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THE EFFECT OF SWIMMING EXERCISE ON THE CORRECTION OF THORACIC KYPHOSIS IN PATIENTS WITH MUSCLE DYSTROPHY

ALIAKBAR NAJAFVAND DERIKVANDI[1*] AND BIJAN GOUDARZI[1]

[1] M.Sc. Sport pathology and correction exercise, Islamic Azad University, Boroojerd Branch, Boroojerd, Iran

***Corresponding Author: E Mail: 111akbarjudo@gmail.com, Bijan35454@yahoo.com**

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ABSTRACT

Muscular dystrophy is one of the muscle diseases, in which the spinal column deformities occur due to muscle atrophy and progressive neuromuscular disorders. The aim of this study is to investigate the effect of eight weeks particular swimming exercises on kyphosis in patients with masculine dystrophy. A quasi-experimental method was used in this study. Eleven patients with muscular dystrophy were selected through purposive sampling and divided into two groups randomly including selective swimming exercises (n=6) and control group (n=5). Special training in water includes corrective swimming exercises and preparatory backstroke exercises. The study conducted under the supervision of researcher for eight weeks, three sessions per week and the time allocated was between 60-45 minutes. Moreover, at –test was used for statistical analysis and a significance level was set at $p<.05$. A significant decrease ($p <.05$) was observed in the thoracic kyphosis angle in practice group. However, no significant difference was observed in the control group ($p< .05$). Comparison of changes made during eight weeks (difference between pre-test and post-test) a significant difference ($p<.05$) was observed between the two particularly corrective swimming exercises and control groups. According to the obtained findings in this research, particular swimming exercises include corrective exercises and training backstroke exercises play a positive role in improving thoracic kyphosis disorder in patients with muscular dystrophy.

Keywords: muscular dystrophy, kyphosis, corrective swimming exercises, backstroke

1. INTRODUCTION

A wide range of diseases include those with hereditary neuromuscular deficiencies. Their main features are muscle weakness and muscle assimilates. These diseases are categorized into different types such as Duchene, Fasyv Askapvlv humoral, and Limbé Gyrdl muscular weakness and inheritance pattern, in terms of their location. Duchene, Becker dystrophies and congenital muscular dystrophies are common types of these diseases. Muscular dystrophies are caused by cell membrane defect. Defect appears clearly in the sarcolemma. Cells are connected to each other through a set of (complex) massive protein in muscle tissue and defects in any component of this complex leads to a kind of dystrophy [1, 2].

Inherited progressive muscle disorders created by defects in the gene which is necessary for muscle function. Major disruption in dystrophic gene, occurs in muscle weakness [3]. Muscular dystrophy includes a wide range of disabilities and medical problems in adults that need timely diagnosis and management. Weight control and orthosis use can make some things practicable as much as possible for patients. Taking into account the severity and progression of the disease, the patient may require surgery. Patients' main issues such as employment, personal relationships, sex, parents, chronic disability, need clear analysis and sympathetic management. After that, respiratory failure is of considerable reservations [4, 5].

Investigations have shown that muscular dystrophy leads to spinal muscular astrophy, and progressive neuromuscular disorders in patients. It could also affect their respiratory and cardiovascular function [3, 6].

Long-term exposure of spine in a difficult situation that is due to weak muscular dystrophy and structural defects in the membrane building muscle cause undesirable state for muscles and organs. These factors cause fatigue and pressure on the bones, joints, ligaments, muscles, organs, skin and ultimately they impair the cardiovascular system and digestive system [7]. Many of the spine deformation reduce the opening amount of chest and lead to reduced vital capacity, respiratory disorders, and negative effects on the cardiovascular system, finally they change in the patient's lung capacity [5, 7].

In patients with muscular dystrophy, deformation of the spine occurs due to muscle weakness and lack of coordination between the forces affects the spine [6]. One of the anomalies of the spine that occurs in

patients with muscular dystrophy increase curvature in the spine or a curvature of the thoracic vertebrae that is called Kyphosis [8]. In addition to changing the shape of the body and spine, postural abnormalities of kyphosis increase and eventually cause other physiological, biomechanics, respiratory disorders and balance problems [5, 6].

