DOI: https://doi.org/10.53350/pjmhs22161566

ORIGINAL ARTICLE

The Effect of Electrical Muscle Stimulation (EMS) Enhanced Schroth Method Training on Cobb Angle and Quality of Life in Patients with Scoliosis

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ABSTRACT

Aim: Different treatment models are applied in cases that affect the quality of life of individuals with scoliosis. It has been stated that exercise applications, especially used in addition to physical therapy, are effective in the treatment process of patients with scoliosis. In recent years, Electrical muscle stimulation (EMS) has been used to increase the performance of athletes. Accordingly, this study was planned to examine the effect of Electrical muscle stimulation (EMS) application on scoliosis cobb angle and quality of life in patients with scoliosis.

Methods: Twenty-four female scoliosis patients with scoliosis Cobb angle between 250 and 400 in the thoracic region between the ages of 14-26 participated in the study. The patients participating in the study were divided into three different groups as EMS Schroth exercise group (EMSS=8), Schroth exercise group (SE=8) and control group (CG=8). In addition, height, body weight, body mass index (BMI), Cobb angle measurements were taken for each group before and after the study. Scoliosis Research Society 22 scale (SRS-22) was used for these measurements. SPSS 25 statistical package program was used to evaluate the data. Since the data were not normally distributed, Mann Whitney U-test was used for pairwise comparisons. Kruskal Wallis H-tests were used to compare more than two groups. The level of significance was accepted as $P<0.05$ in the evaluations.

Results: It was determined that there was no statistically significant difference between the age, weight, height and BMI of the EMSS, SE and CG participants and it was found that the EMSS cobb angle decreased statistically. Also, it was stated that there was a stable and very slight decrease in the SE cobb angle. It was determined that there was a statistically significant difference in the negative direction in the CG cobb angle. It was determined that there was a significant change in SRS-22 scale values in all sub-dimensions of EMSS and SE, and there was no statistically significant difference in the pre-test and post-test mean scores of the other sub-dimensions except the pain sub-dimension of the CG scale.

Conclusion: EMS exercises will save time in terms of faster recovery of patients in the treatment of scoliosis. Besides, it will be very beneficial in terms of time and cost by shortening the rehabilitation period of athletes after sports injuries.

Keywords: Scoliosis, Electrical muscle stimulation (EMS), Schroth Method, Cobb Angle, Quality of Life.

INTRODUCTION

Scoliosis can be defined as a 3-dimensional deformity in which lateral deviation and rotation of the vertebrae occur, as well as changes in the sagittal plane[1]. While the spine is seen to have a straight alignment when viewed from the front or the back, lateral flexion is seen in the scoliotic spine to one side or to one side first and then to the other side[2]. Scoliosis is a very common problem. A large-scale study has not yet been conducted to determine the prevalence of scoliosis in our country. Studies conducted in schools in different provinces have revealed that the frequency of scoliosis varies between 0.2% and 4%[3]. According to the estimates made by considering the statistics of other countries, it is stated that there are approximately 207,000 individuals with scoliosis in Turkey. Scoliosis Support Group estimates that there are 2.5 million scoliosis patients in Turkey[4].

Scoliosis is one of the most common spinal deformities in adolescence. Most of the patients apply to the health institution after the deformity develops, when the asymmetry in the shoulders, waist and ribs of their family and friends is noticed[5]. In addition to deformation in the body, it is a pathology that can lead to cardiopulmonary complications, especially in progressive cases. In the future, recurrent lung infections can cause severe clinical disorders such as hypoxia, increased pulmonary resistance, and right heart failure as a result of pulmonary hypertension[6]. In addition to all these physical and cosmetic deformities, emotional disorders are inevitable. All physical and socio-psychological factors caused by scoliosis on patients have an impact on their quality of life[7].

In the literature, there are observation, patient education, physiotherapy, correct posture in daily living activities, use of corsets, manipulative approaches, biofeedback, electrical stimulation and surgical applications as treatment options for scoliosis[8]. In the treatment of scoliosis, special exercise methods are used alone or in combination with a corset in many countries[9]. The three-dimensional Schroth method is one of these special exercise methods. The advantage of this program is that special 3D postural correction mechanisms are defined for different curvature patterns[10]. It has been determined that the Schroth method reduces the angle of curvature, the need for surgery and pain, and increases the vital capacity.

However, it is stated that there was no increase in the curvature of scoliosis patients who were followed up for 3 years after exercise[11]. Although many studies have been presented in the literature

and scoliosis is so common, there is only one study conducted in our country[11]. Studies showing the results of the Schroth method in the literature continue to increase. Clinical studies have shown that the Schroth method can stop the progression of the curvature in adolescents, reduce it, reduce pain and the need for surgery.

