

# Outcome assessment of bracing in adolescent idiopathic scoliosis by the use of the SRS-22 questionnaire

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**Abstract** The SRS-22 questionnaire is specifically designed for the assessment of quality of life in spinal deformity patients. This study is the first to use it to assess the quality of life of adolescent idiopathic scoliosis patients under brace treatment and compares the results with an observational group matched by age and curve magnitude. Forty-six patients were enrolled into each group. Overall, it was found that patients under observation had a significantly better quality of life than braced patients. Specifically, the domains for function/activity and self-image were most affected. This effect was most apparent in those with a curve magnitude of under 20°. The scores did not improve significantly with the duration of brace wear, suggesting little adaptation. This study has implications for treatment, and more attention will need to be given to those with mild but progressive curves to help improve patients' understanding of their treatment and hence their compliance and satisfaction.

**Résumé** Le questionnaire SRS-22 est spécifiquement dévolu à l'évaluation de la qualité de vie chez les patients présentant une déformation rachidienne. Cette étude est la première qui utilise l'information relative à la qualité de vie

des adolescents présentant une scoliose idiopathique, traitée par plâtre, en comparant ces résultats avec un groupe identique sur le plan de l'âge et de l'importance de la déformation. Quarante-six patients ont été étudiés dans chaque groupe. Il est évident que les patients sous simple surveillance ont une qualité de vie bien supérieure à ceux traités par plâtre. De façon spécifique, ce sont surtout les critères d'activité et d'image de soi-même qui sont les plus affectés. Cet effet est surtout apparent chez les patients dont la courbe est inférieure à 20°. Les scores ne s'améliorent pas avec le temps, ce qui aurait pu suggérer une petite adaptation. Cette étude a des implications sur le traitement et une attention particulière doit être apportée à tous les patients présentant une courbe d'aggravation progressive de façon à améliorer leur compréhension du traitement et améliorer leur compréhension, leur compliance et leur satisfaction vis-à-vis du traitement.

## Introduction

Bracing is the most common form of treatment for scoliosis with curves between 25° and 40° [11]. However, the effectiveness of bracing is still controversial. Several studies have questioned the effectiveness of bracing in patients with adolescent idiopathic scoliosis [6, 9, 10]. Most of these were long-term follow-up studies assessing the effectiveness of bracing in terms of curve progression on radiographs; however, very few of them used lifestyle questionnaires as a method of assessment [3, 7, 16]. However, this is of importance as it may have a significant impact on compliance and therefore the success of brace treatment.

The full effect of formal full-time brace use on the physical, psychological and social health of adolescent

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patients is controversial. A study looking at the Milwaukee brace, which has a poor external appearance, found that after the initial shock of learning about the condition and its treatment, the psychological, social and lifestyle effects on the patients were minimal [7]. Other studies suggested that bracing had a psychological impact, causing low self-esteem and a more negative self-image, but no psychopathological changes in the long term [4, 12]. On the other hand, there are studies claiming that bracing did not have a negative impact on body image [13, 14, 16]. Differences may result from the type of brace used, as well as differences in culture and the attitudes of patients.

Until recently, there has been no standardised outcome assessment questionnaire on patients' perceived outcome for the treatment of adolescent idiopathic scoliosis (AIS). The original Scoliosis Research Society (SRS) health-related quality-of-life outcome assessment tool was developed by Haer et al. to provide a simple, practical, disease-specific, assessment for patients with idiopathic scoliosis [8]. It consists of seven domains and was modified into the SRS (mSRS) quality-of-life questionnaire for better score distribution, internal consistency and concurrent validity in comparison to Short Form 36 (SF-36), which is another generic measure of patient's health and well being. The final version of the SRS-22 health-related quality-of-life questionnaire was produced by Asher et al. after two further modifications to the mSRS [2].

The purpose of this cross-sectional study was to determine the effect of bracing on the quality of life of patients with adolescent idiopathic scoliosis using the SRS-22 outcome assessment tool. Specifically, we were interested in determining whether patients treated by bracing had any differences in quality-of-life scores compared with a group matched for age and curve magnitude, but treated by observation alone, and the effect of curve magnitude, duration of bracing and age on the bracing outcome.

## Materials and methods

All patients attending the scoliosis out-patient clinic at the author's institution were routinely asked to fill in a SRS-22 questionnaire at every visit. We retrospectively identified patients with a diagnosis of adolescent idiopathic scoliosis that had progressive curves and were undergoing brace treatment. These were then matched to a group of patients of a similar age and curve magnitude, but who had non-progressive curves and were under observation only. Additional information on intervention duration and curve magnitude was recorded.

