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ORIGINAL ARTICLE

THE IMPACTS OF INSTRUMENTED POSTERIOR FUSION SURGERY ON PULMONARY VOLUME AND FUNCTION IN ADOLESCENTS IDIOPATHIC SCOLIOSIS

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ABSTRACT

Objective: There is conflicting evidence regarding the effect of spinal deformity correction on pulmonary function in adolescent idiopathic scoliosis (AIS).

Materials and Methods: This study evaluated postoperative pulmonary function and capacity in AIS patients undergoing instrumented posterior fusion. Pulmonary parameters assessed included forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), total lung capacity (TLC), residual volume (RV), and the RV/TLC ratio. Postoperative results were compared with predicted values from a healthy community cohort. Subgroup analyses based on Cobb angle, age, and gender were also conducted.

Results: Instrumented posterior fusion surgery led to significant changes in TLC (p=0.000) and RV (p=0.014), with increased lung volumes postoperatively. However, there were no significant changes in the FEV1 and FVC ratios compared to predicted values (p=0.070 and p=0.142, respectively). When categorized by age, significant differences in FEV1 were observed in patients aged >16 years (p=0.037). Despite increased lung volumes, no significant impact on functional pulmonary capacity was found during the two-year follow-up.

Conclusion: Instrumented posterior fusion surgery increases lung volumes, such as TLC and RV, in AIS. However, these volume changes do not result in significant improvements in functional pulmonary capacity, like FVC and FEV1. This suggests that while the surgery may relieve some mechanical constraints, it does not fully restore pulmonary function. The limited functional recovery may be due to incomplete alveolar maturation during childhood. Further research is needed to explore the relationship between spinal deformities and pulmonary function, focusing on genetic and histological factors.

Keywords: Adolescent idiopathic scoliosis, instrumented posterior fusion surgery, pulmonary function, pulmonary volume, respiratory outcomes

INTRODUCTION

The main complaints of people with scoliosis include not only cosmetic problems, back pain, and psychological and social problems, but also cardiopulmonary disorders[1]. It is reported that pulmonary problems caused by scoliosis not only interfere with daily activities but also lead to premature death[2,3]. It has also been shown that thoracic scoliosis in particular is responsible for a significant reduction in lung capacity[4]. This can be attributed to either a decline in the biomechanics of the thorax or the completion of alveoli development during early infancy, namely between the ages of two and three years[2,5]. According to reports, individuals with AIS have inferior lung function and capacity in comparison to the healthy population with similar physiological features[6].

While the ultimate impact of instrumented posterior fusion surgery on pulmonary function remains undetermined, some studies have reported that this surgical method enhances pulmonary function[6-9]. However, other data suggest that posterior fusion surgery does not have a significant effect on pulmonary function[10-12]. The results of a study conducted by Lenke et al.[13] in 2002 on a total of 42 people showed that spinal fusion (both anterior and posterior) reduces the maximum oxygen uptake without affecting the overall capacity

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of the lungs. After a thorough review of the existing literature, we have come to the conclusion that the debates on this topic are still not closed.

An accurate diagnosis of respiratory diseases requires the use of reliable normal values. Lung capacity is strongly influenced by factors such as height, gender, and age. It is highly recommended that reference values should be updated regularly, especially as the paediatric and adolescent population continues to develop. Over the past three decades, there has been an improvement in nutrition and overall health. Additionally, there has been a shift in maturation patterns, with the onset of puberty occurring at a younger age. A comprehensive description of the computation of predictive values for lung volume based on population data has also been provided. Whole-body plethysmography is a technique employed to quantify lung volume, capacity, and resistance. This approach is very standardised, but it necessitates the use of specialised equipment, professionals with expertise in the field, and the patient's cooperation. Plethysmography utilises Boyle's law to quantify the intrathoracic gas volume, specifically the functional residual capacity. After establishing this, the remaining volume and total lung capacity (TLC) can be approximated[14].

This research aims to investigate the impact of instrumented posterior fusion surgery on lung function and lung capacity in adolescents diagnosed with idiopathic scoliosis.