Electrical muscle stimulation (EMS), which is widely used for rehabilitation purposes and sporty performance enhancement, is used to obtain muscular contractions by means of electrical currents applied to the muscle or nerve regions via the skin, is an unconventional exercise method that is used to obtain functional gains in physical performance. It is known that the effects of EMS applications in many sports branches such as swimming, basketball, volleyball, ice hockey, rugby, tennis, football, gymnastics, athletics, weightlifting and ski running[12] are discussed in order to increase sportive performanceFor nearly 30 years, there has been a great increase in EMS studies in athletes, a wide variety of applications and devices have been produced, and as a result, EMS has started to attract attention as a new strength training method for athletes[13]. EMS is also used to shorten the rehabilitation process.

The aim of this prospective controlled clinical study was to investigate the effects of Schroth exercises combined with EMS for six months on patients with scoliosis and compare the observed effects with an established multimodal treatment. Moreover, it was conducted to investigate the difference between a group with scoliosis who did not exercise.

MATERIAL AND METHODS

Participants and Study Design: This study was carried out with patients who applied to İnönü University Turgut Özal Medical Center Orthopedics and Traumatology Department in Malatya province of Turkey with scoliosis problem. G-power analysis was performed to determine the number of patients to participate in the study. As a result of the analysis, when the Type I error rate was accepted as 0.05, the expected power value was 0.80, and the effect valence was considered as moderate, the number of participants to be included in each group was determined as 8 patients. Accordingly, 24 female scoliosis patients with scoliosis Cobb angle between 250 and 400 in the thoracic region between the ages of 14-26 participated in the study. The patients participating in the study were divided into three different groups as EMS Schroth exercise group (EMSS=8), Schroth exercise group (SE=8) and control group (CG=8). Also, height, body weight, body mass index (BMI), Cobb angle measurements of the patients before and after the study were taken for each group and Scoliosis Research Society 22 scale (SRS-22) was used. The diagnosis of scoliosis was made using the Cobb method.

Before the study, approval from İnönü University Clinical Research Ethics Committee (2018/87) and signed voluntary consent forms were obtained from the participants. Studies were carried out in accordance with the Declaration of Helsinki. The study was conducted between May 2019 and September 2019. Sampling inclusion criteria; a) female patients with scoliosis with Cobb angle between 25^0 and 40^0 in the thoracic region, (b) between the ages of 14 and 16, (c) voluntarily participate to the study and (d) to reside in the Malatya.

SRS-22 Scale: It is a widely accepted scale developed by the association to assess the health-related quality of life of

patients with scoliosis in the USA. The reliability and validity of the Turkish version of the scale was evaluated made by Alanay et al. (2005)[14]. The scale consists of 22 questions and 5 sub-dimensions. Sub dimensions; pain, evaluation of general appearance, spine functions, mental health and satisfaction with treatment. All of these sections can be evaluated separately and/or all questions can be evaluated as a total score. Each statement is scored in a five-point Likert type from negative (1) to positive (5). Total points to be taken from each sub-dimension ranges from 0 to 13 for satisfaction with the treatment, 0-25 for pain, evaluation of general appearance, spine functions and mental health. High scores on the scale indicate an increase in quality of life, while low scores indicate a decrease. The Cronbach α coefficient of the Turkish version of the scale was .86. The reliability coefficient obtained in the study was .84.

Exercise protocol: Schroth exercises including the same movements were performed for both groups three days a week. EMSS was applied 3 times a week together with Schroth exercises. EMS currents were placed near the weak spine and the current intensity was adjusted before each study and applied for 40 minutes. The classic Schroth exercise group included the same movements and performed at the same time. The study was conducted as a total of 78 sessions over 26 weeks. Cobb angles were checked in the control group at the beginning and end of the study, and corset wearers were allowed.

Data Analysis: IBM Statistics (SPSS version 25.0, Armonk, NY) package program was used to evaluate the data. Number and percentage distributions are given in the independent variables. In addition, arithmetic mean and standard deviations are given for dependent variables. Due to the non-normal distribution of the data in Kolmogorov-Smirnov and Levene's test results, Mann Whitney U-test was performed in pairwise comparisons. Kruskal Wallis H-tests were used to compare more than two groups. The level of significance was accepted as $P<0.05$ in the evaluations.

