To Compare the Effect of Eccentric Exercise Vs Concentric Exercise when Combined with Wobble Board Exercise on Propriception of Knee Joint after Inducing Fatigue in Quadriceps Muscle

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Abstract

Background: Proprioception, as the perception of positions and movements of the body segments in relation to each other, without the aid of vision, touch or the organs of equilibrium[1,6].

Objective: The main objective of this study is to focus on the difference between the effect of eccentric exercise vs concentric exercise when combined with wobble board exercise on proprioception of knee joint after inducing fatigue in quadriceps muscle.

Study Design: Experimental Study.

Methods: In this experimental studytotal 40 subjects were selected by convenient sampling and divided into two groups. Subjects of both groups were selected according to Inclusion/Exclusion criteria and informed consent were taken from all subjects and methodological protocol was introduced and applied to subjects and statistical analysis is done with the help of unpaired-t test.

Results: There were significant differences seen in that eccentric and concentric exercises with wobble board exercise are very effective in improving proprioception. But eccentric exercise with wobble board exercise has better effect in improving proprioception.

Conclusion: It is concluded that fatigue decreases the proprioception and eccentric exercise with wobble board exercise give better result to improve proprioception.

Key Words: *Proprioception, Fatigue, Goniometer, eccentric and concentric exercise*

Introduction

In 1906, Sherrington defined "Proprioception" as the perception of positions and movements of the body segments in relation to each other, without the aid of vision, touch or the organs of equilibrium[1,6]. The importance of the proprioception in knee function, stability injury prevention has been studied extensively in literatures. Proprioceptors are responsible for the deep sensations. These receptors receive stimuli from muscles, tendons, ligaments, joints and fascia and are responsible for position sense awareness of joint at rest, movement and vibration[2]. Proprioception includes balance, co-ordination and agility because the body's ability to react appropriately to external forces[3].

Balance is defined as person's ability to maintain an appropriate relationship between the body segments and between the body and the environment and to keep the body's center of mass over the base of support when performing a task[9]. It is assumed that some form of muscle spindle desensitization or perhaps ligament

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relaxation and Golgi tendon desensitization occurs with excessive fatigue which leads to decreased efferent muscle response and poorer ability to maintain balance[10].

It is believed that the Central Nervous System (CNS) links together afferent propriocep- tive feedback from multiple joints of a limb segment and redundancy of the afferent information can be used as an "error check" to improve proprioceptive feedback in order to maintain function.[1,4] Reproduction ability is decreased; possibly due to increased sensitivity of capsular receptors from muscle fatigue-induced laxity[8]. The assessment of potential injury risk before sports participation followed by intervention may decrease the relative injury incidence in athletes. The integrity and control of the proprioceptive acuity is essential for the maintenance of balance[1,5.]

In humans, the effect of fatigue on proprioception has been investigated at various joints. For the shoulder joint, Voight (1996), Carpenter (1998) concluded the proprioceptive acuity following fatigue has been shown to be reduced Sterner and co-workers (1998) showed that the force capacity of the subjects was rapidly reversed after the fatiguing protocol used, suggesting that the fatigue state was not deep and long-lasting, which might explain the missing effect on proprioception[11,17].

Torres R, VasquesJ (2010) also concluded that eccentric exercise leading to muscle damage alters joint proprioception, suggesting that there might be impairment in the intrafusalfibers of spindle muscles and in the tendon organs[16]. There are also many studies which suggest that decreased proprioception alters balance of a person. Hussein (2015) and GajananaPrabhu (2013) concluded in their studies that combined balance and isotonic exercise have better results in increasing proprioception[13,3].

In this study we also can identifying the effect of fatigue on proprioception and which isotonic exercise with wobble board exercise has better results to increase proprioception.

Aims and Objectives

The aim of this study is to investigate either eccentric strengthening exercise combined with wobble board training or concentric strengthening exercise combined with wobble board training is better to improve the proprioception in physiotherapy students.

1. To compile a literature on eccentric and concentric strengthening exercise in detail.

2. To compile literature of balance board or wobble board training in detail.

3. Literary study of proprioception.

4. Effect of either eccentric strengthening exercise combined with wobble board training or, concentric strengthening exercise combined with wobble board training on proprioception in physiotherapy students.

Methodology

Study Design

The study design is experimental in nature.

Sampling Method

Convenient sampling was done.

Sample

40 healthy subjects both male and female physiotherapy students with mean age 20.9±2, were selected for the study after using selection criteria & were divided in two groups A & B by convenient sampling.

PLACE

This study was performed in the research lab of physiotherapy department at College of Physiotherapy, Baba Mastnath University, AsthalBohar, Rohtak.

