

Comparative multifactorial analysis of the effects of idiopathic adolescent scoliosis and Scheuermann kyphosis on the self-perceived health status of adolescents treated with brace

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Abstract Bracing is the most effective non-operative treatment for mild progressive spinal deformities in adolescence but it has shown a considerable impact on several aspects of adolescents' functioning. This cross-sectional study investigated the self-perceived health status of adolescents with the two most common deformities, treated with body orthosis. Seventy-nine adolescents with spinal deformities (idiopathic adolescent scoliosis, thoracic Scheuermann kyphosis) and 62 adolescents without spinal deformities were asked to complete the Quality of Life profile for Spine Deformities Instrument. This study showed that adolescents with deformities are significantly less likely to have back pain in training than controls, but more likely to have difficulty in forward bending, and in the most common daily activities while in brace. These individuals claim they wake up because of back pain and feel quite nervous with the external appearance of their body. These patients face often problems with their relations with friends, while they reported difficulties in getting up from bed and sleep at night more often than their counterparts without deformities. As they grow older, patients feel increasing ashamed of their body, as they are more concerned about the future effect of the deformity on their body. As the bracing time in-

creases, patients have much more probability than controls to get low back pain. Girls with deformity have a higher probability than boys to get low back pain while working in the house and while training. Individuals with larger spinal curvatures have more difficulties in bending and increased incidence of back pain than their counterparts with smaller curvatures. Psychological reasons associated mainly with relations at school and back pain are the main causes for low compliance in adolescents with spinal deformities treated with body orthosis. Careful instructions for all individuals who will undergo brace therapy, psychological support for all patients who develop psychological reactions and physical training particularly for older girls should be recommended to increase bracing compliance.

Keywords Bracing · Idiopathic scoliosis · Scheuermann · Quality of life

Introduction

Bracing has been established as the most effective non-operative treatment for adolescences with mild idiopathic scoliosis and Scheuermann kyphosis [21, 29].

The effect of bracing in altering the natural history of progressive adolescent idiopathic scoliosis seems nowadays to be almost generally accepted [12, 25]. However, bracing has a quantifiable impact on several aspects on adolescent and family functioning [13, 30]. The stressor effects of bracing, applied for multiple reasons, in relation to different psychological reactions (panic, negative mood, depression, anger, or feelings of responsibility for illness during the initial adjustment

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period, emotional disturbances of body image, self-esteem and sexual attitudes) have been reported [1, 7, 12, 18, 19, 32, 34, 40]. Factors contributing negatively to copying with orthoses include length of time that the brace must be worn, failure of the brace [34], or previous poor adjustment behaviour [14, 37]. Accordingly, there is evidence that brace treatment has implications in some self-perceived health status areas involved in the concept of quality of life [34]. It seems therefore reasonable to assume that deleterious effects on the quality of life may vary in relation to the type of brace selected for treatment.

The purpose of this investigation was to compare the self-perceived health status of adolescents with the most common spinal deformities treated with orthoses versus individuals without deformity using the Quality of Life Profile for Spine Deformities (QLPSD)

Materials and methods

Three comparable groups (A–C) of adolescents of the same ethnicity, race and geographic region (Mediterranean) were selected for the purpose of this study. Group A, consisted of 41 patients (35 females and six males), aged (average \pm SD) 13 + 1.5 years (range 11–15 years), with adolescent mild idiopathic scoliosis (scoliotics), group B consisted of 38 patients (nine females, 29 males) with an average age of 13 + 2 years (range 11–16 years) with Scheuermann kyphosis (kyphotics) and group C of 62 individuals (38 girls, 24 boys) aged 12 + 2 years (range 10–16 years) without spinal deformities that was used as control group. The patients with spinal deformities were randomly selected in different periods of bracing time to make comparisons including the variable time. The 52 controls were selected after the selection of the patients so as to be age- and gender-matched. The indications for bracing in scoliotics were: progressive adolescent idiopathic scoliosis (documented radiologic progression $>5^\circ$), Cobb angle more than 20° , thoracic scoliosis apex at T₇-vertebra or lower and skeletal immaturity at the beginning of bracing (Risser sign 0–2). Respectively for the Scheuermann kyphosis the indications for bracing were: typical radiological signs for Scheuermann disease on the involved thoracic endplates, Cobb angle at least 50° with documented radiologically progression of $>5^\circ$ and skeletal immaturity (Risser sign 0–2). The thoracic kyphosis angle at initiation of bracing was $58^\circ \pm 6^\circ$ (range 50° – 70°). The scoliotics (Table 1) were treated with the Cheneau brace whereas kyphotics were treated with a custom-made hyperextension orthosis. All individuals were advised to wear the brace

