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REVIEW OF RESEARCH

EFFECTS OF 8 WEEKS STRETCHING EXERCISE WITH HUBER ON KYPHOSIS AND BALANCE OF MIDDLE AGED MEN

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ABSTRACT

This study aims to investigate the effect of eight-week strength exercises by Huber and Kyphosis device on the balance among middle-aged men. Thirty middle-aged men suffering kyphosis from Tehran with a mean ± standard deviation of age about 50.5 ± 2.1 years, height about 173.4 ± 4.5 cm and weight about 78.4 ± 8.6 kg were targetedly selected and randomly divided into two experimental and control groups (n=15 for each group). Eight-week sensorimotor rehabilitation exercise protocol was performed by the Huber rehabilitation device (three one-hour sessions per week). Static balance was evaluated based on BESS test, the dynamic balance was assessed using SEBT test, and the kyphosis angle was measured byflexible ruler (Cobb method). The research data analysis was performed by dependent and independent t-test was used. Results showed that a significant and meaningful difference is observed in the experimental group regarding the static and dynamic balance, as well as the kyphosisangle before and after the exercises. It can be concluded that eight-week stretching exercises by Huber device improves the static and dynamic balance and reduces the kyphosisangle among middle-aged men and so, such exercises can be used to improve the balance and the kyphosisangle in aged people, alongside other complementary methods.

KEYWORDS: *Stretching Exercises, Huber Device, Kyphosis, Balance.*

INTRODUCTION :

The quality and human body's physical condition is very important in human life, because the positive and negative changes and variations due to this issue influence human other conditions. Consequences of incorrect body posture are so extensive that should be considered and investigated in physical, psychological, economic, social and cultural dimensions. There are numerous meanings and intentions of human body physical condition and also many interpretations and explanations have achieved. This concept is a specific trait of humankind or a sign of phylogeny for anthropologists. This concept for an orthopedist means wellbeing and muscular and skeletal health of the body (1). One of the body parts that can change due to its specific

characteristics is the spinal alignment. Different curvatures of the spinal alignment would make proper distribution of power and would prevent inappropriate pressure on the spine and pelvis. Therefore, since the available discs between spines act as spherical joint and provide anymovement around three axes of motion, they are susceptible of being influenced by affecting factors on spinal alignment (1).

Usually after crossing the middle age border, many of body systems and organs, including the elderly neuromuscular system suffer regressive changes. According to this issue, falling down is one of the major problems in aging time which sometimes leads to different organs or pelvic bones fractures, and accordingly makes them bedridden and ultimately can lead to death(2) . Generally, decreasing of muscle strength and range of joints motion, weakness of visual, vestibular and proprioceptive senses, are known as the effective internal factors in balance control disorder in elderly (2).

One of the body parts that can change due to its specific characteristics is the spinal alignment. Different curvatures of the spinal alignment would make proper distribution of power and would prevent inappropriate pressure on the spine and pelvis. Vertebral anomalies are complex and dynamic processes that occur in the sagittal and coronal levels in the dorsal column - lumbar (3). One of the spine area anomalies is thoracic kyphosis, in the kyphosis anomaly, shoulders come forward and chest falls a bit down and respiratory muscles become shorter and weaker (3). Back muscles lose their ability for maintaining body posture and subsequently their lengths increase, so the muscle balance in posterior and anterior part will collide (1). Muscle weakness will have adverse effects on the body structure, which, if neglected, may become fixed and incorrigible abnormalities (4). Rahnemaet al. (2009), studied the effect of eight weeks of corrective exercises on abnormalities of the spine (kyphosis, scoliosis, lordosis) on 12-14 years old girl students. The findings of this research showed that eight weeks corrective exercises have caused a significant reduction in the kyphosis angle participants in students (5). On the other hand, falling down is one of biggest problems that affect the health of old people. In 2009, more than 1.6 million elderly were treated in emergency departments due to falling down. 20 to 30 percent of elderly who fall down, suffer from moderate to severe fractures, including hip or head fractures, which reduce the mobility and independence of person and in many cases increase the early death risk(6). More than half of the falling down damages in older people require hospitalization and in many cases lead to transfer them to nursing homes and getting away from social activities (7). In addition, complications from falling down lead to heavy treatment costs for old person, to his family and community. Appropriate exercise and body activity are of the proposed methods in order to improve balance, that their benefits have been demonstrated in previous studies. Physical activity by improving coordination and balance, decreasing muscle weakness, increasing recall of motion neurons, increasing resistance to muscular fatigue and developing hypertrophy especially in muscular fibers of type two (II), reduce the risk of falling down in old people (8). Morris (2011) studies showed that people along with getting older can develop balancing skills by using body exercise and even can regain some of the lost skills through exercise (9). Barnett et al (2003) showed that attending in weekly group exercise program along with home exercise, improves balance and reduces the risk of falling down in old people (10). However, due to the unwillingness of old people for long-term sport activities, detection the effect of muscle fatigue acting in various joints on the balance and subsequently designing exercises to postpone fatigue in these muscles are major issues that have not been in the center of interest for researchers so far. Hence, due to the increasing population of old people and the importance of protecting and preserving them, In addition to biomechanical, physiological and psychomotor studies, evaluation effective factors on healthy and independence life changes are necessary. According to the above, the main question is whether the eight weeks stretching exercises will improve kyphosis and balance in middle-aged men?

