

The Recovery Physical Therapy Effects upon the Ventilation Dysfunction in Patients with Ankylosing Spondylitis

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ABSTRACT: Purpose - The evaluation of the ventilation function improval in patients with ankylosing spondylitis following the medical recovery procedures. **Methods** - The study included 24 patients that were diagnosed with AS stages I and IV that were monitored for 24 months. We recorded ventilation functional tests, respiratory gas levels, thorax involvement in inspiration and expiration, the medical, physical and balneotherapy that they had followed. The activity of the disease was evaluated using the BASDAI score. The evaluation of the functional disability was based on the BASFI score and the life quality needed the QLQ questionnaire. The age of the disease has started was also considered. **Results** - The study included 24 patients, 22 men and two women (11/1 men/female ratio), ages between 35 and 55 years. The disease has begun 18 plus or minus 2 years before. After 24 months a significant improval was noticed concerning the restrictive ventilation dysfunction specific parameters and also an increase of oxygen pressure by 7 plus or minus 2 mmHg. **Conclusions** - The constant and correct application of respiration recovery and the spine mobility procedures lead to better life quality regarding the patients with AS and the main parameters that evaluate ventilation dysfunction.

KEYWORDS: *ankylosing spondylitis, respiratory function, physical therapy*

Introduction

Ankylosing spondylitis (AS) represents an increasingly frequent disease that can lead to significant damage to the respiratory system in advanced stages [1]. Thus, the effort capacity will diminish and the life comfort of the patients will be altered. Is a progressive systemic rheumatic disease, characterized by the inflammation of the sacroiliac joints, joints of the spine and occasionally large peripheral joints [1, 2].

It evolves in four stages – sacroiliac, lumbar, dorsal and cervical – while occurrence of complications and extra-articular impairment is fairly common in the advanced stages of the disease [1].

In stage III (dorsal or thoracic) patients have chest and thoracico-abdominal pain as well as a limitation of the thorax expansion due to costovertebral and sternocostal joint damage during the inflammatory process. This difficulty in breathing progressively accentuates due to the restrictive ventilatory dysfunction produced by chest stiffness [1-4]

Purpose of the study

The evaluation of the ventilation function improval in patients with ankylosing spondylitis following the medical recovery procedures.

Patients and methods

The study included 24 patients that were diagnosed with AS stages I and IV, with lumbosacral initial setting. The modified New York criteria (1984) were used for the inclusion.

Patients that had an evolution outburst of the disease were not included and neither did the ones with cardiac insufficiency phenomena, pectoral angina or coronary ischemia of any other kind, patients with fever and also the ones with chronic bronchopneumonia, tuberculosis, severe psychic diseases or lack of cooperation.

They were monitored for 24 months, according to the following parameters: ventilation functional tests, respiratory gas levels, thorax involvement in inspiration and expiration, the medical, physical and balneotherapy that they had followed. The age of the disease has started was also considered.

The activity of the disease was evaluated using the BASDAI score. The evaluation of the functional disability was based on the BASFI score and the life quality needed a dedicated 10-items/points questionnaire.

Gasometry and functional ventilation tests were applied to all patients at the beginning of the study and every 6 months. All patients had medical therapy with non-steroid anti-inflammatory drugs and physical therapy while being in the hospital and also at home with the

exercise program for maintaining the mobility of the spine and for respiratory recovery.

We interpreted the data by using descriptive statistics and the Mann Whitney and Wilcoxon non-parametric tests for analyzing differences between means. Continuous data was expressed as mean and standard deviation (SD) All calculations were performed in GraphPad Prism 6 Demo (GraphPad Software Inc., USA).

Results

The study included 24 patients, 22 men and two women (11/1 men/female ratio, Fig.1), aged between 35 and 55 years. The disease debuted at a mean of 18 years (SD=2 years) before inclusion. We found a significant difference between the time disease started and the age of patients at inclusion (Mann-Whitney test, $p < 0.0001$, tables 1, 2 and Fig. 2, 3)

After 24 months a significant improval was noticed concerning the restrictive ventilation dysfunction specific parameters and also an increase of oxygen pressure by a mean 7 mmHg (SD=2 mmHg). The Mann-Whitney test revealed a strong correlation between successful treatment and an increase oxygen pressure ($p < 0.0001$, tables 3, 4 and Fig. 4, 5).

We have found significant improvement of respiration motions after physical treatment; thorax involvement was greatly reduced in all

patients after 24 months of rehabilitation techniques.

We have found a notable improvement in BASDAI, BASFI and Quality of Life scores after 24 months of treatment (Wilcoxon test, $p < 0.0001$). The results are presented in tables 4–10. Mean scores were significantly different (Fig. 6–11).

