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Effectiveness of retrowalking on hamstring tightness and dynamic balance in young collegiate students

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Abstract
Hamstring flexibility plays an important role in basic movements such as walking and running. Studies have been suggested that hamstring tightness are associated with various sports injuries. This study is done to find out the effectiveness of retro walking on hamstring tightness and dynamic balance in young collegiate students. Experimental study design.40 samples participated in the study with the age group of 17-25 years.40 subjects were divided into two groups, Group A [Retrowalking and active stretching] and Group B [Active stretching].Pre and post test values of AKET and SEBT of Group A and Group B were measured. Total duration of the study was for 4 weeks. Active knee extension test and star excursion balance test was used as the outcome measure. Both groups have yielded significant improvements on the hamstring flexibility (P=0.000).Dynamic balance was significantly improved in all 8 directions in Group A with (P=0.000) and Group B showed significant improvement in 7 directions with (P=0.000) in medial, antero-medial, posterior, posteromedial, postero-lateral directions followed by lateral (P=.004),antero-lateral(P=.001). And insignificant improvement in anterior direction (P=0.008). This study concludes that in Group A (RW AND AS) and Group B (AS) there is improvement in hamstring flexibility. In post intervention AKET between two groups, Group A showed highly significant improvement than Group B. In post intervention SEBT between two groups, Group A (RW and AS) showed highly significant improvement than Group B (AS) in four directions such as medial, antero-lateral, posterior, postero-lateral and insignificant improvement in other four directions such as lateral, anterior, antero-medial, postero-medial.

Keywords: retro walking, active stretching, hamstring flexibility, dynamic balance

Introduction

Flexibilty is the ability to move a single joint or series of joints smoothly and easily through an unrestricted, pain-free Range of motion. Muscle length in conjunction with joint integrity and the extensibility of periarticular soft tissues determine flexibility. The extensibility of musculotendinous units that cross a joint is based on their ability to relax and yield to a stretch force. The arthrokinematics of the moving joint as well as the ability of periarticular connective tissues to deform also affect joint Range of motion and an individual's overall flexibility.

The muscles of the back of the thigh are called hamstring muscles. They comprise the semitendinosus, the semimembranosus, The biceps femoris. They cross the hip and knee. The muscles act as the flexors of the knee and extensors of the hip. According to AME Ridderikhoff, the hamstrings also have major roles in forward propulsion and transferring power between hip and knee joints during athletic movements. The hamstrings have a major role in hip extension and hip hyper-extension. During running and long jumping, the hip needs to extend and then hyper –extend to propel the body forward. If the hamstring strength or flexibility are lacking, running speed and long jump distance will be decreased according to RON JACOBS. During the upward phase of jumping, the joints of the lower body do not extend simultaneously. They extend in the sequence from the hip to the knees to the ankles to the toes. According to Maarten Bobbert, the hamstrings are the first to be activated, which allows for hip extension to occur first in the sequence. if the hamstrings lack adequate strength or co-ordination, this sequence will be altered and performance will decrease. The length of the hamstring muscle is considered to play an important role in both the effectiveness and efficiency of basic movements such as walking and running, jumping and controlling some movement in the trunk. In walking, they are the most important as an antagonist to the quadriceps in the deceleration of knee extension.

Short hamstrings are associated with various problems including specific disorders of the lumbarspine, general dysfunction syndromes of the low back and sports related injuries (RILEY *et al* 2007) [11]. Lack of flexibility as the cause of strains, sprains and overuse injuries in sports is a widely held belief. Tight hamstrings contribute to sway back by pulling the knees behind the body's vertical centerline (i.e; locking the knees). The whole body sways forward, accentuating the spinal curves. If the outer hamstrings are tighter than the inner ones, the lower leg rotates toe-outward. This twist in the knee joint contributes to knee pain, to knee problems when running, to ligament injuries and to loss of cartilage. Hamstring tension has far –reaching effects on movement, balance and the health of joints. Hence flexibility of a muscle is an important factor in the performance of motor skills and in the prevention of injuries.

