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The impact of corrective surgery for thoracolumbar kyphotic deformity on health-related quality of life in patients with ankylosing spondylitis

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Abstract

Ankylosing spondylitis is a chronic inflammatory disease. It might affect the facet, sacroiliac joint, and vertebra regions. It leads to thoracolumbar kyphotic deformity in the spine region. Both ankylosing spondylitis and kyphotic deformity impair the patients' quality of life. Our objective was to assess the impact of the correction of kyphotic deformity in ankylosing spondylitis on health-related quality of life. 11 thoracolumbar kyphosis patients diagnosed with ankylosing spondylitis were operated and their deformity was corrected. Medical Outcome Study Short Form-36 (SF-36), visual analog scale (VAS), and Oswestry disability index (ODI) studies were performed on patients before surgery and 1 month after surgery to assess their impact on health-related quality of life. In our study, postoperative changes in the sub-parameters of the SF-36 test, which was used to assess the health-related quality of life of patients, were determined to be statistically significant compared to post-surgery. Likewise, postoperative changes in VAS and ODI tests compared to pre-surgery were also statistically significant. Corrective surgery of thoracolumbar kyphosis in patients with ankylosing spondylitis has a positive impact on both better health-related quality of life and recovery of back and low back pain.

Keywords: ankylosing spondylitis, thoracolumbar kyphosis, visual analog scale, oswestry disability index, health-related quality of life

1. Introduction

Ankylosing spondylitis (AS) is a chronic inflammatory disease. It primarily affects sacroiliac and facet joints as well as intervertebral disc structures. It causes thoracolumbar kyphotic deformity. This deformity causes cosmetic and functional impairments in patients and commonly ends up with a decrease in quality of life (1). The techniques of Multiple Smith-Petersen osteotomy (SPO), pedicle subtraction osteotomy (PSO), poly-segmental wedge osteotomy (PWO), and vertebral column resection (VCR) osteotomy are used in surgeries to correct thoracolumbar kyphotic deformity (2, 3).

AS has various effects on patients' health-related quality of life (HRQoL), including both physical and psychological domains (4). One of the most popular tools to study these effects is the 36-item Medical Outcome Study Short Form-36 (SF-36) test. SF-36 defines to what extent a health-related problem impacts an individual's functional ability, mental state, and perceived well-being in social and physical aspects (5). Moreover, patients with AS have common back pain. Visual analog scale (VAS) and Oswestry Disability Index (ODI) are frequently used methods in assessing these effects (6, 7).

The impact of AS disease on health-related quality of life has been revealed in the literature (8, 9). Furthermore, it is prevalently used by researchers for rheumatological and musculoskeletal disorders (10).

Our objective in the study was to assess the clinical well-being after corrective surgery of kyphotic deformity that occurs in AS disease, which is not adequate in the literature, using the VAS and ODI scales, and the impact on health-related quality of life using the 36-item Study Short Form-36 test.

2. Materials and Methods

Our study was performed in accordance with the Declaration of Helsinki. Written informed consent was obtained from all patients before the tests. Ethics approval was obtained from Memorial Hospital ethics committee (Memorial Hospital ethics committee's decision dated 26.04.2021 and numbered 16). Between January 2017 and February 2021, 11 patients who met AS New York criteria and were operated with the diagnosis of thoracolumbar kyphosis were included in the study (11).

