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Efficacy of Retrowalking Versus Passive Static Stretching on Hamstring Tightness And Balance in Young Collegiate Students

KEYWORDS: Retrowalking, Passive static stretching, Hamstring Flexibility, Balance.

Shaji John Kachanathu	Shibli Nuhmani	Dinesh Chand
College of Applied Medical Sciences, King Saud University, Riyadh, KSA	Faculty of Applied Health Sciences, Jamia Hamdard, New Delhi, India	Faculty of Applied Health Sciences, Jamia Hamdard, New Delhi, India

ABSTRACT *Objectives: Hamstring flexibility (HF) plays an important role in basic movements such as walking and running. Studies have been suggested that hamstrings tightness are associated with various sports injuries. Dearth of studies done to compare the efficacy of passive static stretching (PSS) and retro walking (RW) on HF and balance.*

Methods: 30 collegiate students with mean age of 23.93±0.96 years participated in the study and divided into two groups, RW and PSS groups (n=15), they received RW and PSS respectively. Total duration of the study was for 6 weeks. Intervention outcomes were measured by HF and balance components.

Results: Both groups RW and PSS have yielded significant improvements on the HF (p=0.000). Balance components such as static and dynamic balance were significantly increased in RW group (p=0.000), whereas PSS group showed insignificant improvement on static balance, however, 4 out of 8 directions of dynamic balance showed significant improvement.

Conclusions: RW and PSS both equally helpful to increase HF. Balance is concerned, PSS is not effective as compared to RW, whereas RW contributes a significant role in both static and dynamic balance.

Introduction

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 various tasks. Athletic trainers and coaches have used backward running (BR) drills to increase the athlete's coordination and endurance. Threlkeld et al. (1989) examined both the kinetics and kinematics of backward running in ten subjects and concluded that backward running may provide a clinically useful means of increasing knee extensor strength, while minimizing harmful joint stress in the process. Similarly, Flynn and Soutas (1995) suggested that backward running could decrease patellofemoral joint reaction forces and decrease eccentric loading of the patellar tendon, both of which may be beneficial in patients with patellofemoral dysfunction.

Another benefit of retro motion includes practice and training of skills used in specific sports. Many court and field sports, such as basketball, American football and soccer all incorporate backward running during competition. Performing the activity during training may allow one to improve performance and/or reduce potential for injury. Acute musculoskeletal injuries can lead to a myriad of secondary problems during recovery and rehabilitation.

The length of hamstring muscle is considered to play an important role in both the effectiveness and the efficiency of basic movements, such as walking and running. Clinical observations have suggested that short hamstrings are associated with various problems, including specific disorders of the lumbar spine, general dysfunction syndromes of the low back, and sports-related injuries (Riley et al.2007). Lack of flexibility as the cause of strains, sprains, and overuse injuries in sports is a widely held belief. Consequently, there is no study done to compare the effects of passive static stretching and retrowalking on hamstring length and on balance, thus the purpose of this study is to determine the efficiency of retrowalking (RW) versus static passive stretching (SPS) on hamstring length and balance.

Methodology:

A convenience sample of 30 collegiate students group consisted of 15 male and 15 females participated in the study. They were recruited according to the inclusion and exclusion criteria. Inclusion criteria based on healthy young male or female of age group between 20-25years with normal BMI value and ROM of knee flexors (hamstring) of an inability to achieve 160^0 of active knee extension. Basic characteristics of sample size were 23.93±0.96 years of age, height of 168.73±8.61cm, weight of 59.53±7.61kg and limb length of 90.53±5.75cm. Subjects were randomly allocated in to two groups, RW group and PSS group (n=15) and they received RW and PSS respectively. For RW group provided an opportunity to acclimate with backward walking on a treadmill by three supervised 10 minutes practice sessions at 0^0 of inclination. During interventional period the treadmill was adjusted to produce a speed of 4km/h and 0^0 inclinations for 6 minute period of retrowalking 3 times a week. For PSS group, passive static stretching was given to both the lower extremities of the subjects in supine lying over the bed, with stretch hold duration of 30 seconds, 4 times per session with 10 sec rest in between each repetition, 3 times per week. Total duration of the study was for 6 weeks with frequency of 3 days per week. Interventional outcomes measured by hamstring length and balance components by Standing Stork Test (SST) and Star Excursion Balance Test (SEBT) for static and dynamic balance respectively.

