Original article

Factors related to quality of life of patients with adult spinal deformity and chronic low back pain

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Abstract

There is no consensus on the association among spinal alignment with back pain, physical function, and quality of life (QOL) of patients with adult spinal deformity (ASD). Moreover, research on elderly patients with ASD is limited. Therefore, this study aimed to clarify the factors associated with QOL of patients with ASD and chronic low back pain. Physical functions associated with QOL, which reflects physical activity, were examined. A total of 43 patients with chronic back pain (age 70.0 ± 4.7 years) persisting for over 3 months and ASD according to the Scoliosis Research Society–Schwab classification were included. Radiographic spinopelvic parameters, Japanese Orthopaedic Association Back Pain Evaluation Questionnaire score, visual analogue scale score, mobility of lumbar extension (LL-Ext) and flexion (LL-Flex), six-minute walk test (6MWT) score, and Timed Up and Go test (TUG) scores were used. Gait QOL was significantly correlated with 6MWT score (r = 0.38), LL-Flex (r = 0.42), LL-Ext (r = 0.58), and pelvic tilt (r = 0.31). Social QOL was significantly correlated with 6MWT score (r = 0.43), LL-Ext (r = 0.47), and pelvic incidence–lumbar lordosis (r = 0.31). Multiple regression analysis identified 6MWT score (β = 0.563, $p < 0.001$) as a significant factor for Gait QOL and VAS score as a significant factor for Social QOL (β = 0.504, $p < 0.001$). As a conclusion, QOL (Pain QOL, Lumbar QOL, Gait QOL, and Social QOL) of the patient with spinal deformity and chronic low back pain was related to each other, and especially, it was indicated that Gait QOL and Social QOL had the very strong relevance from the relationship between walking function and VAS score.

Introduction

Aging causes kyphoscoliosis [1], and such deformations in adulthood are described as adult spinal deformities (ASD) [2]. The primary symptoms of ASD include back pain due to deformities and mental instability due to external problems [3]. In epidemiological studies involving large cohorts, ASD was identified in approximately 70% of the elderly [4]. Exercise therapy is considered the first choice as a general treatment for ASD;

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however, in cases with severe deformation, spinal fusion is often performed without exercise therapy to correct the deformation [5,6]. For this surgery, the trunk bending forward motion, extension motion, and rotation motion are restricted to repair a wide range of intervertebral fixations involving the spinal deformation region; however, postoperative QOL often declines in such cases [7]. These facts underscore the importance of slowing the progress of deformation with exercise therapy before it becomes severe.

Although various factors associated with ASD affect QOL, sagittal plane posture shows the most influential evidence [8,9]. Kyphotic changes lead to thoracic kyphosis, lumbar lordosis, and pelvic posterior tilt [10], and the greater the degree of these changes, the lower the QOL [8]. Therefore, the goal of surgical treatment for ASD in patients with severe kyphotic deformities is an ideal sagittal orientation [9].

However, certain factors such as the necessity of improvement of physical function in physical function have not been clarified in studies evaluating the QOL of patients with ASD conducted to date. Often, patients with ASD are young, and they present with only moderate spinal deformities. In studies with high evidence reported to date, patients presented with moderate kyphotic deformities and were < 65 years of age. Moreover, research on elderly patients with severe deformities is limited, and the association between physical function and QOL remains to be clarified. Chronic back pain is a symptom observed in several patients with patients, and exercise therapy is the first choice for treatment in these patients [11] as it is expected to reduce back pain and improve posture and QOL by improving physical function [12]. However, the association between physical function and QOL remains unclear, and the relevant evidence is limited. Improvements in and optimizations of exercise therapy are feasible if the factors associated with QOL are identified.

Therefore, the present study aimed to clarify the factors associated with the QOL of patients with ASD and chronic low back pain and explore the physical functions associated with QOL, which reflect physical activity.