Humans generally learn to walk and run in a forward direction with little difficulty. This is inherently logical since our field of view is in the forward direction. The ability to move backwards is necessary for normal daily activities and allows the body to be positioned to accommodate to various tasks

Backward running was associated with increased cadence and decreased stride length when compared with forward walking. In backward walking, the stance begins with toe contact and ends when the heel is lifted off the ground (VILENSKY *et al* & KRAMA). Threlkeld *et al* (1989) stated that backward running may provide a clinically useful means of increasing knee extensor strength while, minimizing harmful joint stress in the process. Various sports such as soccer, football and basket ball incorporate backward running to improve performance and reduce potential for injury. Flynn and soutas (1995) suggested that backward running could decrease patello-femoral joint reaction forces and decrease eccentric loading of the patellar tendon, both of which are beneficial in patients with patella-femoral dysfunction. Backward running increases co-ordination and endurance maintains cardiopulmonary fitness and facilitates neuromuscular function [1]. The aim of this is to find out the effectiveness of retro walking on hamstring tightness and dynamic balance in young collegiate students.

Materials and Methodology

The study design was experimental, prepost type. 40 samples were selected by convenient sampling technique. The study centre was SRM College of Physiotherapy for a period of four weeks. Males and females of age group 17 -25 years with normal BMI are included in the study. Left lower extremity is included for the study with range of motion of knee flexors [hamstrings] of an inability to achieve 160 degree of active knee extension. Individuals with hamstring injury at least for the past 1 year, back pain, unhealed fractures in the lower extremity, ligament injuries in the lower extremity for the past 6 months. acute inflammatory and infectious process in the extremity, hyper mobility of the lower extremity joints are excluded from the study

Procedure

A convenient sample of 40 collegiate students were recruited for the study. Informed consent form were taken from them. They were recruited according to the inclusion and exclusion criteria. Subjects were randomly allocated in to two groups, Group A [Retro walking and active stretching] [n=20] and Group B [active stretching] [n=20]. For Group A provided an opportunity to acclimate with backward walking on a treadmill by three supervised 10 minutes practice sessions at 0 degree of inclination. During interventional period the treadmill was adjusted to produce a speed of 4km/h and 0 degree inclinations for 6 minute period of retrowalking 3 times a week. And, active hamstring stretching was given to left lower extremities of the subjects, with stretch hold duration of 15 seconds, total 3 sessions, 4 times per session with 10 sec rest in between each repetition, 3 times per week. For GROUP B active hamstring stretching was given to left lower extremities of the subjects, with stretch hold duration of 15 seconds, total 3 sessions, 4 times per session with 10 sec rest in between each repetition, 3 times per week Total duration of the study was for 4 weeks with frequency of 3 days per week. The pre and post test values o AKET and SEBT of Group A and Group B were measured.

Retro Walking on Treadmill

Fig 1

Outcome measures

Active knee extension test

Preparation

Lie supine on mat or bench. Bend hip and knee at right angles so thigh is vertical and lower leg is horizontal.

Execution

Extend knee and hold position. Repeat on opposite leg.

Measurement

Angle of knee is noted with universal goniometer. Inability to achieve 160 degree of knee extension is recruited for the study Ankle may be kept in neutral position or plantar flexed (pointed). Thigh may be stabilized vertically by test administrator.

Star Excursion Balance Test

Before the test is performed, there is a set up been done. 4 strips of athletic tape with a length of 6-8 foot is been used to form a ‘+’. After this is been done, another 4 strips of athletic tape of the same length is used to form an ‘x’ All the different lines are been separated from each other by an angle of 45°. The goal of the SEBT is to maintain single leg stance The person performing test must maintain a base of support on one leg, while using the other leg to reach as far as possible in 8 different directions. The person must reach in 8 different positions, once in each of the following directions:

1. Anterior, 2. Anteromedial, 3. Medial, 4. Posteromedial, 5. Posterior, 6. Posterolateral, 7. Lateral, 8. Anterolateral

Table 1: Comparison of Aket Group A Pre Test and Post Test Based on Paired ‘T’ Test

