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EFFICACY OF COMPUTER ASSISTED BALANCE TRAINING PROTOCOL VS. CONVENTIONAL BALANCE TRAINING PROTOCOL IN NORMAL POPULATION.

Physiotherapy

KEYWORDS: Balance, static balance, dynamic balance, sebt

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ABSTRACT

Introduction: Balance is defined as maintaining the centre of gravity within the base of support. It is considered a risk factor for several injuries and consequently a focus of many strengthening, injury prevention, and rehabilitation programs. There are several studies that have evaluated the ability of balance training to improve balance ability in a healthy population with no general consensus. **Aim and objective:** To compare the effect of computer assisted balance training and conventional balance training in improving balance score. **Methodology:**30 subjects who fulfilled inclusion criteria on the basis of lottery method were randomly allocated in groups. 30 subjects were divided into conventional balance training protocol group (N=15) and computer assisted balance training protocol group (N=15). Balance of the subjects were evaluated on the basis of star excursion balance test score and global balance score. **Result:** Mean age of Group A was 22.46±2.26 and mean age of Group B was 21.13±1.30. Unpaired t-test between the post test of Group A and Group B reveals statistically significant difference. Group A is more effective as compared to Group B. T-value of GBS M/L of Group A and Group B is 2.15 with p-value 0.03 whereas in A/P direction t-value is 2.08 with p-value 0.04. T-value of SEBT score of left leg in Group A and Group B is 2.20 with p-value 0.03 whereas for right leg t-value is 2.23 with p-value 0.03 which have been represented in table and graph respectively. Conclusion: Computer assisted balance training protocol is effective as compared to conventional balance training protocol.

INTRODUCTIONBalance is generally defined as the ability to maintain the body's center of gravity within its base of support and can be categorised by either static or dynamic balance [1][2][3]. Nashner concludes that balance is achieved through a compilation of sensory, motor and biomechanical processes [3]. The overall goals of the postural control system, stability and function are achieved through integrated CNS of control.[4] Various postural control systems like Reactive postural control system, Proactive(anticipatory) postural control system and Adaptive postural control system[4][5][6] help in balance training.

Balance can be assessed through vestibular, visual and somatosensory processes [2]. Several studies have reported the use of all three of these modes of sensory input for postural rehabilitation with varying degrees of success.[9]

It is well known that an increased inflow of signals from sensory modalities via various ways can enhance plasticity of the brain. Sensory processes (including vision, audition, proprioception, touch and pressure) can mediate feedback information that is available as a result of movement. Visual feedback via a mirror is a simple, inexpensive and most importantly a patient specific treatment.[21] Astrid Zech et al. in his study on balance training for neuromuscular control and performance enhancement concluded that, clinically, balance training is an effective intervention to improve static postural sway and dynamic balance in both athletes and non athletes. Improvement in lower extremity muscle strength after balance training in non athletes as compared to untrained control group were seen in study.[22] Study from Mein-Yun Liaw proved that the postural sway increases with age and that all age groups found it difficult to maintain their balance with increases in complexity of visual or/and somatosensory cues.[23] Slight but powerful everyday life experiences could affect adult brain structures.[24] Various techniques are available for balance training like Frenkel's exercise[4], proprioceptive neuromuscular facilitation[4], tai chi[15][16] as well as balance training in the form of biofeedback like Kinaesthetic Ability Trainer(KAT)[17], Biodex stability system[18], My Fitness Balance Trainer (MFT)[19]. Various balance training programs are followed up but there is no comparison that which of the balance program is better as intervention.

METHODOLOGY

STUDY DESIGN: Experimental study design

SAMPLE SIZE: Total sample of 30 subjects were taken. They were divided into two groups:-Group1- computer assisted balance training and Group 2- conventional balance training

INCLUSION CRITERIA [8,26,11,12,22]

Males and females with age group 20-30 years, BMI ranging between 18.9kg/m^2 to 24.9kg/m^2, subjects having Global balance score less than 100.

EXCLUSION CRITERIA [2,3,11,12]

Defect in vision even after correction, individual diagnosed with cases of systemic, neurological, musculoskeletal, psychiatric disorders and disabilities, defect in hearing.

OUTCOME MEASURES: Global balance score[11-12], star excursion balance test score

PROCEDURE

40 subjects were contacted out of them 35 gave their consent and finally sample of 30 subjects who fulfilled inclusion criteria on the basis of lottery method were randomly allocated in groups[29].Participants were divided into 2 groups:- GROUP A-Including 15 participants for computer assisted balance training. GROUP B-Including 15 subjects for conventional balance training program in front of mirror.