Muscular dystrophy treatment goals include improving long-term outcomes, longevity, and quality of life in these patients [4]. Given the need for treatment interventions to increase muscle strength, it seems that one of treatment strategies is appropriate exercise program in these patients in order to increase muscle strength and endurance [6].Corrective exercise with physical therapy are effective to improve abnormalities of the spine; consequently they had to improve physiological and biomechanical capabilities such as breathing capacity, balance and the quality of life [9]. Given the state of muscular dystrophy, these patients may have problems with the exercise on land. Research has shown that exercise with tools and environments that decrease the effect of gravity is one of the ways to exercise among patients with muscular dystrophy in order to improve physical function.

This study has been designed to investigate the effect of an eight week swimming training on the thoracic kyphosis in men with muscular dystrophy with regard to the prevalence of spinal abnormalities in patients with muscular dystrophy as well as their muscle weakness and muscular in ability to exercise [7].In addition, in recent research correction swimming exercise and the role of swimming training to improve kyphosis have been confirmed [9].

2. MATERIALS AND METHODS

A quasi-experimental design was conducted to evaluate the effect of an eight-weeks elective swimming exercises over the thoracic kyphosis in patients with muscular dystrophy. Eleven volunteered patients with thoracic kyphosis were selected among patients with muscular dystrophy. They were randomly assigned to two swimming exercise (n=6) and control groups (n=5) after signing an informed consent by the patients and their parents. The control group received no intervention.

2.1 Measurements

The participants' weight and body mass index and kyphosis were measured after measuring the anthropometrics' indexes of the patients including standing and sitting height.

2.2 Before performing measurements

Necessary explanation about how to do it, being comfortable in standing position,

looking straight forward, feeling comfortable in standing and equal distribution of weight on both feet were given to all participants [11].Measurer and colleagues considered the standing position, looking straightforward, feeling comfortable and equal distribution of weight on each leg of subjects, during measurement.

After placing subjects in interest position, the redundancy place of the spinal T2 and T12 were identified, using surface anatomical and touch, then redundancies were marked on the skin through marker [12]. After that, a flexible ruler was placed between marked points and an equal pressure was inserted on the ruler so that no space remains between the skin and the ruler.

The measurer holds the upper and lower parts of the flexible ruler with both hands without changing the shape of the created an arch in a flexible ruler and gently puts it on paper without making any changes. Then the specified points were marked and the curve of ruler was plotted on paper, using a pencil mark. Flexible ruler was picked up and a straight line was drawn from two specified points T2 to T12.

Filed line length between the spinal shock redundancies was measured and named by the letter "l". The line "l" was measured as the arch width "h" from the deepest point of the arch, then the obtained angle of curvature of the arch dorsal spines flexible ruler was calculated by placing indexical values in the formula. Khalkhal and colleagues [13, 14]have reported correlation of r= 0.89 the standard method using flexible ruler (x-ray) to measure thoracic kyphosis.

2.3 Exercise

The exercise group enrolled in24 sessions over eight weeks,3 days a week. The training time was considered at18-17.After explaining about the sport and its benefits, the training group were under selective swimming exercise according to their body condition and muscle weakness due to their illness.

Selective swimming exercise was designed and performed according to studies that have confirmed corrective movements in the water and swimming training role [9, 15, 16] in the treatment of spinal Nanjary. Therefore, the main movements included swimming and corrective swimming exercises in this study were performed within the shallow part of the pool for patients with muscular dystrophy.

2.4 Warm up

In the present study, the warm up exercises including walking forward, backward and sideways across the pool and body stretching was about 10 minutes in the shallow pool at the beginning of each session.

2.5 Special stretching exercises

Stretching exercises in current research was designed based on Azizi and colleague training (2012) as explained below. All flexibility movements were performed using static stretching exercise technique by person or with the help of another person. The main emphasis was laid on returning short muscles to their normal length in the anterior chest (major pectoral, minor pectoral, intercostal muscles, teeth anterior and other muscles in this area).About 15-10 minutes of workout time were devoted to flexibility exercises. The duration of each stretch was 15-10 seconds and ran in 10-5sets that include the following actions:

1. Stretching the arms overhead with straight elbows.
2. Stretching from the back in a way that hands lock behind and elbows come upwards slowly.
3. Taking hands away horizontally while palms facing up.
4. Taking elbows away while hands are on shoulder.
5. Opening the shoulders with the bent elbow while the subjects' palms face backward and they take the edge of the pool, asking them to bend their knee and pull their body down then keep the body in that position.
6. Opening hands with straight elbow while subjects have put their hands on the edge of the pool walk a step forward slowly. They were asked to keep their body in this position.
7. Stretching hands of the parties using the helper aid while subject's hands open side. Helper takessubject's elbows from behind and pull themback and upto the threshold of pain .
8. Stretching hands with the helper aid while one's hands lock behind the neck.
9. Helperholds under one's elbows behind the body and pulls them up and back to the threshold of pain.

2.6 Special reinforcermoves

Reinforced excercises in this study includes 15-10 minutes resistance training exercises in the pool according to Azizi and colleagues's (2012) excercises, which were designed in whichinclude the following steps

1. Pull the bent hand while subjectmoves engaged hand forth and the other hand backwardfrom the other side of the shoulder with the bent elbow.

2. stretch the flat hand with an emphasis on back muscles contraction
3. stretch across the body with one hand (horizontal abduction hand while the other hand is on the side)
4. Press the shoulder backward. Approaching the shoulder to each other on the corner of the pool.
5. take hands away (abduction) horizontalyand simultaneously while subjects palms facing back, subjects take their hands away from the midline of the body slightly with bent elbows.
6. Press the back while standing, legs shoulder-width apart. Subjects must stand facing the wall and taking the wall of the swimming pool. subjects were asked to look at the ceiling without bending the neck, then holdtheir torso away from the wall, then release.
7. Drag bent elbows backward while subjects's bending elbows are at shoulder level and parallel forearms standing straight on the surface of water. they were asked to slow down their elbows press them back and squeeze their shoulder bones's edge close to each other.
8. Smooth the chest while the subjects had their backs to the wall and use the edge of the swimming pool as a fulcrum. They were asked to open their dorsal spines slowly take the elbow away while hands are on shoulder untill elbows come together in the back and shoulders are close to each other.

It should be noted that in all water movements that were dynamic or reinforcements contraction subjects performed returned movementin a relaxation way so that the muscles of the chest area (the muscles that are in the opposite of main donors)were not in contraction state [9].

2.7 Swimming preliminary exercises

Preliminary backstroke exercises were conducted under the supervision of a swimming instructor in the pool for 15-10 minutes in this study. Preliminary exercises and training was administrated with the help of another person and aid to maintain buoyancy of subjects because subjects were not familiar with swimming. The swimming training was conducted for 30 seconds periodic rotations.The rest time between periodic rotations was about a minute, but in the case of fatigue more relaxing time was considered.

2.8 Cool Down

For control group cool-down excercises (recovery) was performed by subjects for 5 minutes at the end of sessions. The control group received no exercise-based intervention from researcher. The subjects continued their ordinary life style.

2.9 Statistical Methods

Descriptive statistics includingmean and standard deviation were used in this study. A paired t-test (t-affiliated) was usedto compare the difference between pre-test and post-test variables of the study. and an independent t-test was used to compare the mean differences created between the experimental and control groups. All statistical analyses were performed at the significant level of 05.0 ≥p.

3. RESULTS AND DISCUSSION

In Table 1, the results of anthropometric variables descriptive statistics including standing and sitting height, weight, body mass index, breast arch length and age of subjects are expressed in both experimental and control groups. In examining changes within groups (Table 2) after eight weeks of specific reforms training, thoracic kyphosis angle decreased significantly in the experimental group (P=0.100). However, no significant difference was observed in the control group (p<.05).

The results of T-test in table 3 revealed that there was significant difference between changes of experimental and control groups (P<0.001).

The independent t-test results presented in Table 3, showed a significant difference between the changes in the specific reforms inthe training and control groups(p<.01).

