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Effect of Resistance-Balance training on dynamic balance in active elderly males

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ABSTRACT

Balance, stability and the prevalence of falls leading to injury are topics of great concern within the older-adult population. It has been suggested that the exercise efficiently counteracts these age related disorders, reducing the risk of falling significantly. The purpose of this study is to consider the effect of Resistance-Balance training on dynamic balance in active elderly males. 20 subjects with average and standard deviation age of 57.83±3.05yr, weight 67.11±4.58kg and height 167.94±4.70cm were randomized to two trial groups. The subjects were randomized consecutively into two Groups: the group submitted for the resistance-Balance Training Program (Intervention Group) for the six week and with 3 sessions per week, consisting of 10 subjects; and the Control group, consisting of 10 subjects without intervention. Dynamic balance was evaluated in all subjects, before and at the end of the trial, with using the Star Excursion Balance Test (SEBT). Descriptive statistics, Paired sample t-test, and t-test for independent groups used to analyze the data (P≤0.05). Significant differences were seen between pre and post reaching distance using SEBT after the applying resistance-balance training program for practice group in all directions of SEBT. However the results not showed any difference between pre and post reaching distance in SEBT for control group. Resistance- Balance specifically considering the methods of this study could be implemented for older adults.

Keywords: Resistance-Balance training, Dynamic Balance, Active Elderly

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INTRODUCTION

As people age, many physical and psychological changes take place in them. One of these changes is a one's ability in maintaining his/her dynamic balance. Dynamic equilibrium is responsible for maintaining balance in angular or rotary movements of the head in space. The crista ampullaris or crista inside the semicircular canal are responsible for maintaining balance while doing rotational movements such as twirling on the dance floor or during a rough boat

ride(1,2). Poor balance has been associated with increased fall risk and mobility disability among older people (3). Falls are multifactorial, and their causes are categorized as intrinsic (personal) and extrinsic (environmental) factors (4, 5). Some examples of intrinsic factors include: altered balance, neurological diseases, sensory deterioration, musculoskeletal diseases, postural hypertension and the use of medication (6). Previous research has clearly identified that balance is an issue with older adults and needs to be maintained or, in some cases, improved. Older adults need to understand that balance will improve the quality of their life. Then, they need to be instructed on how to maintain balance. Functional balance training or training that implements exercises that simulates real-life situations is a non-traditional yet practical way of looking at balance training. Nitz and Choy (7) used a balance training system that involved a work station format on balance in elderly population. Through this type of training, there was a significant reduction in falls. Also resistance training is widely accepted as an appropriate modality improves balance. However, other studies affirm no significant effect of resistance training on balance. Also, few researches have study effect of concurrent resistance training and balance on the balance in elderly people. The purpose of this study is to consider the effect of Resistance-Balance training on dynamic balance in active elderly males.

MATERIALS AND METHODS

20 subjects with average and standard deviation age of 57.83±3.05yr, weight 67.11±4.58kg and height 167.94±4.70cm were randomized to two trial groups. The subjects were randomized consecutively into two Groups: the group submitted for the resistance-Balance Training Program (Intervention Group), consisting of 10 subjects; and the Control group, consisting of 10 subjects without intervention. All subjects read and signed a term of free informed consent that described the procedures which would be realized during the research**.**

Dynamic balance was evaluated in all subjects, before and at the end of the trial, by a physiotherapist who was blinded to the distinct group (Intervention, Control) with using the Star Excursion Balance Test (SEBT).

The Star Excursion Balance Test (SEBT) is a functional test that incorporates a single-leg stance on one leg (e.g. right leg) whilst trying to reach as far as possible with the opposite leg (e.g. left leg). The participants stand in a square at the centre of the grid with 8 lines extending from the centre at 45° increments (see Figure 1).