The study was explained to participants in each group. Assessments were done. Demographic details and anthropometric measurement were done followed by balance measurement. Balance was evaluated on the basis of star excursion balance test score and global balance score.

STAR EXCURSION TEST-Star excursion balance test was checked in anterior, posteromedial and posterolateral directions. Before starting, subject's dominant leg was determined by asking to kick a football. The limb which was initiated for kicking ball was considered dominant. If right leg found dominant, the test would be counter-clockwise, on the contrary, if the left one were dominant, the test would be clockwise. In introductory test, participants practised each direction(Anterior, posterolateral and posteromedial) six times in order to remove learning effect. In main test participants were asked to reach as far as possible along each of three lines, with a light touch on the line and return reaching leg to the centre without losing balance. A trial was repeated if the subject used the reaching leg for a substantial amount of support at any time or removed the foot from the centre of the grid. Averages of three attempts in each direction were computed. Further each reach direction was normalised as the percentage of limb length. So as to normalise leg length between male and females. Normalisation was done by dividing reach distance by limb length multiplied by 100.

PHYACTION BALANCE EXERCISE[11,12]

Phyaction Balance trainer was used. The machine was calibrated by tilting it to extreme left, subject was then asked to stand erect on the moving board with their hands alongside their bodies. They were instructed to stand with both feet on the proprioceptive board as motionless as possible to maintain balance. The Global Score was taken in which a score <100 is better than a score more than or towards 100.Patient stood erect on the moving Board. Patients were instructed to stand as motionless as possible to maintain balance while the board sways over a diameter of 40 cm both in medio-lateral and antero-posterior direction

The duration of balance training will be 30 minutes a day, five times a week for four weeks. All the patients in the group receive 15minutes of medio-lateral balance control exercise and 15 minutes of antero-posterior balance training exercise. Each 15 minutes will be divided into 5 sets of exercise of 3 minutes each set. After each three minutes of exercise patients receives 1 minute rest. Each patient receives antero-posterior balance control exercise after completing 15minutes of medio-lateral exercise in the same manner. Exercise performance will be evaluated initially and then after 4 weeks of training.

THE BALANCE TRAINING PROGRAM[3,21,23,24,28,29,30,31]

On the first day of training level of balance exercise, performance of the patients will be evaluated. The program is based on a compilation of the rehabilitation and balance training protocols validated and published in prior studies.[1][26][27][30] It will be 4-phase balance training protocol consisting of 5 exercise sessions per week for 10 minutes. In all phases each exercise will be performed for 30 seconds, and the legs will be alternated during 30-second rest interval between each exercise. All the exercises will be performed in front of the mirror. The exercise program will include:-1) Maintaining a single-leg stance on a flat surface with eyes open and closed.

2) Performing functional sports activities such as throwing, catching and dribbling on 1 leg.

3) Maintaining double-leg stance while rotating the balance board.

4) Maintaining a single-leg stance on the balance board with eyes open and closed.

5) Performing functional sport activities while in single-leg stance on the board.

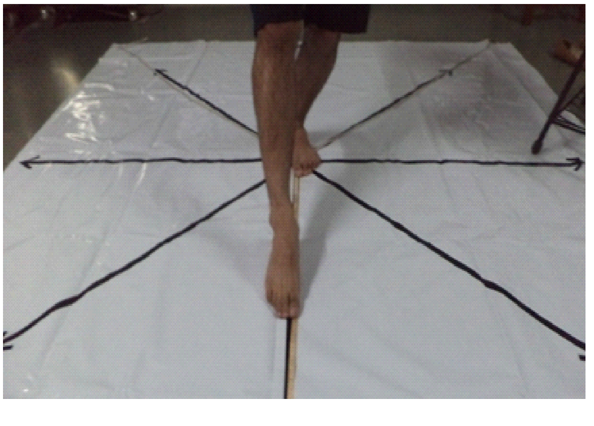

ILLUSTRATION 2: Subject on Phyaction Balance trainer (M/L)

RESULT

30 normal subjects were recruited in the study. Out of 30 normal subjects 15 subjects were randomly allocated in conventional balance training protocol group (group A) and 15 were allocated in computer assisted balance training protocol group (group B). Group A reveals that there are 15 subjects (N) and they have post test mean SEBT (Star excursion balance) score of left leg 106.80 with a standard deviation of 12.27. Post test mean SEBT score of right leg 105.73 with a standard deviation of 12.22. Global Balance score mean of M/L (medio lateral) direction was found to be 20.87 with a standard deviation of 3.58. Mean GBS of A/P (Antero posterior) direction was found to be 20.40 with standard deviation of 5.87.