Aket	Mean	N	Std. Deviation	Std. Error	t	Sig
PRE TEST	133.9500	20	7.05971	1.57860	-10.927	.000
POST TEST	149.3500	20	6.39305	1.42953		

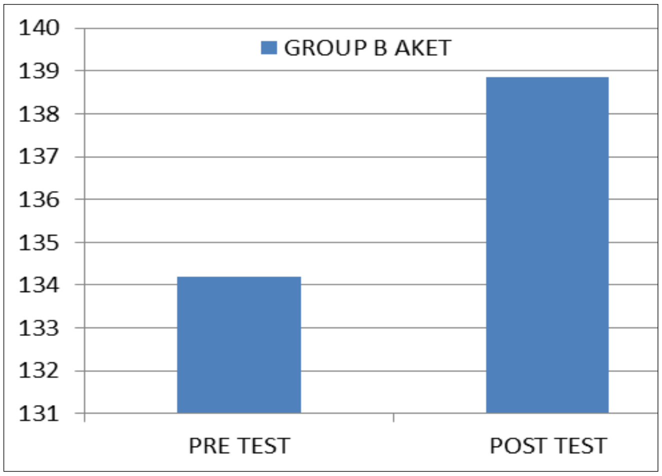

Fig 2: Shows the Comparison of Aket of Group B Pre Test and Post Test

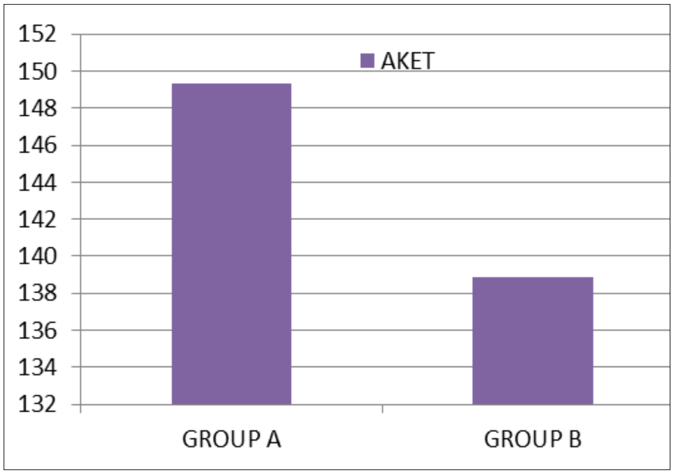

Fig 3: Shows the Comparison of Post Test Aket Between Group A and Group B

Table 2: Comparison Of Sebt Group A Pre Test And Post Test Based on Paired 't' Test

SEBT [GROUP A]		Mean	N	Std.Deviation	t	Sig
Medial	Pre test	57.3500	20	5.28429	-8.245	.000
	Post test	64.500	20	4.78457		
Lateral	Pre test	46.9500	20	7.18533	-7.696	.000
	Post test	56.8000	20	6.04022		
Anterior	Pre test	53.8500	20	7.39328	-10.159	.000
	Post test	62.0000	20	6.32456		
Antero-Medial	Pre test	56.5500	20	6.41934	-4.921	.000
	Post test	62.9500	20	7.27270		
Antero-lateral	Pre test	54.1500	20	6.86160	-8.876	.000
	Post test	61.5000	20	5.83546		
Posterior	Pre test	51.1500	20	5.85145	-9.862	.000
	Post test	61.3000	20	6.57027		
Postero-medial	Pre test	56.0000	20	6.50506	-5.420	.000
	Post test	61.3000	20	7.20088		
Postero-lateral	Pre test	49.1500	20	5.77905	-9.528	.000
	Post test	60.4000	20	6.81639		

Table 3: Comparison of Sebt Group B Pre Test And Post Test Based On Paired 'T' Test

