










TELEREHABILITATION FOR ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS: PAIN, QUALITY OF LIFE, AND DISABILITY DURING COVID-19

İDİOPATİK SKOLYOZLU ERGENLER İÇİN TELEREHABİLİTASYON: COVID-19 SIRASINDA AĞRI, YAŞAM KALİTESİ VE ENGELLİLİK

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ABSTRACT

Objective: To evaluate the effectiveness of 3D scoliosis exercise training delivered via telerehabilitation on pain, function, and disability in adolescents with idiopathic scoliosis during the COVID-19 lockdown.

Method: This study was conducted between April 2020 and October 2020 during the pandemic period. The effects of face-to-face exercises before the pandemic and continued exercises via telerehabilitation during the pandemic on overall health, mental well-being, pain, and physical condition were evaluated. Forty-four participants with scoliosis (27 females, 17 males) participated in a 12-week 3D scoliosis exercise program led by an experienced physiotherapist. Assessments were conducted online using SRS-22, SF-36, and ODI scales before and after social isolation.

Results: The mean age of the sample was determined to be 14.77±2.38 years. The mean SRS-22 Pain scores before and after the lockdown were 22.11±2.45 and 22.18±2.54, respectively. However, no significant differences were found between the two assessments in terms of SRS-22, SF-36, and ODI scores.

Conclusion: Telerehabilitation-based 3D scoliosis exercises may help maintain pain, function, and disability levels in adolescents with scoliosis during lockdowns. Regular home exercise programs are recommended when face-to-face therapy is unavailable. Future research should explore simulation-based training to enhance effectiveness.

Key Words: COVID-19, 3-Dimensional scoliosis exercises, Disability, Scoliosis, Spine

ÖZ

Amaç: COVID-19 kısıtlamaları sırasında idiyopatik skolyozu olan ergenlerde telerehabilitasyon yoluyla verilen 3D skolyoz egzersiz eğitiminin ağrı, fonksiyon ve engellilik üzerindeki etkinliğini değerlendirmek.

Yöntem: Bu çalışma, Nisan 2020 ile Ekim 2020 tarihleri arasında pandemi döneminde gerçekleştirildi. Çalışmada, pandemi öncesinde yüz yüze yapılan ve pandemi sırasında telerehabilitasyon ile devam eden egzersizlerin genel sağlık, zihinsel sağlık, ağrı ve fiziksel duruma etkileri değerlendirildi. Skolyozlu 44 katılımcı (27 kadın, 17 erkek), deneyimli bir fizyoterapist tarafından yönetilen 12 haftalık 3D skolyoz egzersiz programına katıldı. Değerlendirmeler, sosyal izolasyon öncesi ve sonrası SRS-22, SF-36 ve ODI ölçekleri kullanılarak çevrimiçi yapıldı.

Bulgular: Örneklemdeki ortalama yaş 14.77±2.38 yıl olarak belirlendi. Kapanma öncesi ve sonrası ortalama SRS-22 Ağrı skorları sırasıyla 22.11±2.45 ve 22.18±2.54'tü. Ancak, iki değerlendirme arasında SRS-22, SF-36 ve ODI skorlarında anlamlı bir fark bulunmadı.

Sonuç: Telerehabilitasyon temelli 3D skolyoz egzersizleri, skolyozlu ergenlerde kapanma sırasında ağrı, işlev ve engellilik düzeylerinin korunmasına yardımcı olabilir. Yüz yüze terapinin mümkün olmadığı durumlarda düzenli ev egzersiz programları önerilmektedir. Gelecekteki araştırmalar, etkinliği artırmak için simülasyon tabanlı eğitimi keşfetmelidir.

Anahtar Kelimeler: COVID-19, 3-Boyutlu skolyoz egzersizleri, Engellilik, Skolyoz, Omurga

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INTRODUCTION

Adolescent idiopathic scoliosis (AIS), characterized by lateral deviation, axial rotation, and abnormal sagittal curvature of the spine, is the most common (70-80%) spinal deformity with an unknown cause [1]. Except for advanced cases, individuals with AIS usually do not experience any health problems during growth. However, emerging deformities often lead to decreased quality of life and psychological disorders in adolescents [2]. The main treatment options for preventing scoliosis progression include scoliosis-specific exercises, other physiotherapy applications, bracing, and surgical techniques [3]. Scoliosis-specific exercises consist of a series of specific movements aimed at stabilizing the spine, together with the three-dimensional correction of the spine, pelvis, and thoracic cage, tailored individually and applied for therapeutic purposes in reducing spinal deformity [4]. Various studies have found that scoliosis-specific exercises reduce the Cobb angle and trunk rotation angle in patients with AIS, and that these exercises are superior to traditional physiotherapy treatments in improving deformities [5-7]. In short, scoliosis-specific exercises can control the curve optimally for a prolonged period, prevent its progression, improve quality of life, and reduce the need for braces.