RESEARCH METHOD

According to the existence of experimental and control groups, dependent and independent variables and having pre-test and post-test design, the current research method was semi experimental and practical. Statistical population of this research was all middle aged men of Tehran with kyphosis complication, aged from 40 to 55 years old. The statistical sample included 30 middle-aged men that were suffering from kyphosis complication and voluntarily participated in this research project and after matching, they were divided into two

experimental and control groups including 15 persons. First, before implementing, the rate of kyphosis and static and dynamic balance were assessed and recorded through the relevant tests in order to assess dependent variables. Then experimental group did their exercises under the supervision of a researcher for eight weeks (three sessions per week). After completing the exercise program, in order to record post-test, all participants were assessed again.

To measure the exact curvature of dorsal spine and in order to determine the degree of kyphosis, flexible ruler was used. First the fourth and twelfth thoracic vertebra were diagnosed and marked in standing position. The researcher did the measurement twice for each participant to increase the accuracy. In this regard, using the method of marking on naked bust of participants, first the fourth and twelfth thoracic vertebras were marked on vertebral of samples and the flexible ruler was lying on their vertebral column. The settlement of T4 and T12 vertebras on flexible ruler was also marked. Then the ruler was transferred carefully on a paper and the curve was plotted then the places of fourth and twelfth vertebras was plotted and marked and by using an ordinary ruler a line was drawn to connect two points of T4 and T12 in order to obtain the width of curvature (h) and finally by placing obtained information in the equation (l/h2θ=4arc tg), angle of back curvature (kyphosis) was calculated. In this formula (l) is the length of curve and shows the distance between the last cervical vertebra to the last thoracic vertebra, (h) is a line that plumbs from the middle of curve to the middle of line (l).

The different steps of measurement were repeated three times for each participant (with one minute rest between repetitions) and the average of obtained angles was rated as a measurement indicator. A person whose kyphosis angle was less than 20 degrees were suffering from back straight, between 20 to 50 was normal degree, between 50 to 70 was kyphosis degrees and more than 70 degrees identified as hyper kyphosis complication (1).

BESS test was used to evaluate the static balance of participants. This test consists of three fixed positions; each of them was implemented on stable and unstable surfaces. The unstable surface was made in Iran compressed foam padding with dimensions of 50×40×6 centimeters, and the stable surface was stiff and thin carpeting flooring (Figure 1). These three conditions included: standing on both feet (legs pair), standing on no dominant feet with flexion of 30 degrees in the thigh and 45 degrees at the knee of dominant leg (a foot up) and standing on both feet so that two feet be behind each other and on one line and the front foot heel should have contact with other foot paw and dominant foot should be in front and no dominant foot should be behind. In all three positions eyes were closed and hands were on waist. Each position last for 20 seconds and the score is determined by recording errors. The errors include opening eyes, dragging hands from waist, touching floor with a foot that is not in contact with ground, hopping and stepping and any movement, getting the toe or heel from ground, moving thigh inside or hip abduction more than 30 degrees and staying away from the situation more than five seconds (11).

Also, Star Excursion Balance Test was used to evaluate the dynamic balance. In this test, eight directions are plotted on the ground in form of star with 45 degrees angle relative to each other. Inorder to implement this test and also to normalize the data, the actual length of the foot from upper anterior iliac spine to the inner ankle is measure. After the necessary explanations about test by examiner, each participant practices this test to overtake testing procedure. In addition before starting the test, the dominant foot of participants was determined, to see if the right foot is dominant the test be performed in the counterclockwise direction and if the left foot is dominant the test be performed in a clockwise direction (Figure 2).