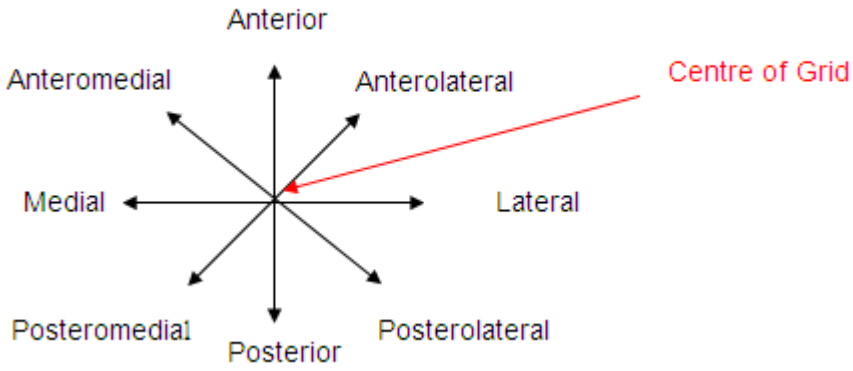

Figure 1: The Star Excursion Balance Test Layout Plan (SEBT)

Each of the 8 extended lines extending represent the individual directions which each subject are required to reach out with the most distal part of their reach foot. The eight directions consist of antero-lateral (AL), anterior (A), antero-medial (AM), medial (M), postero-medial (PM), posterior (P), postero-lateral (PL) and lateral (L). A standard tape measure (cm) was used to quantify the distance the subject had reached from the centre of the grid (see Figure 2) to the point that the subject managed to reach along each diagonal line. Set guidelines for each trial were adhered to (Figure 2) (8).

Trials were discarded if the examiner felt that
(1) The subject lifted the stance foot from the centre of the grid (2) Subject lost his/her balance (3) Subject did not touch the line with the reach foot while continuing to fully weight bear on the stance leg.

Figure 2: Guidelines for each trial

Training protocol:

The resistance plus balance group performed resistive exercises consisting of one set of 12-15 repetitions at a RPE of 12-13 (somewhat hard). These sets and repetitions are the recommendation by ACSM's Guidelines for Exercise Testing and Prescription for older adults (9). The exercises performed by the resistance training group were: bench press, lateral pull down, bicep curl, inclines chest press, triceps pushdown, leg press, calf raise, leg curl, abdominal machine and low back machine. Each subject was instructed to lift the weights at a rate of two counts up and two counts down. Once the subject was able to complete 15 repetitions without reaching a RPE of 13, the weight was increased by 5%.

Also this group participated in balance classes. These classes consisted of a half hour of functional training twice a week aimed at increasing balance. The program consisted of various exercises on a fitball, soft foam balance beam and ankle extension board. Five exercises were performed on the fitball and five on the soft foam balance beam, each exercise was performed for two minutes. The ball exercises were as follows: ball sit and balance, ball balance seated with one foot alternating feet every 5-sec, sit to standing to sit with ball, arm reach seated on ball and ball rolls. Each of these exercises had the flexibility to become progressively harder as each individual increased their balance. The sit to standing to sit and ball roll exercises included a 5-sec rest period between movements. The soft foam balance beam exercises were as follows: OLS with alternating legs every 5-sec, tandem walking, object pick up from floor, object move from shelf to floor, and chair raise. All exercises except the tandem walking included a 5-sec rest period between repetitions. The ankle extension board was used as an advancement tool. The control group was instructed to maintain usual exercise and daily activities throughout the 6 week training period.

Statistical Analyses

Standard descriptive statistics were used to report means, standard deviation, and range for baseline characteristics. Paired sample t-test, and t-test for independent groups used for determine significant differences among groups and between pre-test and post-test periods. Statistical analyses were conducted in SPSS, Version 16.0 (SPSS Inc, Chicago, IL). Statistical significance was established a priori at $P \leq 0.05$).

