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EFFECTIVENESS OF ECCENTRIC TRAINING, DYNAMIC RANGE OF MOTION EXERCISES AND STATIC STRETCHING ON FLEXIBILITY OF HAMSTRING MUSCLE AMONG FOOTBALL PLAYERS

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ABSTRACT

Background: Hamstring stretch is an important part of treatment programs aimed at decreasing the likelihood of hamstring injury. Few studies have examine the effect of eccentric training, static stretching and dynamic range of motion(DROM) exercise in improving hamstring flexibility this study compares the effect of eccentric training and static stretching in improving hamstring flexibility. The purpose of this study was to determine the effects of Eccentric training, Static stretching and Dynamic range of motion (DROM) exercise in improving hamstring flexibility and the second objective is find which technique is more effective in improving hamstring flexibility when compared with a control group. Study design is Experimental pre-test post-test design.

Methods: 88 male subjects with limited hamstring flexibility were recruited for this study were assigned to four group. Group1 received eccentric training, group2 received dynamic range of motion exercise, group3 received static stretching and group4 was served as control group. Hamstring length was measured pre intervention and post intervention using a self-monitored active knee extension test.

Results: Eccentric training, static stretching and dynamic range of motion exercise showed a significant increase in hamstring length between pre and post intervention. Following a between group analysis done by independent t test revealed a significant difference between group1 group2 and group3

Conclusion: It is concluded that eccentric training, dynamic range of motion (DROM) exercise and static stretching groups improved hamstring flexibility.

Keywords: Eccentric training, Dynamic range of motion (DROM), Active knee extension (AKE), Hamstring muscle, Flexibility, Static stretching

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INTRODUCTION

The most common injuries in nearly all forms of team and individual sports involving the lower body is hamstring strain[1]. Analysis of epidemiological injury studies assessing these sports consistently ranks hamstring strain injuries as one of the most prevalent factors resulting in missed playing time by athletes.[1] Reported factors that contribute to hamstring injuries include the lack of muscle flexibility[2], improper warm-up, fatigue, disproportional hamstring to quadriceps strength.[3] Lack of hamstring flexibility was the single most important characteristic of hamstring injuries in athletes[3] and poor body mechanics during running[4]. Flexibility of muscle is the ability of a muscle to lengthen, allowing one joint (or more than one joint in one series) to move through a range of motion.[5] Warm-up and stretching are advocated by clinicians to increase muscle length Loss of flexibility is defined as the decrease in the ability of a muscle to deform. Lasting effects of stretching are important clinically because lasting effects may relate to optimizing function, injury prevention, and enhanced muscle performance.

A relative new method to lengthen muscle is called dynamic range of motion exercises (DROM). The method is described regarded as an alternative to static stretching. DROM exercise is a technique that allows the muscle to elongate naturally in its relaxed state. This elongation is achieved by having the subject concentrically contract the antagonist muscle to move the joint through the full available range in a slow controlled manner to stretch the agonist muscle group.[6] Eccentrically training a muscle through a full range of motion theoretically could reduce injury rates and improve athletic performance and flexibility. It is found that there were gains achieved in range of motion of knee extension (indicating improvement in hamstring flexibility) with eccentric training.[6] This method is also an alternative to static stretching.

Static stretching, considered to be the gold standard for increasing flexibility, is elongating a muscle to tolerance and sustaining the position for a long time, some of the proposed benefits of enhanced flexibility are reduced risk of injury, pain relief, and improved athletic performance.[6,7] More efficacy and effectiveness in movement as a result of enhanced muscle flexibility will assist in preventing or minimizing injuries and may enhance performance.[8,9]

Three types of stretching have been traditionally defined in the literature in an effort to increase flexibility they are ballistic stretching, proprioceptive neuromuscular facilitation and static stretching. Ballistic stretching is a technique involving rhythmic bouncing movement of the extremity to lengthen the muscle. Proprioceptive neuromuscular facilitation (PNF) involves the use of brief isometric contractions of the muscle stretched before statistically stretching the muscle.

Eccentric training and DROM training may be a beneficial alternative for static stretching. But no study has been compared the effectiveness between the eccentric training, DROM training and static stretching on increasing the flexibility of hamstring. The purpose of the study is to compare the improvement of hamstring flexibility after 6 week eccentric training, DROM exercise and static stretching.