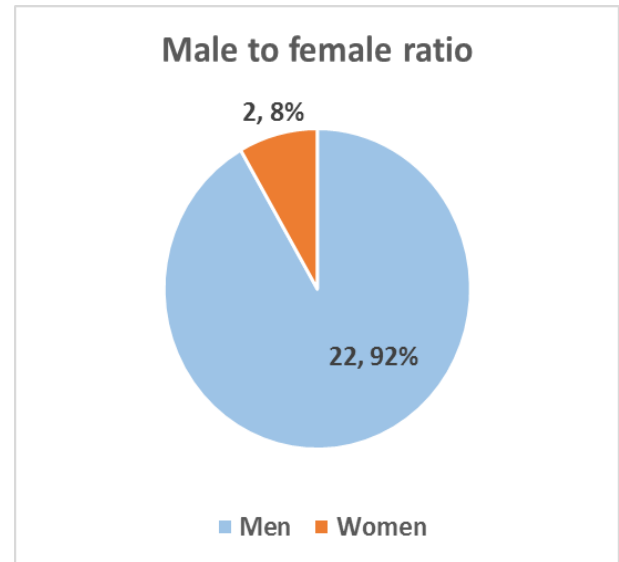


Fig.1. Male to female ratio in the studied lot.

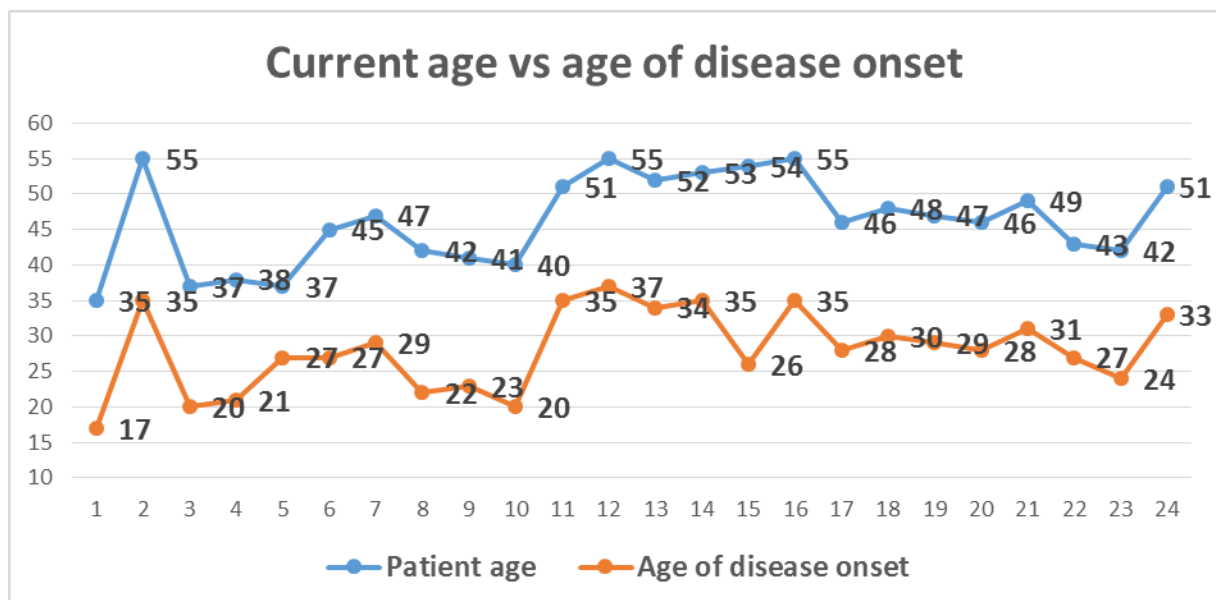


Fig.2. Comparison of patient age versus age of disease onset.

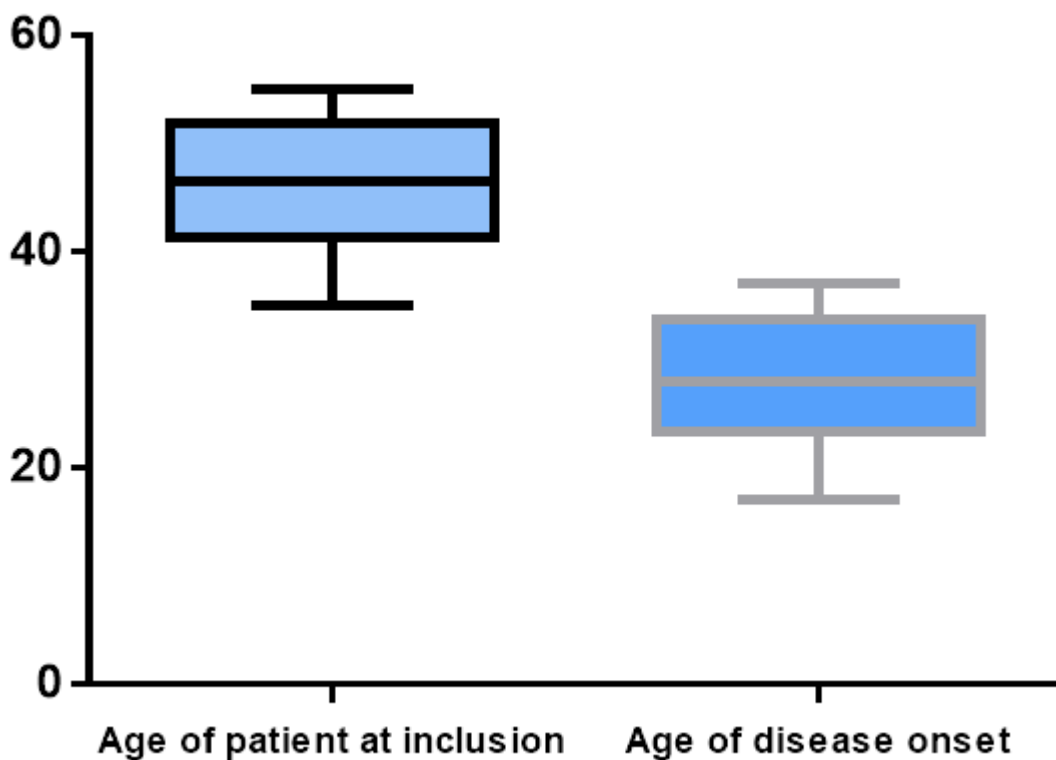


Fig.3. Mean age of inclusion versus mean age of disease onset.