Selection Criteria

Inclusion criteria

1. Physiotherapy students, having healthy status

2. Age 18-21 years.

3. They should be regular.

4. Who did not undergo in any form of medication for any knee pathology condition during the course of the study or

5. any other interventions which could influence the study?

Exclusion criteria

1. Knee joint pathology
2. Musculoskeletal problem such as pain, fracture
3. Psychiatric condition like depression, anxiety
4. Uncooperative subject
5. Respiratory and heart problems
6. Pregnancy

VARIABLES

Independent variable

1. Eccentric and Concentric exercises
2. Wobble board

Dependent variable

1. Strength
2. Proprioception
3. ROM

INSTRUMENTATION

Strain gauge was used to measure strength of quadriceps muscle before and after fatigue[1,12].

Universal goniometer was used to measure proprioception and wobble board was used to improve balance[13,14].

Static cycle was used to induce fatigue.

Chair was used for eccentric and concentric exercise protocol.

Material and Methods

40 healthy subjects, both male and female physiotherapy students, with mean age 20.9±2, having no injury or pathology in knee joint, were selected for the study & were divided in two groups A & B by convenient sampling.

All the patients signed an informed consent form and were informed about the whole procedures before testing and training[13,14.]

The subject was asked to be seated on the couch with 90º flexion of the knee joint and goniometer was placed on knee joint. Axis of the goniometer was placed in the region of lateral condyle of the femur, moving arm was placed parallel to the lateral mid-line of the fibula towards the lateral malleolus and stationary arm was placed parallel to the lateral mid-line of femur. Then asked to close the eyes and then the leg of the patient was passively extended at 50º and then the leg was returned back to the same original position. The subject was asked to repeat this actively three times and three different readings were recorded by goniometer.

The same subjects in both the groups were put to fatigue by asking to do static cycling for the period of 20 minutes. The strain gauge was used in order to record the strength of the quadriceps muscle in the above fatigued subjects. Now in both the groups A and B proprioception of knee joint was again measured post fatigued by using universal goniometer. The subject was asked to be seated on the couch with 90º flexion of the knee joint and then asked to close the eyes and the leg of the patient was passively extended at 50º and then the leg was returned back to the same original position. The subject was asked to repeat this actively three times and three different readings were recorded.

After the completion of the above protocol the subjects in group A were submitted to eccentric contraction exercises in form of active strengthening exercises with minimum resistance (10 repetitions with 3 sets), starting from standing and asked the patient to sitting on chair slowly (90°), 6 seconds rest between each repetition and 1 minute rest between the sets. After this the subjects were asked to perform wobble board exercise in standing position for 15 minutes.

The subjects in group B were submitted to concentric contraction exercises in the form of active strengthening exercises with minimum resistance (10 repetitions with 3 sets), from 90° to 0° sitting on chair, asked the patients to extend his knee to zero position, 6 seconds rest between each repetition and 1 minute rest between the sets. After this the subjects were asked to perform wobble board exercise in standing position for 15 minutes.

All the readings were assessed pre- and post-fatigue after 8 weeks.

Result

Data was meaningfully assorted through calculation of Mean and Standard Deviation. Thereafter Paired and Unpaired' test was applied in group A and group B within and between the groups. The level of Significance was fixed at <0.05.

Table 1: Description of the subjects with mean age (standard deviation)

Groups	Mean	Standard Deviation	Number of Subjects
Group A	18.55	0.60	20
Group B	19.85	6.54	20

Table shows description of the subjects with mean value of age with standard deviation for the Group A (n=20) Normal subjects are 18.55±0.60 respectively. Group B (n=20) Subjects with mean value of age and standard deviation 19.85±6.54 respectively.

Table 2 Comparison between pre intervention proprioception error in group A before and after fatigue

Paired 't' Test	Pre intervention	
Groups A	**Pre fatigue**	**Post fatigue**
Mean	6.17	9.82
S.D.	5.73	7.68
't' value	2.7	
Result	S	

P>0.05 Non significant (NS)

P<0.05 Significant (S)

Table shows comparison betweenpre reading proprioception error in group A before and after fatigue find out with the help of paired-t test and 't' value was 2.702672367. The results were significant for proprioception error(p>0.05).

Table 3 Comparisons between pre intervention proprioception error in group B before and after fatigue

Paired 't' Test	Pre intervention	
Groups B	**Pre fatigue**	**Post fatigue**
Mean	5.32	8.15
S.D.	5.02	7.59
't' value	2.93	
Result	S	

P>0.05 Non significant (NS)

P<0.05 Significant (S)

Table shows comparison betweenpre reading proprioception error in group B before and after fatigue find out with the help of paired-t test and 't' value was 2.93877. The results were significant for proprioception error(p>0.05).