as tolerated for the first 4 weeks until they reach the desired full-time regimen of 23 h a day. After this period all individuals in both groups were advised to wear their brace 23 h/daily, under the supervision of their parents. However, the compliance of each particular adolescent with deformity was different and was recorded on the basis of the parents' report. Compliance was calculated as the reported time in brace divided by the 23 h of recommended wearing time. Compliance was further divided to high ($>90\%$), intermediate (50–90%) and poor ($<50\%$). Compliance was calculated in individuals of both groups and both genders.

The variables (Table 1) that were studied in the scoliotics were: gender, age, total bracing time until the study, daily bracing time, maximal axial trunk rotation (ATR) as measured with the Scoliometer, curve levels, number of included levels in the curve as well as the Cobb angle with and without Brace.

All individuals of all three groups were asked to complete the QLPSD questionnaire [4], which had been translated and validated into their native (Greek) language.

The cross-cultural adaptation process was carried out as outlined by Beaton and Bombardier [2]. Following that, the validated and adapted to Greek language QLPSD questionnaire was then given during an interview to the selected 52 controls, 41 scoliotics and 38 kyphotics. The patients filled the questionnaire in a period between 8 and 16 months after starting bracing. During the interview the independent observer (orthopaedic surgeon) talked to each particular individual, described the purpose of the study, asked the parents for their participation in this study and tested for consequent or not consequent wearing of the brace

Table 1 Cumulative data for 42 patients with scoliosis

Parameter	Average	SD	Range
Bracing time since starting of bracing (months)	11	3	8–16
Daily bracing (h)	13	6	6–23
ATR ^a (scoliometer) thoracic	8	4	3–15
ATR (scoliometer) lumbar	8	4	3–17
ATR (scoliometer) thoracolumbar	6	0.5	6–7
Number of Included vertebra in scoliotic curves	8	3	4–12
Thoracic scoliosis ^b without Brace	34	12	21–73
Lumbar scoliosis ^b without Brace	28	9	20–47
Thoracic scoliosis ^b with Brace	23	13	0–55
Lumbar scoliosis ^b with Brace	18	10	5–36

^a Axial trunk rotation

^b Degrees Cobb

by the patients. The compliance and the reasons for not consequently bracing were recorded for each particular individual with deformity.

Statistical analysis

The statistical method used in the present study was the ordinal logistic regression, so as to take into account the ordinal nature of the data (variables: QLPSD, with ordered categories) and examine the effect of spinal deformities on the outcomes. Finally, the authors proceeded with a multivariate ordinal logistic regression with outcomes the domains of the validated and nationally adapted QLPSD questionnaire and some other variables such as gender, age (years), duration of bracing (months), average time of daily bracing (hours), Cobb angle of scoliosis (scoliotics) and kyphosis (kyphotics), location and pattern of scoliosis and maximal ATR, as measured with the Scoliometer [26]. All these variables, which refer to the diseased groups (scoliosis, kyphosis) along with the stepwise regression led to the final multivariate model. The value of Odd’s ratio (OR) was used for comparison. The *P*-value used to define the statistically significant was *P* < 0.05.

Results

Although all patients with deformities (groups A and B) were advised to wear their braces for 23 h a day, their parents reported that their children wore the braces for an average 13 h, range 6–23 h daily. The mean objective compliance (Table 2) was 57% (range 26–100%); high compliance was observed in 42% of girls versus 52% of boys with deformities. Highly compliant patients wore the brace as recommended, being with only short periods out at home for personal hygiene reasons. Intermediate compliance resulted from reduced brace wear during school hours. Poorly

compliant patient at loosely scattered intervals with night time preferred.