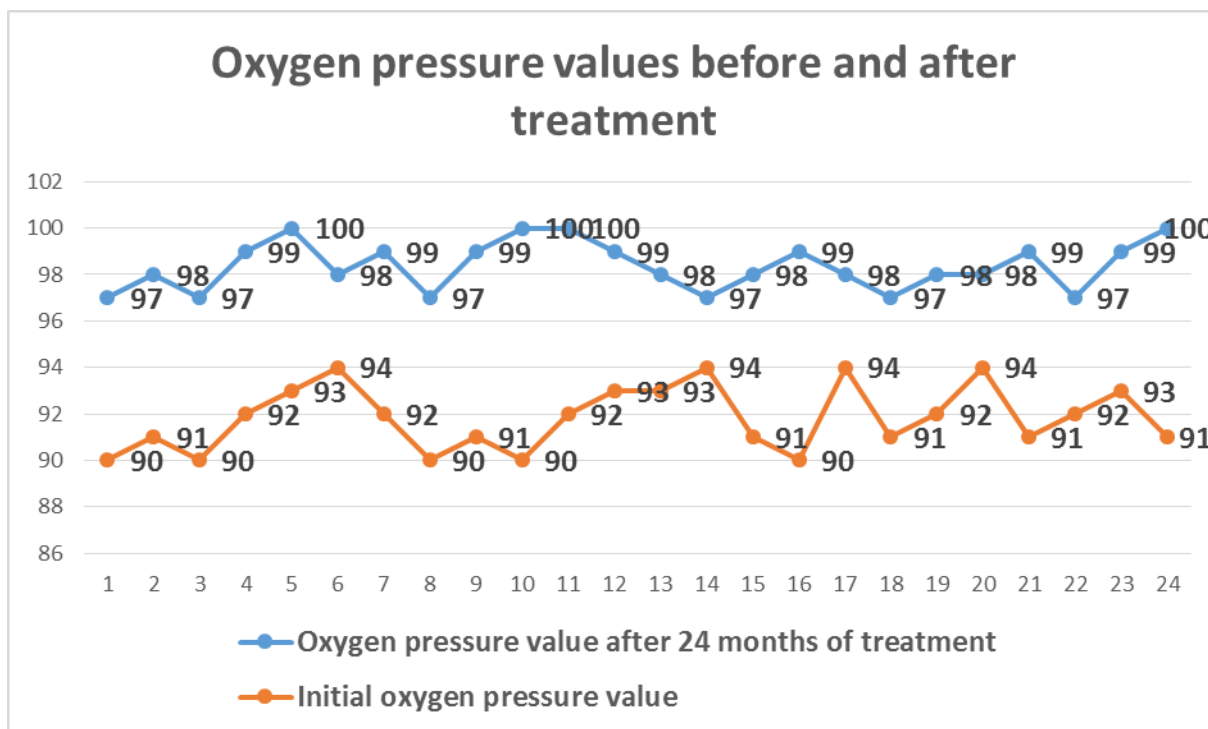


Fig.4. Variation of oxygen concentrations before and after physical treatment.

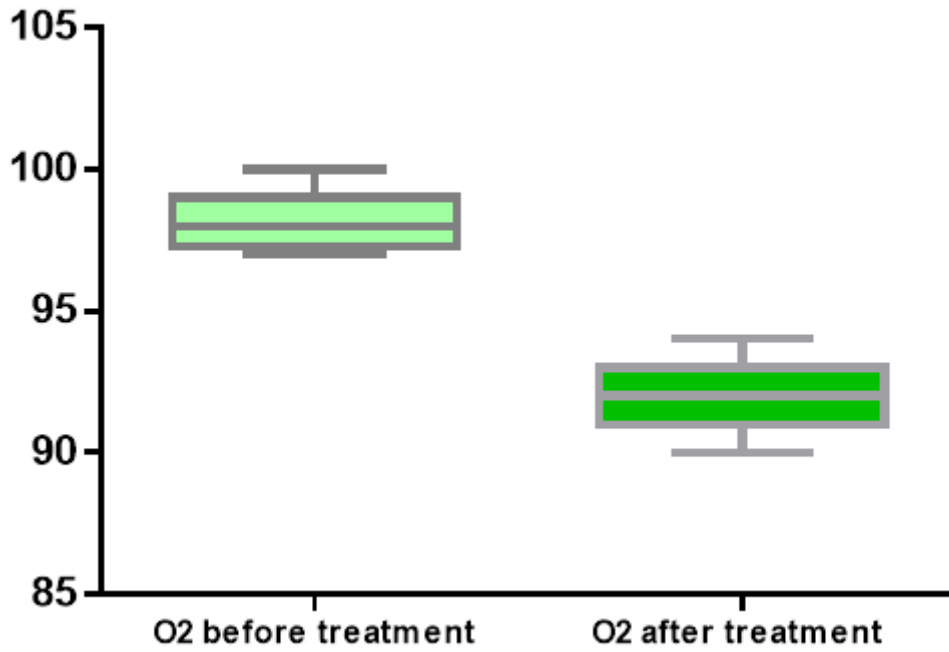


Fig.5. Mean oxygen concentrations before and after physical treatment.

