



EFFECT OF PERIPHERAL FATIGUE ON DYNAMIC BALANCE AMONG COLLEGE GOING STUDENTS

Science

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ABSTRACT

Fatigue is an important component of physical activity which can affect performance of not only sports but also activities of daily living. Various protocols are being used to enhance the fatigue resisting capacity of the individual. This present research study provides insight about the techniques which are effective in producing less fatigue and make improvement of performance of an individual. The study includes a sample of 25 subjects were included to participate. Dynamic balance using Star excursion balance test (SEBT) was measured before inducing fatigue and post test measurement was also taken. The results shows significant difference in the pre and post readings of dynamic balance in all directions of SEBT i.e. anterior, medial, postero-medial, posterior, postero-lateral, lateral, antero-lateral directions, except antero-medial direction, when peripheral fatigue was introduced. This study concluded that peripheral fatigue affect most of the directions of dynamic balance except in antero-medial direction. Dynamic balance decreases or imbalance takes place when the individual is suffering from fatigue.

KEYWORDS:

Peripheral Fatigue, Dynamic Balance, Star excursion balance test

Introduction

Fatigue is a common experience of individuals suffering from chronic illnesses. Mechanisms responsible for fatigue may be central or peripheral. Peripheral fatigue refers to exercise-induced processes that lead to a reduction in force production and that occur at or distal to the neuromuscular junction. Central fatigue can be demonstrated by an increase in the increment in force evoked by nerve stimulation during a maximal voluntary effort^{1,2}. Central and peripheral fatigue develop more slowly during sub maximal exercises. Mechanisms that cause fatigue are task dependent. Critical variables include exercise type and intensity, load (force or torque), specific muscle group tested, physical environment (particularly temperature), and duty cycle (percentage of time in muscle contraction and rest).

Balance is the ability to maintain stability within the base of support.³ Injuries can be prevented by improving joint proprioception and balance control. The precise physiologic mechanisms behind the fatigue-mediated alterations in neuromuscular control of the knee have yet to be determined. One possible explanation is that neuromuscular fatigue affects knee joint proprioception with subsequent changes in motor control of the lower limb.

Severe exercises which causes muscle fatigue may have an impact on joint proprioception and increase knee anterior posterior laxity. Thacker et al., 2003 stated that muscle fatigue and poor proprioception increase joint laxity and may lead to knee injury⁴. Mild exercise will improve proprioception senses and postural control which will prevent the impairments.³

The relative contribution of joint and muscle receptors to measured proprioceptive deficits following fatigue protocols also remains controversial. It is generally accepted that the greatest contribution to position sense and kinesthesia is from muscle receptors, primarily muscle spindles and Golgi tendon organs^{5,6}. Since fatigue protocols would presumably affect muscle tissue more than joint tissue, diminished position sense may conceptually be thought of as secondary to loss of muscle receptor input.

Fatigue induced by general exercises such as cycling or running better resembles conditions in daily life and physical activities induced by exercising the lower extremities isolated in an isokinetic device. Isokinetic or isometric contraction exercises are often used to fatigue muscles. These activities are usually not functional or direct sport activity related. Isokinetic exercise is used to provide objective measure of a muscle's ability to generate force⁷

This study focus on generating the peripheral fatigue using isokinetic dynamometry and then to see the effect of fatigue on dynamic balance using star excursion balance test (SEBT).

Material and Methodology- Subjects both males and females aged 18-25 year and not involved in any physical fitness activity and resistance training were included. Individuals with any neurological abnormalities, any recent joint pathology or recent surgery and trauma and any biomechanical abnormalities of lower extremity were excluded. Dynamic balance was measured before inducing the fatigue using isokinetic dynamometry. Then all 25 subjects were given five minutes warm-up on static cycle before isokinetic dynamometry. Subjects were positioned in a upright position on isokinetic dynamometer with knee flexed till 90 degree. The upper limit was set at 0 degree of extension with a speed set at 60 degree per second for extension and 180 degree per second for flexion. Subjects were instructed to exert the maximum force and complete five maximal isokinetic repetitions at slow speed (60°/sec) then a rest period of 10 seconds followed by maximal isokinetic repetitions at fast speed (180°/sec) till the patient get fatigue⁸.

Assessment of fatigue was done by rate of perceived exertion (RPE) which is the measure of intensity of exercise. The RPE scale runs from 0 – 10. The numbers below relate to phrases used to rate how easy or difficult an individual find an activity. For example, 0 (nothing at all) would be how you feel when sitting in a chair; 10 (very, very heavy) is how you feel at the end of an exercise stress test or after a very difficult activity.