The vast majority of individuals with poor and intermediate compliance wore their braces during sleeping in the night but not in the school and when they go out with friends. These individuals reported that the main cause for low compliance was psychosocial reactions associated with their relations at home and at school with schoolmates and teachers. Back pain was the second reported reason for low compliance.

Patients in the age between 11 and 13 years showed better compliance than patients from the age of 14 years and older.

Multivariate analysis

Individuals with deformities

1. *Flexibility (in brace) (Question No. 1, Appendix):* Both Scoliotics (OR = 4.997, *P* = 0.002) and kyphotics (OR = 4.923, *P* = 0.005) are five times more likely than controls to have problems in forward bending.
2. *Flexibility (in brace) (Question No. 2, Appendix):* Both Scoliotics and kyphotics are seven times (OR = 6.773, *P* < 0.001) and 4.5 times (OR = 4.432, *P* = 0.010) more likely than controls to have difficulty in dressing up respectively.
3. *Flexibility (in brace) (Question No. 3, Appendix):* Both Scoliotics and kyphotics are 5.5 times (OR = 5.49, *P* = 0.001) and 4.5 times (OR = 4.58, *P* = 0.01) more likely than controls to have difficulties in picking up something from the floor respectively.

Individuals with scoliosis

1. *Psychosocial functions (Question No. 3, Appendix):* For every additional month of bracing, the individual with longer bracing time is on average 8.8% less likely to loose friends than another with shorter bracing time (OR = 0.911, *P* = 0.019).
2. *Psychosocial functions (Question No. 7, Appendix):* For every additional month of bracing, the individual with longer bracing time is on average 5.7% less likely to spend less time with his/her friends than another with shorter duration of therapy (OR = 0.942, *P* = 0.028).
3. *Sleep problems (Question No. 1, Appendix):* For each additional hour in daily bracing, a subject is

Table 2 Compliance in patients with spinal deformities treated with brace

Deformity	Compliance (N)					
	Girls			Boys		
	High	Intermediate	Low	High	Intermediate	Low
Scoliosis	16	13	7	3	0	2
Kyphosis	6	8	2	11	7	4
Total	22	21	9	14	7	6

on average 13% less likely 0.869 ($P = 0.014$) to have problems while getting up from bed than another with bracing of shorter time.

4. *Sleep problems (Question No. 2, Appendix)*: For each additional hour in daily bracing, a subject is on average 11.2% less likely (OR = 0.887, $P = 0.027$) than another with shorter therapy to have problems in night sleep.
5. *Sleep problems (Question No. 3, Appendix)*: For each additional hour of daily bracing a scoliotic is on average 16.4% less likely (OR = 0.835, $P = 0.002$) to have problems with sleeplessness than another with shorter time of bracing.
6. *Back problems (Question No. 1, Appendix)*: For every additional hour in daily bracing, a scoliotic is on average 23% less likely (OR = 0.770, $P = 0.001$) to wake up due to back pain than another with shorter bracing.
7. *Body opinion (Question No. 1, Appendix)*: For every additional month in total bracing time, a scoliotic is on average 12.2% more likely (OR = 1.122, $P = 0.029$) to feel nervous when he/her wears swimsuit than another with shorter therapy.
8. *Body opinion (Question No. 2, Appendix)*: For every additional year in chronological patient's age, a scoliotic is on average 45.2% more likely (OR = 1.452, $P = 0.023$) to feel ashamed of his/her body than a younger individual.
9. *Body opinion (Question No. 4, Appendix)*: For each additional year in chronological patient's age, a scoliotic is on average 29.2% more likely (OR = 1.292, $P = 0.020$) to worry about the future effect of scoliosis on his/her body.

Adjusted to the remaining covariates

(1) *Flexibility (in brace) (Question No. 1, Appendix)*: When the scoliosis curve increases by one degree (Cobb), a scoliotic is on average 15.2% (OR = 1.152, $P = 0.012$) more likely, to have problems with forward leaning compared to another one with smaller curvature.