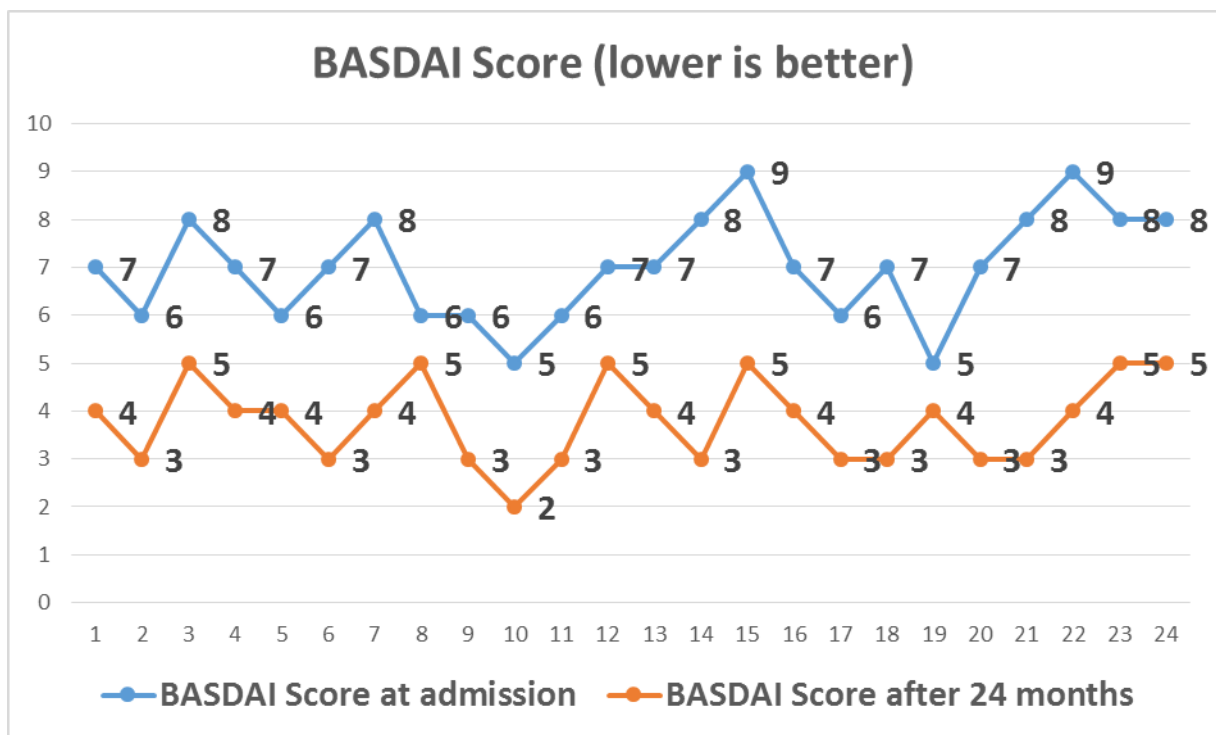


Fig.6. BASDAI score values before and after physical treatment (lower values are better).