Assessment of dynamic balance was done by star excursion balance test: Subjects were given 6 trials before the start of the test to get familiar with the procedure of test a verbal and visual on one leg at the center of the "star" with both hands on the waist and reached with the opposite leg in a particular direction as far as possible, touching the lines with toes. A tester marked this point for measurement. Repeat test was done if the subject was unable to maintain balance on stance leg during the reaching motion or if the reach leg was used to provide support during the test⁹. Test was performed in all direction. Total 3 trials were done in respective direction and best of the 3 readings was taken as final reading.

Results -

Table 1: Mean value of dynamic balance of peripheral fatigue subjects in SEBT ANTERO-MEDIAL direction

Dynamic Balance (Anterio-medial direction of SEBT)	(mean±sd) (cm)	Paired t-value	p-value
PRE DYNAMIC BALANCE	74.45±10.57	2.04	0.053
POST DYNAMIC BALANCE	69.97±12.27		

The Pre-post differences of dynamic balance in antero-medial direction were not statistically significant (p=0.053). The result revealed that peripheral fatigue had no effect on the dynamic balance of the subjects in ANTERO-MEDIAL direction.

Table 2: Mean value of dynamic balance of peripheral fatigue subjects in SEBT MEDIAL direction.

DYNAMIC BALANCE(Medial direction)	(mean±sd) (cm)	Paired t-value	p-value
PRE DYNAMIC BALANCE	66.87±7.56	2.15	0.042
POST DYNAMIC BALANCE	61.94±10.10		

The pre-post differences were statistically significant ($p < 0.01$) in medial direction. The result revealed that fatigue affects the dynamic balance of the subjects in medial direction.

Table 3: Mean value of dynamic balance of peripheral fatigue subjects in SEBT POSTERO-LATERAL direction.

DYNAMIC BALANCE(Posterior-lateral)	(mean±sd) (cm)	Paired t-value	p-value
PRE DYNAMIC BALANCE	62.73±9.34	4.12	0.00
POST DYNAMIC BALANCE	58.35±9.22		

The Pre-post differences were statistically significant ($p < 0.01$) in posterior-lateral direction. The result revealed that fatigue affects the dynamic balance of the subjects in postero-lateral direction.

Table 4: Mean value of dynamic balance of peripheral fatigue subjects in SEBT LATERAL direction.

DYNAMIC BALANCE(lateral direction in SEBT)	(mean±sd) (cm)	Paired t-value	p-value
PRE DYNAMIC BALANCE	72.26±11.55	6.13	0.00
POST DYNAMIC BALANCE	56.21±9.97		

The Pre-post difference in lateral direction were statistically significant ($p < 0.01$). The result revealed that fatigue affects the dynamic balance of the subjects in lateral direction.

Table 5: Mean value of dynamic balance of peripheral fatigue subjects in SEBT antero-lateral direction.

DYNAMIC BALANCE(Anterior-lateral direction in SEBT)	(mean±sd) (cm)	t-value	p-value
PRE DYNAMIC BALANCE	72.22±11.49	2.51	0.019
POST DYNAMIC BALANCE	68.20±13.34		

The Pre-post differences in antero-lateral were statistically significant ($p < 0.01$). The result revealed that fatigue affects the dynamic balance of the subjects in antero-lateral direction.

Discussion-The result of the present study can be supported by physiological theories of balance which states that athlete playing multiple sports disturbed their equilibrium to a near maximum as they choose different movement trajectories in an attempt to obtain a maximum reach distance. Balance has been found to be of prime importance in sports from the point of view of not only rehabilitating from an injury but also for prevention of injury. Balance is a broad term covering static as well as dynamic balance. Both types of balance are important but dynamic balance is more significant in prevention of injury during sporting activity as it is being constantly challenged during sports performance and hence need to be near normal for prevention of occurrence of any injury. Phillip J. Plisky, et al 2004¹⁰, work on the Lower quarter Y balance test grid as a Predictor of Lower Extremity Injury in High School Basketball Players. And they investigated that the SEBT could predict lower extremity injury in high school basketball players. Main focus of any sports activity or any training protocol is to improve an individual players balance as far as balance is concerned and it has been seen that multiple sports provides relatively greater challenge to limits of balance as compared to single sport. Hence it is suggested that individuals playing single sports should incorporate multiple recreational activities during their training program to improve their dynamic balance while keeping focus on their particular single sport along side. This will not only improve their performance in sports but also provide greater chances of prevention of injury as a post to the situation where they are playing and training only one sporting activity. Mechanism of peripheral fatigue is loss of electrical conduction from muscle membrane to tubule system, impaired calcium release from sarcoplasmic reticulum, impaired interactions between myosin and actin during cross bridge cycling, impaired re-uptake of calcium, bioenergetic failure due to impaired oxidative phosphorylation, glycolysis, or both¹¹

Thus this present study concluded that the peripheral fatigue affects most of the directions of dynamic balance except in Antero-medial

direction. Dynamic balance decreases or imbalance takes place when the individual is suffering from fatigue. Therefore the peripheral fatigue had a very strong relationship with dynamic balance.

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