Effect of a Preoperative Protocol of Aerobic Physical Therapy on the Quality of Life of Patients With Adolescent Idiopathic Scoliosis: A Randomized Clinical Study

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Abstract

Patients with adolescent idiopathic scoliosis (AIS) have lower potential for physical activity because of lung dysfunction and lower muscle strength, which can be reversed by the cardiorespiratory and musculoskeletal conditioning provided by standardized physical activities.

We conducted a study to determine if a preoperative protocol of aerobic exercise would improve quality of life (QoL) both before and after training and if there would be any differences between patients who received the therapy and those who did not. Patients with the indication of surgical correction of AIS were randomized to receive or not receive a 4-month preoperative course of aerobic physical training. At baseline and after 4 months, they were evaluated with the Short Form-36 questionnaire (SF-36).

QoL scores improved for the study group but did not change for the control group. In all QoL domains, the study group's mean score increased significantly between baseline and 4 months. We concluded that the proposed preoperative physical therapy protocol improved the QoL of patients with AIS.

Adolescent idiopathic scoliosis (AIS) affects 1% to 3% of the population aged 10 to 18 years.[1] Defined as a lateral flexion deformity and rotation of the spine, AIS can lead to thoracic changes that culminate in the reduction of diaphragmatic and anterior-posterior and transverse diameter of the chest during inspiration, modifying the distribution of air and the pulmonary function.[2-4]

Curvatures of more than 45° are usually surgically addressed. When they are not addressed, deformity progresses in adulthood and affects longevity (life expectation) and quality of life (QoL).[5]

Multidisciplinary teams are very interested in valid measures that can be used to objectively quantify the impact of treatments on health-related QoL, ultimately to establish whether these treatments are effective.[6,7] Results should therefore be analyzed in physical and psychosocial domains, which are measurable with the Short Form-36 questionnaire (SF-36).[8]

Following the hypothesis of lower potential for physical activity caused by lung dysfunction in AIS, many researchers report deconditioning in this population and think the factor responsible for these patients' lower muscle strength can be reversed by the cardiorespiratory and musculoskeletal conditioning provided by standardized physical activities.[9-11] Alves and colleagues[12] reported improved lung function in AIS patients undergoing an aerobic training program.

Given the paucity of literature regarding how this deconditioning influences AIS patients' QoL, we conducted a study to determine if a preoperative protocol of aerobic exercise therapy would improve QoL both before and after training and if there would be any differences between patients who received the therapy and those who did not.

Materials and Methods

This randomized clinical trial was conducted by the Spine Surgery Group, Department of Orthopaedics and Traumatology, Santa Casa de São Paulo, a public, university hospital in Brazil, after being approved by the institution's ethics committee in research. We examined the effect of a preoperative physical therapy protocol on the QoL of patients after surgical correction of AIS. All patients or their legal guardians signed informed consent forms for the procedures and participation in the study.

Recruitment of patients ran from August 2011 to March 2012, at which point 43 patients with AIS and the indication for surgical correction were admitted to the service. Inclusion criteria were age 10 to 18 years, thoracic curvature of 45° or more, indication for surgical correction of the deformity, and no previous or current heart or lung disease. Exclusion

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criteria were thoracic curvature of less than 45°; previous or current heart, lung, or neurologic disease or condition that would interfere with the patient's understanding of the physical therapy orientations; and previous surgery for correction of spinal deformity.

Of the 43 patients initially recruited, 3 did not participate in the research because they were not residents of São Paulo, the city where the reassessment and monitoring would be done. The other 40 patients were randomized into either a control group (20 AIS patients who did not receive physiotherapy before surgery) or a study group (20 AIS patients enrolled in a preoperative physiotherapy protocol).

For all patients, radiographs were obtained with anteroposterior and profile incidences in the standing position to measure the spinal curvature according to the method of Cobb.[13] All patients were given the SF-36 at baseline and after 4 months (period of physiotherapy protocol for the study group).

Physiotherapy Protocol

Patients in the study group underwent a 4-month physiotherapy protocol based on the methods of Bouchard and Shephard[14] and Covey and colleagues[15]: three 60-minute sessions per week (intervals between sessions) under the guidance of a physiotherapist. Each session had 3 parts:

- 10 minutes of warm-up (stretching and low-intensity aerobic exercises, like walking slowly with increasing speed).
- 40 minutes of aerobic exercise on a treadmill or stationary bike, with labor intensity maintained at 60% to 80% of maximum heart rate.
- 10 minutes of cool-down and relaxation (stretching and aerobic exercises with low energy expenditure and relaxation techniques).

