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Brace and deformity-related stress level in females with adolescent idiopathic scoliosis based on the Bad Sobernheim Stress Questionnaires

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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Summary

Background: Psychopathological symptoms occur more often in chronically ill patients than in healthy populations. The aim of this study was to analyze the associations between different types of treatment and stress levels.

Material/Methods: The study group consisted of 69 females, of whom 35 were treated conservatively with a Cheneau brace; the other 34 subjects were treated operatively and, after correction of scoliosis with thoracoplasty, wore a brace for 12 weeks during the postoperative period. Patients completed the Polish versions of the Bad Sobernheim Stress Questionnaire-Deformity and the Bad Sobernheim Stress Questionnaire-Brace.

Results: Patients who were treated surgically felt a moderate level of stress connected with wearing the brace and with body deformation. The group treated conservatively felt moderate stress connected with wearing the brace, but a low level of stress in relation to body deformation. The groups differed significantly statistically in the level of stress felt regarding body deformation (p=0.004). In the group treated conservatively, the correlation between the level of stress, the age at which treatment was initiated, and degree of apical translation proved to be significant.

Conclusions: Patients treated surgically in comparison with patients treated conservatively report higher stress levels connected with body deformation. A higher level of stress depends on the degree of trunk deformation on the frontal plane; stress is also higher in patients who begin conservative treatment at a later age.

key words: scoliosis • spine deformity • appearance • brace treatment • psychological stress

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Current Contents/Clinical Medicine • IF(2009)=1.543 • Index Medicus/MEDLINE • EMBASE/Excerpta Medica • Chemical Abstracts • Index Copernicus

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BACKGROUND

The psychological aspects of scoliosis as a chronic disease, usually diagnosed in adolescence, are a source of stress and fear for patients, particularly when dealing with the illness' diagnosis and treatment [1–6]. A critical period regarding stress levels has been identified as the initiation of conservative treatment [7–9]. Equally important, people with scoliosis experience a real sense of rejection by peers and feel stigmatised due to their appearance, which is magnified further by the specific problems of adolescence [10].

Scoliosis and its treatments hinder proper personality and identity development and disturb the development of body image. Psychopathological symptoms such as depression and neuroticism occur more often in chronically ill patients in adolescence than in healthy populations [11–13]. Bengtsson et al [14] found that psychopathological symptoms such as emotional hypersensitivity, dysphoric mood and aggressive behaviour may occur in patients with scoliosis.

An analysis of the literature shows that potential differences in the health-related quality of life between patients with adolescent idiopathic scoliosis treated operatively or conservatively have not been well explored, and the results of studies on this problem remain ambiguous [7,15–18]. Until now, attempts to assess the negative influence of conservative treatment on the condition of patients were usually carried out using general methods that did not take into account specific requirements related to using a brace [1,7,19–21]. Little attention has been paid to stress levels related to trunk deformations such as a rib hump, asymmetrical shoulders, waist and chest, or the degree of kyphosis, in patients treated using various methods [8,22]. There also limited data on the prevalence of such personality traits as the level of self-criticism, extra-introversion or the severity of self-reported psychopathological symptoms such as mania and paranoia in adolescents with scoliosis [11–13].

The majority of the research in this area has investigated long-term outcomes after brace or surgical treatment [4,21,23,24]. The aim of this study was to determine whether short-term differences exist in psychopathological symptoms between female adolescents with scoliosis treated surgically or conservatively, since it has been proven that even a treatment period as short as 3 months might negatively affect a patients' health-related quality of life (HRQoL) [1,19]. Ugwonali et al. [20] and Matsunaga et al. [25] studied the effects of conservative treatment over an even shorter time span – a 4-week observation period from the start of treatment.

This cross-sectional study consists of 2 parts. The aim of the first part of the study was to compare stress levels related to trunk deformation and the use of an orthopaedic brace in patients treated conservatively, as well as in patients treated operatively with thoracoplasty, who for 12 weeks wore a brace to stabilize the chest after surgery. In the second part of the study we analysed the personality characteristics of adolescents with idiopathic scoliosis after brace or surgical treatment, compared to healthy controls.

Additional assessment involved the relation between the Cobb angle, the apical translation before and after treatment,

percentage of scoliosis correction, the duration of brace wearing on a daily and monthly basis, stress levels and personality traits. This article presents the first part of the study.