The aim of this study was to find whether a six week Eccentric training, Dynamic range of motion and static stretching will improve hamstring muscle flexibility in football players".

METHODOLOGY

This study was conducted in elderly people of age group ranging from 18 to 25. Prior to the participation in this study the subjects were explained about the study and informed consent was taken. The subjects were assessed for inclusion and exclusion criteria and those fulfilled the criteria were included in the study. Sampling method was Convenient sampling where 88 subjects were selected (22 in each group). Subjects were Football players from in and around Mangalore. Study design was Pretest Posttest Experimental Study. Materials used were A goniometer, A couch, Theraband, Marker, Data sheet, Watch

Inclusion criteria was that subject should be a regular football player, age group between 18 to 25, Limited hamstring flexibility as determined by an active knee extension (AKE) angle of 30 degree or more, Male football players

Exclusion criteria was that subject should not have any acute 3rd degree hamstring injury, Acute knee injuries, Should not have any neurological deficits, Any spinal pathology, Hyper flexible
Data were analysed using SPSS (Statistical Package for Social Sciences) version 17.0 software.

Procedure

Eighty eight male football players aged from 18 to 25 were assigned in to four groups for the study. Each group contains 22 members who met the inclusion criteria and completed the study.

Mean age of these subjects was (22.73 in 1stgroup, 21.94 in 2nd group, 22.34 in 3rd group and 21.65 in 4th group). All subjects signed an institutionally

approved informed consent statement prior to data collection

All subjects included in this study were required to have limited hamstring flexibility of dominant extremity as determined by an active knee extension (AKE) angle of 30 degrees or more while in 90 degrees of hip flexion. Zero degrees of knee extension was considered full hamstring muscle flexibility.

Measurement procedure

The measurement of knee extension of all four groups is measured by using self -monitored active knee extension method (AKE).[10]

To perform the self -monitored AKE test, subjects were supine with the contralateral lower extremity in relaxed position and flexed their dominant knee and hip to 90 degrees. In this procedure two examiners are present. Both monitored the position of the femur with their right hand, and were instructed to extend their leg as far as possible, keeping their foot relaxed, and hold the position for 5 sec. each participants performed a single repetition of the movement to familiarize themselves with the action. A second repetition was performed and at the end of the 5 sec holding period the angle of knee extension was measured using a standard goniometer.

The lateral epicondyle was palpated and, and the goniometer was centered over it. The lateral malleolus of the tibia and the greater trochanter of the femur were then marked. The arms of the goniometer were aligned with the proximal and distal land marks. The goniometer measurement was taken at the end range of knee extension and recorded[6].

The eccentric group performed full range-of-motion eccentric training for the hamstring muscles. The subject wills lye supine with the leg fully extended. A black Theraband is wrapped around the heel and the subject held the ends of the Theraband in each hand then the subject will bring the hip in to flexion by pulling the theraband the knee should be kept locked the subject is also resist the hip flexion by eccentrically contracting the hamstring muscles during the entire range of hip flexion. The subject is instructed to provide sufficient resistance with the arms to overcome the eccentric activity of the hamstring muscles. Once full flexion was achieved the subject has to hold for 5 sec and it was repeated for 6 times without any interval

Dynamic range of motion training is performed by lying supine and holding their hip in 90degree of flexion. The subject then actively extended the leg (5 seconds), held the leg at the end of knee extension for 5 seconds, and then slowly lowered the leg (5 seconds), which is considered one repetition. The DROM movement is repeated for six repetition.

Static stretching is done by standing erect with the left foot planted on the floor and pointing straight ahead (no hip internal or external rotation). The right hamstring muscles is stretched by placing the right calcaneal aspect on an elevated surface (high enough to cause a gentle stretching sensation in the posterior thigh) with the knee fully extended and toes pointed to the ceiling (again, no hip internal or external rotation). The subject then flexed forward from the hip, maintaining the spine in a neutral position, while reaching the arms forward until a gentle stretching felt in the posterior thigh. Once this position was achieved, the stretch is sustained for 30 second.