RESULTS

Table 1: Age, weight, height and BMI values of the participants

	N	EMSS	SE	CG
		$\bar{x}$±SD	$\bar{x}$±SD	$\bar{x}$±SD
Age	8	15.10±1.80	15.50±1.68	15.20±1.26
Weight	8	65.12±6.66	66.86±8.22	65.30±3.42
Height	8	162.40±7.7	164.32±4.46	163.80±2.40
BMI		24.50±2.24	24.68±1.78	24.42±1.62

According to Table 1, it was determined that there was no statistically significant difference between the age, weight, height and BMI of the participants in the EMS Schroth group, Schroth group and Control group.

According to Table 2, the reduction in Cobb angle was found to be statistically significant in the EMS Schroth group. In addition, it was determined that there was a

stable and very little decrease in Cobb angle in the Schroth group. However, it was determined that there was a statistically significant difference in the cobb angle pre-test and post-test mean scores of the control group.

Table 2: Cobb angle pre-test post-test results of the participants

		EMSS			SE			CG		
Cobb	N	x̄±SD	Z	P	x̄±SD	Z	P	x̄±SD	Z	P
Pre-test	8	32.54±5.80	-3.868	.000*	33.26±8.05	1.324	.152	31.86±5.12	-2.034	.018*
Post-test	8	28.52±3.38			32.10±3.82			34.70±5.42		

*p<.05

Table 3: SRS-22 scale pre-test and post-test results of the participants

SRS-22 Scale Sub-Dimensions		EMSS			SE			CG		
	N	x̄±SD	Z	P	x̄±SD	Z	P	x̄±SD	Z	P
Pain pre-test	8	11.90±1.85	-3.062	.000*	12.20±2.18	1.524	.172	12.44±2.26	2.982	.016*
Pain post-test	8	20.06±2.44			15.14±.39			11.73±2.18		
Evaluation of general appearance pre-test	8	14.32±1.74	3.925	.000*	15.21±1.03	3.238	.002*	15.42±2.82	1.275	.172
Evaluation of general appearance post-test	8	22.22±2.86			18.28±2.26			14.62±2.27		
Spine functions pre-test	8	15.26±1.39	3.538	.000*	14.82±1.06	3.218	.006*	16.29±1.10	1.220	.216
Spine functions post-test	8	19.38±1.92			16.18±1.92			15.28±1.31		
Mental health pre-test	8	15.28 ±1.28	2.628	.009*	14.66±1.25	2.832	.022*	16.26±1.26	.487	.525
Mental health post-test	8	18.05±1.57			16.02±2.29			16.15±1.52		
Satisfaction with treatment pre-test	8	4.26±.86	3.279	.000*	5.26±1.22	3.216	.006*	4.25±1.22	1.242	.142
Satisfaction with treatment post-test	8	9.28±1.95			7.45±1.23			4.10±2.28		
Total pre-test	8	61.02±3.74	3.922	.000*	62.15±2.83	3.922	.001*	64.66±7.48	-	.093
Total post-test	8	88.99±6.95			73,07±3.14			61.88±7.04	1.677	

According to Table 1, it was determined that there was no statistically significant difference between the age, weight, height and BMI of the participants in the EMS Schroth group, Schroth group and Control group.

DISCUSSION

There was no statistical difference on the pre- andpost-test scores of all groups participating in the study. Studies on scoliosis in the literature vary between 6-19 age groups[5]. In the studies, the age distribution of patients who had scoliosis surgery ranged from 8 to 28 (78.8%). Most of the participants are women and more than half (62.2%) are between the ages of 14-19. These data are in parallel with our study group.

When the study findings were examined, it was determined that the decrease in the cobb angle in the EMS Schroth group was statistically significant in the pre-test and post-test values of the cobb angle values. In the Schroth group, it was determined that the cobb angle was stable and slightly decreased. In the control group, there was a statistically significant difference in the pre-test and post-test mean scores. According to studies in the literature, the movements of patients with Scoliosis are completely or partially restricted due to the curvature of their bodies. As the degree of curvature increases, the movement restrictions also increase[6]. In order to slow progression of scoliosis curvatures, swimming, pilates and physical exercises are recommended together with conservative treatment. In this study, it was observed that the cobb angle of individuals was reduced when Schroth movements were applied together with EMS. Schroth method is a type of exercise that has been used for the treatment of scoliosis for a hundred years. New treatment modalities have also been determined by using technological possibilities.