MATERIAL AND METHODS

Structure of the study

Forty-three patients treated surgically and 55 patients treated conservatively who fulfilled the inclusion criteria received in-depth information on the aim of the study and were assured of anonymity. In order to proceed with asking patients to fill out the questionnaire, the patients gave their informed consent, which, for subjects under 18 years old, was granted by their parents. Seventy-three percent of patients treated surgically and 63.6% of those treated conservatively filled out the questionnaires. The assessed group consisted of 69 white females, of whom 35 were treated conservatively; 34 were treated operatively and after correction of scoliosis with thoracoplasty wore a brace for 12 weeks in the postoperative period. Patients were recruited into the study consecutively. They were treated in the Pediatric Orthopedics and Traumatology Clinic at the Poznan University of Medical Sciences by the same doctor. The age span for the whole group ranged from 12 to 18 years.

A homogenous group of female patients was included in the study group. The results of Sapountzi-Krepia et al. [4], Payne et al. [26] and a review of the studies carried out by Eliason and Richman [27] indicates, however, that a difference between the sexes exists in reaction to body deformation due to scoliosis and treatment methods. This may be due to the fact that higher values of the Cobb angle related to scoliosis occur more frequently in female patients [28]. The same selection criterion of choosing only female subjects in a study devoted to the psychological characteristics of patients with scoliosis treated operatively or conservatively was applied and justified in a similar study by Noonan et al. [29].

All the patients involved in the study attended public schools; 66.4% of patients attended high school, 29.8% were junior high school students and 3.8% attended primary school. Regarding place of residence, 31.7% of patients lived in rural locations, 27.9% lived in a town with a population of less than 25,000, 13.5% lived in a town with a population of 25,000 to 200,000, and the remaining 26.8% lived in cities with a population of over 200,000.

Methodology of x-ray examination

As provided by the Harms Study Group [30], X-ray images were taken in an upright position with the iliac ala exposed in an anterior-posterior projection. To assess the group that was treated operatively, we used x-ray images taken pre- and postoperatively. To assess the group that was treated conservatively, we used x-rays that were taken before the application of the Cheneau braces.

The following parameters adopted by D'Andrea et al. [30] were considered: the Cobb angle in the main curve, and the distance between the apical vertebra of scoliosis and the central sacral vertical line (in centimetres), described as the degree of the apical translation of the centre sacral vertical line. Moreover, we considered the location of the

major deformation curve and, in cases where patients were treated operatively, the range of spondylodesis. Percentage of scoliosis correction was also taken into account.

Participants

Inclusion criteria for the study group treated conservatively were as follows: female, 12–17 years old, minimum length of Cheneau brace wearing of at least 12 hours a day, Cobb angle of scoliosis of 20–40 degrees, a minimum period of 3 months of Cheneau brace wearing. Following the criteria of the Scoliosis Research Society regarding the location of apex [31], thoracic scoliosis was identified in 62.8% of the patients, thoracic-lumbar scoliosis in 31.4%, and lumbar scoliosis in the remaining 5.8%. No other diseases leading to deformity of the trunk were identified in patients treated conservatively. See Table 1 for additional information on the group treated conservatively.

Inclusion criteria for the group treated surgically were as follows: female, 12–18 years old, scoliosis treated surgically with thoracoplasty and the wearing of an underarm brace for a period of 3 months postoperatively. The minimum follow-up after which patients were asked to fill out the questionnaires in the surgically treated group was 3 months. The correction of scoliosis was the first operation carried out in the spinal region of these patients. None of patients suffered from postoperative complications that could have influenced the results.

Working analogically, as in the division of patients who underwent conservative treatment, using the criteria of the location of the apex according to SRS regulations [31], 82.4% of patients treated surgically were identified with thoracic scoliosis, 11.8% with thoracic-lumbar scoliosis, and 5.8% with lumbar scoliosis. Additional information on the group treated surgically is shown in Table 2.

Methods

Patients completed the Polish versions of the Bad Sobernheim Stress Questionnaire-Deformity (BSSQ-Deformity) and the Bad Sobernheim Stress Questionnaire-Brace (BSSQ-Brace). In earlier studies [32] we submitted the BSSQ-Brace and BSSQ-Deformity to a process of cultural adaptation to Polish conditions. The Polish versions of the BSSQ-Brace and BSSQ-Deformity received high scores for internal consistency and test-retest reliability [32].