(1) *Flexibility (in brace) (Question No. 1, Appendix)*: For each additional hour in daily bracing, a scoliotic is at an average of 16.9% (OR = 0.830, $P = 0.002$) less likely to have problems with forward bending than another with less time (on a daily basis).

10. *Respond evaluation (Question No. 1, Appendix)*: For each additional year of chronological age, an older scoliotic is on average 20.1% less likely (OR = 0.799, $P = 0.045$) to feel better during their last visit to the physician than a younger one.

Kyphosis group

1. *Psychosocial functions (Question No. 4, Appendix)*: For every additional month in bracing, a kyphotic is on average 8.6% less likely (OR = 0.913, $P = 0.027$) to be easily irritated than another with less bracing time.

2. *Sleep problems (Question No. 2, Appendix)*: For each additional degree in thoracic kyphosis angle, a kyphotic is on average 8.6% less likely (OR = 0.914, $P = 0.028$) not to sleep well at night than another with less magnitude.

3. *Sleep problems (Question No. 2, Appendix)*: Female kyphotics are on average more than nine times (OR = 9.327, $P = 0.028$) more likely to have problems with sleeplessness than boys.

Adjusted for the remaining covariates

(a) Girls are on average 11 times (OR = 10.891, $P = 0.021$) more likely to have back pain while working in the house compared to boys.

(b) Girls are on average 13.5 times (OR = 13.639, $P = 0.031$) more likely to have back pain while training than boys.

Table 3 Validation of Quality of Life Profile for Spine Deformities Instrument

QLPSD domain	Questions no.	First evaluation ^a		Second evaluation ^b	
		Pearson R1	P value	Pearson R2	P value
Psychosocial function	1	0.52	0.001	0.52	0.001
	2	0.13	NS	0.376	<0.05
	3	0.3	NS	0.412	<0.01
	4	0.48	<0.01	0.48	<0.01
	5	0.23	NS	0.378	<0.02
Sleep problems	6	0.42	<0.01	0.42	<0.01
	7	0.57	<0.001	0.57	<0.001
	1	0.7	<0.001	0.7	<0.001
Back problems	2	0.34	<0.05	0.34	<0.05
	3	0.26	NS	0.387	<0.02
	1	0.57	<0.001	0.57	<0.001
Body opinion	2	0.4	0.01	0.4	0.01
	3	0.47	<0.01	0.47	<0.01
	4	0.70	<0.001	0.7	<0.001
	1	0.02	NS	0.324	<0.05
Flexibility	2	0.49	<0.01	0.49	<0.01
	3	0.63	<0.001	0.63	<0.001
	4	0.35	<0.05	0.35	<0.05
	1	0.17	NS	0.35	<0.05
Respond evaluation	2	0.79	<0.001	0.79	<0.001
	3	0.07	NS	0.33	<0.05
	1	0.24	NS	0.37	<0.02
	2	0.03	NS	0.39	<0.02

^a Comparison between first and second response

^b Comparison between second and third response

Adjusted for kyphosis angle

- (1) Girls are on average 24 times (OR = 24, $P = 0.033$) more likely to feel ashamed of their body than boys.
- (2) Girls are on average 16 times (OR = 15.926, $P = 0.014$) more likely to think that their body is in-attractive than boys.

Adjusted for bracing time

- (1) *Flexibility (Question No. 3, Appendix)* For every additional year of chronological age, a kyphotic is on average 37.1% less likely (OR = 0.628, $P = 0.045$) to have difficulty in picking up something from the floor than a younger one.

Adjusted for chronological age, boys are on average 12 times (OR = 12.478, $P = 0.027$) more likely to feel much better during their last visit to the physician than girls.