RESULTS

Table 1 shows Personal Characteristics of resistance-balance training and control group. T-test results showed no significant differences between the variables of height, weight and age of two groups' subjects that indicated to be homogeneous both groups in these variables. Also in the pretest of SEBT, distance of reaching in each of direction eight showed no significant difference between control and experimental subjects. Significant differences were seen between pre and post reaching distance using SEBT after the applying resistance-balance training program for practice group in all directions of SEBT. However the results not showed any difference between pre and post reaching distance in SEBT for control group (diagram 1).

Table 1: Personal Characteristics of resistance-balance training and control groups

Variable	group	N	Mean	SD
Age(years)	resistance-balance	8	57.50	2.39
	control	10	58.10	3.60
Height(cm)	resistance-balance	8	167.50	3.74
	control	10	168.30	5.53
Weight(kg)	resistance-balance	8	67.75	3.45
	control	10	66.60	5.46

DISCUSSION

The purpose of this study was to consider the effect of Resistance-Balance training on dynamic balance in active elderly males. The results of the study showed that resistance-balance training for six weeks had a significant effect on dynamic balance in active elderly males. The findings in the present study in line with the findings of Nagy et al (12), Nitz and Choy (7), Hu and Woollacott (13), Wolfson et al (14) and Liu-Ambrose et al (10), and don't in line with the findings of Buchner et al (11) that can be probably attributed to the type and time of training. Buchner et al in their study used a combination of resistance and powerful training while in the present study the combination of resistance and balance training were used. The probable reasons of increase in dynamic balance as result of resistance-balance training can be considered because of muscle strength increased of lower extremity in subjects after doing resistance training program, facilitate the situation in order to using great and fast-twitch motor units, increase in muscle coordination, exertion of stress to muscular nervous system and the process of disinhibition and mental factors as a result of resistance training as well as increase of muscle strength, the muscle range of motion, nervous control of movements and mental factors and exertion of overload in transferring information through three parts sensory system of central nervous organ(systems of visual, vestibular and somatosensory sensory).

SEBT needs muscular nervous control during doing the test for a suitable position of joint and the strength of the muscular structure around the joint (15). Olmsted et al through their studies found that the relied leg while performing the test needs dorsi-flexion of ankle, knee and hip. So lower extremity need suitable range of motion, strength, activity of deep receptors and muscular nervous control (15,16). Eral and Hertel (2001) found that with exception of gastocemius muscle activation of the lower extremity is direction dependent. During SEBT in all directions, the co-contraction of the quadriceps femoris and hamstring muscles occur (they found that co-contraction of the quadriceps and hamstring were apparent during each of the eight direction). They also established that the quadriceps were most active during the three anterior, anterolateral and anteromedial directions.

As, to do these anterior excursions, one must lean backward and the body should be in extension position in order that he/she could control his/her dynamic-balance. In this position, the gravity which act on the upper body causes high torque of flexion knee and should be controlled by torque of extension (eccentric contraction) which is produced by quadriceps femoris muscle whereas the vastus lateralis demonstrated high activity during the medial and posteromedial excursions and the justification for this can be related to muscular stability which occur against the muscular forces that in these excursions are active for SEBT.

On this basis, it can be concluded that the increase of strength and eccentric control of quadriceps femoris muscles can improve dynamic control in this excursions (16). During the SEBT, the biceps femoris muscle becomes active and has the most activity in posterolateral, posterior and lateral excursions. The interpretation can be explained regarding the effect of the gravity force on body which causes hip flexion movement torque. For doing anterior excursions one should have flexion in the trunk that he/she may extends the leg towards back in this case, hamstring muscles should be contracted eccentrically so resistant against the hip flexion movement. Also doing lateral excursion urgently needs a thigh lateral rotation so results in the high activity of the biceps femoris muscle (16).