BSSQ-Brace and BSSQ-Deformity serve to evaluate stress levels as a result of body deformation and stress levels relating to the use of a brace in scoliosis patients. Answers were marked on a 4-point scale, from 0 to 3 [22]. The number of points possible ranges from 0 to 24; the higher the score, the lower the level of stress felt by the respondent. The interpretations of the results are as follows: 0–8 points indicate a high level of stress; 9–16 points indicate a moderate level of stress, and 17–24 points indicate a low level of stress [22].

Statistics

In respect to statistical quantitative features, we determined mean and standard deviations. In respect to qualitative features, we gave the number of units that belong to described

Table 1. Characteristics of study participants-patients treated operatively and conservatively.

Parameters	Patients treated operatively mean (SD)		Patients treated conservatively mean (SD)	
Weight [kg]	52.5	(7.5)	50.7	(6.4)
Height [cm]	166.5	(6.9)	164.1	(6.1)
Age at assessment [years]	16.1	(1.5)	14.8	(1.4)
Age at initiation of treatment [years]	14.8	(1.2)	13.6	(1.6)
Brace [hours/day]	–		14.9	(3.2)
Brace [months]	–		16.0	(11.5)
Preoperative Cobb angle	54.6	(9.0)	–	
Postoperative Cobb angle	21.1	(9.9)	–	
Cobb angle	–		27.7	(7.5)
Postoperative scoliosis correction [%]	62.0	(15.2)	–	
Preoperative apical translation [cm]	4.5	(1.4)	–	
Postoperative apical translation [cm]	1.4	(1.0)	–	
Apical translation [cm]	–		2.0	(1.2)
Range of spondylodesis (n of vertebrae)	8.6	(2.8)	–	

categories of a given feature respective percentages. As the majority of considered features and results were not normally distributed, we used non-parametric tests to verify the hypothesis.

To establish relations between quantitative features, we used Spearman's rank correlation (marked as rS). The Mann-Whitney test was used to compare the 2 groups in respect to a quantitative feature. As a border level of statistical significance we adopted p=0.05; test results whose p value exceeded this level were treated as insignificant. The same criterion in this kind of assessment was used by Weigert et al. [21]. Statistical calculations were performed using Statistica software.

Ethical considerations

The study design was approved by the Ethics Committee of Poznan University of Medical Sciences (approval number 268/08) and was carried out following universal ethics principles.

RESULTS

The 2 analyzed groups do not differ in terms of weight (p=0.494), height (p=0.166), Body Mass Index (p=0.914) and the location of the major deformation curve (p=0.383). There are statistical differences in the characteristics among

Table 2. BSSQ-Brace and BSSQ-Deformity Results in patients treated surgically and conservatively.

BSSQ	ST (n=34)	BT (n=35)	Comparison BT-ST	Comparison of BSSQ-Brace and BSSQ-Deformity results
	mean (SD)	mean (SD)	p value	p value
BSSQ-Deformity	14.4 (5.6)	18.3 (4.5)	0.004*	for BT p<0.001*
BSSQ-Brace	11.0 (5.3)	12.3 (4.6)	0.199	for ST p=0.015*

ST – surgical treatment; BT – brace treatment; BSSQ – Bad Sobernheim Stress Questionnaire. *p<0.05.

Table 3. Correlation between selected parameters in patients treated conservatively.

BSSQ	Age at initiation of treatment [years]	Age at assessment [years]	Cobb angle	Apical translation [cm]	Brace [hours/day]	Brace [months]
BSSQ-Deformity	r_s=−0.201 p=0.246	r_s=−0.017 p=0.924	r_s=−0.145 p=0.406	r_s=−0.443 p=0.008*	r_s=0.027 p=0.876	r_s=0.212 p=0.222
BSSQ-Brace	r_s=−0.369 p=0.029*	r_s=−0.318 p=0.063	r_s=−0.107 p=0.543	r_s=−0.326 p=0.056	r_s=−0.165 p=0.343	r_s=0.013 p=0.943

BSSQ – Bad Sobernheim Stress Questionnaire. *p<0.05.

the 2 analyzed groups. In regards to the Cobb angle and the apical translation, we took into account both preoperative and postoperative values of the Cobb angle and the apical translation in the group treated surgically. The groups differed significantly in regards to the preoperative (p<0.001) and postoperative (p=0.004) values of the Cobb angle. The groups differed significantly in regards to the preoperative (p<0.001) and postoperative (p=0.025) values of the apical translation. A higher value of apical translation equates with a higher degree of decompensation and deformation of the trunk, which is related to aesthetics.