Discussion

Brace therapy has often been used for the treatment of the most common spinal deformities in

Table 4 Univariate analysis: Comparison between deformity and Controls

Domains ^a	Question ^a no.	Scoliosis (P value)	Kyphosis (P value)	Level of significance (P value)
Psychosocial	1	0.748	0.782	0.1781
	2	0.475	0.612	0.5142
	3	0.317	0.779	0.5743
	4	0.834	0.609	0.1760
	5	0.574	0.812	0.7328
	6			
	7	0.583	0.810	0.4269
Sleep	1	0.312	0.117	0.1922
	2	0.961	0.779	0.2197
	3	0.744	0.294	0.3031
Back problems	1	0.256	0.796	0.5374
	2	0.374	0.298	0.3471
	3	0.435	0.142	0.7629
	3	0.060	0.069	0.3624
Body opinion	1	0.352	0.634	0.1337
	2	0.242	0.326	0.0092*
	2	0.669	0.562	0.0249*
	2	0.410	0.749	0.2240
Flexibility	1	0.002*	0.005*	0.0110*
	2	< 0.001*	0.010*	0.0876
	3	0.001*	0.010*	0.5526
Respond	1	0.048*	0.048*	0.4278
	2	0.021*	0.238	0.5722

* Statistical significant results ($\alpha = 5\%$)

^a Appendix A, B and Table 2

adolescence. To understand spinal bracing efficacy and clinical effectiveness in the conservative treatment of spinal deformities, it is essential to measure and record such confounding variables including compliance.

At puberty, physical appearance, the need to affiliate with peers and the need to assert one's independence are very important. While mild spinal deformities itself may not interfere with these needs, treatment either conservative with orthoses or surgical often does.

The majority of adolescents, who wear brace for scoliosis are girls. For the girls, particularly in the adolescence, their external appearance due to the deformity, is of major importance and significantly affect on their social relations. Brace therapy may cause to the patient great emotional distress and different psychological reactions. This type of emotional distress seem to be very important since it probably shapes the social interaction of the patient.

Compliance with bracing by some adolescents with scoliosis is an ongoing problem with the orthotic management of scoliosis. Historically, compliance was measured using patient interviews, pad/strap forces, or temperature [15, 35, 38]. These measurements are subjective, limited to laboratory or short-term monitoring only, required patient intervention, or lacked date/time recording. These authors [15, 35, 38] found an objective average compliance ranging from 65 to 75%. These investigators [35, 38] found no correlation between compliance and prescribed regimen. This was also justified in the present study since there were no differences in compliance

Table 5 Multivariate logistic regression: comparison between scoliotics, kyphotics and controls

	$\hat{\beta}_i$	SE	Odds ratio	P value
Back 4				
Scoliosis	0.937	0.497	2,553	0.060
Kyphosis	1,027	0.565	2,794	0.069
Flexibility 3				
Scoliosis	-1,704	0.524	0.182 (5.497)	0.001*
Kyphosis	-1,522	0.594	0.218 (4.584)	0.010*
Respond 1				
Scoliosis	-0.991	0.500	0.371 (2.695)	0.048*
Kyphosis	-1,128	0.569	0.324 (3.089)	0.048*
Respond 2				
Scoliosis	-1,296	0.560	0.274 (3.656)	0.021*
Kyphosis	-0.730	0.618	0.482 (2.074)	0.238

* Statistical significant results ($\alpha = 5\%$)

SE = standard error of coefficient

β_1 = coefficient

between scoliotics and kyphotics treated with different braces. The compliance reported by the individuals in this study is comparable to that reported by others. The measured average compliance of 57% indicated *de facto* part-time bracing. No patient completely adhered to the treatment protocol although of 41% testified to full compliance. There was a gender-related compliance in this study. More specifically, high average compliance was observed in 52% of boys and in 42% of the girls. In contrast to this study there a recent investigation disclosed low (average 38%) compliance in boys treated with brace for idiopathic scoliosis. The authors speculated that this poor compliance was due to the older age of the male patients and their refusal to cooperate with the orthotic programme [20]. Age appears to be one of the factors that correlates with compliance; younger patients showed higher compliance. The present study showed higher compliance in the ages between 11 and 14 and less in older children. DiRaimondo and Green [9] demonstrated higher compliance among grade school patients than among those in high school. They speculated that because menarche and Risser sign are age-related factors they may affect compliance. Additionally, there is a speculation that bracing has an effect on the psychosocial development of adolescent patients [14, 28, 34]. In the present study, highly compliant patients wore the brace as recommended, being with only short periods out at home for reasons personal hygiene. Intermediate compliance resulted from reduced brace wear during school hours. In the present study, it was apparent that where there was poor compliance the patient clearly took her/his brace off during the most socially important hours of the day, i.e. when fashion was most important. During school hours, this was not such an issue as some patients said their uniform adequately hid their brace. These observations are very close to those previously reported by others [35] in similar populations.