When the SRS-22 scale pre-test and post-test results of the participants were examined, it was determined that the data in the EMS Schroth group in the pain sub-dimension changed statistically positively. A positive change was detected in the Schroth movement group. It was determined that the value in the pain sub-dimension changed negatively in the control group. In many studies in the literature, it is stated that pain and function limitation of patients with scoliosis affect self-confidence, mental health and decrease their quality of life[15]. Although the participants' pain scores were high before the study, their pain scores decreased after the study in the EMS Schroth group and Schroth groups. There was no significant differences in the control group. These data show that the applications in the EMS Schroth group and Schroth groups are beneficial. Verma et al. (2010) reported that patients with idiopathic scoliosis had reduced pain levels after surgery[15]. It is a known situation that scoliosis surgery applications are very expensive. Therefore, the result of this study is very valuable as it is a solution to financial problems in the health sector.

The general appearance evaluation score of the patients was found to be statistically significant after the study in the EMS Schroth group and Schroth groups. These data show that patients like their appearance after scoliosis surgery and their quality of life is positively affected. In a study in the literature, the reasons for patients

to have surgery were evaluated. All of the patients have primarily aesthetic concerns. Other reasons cause less anxiety[16]. In a study evaluating patients who did not receive treatment, it was found that the quality of life of patients in terms of physical function was affected[5]. This is an important finding in terms of supporting the need for treatment in terms of quality of life. Şenköylü et al. (2009) evaluated 31 patients who had scoliosis surgery in their study and found the general appearance evaluation score to be 20.7±2.8[17]. In this study, the general appearance evaluation of the EMS Schroth group was found to be 22.22±2.86, which indicates a very high level of satisfaction. It can be thought that natural treatments make the patients more satisfied, since the operation and the rehabilitation process after it are painful.

In the study, the spinal function score of the EMS Schroth group was found to be very high, normal in the Schroth groups and low in the control group. These data show that the quality of life of patients with scoliosis improves after EMS Schroth and they return to their daily activities. In the study of Şenköylü et al. (2009), the spinal function score was found to be 22.1±3.1[17]. These results support the findings of this study.

It was determined that the scoring in the EMS Schroth group in the mental health sub-dimension of the SRS-22 scale was statistically positive. A positive improvement was also detected in the Schroth movement group. In the control group, the mental health sub-dimension values were found to be negative. Benli et al. (2007) observed 109 patients who had scoliosis surgery for 10 years. According to the results of the study, the patients' appearance disorders and pain affect them psychologically[18]. This result indicates that the mental health sub-dimension of quality of life is high. The improvement in the appearance of the patients after the EMS Schroth and Schroth exercise applications affected the quality of life positively. Senkoylu et al. (2009) stated that the mental health score was 19.4±2.5 in his study[17]. This result supports our study.

In our study, the satisfaction score from the treatment was found to be 9.28±1.95. With this high data, it can be said that the participants were very satisfied with the EMS Schroth application and their quality of life was positively affected. Şenköylü et al. (2009) found the satisfaction score from the treatment as 9.1±1.1 in their study[17]. The overall quality of life score of the current study was found to be 88.99±6.95. Şenköylü et al. (2009) found a total score of 90.9±11.8 in their study[17]. When the studies in the literature and the current study are compared, it can be stated that the quality of life of patients with scoliosis is quite good after the EMS Schroth method. There was a statistically significant relationship between the EMS Schroth group and Schroth exercise groups in all sub-dimensions and total scores of the SRS-22 scale. The fact that all dimensions affect each other positively also reflects positively on the quality of life. As a result of the study reveal that the EMS Schroth group and Schroth exercise practices affect the quality of life of the patients positively.

Long-term treatments and various types of core stabilization exercise methods can also be considered to have a great effect on improving the Cobb angle[19]. Scoliosis treatment is generally applied as conservative and/or surgical treatment[6]. As a result of the study can be recommend to use EMS Schroth exercise application as an alternative to these treatments. Salih (2007) applied conservative treatment with corset to 14 of 45 patients in his study. However, surgical treatment is the preferred method because of the failure of conservative treatment[16]. Considering the difficulty of compliance with corset treatment, the length of the treatment period, and the prejudices of patients against this treatment in adolescence, the use of EMS Schroth exercise application is remarkable. The increase in national and international scientific research on EMS will be important in terms of better understanding the neuromuscular effects of electrical muscle stimulations and making their use for sportive and rehabilitation purposes more effective.

CONCLUSION

In the light of the data obtained, it was concluded that the curvature of the spine negatively affects the lives of adolescents and the more practical EMS application has a positive effect on the quality of life in scoliosis patients. Finally, it can be said that EMS exercises will save time in terms of faster recovery of patients in the treatment of scoliosis. Besides, it will be very beneficial in terms of time and cost by shortening the rehabilitation period of athletes after sports injuries.

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