Patients wore a custom-made rigid underarm brace that was molded by an experienced orthotist using a Risser

table. All patients were asked to wear the brace for a minimum of 20 h, and marks were made on the straps of the brace to ensure that they applied the correct pressure. Those that were found to be non-compliant to bracing were excluded from the study.

The mean score from each domain was calculated as recommended by the Scoliosis Research Society. One sample t-test was used to compare the mean scores of the five domains of braced patients with non-braced patients under observation alone. The mean scores of braced patients and patients under observation were also compared with respect to the severity of scoliosis (different Cobb angle groups). The effect of bracing with the time in the brace was observed to see if there was any impact of bracing.

## Results

### Comparison between braced and observation group

A total of 46 patients who had progressive curves and were braced were identified. There were 6 males and 40 females, with a mean age of 16 years (range 11 to 20 years). Their mean Cobb angle measurement was  $28.8^\circ$  ( $\pm 9.97$ , ranging from  $10$  to  $50^\circ$ ). This was matched by age and curve magnitude to another group of 46 patients that were under observation only. There were 10 males and 36 females, with a mean age of 18 (ranging from 12 to 22). The average Cobb angle size was  $28.8^\circ$  ( $\pm 9.97$ , ranging from  $10$  to  $50^\circ$ ).

The overall score for the braced group was significantly lower than that of the observation group (see Table 1). This is mainly due to a difference in their function/activity score and their self-image score, thus suggesting that patients that were braced had a poorer self-image and reduced activity level.

**Table 1** Comparison between patients under observation and braced patients

	Observation group	Bracing group	P-value
No.	46	46	
Age (years)	18	16	
Cobb angle (degrees)	28.8	28.8	
SRS-22 results			
Function/activity	4.89	4.53	0.00007
Pain	4.65	4.62	0.7
Self-image	4.04	3.63	0.0007
Mental health	4.50	4.31	0.1
Satisfaction	3.98	3.90	0.6
Total score	4.47	4.24	0.005

### Comparison between braced and observation group with respect to curve magnitude

There were 9 patients with Cobb angles less than 20° in the braced group and 9 patients in the observation group, 20 patients with Cobb angles between 20 and 30° in the braced group and 20 patients in the observation group, 10 patients with Cobb angles between 30 and 40° in the braced group and 10 patients in the observation group and 7 patients with Cobb angles more than 40° in the braced group and 7 patients in the observation group.

Overall, the biggest difference between bracing and observation was found in those with less than a 20° curve. The total score and three of the five domain scores showed significant differences (see Table 2), while for curves of over 20°, no significant trend in differences could be identified. This suggests that for mild but progressive curves (under 20°), patients had the most difficulty accept-

ing the brace and had the most problems with their daily function/activity, pain and self-image ( $P < 0.05$ ).

### Effect of bracing with time in brace

The average time in braces for the 46 patients that were braced was 2.3 years, ranging from 1/2 to 6 years. As shown in Table 3, there was a positive correlation of function/activity and pain with time, and a negative correlation of self-image, mental health, satisfaction and total score with time. These suggest that function/activity improved with time in the brace, but image/appearance decreased with time in the brace. However, this correlation was not strong.

### Effect of SRS-22 score with age in patients under observation

The group of patients under observation was examined to see if the SRS-22 scores were affected by patients' age (see Table 4). Overall, there was a negative correlation, suggesting that older patients with even mild to moderate curves were becoming increasingly unhappy with their scoliosis. Again, although there is a trend, the correlation is not strong.

**Table 2** Comparison of patients under observation and braced patients with respect to Cobb angles

	Observed	Braced	P-value
<i>Cobb angle &lt;20°</i>			
Number of patients	9	9	
Function/activity	4.91	4.49	0.01
Pain	4.82	4.42	0.03
Self-image	4.31	3.62	0.006
Mental health	4.76	4.42	0.07
Satisfaction	4.17	3.94	0.4
Total score	4.65	4.21	0.003
<i>Cobb angle 20–30°</i>			
Number of patients	20	20	
Function/activity	4.88	4.48	0.02
Pain	4.65	4.62	0.8
Self-image	3.96	3.72	0.2
Mental health	4.70	4.43	0.2
Satisfaction	3.70	4.03	0.3
Total score	4.47	4.28	0.1
<i>Cobb angle 30–40°</i>			
Number of patients	10	10	
Function/activity	4.94	4.54	0.08
Pain	4.74	4.70	0.8
Self-image	4.10	3.42	0.09
Mental health	4.70	3.88	0.02
Satisfaction	3.95	3.55	0.3
Total score	4.56	4.08	0.06
<i>Cobb angle &gt;40°</i>			
Number of patients	7	7	
Function/activity	4.83	4.66	0.3
Pain	4.49	4.71	0.2
Self-image	3.54	3.66	0.7
Mental health	4.63	4.34	0.4
Satisfaction	3.79	3.93	0.7
Total score	4.32	4.31	0.99