In the previous literature there is a high rate of subjectively overestimated compliance, which was obviously due to reports of bracing that derived from adolescents. However, objective measurement with actual monitoring of brace wear showed that actual brace compliance is much less than claimed by patients or parents [16] so that some authors thought that <15% of their patients with scoliosis were fully compliant with a 23-h/day schedule [9]. The reported poor compliance during brace therapy for idiopathic scoliosis seems to be directly linked with psychological reactions that have been reported by several authors [14, 34, 40].

Non-compliance has been reported between 20 and 85% [3–5, 8–12, 20, 22, 33, 41]. In the present study, non-compliance ranged between 0 and 74%.

Lindeman and Behm [28] looked at the psychological factors that predict poor brace-wear self-reported compliance. The authors found that girls who were noncompliant with the brace wearing were those who were anxious about the possibility of failure and did not expect to succeed in dealing with their scoliosis. They also found to have low self-esteem, and did not seek social support. However, boys who were non-compliant with brace wearing had high self-esteem, high expectations about the success of their bracing treatment, and sought social support. The only factor that predicted non-compliance across gender lines was sleeping problems.

Gender differences in compliance were also found in another study [36]. The authors looked at perceptions of body image, happiness and satisfaction in male and female adolescents wearing the Boston brace. Although all adolescent subjects with scoliosis were found to have a poorer body image perception than did the control group, boys with scoliosis were found to have better body image perception than girls with scoliosis.

To author's knowledge, emotional distress related to bracing has been reported only in adolescents with idiopathic scoliosis [17, 18, 30, 40], that in some cases reaches the 84% of the patients [30]. The present study disclosed also the psychologic reactions in adolescents suffering not only from scoliosis but as well as from Scheuermann kyphosis.

It seems that besides spinal deformity, bracing itself induces emotional distress. Matsunaga et al. [31] compared three groups of patients with idiopathic scoliosis, who had undergone either brace therapy, or surgical treatment or non-treatment and showed that the use of braces had markedly greater psychologic effects than the other treatments [31].

A previous investigation [8] measured quality of life was measured in 112 adolescents using the QLPSD instrument. Areas measured by the instrument included psychosocial functioning, sleep disturbances, body image and back flexibility. Results of the study [8] found that, compared to the Milwaukee brace, the Charleston and Boston braces have a lower impact on overall quality of life and on the psychosocial functioning of adolescents with spine deformities. The impact of brace treatment on quality of life in patients with severe disease (i.e. idiopathic scoliosis and Scheuermann's disease) was greater than in patients with less severe curves. Length of time wearing the brace was also a factor.

The authors [8] speculate that the transition from childhood to adolescence may have played a role in these results. Using the QLPSD instrument in the present study, the authors observed similar psychological reactions in individuals with both deformities. These psychological reactions were observed in this study more often among the girls and was increasing with the age independently from the type of brace used. This study justified the observation of Climent et al. [8] that patients with larger curvatures developed greater emotional distress.

Another variable that appears to significantly affect the emotional distress in adolescents with scoliosis is the duration of bracing. Quality of life impact began after the initial stressful bracing period but began to decline during the course of time. Some authors [8, 30] reported that the emotional distress that appears at the start of bracing diminishes after the patient accepts brace treatment. This observation was justified in the present study. The explanation for the improvement of psychological function with time is possibly given by some investigators, who have noted psychological adaptation to wearing of brace [34]. This study showed that the problem of adaptation with bracing was more evident in older adolescents because they felt ashamed of themselves at starting of bracing.

In the present study, the age of the patients was shown to have a twofold effect on the quality of the life of adolescents with spinal deformities. The positive effect was that older individuals showed a better adaptation to bracing, while the negative effect was that older adolescents worry about the future effect of the spinal deformity on their body stronger than younger adolescents. Similar observations regarding the effect of body deformity due to scoliosis on patients were made in similar populations by others [1].