Results:

Data analysis was done by using the software package SPSS 16.0. The mean and standard deviation of all the variables were analyzed. t-test comparison was applied to pre-test and post test readings between groups. The post- test score was significantly different from the pre-test for hamstring length within both groups (P = 0.000) (Table 1)(Graph 1).

Static balance assessed by SST showed significant difference in post-test score as compared to pre-test score in RW group (p = 0.000) whereas PSP group (P= 0.065) (Table 1)(Graph 2).

Dynamic balance assessed by SEBT showed highly significant difference in RW group (p = 0.000) as compared to PSP group in all eight directions. Whereas PSP showed significant improvement only in four directions such as in Anterior (p= 0.006), Antero-lateral (p= 0.022), Medial (p= 0.000), Antero-medial (p= 0.001) reach distances. However, rest four directions were insignificant in PSP group such as in Lateral (p= 0.313), Postero-Lateral (p= 0.114), Posterior (p= 0.461), Postero-medial (p= 0.183) reach distances(Table 1)(Graph 3).

Discussion

Both RW and PSP groups showed significant improvement in hamstring length in post intervention. 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. 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 backward walking on treadmill. Improvement by the RW 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.

Cipriani et al (1995) showed an increased activity of rectus femoris muscle as during backward walking, the normal eccentric contraction of the rectus femoris is replaced by a concentric contraction. Due to this increase in concentric activity of rectus femoris, hamstring may be loaded under eccentric stretch and could be a reason in the gains of the hamstring length. These results could explain the gain in hamstring length in current study as well.

Improvement by the PSP in hamstring length can be explained by the changes in viscoelastic 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 inhibition 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 behavior 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 behavior of structures under a fixed force when the force is either held or reached successively in cyclic manner (Halbertsma et al.1999).

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. Weijer et al (2003) also reported significant increases in the hamstring length after passive static stretching. Gasdosik (1991) observed a concomitant increase in hamstring length after static stretching and demonstrated lengthening adaptations to stretching regimen. 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.

RW group showed significant improvement in both static and dynamic balance, but there were no significant improvement found in PSP group in static balance. However, gains in four out of eight directions of SEBT of dynamic balance have revealed significant improvement.

In RW group 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 in 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 RW can stimulate joint mechanoreceptors leading to increased proprioception input which can be the reason for the increase in balance in retro walking group.

Cipriani et al (1995) had shown increase in the EMG activity of gastrocnemius muscle with RW. As in current study the measurement tool to assess the static balance has a important component of heel off the ground in final position done by the activity of gastrocnemius and various other muscles around ankle. During RW there is increase in activity of gastrocnemius and other muscles around ankle thus a more stable ankle. Improvement in the static balance of the RW group may be because of the fact that with RW gastrocnemius is loaded more.

The gains in dynamic balance in the present study could be explained by the reason that there was an increase in static balance and thus in dynamic balance assessment by SEBT which require stability around ankle on stance limb can be the reason of increase in the reach distance by the other limb. 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 RW was itself a dynamic activity and stress more dynamic control over the body during RW

Our findings correlates with various previously done studies which states that there was no significant difference of static stretching on balance or acute effects of stretching showed adverse effects on balance. Behm et al. (2004) reported that static stretching with a stretch duration of 45 seconds adversely affects the balance. Costa (2009) had observed, no significance improvement in the balance scales after passive stretching of 45 seconds. However, they had also reported that a stretching duration of 15 seconds hold may improve balance performance by decreasing postural instability. Little and Williams (2006) had shown no detrimental effects of static stretching of duration of 30 sec. on performance measures.

Furthermore, the improvement in dynamic balance in four out of eight directions (anterior, antero-lateral, antero-medial and medial) could be explained as the increase in reach distance because of the reason that as there was increase in hamstring length, it could affect the reach distance in above directions and thus increased in the reach directions had been observed.