A homogenous group of only female patients was included in the study group. There are significant differences between patients treated with a brace and patients treated operatively in regards to age at assessment (p=0.001) and at initiation of treatment (p=0.002).

Patients treated surgically felt a moderate level of stress related to wearing a brace over a short follow-up after the surgical correction, as well as stress related to trunk deformation. Patients treated conservatively also felt a moderate level of stress related to wearing a brace, similar to the group treated surgically; however, the stress level related to body deformity was low (Table 2). This difference is statistically significant (p<0.001, Mann-Whitney test) (Table 2). This indicates that brace wearing increased the level of stress more than the stress induced by the deformity alone.

In comparison, the 2 groups have significant statistical differences solely in relation to stress levels due to body deformation (p=0.004), where the group treated surgically reported higher stress levels (Table 2).

In the group that underwent conservative treatment, we noted that the older the patients were when treatment began,

the higher the stress due to wearing a brace. We also observed that the higher the apical translation, the higher the stress levels connected to trunk deformation, confirming our assumptions. There were no significant correlations between the value of the Cobb angle and the length of time the brace was worn, and stress levels in patients treated conservatively (Table 3).

Due to the existence of a significant statistical correlation (p=0.008) pre-operatively between the degree of translation and stress levels due to body deformation in patients treated conservatively, we attempted to identify a translation value that would divide the group into 2 parts with clearly different stress levels. Based on the analysis of correlation and the Mann-Whitney test result, it became evident that patients with a preoperative translation degree of less than 2.5cm displayed stress levels connected to trunk deformation (19.5 SD 3.6) significantly (p=0.015) lower than in patients with a degree of translation higher than or equal to 2.5 cm (15.2 SD 5.2).

Similarly, where there was a clear statistical correlation (p=0.029) between age at the start of treatment and stress levels due to the use of a brace in patients treated conservatively, we determined that patients who began treatment at age 13 or earlier felt stress levels (14.7 SD 3.8) significantly (p=0.018) lower than in patients who began treatment at the age of 13 or over (10.6 SD 4.5).

It appeared, contrary to our expectations, that in the surgically group treated there were no significant correlations between the preoperative and postoperative Cobb angle in the main curve and the apical translation, the percentage of correction of scoliosis after surgery, the range of spondylodesis, and the age of the patient, with BSSQ scores (Table 4).

Table 4. Correlation between selected parameters in patients treated operatively.

BSSQ	Age at initiation of treatment [years]	Age at assessment [years]	Preoperative Cobb angle	Postoperative Cobb angle	Preoperative apical translation [cm]	Postoperative apical translation [cm]	Range of spondylodesis [n of vertebrae]	Postoperative scoliosis correction [%]
BSSQ-Deformity	$r_s=-0.024$ $p=0.893$	$r_s=0.122$ $p=0.493$	$r_s=-0.102$ $p=0.565$	$r_s=-0.040$ $p=0.820$	$r_s=-0.041$ $p=0.818$	$r_s=-0.038$ $p=0.830$	$r_s=-0.206$ $p=0.242$	$r_s=0.040$ $p=0.823$
BSSQ-Brace	$r_s=-0.096$ $p=0.591$	$r_s=-0.059$ $p=0.740$	$r_s=-0.129$ $p=0.466$	$r_s=-0.218$ $p=0.216$	$r_s=-0.031$ $p=0.860$	$r_s=-0.177$ $p=0.316$	$r_s=-0.158$ $p=0.372$	$r_s=0.181$ $p=0.305$

BSSQ – Bad Sobernheim Stress Questionnaire.

DISCUSSION

The accepted age range for the entire study was 12–18 years, since we concentrated on the effects of scoliosis treatment methods on adolescent patients. A similar range, in studies on the quality of life in adolescent patients with scoliosis, was used by Kahanovitz et al., Payne et al., Vandal et al., Sapountzi-Krepia et al., Ugwonali et al., Vasiliadis et al., and Smith et al. [4,19,20,23,26,33,34].

In the group that underwent conservative treatment, as well as the group treated surgically, a common factor was the minimum 3 month period when the brace was to be worn. Numerous studies have focused on the influence of a longer period for this method of treatment [4,21,23,24]; however, studies by Kahanovitz and Weiser [1] indicated that even a period as short as 3 months is of significance in the psychosocial functioning of patients. A similar criterion of at least a 3-month period of conservative treatment was applied in further studies by Kahanovitz et al. [19]. According to Ugwonali et al. [20], just a few weeks of conservative treatment gives the opportunity for a stable evaluation of these results, which supports the patient selection criteria in our study.