MATERIALS AND METHODS

This study evaluated the preoperative and two-year postoperative plethysmography data of 40 patients who had instrumented posterior fusion surgery for adolescent idiopathic scoliosis (AIS) between 2015 and 2020. Consent form was filled out by all participants. The study was approved by Atatürk University Faculty of Medicine Clinical Research Ethics Committee (decision no: 03, date: 31.03.2023). During this period, approximately 30 cases per year underwent surgery at our center. However, only patients meeting the inclusion criteria were selected, which resulted in a total of 40 cases being analyzed in this study. Although the number of eligible patients was higher, many were excluded due to challenges in follow-up. Some patients were unable to complete the pulmonary function tests, while others declined participation. Additionally, a portion of the patients lived in rural areas and could not attend follow-up visits, and some relocated to different cities, making long-term evaluation difficult. Consequently, the final study cohort consisted of 40 patients who met the inclusion criteria and completed the necessary assessments. All surgeries were performed using a standard posterior approach, and intraoperative neuromonitoring was used in all cases. Patients with neuromuscular, congenital and early-onset were excluded from this study. At the time of surgery, some of these patients were already adults but had been diagnosed with AIS in the past, although they had not received any treatment for it (Figure 1).

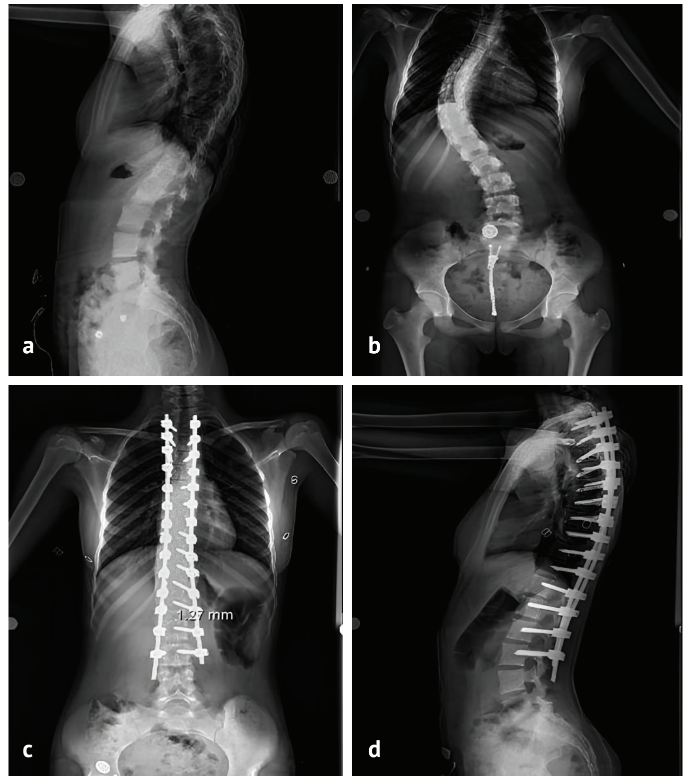


Figure 1. (a) Exemplary X-ray AP images of the patient before the surgical procedure, (b) exemplary X-ray lateral images of the patient before the surgical procedure, (c) exemplary X-ray AP images of the patient after the surgical procedure, (d) exemplary X-ray lateral images of the patient after the surgical procedure
AP: Anteroposterior

This is done with the help of plethysmography, taking into account factors such as age, gender, and Cobb angle. Measuring lung volume is essential for determining if the decrease in vital capacity is caused by a mechanical restriction or an increased dead space. Furthermore, the ratios of respiratory parameters to predictive values were calculated in this study in order to minimise the impact of physiological development and corrected actual height on the change in pulmonary function in adolescent patients.

All patients underwent instrumented posterior fusion surgery by the same surgeon. Furthermore, all patients underwent a breath test three times by the same technician and with the same device. Maximum exhaled air volume data were recorded and analysed by the body plethysmography method using a mouthpiece in a constant pressure cabin. The parameters of TLC, residual volume (RV), forced vital capacity (FVC), and forced expiratory volume in one second (FEV1) were all assessed. The data analysis and comparison were analysed by the same pulmonologist. Throughout the whole period of the trial, the patients did not undergo any type of rehabilitation. We presumed that establishing the correlation between these criteria and the data obtained from the patients, as well as the predictive data from healthy populations with similar features, would provide us with a more objective perspective (Figure 2).