The COVID-19 infection has posed a serious threat to the health-related wellbeing of millions of people. The impact of this pandemic is far-reaching and includes significant psychological distress to populations worldwide [8,9]. Clearly, the psychological impact of COVID-19 has affected both infected and uninfected individuals, including those with AIS. The psychological stress caused by COVID-19 on these patients may exacerbate their symptoms [10]. The psychological strain induced by COVID-19 may further exacerbate the symptoms experienced by these patients, particularly amid decreases in physical activity and increases in sedentary behaviors during their respective lockdowns, compounded by a general reduction in health services utilization [11,12]. Additionally, billions of people were quarantined in their homes to prevent the spread of COVID-19. Physical inactivity due to social isolation could lead to musculoskeletal problems and higher levels of pain severity due to muscle weakness [13]. This situation has further decreased the physical activity levels of patients with AIS and disrupted their former face-to-face exercise treatments. The transition from face-to-face exercise sessions to home programs through telerehabilitation has gained more importance in reducing the negative effects of COVID-19. Early COVID-19 publications on scoliosis focused on the symptoms, psychological status, quality of life, and prognosis of the disease in patients with scoliosis during the pandemic [13-17]. However, no study has compared the pre- and post-lockdown levels of pain, quality of life, and functionality of patients with AIS who were followed up with a home program during the social isolation period.

The aim of our study was to determine the effects of telerehabilitation-based 3D scoliosis exercise training on pain, functionality, and disability during the COVID-19 lockdown period in individuals with AIS.

METHOD

Study Design and Participants

The current inquiry was undertaken from April 2020 to October 2020, a period notably situated amidst the pandemic outbreak. The temporal alignment of this study within the pandemic milieu affords a direct examination of the repercussions stemming from lockdown measures and the broader pandemic context. The initial assessment was designed to evaluate the effects of face-to-face exercise sessions conducted before the pandemic on overall health, mental well-being, pain, and physical condition. The second assessment aimed to determine the same effects while maintaining the continuity of exercises during the pandemic period. The sample size for this investigation was calculated using a power analysis. Based on the results of a pilot study involving 5 subjects, a sample size of 40 subjects was required to provide an

effect size of 0.40, an alpha level of 0.05, and a power of 0.80. The study included 44 individuals (27 females and 17 males) with AIS who were diagnosed in the Orthopedics and Traumatology Clinic, followed up with the diagnosis of AIS for at least one year, and were treated conservatively. All participants met the following inclusion criteria: (1) 7-18 years of age, (2) Risser stage 0-3, (3) Cobb angle between 10°-30°, (4) Lenke type 1 curvature, (5) Absence of pulmonary or thoracic diseases such as rib fracture, atelectasis, asthma, (6) Absence of any neurological or psychiatric disease and no chronic disease requiring drug use, (7) Parents allowing the child to participate in the study, and (8) Involved in face-to-face 3D scoliosis exercise program before social isolation for three months. Individuals who had non-idiopathic scoliosis, those who had undergone spine surgery in the last year, who used corsets, who remained in social isolation for less than three months, who discontinued their exercise program, and those infected with COVID-19 during the study period were excluded.

All participants were informed about the content, purpose, and effects of the study.

Outcome Measures

Pain and Scoliosis-Related Quality of Life: The Scoliosis Research Society-22 questionnaire (SRS-22) was used to assess health-related quality of life. This scoliosis-specific quality of life scale, developed by the Scoliosis Research Society, has been validated and proven reliable in multiple languages [18,19]. The Turkish version's validity and reliability were established by Alanay et al. in 2005 [20]. The SRS-22 is a 5-point Likert-type scale consisting of 22 questions, divided into five subgroups: pain, general appearance/image, spine function, mental health, and satisfaction with treatment. Each question offers responses ranging from negative to positive, with scores ranging from 1 to 5. Subgroup scores are derived by summing scores and dividing by the number of questions answered. Thus, both subgroup and total scores range from 1 (lowest) to 5 (highest), with higher scores indicating better quality of life [18-20]. The SRS-22 questionnaire was administered to participants online before and after social isolation via Google Forms.