## Discussion

The SRS-22 questionnaire is a quality-of-life questionnaire developed to target adolescent and juvenile onset idiopathic scoliosis. It consists of five domains: function/activity (5 questions), pain (5 questions), self-image/appearance (5 questions), mental health (5 questions) and satisfaction with management (2 questions), making 22 questions in total. The SRS-22 standardises the quantification of an individual patient's views and comments in order to evaluate the results of treatment on a global basis. Each question from the SRS-22 consists of five options scored from 1 to 5. The higher the score, the more satisfied the patient is. The Cobb angles of braced patients were matched with patients under observation alone since it was shown that the Cobb angle was correlated with the SRS-22 outcome scores [19].

**Table 3** Effect of bracing with time in brace

	Correlation coefficient	R <sup>2</sup>
Function/activity	0.46	0.21
Pain	0.22	0.05
Self-image	-0.22	0.05
Mental health	-0.30	0.09
Satisfaction	-0.37	0.14
Total score	-0.11	0.01

**Table 4** Effect of SRS-22 score with age in patients under observation

	Correlation coefficient	R <sup>2</sup>
Function/activity	−0.45	0.20
Pain	−0.59	0.35
Self-image	−0.50	0.25
Mental health	−0.43	0.19
Satisfaction	0.18	0.03
Total score	−0.50	0.26

Overall, bracing has a significant impact on the quality of life of the patient. This is especially apparent for their daily function and self-image. Indeed, if one looks at the questions that were asked, this result can be expected.

Questions that were asked to assess function include: What is your current level of activity? What is your current level of work/school activity? Does your back limit your ability to do things around the house? Does your back condition limit your going out with friends/family?

Questions that were asked to assess self-image include: If you had to spend the rest of your life with your back shape as it is right now, how would you feel about it? How do you look in clothes? Which of the following best describes the appearance of your trunk, defined as the human body except for the head and extremities? Do you feel that your back condition affects your personal relationships? Do you feel attractive with your current back condition?

Thus, it can be inferred from these questions and scores that patients do not enjoy wearing the brace, although they accept the fact that they have scoliosis and therefore need treatment. Hence, despite their lack of enjoyment, they were satisfied with the treatment, and there was no significant difference in the satisfaction domain between the observed and brace groups.

With the stratification by curve magnitude, it would seem that those with curves of under 20° had the most problem with brace wearing. While it is unusual to start bracing for such a small curve, these patients had progressive curves on follow-up and were started on early bracing after discussion with the concerned family. This may be because these curves are cosmetically very acceptable, and therefore these patients have the most problems with understanding the need to wear a brace, thus impacting on their quality of life. This may have significant implications for brace compliance and therefore curve progression. Although these are not the subjects of the current study, patients that are most unhappy about their brace may also be the ones that are most likely not to wear the brace. Thus, special attention may be needed in this

group of patients, or bracing should not be commenced until the curve is over 20°.

The effect of bracing on the quality of life of individuals has not been well studied, with some suggesting a negative impact, while others found no significant differences [5, 16–18]. This may be explained by the use of different kinds of braces, different bracing regimes and cultural differences in patients' ability to accept bracing. This study is based on the use of a tailor-made underarm brace (Boston brace), and a homogenous population, as such, the findings here may not be directly applicable to other ethnic groups or bracing regimes.

Interestingly, in both the braced group and the observation group, there seems to be a trend to a reduction of the quality of life with time. In the braced group (see Table 3), this may be explained by the fact that as the patients became older, they were more self-aware and had a higher demand for their social life, hence the reducing scores for self-image, mental health and satisfaction with bracing, while as they became more adapted to the brace, function and pain scores improved. On the other hand, for the observation group (see Table 4), as they became older, they also had higher expectations for their backs; hence, all domains have a reducing score, except for satisfaction, as they had not been treated.

The current study did not take into account the position or pattern of scoliosis as this was found not to be a significant factor in outcome, except for left thoracic curves, which are very rare [1, 15].

Adolescence is a transitional period involving not only physical growth but also psychological instability. Treatment for idiopathic scoliosis often coincides with adolescence, which might further complicate the challenging period with the wearing of an externally visible brace. Therefore, more attention should be paid to the physical and psychosocial impact of bracing among adolescents, especially those with mild curves.

