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Assessing the Impact of Rotational Angular Breathing on Lung Functions and Health-Related Quality of Life in Adolescent Idiopathic Scoliosis

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ABSTRACT

Background: The Adolescent Idiopathic Scoliosis deformity manifests itself during the adolescent development spurt. On the other hand, adolescent therapy aims to lessen curve growth, thus reducing the likelihood of back discomfort, weakness, aberrant pulmonary function, and cosmetic diseases and improving quality of life. Schroth exercises (Rotational breathing exercises) consider the positioning of the entire body to establish a stable, corrected posture. The study aimed to determine the impact of adding rotational angular breathing exercises on the 1-year outcome of mild adolescent idiopathic scoliosis. The study's objectives were to assess the effect on daily living activities using short form 36, assess the effect on respiratory functions using pulmonary function test, and find out the difference in respiratory functions.

Methods: Participants in the study were between the ages of 10 and 15 years (19 Male and 17 Female), diagnosed with a specific type of AIS, characterized by Cobb's angle measurements less than 20° for curves in the thoracic region and less than 15° for curves in the thoracolumbar area. Cases of group 1 had undergone the specific breathing exercise protocol, i.e., Rotational angular breathing exercises; however, other groups followed conventional exercise therapy.

Results: A significant finding of this study is that parameters related to quality of life significantly improved in groups ($p<0.01$), with the test group showing more significant improvement than the conventional group. Following intervention, group 1 appeared with a significantly higher FVC ($p=0.001^*$) of 2.63 ± 0.36 compared to the other group's FVC of 2.19 ± 0.40. Also, group 1 showed significantly greater FEV1 ($p=0.01^*$) and VC ($p=0.002^*$) after intervention compared to group 2.

Conclusion: It was observed that there was a notable improvement in HRQL parameters within the group 1 community. Significant variations in pulmonary function were also observed in this study between the groups, with group 1 showing a significant change in FVC, FEV1, and VC.

Keywords: AIS, Rotational angular breathing exercise, Health-related quality of life, Daily living activities, Schroth exercises.

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INTRODUCTION

Adolescent idiopathic Scoliosis (AIS) is a lateral spine curvature affecting teenagers between the ages of 10 and 15. Its etiology is currently unknown. Cobb states that if the curvature is more than 10 degrees, the prevalence of AIS is two to three percent [1,2].

The exact cause of AIS remains unknown; however, potential causes include genetic and/or environmental factors [3]. Furthermore, although the trend of inherited sensitivity is unknown, family history is commonly linked to this. Perhaps the most accepted explanation available now is genetic heterogeneity [4].

The AIS deformity manifests itself during the adolescent development spurt. The deformity does not progress in most cases. But in others, it's getting better. The development is more likely in prepubescent children than boys [5]. Adolescent therapy, on the other hand, aims to lessen curve growth [6], thus reducing the likelihood of back discomfort, weakness, aberrant pulmonary function, and cosmetic diseases and improving adult quality of life in the process.

Scoliosis might have varying effects on lung functions. There might not be any pain or other associated symptoms at first. The leading respiratory side effects are caused by restrictive airway disease, and often, the period of scoliosis reflects the severity of the patient's disability [7].

Apart from patients at high risk of progression, it is necessary to identify outpatients with low risk of curve progression. Additionally, it is necessary to identify patients who only need follow-up care and those who should be referred for specific surgical treatments. Referring patients with low curve progression who are not suitable for referrals to the surgeon should be avoided as this may lead to anxiety, missed work and school time, and unintended radiation [8].

Various standard studies have been reviewed, but the report on the effectiveness of exercise therapy in treating AIS still showed a shortage of high-quality studies in this area [9]. Suppose the thoracolumbar spine curve is less than 25^0 and the lumbar spine curve is less than 20^0. In that case, the exercises for AIS patients are more helpful in correcting abnormalities and improving their quality of life (QOL) [10].

Scoliosis-specific exercise regimens have been utilized in various European countries to treat idiopathic scoliosis in young people. However, there was a lack of aligning the pelvis, rib cage, and spine to the "standard" anatomical positions in exercises [11].