At the end of the protocol therapy, all patients were reevaluated. The researcher who evaluated a patient was never the physiotherapist who worked with that patient, and the evaluator was blind to which group each patient belonged.

Statistical Analysis

Summary measures (mean, SD, median, minimum, maximum) were used to describe the QoL scores in each domain according to groups and evaluation times. To compare the QoL scores in each domain, we used 2-factor analysis of variance with repeated measures assuming an autoregressive correlation matrix of order 1 between times with logarithmic link function, followed by Bonferroni multiple comparisons to compare each group. The tests were performed with a significance level of 5%.

Results

The control group consisted of 20 AIS patients with a median (SD) age of 14.12 (1.83) years and a median (SD) scoliosis angle of 64.18° (16.62°). The study group (preoperative physiotherapy protocol) consisted of 20 AIS patients with a

Table I. QoL Domain Scores by Moments and Groups

QoL Domain	Moment	Group											
		Control						Study					
		Mean	SD	Median	Minimum	Maximum	N	Mean	SD	Median	Minimum	Maximum	N
Functional capacity	Initial	48.50	8.29	47.50	35.00	65.00	20	54.75	15.52	57.50	15.00	75.00	20
	4 mo	49.50	8.26	47.50	35.00	70.00	20	91.25	7.23	92.50	70.00	100.00	20
Physical health	Initial	58.75	28.42	50.00	25.00	100.00	20	61.25	23.61	75.00	25.00	100.00	20
	4 mo	58.75	23.33	50.00	25.00	100.00	20	96.25	9.16	100.00	75.00	100.00	20
Pain	Initial	76.10	14.55	74.00	52.00	100.00	20	77.75	16.05	74.00	51.00	100.00	20
	4 mo	76.70	14.54	74.00	52.00	100.00	20	97.10	7.33	100.00	74.00	100.00	20
General health status	Initial	29.90	7.56	27.00	20.00	42.00	20	26.55	7.94	25.00	15.00	42.00	20
	4 mo	29.90	6.47	31.00	20.00	42.00	20	68.20	6.34	71.00	50.00	77.00	20
Vitality	Initial	41.00	7.71	40.00	30.00	55.00	20	43.00	7.15	42.50	30.00	60.00	20
	4 mo	41.25	6.46	40.00	30.00	50.00	20	81.25	3.19	80.00	75.00	85.00	20
Social aspects	Initial	51.88	10.94	50.00	37.50	75.00	20	51.88	9.31	50.00	37.50	75.00	20
	4 mo	52.50	9.60	50.00	37.50	62.50	20	84.38	10.63	87.50	62.50	100.00	20
Emotional aspects	Initial	35.00	22.88	33.33	0.00	66.67	20	31.67	25.31	33.33	0.00	100.00	20
	4 mo	38.33	31.11	33.33	0.00	100.00	20	93.33	13.68	100.00	66.67	100.00	20
Mental health	Initial	49.20	9.72	52.00	32.00	68.00	20	49.00	8.89	50.00	28.00	68.00	20
	4 mo	49.00	7.21	50.00	36.00	64.00	20	86.40	4.75	88.00	72.00	92.00	20