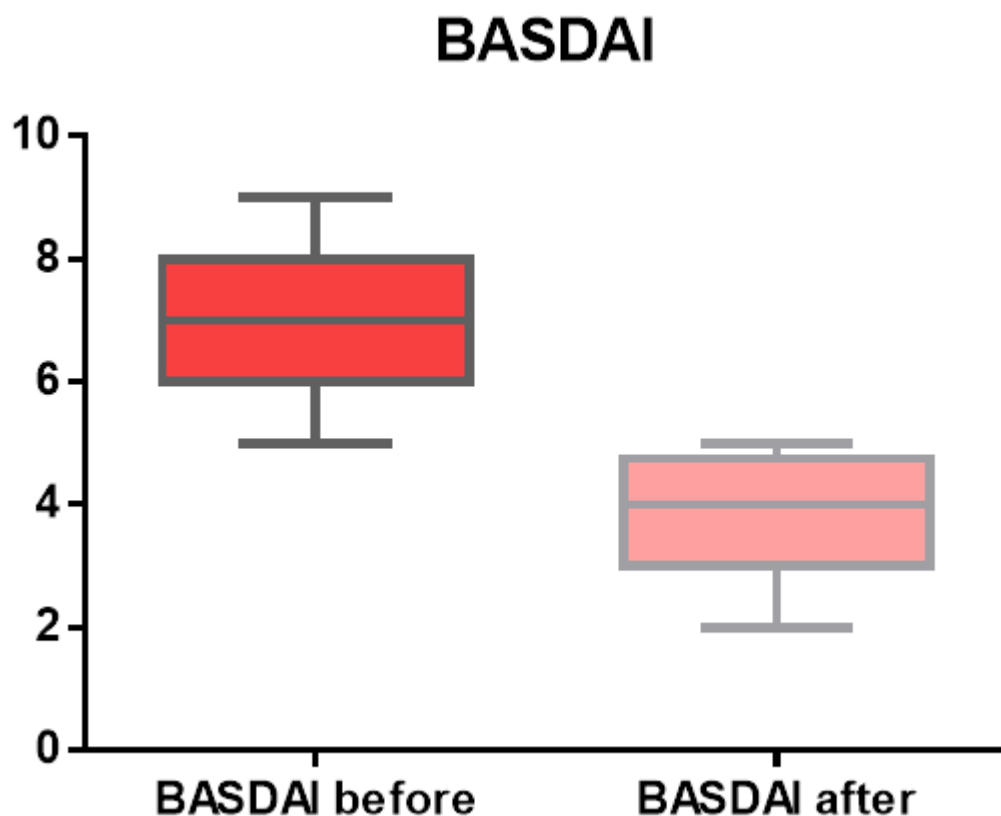


Fig.7. Mean BASDAI score values before and after physical treatment (lower values are better).

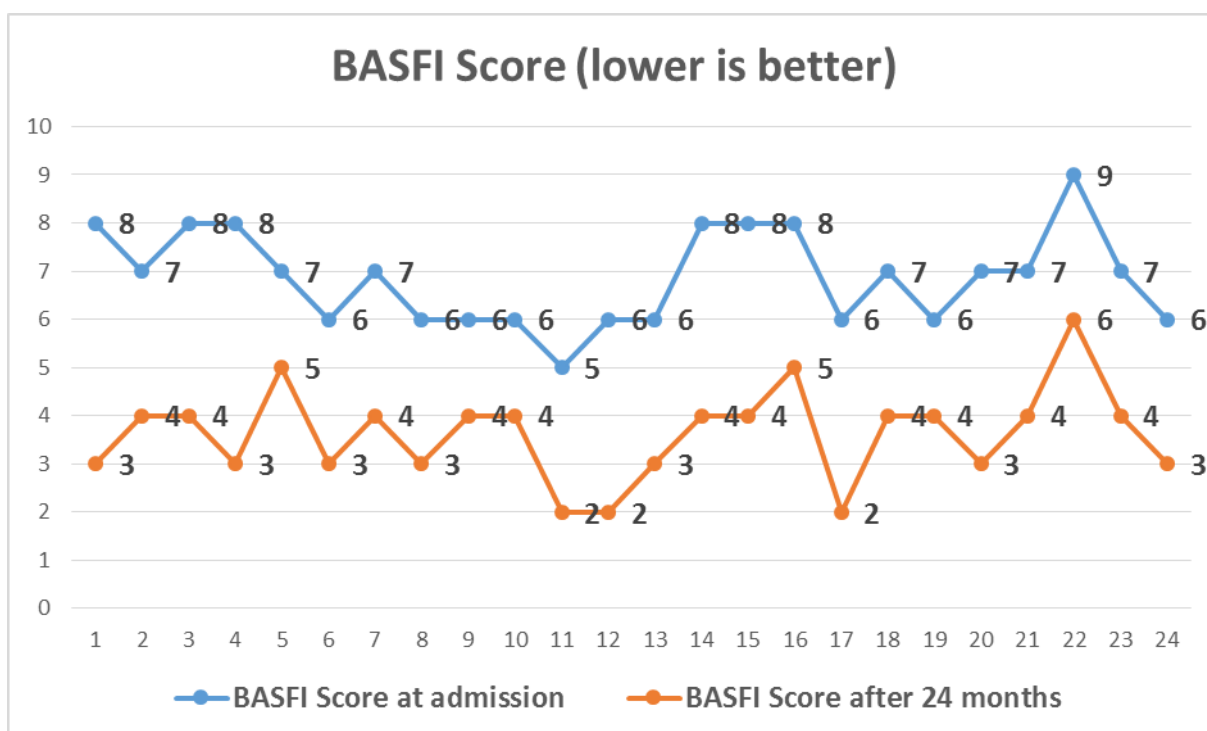


Fig.8. BASFI score values before and after physical treatment (lower values are better).