Physiotherapy, mainly exercises, if implemented correctly, can stop the curve from progressing and reduce the requirement for braces. Also, scoliosis correction exercise has appeared to be a significant factor that improved lung function. In conjunction with a brace, exercises increase the effectiveness of therapy to the treatment by brace only [12,13]. In patients with AIS, physical exercises resulted in notable improvements in respiratory muscle strength [14].

Effects of Schroth exercises on curve progression, topographic shifts, and Quality of life (QOL) in adolescent idiopathic Scoliosis (AIS) cases have shown great results. Schroth exercises are better for improving the overall quality of life of AIS cases, even during bracing. Therefore, these exercises positively impact treatment, especially on the QOL of patients [15]. The core and trunk are the focus of Schroth exercises and are specially targeted at positioning the entire body in such a manner to establish a stable, corrected posture. While maintaining good posture, the patient is taught to strengthen the spine muscles using the exclusive technique of the Schroth method i.e. corrective rotational breathing, also called rotational angular breathing (RAB) [16].

The current study aimed to determine the impact of adding rotational angular breathing exercises on the 1-year outcome of mild adolescent idiopathic scoliosis (curves < 15 in the thoracic region and < 20 in the lumbar region). The study's objectives were to assess the effect on daily living activities using short form 36 and to assess the effect on respiratory functions using a pulmonary function test and, therefore, to determine the effective exercise regimen for AIS patients.

MATERIAL AND METHODS

The study design was a Pre-test and Post-test design. Inclusion criteria for subjects were Individuals with AIS who had a thoracic curve of <20 degrees or a thoracolumbar curve of <15 degrees and who visited the Orthopaedics and PMR department OPD at King George's Medical University. People were excluded from the study if they had conditions like:

- AIS with fixable abnormalities.

- Any disease or malformation of the lower extremities affecting the spine's alignment.

- Systemic disease or issues with the heart and lungs.

- Patients who have had spinal operations or rehabilitation in other places.

- Patients with problems with thinking or memory.

Sample size (Hayes and Bennet, 1999)[17] was calculated, and 36 subjects were included. All subjects were assigned to two groups (Group 1&2 respectively). The study spanned one year from the time subjects were recruited. Participants in the study were between the ages of 10 and 15 years. They were also required to give consent for active participation. A baseline data of all the participants were collected by a blinded observer following assessment for:

1. Pulmonary function test: It was done using the Spirometry method. All the participants were asked to take a deep breath followed by exhaling maximum air into the mouthpiece of the spirometer. The amount of air inhaled and exhaled was recorded by a spirometer.

2. Health-related QOL using short form-36. HRQOL is a globally valid and widely used tool for assessing quality of life. A person's functional capability, pain level with

activity, mental status, and self-image are surveyed using Short form-36 [22].

Cases of group 1 had undergone the specific breathing exercise protocol, i.e., Rotational angular breathing exercises; however, other groups followed conventional exercise therapy.

A. Rotational angular breathing exercises (RAB)- All the mentioned exercises were performed twice daily for 25-30 minutes with 20 repetitions. Patients were asked to do the correct pelvic alignment and then perform spinal extension exercises followed by rotational angular breathing (RAB) techniques to bring the spine and ribs into the best position. After completing it, patients were asked to stretch body muscles isometrically to strengthen weak muscles and maintain corrected posture [15].

B. scoliosis correction exercises- First, the patients were asked to perform active self-correction exercises in which strengthening exercises of the side flexors of the trunk (convex side of the curve) and stretching exercises of the side flexors of the trunk (Concave side of the curve) were practiced. It was followed by spinal extension exercises (Chest raising in prone lying, reverse SLR, and bridging exercises). Finally, deep breathing exercises (Apical, Lateral, and Basal) were performed. All the exercises were done twice daily with 20 repetitions for 25-30 minutes.

After the one-year completion of the exercise protocol, both the groups were re-assessed using the pulmonary function test and HRQL (SF-36) as outcome measures.