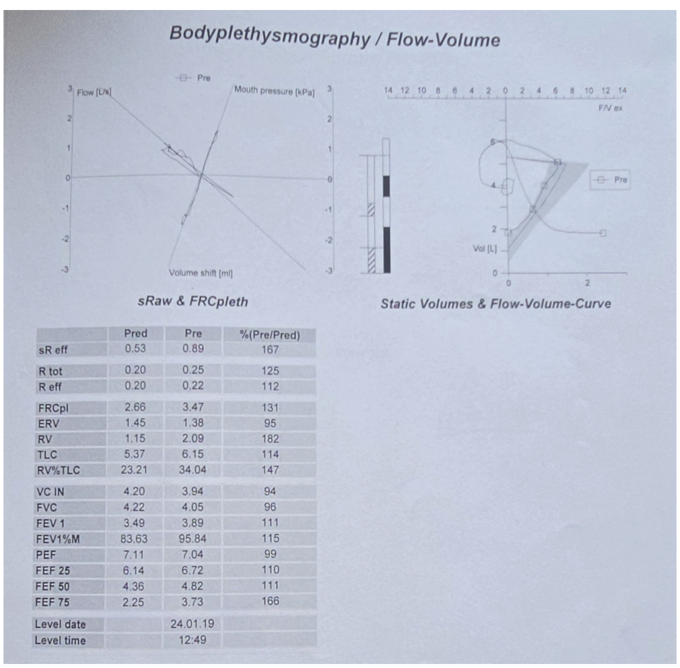
At the time of surgery, some of these patients were already adults but had been diagnosed with AIS during adolescence. Specifically, the 25-year-old patient included in the study was diagnosed with AIS in early adolescence but had not undergone treatment until adulthood. Therefore, the inclusion of this patient aligns with the study criteria.

Furthermore, all patients underwent a breath test three times by the same technician and with the same device. The tests were conducted by an experienced pulmonary function technician, and all data were evaluated by a pulmonologist specialized in respiratory function analysis. Maximum exhaled air volume data were recorded and analyzed by the body plethysmography method using a mouthpiece in a constant pressure cabin.

Statistical Analysis

The data were analysed using the Statistical Package for the Social Sciences (SPSS v20) software. While categorical variables were presented as numbers and percentages, numerical variables were presented as mean ± standard deviation and median (first quartile: Q1-third quartile: Q3). While the suitability of the numerical variables for the normal distribution was examined using the Kolmogorov-Smirnov test, the z-values calculated for skewness and kurtosis were analysed using graphical methods. The paired-samples t-test was used to compare subsequent measurements of variables that follow a normal distribution, while the independent-samples t-test was used to compare measurements between two independent groups. Consecutive measurements of non-normally distributed variables and comparisons for independent groups were carried out using the Wilcoxon test or the Mann-Whitney U test, respectively. The statistical significance level for all the analyses was set at $p<0.05$.

In the statistical power analysis of our study, a G*Power value of 67.56% was determined for the RV/TLC parameter.



	Pred	Pre	%(Pre/Pred)
sR eff	0.53	0.89	167
R tot	0.20	0.25	125
R eff	0.20	0.22	112
FRCpl	2.66	3.47	131
ERV	1.45	1.38	95
RV	1.15	2.09	182
TLC	5.37	6.15	114
RV%TLC	23.21	34.04	147
VC IN	4.20	3.94	94
FVC	4.22	4.05	96
FEV 1	3.49	3.89	111
FEV1%M	83.63	95.84	115
PEF	7.11	7.04	99
FEF 25	6.14	6.72	110
FEF 50	4.36	4.82	111
FEF 75	2.25	3.73	166
Level date		24.01.19	
Level time		12:49	