2.1. Inclusion criteria

1) Patients with a T1--12 angle of ≥60 °

2) Patients with a Global kyphosis (GK) angle of ≥70 ° (GK: Cobb angle between T1 and L5)

3) Patients with a coronal curve of <20 °

4) To not have a history of spine surgery

2.2. Exclusion criteria

Patients with severe systematic disease PSO was applied to 9 of 11 patients and multi-level SPO was applied to 2 of them. VAS, ODI, and SF-36 assessment studies were performed

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before the surgery and 1 month after surgery. SF-36 assessment scale consists of 8 sub-parameters. The assessment is performed with the sub-parameters including; physical function (10 items), social function (2 items), role physical (4 items), role emotional (3 items), mental health (5 items), vitality (4 items), bodily pain (2 items) and general health (5 items) (5). The sub-parameters are presented in Table I. In the ODI scale, the responses to the queries of pain severity, degree of pain change during personal care, lifting load, walking, standing, sitting, sleeping, social life, and travels are assessed. A score between 0 and 5 is given for each answered query. Queries, which have not been answered by the patient, are not taken into consideration. Assessment is calculated via the formula of the patient score= (the score obtained by the patient/the maximum possible score) X 100, considering the answered queries (12). VAS is used for digitizing some values that cannot be measured numerically. Two end definitions of the parameter to be assessed are written on both ends of a 100 mm line, and the assessment is made by asking the patient to indicate where his condition suits on this line by drawing a line or by placing a point or pointing (13).

Table I. Demographic characteristics of the patients

Number of patients	n: 11
Male	72% (n:8)
Female	28% (n:3)
Age	54.3 ±10.3

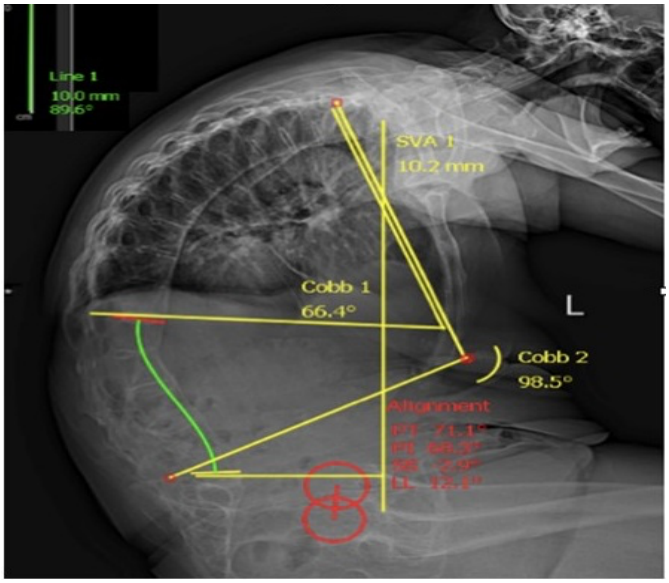

Fig. 1. Preoperative measurements of the patient with ankylosing spondylitis via the Surgimap. SVA: Sagittal Vertical Axis, PT: Pelvic Tilt, SS: Sacral Slopej Pl: Pelvic Insidence LL: Lumbar Lordosis

2.3. Surgery prodecure

Scheduling of the surgeries was made based on the scoliosis graphics taken from the patients before surgery. Measurements were made using the software of Surgimap (Neramis, Inc). The scoliosis radiograph of a measured patient is presented in Fig. 1. Under general anesthesia, the patient was placed on the operating table in a V-shaped prone position. Motor evoked potentials (MEP) and somatosensory evoked potentials (SSEP) of all patients were examined during surgery. The surgical area was determined via C-arm fluoroscopy. The subcutaneous was opened with a posterior midline approach. The fascia was opened bilaterally and the paravertebral muscles were dissected according to the procedure. Pedicle screws were placed. Osteotomy was applied to the vertebra or vertebrae according to the osteotomy technique, which was calculated on the Surgimap at the onset of the procedure. Correction maneuvers were performed with the help of the spinal surgery table under fluoroscopy and neuromonitoring. The layers were closed according to the procedure after the fusion process was performed and hemostasis was achieved, and then the procedure was completed. After surgery, follow-up scoliosis radiographs were taken on the second day, and the degree of correction of kyphotic deformity was measured (Fig. 2).

