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EFFECTS OF NEUROMOTOR FACILITATORY TRAINING ON DYNAMIC BALANCE ABILITY IN YOUNG COLLEGIATE MEN

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ABSTRACT

Purpose: The purpose of this study was to estimate the effects of neuromotorfacilitatory training on dynamic balance ability in young collegiate men.

Methodology: Collegiate men 18 to 25 years of age were randomly allocated into intervention and placebo training groups with 30 subjects in each group. Neuromotorfacilitatory training intervention consisted of equillibrium control exercises, closed kinematic chain exercises, PNF patterns and rhythmic stabilization exercise for 8 weeks. Dynamic balance ability was determined by the Eyes closed dynamic (ECD) standing balance test. Pre and post intervention data were analysed to estimate differences with Student's unpaired 't'test.

Results: 60 young adults (mean age 21.62±1.12 yrs.) completed the study. ECD balance (in secs.)showed statistically significant improvement from mean5.23±1.68to mean 8.22±2.62 ($p< 0.01$) for non- dominant leg and from mean 5.28±1.54 to 8.01±2.28 ($p< 0.01$)for dominant leg in the intervention group.In placebo training group, ECD balance (in secs.) showed no significant changes from5.23±1.57to 4.88±1.14($p>0.05$) for non- dominant leg and from 5.11±1.08 to 5.26±0.90($p>0.05$)for dominant leg.

Conclusion: Neuromotorfacilitatory training improved dynamic balance ability in young adults.

Key words: Neuromotorfacilitatory training, athletic performance, dynamic balance, Proprioceptive Neuromuscular Facilitation

INTRODUCTION

Proprioceptive training that has been used in rehabilitation following sports-related injuries is becoming recognized as an important component of sports injury prevention.[1–8]

The association between muscle imbalance and extremity injury has been established.[9]It has been reported that proprioception can still be affected one year after injury following a rehabilitation program. [10]

Several research studies have indicated proprioception may play a major role in injury reduction.[11-14]Results of randomized trials indicate that multidimensional interventions, including proprioceptive training help reduce injuries to the lower limbs in particular sports.[1-8] However, the programs in these trials incorporated multiple components like warm-up, flexibility & strength training, sport-specific training and rehabilitation. The effects of such interventions on balance ability remain unclear. More so, the use of these techniques on balance in sedentary young adults has not been studied.

The improvement in static balance following balance training has been reported by several studies.[15,16,18] Nevertheless, these trials did not

study the effect of dynamic proprioceptive balance training, a more likelyinfluence on postural control in athletic conditions.Less research has attempted to document the influence of balance on performance measures. It has also been reported that the evidence for the effects of short and long term applications to unstable environments is inconclusive, and deserves more substantial research.[19]

Available evidence concerning the intensity and frequency of exercises, and optimal methods for progression is inconclusive. A systematic review reported that the frequency and duration of neuromotor exercise training to cause health and fitness benefits are uncertain because there is inconsistency in the quality of available studies, the nature andparameters of exercise described; there is inconsistent duration ofofinterventions, and no uniform outcome measures have been used.[20]

Emery et al[21] found that a home-based proprioceptive balance-training programmefor six months using a wobble board improved static and dynamic balance in healthy adolescents and led to reduction of reported injuries along treatment period. Neuromotor exercise training is reported to be helpfulwhen it is part of exercise regimes for elderly, targeted to improve strength and balance and reduction in risk of falling. [22] High levels of balance and proprioceptive training in gymnasts have been attributed to their ability to stand still under varied controlled proprioceptive input.[23]

A mounting body of evidence indicates that proprioceptive training can improve athletes' strength, coordination, muscular balance, and muscle-reaction times. It is likely to find that improved proprioception can also boost athletic performance. It remains to be established whether a prophylactic neuromuscular and proprioceptive training program could improve dynamic balance ability- one of the determinants of athletic performance- in young adults.

PURPOSE OF STUDY

The purpose of this study was to estimate the effects of neuromotorfacilitatory training on selected athletic performance variable – dynamic balance.