Figure 2. Results of a patient who underwent body plethysmography
FRCpl: Functional residual capacity (plethysmographic), ERV: Expiratory reserve volume, RV: Residual volume, TLC: Total lung capacity, VC IN: Inspiratory capacity, FVC: Forced vital capacity, FEV1: Forced expiratory volume in 1 second, PEF: Peak expiratory flow, FEF: Forced expiratory flow

RESULTS

Out of the total of 40 patients, 30 (75%) were female and 10 (25%) were male. Upon examination of the patients' ages at the time of surgery, we found that our youngest patient was 13 years old and our oldest patient was 25 years old. The mean age of our research group was 16.5 years. The patients' preoperative Cobb angles were measured, with the lowest angle recorded at 40°, the greatest angle at 115°, and the average Cobb angle at 67.90°.

Apart from minor skin infections, there were no complications. These infections were controlled with intravenous antibiotic treatment. There were no subacute or chronic infections, neurological complications, or complications associated with the pedicle screw. Additionally, no surgery-related issues were observed in the follow-up period, and all patients showed uneventful recovery.

Upon analysing the pulmonary function tests of the patients, we observed that the average FVC prior to the surgical procedure was 2,824, while the average FVC post-surgery was 3,164, which was determined to be of statistical significance (p=0.000). Prior to surgery, the average FVC to predictive values ratio was 79.25%. Nonetheless, it was observed that this ratio increased to 83.05% after the operation, even though this change did not meet the standards for statistical significance with a p-value of 0.142. Upon reviewing the data for FEV1, it was observed that the average value prior to the procedure was 2,476; however, this number increased to 2,835 after surgery. The observed change was deemed to be statistically significant, with a p-value of 0.000. The ratio of FEV1 to predictive values was 81.25% before surgery and increased to 86.55% postoperatively. However, this improvement was not of statistical significance (p=0.070).

The investigation of TLC revealed that the mean preoperative value was 4,052, which subsequently rose to 4,787 after surgery. This increase was found to be statistically significant (p=0.000). The preoperative average ratio of TLC to predicted values was 79.25%, which subsequently improved to 92.60% postoperatively, which was also found to be of statistical significance (p=0.000). The average preoperative RV in the lung was 1,408 but increased to 1,678 postoperatively. The RV in the lungs increased from 1,408 before surgery to 1,678 after surgery. The observed change was deemed to have statistical significance (p=0.014). The preoperative average ratio of RV to predicted values was 111.23%, which subsequently rose to 124.53% postoperatively. This shift was similarly deemed to be statistically significant (p=0.046).

The average RV/TLC% of the patients prior to surgery was 36,643, which fell to 35,170 after surgery. Nevertheless, this change did not fulfil the criteria for statistical significance (p=0.388). The preoperative ratio of RV/TLC% to predicted values was 142.237%, which decreased to 133.612% post-surgery. This change did not reach statistical significance (p=0.146). A more comprehensive analysis can be found in Table 1 with the full data.

Gender-based Parameter Comparison

We conducted an analysis of the patient population, categorizing them into two groups based on gender: female (n=30) and male (n=10). We first examined each group separately and then compared the two groups to each other. The statistically significant parameters in the changes in PFT data in our group of female patients were the TLC, the percentage of predicted TLC (pre/pred TLC%), the FEV1, the percentage of predicted FEV1 (pre/pred FEV1%), the FVC, the percentage of predicted FVC (pre/pred FVC%), the RV, and the percentage of predicted RV to TLC (pre/pred RV/TLC%).

Among our sample of male patients, the parameters TLC, pre/pred TLC%, pre/pred FMC%, and pre/pred RV% were shown to have a statistically significant impact on the changes seen in the PFT results. The data are displayed in Table 2.

Upon comparing two distinct gender groups, no statistically significant difference was seen for any of the parameters (Table 3).

An Analysis of Parameters Based on Age

We categorised our patients into two groups based on their age: those under 16 years of age (n=17) and those aged 16 years and older (n=23). We analyzed each group individually and then performed a comparative analysis. Our statistically significant parameters for changes in respiratory test data in the patient population aged 16 years and older were TLC, pre/pred TLC%, FEV1, FVC, RV, and pre/pred RV% values (Table 4).