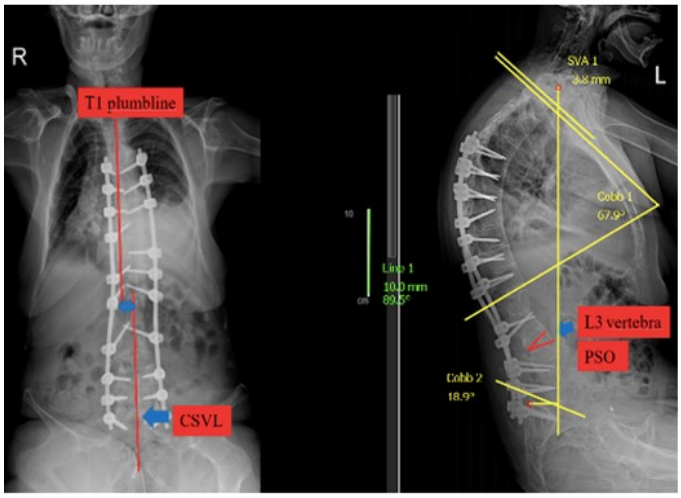

Fig. 2. Corrective surgery with L3 vertebra pedicle subtraction osteotomy. PSO: Pedicle Substraction Osteotomy, CSLV: Central Sacral Vertical Line

2.4. Statistical method

Statistical analysis was performed using Statistical Package for the Social Sciences programme (Version 22; SPSS, Chicago, IL). The Kolmogorov-Smirnov test was used to determine the normality of qualitative the data. Skewed data were analyzed with nonparametric tests. Baseline characteristics were given as mean (standard deviation). Wilcoxon test applied for dependent quantitative data (pre-post). Statistical significance was taken as $p<0.05$.

3. Results

11 patients who had been diagnosed with AS and underwent deformity surgery for thoracolumbar kyphosis were included in our study. Of the 11 patients, 72% (n=8) were male and 28% were female (n=3). The mean age was 54.3 ± 10.3 years. The demographic characteristics of the patients are presented in Table I. In our study, we assessed 8 sub-parameters of the SF-36 test during the preop period and at the 1th month during the postop period to examine health-related quality of life. In preoperative physical function assessment, the scoring was as

follows; minimum:5.0, maximum:30.0, mean:14.032±6.8823, while the postop scoring was as follows; minimum: 80.0, maximum: 100.0, mean: 91.452±6.4799. Regarding the statistical analysis of the physical function changes, the result has a p-value of<0.05 and the difference was significant. In the role physical assessment, preop scoring was as follows; minimum:0.0, maximum:50.0, mean 15.323±19.0147, while postop scoring was as follows; minimum:25.0, maximum:100.0, mean:75.806±22.8070. Regarding the statistical analysis of the role of physical changes, the difference was significant with p<0.05. In the role emotional assessment, preop scoring was as follows; minimum: 0.0, maximum: 66.6, mean: 9.668±17.6072, and postop scoring was as follows; minimum: 33.3, maximum: 100.0, mean: 88.155±20.2954. The difference was significant in the statistical analysis of the role physical changes with p<0.05. In the assessment of vitality, preop scoring was as follows; minimum: 0.0 maximum: 50.0 mean: 16.290±13.4144, and postop scoring was minimum: 50.0, maximum: 80.0, mean: 66.290±8.3634. The difference was significant in the statistical analysis of the vitality changes with p<0.05.