Table 4 Comparisons between post intervention proprioception error in group A and before and after fatigue

Paired 't' Test	**Post intervention**	
Groups A	**Pre fatigue**	**Post fatigue**
Mean	5.78	3.67
S.D.	3.25	2.53
't' value	4.19	
Result	S	

P>0.05 Non significant (NS)

P<0.05 Significant (S)

Table shows comparison betweenpost reading proprioception error in group A before and after fatigue find out with the help of paired-t test and 't' value was 4.190544. The results were significant for proprioception error(p>0.05).

Table 5 Comparisons between post intervention proprioception error in group B and before and after fatigue

Paired 't' Test	**Post intervention**	
Groups B	**Pre fatigue**	**Post fatigue**
Mean	5.83	6.53
S.D.	5.14	3.37
't' value	0.73	
Result	NS	

P>0.05 Non significant (NS)

P<0.05 Significant (S)

Table shows comparison betweenpost reading proprioception error in group B before and after fatigue find out with the help of paired-t test and 't' value was 0.73315. The results were non- significant for proprioception error(p<0.05).

Discussion

The data of present study reveals that Group A (n=20) healthy subjects with mean age 18.55±0.60 and Group B (n=20) healthy subjects with mean age 19.85±6.54examined for proprioception before and after fatigue. Paired-t test was applied within the group A and group B before and after fatigue and pre- and post-intervention and Un-paired t test was applied between the group A and B before and after intervention. In group A during pre-intervention shows mean difference in subjects for proprioception error pre-fatigue 6.28±5.69 and post- fatigue 9.78±7.55 (paired 't' value was 2.7), mean difference in normal subjects of group B for proprioception error pre-fatigue 5.31±5.02 and post-fatigue 8.15±7.55(paired 't' value was 2.93), result shows significant difference in both groups on pre intervention. Paired-t test was also applied in group A and group B post intervention. Mean difference in normal subjects of group A for proprioception error pre fatigue 5.63±3.26 and post fatigue 3.68±2.60 (paired 't' value was 4.19), result shows significant difference in group A, mean difference in normal subjects of group B for proprioception error pre-fatigue 5.87±5.28 and post fatigue 6.65±3.42 (paired 't' value was 0.73), in group B after intervention there is no significant difference found. Un- paired t test was applied between the groups A and B post intervention for proprioception error pre- and post-fatigue. Mean difference in normal subjects for proprioception error pre- fatigue post intervention in group A 5.78±3.25 and in group B 5.83±5.14 (Un-paired 't' value was 0.036) and result shows non-significant difference on pre fatigue, mean difference in normal subjects for proprioception error post- fatigue post intervention in group A 3.67±2.53 in group B 6.53±3.37 (Un-paired 't' value was 3.04) and significant difference found on post fatigue. So, this study shows a significant improvement in perception of joint position sense, thereby alternative hypothesis is accepted.

Gurney B, Milani J and Pederson ME conducted a study role of fatigue on proprioception of the ankle and concluded that the muscle spindle may provide a main component of joint proprioception, but it appears from the results of this study that non-weight bearing proprioception of the ankle joint is not altered by muscular fatigue of the plantar and dorsi-flexors.

Hussein NAMM, Saad MMAH and Sawey NAHEI (2015) concluded that balance training with isotonic resistive exercise gives better improvement of the functional status, muscular strength and knee proprioceptive accuracy in patients with knee osteoarthritis[39]. Mi-Kyoung Kim et al (2015), concluded that muscle fatigue generated by the exercise affected the decline in muscle activity and balance control; it also influenced the side that did not perform the exercise before fatigue due to this effect.

The result of the present study indicated that fatigue reduces knee joint proprioception and after giving isotonic exercise we can improve knee joint proprioception.As we also fatigue the muscle then give a session of eccentric exercise with wobble board exercise to one group and concentric exercise with wobble board exercise to second group for 8 weeks (3-4 days in a week) for improving strength of quadriceps muscle and outcome measures show that eccentric exercise when combined with wobble board exercise improves proprioception of the subjects.

So, it is concluded that eccentric and concentric exercises with wobble board exercise are very effective in improving proprioception. But eccentric exercises with wobble board exercise have better effect in improving proprioception.

Conclusion

The data reveals that Group A(n=20) normal healthy subjects with mean age 18.55±0.60 and Group B(n=20) subjects with mean age 19.85±6.54 examined for proprioception before and after fatigue. The results showed that there were clinically and statistically significant differences between these two groups. It is concluded that fatigue decreases the proprioception and eccentric exercise with wobble board exercise give better result to improve proprioception.

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Conflict of Interest -Nil

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