General Quality of Life: The Short Form-36 (SF-36) was utilized to evaluate the general quality of life of the participants [21]. The Turkish validity and reliability of the SF-36 were established by Koçyiğit et al. [22]. The questionnaire comprises 36 items measuring eight dimensions: physical function, social function, role limitations due to physical problems, role limitations due to emotional problems, mental health, energy/vitality, general pain perception, and overall health. Subscales assess health on a scale of 0-100 points, where 0 indicates poor health and 100 indicates good health.

Disability Status: The Oswestry Disability Index (ODI) was employed to assess the disability levels of the participants. The ODI measures an individual's performance in activities necessary for daily life and evaluates what the patient can and cannot do [23]. The Turkish validity and reliability of the ODI were confirmed by Yakut et al. [24]. It consists of 10 items that evaluate pain severity, self-management, weightlifting, walking, sitting, standing, sleeping, sexual life, social life, and travel. Each item is scored on a range of 0 to 5. The patient's disability status is determined by converting the total score, which ranges from 0 to 50, into a percentage. Higher scores indicate higher levels of disability. The ODI serves as a reliable predictor of pain during isokinetic performance, isometric endurance, sitting, standing, and return to work [25]. The index is a valid questionnaire for assessing health-related quality of life and disability levels in individuals with scoliosis [25,26]. Online application of SRS-22 and ODI to patients with AIS has been reported to be a convenient and reliable way to minimize the loss of follow-up data [27].

Exercise Program

A twelve-week 3D scoliosis exercise program (3 times per week, 60 minutes per session) was administered via telerehabilitation. This

telehealth approach involved individual video conference sessions facilitated by an experienced physiotherapist with a minimum of three years of specialized expertise in scoliosis management. Furthermore, all requisite equipment for home exercises was procured online by the respective families under the guidance of the physiotherapist.

The face-to-face scoliosis-specific exercise programme, which was included in the pre-closure inclusion criteria, was also applied as scoliosis-specific exercises in similar parallelism with a physiotherapist for 60 minutes 3 days a week.

In the 3D scoliosis exercise method, exercises are specifically planned and applied to the structure of the curvature and the individual. The treatment program commenced with defining the primary curvatures, any postural deviations caused by secondary curvatures, and the breathing zones, followed by teaching 3-dimensional corrective breathing exercises.

Auxiliary materials such as a wall bar, mirror, exercise mat, 3 rice bags, sponge pillows, chairs, and two long sticks were utilized during the exercises. Simple supine and side-lying positions were initially selected for the sessions, progressing to positions with increasing difficulty (sitting position, standing, walking).

The exercises were gradually progressed from 1 to 3 sets and from 7-10 to 10-15 repetitions. The 3D scoliosis exercise program applied for 12 weeks is outlined in Table 1. Additionally, Table 2 presents descriptors of Cobb angles for scoliosis and ATR characteristics of all participants. All consents and assessments throughout the study were exclusively obtained from participants and their family.

Table 1. 3D Scoliosis Exercises applied in the study

Beginner	Intermediate	Advanced
3D corrective breathing exercises	3D corrective breathing exercises	3D corrective breathing exercises
Shoulder countertraction in supine	Shoulder countertraction in sitting position	Shoulder countertraction in sitting position
Shoulder countertraction in prone position	Chest twister	Chest twister
Shoulder countertraction in side-lying	Muscle cylinder in kneeling position	Muscle cylinder in kneeling position
Muscle cylinder in supine position	Big bow	Big bow
Muscle cylinder in side-lying position	Shoulder countertraction between two poles	Shoulder countertraction between two poles
Muscle cylinder in sitting position	Schroth gait	Schroth gait
Chest twister	Removing the stool	Removing the stool

Table 2. Descriptors of Cobb angle for scoliosis and ATR characteristics

Characteristics		X±SD	Min	Max
Cobb Angle	Thoracic (°)	19.045±5.332	0	30
	Lumbal (°)	10.980±7.712	0	20
Angle of the trunk rotation		8.490 ± 3.227	3	17

Min:Minimum, Max:Maximum, X:Average, SD:Standard deviation

Ethical Approval

All participants agreed to take part in the study and signed written informed consent. The study was approved by the Ethical Committee of Ankara Yıldırım Beyazıt University (2022/03-10.03.2022) and was conducted in accordance with the Declaration of Helsinki.