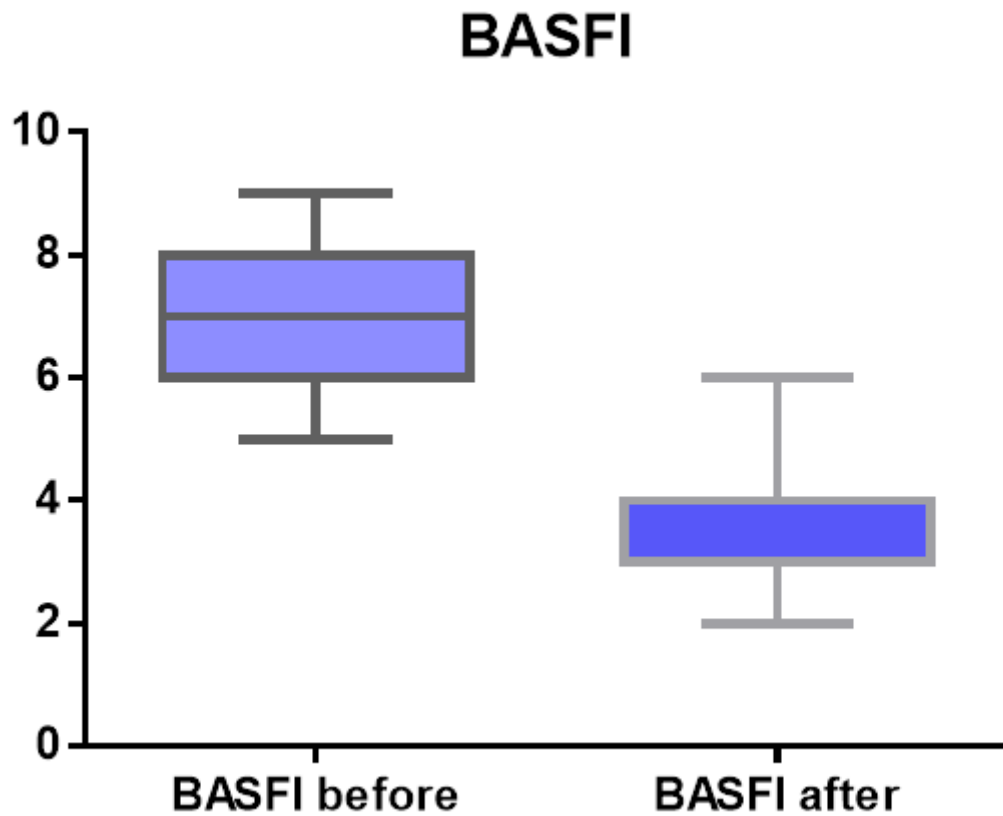


Fig.9. Mean BASFI score values before and after physical treatment (lower values are better).

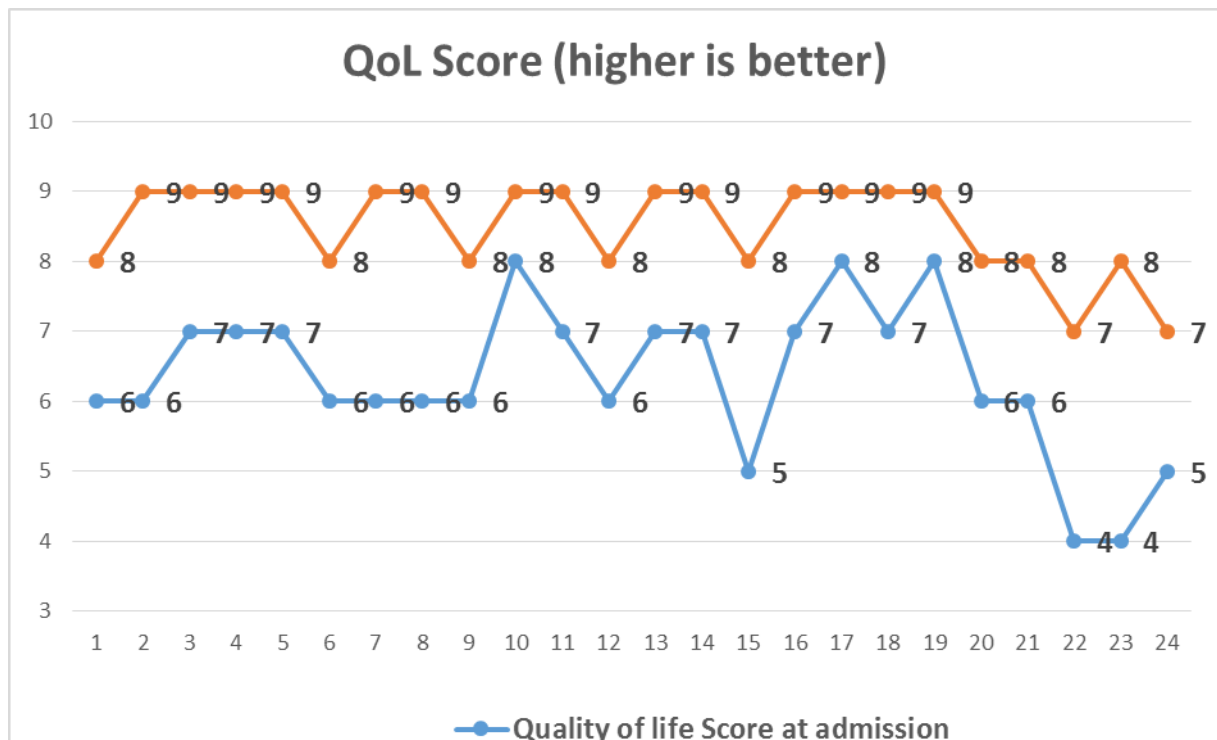


Fig.10. Quality of Life (QoL) score values before and after physical treatment (higher values are better).