Sebt [Group B]		Mean	N	STD. Deviation	t	SIG
Medial	PRE TEST	57.1500	20	4.77135	-7.092	.000
	POST TEST	60.1500	20	4.64843		
Lateral	PRE TEST	49.0500	20	4.97864	-3.323	.004
	POST TEST	53.0000	20	4.00000		
Anterior	PRE TEST	55.2000	20	4.47919	-2.960	.008
	POST TEST	57.8500	20	5.13271		
Antero-Medial	PRE TEST	55.7000	20	5.52602	-5.232	.001
	POST TEST	60.1000	20	3.83749		
Antero-Lateral	PRE TEST	53.1000	20	3.25900	-3.935	.000
	POST TEST	56.2000	20	4.73064		
Posterior	PRE TEST	50.2500	20	4.39946	-4.561	.000
	POST TEST	54.4000	20	4.82755		
Postero-Medial	PRE TEST	55.4500	20	4.17354	-4.914	.000
	POST TEST	58.4000	20	4.84931		
Postero-Lateral	PRE TEST	50.0500	20	4.08431	-4.971	.000
	POST TEST	53.1500	20	4.18361		

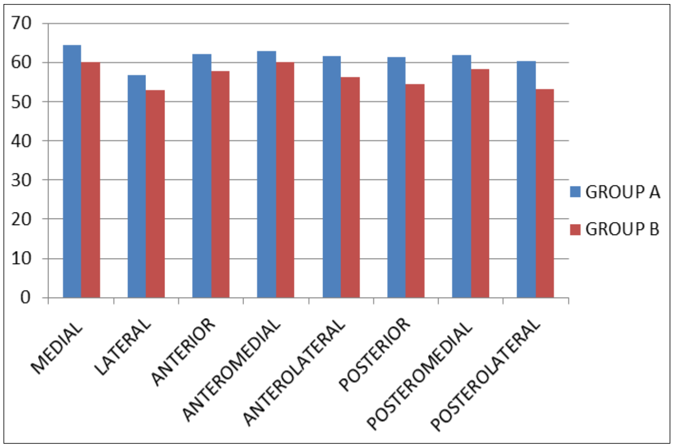

Fig 4: Shows the Comparison of Sebt between Group A and Group B

Results

According to Table 1

Comparison of AKET Group A pre test and post test based on paired 't' test.It shows the mean value of pre test (133.9500) and post test (149.3500). In this P=0.000 which says there is statistically significant difference exist between them. Group A (RW AND AS Group) yielded significant difference on hamstring flexibility.

According to Fig 2

Comparison of AKET Group B pre test and post test based on paired 't' test.It shows the mean value of pre test (134.2000) and post test (138.8500).In this P=0.000 which says there is statistically significant difference exist between them. Group B (AS Group) yielded significant difference on hamstring flexibility.

According to Fig 3

Comparison of AKET between Group A and Group B using Independent 't' test. It shows the mean value of the Group A (149.3500) and Group B (138.8500). In this P=0.000 which says there is a significant difference exists between two groups.

According to Table 2

Comparison of Sebt Group A pre test and post test based on paired 't' test.It shows there is a significant difference in all the 8 directions with P=0.000.Hence Group A (RW AND AS Group) yielded significant difference on dynamic balance component in all the 8 directions.

According to Table 3

Comparison of SEBT Group B pre test and post test based on paired 't'test. It shows a significant improvemet in 7 directions with P=.000 in medial, antero-medial, posterior, postero-medial, postero-lateral followed by lateral (P=.004), anterolateral (P=.001). It shows insignificant improvement in anterior direction (P=0.008).