Materials and Methods

A total of 51 patients (age 69.0 ± 6.3 years) who visited the Orthopedic Department of Hospital B located in A Prefecture between April 2015 and May 2019 were enrolled in this study. According to the exclusion criteria, 43 subjects (age 70.0 ± 4.7 years) were included in the analysis (Figure 1). The basic information of the subjects is summarized in Table 1. The exclusion criteria were age of < 65 years, mild deformities without any Scoliosis Research Society (SRS)-Schwab class [13], malignant neoplasms, psychiatric disorders, and serious medical disorders. The SRS–Schwab classification assesses spinal deformities from the frontal and sagittal planes. Frontal plane deformations are classified according to the Cobb angle and the sagittal plane ones according to the overall anteversion angle of the sagittal vertex axis (SVA) and the pelvis form [13]. Radiographic spinopelvic parameters, Japanese Orthopaedic Association Back Pain Evaluation (JOABPEQ) score, visual analogue scale (VAS) score, mobility of lumbar extension (LL-Ext) and flexion (LL-Flex), six-minute walk test (6MWT) score, and Timed Up and Go test (TUG) results were evaluated. The radiographic spinopelvic parameters were measured by an orthopedic surgeon who was proficient in measuring the following items: Cobb angle, SVA, pelvic incidence–lumbar lordosis (PI-LL), pelvic tilt (PT), LL-Flex, and LL-Ext. JOABPEQ classifies QOL into five domains: pain-related disorders (Pain QOL), lumbar dysfunction (Lumbar QOL), gait disturbance (Gait QOL), social life dysfunction (Social QOL), and psychological disorders (Psychological QOL). JOABPEQ scores range from 0 to 100, with a higher score indicating a better health status [14]. The reliability and validity of JOABPEQ have been verified by psychometric

evaluations, and JOABPEQ scores are strongly correlated with the 36-Item Short Form Survey (SF-36) and Oswestry Disability Index, which have a high reliability worldwide [15-17]. 6MWT includes a series of examinations that assess walking ability on the basis of the distance a subject can walk within 6 minutes; its reproducibility and reliability have been verified for various diseases [18]. TUG includes a series of examinations that synthetically evaluate the operational ability of standing up, walking, and turning; it is one of the indispensable evaluations mainly used in the research on falling [18].

Normality of all data was tested by the Shapiro-Wilk test. The associations between the domains of JOABPEQ was obtained by Spearman's correlation analysis. Two separate multiple regression (stepwise method) analysis were performed with the identified domains as dependent variables and the remaining variables except JOABPEQ domains as independent variables. All statistical analyses were performed using R-2.8.1, and a p value of < 0.05 was considered statistically significant.

This study was approved by the Ethics Committee of Hospital B (Approval No: 2015-06) and performed in accordance with the Helsinki Declaration. Written informed consent was obtained from all the subjects before collecting the data.

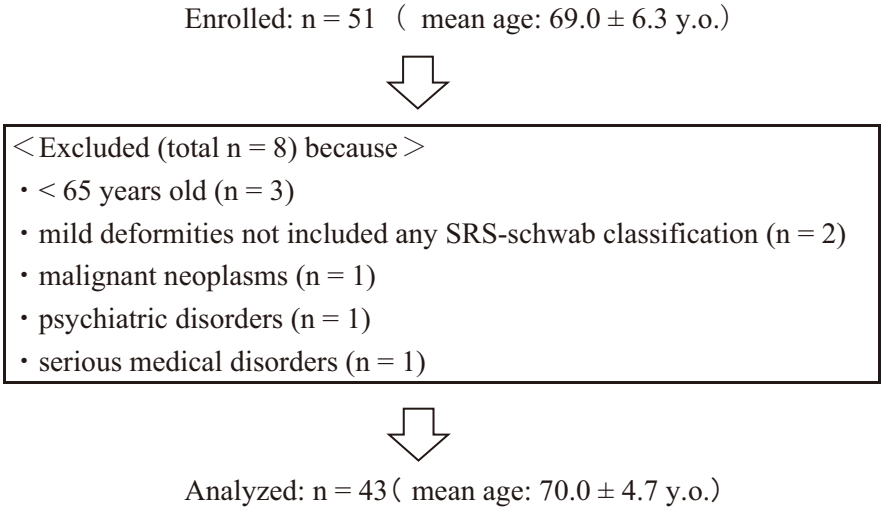

Figure 1. Analysis and selection of subjects.

Table 1. Basic information of subjects (n = 43).