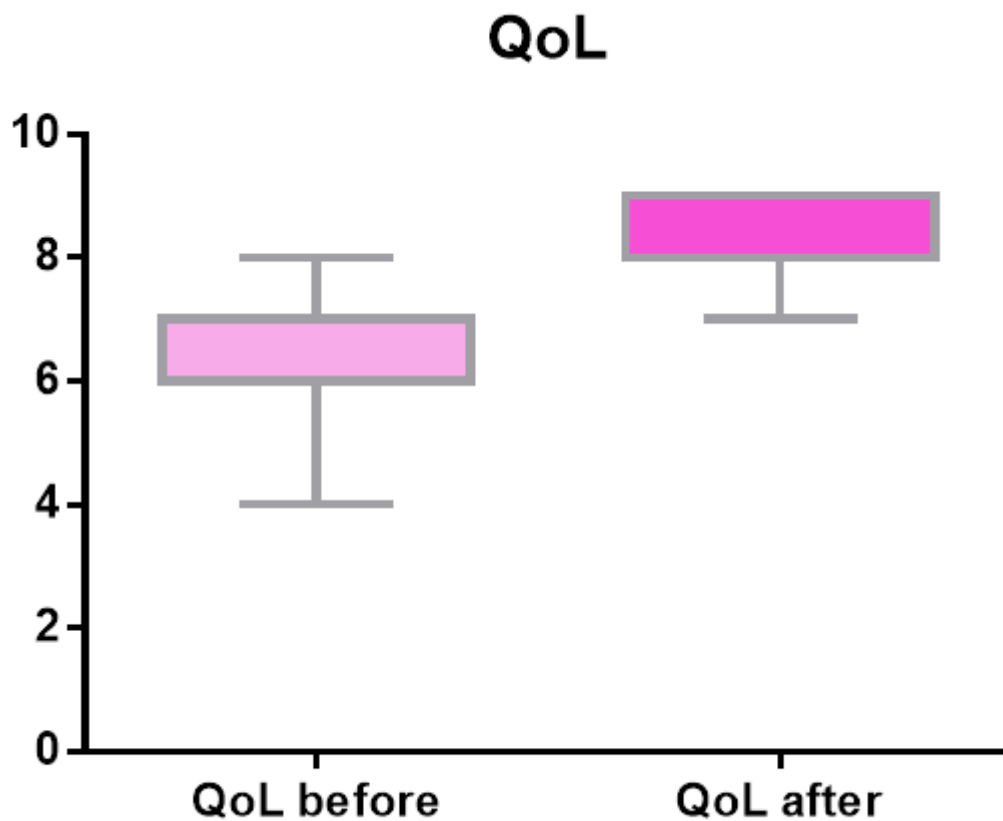


Fig.11. Mean Quality of Life (QoL) score values before and after physical treatment (higher values are better).

Table 1. Descriptive statistics presenting the data for age-related measurements within the patient lot.

	Age of patient at inclusion	Age of disease onset
Number of values	24	24
Minimum	35.00	17.00
25% Percentile	41.25	23.25
Median	46.50	28.00
75% Percentile	51.75	33.75
Maximum	55.00	37.00
Mean	46.21	28.04
Std. Deviation	6.276	5.653
Std. Error of Mean	1.281	1.154
Lower 95% CI	43.56	25.65
Upper 95% CI	48.86	30.43
Mean ranks	36.33	12.67

Table 2. Mann-Whitney test showed significant differences between mean age of onset and age of inclusion in the study.

Age of disease onset vs. Age of patient at inclusion	
Mann Whitney test	
P value	< 0.0001
Exact or approximate P value?	Exact

P value summary	****
Significantly different? (P < 0.05)	Yes
One- or two-tailed P value?	Two-tailed
Sum of ranks in column A,B	872.0 , 304.0
Mann-Whitney U	4.000
Difference between medians	
Median of column A	46.50
Median of column B	28.00
Difference: Actual	-18.50
Difference: Hodges-Lehmann	-18.00

Table 3. Descriptive statistics presenting the data for oxygen pressure, pre and post treatment, within the patient lot.

	O2 before treatment	O2 after treatment
Number of values	24	24
Minimum	97.00	90.00
25% Percentile	97.25	91.00
Median	98.00	92.00
75% Percentile	99.00	93.00
Maximum	100.0	94.00
Mean	98.38	91.83
Std. Deviation	1.056	1.404
Std. Error of Mean	0.2155	0.2866
Lower 95% CI	97.93	91.24
Upper 95% CI	98.82	92.43
Mean ranks	36.50	12.50

Table 4. The Mann-Whitney test showed significant differences between mean oxygen pressure values before and after physical rehabilitation.

O2 after treatment vs.O2 before treatment	
Mann Whitney test	
P value	< 0.0001
Exact or approximate P value?	Exact
P value summary	****
Significantly different? (P < 0.05)	Yes
One- or two-tailed P value?	Two-tailed
Sum of ranks in column A,B	876.0 , 300.0
Mann-Whitney U	0.0
Difference between medians	
Median of column A	98.00
Median of column B	92.00
Difference: Actual	-6.000
Difference: Hodges-Lehmann	-7.000

Table 5. Descriptive statistics presenting the data for BASDAI test scores, pre and post treatment, within the patient lot.

	BASDAI before	BASDAI after	Difference
Minimum	5.000	2.000	-5.000
25% Percentile	6.000	3.000	-4.000
Median	7.000	4.000	-3.000
75% Percentile	8.000	4.750	-3.000
Maximum	9.000	5.000	-1.000
Mean	7.000	3.792	-3.208

Std. Deviation	1.103	0.8836	1.062
Std. Error of Mean	0.2252	0.1804	0.2169
Lower 95% CI	6.534	3.419	-3.657
Upper 95% CI	7.466	4.165	-2.760

Table 6. The Wilcoxon test showed significant differences between mean BASDAI test scores before and after physical rehabilitation.