HYPOTHESIS

Neuromotorfacilitatory training with proprioceptive and stabilization exercises would improve dynamic balance.

METHODOLOGY

Collegiatestudents between the ages of 18 and 25 years fulfilling the requisites of the study, were included using computer generation of random numbers, after obtaining approval for the study and ethical clearance. Subjects not participating in any other lower extremity exercise programme six months prior to / during the interventional period gave informed consent to participate in the study.

Based on the information gathered, the subjects who had history of lower limb musculoskeletal pathology (eg. Fracture, muscular strain, ligament sprain, rheumatologic disease), surgery, systemic diseases, like cardiovascular conditions (eg. IHD, valvular disease, peripheral vascular disease); respiratory problems (eg. Infection /bronchial asthma); neurological disease (eg.Epilepsy, neuropathy, dementia) were excluded from participating in this study.

Prior to experimental treatment, all the subjects were assessed to obtain measures of selected variable. Dynamic balance ability was measured using the Eyes closed Dynamic balance test (ECD) .The test essentially measures single leg stance time on unstable surface in seconds(secs.). Subjects were divided into two groups, namely, experimental group (Group A) and placebo training group (Group B).

The 8 weeks neuromotorfacilitatory training consisted of equilibrium control exercises – single limb stance on firm and foam surfaces, ankle disk training with knee extension and arm

extension, closed kinematic chain lower body exercises, Proprioceptive Neuromuscular Facilitation (PNF) patterns and rhythmic stabilization exercise. Placebo training group received open kinematic chain exercises and relaxation training. Typical exercise session lasted approximately 20 minutes.

After a period of eight weeks both the groups were measured on the criterion variables, which formed the final scores. Baseline data was compared with data after the study period. Data analysis was done using Student's "t" test. The difference between the initial and final means was considered as the effects of neuromotorfacilitatory training on dynamic balance – a determinant of athletic performance.

RESULTS

60 young adult males (mean age 21.62±1.12 yrs.) completed the study period of 8 weeks and were analysed for change in dynamic balance measures following intervention.

Prior to participation in the treatment protocol, ECD measures were estimated for the subjects. Student's" t" test indicated no significantdifference ($p>0.05$)between the two groups in the pre- test measures for non-dominant as well as dominant leg.The measures of ECD after intervention were significantly higher ($p<0.01$)for the subjects who underwent Neuromotorfacilitatory training (Group A) when compared to the placebo training group (Group B). [Table. 1; Fig. 1 and Table. 2; Fig.2]

Following intervention, the ECD measure for non- dominant leg showed statistically significant improvement (mean difference ±SD of 2.99±2.38, Student's "t" test, $p< 0.05$) in the subjects who underwent Neuromotorfacilitatory training (Group A). The change in measure for subjects who underwent placebo training was not statistically significant. (Mean difference ±SD0.36±1.05, $p> 0.05$) [Table. 3]

Following intervention, the ECD measure for dominant leg showed statistically significant improvement (mean difference ± SD of2.73±2.19, Student's "t" test, $p< 0.05$) in the subjects who underwent Neuromotorfacilitatory training (Group A). The change in measure for subjects who underwent placebo training was not statistically significant. (mean difference ± SD of0.147±0.653, $p> 0.05$) [Table. 4]

DISCUSSION

The present study involved young sedentary collegiate male subjects and involved comparison of an eight week neuromotorfacilitatory training and placebo training.

The knowledge of being part of a structured training program under professional supervision may influence performance following participation. There is also a likelihood of learning effect on outcome evaluation variables when they are physically performed tasks. Placebo training was expected to address this issue most effectively. Subjects in the placebo group underwent activities not likely to cause proprioceptive facilitation but at the same time offering an unmistakable perception of participation in training. Such a group of subjects was expected to essentially differ in psychological factors (that may influence the results of a pre- test- post- test study design) when compared to a no-intervention control group.