Item	Subjects Mean ± SD	Remarks
Age (year)	70.0 ± 4.4	-
Height (cm)	150 ± 0.1	-
Weight (kg)	55.2 ± 9.5	-
BMI (kg/m^2)	23.4 ± 3.7	-
Gender (M / F)	(10 / 33)	-
VAS (mm)	54.0 ± 4.6	-
＜X ray spino-pelvic parameters＞		
Cobb angle (°)	22.0 ± 19.0	> 30
SVA (cm)	19.8 ± 7.9	+: 4 to 9.5, ++: >9.5*
PI-LL (°)	46.2 ± 9.6	+: 10-20, ++: >20*
PT (°)	33.5 ± 12.6	+: 20-30, ++: >30*
＜Body function＞		
LL-Flex (°)	2.9 ± 17.6	-
LL-Ext (°)	25.3 ± 18.9	-
6MWT (m)	357.6 ± 150	-
TUG (sec)	7.2 ± 2.6	-
＜JOABPQ＞		
Pain QOL	49.4 ± 33.6	-
Lumbar QOL	66.4 ± 26.9	-
Gait QOL	41.2 ± 28.1	-
Social QOL	46.6 ± 18.3	-
Psychological QOL	42.8 ± 19.4	-

Body Mass Index (BMI).
Gender:Male (M), Female (F).
Visual analogue scale (VAS).
Sagittal vertebral axis (SVA), Pelvic incidence (PI), Pelvic tilt (PT).
Lumbar Flexion (LL-Flex), Lumbar Extention (LL-Ext).
*SRS- schwab classfication; Moderate (+), Severe (++).
Six-minute walk test (6MWT).
Timed up and go test (TUG).
Japanese orthopaedic association back pain evaluation questionare (JOABPEQ). Pain related disorders QOL (Pain QOL),Lumbar dysfunction QOL (Lumbar QOL), Gait disturbance QOL(Gait QOL), Social life dysfunction QOL (Social QOL), Psychological disorders QOL (Psychological QOL).

Results

Pain QOL was significantly correlated with VAS score ($r = -0.52$, $p < 0.01$) and 6MWT score ($r = 0.34$, $p < 0.05$). Lumbar QOL was correlated with VAS score ($r = -0.35$, $p < 0.01$). Gait QOL was significantly correlated with 6MWT score ($r = -0.38$, $p < 0.01$), LL-Flex ($r = 0.42$, $p < 0.05$), LL-Ext ($r = 0.58$, $p < 0.05$), and pelvic tilt ($r = 0.31$, $p < 0.05$). Social QOL was significantly correlated with VAS score ($r = -0.31$, $p < 0.05$), 6MWT score ($r = 0.43$, $p < 0.05$), LL-Ext ($r = 0.47$, $p < 0.05$), and PI-LL ($r = 0.31$, $p < 0.05$). Psychological QOL was correlated with VAS score ($r = 0.48$, $p < 0.05$) and Cobb angle ($r = 0.41$, $p < 0.05$) (Table 2).

Each domain of JOABPEQ achieved significant correlations, and the correlation coefficient ($r = 0.81$) of Gait QOL and Social QOL was the highest. Multiple regression analysis was performed with Gait QOL and Social QOL as dependent variables and factors with significant correlations in univariate analysis as independent variables. Multiple regression analysis identified 6MWT score ($\beta = 0.563$, $p < 0.001$) as a significant factor for Gait QOL and VAS score as a significant factor for Social QOL ($\beta = 0.504$, $p < 0.001$) (Table 3). Factors with correlation coefficients of ≥ 0.7 were excluded in consideration of multicollinearity.

Table 2. Factors associated with quality of life (n = 43).

	Pain QOL	Lumbar QOL	Gait QOL	Social QOL	Psychological QOL
Pain QOL	-	0.64**	0.62**	0.74**	0.35*
Lumbar QOL	0.64**	-	0.64**	0.56**	0.51
Gait QOL	0.62**	0.64**	-	0.81**	0.41*
Social QOL	0.74*	0.56**	0.81**	-	0.51**
Psychological QOL	0.35*	0.51	0.41*	-0.51**	-
VAS	-0.52**	-0.35**	-0.28	-0.31*	-0.48*
TUG	-0.05	-0.07	-0.07	0.01	-0.09
6MWT	0.34*	0.18	0.38**	0.43*	0.37
LL-Flex	-0.36	-0.32	-0.42*	-0.46	-0.22
LL-Ext	0.41	0.40	0.58*	-0.47*	0.28
Cobb-angle	-0.14	0.16	0.18	-0.06	-0.41*
SVA	-0.51	-0.31	-0.34	-0.34	-0.28
PI-LL	-0.21	0.06	-0.08	-0.31*	-0.51
PT	-0.13	-0.08	-0.31*	-0.33	-0.37

*: $p < 0.05$, **: $p < 0.01$

Spearman's correlation analysis.

The above values indicate the correlation coefficient.

Japanese orthopaedic association back pain evaluation questionare (JOABPEQ). Pain related disorders QOL (Pain QOL),Lumbar dysfunction QOL (Lumbar QOL), Gait disturbance QOL(Gait QOL), Social life dysfunction QOL (Social QOL), Psychological disorders QOL (Psychological QOL).