Sapountzi-Krepia et al. [4], similarly to this study, examined the effects of conservative treatment in patients who wore the brace for a minimum of 12 hours per day. Patients who had conservative treatment and those who wore a brace postoperatively had the same type of underarm brace. While the use of an orthopedic brace following thoracoplasty related to surgical correction with anterior or posterior access raises some concerns, many authors still advise wearing a brace for a short period following the operation [35–38]. We decided that the minimum follow-up period of observation for post-operative patients was 3 months. The effect of the surgical treatment on patients' HRQoL within a similar follow-up period was assessed by LaMontagne et al. [39] and Newton et al. [40].

Patients treated conservatively and those who wore a brace postoperatively wore the same type of underarm brace, which, in the context of the proven negative influence of a type of a brace on the psychosocial functioning of patients [41], means that this factor cannot be taken as a reason for the differences in the results of the studied groups.

There are statistical differences in the characteristics among the 2 analyzed groups. The groups differed significantly in regards to the Cobb angle, the apical translation and age. However, these differences are due to indications for different types of treatment of scoliosis. Younger patients with scoliosis of a somewhat smaller Cobb angle more often undergo treatment with a brace. Some of them, after a number of years, experience a progression of trunk deformation that requires surgical treatment.

In relation to the above information from other studies, it is possible to say that the patient group analyzed in this study fulfils conditions permitting comparison with data from other studies.

Reichel and Schanz [10] indicate that the diagnosis and different treatment methods of chronic illnesses pose a complicated combination of stress factors for children and parents. It is necessary to differentiate between the effects of the illness and various scoliosis treatment methods. A review of articles shows that researchers do not agree on the significance of such dependencies [8,21,24,29,42–47].

Surgical treatment of scoliosis is regarded as the orthopedic operation carried out in childhood that places the most strain on the patient's body [48]. According to Schatzinger et al. [49], patient fears immediately before the operation mainly concerned the risk of complications, in particular, the possibility of damage to the spinal cord. Similarly, the long period of convalescence and return to full health requires changes in habits and makes high demands on the patient, which is connected to the necessity for stringent adherence to the recommendations of the doctor [50].

The conservative treatment of scoliosis is related to many different problems. For it to succeed, the patient is required to rigorously adhere to the regime of wearing the brace for many hours [28]. The literature highlights the fears, in relation to their social life, patients have regarding using a brace [10]. The strength of negative experiences connected to this treatment method can be seen in the study results that show that patients wore the brace, contrary to the doctor's orders, only when their parents actively controlled the situation [51].

Many studies, including Cochran and Nachemson [42], Fällstrom et al. [43], Clayson and Levine [2], and Bunge et al. [24], support the hypothesis of the greater negative influence of the conservative treatment of scoliosis compared to surgical treatment on the functioning of patients. These results are supported by Reichel and Schanz [10], who point

out that the conservative treatment of scoliosis is a significant factor in the developmental disturbances of patients. There are studies that minimize the significance of the negative influence of wearing a brace on the quality of life for adolescent patients with scoliosis [18,23,52-55]. The results of our study, however, show that those treated surgically have higher stress levels, however, connected with body deformation.

Fällstrom et al. [43] showed that patients treated surgically demonstrated, in comparison to the group who underwent treatment with a brace, a more positive regard of themselves and their environment. The researchers initially thought that surgical treatment, in comparison to the less "dramatic" conservative treatment, would be the source of more psychological distress. The outcome, however, was the opposite – it is in fact the long-term conservative treatment which is a greater source of stress for the patient [43]. This is contrary to our results.

Vasiliadis et al. [33] used a new questionnaire to study the psychological aspects of brace-use – the Brace Questionnaire. They determined a reverse correlation between the Cobb angle value and activity at school and the social functioning of patients. They also ascertained that the value of the Cobb angle does not affect how patients regard their personal health, their somatic health, emotional functioning, self-esteem or pain levels [33]. However, in comparison to the results at the start of treatment, at the end of treatment patients exhibited worse functioning in all domains of the Brace Questionnaire. Likewise, our results show that the value of the Cobb angle is an insignificant variable from the point of view of stress levels in both groups of patients.