Considering the matters discussed, we can observe that the strength of muscles which encompass and act on the joint and their contraction for the stability of joints of supporting lower body, function of properception and neuromuscular control in order to control dynamic-balance during the SEBT and acquiring the most distance have the most importance. For this reason, in the present study, one of the probable reasons of dynamic-balance improvement as a result of resistance balance training can be related to the increased of the strength of lower body muscles of subjects after taking part in training protocol. The main reason for the increase of strength in the first weeks of training is the adaption in the nervous system. It is thought that the changes which one observed the first 6-8 weeks is for the adaption of nervous system, but there is not any full agreement in this case(17).

The adaptation of nervous system may increase the strength through the following steps. 1- The motor units of fast-twitch and big can only be effective when they need to the great forces. It is suggested that during the maximal voluntary contraction, some of these units never becomes active in persons who have not done any physical exercises, so the exercise can be considered as a way of facilitating the effectiveness of the motor units of fast-twitch and big. 2- The changes can occur in the pattern of electrical stimulation of motor units or stimulation frequency and/or in simultaneity the effectiveness of motor units and by this way can increase strength. 3- The process of disinhibition: The internal feedback mechanisms as Golgi tendon organ control normally the body in producing great tensions. However, when through the exercises, the body is imposed in high levels of tension; the sensitivity of these organs can decrease by the process of disinhibition and allow the person to approach to the absolute force generation of maximal body. 4- With nervous system getting more skill and together with repeating physical exercise the coordination of muscles increase and this topic, facilitates the function. On the other hand, doing resistance exercises which one used in the present study has probably increased the dynamic-balance through imposing stress on nervous-muscular system (17).

As it was mentioned earlier, the improvement of dynamic-balance due to balance training can be attributed to the increase of muscular strength, joints range of motion, neural control of movements, psychological factors and imposing overload over the information transferring through the three sensory systems of central nervous mechanism (visual, vestibular, somatosensory systems). It has been reported that the changes in the range of motion, muscle

strength or length can make disorder in dynamic balance. Decrease in muscular strength of lower extremity can result in exposure of center of gravity against ankle joint that can cause disorder in dynamic balance and falling of the elderly. The improvement of muscular strength can cause displacement of gravity center to the joint ankle and improve the dynamic balance (18). As a result, according to this research the increase of the range of motion and muscular strength can have an important role in improving dynamic balance. Although in this research, muscular strength and joints range of motion and joints range of motion were not measured but it is proved that the resistance and balancing exercises have increased these variables. Also, as the balancing exercises which used in this research, especially are designed like the elderly daily motor tasks, the probable improvement in control of nervous movement, can cause functional adaptations (19). Balancing exercise can have a role in some of the sensory-motor system which is effective in maintaining the dynamic balance of the elderly (19). Balance exercise also improve dynamic balance by imposing overload over transferring information through triple sensory systems of central nervous mechanism (visual, vestibular, somatosensory) and also movement system for maintaining dynamic balance. It has been proved that balance exercises improve propriception and increase neuromuscular coordination (20, 21).

On the other hand, the improvement of the elderly dynamic balance as a result of physical exercises can be gained by the improvement of psychological factors of subjects. From the theoretical point of view, psychological factors such as fear, depression, stress, low self-confidence, low self-esteem and isolationism in interaction with physical internal factors and environmental factors caused increasing of fall risks of the elderly (22, 23).

In other words, any fall is accompanied with psychological effects that can affect the falling risk and the function of the person. The evidence indicates that there is a relationship between psychological disorders in physical acts. The findings indicate that any psychological factor has an important effect on the function of the person and potentially affects their physical function (22). The psychological disorders may be related to the physical ability and performance of the older person and affect their reaction to the exercises. But it has been proves that the psychological disorders of people can be improved by exercises (24).

CONCLUSION

Regarding the results of the research, it seems that applying the balance-resistance training programs can increase the dynamic balance of the elderly. As a result, the balance-resistance training not only can improve the muscular strength, but can increase dynamic balance and in this way the fall risk of the elderly is decreased. Finally, it is highly recommended that using the combined balance-resistance training can decrease the risk of fall in the elderly and improve their dynamic balance.

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