Our statistically significant parameters for changes in respiratory test data in the patient population under 16 years of age were TLC, pre/pred TLC%, FEV1, FVC, RV, and pre/pred RV% values (Table 4).

Our statistical analysis revealed a statistically significant difference between the age groups only for the FEV1 metric (p=0.037) (Table 5).

Comparison of the Parameters According to the Cobb Angle

We divided the patients into two different groups according to their preoperative Cobb angle. Two different groups were formed: those with a Cobb angle below 80° (mild to moderate) (n=24) and those with a Cobb angle above 80° (severe) (n=16).

Table 1. Statistical data of the patients before and after surgery for comparison

	Mean	N	Std. deviation	95% Confidence interval	t	Significance (two-tailed)
TLC-preop	4,052	40	1.3409	-0.5229	-6,998	0.000
TLC-postop	4,787	40	1.4469			
TLC-pre/pred-preop%	79.25	40	17,859	-9,973	-7,997	0.000
TLC-pre/pred-postop%	92.60	40	19,910			
FEV1-preop	2,476	40	1.0568	-0.2096	-4,854	0.000
FEV1--postop	2,835	40	0.9775			
FEV1- pre/pred-preop%	81.25	40	25,964	0.456	-1,862	0.070
FEV1 -pre/pred-postop%	86.55	40	20,400			
FVC-preop	2,824	40	1.2196	-0.1890	-4,552	0.000
FVC-postop	3,164	40	1.1283			
FVC-pre/pred-preop%	79.25	40	23,697	1,333	-1,497	0.142
FVC-pre/pred-postop%	83.05	40	18,330			
RV-preop	1,408	40	0.6053	-0.0586	-2,585	0.014
RV-postop	1,678	40	1.0504			
RV-pre/pred-preop%	111.23	40	38,855	-0.265	-2,064	0.046
RV-pre/pred-postop%	124.53	40	60,868			
RV/TLC-preop%	36,643	40	15.3274	4.8827	0.874	0.388
RV/TLC-postop%	35,170	40	17.0022			
RV/TLC-pre/pred-preop%	142.237	40	45.7620	20.3708	1,485	0.146
RV/TLC-pre/pred-postop%	133.612	40	49.5038			

Pre/pred: Percentage of patient data to predictive data, Preop: Before surgery, Postop: After surgery, TLC: Total lung capacity, FEV1: Forced expiratory volume in 1 second, FVC: Forced vital capacity, RV: Residual volume, Std: Standard

Table 2. Evaluation and statistical analysis of the respiratory parameters within the groups according to gender

Gender		TLC	Pre/pred TLC%	FEV1	Pre/pred FEV1%	FVC
Female	Z	-4,021[b]	-4,209[b]	-3,692[b]	-3,137[b]	-3,569[b]
	Asymptotic significance (two-tailed)	0.000	0.000	0.000	0.002	0.000
Male	Z	-2,803[b]	-2,666[b]	-1,478[b]	-1,632[c]	-1,478[b]
	Asymptotic significance (two-tailed)	0.005	0.008	0.139	0.103	0.139
Gender		Pre/pred FVC%	RV	Pre/pred RV%	RV/TLC%	Pre/pred RV/TLC%
Female	Z	-2,488[b]	-2,531[b]	-1,337[b]	-1,265[c]	-2,108[c]
	Asymptotic significance (two-tailed)	0.013	0.011	0.181	0.206	0.035
Male	Z	-2,052[c]	-1,326[b]	-2,142[b]	-0.051[c]	-0.866[c]
	Asymptotic significance (two-tailed)	0.040	0.185	0.032	0.959	0.386

Pre/pred: Percentage of patient data to predictive data, [b]Based on negative ranks, [c]Based on positive ranks, TLC: Total lung capacity, FEV1: Forced expiratory volume in 1 second, RV: Residual volume

Table 3. Statistical analysis of the values of male and female gender as two different groups