Visual analogue scale (VAS).

Timed up and go test (TUG).

Six-minute walk test (6MWT).

Lumbar Flexion (LL-Flex), Lumbar Extention (LL-Ext).

Sagittal vertebral axis (SVA), Pelvic incidence - Lumbar lordosis (PI-LL),Pelvic tilt (PT).

Table 3. Factors affecting Gait QOL and Social QOL (n = 43).

Dependent variable	Predictor variable	Standard β	β	F value	p value
Gait QOL	6MWT	-0.103	-0.563	15.35	0.001
Social QOL	VAS	-3.649	-0.504	11.24	0.002

Stepwise multiple regression analysis.
Standard partial regression coefficient (β).
Multiple correlation coefficient (squared): 0.317.
Six-minute walk test (6MWT).
Visual analogue scale (VAS).

Discussion

This study was conducted to determine the factors associated with the QOL of patients with ASD and chronic low back pain. The results revealed that 6MWT score was correlated with the Gait QOL, and VAS score was correlated with Social QOL.

Therefore, the QOL of patients with ASD and chronic back pain was associated with different QOL domains, and Gait QOL and Social QOL were particularly strongly correlated with each other. In addition, five JOABPEQ domains were associated with one another. A moderate correlation has been previously reported among Lumbar QOL, Social QOL, and Gait QOL [19]. Social QOL and Gait QOL may be reflected as functional disorders rather than pain intensity [19]. Although all the five domains were independently evaluated, some questions were reflected in multiple domains. Gait QOL comprises five questions and Social QOL comprises four. Among these questions, "Do you have difficulty in walking more than 15 minutes?" is included in both Gait QOL and Social QOL. The results of the present study indicate that 6MWT, which reflected data related to this question, was associated with both Gait QOL and Social QOL. Thus, consistent with previous studies, the present study also suggests that 6MWT score as a walking function indirectly or directly affects Gait QOL and Social QOL.

The factors that directly affected Gait QOL and Social QOL were analyzed by multiple regression analysis. 6MWT score affected Gait QOL, and VAS score affected Social QOL. Some questions in Gait QOL such as "Do you have difficulty in walking more than 15 minutes?" and "Because of lower back pain, you walk only short distances" are related to "walking distance." 6MWT evaluates the distance walked in 6 minutes, which explains the result that 6MWT score, which reflects the long-distance walking ability, affected Gait QOL. Conversely, questions on Social QOL such as "How much work was interrupted by the pain?" and "I do not do any work at home that I usually do because of low back pain" are mainly related to activity. Nonetheless, this domain can also reflect pain.

These results suggest that a physical therapy intervention focusing on improvements in walking function and pain relief will be effective to improve the QOL of patients with ASD and chronic low back pain. The five domains of JOABPEQ were correlated with one another, and Gait QOL and Social QOL were particularly strongly correlated. 6MWT and VAS scores were extracted as factors influencing Gait QOL and Social QOL. In the meantime, it is reported that the lumbar extension range of motion is related to the QOL in the past report [20]. Regarding the lumbar extension range of motion, excursion is narrowed by aging, thereby affecting balancing and rising abilities [21,22]. A systematic review examining the effects of exercise therapy reported pain relief and improvement in physical function by muscle strengthening, stretching, and aerobics [23]. Our previous reports also suggested that physical ther-

apy for 3 months could improve pain relief, walking ability, and QOL [24]. Based on previous reports and the results of this study, physical therapy for pain, gait function, and lumbar range of motion may be effective for improving QOL. However, in our report and previous studies, pain relief was only approximately 50%. In the future, it will be necessary to characterize patients who are expected to benefit from physical therapy.

There were several limitations in this study, pain intensity and deformation degree were analyzed without classification, which is one of the limitations of this study. Also, because lower extremity function was not evaluated in this study, it is difficult to consider 6MWT and TUG. Therefore, future studies should aim at analyzing data by severity. In addition, because the duration of illness and dosing status were not investigated, more diversified investigations should be conducted to include these factors.

As a conclusion, QOL (Pain QOL, Lumbar QOL, Gait QOL, and Social QOL) of the patient with spinal deformity and chronic low back pain was related to each other, and especially, it was indicated that Gait QOL and Social QOL had the very strong relevance from the relationship between walking function and VAS score.

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Conflicts of Interest

There are no conflicts of interest to declare.

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