## Conclusion

Despite the ongoing debate regarding the effectiveness of brace treatment on patients with adolescent idiopathic scoliosis, our results indicate that bracing had a greater negative impact on the quality of life, especially at a function or activity level in patients with mild curves. In patients with severe curves, bracing did not seem to have as great an effect on the quality of life. These results also demonstrate the utility of the SRS-22 questionnaire as a health-related quality of life questionnaire taking into account not only the physical health of the patient, but also the emotional and psychosocial factors previously overlooked in traditional outcome studies.

## Key points

- Bracing has a negative impact on the quality of life of patients compared to patients under observation, especially in patients with mild curves.
- Recommendation: attention should be paid to patients with mild curves, and perhaps they should be given counselling.

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## References

1. Asher M, Lai SM, Burton D et al (2003) Discrimination validity of the Scoliosis Research Society-22 patient questionnaire: relationship to idiopathic scoliosis curve pattern and curve size. *Spine* 28(1):74–77
2. Asher MA, Lai SM, Burton DC (2000) Further development and validation of the Scoliosis Research Society (SRS) Outcomes Instrument. *Spine* 25:2381–2386
3. Dickson JH, Mirkovic S, Noble PC et al (1995) Results of operative treatment of idiopathic scoliosis in adults. *J Bone Joint Surg Am* 77:513–523
4. Fallstrom K, Cochran T, Nachemson A (1986) Long-term effects on personality of development in patients with adolescent idiopathic scoliosis. Influence of type of treatment. *Spine* 11:756–758
5. Gabos P, Bojescul J, Rich L et al (2002) Long-term follow-up of adolescent idiopathic scoliosis in women treated with the Wilmington brace. *Spine J* 2(5)Supp 1:116
6. Goldberg CJ, Moore DP, Fogarty E et al (2001) Adolescent idiopathic scoliosis: the effect of brace treatment on the incidence of surgery. *Spine* 26(1):42–47
7. Gratz RR, Papalia-Finlay D (1984) Psychosocial adaptation to wearing the Milwaukee brace for scoliosis. A pilot study of adolescent females and their mothers. *J Adolesc Health Care* 5(4):237–242
8. Haheer TR, Gorup JM, Shin TM et al (1999) Results of the scoliosis research society instrument for evaluation of surgical outcome in adolescent idiopathic scoliosis: a multi-centre study of 244 patients. *Spine* 24:1435–1440
9. Karol LA (2001) Effectiveness of bracing in male patients with idiopathic scoliosis. *Spine* 26(18):2001–2005
10. Katz DE, Durrani AA (2001) Factors that influence outcome in bracing large curves in patients with adolescent idiopathic scoliosis. *Spine* 26(21):2354–2361
11. Lonstein, Bradford, Winter, Ogilvie (1995) MOE's textbook of scoliosis and other spinal deformities, 3rd edn. WB Saunders
12. Maclean WE, Green NE, Pierre CB et al (1989) Stress and coping with scoliosis: psychological effects on adolescents and their families. *J Pediatr Orthop* 9:257–261
13. Noonan KJ, Dolan LA, Jacobson WC et al (1997) Long-term psychosocial characteristics of patients treated for idiopathic scoliosis. *J Pediatr Orthop* 17:712–717
14. Olafsson Y, Saraste H, Ahlgren RM (1999) Does bracing affect self-image? A prospective study on 54 patients with adolescent idiopathic scoliosis. *Eur Spine J* 8:402–405
15. Ramirez N, Johnston CE, Browne RH (1997) The prevalence of back pain in children who have idiopathic scoliosis. *J Bone Joint Surg Am* 79:364–368
16. Ugwonalie OF, Lomas G, Choe JC et al (2004) Effect of bracing on the quality of life of adolescents with idiopathic scoliosis. *Spine J* 4(3):254–260
17. Vitale MG, Levy DE, Choe JC, Gelijns AC, Moskowitz AJ, Royce DP (2001) Pediatric spine deformity: assessing patient outcomes and quality of life. Rosemont, IL: American Academy of Orthopaedics 68th Annual Meeting Proceedings vol. 2:547
18. Weinstein S (2000) Bristol-myers squibb/zimmer award for distinguished achievement in orthopaedic research. Long-term follow-up of paediatric orthopaedic conditions. *J Bone Joint Surg* 82-A(7):980–990
19. Wilson PL, Newton PO, Wenger DR (2002) A multicenter study analyzing the relationship of a standardized radiographic scoring system of adolescent idiopathic scoliosis and the scoliosis research society outcomes instrument. *Spine* 27(18):2036–2040