	TLC	Pre/pred TLC%	FEV1	Pre/pred FEV1%	FVC
Mann-Whitney U test	124.000	144.500	136.000	141.000	115.500
Wilcoxon W	589.000	609.500	191.000	196.000	170.500
Z	-0.812	-0.172	-0.437	-0.282	-1,078
Asymptotic significance (two-tailed)	0.417	0.863	0.662	0.778	0.281
	Pre/pred FVC%	RV	Pre/pred RV%	RV/TLC%	Pre/pred RV/TLC%
Mann-Whitney U test	108.000	149.500	139.500	102.000	115.000
Wilcoxon W	163.000	614.500	194.500	567.000	170.000
Z	-1,316	-0.016	-0.328	-1,499	-1,093
Asymptotic significance (two-tailed)	0.188	0.988	0.743	0.134	0.274

Pre/pred: Percentage of patient data to predictive data, TLC: Total lung capacity, FEV1: Forced expiratory volume in 1 second, FVC: Forced vital capacity

Table 4. Evaluation and statistical analysis of patients under and over 16 years of age within the groups

Age		TLC	Pre/pred TLC%	FEV1	Pre/pred FEV1%	FVC
<16	Z	-3,351[b]	-3,012[b]	-2,642[b]	-0.994[b]	-2,272[b]
	Asymptotic significance (two-tailed)	0.001	0.003	0.008	0.320	0.023
≥16	Z	-3,619[b]	-3,916[b]	-2,840[b]	-1,887[b]	-3,243[b]
	Asymptotic significance (two-tailed)	0.000	0.000	0.005	0.059	0.001
Age		Pre/pred FVC%	RV	Pre/pred RV%	RV/TLC%	Pre/pred RV/TLC%
<16	Z	-0.398[b]	-3,297[b]	-2,926[b]	-0.454[c]	-1,306[c]
	Asymptotic significance (two-tailed)	0.691	0.001	0.003	0.650	0.191
≥16	Z	-1,502[b]	-1,292[b]	-0.969[b]	-1,386[c]	-1,655[c]
	Asymptotic significance (two-tailed)	0.133	0.196	0.333	0.166	0.098

Pre/pred: Percentage of patient data to predictive data, [b]Based on negative ranks, [c]Based on positive ranks, TLC: Total lung capacity, FEV1: Forced expiratory volume in 1 second, FVC: Forced vital capacity, RV: Residual volume

The statistically significant parameters in our group of patients with Cobb angles <80°, both before and after surgery, were TLC, pre/pred TLC%, FEV1, pre/pred FEV1%, FVC, and RV values (Table 6).

When comparing two different groups separated by the Cobb angle, no statistically significant difference was found for any of the parameters (Table 7).

Table 5. Data from the statistical comparison of the two groups by age

	TLC	Pre/pred TLC%	FEV1	Pre/pred FEV1%	FVC
Mann-Whitney U test	182.000	150.000	113.000	180.500	134.000
Wilcoxon W	302.000	475.000	438.000	505.500	459.000
Z	-0.154	-1,049	-2,082	-0.196	-1,495
Asymptotic significance (two-tailed)	0.878	0.294	0.037	0.845	0.135
	Pre/pred FVC%	RV	Pre/pred RV%	RV/TLC%	Pre/pred RV/TLC%
Mann-Whitney U test	153.500	175.000	118.500	138.000	179.000
Wilcoxon W	478.500	295.000	238.500	258.000	299.000
Z	-0.953	-0.350	-1,929	-1,383	-0.237
Asymptotic significance (two-tailed)	0.341	0.727	0.054	0.167	0.812

Pre/pred: Percentage of patient data to predictive data, TLC: Total lung capacity, FEV1: Forced expiratory volume in 1 second, FVC: Forced vital capacity, RV: Residual volume

Table 6. Evaluation and statistical analysis of the data within the groups according to the Cobb angle