BASDAI after treatment vs. BASDAI before treatment	
P value	< 0.0001
Exact or approximate P value?	Exact
P value summary	****
Significantly different? (P < 0.05)	Yes
One- or two-tailed P value?	Two-tailed
Sum of positive, negative ranks	0.0 , -300.0
Sum of signed ranks (W)	-300.0
Median of differences	
Median	-3.000

Table 7. Descriptive statistics presenting the data for BASFI test scores, pre and post treatment

	BASFI before	BASFI after	Difference
Minimum	5.000	2.000	-5.000
25% Percentile	6.000	3.000	-4.000
Median	7.000	4.000	-3.000
75% Percentile	8.000	4.000	-3.000
Maximum	9.000	6.000	-2.000
Mean	6.875	3.625	-3.250
Std. Deviation	0.9918	0.9696	0.8470
Std. Error of Mean	0.2025	0.1979	0.1729
Lower 95% CI	6.456	3.216	-3.608
Upper 95% CI	7.294	4.034	-2.892

Table 8. The Wilcoxon test showed significant differences between mean BASFI test scores before and after physical rehabilitation.

BASFI after treatment vs. BASFI before treatment	
P value	< 0.0001
Exact or approximate P value?	Exact
P value summary	****
Significantly different? (P < 0.05)	Yes
One- or two-tailed P value?	Two-tailed
Sum of positive, negative ranks	0.0 , -300.0
Sum of signed ranks (W)	-300.0
Median of differences	
Median	-3.000

Table 9. Descriptive statistics presenting the data for QoL test scores, pre and post treatment

	QoL before	QoL after	Difference
Number of values	24	24	24
Minimum	4.000	7.000	1.000
25% Percentile	6.000	8.000	2.000
Median	6.000	9.000	2.000
75% Percentile	7.000	9.000	2.750

Maximum	8.000	9.000	4.000
Mean	6.333	8.500	2.167
Std. Deviation	1.090	0.6594	0.7020
Std. Error of Mean	0.2225	0.1346	0.1433
Lower 95% CI	5.873	8.222	1.870
Upper 95% CI	6.794	8.778	2.463

Table 10. The Wilcoxon test showed significant differences between mean QoL test scores before and after physical rehabilitation.

QoL after treatment vs. QoL before treatment	
P value	< 0.0001
Exact or approximate P value?	Exact
P value summary	****
Significantly different? (P < 0.05)	Yes
One- or two-tailed P value?	Two-tailed
Sum of positive, negative ranks	300.0 , 0.0
Sum of signed ranks (W)	300.0
Median of differences	
Median	2.000

Discussion

Recovery procedures for chest mobility are essential in improving prognosis and comfort of life of patients with AS [5-9].

Passive and active-passive mobilization of the head and shoulders, the arms and hands, are executed after a well-established program and are repeated 2-3 times a day. Upper limbs should stay in semi-abduction. Massage of the neck, shoulders and chest is also advised.

Considering that almost all patients with stages III and IV AS have abdominal breathing (due to costovertebral and sterno-costal joint damage during the inflammatory process) it is absolutely necessary to retrain the diaphragm and abdominal wall muscles in the respiratory process [5, 6].

Respiratory gymnastics must selectively act on each respiratory phase, following four objectives [1, 3, 8-10]:

- Increasing the mobilized air volumes for the entire lung
- Coordination of the respiratory rate
- Toning respiratory muscles
- Decrease ventilatory labor

The most disturbing symptom for a respiratory patient is the lower effort capacity expressed by dyspnea of different degrees. Administering O₂ to correct hypoxemia is very important for increasing ventilation efficiency and the available energy of the inspiratory muscles [1, 2, 6].

Increasing the efficiency of the respiratory muscles can be achieved by improving muscle

metabolic capacity to faster extract energy sources from the blood and use them as well as possible. Like with any muscle, this metabolic capacity increases as the muscle is trained by physical effort [2, 5-7].

Muscle training should be performed in general physical rest to reduce peripheral metabolic needs and to obtain a preferential distribution infusion to peripheral musculature.

In the methodology for functional recovery of respiratory deficiencies, physiotherapy represents one of the main procedures. It is applied during hospital admissions; however, it is imperative that patients continue their daily exercises at home, to maintain mobility of the ribcage and consequently of the respiratory muscles [2, 10].

The main issue that we focused on in our patients were:

- Relaxation techniques
- Posture (items facilitating breathing and bronchial drainage)
- Corrective gymnastics
- Respiratory Reeducation
- Dosed effort training.

We found several parameters that improved after correct physical rehabilitation techniques. This is in accord with recent studies [3], as well as classical literature [5-7]. Patients with rheumatic disease experience rapid and important improvement of the quality of life, thus extending life expectancy and reduce co-morbidity.

This is a preliminary study on a limited number of patients, this being the main

drawback of this research; future studies in the form of large scale multi-center trials, preferably with randomized candidates, should be performed to determine the exact extent to which physical rehabilitation can aid AS patients, with high implications for therapy and management.

Conclusions

The constant and correct application of the respiration recovery and the spine mobility procedures lead to better life quality regarding the patients with AS and the main parameters that evaluate ventilation dysfunction: oxygen pressure and residual volume, vital capacity, maximal expiratory volume, inspiratory reserve volume, expiratory reserve volume, total pulmonary capacity.

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