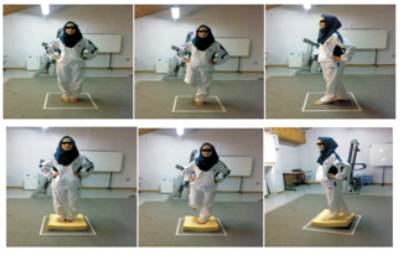

Figure 1: BESS balance test

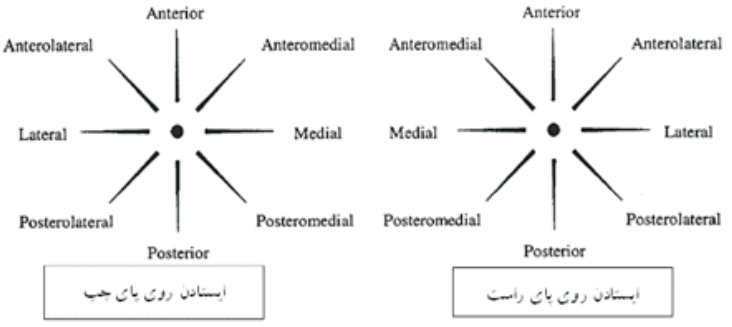

Figure 2: Star Excursion Balance Test

Exercising program: The number of exercising sessions in this study was eight weeks (three sessions per week and 40 minutes per each session) including 5 minutes of warming up, 15 minutes of stretching, 15 minutes of sensorimotor exercising and 5 minutes of cooling. They did these exercises by using the Huber device made in Germany. These exercises were done on an uneven surface. In this exercise, person improves his motion function by receiving sensory information. Performance of these exercises is similar to neuromuscular coordination test. The difference is that the amount of compression and traction here depends on person's performance in neuromuscular coordination of each exercise. Sensorimotor exercises were designed based on the overload principle. The exercising volume was increasing and the person was going to higher levels just in the case that they had acquired the necessary exercising neuromuscular coordination. The person was adjusting his performance balance and neuromuscular coordination in both sides of his body on the device using sense of seeing, and examiner was also trying to correct person's posture using auditory and tactile senses of the patient. Considering the fact that the neutral status of lumbar spine and pelvis was too important for increasing person's motion control, examiner was teaching the correct movement of the hip and lumbar vertebrae to the patient. Finally, in order to cooling down, they did stretching exercises on the device for five minutes.

In order to analyze the data, first of all, the correlated t-test and independent t-test were used to assess the differences between groups in order to compare the research groups. Confidence level was 0.05 and all statistical calculations were performed using SPSS software (version 22).

FINDINGS

Descriptive information of persons, including information about age, height, weight and leg length of the samples are presented in Table 1 and the results of the pre-test, post-test, as well as the results of statistical analysis is presented in Table 2. According to the information in Table 2, for the experimental group after completing the exercising program, the results showed that there is significant difference in static balance (with open and closed eyes, dynamic balance and kyphosis angle). But no significant difference was observed in the control group.

Table (1) Mean and standard deviation of age, weight and height of the control and experimental groups.

Variables	Experimental	Control
Age (years old)	1/9±50/3	2/4±50/7
Weight (kg)	6/5±76/5	10/1±80/3
Height (cm)	5/2±172/5	3/4±174/2

Table (2)Mean and standard deviation of age, weight and height of the control and experimental groups.

Variables		Pre-test	Post-test	T	P
Static balance with eyes open	Experimental	1/88±12/6	1/7±15/6	-13/7	0/001
	Control	1/9±12/6	1/9±11/9	-0/98	0/34
Static balance with eyes closed	Experimental	1/5±14/3	1/4±16/07	-9/5	0/001
	Control	1/69±15	1/7±15/1	-1/96	0/07
Dynamic balance	Experimental	2/4±102/5	2/6±108/9	-25/7	0/001
	Control	4/1±107/5	4/3±108/1	-0/33	0/75
Kyphosis angle	Experimental	4/5±54/4	6/01±46/6	7/17	0/001
	Control	5/1±56/9	5/03±57	-0/62	0/55