The intervention for experimental groups was a six week program, and each group received intervention 1 session a day for 3 days for six weeks. And the posttest measurement of control group is taken after six weeks. Control group were not performing any interventions and the participants in this group were instructed not to involve in any of the physical activities other than normal daily activities. Post- test measurements were taken 6 weeks later.

Figure 1: Tool used for the study

Figure 2: Measuring active knee extension range

Figure 3: Eccentric training done in supine lying with black theraband

Figure 4: Dynamic range of motion exersice done in supine lying.

Figure 5: Static streching done in Standing position with leg to be streched Is kept on chair

RESULTS

TABLE 1: Age, height and weight comparison between the groups

INTERVENTION GROUPS	AGE	HEIGHT (Cm)	WEIGHT (Kg)
ECCENTRIC TRAINING	22.73 ± 2.60	171.78 ± 4.53	68.26 ± 9.35
DROM	21.94 ± 2.74	170.78 ± 4.78	67.55 ± 9.78
STATIC STRETCHING	22.34 ± 2.35	172.67 ± 4.00	67.45 ± 9.23
CONTROL	21.65 ± 2.45	171.89 ± 4.32	65.33 ± 9.02

Table 1 shows age, height and weight comparison between four groups with number of 22 subjects in each group. And there is no significant difference between both group for age, height and weight

TABLE 2: Comparison between mean values of pre-test and post- test AKE ROM of all four groups

	Pretest	Standard deviation	Post test	Standard deviation	Mean change	P value
Group 1(22)	35.56 ±0.69	3.24	25.20 ±0.76	3.56	10.36	.0001
Group 2(22)	36.50 ±0.69	3.28	30.15 ±0.70	3.31	6.34	.001
Group 3(22)	35.70 ±0.75	3.53	25.93 ±0.88	4.13	9.77	.0001
Group 4(22)	35.38 ±0.71	3.36	35.00 ±0.74	3.50	0.38	<.05

Comparison is done between pretest and posttest values of AKE ROM of four groups, where the eccentric group have a pretest mean of 35.56 and standard deviation of 3.24 and posttest AKE ROM with mean of 25.20 and standard deviation of 3.56 shows mean change of 10.36 shows P value of .0001 which is highly significant(>.015)

The DROM group has mean of 36.50 and standard deviation of 3.28 and posttest AKE ROM with mean of 30.15 and standard deviation of 3.31 shows a mean change of 6.34, shows P value of .001 which is highly significant(>.015)

The static stretch group has a pretest mean of 35.70 and standard deviation of 3.53 and posttest AKE ROM with mean of 25.93 and standard deviation of 4.13 shows a mean change of 9.77, shows P value of .0001 which is highly significant(>.015)

The control group has a pretest mean of 35.38 and standard deviation of 3.36 and posttest AKE ROM with mean of 35.00 and standard deviation of 3.50 shows a mean change of 0.38, shows P value <.05 which is not significant

1. **ECC**
2. **DROM**
3. **SS**
4. **Control**

TABLE 3: Comparison between values of mean changes AKE ROM between all four groups

GROUP		MEAN DIFFERENCE	P VALUE
ECCENTRIC	CONTROL	9.98	.0001
ECCENTRIC	DROM	4.02	.001
ECCENTRIC	STATIC	0.59	<.05
DROM	STATIC	3.43	.001
DROM	CONTROL	5.96	.001
STATIC	CONTROL	9.39	.0001

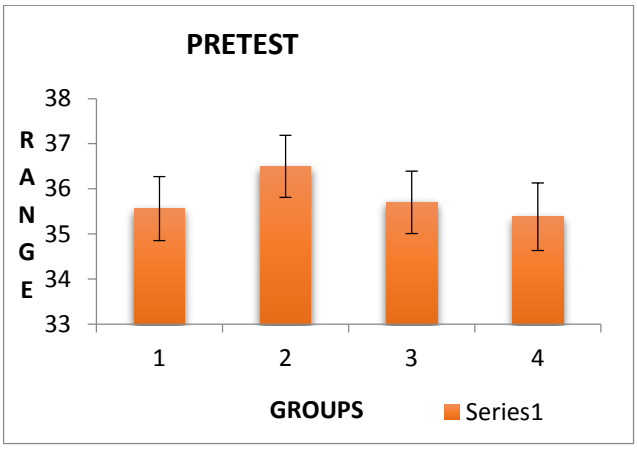
Table 3 compares the mean changes between the four groups. Eccentric training when compared with control group shows a mean difference of 9.98 showing a P value of .0001 which is highly

significant. Eccentric training when compared with DROM group shows a mean difference of 4.02 showing a P value of .001 which is highly significant