According to Fig 4

Comparison of SEBT between Group A and Group B using independent 't' test. It shows there is a significant difference exist between two groups in four directions such as medial (0.006), anterolateral (.003), posterior (P=.001), posterolateral (P=.000). however there is no significant difference exits between two groups in other four directions such as lateral (P=0.024), anterior (P=0.028), antero-medial (P=0.129), postero-medial (P=.0888),

Discussion

Both Group A and Group B showed significant improvement in hamstring length in post intervention. And in post intervention, a significant difference exist between two groups. Whitley *et al* (2009) reported retro locomotion may be a practical means to improve flexibility of the low back and hamstrings as evidenced by improved sit and reach scores[12]. Kumar and Ashraf (2009) also observed a decrease in the angles for the hip and the knee and an increase in the angle for the ankle joint after back ward walking on treadmill. Improvement by the retrowalking in hamstring length can be explained by reduced range of motion at the hip joint with greater flexion and lesser extension and a combination of maximum knee extension with hip flexion[13].Cipraini *et al* (1995) showed an increased activity of rectus femoris muscle as during back ward walking, the normal eccentric contraction of the rectus femoris is replaced by a concentric contraction[3]. Due to this increase in concentric activity of rectus femoris, hamstring may be loaded under eccentric length. These results could explain the gain in the hamstring length.

Improvement by the active stretching in hamstring length can be explained by the changes in visco-elastic properties of human tendon structures, which states that stretching decreases the viscosity of tendon structures but increases the elasticity (Kubo *et al* 2001). The neurophysiological component is explained by the inhbition of muscles exposed to stretching. Inhibition decreases the activity of the contractile component and results in an increased extensibility of the muscles and an increase in range of motion (ROM) of the joint. The biomechanical component is described by the properties of muscles tissue undergoing stretch. Elastic behaviour refers to the property of a structure to elongate when a force is applied, and to return to its original length when force is taken away. Viscous behavior refers to property of a structure to elongate when a force is applied, but where the elongation is dependent on rate change. Hence, it appears that the elongation of a muscle is determined by the exerted force and force rate. When a structure is stretched to a fixed length either once or repeatedly in cyclic succession, the acting force at that length will decrease over time. Creep is the behaviour of structures under a fixed force when the force is either held or reached successively in a cyclic manner (Halbertsma *et al* 1999)[6]. Wiemann and Hahn (1997) has attributed the gains in hamstring length to an increase of subject's tolerance to stretching strains. They have also concluded that getting used to stretching strains seems also to be responsible for the observation that subjects believe they have gained longer or more relaxed muscles after a stretching programme[5]. Roberto *et al* (2010) reported an increase in hamstring length in active and static stretching techniques although the active stretching produced the greater gain in the AKER test, and the gain was almost completely maintained 4 weeks after the end of the training, which was not seen with the passive stretching group[14].

As per dynamic balance is concerned, Group A (RW and AS) showed highly significant improvement than Group B (AS) in four directions such as medial, antero-lateral, posterior, postero-lateral and insignificant improvement in other four directions such as lateral,anterior, anter-omedial, postero-medial.

In retrowalking improvement could be explained through enhanced proprioceptive input and better static posture control through muscles around ankle. The plantar surface of the foot plays significant role in providing sensory input to central nervous system for balance and posture control. Three mechano-receptors (Merkel's disc, Pacinian corpuscles, Meissner complex) send somatosensory input to the brain by sensing pressure and stretching motions in tissues which surrounds them. Input that come from bottom of the foot in particular are of great importance as they indicate movement of the body over the base of support (BOS). Thus weight bearing exercises such as Retrowalking can stimulate joint mechanoreceptors leading to increased proprioception input which can be the reason for the increase in balance in retro walking. Further, as there was an increase in length of the hamstring muscle found by Whitley *et al*. (2009), this could also be the possible reason for increase in the reach distance which is a sign of increase in the dynamic balance. However Retrowalking was itself a dynamic activity and stress more dynamic control over the body during Retrowalking. Costa (2009) had reported that a stretching duration of 15 seconds hold may improve balance performance by decreasing postural instability.

Conclusion

This study concludes that Group A (RW AND AS) and Group B (AS) are both helpful to increase hamstring flexibility. In post intervention AKET between two groups, Group A showed highly significant improvement than Group B. In post intervention SEBT between two groups, Group A (RW and AS) showed highly significant improvement than Group B (AS) in four directions such as medial, antero-lateral, posterior, postero-lateral and insignificant improvement in other four directions such as lateral, anterior, anter-omedial, postero-medial.

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