Regarding the assessment of mental health, preop scoring was as follows; minimum: 12.0, maximum: 72.0, mean: 45.290±18.1369, and postop scoring was minimum: 36.0, maximum: 80.0, mean: 65.290±11.5649. The difference was significant in the statistical analysis of the mental health changes with p<0.05. In the assessment of social function, preop scoring was as follows; minimum: 0.0, maximum: 50.0, mean: 14.516±16.1686, and postop scoring was minimum: 7.0, maximum: 100.0, mean: 75.629±19.9629. The difference was determined to be significant in the statistical analysis of the social function changes with p<0.05. In the assessment of bodily pain, preop scoring was as follows; minimum: 0.0, maximum: 67.5, mean: 13.500±15.1231, and postop scoring was minimum: 65.0, maximum: 100.0, mean: 89.032±9.8463. The difference was found to be significant in the statistical analysis of the bodily pain changes with p<0.05. In the general health assessment, preop scoring was as follows; minimum: 10.0, maximum: 50.0, mean: 33.387 ± 11.7748, and postop scoring was minimum: 50.0, maximum: 85.0, mean: 70.806±10.7313. The difference was significant in the statistical analysis of the general health changes with p<0.05. Statistical data are summarized in Table II and Table III. Moreover, we used VAS and ODI tests in our study to assess the pain. Preop VAS scoring was minimum: 5.0, maximum: 10.0, mean: 7.839±1.3928, and postop scoring was minimum: 1.0, maximum: 4.0, mean: 2.065±1.0935. The difference was significant in the statistical analysis of the changes in the VAS values with a p<0.05. Preop ODI scoring was minimum: 53.3, maximum: 90.0, mean: 77.765±11.5304, and postop scoring was minimum: 0.0, maximum: 8.5, mean: 5.042±2.0334. In the statistical evaluation of the changes in ODI data, the difference was significant with a p-value of<0.05. Statistical data are summarized in Table 4 and Table 5.

Table 2. The values of SF-36 sub-parameters of the patients

	Minimum	Maximum	Mean	Std.	Minimum
Physical function (preop)	5.0	30.0	14.032	6.8823	47.366
Role physical (preop)	.0	50.0	15.323	19.0147	361.559
Role emotional (preop)	.0	66.6	9.668	17.6072	310.012
Vitality (preop)	.0	50.0	16.290	13.4144	179.946
Mental health (preop)	12.0	72.0	45.290	18.1369	328.946
Social function (preop)	.0	50.0	14.516	16.1686	261.425
Bodily pain (preop)	.0	67.5	13.500	15.1231	228.707
General health (preop)	10.0	50.0	33.387	11.7748	138.645
Physical function (postop)	80.0	100.0	91.452	6.4799	41.989
Role physical (postop)	25.0	100.0	75.806	22.8070	520.161
Role emotional (postop)	33,3	100,0	88,155	20.2954	411.905
Vitality (postop)	50.0	80.0	66.290	8.3634	69.946
Mental health (postop)	36.0	80.0	65.290	11.5649	133.746
Social function (postop)	7.0	100.0	75.629	19.9629	398.516
Bodily pain (postop	65.0	100.0	89.032	9.8463	96.949
General health (postop)	50.0	85.0	70.806	10.7313	115.161

Table 3. Statistical analysis results of SF-36 parameters

	Z	Asymp. Sig. (2-tailed)
Physical Functions (postop)	-4.877[b]	0
Physical Functions (preop)	-4.828[b]	0
Role physical (postop)	-4.947[b]	0
Role physical (preop)	-4.871[b]	0
Role emotional (postop)	-4.869[b]	0
Role emotional (preop)	-4.858[b]	0
Vitality (postop)	-4.777[b]	0
Vitality (preop)	-4.868[b]	0

a. Wilcoxon Signed Ranks Test, b. Based on negative ranks.

Table 4. Results of patients' VAS and ODI values

	Minimum	Maximum	Mean	Std. Deviation	Variance
VAS (preop)	5.0	10.0	7.839	1.3928	1.940
VAS (postop)	1.0	4.0	2.065	1.0935	1.196
ODI (preop)	53.3	90.0	77.765	11.5304	132.951
ODI (postop)	.0	8.5	5.042	2.0334	4.135

VAS: Visual Analog Scale ODI:, Oswestry Disability Index

Table 5. VAS and ODI statistical values of the patients

Test Statistics		
	VAS (preop) VAS (postop)	ODI (preop) ODI (postop)
Z	-4.905b	-4.860b
Asymp. Sig.	.000	.000

4. Discussion

Ankylosing spondylitis is a chronic progressive inflammatory disease associated with HLA-B27, included in the group, namely spondyloarthritis (14). Back pain and hip pain due to involvement of the spine and sacroiliac joints are common in AS. It leads to fusion particularly in the anterior part of the vertebra and causes limitation of movement and related thoracolumbar kyphosis (15, 16).