DISCUSSION AND CONCLUSION

The aim of this study was to investigate the effect of eight weeks stretching exercises with Huber device on the kyphosis and balance of middle-aged men. The results showed that eight weeks of stretching exercises with Huber device have improved the static and dynamic balance in middle-aged men suffering kyphosis complication. Stretching exercises with Huber device probably improve the proprioception, which may help to improve balance. On the other hand, neuromuscular coordination plays a major role in designing the sensorimotor exercises with Huber. The exercises used in this study were performed on a moving platform, which makes person to use the balance mechanism in his exercise and by commencing the ankle and hip strategy, proprioceptive receptors of pelvis and trunk which are mainly responsible for the balance, keep the body in balance (12). Huber device is equipped with handles with sensors that receive the amount of applied compression and traction and show them on the scan as feedbacks. This part of the device is used to increase muscle strength by the pressure of hands to the handles on both sides, in order to strengthen the muscles of the anterior trunk, while dragging of the handles is used to strengthen the posterior muscles. Since the Huber device is capable of simultaneous recording and showing the effort of individuals, one can modify and correct his body and the amount of contraction applied on the handles based on the test and error according to the recorded information on the device in the case of incorrectness. This is done by the central neural system; this means that the cerebellum is constantly receives new information from the control areas (in the brain and spinal cord) (12). Also, information is received from different parts of the body such as muscles, joints, skin, eyes and ears. Then, the cerebellum compares the movements which have really done with those desired by the motion system. If these two movements do not fit with each other satisfactorily, proper messages are sent back to the motor system to reduce or increase particular muscle activity levels (13). Finally, when the duration of the pre-registered exercise time finished, neuromuscular coordination device shows the amount of anterior and posterior muscle contraction force and balance on both sides of the patient's body. If the neuromuscular coordination is more than 71 percent, exercise intensity will be increased, in order to increase the balance, neuromuscular coordination, proprioception, strength and endurance of muscles (12).

Results of the present study showed that eight weeks of stretching exercises with Huber device has reduced the kyphosis angle in middle-aged men suffering kyphosis complication. For explaining this hypothesis it can be said that, the reason of kyphosis angle reduction after a period of stretching exercises with Huber device can be related to strengthening of the stretched muscle in posterior area of the spine through strength and endurance exercises without using weights except for the weight of the person's body. Also stretching exercises were conducted with no help in the thoracic region and caused the relative rehabilitation of the shortened muscles to their normal length and the movability of the spine. Hrysomallis et al (2001) showed that by increasing the back extensor muscle strength through exercise, the amount of kyphosis is reduced (14). Meyer (2003) stated that strength exercises affect the length of the muscles tendon, shifts different parts of the skeleton and cause the stability and consistency of the ligaments (15).

On the other hand, stretching exercises act as coordinator of agonist and antagonist muscles. Therefore,

such exercises increase the length of the muscles in the concave side and cause an increase in the energy and strength of the muscles in the convex side and finally, reduce the abnormality amount (16). Barrett (2004), used strength exercises to increase the strength of spinal cord straightening muscles of spine in patient suffering kyphosis, and concluded after doing these exercises that strengthening of the spinal cord straightening muscles of the spine has an important role in maintaining the postural structure and this type of exercises can help to improve kyphosis abnormality in patients (16). Due to the fact that the spinal cord straightening muscles of the spine are of the most important muscles to keep stature upright, by strengthening these group of muscles we can contribute to the strength of the spine and finally reduce abnormality. Compensatory changes of lumbar lordosis are formed by the dorsal muscles and after creating these compensatory changes, they tend to maintain the stability of the spine (15). As displacement of the gravity line usually occurs on the front or side of the spine, as soon as the slightest change occurs in the gravity line, back or side muscles of the spine (usually extensor muscles of the spine) become more active. These muscles are the first elements responsible for maintaining spinal stability; if these muscles are paralyzed, despite the action of ligaments and stature joints, maintaining the balance will be impossible (16). Also, one of the most important shoulder girdle flexor muscles is pectoral muscles. Studies have shown that resting of the muscle in short mode or its activity in a limited range can lead the muscle shortened (17). It seems that the long-term activity of the hands in front of the body and the hump mode that can have different reasons, or even the weakness of shoulder adductors can lead shoulders to getting away from each other, and in this case, strong anterior muscles draw shoulder towards them and shoulder takes a forward-protruded position. So dentate anterior, major pectoral and minor pectoral muscles protrude shoulder and minor pectoral helps anterior tilt and shoulder spin-down and also humerus spins towards inside (20-18).

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