Table 1. Comparison of outcome variables within groups

Outcomes	Groups	Pre-test Mean ± S.D	Post-test Mean ± S.D	t-value	p-value
Ham. Flexibility	RW	142.93 ± 6.31	152.24 ± 6.69	13.178	0.000
	PSP	140.80 ± 6.82	147.66 ± 7.62	11.007	0.000

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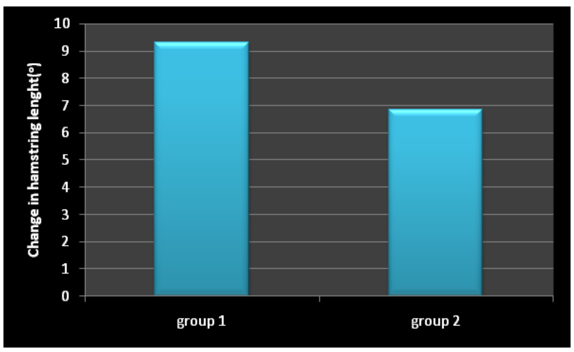
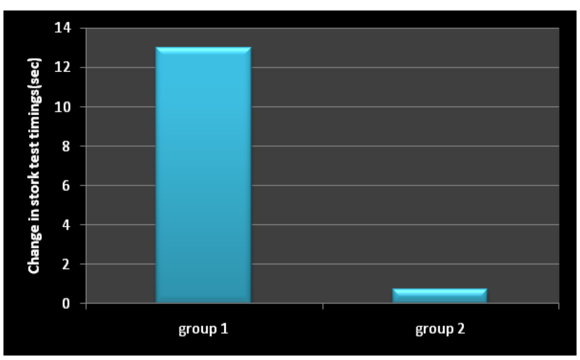
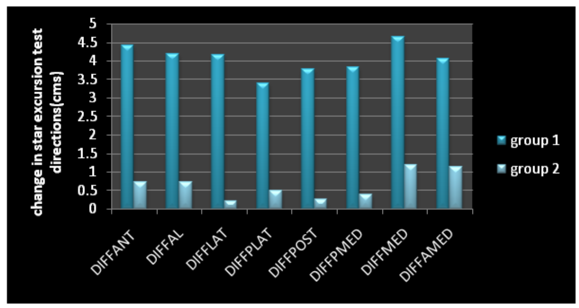
Outcomes	Groups	Pre-test Mean ± S.D	Post-test Mean ± S.D	t-value	p-value
SST	RW	5.13 ± 0.80	18.14 ± 4.52	10.943	0.000
	PSP	5.76± 0.92	6.49 ± 1.63	1.999	0.065
SEBT Anterior	RW	71.73 ± 7.38	76.16± 7.78	5.402	0.000
	PSP	73.13 ± 8.89	73.86 ± 8.90	3.214	0.006
SEBT Antero-Lateral	RW	69.33 ± 7.57	73.53± 7.53	14.386	0.000
	PSP	72.06 ± 7.95	72.80 ± 8.31	2.582	0.022
SEBT Lateral	RW	71.66 ± 7.43	75.83 ± 7.20	12.500	0.000
	PSP	73.53 ± 8.23	73.76 ± 8.37	1.047	0.313
SEBT Postero-Lateral	RW	69.26 ± 7.80	72.66 ± 7.23	11.274	0.000
	PSP	70.30 ± 9.15	70.80 ± 8.41	1.685	0.114
SEBT Posterior	RW	67.03 ± 7.01	70.80 ± 6.43	10.93	0.000
	PSP	69.96 ± 9.32	70.23 ± 9.37	0.759	0.461
SEBT Postero-Medial	RW	68.06 ± 8.47	71.90 ± 8.62	18.183	0.000
	PSP	68.50 ± 8.76	68.90 ± 9.33	1.402	0.183
SEBT Medial	RW	60.16 ± 8.01	64.83 ± 8.05	6.735	0.000
	PSP	60.10 ± 9.49	61.30 ± 9.46	5.527	0.000
SEBT Antero-Medial	RW	67.43 ± 3.53	71.50 ± 3.38	6.735	0.000
	PSP	68.33 ± 3.80	69.46 ± 3.70	5.527	0.001



Graph 1.Comparison of the change in Hamstring length between groups.



Graph 2.Comparison of the change in standing stork test timing between groups



Graph 3. Comparison of the change in star excursion test distance in eight directions between groups.

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