Cobb		TLC	Pre/pred TLC%	FEV1	Pre/pred FEV1%	FVC
<80	Z	-3,670[b]	-3,700[b]	-3,150[b]	-2,221[b]	-3,112[b]
	Asymptotic significance (two-tailed)	0.000	0.000	0.002	0.026	0.002
≥80	Z	-3,296[b]	-3,299[b]	-2,732[b]	-0.440[b]	-2,480[b]
	Asymptotic significance (two-tailed)	0.001	0.001	0.006	0.660	0.013
Cobb		Pre/pred FVC%	RV	Pre/pred RV%	RV/TLC%	Pre/pred RV/TLC%
<80	Z	-1,657[b]	-2,109[b]	-1,690[b]	-0.902[c]	-1,511[c]
	Asymptotic significance (two-tailed)	0.098	0.035	0.091	0.367	0.131
≥80	Z	-0.189[b]	-2,041[b]	-1,508[b]	-0.973[c]	-1,287[c]
	Asymptotic significance (two-tailed)	0.850	0.041	0.131	0.331	0.198

Pre/pred: Percentage of patient data to predictive data, [a]Wilcoxon signed ranks test, [b]Based on negative ranks, [c]Based on positive ranks, TLC: Total lung capacity, FEV1: Forced expiratory volume in 1 second, FVC: Forced vital capacity, RV: Residual volume

Table 7. Comparison and statistical analysis between the two groups according to the Cobb angle

	TLC	Pre/pred TLC%	FEV1	Pre/pred FEV1%	FVC
Mann-Whitney U	176.500	158.500	118.000	179.000	138.500
Wilcoxon W	527.500	509.500	223.000	530.000	243.500
Z	-0.156	-0.667	-1,816	-0.085	-1,234
Asymptotic significance (two-tailed)	0.876	0.505	0.069	0.932	0.217
	Pre/pred FVC%	RV	Pre/pred RV%	RV/TLC%	Pre/pred RV/TLC%
Mann-Whitney U	151.000	160.000	162.000	177.000	136.000
Wilcoxon W	502.000	265.000	267.000	282.000	487.000
Z	-0.882	-0.624	-0.568	-0.142	-1,304
Asymptotic significance (two-tailed)	0.378	0.532	0.570	0.887	0.192

Pre/pred: Percentage of patient data to predictive data, TLC: Total lung capacity, FEV1: Forced expiratory volume in 1 second, FVC: Forced vital capacity, RV: Residual volume

Apart from minor skin infections, there were no complications. These infections were controlled with intravenous antibiotic treatment. There were no subacute or chronic infections, neurological complications, or complications associated with the pedicle screw.

DISCUSSION

Studies have already been conducted on the relationship between instrumented posterior fusion surgery and pulmonary function in individuals with scoliosis. To add to the existing knowledge in literature, the present study investigated the previously unexplored relationship between the ratio of RV to TLC (RV/TLC%) and its association with predictive values.

Our study has demonstrated that while surgical therapy led to an increase in lung capacity, it did not have a significant impact on pulmonary function. Furthermore, no significant correlation was found between patients' age, gender, Cobb angle values, and lung capacities and functions. The patients' postoperative measurements of TLC and RV indicate that the surgical treatment successfully addressed the deformity in three dimensions but did not have any impact on lung parenchyma or function. Given that the development of deformity began after the age of 10 in the AIS patients investigated in the present study, the lack of recovery of the lungs suggests that the problem should be considered earlier or as multifactorial. Previous publications have reported that patients complete ninety per cent of their alveolar maturation by the age of seven[5]. It has been noted that the lung, which has reached its advanced stage of development at the age of seven years, does not return to its original state after correction of the chest wall deformity that occurs after the age of ten years. One possible explanation for this condition is that it may be related to the limited ability of the alveoli to regenerate. Alternatively, it might be due to the interaction between the collagens that affect the alveolar surface. Another issue to consider is the role of hereditary factors in the development of both alveoli and scoliosis. Further investigation is needed to determine the exact cause.

In our study, all patients had thoracic scoliosis, and sagittal plane deformities such as hypokyphosis or hyper kyphosis were also considered. The extent of postoperative correction was evaluated; however, its direct impact on pulmonary function tests remains unclear. Although thoracic deformities and sagittal balance may influence respiratory mechanics, further studies with larger cohorts and detailed subgroup analyses are required to clarify their role in pulmonary function outcomes.