Statistical analysis:

Statistical analysis was done by a statistician who did not know the treatment methods followed in the two groups. Results have been presented as mean ± SD and percentages. Continuous data is given as mean ± SD, while dichotomous data is given as percentages. Group performance measures were compared across periods using repeated measures analysis of variance with general linear models. Groups were also compared using ANOVA (one-way) and Tukey's post hoc test. Categorical/dichotomous variables have been analyzed using the chi-square ($\chi 2$) test. A $p<0.05$ has been regarded as statistically significant. The total analysis was done using the software SPSS (16.0 version).

RESULTS

A total of 19 males and 17 female patients from the 12 to 15-year age group revealed no significant difference ($p>0.05$) between the groups in terms of age and sex, indicating that the age and gender of the groups could be compared. The mean ages of the groups were 12.15 ± 1.74 years and 11.53 ± 1.44 years, respectively. Most patients in groups 1 (61.3%) and 2 (55.7%) were men. A crucial finding of this study is that parameters related to quality of life significantly improved in groups ($p<0.01$), with the test group showing greater improvement than group 2. The parameters evaluated were the function, discomfort, self-perceived image, mental well-being, and management satisfaction, as shown in Table 1.

Table 1: Evaluation of function, discomfort, self-perceived image, mental well-being, and management satisfaction (Pre-test & Post-test)

Variables	Group 1 (n=18)		Group 2 (n=18)		p-value[1]
Function	**Mean**	**±SD**	**Mean**	**±SD**	
Pre-Intervent	2.62	0.41	2.76	0.59	0.26
Post-Intervent	4.13	0.01	3.48	0.51	p=0.001*
Mean difference	1.48	0.44	0.56	0.47	
p-value[2]	p=0.001*		p=0.003*		
Pain					
Pre-Intervent	2.51	0.17	2.38	0.36	0.41
Post-Intervent	3.74	0.35	3.26	0.32	p=0.0001*
Mean difference	1.41	0.49	0.78	0.45	
p-value[2]	p=0.001*		p=0.002*		
Mental health					
Pre-Intervent	2.83	0.46	3.17	0.41	0.18
Post-Intervent	3.79	0.37	3.39	0.45	p=0.04*
Mean difference	0.87	0.42	0.32	0.24	
p-value[2]	p=0.001*		p=0.003*		
Self-perceived image					
Pre-Intervent	2.64	0.31	2.77	0.08	0.13
Post-Intervent	3.57	0.34	3.69	0.12	p=0.001*
Mean difference	0.96	0.33	0.36	0.14	
p-value[2]	p=0.001*		p=0.002*		
Satisfaction with Management					
Pre-Intervent	2.13	0.15	1.89	0.01	NA
Post-Intervent	3.97	0.52	2.48	0.75	p=0.001*
Mean difference	1.89	0.54	0.63	0.74	
p-value[2]	p=0.001*		p=0.003*		

[1]Mann Whitney U test, [2]Wilcoxon rank-sum test, *Significant

While comparing the pulmonary function tests, a statistically insignificant difference ($p>0.05$) was found during the pre-intervention period [Table: 2]

Table 2: Evaluation of pulmonary function tests between the groups before the intervention

Pulmonary function test	Group 1 (n=18)		Group 2 (n=18)		p-value[1]
	Mean	**±SD**	**Mean**	**±SD**	
Forced VC	1.59	0.22	1.81	0.45	0.35
FEV1	1.48	0.24	1.66	0.49	0.16
FEV1/FVC	85.12	13.06	81.32	12.76	0.74
PEF	3.77	1.14	4.11	1.35	0.69
Vital Capacity	1.78	0.17	2.06	0.45	0.12

[1]Unpaired t-test

Following the intervention, group 1 appeared with a significantly higher FVC (p=0.001*) of 2.65 ± 0.35 compared to the FVC of other group i.e. 2.20 ± 0.39. Also, group 1 showed significantly greater FEV1 (p=0.01*) and VC (p=0.002*) after intervention compared to group 2. Nonetheless, there was no significant difference in the FEV1/FVC and PEF between the groups at post-intervention (p>0.05*) (Table: 3)

Table 3: Evaluation of pulmonary function tests among the groups at post-intervention