Results indicated that an eight week intervention based on neuromotor facilitation was instrumental in improving dynamic balance ability – one of the determinants of athletic performance.The findings indicate that in sedentary young adults, neuromotor facilitation may be considered to enhance athletic performance in addition to the widely reported beneficial effect in injury prevention. The relatively short duration of the training time probably would indicate feasibility of incorporating such intervention in physical education among collegiate students. Neuromotor facilitation techniques highlighting PNF and

closed kinematic chain exercises form the mainstay in balance rehabilitation, reversing the joint instability caused following the injury by recoveringproprioception and kinaesthesia- the two most commonly recognized factors to be involved following injury. [24] Enhancement of these factors may have been the mechanism underlying the improvement in balance ability following neuromotorfacilitatory training in the population of the present study.

In the present study dynamic balance ability was evaluated in both instances of standing on non-dominant leg as well as while standing on the dominant leg. Dominance was ascertained by considering the subject's preference of leg to kick a ball. Baseline ECD scoresshowed no significant difference ($p>0.05$) between non-dominant and dominant leg instances ($p=0.899$ in group A and $p=0.731$ in Group B), thereby ruling out the role of dominance on dynamic balance ability assessment.

Comparable effects on balance indicated by postural stability, have been reported by studies on athletes, and corroborates the findings of the present study. A 6-week neuromuscular training program designed to decrease occurance of ACL injuries reported improvement in objective measures of postural stability among high school female athletes.[25]Romero-Franco N, et.al. determined the effect of a 6-week specific-sprinter proprioceptive training program on core stability and gravity centre control in sprinters and concluded that the training program provided postural stability with eyes open and improvements in gravity centre control measures.[26] Proprioceptive training, and resultant improvements in gravity centre control measures may have contributed to enhancement of dynamic balance ability as indicated by the results of the present study.

There were several limitations of the present study. Factors like height and weight, previous training of the subjects of any kind prior to six months of experimental treatment and life style habits of the students outside the college were not taken into consideration. The climatic conditions at the time of testing the subject may have influenced the results. Future trials may consider eliminating some of these probable influences. An inherent limitation of the present study was that it included only male subjects. Future trials may be performed with female subjects in order to generalize the results in young sedentary adults. Additionally the effects of neuromotorfacilitatory training may be evaluated in young adults actively involved in specific sports to find out the influence of training on the determinants of athletic performance and skills of the games.

CONCLUSION

It was concluded based on the results of the present study that an eight week duration of neuromotorfacilitatory training improved dynamic balance ability in sedentary young collegiate adults.Neuromotor facilitation techniques may be applied in athletic trainingin this population.Consequently, sporting events that require improvement of this specific attribute in the player may adopt the same as part of training.The results strengthen the evidence database that defines the role of exercise interventions based on neuro-rehabilitation in athletic training.

The neuromotorfacilitatory training of the duration and frequency studied,that led to improvement in dynamic balance when compared to the control population which underwent placebo training,essentially comprised of proprioceptive and stabilization exercises targeting lower body.

A placebo training group being used for comparison rescinds possible Hawthorne effect influencingoutcome evaluation variables following the exercise participation. The comparison with such a group also annuls the likelihood of learning effect on the results (as they are physically performed tasks). Though not

worthy of indubitable establishment based on the conclusion, improvedbalance abilityseen following the intervention mayunderwrite reduction in the risk of injury and may even enhance other related variables of functional capacity / athletic performance.Determination of suchinfluences of the intervention studied would generate scope for the conclusions of the present studyto be taken further with greater implications in the field of training.