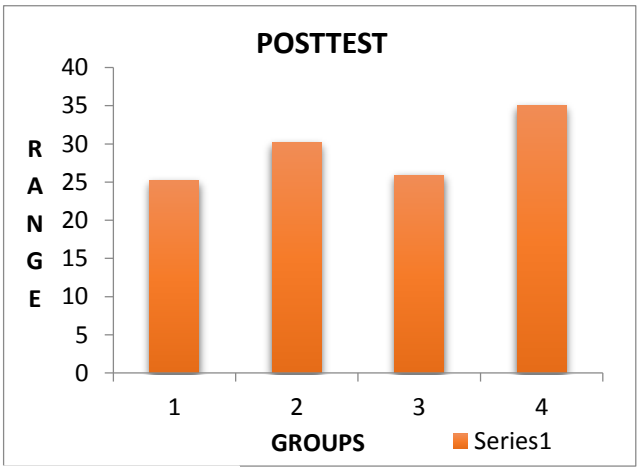
Eccentric training when compared with Static stretching group shows a mean difference of 0.59 showing a P value of < .05 which is not significant. DROM group when compared with static stretching group shows a mean difference of 3.43 showing a P value of .001 which is highly significant.
DROM group when compared with Control group shows a mean difference of 5.96 showing a P value of .001 which is highly significant. Static stretching group when compared with Control group shows a mean difference of 9.39 showing a P value of .0001 which is highly significant

- **Graphical representation of Tables 1,2 and 3 is give below:**

GRAPH 1: Mean degrees for pretest AKE range of motion for Eccentric, DROM, Static stretch and Control groups

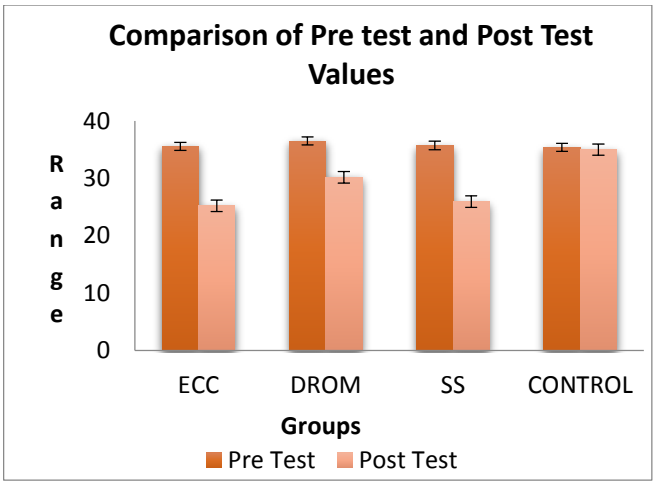


GRAPH 2: Mean degrees for post-test AKE range of motion for Eccentric, DROM, Static stretch and Control groups

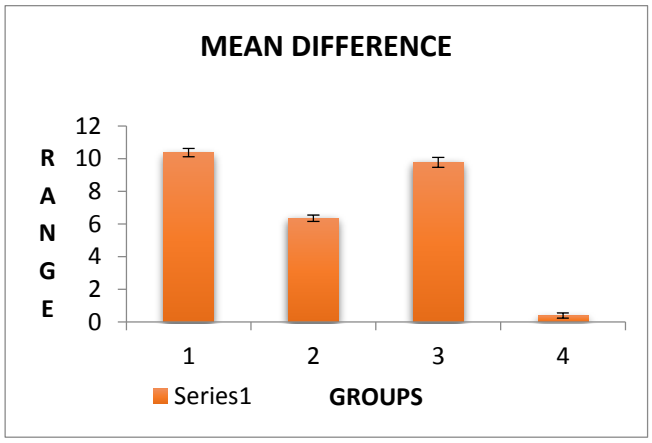


1. **ECC**
2. **DROM**
3. **SS**
4. **Control**

GRAPH 3: Comparison of pre-test and post-test values



GRAPH 4: Mean degrees of difference between post-test AKE range of motion for Eccentric, DROM, Static stretch and Control groups