Pulmonary function test	Group 1 (n=18)		Group 2 (n=18)		p-value[1]
	Mean	±SD	Mean	±SD	
FVC	2.65	0.35	2.20	0.39	p=0.001*
FEV1	2.34	0.51	1.91	0.37	p=0.01*
FEV1/FVC	85.58	8.21	84.94	6.44	p=0.36
PEF	5.59	1.39	5.84	1.93	p=0.81
VC	2.68	0.30	2.35	0.39	p=0.002*

[1]Unpaired t-test, *Significant

DISCUSSION

Rrecaj-Malaj S. et al. (2018) concluded that subjects of scoliosis had well-practiced Schroth and Pilates exercise protocols and not only had high-quality outcomes in reducing Cobb angle but also prevented the progression of the curve, improved the flexibility strength of muscles of the trunk and setting good posture by correcting abnormal spinal curve. Also, there were good improvements in their quality of life parameters [18].

Cong H. et al. (2021) reported in a study of patients of AIS that there was an improvement in QOL parameters by exercises. They stated that exercises are adequately recommendable for adolescent idiopathic scoliosis patients in terms of improvement in physical strength, endurance, and quality of life [19].

The current study has demonstrated exercise to improve AIS patients' quality of life. Results have demonstrated a remarkable improvement in quality of life in patients with AIS when additional Rotational angular breathing exercises were added. It was observed that there was a notable improvement in HRQL parameters within the Group 1 community. When the group 1 sample was assessed using the Short Form 36 (SF-26), all parameters significantly improved, including social functioning, emotional well-being, and physical well-being. Additionally, there was a significant change in this group's level of discomfort to the other group.

Rafferty A. et al. (2023), in their systematic electronic database search review, found 15 studies that followed exercise therapy protocol to enhance lung functions in adolescent idiopathic scoliosis cases. These studies recorded lung functions pre and post-therapy sessions. Based on the findings, the study concluded that exercises have improved lung functions in subjects with adolescent idiopathic scoliosis [20].

Amaricai E. et al. (2020) assessed pulmonary functions and functioning ability in adolescents with modest scoliosis (thoracic and thoracolumbar). Cases of Scoliosis underwent 12-week well-monitored exercise sessions. Finally, after three months of exercise sessions, these children were reported to have better lung functions and functional ability [21].

Significant variations in pulmonary functions were also observed in the present study between the groups, with group 1 showing a significant change in FVC, FEV1, and VC. There was a more significant improvement in all the parameters of lung functions in group 1 compared to the other group, proving that rotational angular breathing exercises are more beneficial in improving lung functions.

Limitations of the study: The current study involved the participation of 36 patients, so the results appeared to be confined to only a bunch of people. Therefore, more relevant results can be achieved using a larger sample size. Also, a more extended treatment period is needed for the evident results.

CONCLUSION

The current study observed the efficacy of conservative treatment for AIS and demonstrated the effectiveness of Rotational angular breathing exercises in patients with AIS. The treatment may be more beneficial for AIS patients (group 1) with pulmonary function problems, health-related quality of life, and functional status than other groups who underwent conventional exercises and did not follow the same exercise regimen.

Since there is improvement in both groups, more significant improvement was achieved in the group assigned to rotational angular breathing, signifying the efficacy of these exercises. Therefore, it is more relevant to recommend rotational angular breathing to AIS patients. Although the current study has revealed evident results regarding the efficiency of these exercises, work may be required to prove the same.

Conflict of interest: The author states no conflict of interest.

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Declarations

Ethical Approval: The study was approved by the Institutional Ethics Committee.

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REFERENCES

[1] Cobb JR. Outline for the study of scoliosis. Instr Course Lect AAOS. 1948;5:261-75.

[2] Weiss, H., Negrini, S., Rigo, M. Indications for conservative management of scoliosis (guidelines). Scoliosis 1, 5 (2006).

