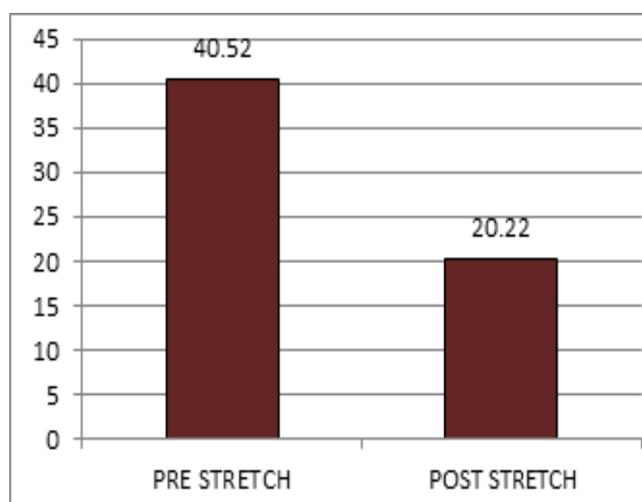


Table1: pre and post test mean and standard deviation

Group		Mean	N	Std. Deviation	Std. Error Mean
A	Pre T/t	40.52	38	6.15	0.99
	Post T/t	22.21	38	6.41	1.03

Table 2: The mean change in active knee extension test and paired t test

Pre T/t- Post T/t	Paired Differences					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
	18.31	3.19	0.51	17.26	19.36	35.31	37	0.000 p<0.05

Figure 2: pre and post intervention (mean) change in 1RM

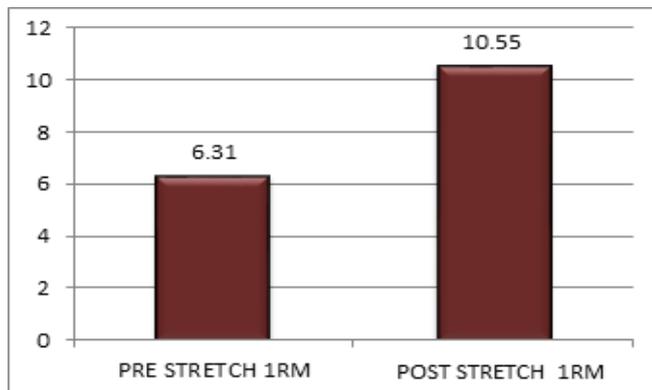


Table 3: pre and post test mean and standard deviation

Group		Mean	n	Std. Deviation	Std. Error Mean
A	Pre T/t	6.31	38	0.85	0.13
	Post T/t	10.55	38	1.29	0.21

Table 4: The mean change in 1RM and paired t test

Pre T/t- Post T/t	Paired difference					T	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
	4.23	0.70	0.11	4.00	4.46	37.06	37	p<0.05

After applying paired t-test, there was significant improvement found in hamstring muscle flexibility and muscle strength

DISCUSSION

Flexibility is an important physiological component of fitness and reduced flexibility can cause inefficiency in the workplace. Muscle tightness is a limiting factor for optimal physical performances and an important intrinsic factor for sports injury. The tight hamstrings are example of muscle group that have a tendency to shorten. A tight hamstring causes increased patellofemoral compressive force and may lead to low back .This study concluded that static stretching significantly improves the hamstring muscle strength The basic muscle physiology beyond this findings

is that when the muscle is stretched muscle spindle records the change in length and sends signal to the spine which convey this information. This triggers the stretch reflex (myotatic reflex) which attempts to resist the change in muscle length by causing the stretched muscle to contract. The more sudden the change in muscle length, the stronger the muscle contraction will be. The basic function of muscle spindle helps to maintain muscle tone and to protect the body from injury. Strength refers to the force output of a contracting muscle and is directly related to the amount of a tension a contracting muscle can produce. When a muscle is stretched, initial lengthening occurs in the series elastic component and tension rises shapely.

The most important characteristics of a muscle are its ability to develop tension and to exert a force on the bony lever. Tension can be either active or passive and the total tension that a muscle can develop includes both active and passive components. Active tension in the muscle can be modulated by several factors- tension may be increased by increasing the frequency of firing of a motor unit or by increasing the frequency the number of motor units that are firing, tension may be increased by recruiting motor units with a larger number of fibers, the greater the number of cross-bridges that are formed, the greater the tension, Muscle that have large physiologic cross-sections are capable of producing more tension than muscle that have small cross sections, tension increases as the velocity of active shortening decreases and as the velocity active lengthening increases. One of the most fundamental concepts in muscle physiology is the direct relationship between isometric tension development in a muscle fiber and the length of the sarcomeres in a muscle fiber the identification of this relationship was, and continues to be, the primary evidence supporting the sliding filament theory of muscle contraction. The isometric sarcomeres length-tension relationship was determined using isolated single muscle fibers under very controlled circumstances. There is an optimal sarcomeres length at which a muscle fiber is capable of developing maximal isometric tension at optimal sarcomeres length because the thick and thin filaments are positioned so that the maximum number of cross-bridges within the sarcomeres Sarah M. Marek et al (2005) concluded that both acute effect of static and proprioceptive neuromuscular facilitation stretching Caused similar deficits in strength, power output.¹³So static stretching is effective for improvement of flexibility and strength of hamstring muscles

CONCLUSION

The study “Effect of static stretching on the hamstring tightness” concluded that there was significant improvement of hamstring muscle flexibility and strength.

Static stretching is effective for improving the strength of the hamstring muscle in female population. So it is possible that females who are unable to participate in traditional strength training activities may be able to experience gains through static stretching.

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