Another significant observation, which derived from this study was that girls with deformities faced problems with sleeplessness more often than boys. The theoretical explanation for these observations should be that these girls feel much more ashamed of their body because of their back deformity that makes their body is unattractive.

Previous studies [6, 27] compared the motion restriction and trunk stiffness provided by three thoracolumbosacral orthoses and showed that there were no difference in either subject-perceived or measured restriction of spine motion between the orthoses. This study justified that previous observation that bracing

reduced capability of adolescents to perform common daily activities at home and outside, obviously by reducing spine mobility.

Back pain is not a rare complaint among adolescents [23, 24]. However, back pain is often reported by adolescents with scoliosis and kyphosis during bracing. The possible explanation for back pain is that bracing with the time reduces muscle mass and weakens their strength, thus inducing more stress on the discs, ligaments and facets. The increased incidence of back pain among girls with deformities vs. boys should be due to the constitutively weaker muscle system of the girls as compared to that of the boys, which becomes even weaker because of bracing. Therefore, back muscle strengthening during bracing is strongly recommended.

The present study showed that the QLPSD is a useful instrument to test the psychological and physical impact of bracing on the quality of life of adolescents. Some authors [21] evaluated the effectiveness of performing personality tests for patients with idiopathic scoliosis who underwent brace therapy and concluded that these tests are useful for evaluating psychological effects and ensuring continuation of therapy minimizing patient dropout.

This study disclosed several significant similarities in most of the quality of life domains and only few differences in the effects of each particular brace and spinal deformity itself on the quality of life of the individuals of each particular deformity.

When the patient is experiencing significant psychological distress, one-on-one psychological intervention is warranted [39]. Because of the importance of family dynamics, therapy likely will include a family component. The effectiveness of peer support groups for adolescents has been researched, and no findings were positive. Wysocki et al. [42] compared the perceived effectiveness of education/support groups to Behaviour Family Systems Therapy in the treatment of parent/adolescent conflicts. Behaviour Family Systems Therapy was rated significantly positively by parents and adolescents.

Interview and eventually psychological support for all patients who show reduced compliance should be as early as possible conducted. Physical training for all individuals being in brace treatment, particularly for older female adolescents, should be recommended to improve physical functioning, reduce back pain and subsequently to increase compliance (Tables 3, 4, 5).

Appendix: Items of the quality of life for spine deformities

(A) Psychosocial function

1. I leave the house less frequently than I used to
 - Very often
 - Often
 - Sometimes
 - Rarely
 - Never

2. I do not enjoy my weekends
 - Very often
 - Often
 - Sometimes
 - Rarely
 - Never

3. I have lost some friends
 - Many
 - Enough
 - Some
 - A few
 - None

4. I get angry very often
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never

5. I find it difficult to relate to other people
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never

6. I have had to give up my favorite pastime
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never

7. I spend less time than usual with my friends
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never

(B) Sleep disturbances

1. I always experience discomfort when getting out of bed
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never

2. I do not sleep well at night
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never

3. I find it difficult to fall asleep
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never

4. Backache wakes me up at night
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never

(C) Body image

1. I am ashamed to be seen in a swimsuit
 - Always
 - Often
 - Sometimes
 - Rarely
 - Never

2. I am ashamed of my body
- Always
 - Often
 - Sometimes
 - Rarely
 - Never
3. I feel that I am badly shaped
- Always
 - Often
 - Sometimes
 - Rarely
 - Never
4. I worry a lot that my back may affect my life in the future
- Always
 - Often
 - Sometimes
 - Rarely
 - Never

(D) Back flexibility

1. I have difficulty bending forward
- Always
 - Often
 - Sometimes
 - Rarely
 - Never
2. I have problems getting dressed
- Always
 - Often
 - Sometimes
 - Rarely
 - Never
3. I find it difficult to pick up things that I have
- Always
 - Often
 - Sometimes
 - Rarely
 - Never

(E) To evaluate responsiveness

1. Regarding my last medical evaluation with my back specialist, I feel
- Much better
 - Better
 - The same
 - Worse
 - Much worse
2. My present health status, in general, is
- Very good
 - Good
 - Fair
 - Poor
 - Very poor

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