1. **ECC**
2. **DROM**
3. **SS**
4. **Control**

DISCUSSION

Hamstring strain has been described as being among one of the most difficult and refractory condition to treat in sports medicin[11]. Stretching for the general population of active individuals have been a mainstay in warm-ups and cool-downs during exercise, sport practices, and athletic events. Researchers have compared the effectiveness of different techniques to improve hamstring flexibility.[12] Static stretching is thought be the golden standard for improvement of hamstring flexibility and in recent years there has been an increase in the use of negative work, or eccentric contractions, as a stretching modality to improve flexibility[13]. Another method of improving the hamstring flexibility is DROM exercise. The objective of our study was to compare the effect of the three interventions on improving hamstring

flexibility and to find which intervention is more effective in improving hamstring flexibility.

Eccentric training is an important method because most injuries in the sports occur in the eccentric phase of activities. Hamstring muscles are more commonly injured when working eccentrically while deceleration or landing so eccentrically training a muscle through full ROM is necessary in reducing injury rates and improve muscle performance. Very few studies have been done to find the use of an agonist contraction to improve flexibility. In our study we compared the effect of eccentric training and static stretching there was a significant improvement in the hamstring flexibility in both groups, the eccentric training group had a higher improvement but it was not significant. In another prospective, Keith et al reported the effect of eccentric training on the concentric strength of the hamstring and quadriceps and found that the eccentric training had improved the concentric strength of quadriceps.[14] A study done in a different set up peter et al described the role of eccentric training in sprinting and they suggested that it is a valid method of preventing hamstring injuries in sprinting.[15]

Dynamic range of motion exercise contracts the antagonist muscle which causes the lengthening muscle to relax due to the principal of reciprocal inhibition. Therefore DROM is a more natural way to elongate the muscle and does so in a relaxed state. In the present study, DROM exercise when compared with eccentric training showed improvement in hamstring flexibility in both the groups. DROM exercise was not as much as effective as that of eccentric training. Bandy et al described the effect of dynamic range of motion on hamstring flexibility of the high school males. The result of this study suggests that there is a significant improvement in the hamstring flexibility[7] Similarly William et al demonstrated the effect of DROM in slump sitting position on the hamstring flexibility and they found that the hamstring flexibility had improved markedly.[13]

Static stretching was considered to be the golden standard for improving hamstring flexibility the benefits of slower stretch prevents the tissue from having to absorb great amounts of energy per unit time, static stretching has the least associated injury risk and is believed to be the safest and most frequent method of stretching.[7] In the current study we compared the effects static stretching with DROM exercise, the results showed a significant improvement in the hamstring flexibility in both groups and there was a significant difference between two groups, the static stretching group showed an increased flexibility than that of DROM. Volkert et al described the effect of static stretching and warm up exercises on hamstring length over a course of 24 hours and they found that there was a significant increase in the hamstring length.[16] In another study Bandy et al compared the effects of five daily frequencies and duration of static stretching on hamstring flexibility and found that a- 30 sec duration was an effective amount of time to sustain a hamstring stretch in order to increase ROM.[17]According to the present study the eccentric training, DROM exercise and static stretching groups showed significantly greater gains in flexibility of hamstring muscle group than control groups. The gain achieved by static stretching and eccentric training was not significantly different from each other, the gains achieved by DROM exercise was significantly higher but not as much as that of eccentric training and static stretching.

CONCLUSION

It has been concluded that eccentric training, static stretching and dynamic range of motion exercises are effective in improving hamstring flexibility. The comparison done between four groups suggests that eccentric training is the most effective technique in improving hamstring flexibility. The gain achieved by static stretching and eccentric training was not significantly different from each other, the gains achieved by DROM exercise was significantly higher than but not as much as that of eccentric training and static stretching.

Future scope

Further studies can be done to determine the effectiveness of eccentric training on other muscle groups.

The present study comprises of male football players a future study can be done on female athletes.

A follow up study can be done for finding how long the effects of stretching will last.

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