Statistical Analysis

The distributions of age and the score differences between pre- and post-lockdown assessments for SRS-22, SF-36 and ODI were examined by Shapiro-Wilk’s test, normality plots, and skewness/kurtosis statistics. All quantitative variables were reported as mean ± standard deviation (SD), and median (interquartile range, IQR: 1st-3rd quartile). Gender was summarized in frequency (%).

Considering the distribution of the differences in the scores, the paired samples t-test was used to compare SRS-22 pain score, SF-36 vitality score, and SF-36 general mental health score between two periods, and the Wilcoxon signed-rank test was performed for other scores.

All other statistical analyses were performed via IBM SPSS Statistics 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). A p-value≤0.05 was considered as statistically significant [28].

RESULTS

The mean age of the sample was 14.77±2.38 years, with a median age of 15 (IQR: 13-17, range: 7-18). The sample consisted of 61.4% (n=27) females. The mean SRS-22 Pain score was 22.11±2.45 and 22.18±2.54 before and after the lockdown, respectively. The median SRS-22 total score was 89.5 (IQR: 84.0-97.8) before the lockdown and 91.5 (IQR: 82.3-96.0) after the lockdown. However, there were no significant differences in the SRS-22, SF-36, and ODI scores between the two assessments (p>0.05, see Table 3). Table 3 shows the SRS-22, SF-36, and ODI scores before and after the lockdown.

Table 3. Pre- and post-lockdown scores of SRS-22, SF-36, and ODI

Variables	Pre-lockdown (Mean±SD)	Post-lockdown (Mean±SD)	p
SRS-22			
Pain*	22.11±2.45	22.18±2.54	0.856
Self-image/ appearance	17.52±3.06	17.32±3.41	0.962
Function/activity	22.66±2.50	22.80±2.78	0.459
Mental health	18.43±4.26	18.41±3.74	0.870
Satisfaction with management	8.59±1.34	8.41±1.72	0.484
Total	89.32±9.39	89.11±10.24	0.645
SF-36			
Physical functioning	90.00±12.71	87.95±15.53	0.195
Physical role limitation	76.14±34.08	82.39±28.82	0.179
Emotional role limitation	67.42±40.98	68.94±38.98	0.702
Vitality/Fatigue*	59.77±19.76	59.55±19.70	0.916
General mental health*	65.09±21.88	67.73±21.28	0.207
Social functioning	80.40±25.49	85.80±16.08	0.252
Bodily pain	82.84±20.06	87.39±16.00	0.214
General health perceptions	65.00±16.91	66.14±16.67	0.371
ODI			
	4.84±5.63	3.98±5.43	0.200

SRS-22:Scoliosis Research Society-22 Questionnaire, SF-36:Short Form-36 Questionnaire, ODI:Oswestry Disability Index, IQR:1st quartile – 3rd quartile, CI:Confidence Interval, *Compared by paired t-test and Cohen’s d was provided, while Wilcoxon signed-rank test was performed and rank biserial correlation was calculated for the others.

DISCUSSION

In our study, whose aim was to determine the effects of telerehabilitation-based scoliosis-specific exercise training on pain, functionality, and disability in individuals with AIS during the COVID-19 quarantine period, we observed preserved pain, disability, functionality, and quality of life outcomes in AIS patients who underwent scoliosis-specific exercise training through telerehabilitation during the lockdown period.

Telehealth services and telerehabilitation, which have become more popular with the COVID-19 epidemic, should play a significant role in the rehabilitation of adolescent and juvenile scoliosis due to the requirement for regular follow-up and personalized exercise programs over long periods. The data from this study confirm that positive results can be achieved via telerehabilitation and remote follow-ups. The absence of significant differences between pre- and post-lockdown SRS-22, SF-36, and ODI scores indicates that the negative effects of the COVID-19 lockdown period can be mitigated in individuals with scoliosis through remote follow-ups and regular home exercise programs when face-to-face treatment is not feasible.

Furthermore, the higher pre-lockdown scores suggest that face-to-face rehabilitation sessions, even if intermittent, should be considered in the exercise treatment of AIS. This is because corrections requiring tactile and/or vibration stimuli, as well as corrections required to perform exercises symmetrically and correctly, may not be achievable through telerehabilitation alone.

The COVID-19 pandemic prompted a rapid expansion of telemedicine across medicine. Telemedicine allows for social distancing while also having the potential to save expenses and improve access to care [29]. Consistent with this trend, our results demonstrated similar outcomes in both periods of face-to-face rehabilitation (i.e., pre-pandemic) and telerehabilitation (i.e., post-lockdown) in measurements affecting the quality of life and disability levels in AIS.