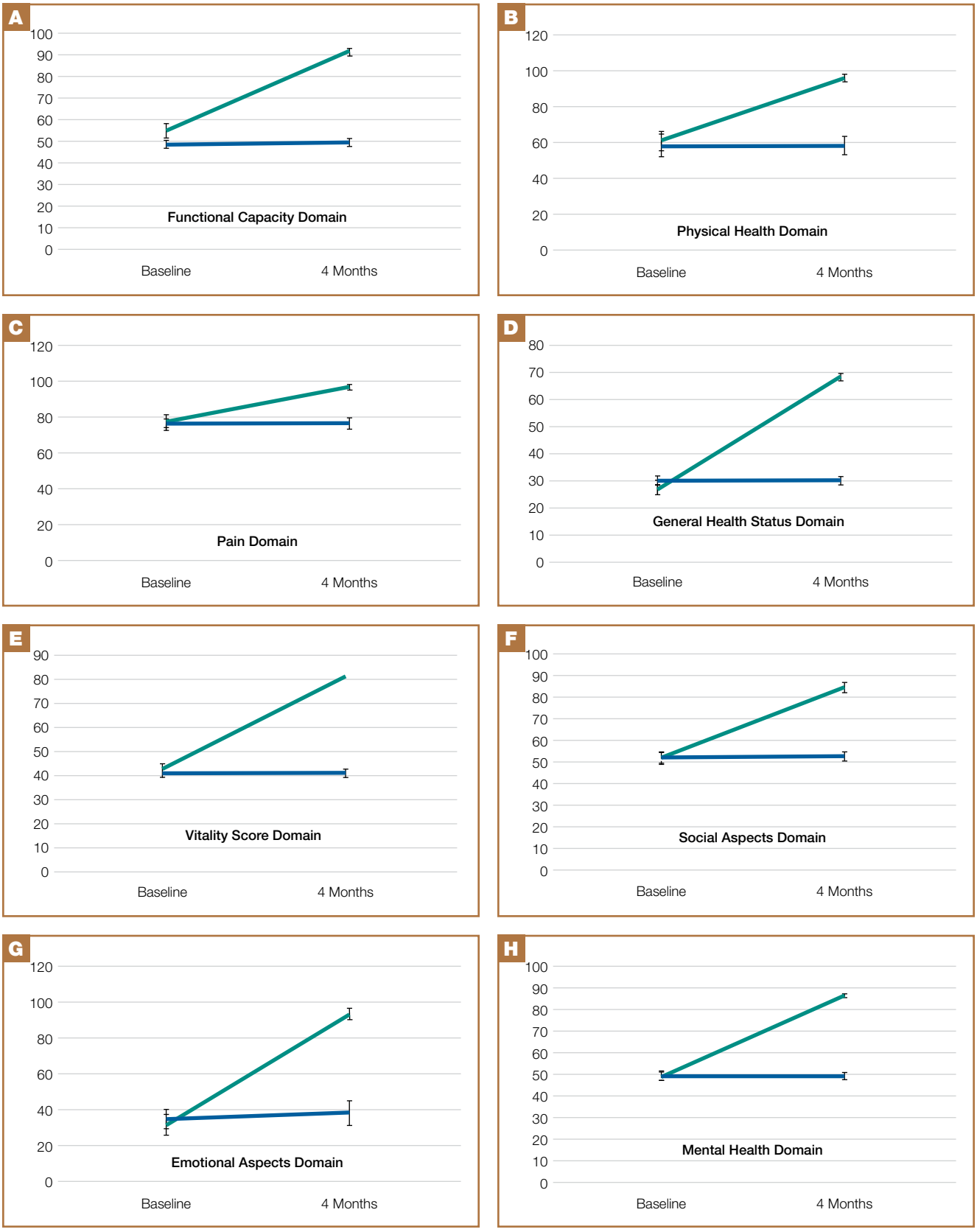

Figure. Variation in mean SF-36 score domains (y-axis) in each group according to time (x-axis). Baseline (left); final moment, at 4 months (right). Control group (blue), study group (green). Domains: (A) functional capacity, (B) physical health, (C) pain, (D) general health status, (E) vitality score, (F) social aspects, (G) emotional aspects, (H) mental health.

median (SD) age of 13.86 (1.02) years and a median (SD) scoliosis angle of 65.54° (14.58°). There were no significant differences between the 2 groups with respect to age ($P = .31$) or scoliosis angle ($P = .29$).

Between initial and final (4-month) evaluations, all 8 SF-36 domains changed (**Table I**). QoL scores improved for the study group but did not change for the control group (**Figure**). Mean QoL scores in all domains were not statistically the same over time in both groups (Group × Time, $P < .05$). For all QoL domains, the study group's mean score increased

Table II. Results of Bonferroni Multiple Comparisons Between QoL Domain Scores Between Groups and Evaluations (Initial or at 4 Months)[a]