Samuelsson and Riccardi [56] showed that a higher risk of emotional disturbances is not connected to the age or sex of a child, nor is it dependent on the level of the severity of the illness, but rather on how visible its symptoms are. Likewise, other studies show that patients whose symptoms are most visible, most often report emotional difficulties [17,18,57], but our results only partly support these findings. We found that in the group of patients using a brace, the most important factors were connected with the degree of body deformation and the degree of translation of the apical vertebra of the curve, but the remaining points connected to the degree of trunk decompensation, such as the value of the Cobb angle or the degree of translation postoperatively, and the percentage of postoperative correction in patients treated operatively turned out to be meaningless. Our results show that the connection between how visible the body deformation is and an increased risk of various disturbances is very complex.

The studies by Kotwicki et al. [58], using the BSSQ-Brace and BSSQ-Deformity results, show that stress caused by body deformity is quite low in patients treated conservatively. It also determined that brace treatment additionally increases the level of stress felt due to spinal deformation. Our results, however, show that patients treated surgically felt a moderate level of stress both due to using a brace in the short postoperative period, and body deformation. Our results confirm the observations of Botens-Helmut et al. [22] and Kotwicki et al. [58] of higher stress levels due to brace wearing in comparison to stress connected only to trunk deformation.

For this study the reactions of patients in the early phase of brace wearing are significant. It is emphasised that the early stages of brace treatment are a critical period for the intensity of stress and coping mechanisms [7,8]. Apter et al. [7] stated that this crisis occurs in the first 2-6 weeks of conservative treatment. Some patients demonstrate fear and depression [59,60], as well as a decrease in self-esteem [7,45], especially when they realise the implications of the diagnosis and recommended treatment methods [60]. MacLean et al. [8] report that up to 84% of patients admitted to such difficulties during brace treatment, and that the longer the time recommended for wearing a brace on the daily basis, as well as if a patient was previously poorly adapted to society, the more difficult it is for the patient to adapt to a new difficult situation [51,53,59]. Incidents of self-harm have been known to occur [7], which is in contrast with the results we obtained showing that there is no connection between the length of time a brace is worn and an increase in stress levels.

A short period of brace wearing has a much greater effect, as highlighted many times (Fällstrom et al. [43], Clayson et al. [44]), in comparison to longer periods, on the psychosocial functioning of patients, which reflects the depth of the crisis connected to the start of treatment. However, our findings do not support these results. We observed a different order, connected to the older age of patients when treatment began. As Climent et al. [40] stated, however, for older adolescents the use of a brace is a larger social problem than for a patient who is just coming into adolescence [40]. This point may explain to a certain extent our results showing a higher level of stress in patients who began treatment at the age of 13 or older.

Andersen et al. [61] shows, however, that patients who began conservative treatment at the age of 16 or older have much greater difficulties forming relationships with the opposite sex in comparison to patients who began brace therapy before age 16. Similarly, our study shows that the age at which treatment begins is significant for the psychosocial functioning of patients, and patients who began treatment later are subject to much greater stress.

Our research indicates that there are differences in stress levels between adolescent females with scoliosis in the short-term after brace or surgical treatment. There are implications that can be drawn from our study for future research: examining the potential differences in stress levels related to trunk deformation (and perhaps stress related to memory of wearing of an orthopedic brace) in female and male patients treated conservatively, as well as in patients treated operatively, in a long-term follow-up.

Limitations

The cross-sectional character of our study constitutes a certain limitation; it was not possible to state whether there were differences between groups prior to treatment and whether such differences affected outcomes. An example may be the value of Cobb angle in both study groups, which contributes to different expectations of patients in regard to treatment results. Similar restrictions in sectional studies were indicated by Bunge et al. [24]. However, Climent and Sanchez [41] believe that cross-sectional studies are a

valid option, due to the nature of the scoliosis and indications for application of various therapeutic approaches.

Studies herein require an adoption of an assumption relating to the issue of randomization. Such an assumption shows that there were no differences between groups that were treated surgically and conservatively in respect to measured traits of character prior to treatment. Such an assumption seems plausible, as the occurrences of scoliosis that require treatment is random. Similar problems and the need for adopting such an assumption were voiced by Noonan et al. [29].

Conclusions

There were differences in stress levels between female patients with scoliosis in the short-term after brace or surgical treatment – the group treated surgically had higher stress levels connected with body deformation. Our results show that patients already experiencing stress caused by trunk deformity had additional stress related to conservative treatment. Moreover, we found that a higher level of stress depends on the degree of trunk deformation on the frontal plane. Stress is also higher in patients who begin conservative treatment at a later age.

Acknowledgments

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