This study represents the first attempt in the literature to evaluate the effect of 3D scoliosis exercises administered via telerehabilitation on the quality of life and disability levels in adolescent and juvenile idiopathic scoliosis patients during the COVID-19 lockdown period. With the COVID-19 pandemic, efforts to limit the spread of viral infections necessitated the interruption of non-emergency health services. Although these restrictions made standard face-to-face rehabilitation less accessible, telehealth services today can serve as an effective alternative, supporting exercise tracking in individuals with scoliosis. According to Dermott et al. [14], there has been a significant decrease in hospital admissions due to scoliosis after the COVID-19 period. Concerns about the risk of disease transmission may have made treatments more difficult, leading to longer diagnosis times. This underscores the importance of ensuring that treatment remains comprehensive and that individuals continue their exercises at home to reduce the progression of scoliosis.

A study by Marin et al. [29] in 2021, which compared the effectiveness of telemedicine services in individuals with AIS, found that remote exercises were perceived positively by all subjects. The utilization of telerehabilitation as a means of therapeutic exercise delivery is crucial in these patients, as supported by our research.

While the outcomes of our study did not show improvement, they remained stable. However, there were some concerning findings regarding certain subdomains of the SRS-22 questionnaire. Personal image, mental health, satisfaction with treatment, and general scores were lower after the pandemic, possibly due to the psychosocial impact of the pandemic and social isolation. Conversely, pain and function subscales were higher after the pandemic compared to before, indicating the positive effect of continuous follow-up of home exercise programs on pain and functional loss caused by deformity in individuals with adolescent and juvenile idiopathic scoliosis. Although

these results were not statistically significant, they suggest that 3D exercises are perceived as effective from the patient's perspective.

Obtaining similar results in both pre- and post-lockdown periods in certain sub-scales of SF-36, such as limitations in physical role, limitations in emotional role, general mental health, social function, body pain, and general health perception, suggests that the negative physical, emotional, and social effects of the lockdown on individuals in this age group can be mitigated with home exercise and telerehabilitation programs. The similarity of the ODI total scores during and after the restrictions indicates that the limitations of movement and the period of staying at home are not directly related to the pain caused by scoliosis and the level of disability in daily life activities such as sleeping, standing, sitting, social life, sexual life, and traveling. A study by Kieser et al. [10] on adults who underwent surgical treatment for spinal deformities included similar test parameters. Despite the negative effects of the pandemic on the participants, the authors found no difference in SRS-22 and SF-36 test parameters. Although similar results were observed in our study regarding these parameters, it is likely that the lack of difference in these parameters might be attributed to individuals adapting to continue their exercises with the help of telerehabilitation while staying at home [12].

Contrary to our study, the same study reported an increase during the pandemic in ODI pain and movement restriction scores, but no difference in daily life activity and sociality [12]. This is likely a result of inactivity due to home confinement, as their sample consisted of adults with spinal surgery. However, our participants were individuals with juvenile or adolescent scoliosis with no history of surgical treatment. The absence of any difference in pre- and post-lockdown ODI scores can also stem from the fact that our sample continued their exercise treatment program via telerehabilitation during home confinement.

Limitations

This study has some limitations that need to be addressed. The absence of an investigation into radiological parameters, including Cobb angles, gibbosity values, and posture evaluations, precludes an understanding of the impact of the COVID-19 period on these metrics. Restricted access to fresh X-rays during the pandemic and lockdown necessitated the formulation of the exercise plan for telerehabilitation based on existing radiographs. Consequently, the direct effects of the pandemic on these radiological parameters remain undetermined. Additionally, the long-term effects of COVID-19 on patients with AIS could not be evaluated. Therefore, further studies including long-term follow-ups are warranted to address these limitations.

CONCLUSION

Pain, disability, functionality, and quality of life outcomes in AIS patients who underwent scoliosis specific exercise training through telerehabilitation during the lockdown period were preserved post-lockdown period. As a conclusion, for the patients with AIS, regular follow-up of exercises could be highly recommended as a home program in cases where face-to-face rehabilitation is not possible. Also, although the results of the study showed that pain, functionality, and quality of life scores were preserved in individuals with AIS during the pandemic period, simulation-like trainings are needed.

Ethical Approval: 2022/03 Health Sciences Ethics Committee of Ankara Yıldırım Beyazıt University

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