Table 1.ECD (in secs.) for Non-dominant leg

ECD – Non dominant leg					
	Group	N	Mean	Std. Deviation	t
Pre	A	30	5.230	1.684	0.008
	B	30	5.233	1.569	p=.994 ns
Post	A	30	8.220	2.615	6.423
	B	30	4.877	1.135	p<0.001 vhs

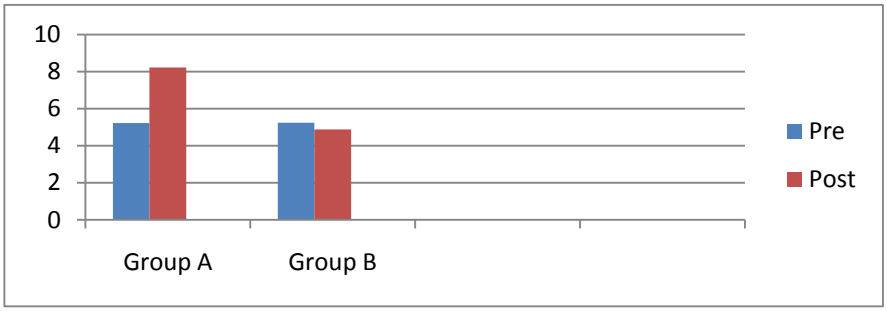

Fig. 1. ECD (in secs.) for Non-dominant leg

Table 2. ECD(in secs.) for Dominant leg

ECD - Dominant leg					
	Group	N	Mean	Std. Deviation	t
Pre	A	30	5.283	1.537	0.496
	B	30	5.113	1.079	p=.622 ns
Post	A	30	8.013	2.279	6.153
	B	30	5.260	0.901	p<0.001 vhs

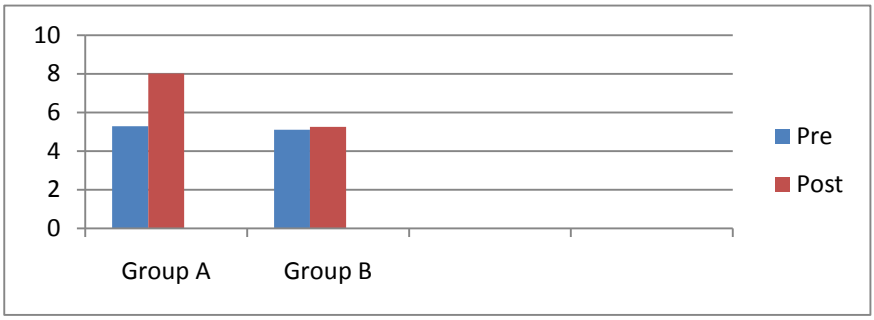

Fig. 2.ECD for Dominant leg

Table 3. Groupwise paired differences in ECD(in secs.).. Non dominant leg
Paired Samples Test: ECD. Non-dominant leg

Group			Paired Differences		t	p
			Mean	Std. Deviation		
A		Pre –post	-2.990	2.384	-6.868	<0.001 vhs
B		Pre –post	0.357	1.048	1.863	.073

Table 4. Groupwise paired differences of ECD (in secs.). Dominant leg Paired Samples Test: ECD Dominant leg

Group			Paired Differences		t	p
			Mean	Std. Deviation		
A		Pre –post	-2.730	2.189	-6.830	<0.001 vhs
B		Pre –post	-0.147	0.653	-1.231	.228