Group B reveals that there are 15 subjects (N) and they have post test mean SEBT score of left leg 99.07 with a standard deviation of 5.85. Post test mean SEBT score of right leg 97.93 with a standard deviation of 5.75. GBS mean of M/L direction was found to be 24.67 with a standard deviation of 5.80. Mean GBS of A/P direction was found to be 25.07 with standard deviation of 6.37.

	GROUP A (N=15)	
MEAN	106.80	99.07
S.D	12.27	5.85
P-VALUE	0.03*	
T-VALUE	2.20	

TABLE 1.1: COMPARISON OF SEBT SCORE (LEFT LEG) POST-TEST GROUP A TO GROUP B

	GROUP A (N=15)	GROUP B(N=15)
MEAN	105.73	97.93
S.D	12.22	5.75
P-VALUE	0.03*	
T-VALUE	2.23	

TABLE 1.2: COMPARISON OF SEBT SCORE (RIGHT LEG) POST-TEST GROUP A TO GROUP B

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	GROUP A(N=15)	GROUP B (N=15)
MEAN	20.87	24.67
S.D	3.58	5.80
P-VALUE	0.03*	
T-VALUE	2.15	

TABLE 1.3: COMPARISON OF GLOBAL BALANCE SCORE (M/L) POST-TEST GROUP A TO GROUP B

	GROUP B(N=15)
	25.07
S.D	6.37
P-VALUE	0.04
T-VALUE	2.08

TABLE 4.5 COMPARISON OF GLOBAL BALANCE SCORE (A/P) POST-TEST GROUP A TO GROUP B

DISCUSSION

The result for Group A shows better balance score as compared to Group B. Improvement in balance score after intervention period could be due to training or conditioning enhancement of non postural muscular use pattern, compensatory postural strategies, increase in neuro transfer between brain and effector muscle through descending pathway, facilitation of neural pathway, enhancement of vestibulo cochlear pathway, sensory motor integration and neuroplasticity. In addition by giving the individual visual feedback, they become more aware of body displacement and orientation in space, they were able to integrate somatosensory and visual information in relation to stance and movement, which may recalibrate deficient proprioceptive information and compensate the Sensorimotor deficit.

Computer assisted group utilized graphical representation, in which, maintenance of their balance was visualised in a more advanced and precise manner. Compared to conventional balance group in which Mirror was the visual feedback. Visual feedback plays major role during observation of movement and later on execution of movement. Mirror neurons which are present in the pre-motor cortex, the supplementary motor area, the primary somatosensory cortex, and the inferior parietal cortex are responsible for observation of movements. Areas in the pre motor cortex become activated that are also active when the movement is executed. During execution of movement the areas which are activated are the prefrontal cortex, the pre-motor cortex, the supplemental motor area, the cingulated cortex, the parietal cortex and the cerebellum.[19][20]

Maintenance of postural control requires an individual to maintain the centre of gravity within the base of support. Possible contributions of muscle fatigue to perturbation in joint position sense have been attributed to decrease in motor neuron output or desensitization of type 3 and 4 muscular afferents.

The significant difference among the protocol is as a result of ensemble coding in relation to sensory information. By this theory, afferent signals from various peripheral receptors, including muscle spindles and golgi tendon organ, joint capsule and ligamentous mechanoreceptors, and cutaneous receptors, are processed centrally and returned via gama-motor neurons to the muscle spindle, which is referred to as the "final common input". The muscle spindle then creates a composite signal that is projected onto contractile fibres via alpha-motor neurons.[3] This composite signal provides the information necessary to facilitate neuromuscular control. These adaptations of the CNS are in response to peripheral training. Subjects likely gained familiarity with specific tasks and thus were able to alter existing motor-control programs or develop new ones to meet the demands of new balancing task.

Continuous perturbation in M/L and A/P direction change with continous rest in between must have led to more improvement in the balance.

CLINICAL RELEVANCE

The UNIPHY PHYACTION BALANCE TRAINER can be used for identifying balance dysfunction as well as for balance training. Functional balance, postural stability is essential in activities of daily living and should be practised by normal population as well. Our findings indicates that Computer assisted balance training protocol is significantly good in improving balance scores. Continuous activity in M/L and A/P direction focused more on the two aspects to control balance.

LIMITATION OF THE STUDY

1. There is gender difference among the two groups.
2. The sample size was small.
3. Time constraints for training.

SCOPE FOR FUTURE RESEARCH

Future investigation involving subjects with balance dysfunction and other health disorders. Study should see balance improvement in various professionals as well.

CONCLUSION

It can be concluded from the present study that computer assisted balance training protocol is significantly effective as compared to the conventional balance training protocol.

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