Planning of kyphosis correction surgery and the osteotomy technique to be chosen in AS disease is effective on the amount of correction. SPO, PWO, PSO, and VCR are among the osteotomy techniques that are used in corrective surgery for deformity of AS patients (17, 18, 19). Deformity is progressive in AS disease. Thoracolumbar kyphosis in patients leads to sagittal imbalance. Due to this, the patient experiences restriction of forward gaze. It leads to impaired walking and problems in activities such as climbing up and down stairs as well as climbing ramps. Patients might experience frequent falls. Hence, it causes physical dysfunction and physical problems (20, 21). Likewise, the results of our study were in line with the literature. Before surgery, patients had functional restrictions due to their deformity. Following the deformity correction surgery, the restriction of forward gaze recovered in patients thanks to the correction of sagittal imbalance. Daily walks, climbing up and downstairs, climbing ramps, and routine activations of the patients improved. The restriction due to physical function and physical problems, which are among the SF-36 sub-parameters, differed significantly compared to preop.

Deterioration in bone structure, vertebral collapse fractures, inflammatory events in the joints, and flexion contracture deformities of the spine cause back and hip pain (22). Deformity in AS patients induces internal organ compression and rib pain due to advanced kyphosis (23). In our study, we used the VAS and ODI scale to assess pain. An improvement was detected in postop pain compared to preop. The changes in these values were statistically significant. Furthermore, the change in the pain sub-parameter of the SF-36 scale was statistically significant. The results related to pain experienced prior to correction surgery were similar to the findings in the literature (24).

Redesigning the sagittal balance in the spine, eliminating the need for compensatory mechanisms following correction surgery, and eliminating the compressive pain in the ribs or organs due to deformity by correction help to achieve these outcomes. Due to physical dysfunction and pain, the daily activities of AS patients fall behind compared to the normal population. This situation deteriorates social interactions. In our study, the change in the social function sub-parameter of the SF-36 scale displayed a statistically significant change after surgery compared to the preop period. In the postop period, a significant improvement was achieved in family relationships, time spent with the society, increase in job competencies, self-sufficiency and emotional well-being, and social function changes. Statistically, these sub-parameters changed significantly. There is considerably limited information in the literature about the basic mechanism of fatigue, which is clinically common in AS patients. However, it has been revealed in the previous studies that there are strong correlations between the patient's individual daily activity, physical capacity, back pain, spine flexibility, and quality of life (25). In our study, postop fatigue improved significantly compared to the preop period. The change after surgery was statistically significant. We consider that this result is due to the improvement of the physical functions of the patient, the ability to perform daily activities, no need for compensation mechanisms due to deformity correction, and the absence of pain. The changes in the general health perception in the SF-36 scale sub-parameter were statistically significant after surgery compared to the preop period. It is due to changes in physical and social functions, as well as a reduction in pain and fatigue. Our study has some limitations. Coronal imbalance in AS patients was not assessed in the study. The small number of patients and short follow-up periods are other limitations of our study.

AS is important for spine surgeons because of its progressive deformity, albeit it is a chronic inflammatory disease. The anormal balance in spinopelvic parameters impacts the quality of life directly. As back pain, progressive restriction of spine movements, and severe thoracolumbar kyphosis impair the quality of life in patients, well-planned surgery will be helpful in improving the quality of life by solving these problems.

Conflict of interest statement

The authors have no conflict of interest declaration.

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