REFERENCES

1. Bahr R, Lian O. A two-fold reduction in the incidence of acute ankle sprains in volleyball. Scand J Med Sci Sports 1997;7: 172-7.
2. Caraffa A, Cerulli G, Projetti M, Aisa G, Rizzo A. Prevention of anterior cruciate ligament injuries in soccer. A prospective controlled study of proprioceptive training. Knee Surg Sports TraumatolArthrosc 1996;4:19-21.
3. Hewett TE, Lindenfeld TN, Riccobene JV, Noyes FR. The effect of neuromuscular training on the incidence of knee injury in female athletes. Am J Sports Med 1999;27:699-705.
4. Holme E, Magnusson SP, Becher K, Bieler T, Aagaard P, Kjaer M. The effect of supervised rehabilitation on strength, postural sway, position sense and re-injury risk after acute ankle ligament sprain.Scand J Med Sci Sports 1999;9:104-9.
5. Myklebust G, Engebretsen L, Braekken IH, et al. Prevention of ACL injuries in female handball players: a prospective intervention study over 3 seasons. Clin J Sports Med 2003;13:71-8.
6. Tropp H, Askling C, Gillquist J. Prevention of ankle sprains. Am J Sports Med 1985;13:259-62.
7. Wedderkopp M, Kaltoft M, Lundgaard B, Rosendahl M, Froberg K. Prevention of injuries in young female players in European team handball. A prospective intervention study.Scand J Med Sci Sports 1999;9:41-7.
8. Wester JU, Jespersen SM, Nielsen KD, Neumann L. Wobble board training after partial sprains of the lateral ligaments of the ankle: A prospective randomized study. J Orthop Sport PhysTher 1996;23:332-6.
9. Grace TG,Muscle imbalance and extremity injury: A perplexing relationship, Sports Med. 1985; 2:77-82
10. Leanderson J, Eriksson E, Nilsson C, Wykman A, Proprioception in classical ballet dancers: a prospective study of the influence of an ankle sprain on proprioception in the ankle joint. Am J Sports Med. 1996;24:370-374.
11. Besier TF, Lloyd DG, Cochrane JL, Ackland TR. External loading of the knee joint during running and cutting maneuvers. Med Sci Sports Exerc. 2001;33:1168-1175.
12. Cerulli G, Benoit DB, Caraffa A, Ponteggia F. Proprioceptive training and prevention of anterior cruciate ligament injuries in soccer. J Orthop Sports PhysTher. 2001;31:655-660.
13. Ghez C. The control of movement. In: Kandel E, Schwartz J, Jessell T, eds. Principles of Neural Science. New York, NY: Elsevier Science; 1991:533-547.
14. Lephart SM, Riemann BL, Fu FH. Introduction to the sensorimotor system. In:

Lephart SM, Fu FH, eds. Proprioception and Neuromuscular Control in Joint Stability. Champaign, Ill: Human Kinetics; 2000:xvii-xxiv.

15. Tropp H, Askling C, Gillquist J. Prevention of ankle sprains. Am J Sports Med 1985;13:259-62.
16. Gauffin H, Tropp H, Odenrick P. Effect of ankle disk training on postural control in patients with functional instability of the ankle joint. Int J Sports Med 1988;9:141-4.
17. Hoffman M, Payne VG. The effects of proprioceptive ankle disk training on healthy subjects. J Orthop Sports PhysTher 1995;21:90-4.
18. Rozzi S, Lephart SM, Sterner R, Kuligowski L. Balance training for persons with functionally unstable ankles. J Orthop and Sport PhysTher 1999;29: 478-86.
19. Anderson K. Behm DG, The inpact of instability resistance training on balance and stability, Sports Med. 2005;35(1): 45-53
20. Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev. 2009;(2):CD007146
21. Emery CA, Cassidy JD, Klassen TP, RosychukRJ,Rowe BH. Effectiveness of a home-based balance-training program in reducing sports-related injuries among healthy adolescents: a cluster randomized controlled trial CMAJ 2005; 172: 749–54.
22. Bird M, Hill KD, Ball M, Hetherington S, Williams AD, The long-term benefits of a multi-component exercise intervention to balance and mobility in healthy older adults. Arch GerontolGeriatr.2011;52(2):211-6
23. Vuillerme N, Teasdale N, Nougier V, The effect of expertise in gymnastics on proprioceptive sensory integration in human subjects. NeurosciLett. 2001;28;311(2):73-6.
24. Garn SN, Newton RA, Kinesthetic awareness in subjects with multiple ankle sprains. PhysTher. 1988;68(11):1667-71
25. Paterno MV, Myer GD, Ford KR, Hewett TE, Neuromuscular training improves single-limb stability in young female athletes. J Orthop Sports PhysTher.2004;34(6):305-16.
26. Romero-Franco N, Martínez-López E, Lomas-Vega R, Hita-Contreras F, Martínez-Amat A, Effects of proprioceptive training program on core stability and center of gravity control in sprinters. J Strength Cond Res. 2012;26(8):2071-7.