Ankylosing spondylitis is known to hinder lung capacity and pulmonary functions as a result of kyphosis. Research done in individuals with ankylosing spondylitis found that lung volume and lung function showed considerable improvement at the two-year follow-up after correcting the spinal deformity with osteotomy and fusion[15,16]. Although surgical correction can restore lung function in people with kyphosis, a condition that affects the connective tissue of the skeletal system and leads to lung damage, scoliosis patients can potentially increase their lung volume. Nevertheless, the lack of improvement in pulmonary function leads us to assume that there could be a link between lung tissue and AIS. Studies have been conducted on abnormal collagen metabolism and the impact of hereditary variables on the collagen structure of intervertebral discs as potential causes of scoliosis[17].

In a study in which the individual volumes of the right and left lungs were analysed using computed tomography scans in people with scoliosis, no statistically significant difference was found in the total volume changes and the differences between the two sides[12]. Our study, in contrast, has revealed a notable rise in the overall volume. Furthermore, after this study, the question of whether there is an increase in volume on the convex side and a decrease in volume on the concave side after the reconstructed deformity is no longer relevant.

There are studies that show an improvement in pulmonary parameters and functional capacity after a 12-week supervised physiotherapy programmed in children and adolescents with mild or moderate idiopathic scoliosis. Nevertheless, patients who underwent rehabilitation still exhibit poorer values for respiratory parameters and assessments of functional capacity compared to the control group. This study demonstrates the essentiality of engaging in physical exercise following deformity treatment to enhance pulmonary function and overall functioning[18]. Non-invasive rehabilitation techniques may not stimulate lung growth and maturation, but they do prevent lung function from deteriorating[19]. In our study, patients had a standard physiotherapy regimen for six months starting from the third month post-surgery. However, no specialized rehabilitation targeting respiratory function was administered.

The limited population of our study can be attributed to the extended duration of the follow-up period and the challenges associated with conducting pulmonary function tests. Despite initially enrolling 96 patients in the trial, we were only able to evaluate the data of 40 individuals at the conclusion of the follow-up period.

Our study would not only be more useful but also more significant if we had the opportunity to compare it with patients who needed scoliosis surgery but were not operated on. Our study has neither a control group nor results. Therefore, we do not know how respiratory function changes in patients that undergo surgery compared to when surgery is not performed on scoliosis patients.

We are currently conducting ongoing research on this subject. Our primary objectives are to enhance patient volume and extend the duration of follow-up. In addition, patients with scoliosis who have not yet undergone surgery are also being registered. A control group was established by taking advantage of spirometry and plethysmography techniques for measurements. Upon the completion of our forthcoming study, which serves as a direct extension of the ongoing study, its findings will be made publicly available.

CONCLUSION

This study investigated the relationship between instrumented posterior fusion surgery and pulmonary function in individuals with scoliosis, focusing on the previously unexplored association between the ratio of RV to TLC (RV/TLC%) and its predictive value. Our findings indicate that while surgical intervention effectively increased lung volume, it did not significantly improve pulmonary function. This suggests that the structural correction of the deformity does not directly translate into functional recovery of lung tissue.

The absence of a significant correlation between patients' age, gender, Cobb angle, and pulmonary function supports the notion that multiple factors contribute to the respiratory limitations observed in scoliosis patients. The lack of lung function improvement despite increased lung volume highlights the need for further investigation into the role of alveolar development, collagen metabolism, and hereditary factors in scoliosis-related pulmonary dysfunction.

Ethics

Ethics Committee Approval: The study was approved by Atatürk University Faculty of Medicine Clinical Research Ethics Committee (decision no: 03, date: 31.03.2023).

Informed Consent: Consent form was filled out by all participants.

Footnotes

Authorship Contributions

Surgical and Medical Practices: B.P., S.Y., O.K., Concept: B.P., O.K., Design: B.P., S.Y., S.Yılm., B.K., Data Collection or Processing: B.P., S.Y., B.K., Analysis or Interpretation: S.Yılm., B.K., Literature Search: B.P., S.Yılm., E.Ş., Writing: B.P., S.Y., E.Ş., O.K.

Conflict of Interest: The authors have no conflicts of interest to declare.

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