QoL Domain	Group/ Moment	Comparison	Mean Difference	Standard Error	*P*[b]	CI (95%)	
						Inferior	Superior
Functional capacity	Control	Initial–4 mo	–1.00	1.25	> .999	–3.46	1.46
	Study	Initial–4 mo	–36.50	3.00	**< .001**	–42.38	–30.62
	Initial	Control–study	–6.25	3.83	.618	–13.76	1.26
	4 mo	Control–study	–41.75	2.39	**< .001**	–46.44	–37.06
Physical health	Control	Initial–4 mo	0.00	3.54	> .999	–6.93	6.93
	Study	Initial–4 mo	–35.00	4.47	**< .001**	–43.77	–26.23
	Initial	Control–study	–2.50	8.05	> .999	–18.28	13.28
	4 mo	Control–study	–37.50	5.46	**< .001**	–48.21	–26.79
Pain	Control	Initial–4 mo	–0.60	2.04	> .999	–4.59	3.39
	Study	Initial–4 mo	–19.35	3.05	**< .001**	–25.34	–13.36
	Initial	Control–study	–1.65	4.72	> .999	–10.90	7.60
	4 mo	Control–study	–20.40	3.55	**< .001**	–27.36	–13.44
General health status	Control	Initial–4 mo	0.00	0.90	> .999	–1.77	1.77
	Study	Initial–4 mo	–41.65	1.66	**< .001**	–44.91	–38.39
	Initial	Control–study	3.35	2.39	**.966**	–1.33	8.03
	4 mo	Control–study	–38.30	1.97	**< .001**	–42.17	–34.43
Vitality	Control	Initial–4 mo	–0.25	0.66	> .999	–1.54	1.04
	Study	Initial–4 mo	–38.25	1.43	**< .001**	–41.05	–35.45
	Initial	Control–study	–2.00	2.29	> .999	–6.49	2.49
	4 mo	Control–study	–40.00	1.57	**< .001**	–43.08	–36.92
Social aspects	Control	Initial–4 mo	–0.62	2.42	> .999	–5.36	4.11
	Study	Initial–4 mo	–32.50	2.56	**< .001**	–37.52	–27.48
	Initial	Control–study	0.00	3.13	> .999	–6.14	6.14
	4 mo	Control–study	–31.88	3.12	**< .001**	–37.99	–25.76
Emotional aspects	Control	Initial–4 mo	–3.33	4.65	> .999	–12.46	5.79
	Study	Initial–4 mo	–61.67	5.41	**< .001**	–72.28	–51.06
	Initial	Control–study	3.33	7.43	> .999	–11.24	17.91
	4 mo	Control–study	–55.00	7.41	**< .001**	–69.52	–40.48
Mental health	Control	Initial–4 mo	–0.62	1.18	> .999	–2.12	2.52
	Study	Initial–4 mo	–32.50	1.53	**< .001**	–40.40	–34.40
	Initial	Control–study	0.20	2.87	> .999	–5.43	5.83
	4 mo	Control–study	–37.40	1.88	**< .001**	–41.09	–33.71

Abbreviations: CI, confidence interval.

[a]For each row, df = 1. [b]Bold *P* values are significant.

significantly from baseline to 4 months ($P < .05$), and, after 4 months, scores were on average higher in the study group ($P < .05$) than in the control group (**Table II**). At baseline, the groups had statistically similar mean scores ($P > .05$), and the control group showed no statistically significant change in any domain ($P > .05$).

Discussion

The need to translate into numbers subjective concepts such as QoL brings to the health professional practice the challenge of creating scales that demonstrate the difference that each intervention can have on the lives of patients. This is the case in our study, in which we determined the impact of an aerobic preoperative training on the QoL of patients with severe AIS.

The etiology of AIS is still undetermined,[1] and reports of the monitoring of the disease evolution reveal patients suffering from psychosocial difficulties,[6-8] especially during treatment, suggesting that interventions that aim to ameliorate these disorders, such as the aerobic exercises proposed in our study, may decrease the negative impact of scoliosis on the lives of these young people by improving the body self-image.[16]

Over the past decade, interest in assessing patients' perceptions of the consequences of their illness increased,[4] and QoL questionnaires gained prominence and were improved. General questionnaires, such as SF-36, the instrument used in the present study, are already able to determine the impact of treatment on the routine activities of AIS patients.[5] In this study, the negative impact of scoliosis on patients' perceptions of health were found through the analysis of the mean scores of the control and study groups. Both groups' scores were below the expected SF-36 scores achieved by adolescents without spinal deformity and in the same age range studied (10 to 18 years).[17]

In a 10-year follow-up of AIS treatment, Andersen and colleagues[18] found a moderate reduction in perceptions of health and in daily activities, showing that, even after treatment, AIS does not lose its stigma of noticeable deterioration in overall health. This alerts us to the need for interventions, such as the physiotherapy protocol we have proposed, to improve health perceptions.

It is also important to consider that AIS patients, probably because of their lower muscle performance, may be less physically active,[2-5,9] resulting in deconditioning in relation to physical assessment. These patients might not present QoL scores befitting their age. An aerobic training program demonstrates its results on physical assessments of strength.[11,12] However, SF-36 was crucial in assessing the effects on QoL; it was used to categorize treatment benefits. QoL scores showed a significant increase in the 8 domains analyzed, in both comparisons: patients in the study group at baseline versus the same patients at final evaluation, and confronting the favorable evolution of this group with the lowest average scores observed in the control group.

Conclusion

We concluded that this preoperative physical therapy protocol increased AIS patients' QoL, as evidenced by the study group's improvement on all SF-36 domains.

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