[3] Scoliosis Research Society. http:// www.srs.org. (last assessed on 01 Nov 2020)

[4] Miller NH. The role of genetic factors in the etiology of

idiopathic scoliosis. Spine-Philadelphia-Hanley And Belfus-. 2000;14(2):313-8.
[5] Landauer F, Wimmer C. Therapieziel der Korsettbe hand lung bei idiopathic scher Adoleszenten skoliose. Medizinisch Orthopadische Technik. 2003;123(3):33-8.
[6] Adolescent Idiopathic Scoliosis Hand book - 3rd Edition http://www.settingscoliosisstraight.org/HSG_Scoliosis_Handbook858.pdf (Last Assessed on 02/11/2020).
[7] Tsiligiannis T, Grivas T. Pulmonary function in children with idiopathic scoliosis. Scoliosis. 2012 Dec 1;7(1):7.
[8] Jaen-Paul Praud, Canet E: Chest Wall Function and Dysfunction. In: Kendig's Disorders of the Respiratory Tract in Children. Edited by Chernick V, Boat TF, Wilmott RW, Bush A, seventh edn. Philadelphia, PA: SAUNDERS ELSEVIER; 2006: 733-746.
[9] Negrini S, Fusco C, Minozzi S, Atanasio S, Zaina F, Romano M. Exercises reduce the progression rate of adolescent idiopathic scoliosis: results of a comprehensive systematic review of the literature. Disability and rehabilitation. 2008 Jan 1;30(10):772-85.
[10] Zapata K, Parent EC, Sucato D. Immediate effects of scoliosis-specific corrective exercises on the Cobb angle after one week and after one year of practice. Scoliosis and spinal disorders. 2016 Oct 1;11(2):36.
[11] Saltikov J B, Cook T, Rigo M, Mauroy J C D, Romano M, Negrini S. Physical Therapy Perspectives in the 21st Century – Challengesand Possibilities.UK: Intech publishing. April 2012.ISBN 978-953-51-0459-9.
[12] Silveira, G.E.; Andrade, R.M.; Guilhermino, G.G.; Schmidt, A.V.; Neves, L.M.; Ribeiro, A.P. The Effects of Short- and Long-Term Spinal Brace Use with and without Exercise on Spine, Balance, and Gait in Adolescents with Idiopathic Scoliosis. 2022; 58(8):1024.
[13] Kalichman L, Kendelker L, Bezalel T. Bracing and exercise-based treatment for idiopathic scoliosis. J Bodyw Mov Ther 2016;20(1):56-64.
[14] Alves VL, Avanzi O. Respiratory muscle strength in idiopathic scoliosis after training program. Acta ortopedica brasileira. 2016 Dec;24(6):296-9.
[15] Kwan KY, Cheng AC, Koh HY, Chiu AY, Cheung KM. Effectiveness of Schroth exercises during bracing in adolescent idiopathic scoliosis: results from a preliminary study—SOSORT Award 2017 Winner. Scoliosis and spinal disorders. 2017 Dec 1;12(1):32.
[16] Weiss HR, Lehnert-Schroth C, Moramarco M. Schroth Therapy : Advancements in Conservative Scoliosis Treatment. Second edition. Saarbruecken, Germany: Lambert academic publishing; 2018.
[17] Hayes RJ, Bennett S. Simple sample size calculation for cluster-randomized trials. Int J Epidemiol. 1999;28(2):319–26.
[18] Rrecaj-Malaj, S., Hykolli. Quality of life in adolescent's idiopathic scoliosis before and after physical therapy: a preliminary study. Sport Mont. 2018, 16:69-72.
[19] Cong H, Chen L, Shen J. Is physical capacity correlated with health-related quality of life in patients with adolescent idiopathic scoliosis?. Ann Palliat Med. 2021, 10:6220-6227.
[20] Rafferty A, Fleming N, Kiely P, Mockler D, Dockrell S. Does exercise therapy improve pulmonary function in patients with Adolescent Idiopathic Scoliosis?. Physiother Theory Pract. 2023, 39:1095-1105.
[21] Amaricai E, Suciu O, Onofrei RR. Respiratory function, functional capacity, and physical activity behaviours in children and adolescents with scoliosis. J Int Med Res. 2020, 48(4):300060519895093.
[22] Laucis N, Hays R, Bhattacharyya T. Scoring the SF-36 in Orthopaedics: A Brief Guide. J Bone Joint Surg Am. 2015 Oct 7; 97(19): 1628–1634.