Table 1: Anthropometric indices in studied groups

variables	Age (y)	Standing height	Sitting hieght	Weight (kg)	BMI (kg/m^2)	the arc of a chest (cm)
Exercise group	**11.83 ± 1.94**	**142.10 ± 9.78**	71/17±5/23	**33.07 ± 5.75**	**16.26 ± 1.09**	29/52±3/96
Control group	**11.60 ± 1.67**	**138.04 ± 8.20**	69/30±3/77	**31.96 ± 5.42**	**16.68 ± 1.32**	28/80±2/04

Table 2: Results of T-Test to consider changes of group for Angel of back Kyphosis

Variable	Group	Pre-test	Post-test	t	P
Angel of back Kyphosis	**Experimental**	44.17±0.75	42.67±1.03	6.708	0.001
	Control	43.20±1.64	43.20±1.34	**-1.000**	0.374

Table 3: Results of independent T-test to consider changes of groups for Angel of back Kyphosis

Variable	Group	Difference between groups	t	P
Angel of back Kyphosis	**Experimental**	-1.50±0.55	-5.554	0.000
	Control	+0.20±0.45		

4. DISCUSSION AND CONCLUSION

The results showed that an eight-weeks elective training including special corrective swimming exercises and preparatory backstroke exercises decrease backstroke thoracic kyphosis angle (0/55 ± -1 /50) in experimental group. While insignificant increase was seen in patients with dystrophy in the control group (0/45 ± 0/+20). Other researches also showed an improvement in thoracic kyphosis that is due to corrective exercises. In the same line Shondi and colleagues conducted a study in a clinical trial. 25 students with kyphosis were divided into two groups including practice (n = 12) and control (n = 13) groups [17]. Participants exercised for 7 weeks, three sessions a week, each session lasted 45-30 minutes. After the training period, a significant decrease in thoracic kyphosis were observed in the correction group movements.

Pawlowski et al showed that 12 weeks straight spine muscle strength, flexibility exercises and proprioception improves the angle of kyphosis, muscle strength and physical performance of the participants [18]. On the other hand, since the subjects followed their own administered training independently at home, One-year follow-up results showed that thoracic kyphosis angle, muscle strength and physical function has not changed significantly in these patients over the training period.

Synaky et al showed that a two-year strength training increases muscle strength and reduces the angle of thoracic kyphosis in 75-58 year old women, but an eight-year follow-up showed that muscle strength reduced and thoracic kyphosis angle increased again[19]. The results of this study indicate the need to continue the exercises in people with muscle disorders.

Long-term exposure of spine in difficult situations as well as muscle weakness that is created in patients with muscle dystrophy due to structural defect in the muscle membrane structure leads an undesirable state for muscles and organs. These factors cause fatigue and pressure on the bones, joints, ligaments, muscles, organs and skin [4].

Different position changes happen in the areas of trunk, shoulders, and spine in postural kyphosis. In this case, shoulders are rounded. Anterior muscles and ligaments that support the spine reflection in the anterior (anterior longitudinal ligament, particularly the spine s) stiff and shortened. Muscles, ligaments, the posterior trunk and spine become weakened and stretched. Shoulders get away from the spine. Long time

repetition in this situation cause problem in balance and natural direction of lumbar.

Increasing dorsal lateral curvature of the spine in back area, seals pressed and get close to each other in the anterior part, its consequence is increasing the degree of curvature in thoracic area of the spine (kyphosis) [20-22]. Spine kyphosis and back muscles happen due to anterior muscle weakness and posterior trunk.The aim of doing corrective exercises isto strengthen the muscles and to improve the flexibility of muscles stretchin the anterior part[9].

In backstroke swimming, the anterior muscles such as Pectoralis major muscle, small pectoral muscle, anterior teeth, the anterior deltoid when hands are thrown back (shoulder flexion) the external rotation of the arm stretch. The posterior part of the trunk muscles like the large muscles of the back, parallelogram, erector spinae, Adaktvrhay shoulder and triceps of arm become active for the production of progressive force while swimming and reinforced under the effect of these movements [23, 24].

CONCLUSION

Overall, the findings suggest the positive effect of specific corrective exercises and backstroke exercises on improving the angle of thoracic kyphosis that can help patients with muscular dystrophy and the medical team in controlling and improving complications of patients.Considering that one of the most important treatment purposes of dystrophy patients is correcting spinal abnormalities.It seems that this style of trainingimproved changes in these patients because of the extensor muscles of the spine and the anterior chest muscle flexibility and can be useful to improve the quality of life in these patients as treatment plans.

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