

Clinical Studies

Motivations for Compliance With Bracing in Adolescent Idiopathic Scoliosis

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Abstract

Study Design: Cross-sectional study.

Objective: To determine motivations for compliance with bracing among female patients with adolescent idiopathic scoliosis (AIS).

Summary of Background Data: Bracing prevents the need for surgery for the majority of girls with AIS with curves of 20° to 40° and 2 or more years of growth remaining. The main obstacle to success is compliance. The factors that either promote or impede compliance previously have not been fully clarified.

Methods: Participants were females 10 to 16 years of age who were prescribed a brace to be worn 16 hours per day for AIS. Each completed a “Scoliosis Compliance Questionnaire” composed of the SRS-22r and five original sections focused on patients’ attitudes to scoliosis, situations in which they found wearing the brace to be most and least difficult, factors that motivate brace wear, and interventions that could potentially improve compliance.

Results: Thirty-nine subjects completed the study, mean age 13 years (range 11–15 years), at a mean of 15.4 months (range 4–39 months) of brace wear at the time of recruitment. More than 90% of patients stated that their main motivations for compliance were the desire to avoid surgery and to prevent curve progression. Compliance was most challenging during the summer and while at school. Many patients reported pain and skin irritation in the brace. The majority reported they would likely improve their hours of wear if they were able to communicate with a peer in the same situation. SRS-22r scores were similar to those of healthy adolescents.

Conclusions: The most important influences promoting brace wear are the patient’s desire to avoid surgery and to prevent curve progression. Peer support potentially may improve compliance.

Level of Evidence: Level III.

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Keywords: Adolescent idiopathic scoliosis; Bracing; Treatment; Compliance; Females

Introduction

Bracing is effective in preventing the need for surgery for the majority of girls with adolescent idiopathic scoliosis (AIS) who have curves of 25° to 40° and 2 or more years of growth remaining [1–3]. Using temperature sensors to

record compliance, Weinstein and colleagues found that an average of 12.9 hours per day of brace wear was protective against the need for surgery in 90% to 93% of patients [1]. They found a significant association between hours of wear and the likelihood of success, defined as curve magnitude less than 50° at maturity.

An earlier study also using monitoring devices determined that curves did not progress 6° or more in 82% of patients who wore their brace more than 12 hours per day, whereas those who wore their brace fewer than 7 hours per day had no better results than the natural history [2]. In a study of the same group of patients, Sanders and associates determined that “high compliance,” defined as 10 or more hours of brace wear per day, is protective against the need for surgery [3]. Only 2 of 31 patients who

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wore a brace for 10 hours or more per day developed curves $\geq 50^\circ$, and none of the 13 patients who wore a brace for 14 hours per day progressed to a surgical range. However, compliance was low: 31% of patients wore the brace 10 or more hours per day and only 13% wore it 14 or more hours per day. The authors stated, “many factors likely contribute to the low overall compliance with bracing for adolescent scoliosis, including comfort, social issues, and self-image. Some patients may decide that the risk of progression to surgery is more acceptable than wearing a brace.” Counseling of patients based on monitor reports is an effective strategy to improve compliance [4]. Karol and coauthors determined that patients who were counseled based on actual hours of wear wore their orthosis an average of 13.8 hours per day, whereas noncounseled patients wore their brace an average of 10.8 hours per day.

Compliance with the prescription for bracing is a choice and may be affected by individual attitudes to the condition and treatment and perceived stress. The effect of spine deformity and its conservative management on quality of life and stress experienced by scoliosis patients has been extensively studied using various outcome instruments [5–15]. In a study that investigated patient pretreatment attitudes and subsequent compliance with bracing, the questionnaire was administered prior to initiation of treatment [16]. To now, no investigations have been performed to determine the specific factors and circumstances that may either promote or impede compliance with bracing during the treatment period.

The purpose of the present study was to elucidate external factors and individual attitudes that may affect compliance with the prescription for bracing in girls with AIS.

Materials and Methods

Inclusion criteria were girls between the ages of 10 and 16 years of age with AIS and prescribed a Boston Brace (Boston Brace International, Avon, MA) to be worn for 16 hours per day. At the time of initiation of bracing, patients were instructed to sleep in the brace and to also wear it during the daytime for a total 16 hours per day. They were allowed to select hours of daytime wear

based on their activities and preferences and to remove the brace for recreational sports if necessary. Patients were encouraged to be physically active and to exercise regularly.

Recruitment was by the investigators in the spine deformity clinic. Primary caregivers were responsible for monitoring compliance. Each participant completed a “Scoliosis Compliance Questionnaire.” This was composed of the SRS-22r and sets of questions related to the participant’s attitude toward her scoliosis, challenges to bracing, motivations promoting brace wear, obstacles to wearing the brace, and potential interventions that might improve compliance (Tables 1–4) [17–20]. The SRS-22r is a standard validated outcomes instrument [17]. We used this as a standard to determine well-being and health of the subjects and the effect of bracing. In addition, five sets of questions were used to study patient attitudes to bracing. The questions were developed de novo by one of the investigators (Tables 1–4). All participants were treated at the same center by one surgeon. This study was approved by our institutional review board. Statistical analysis of the SRS-22r data was performed using one-sample *t* test. Normal values for SRS-22r and minimum clinically important differences were calculated using previously published data and conversion factors [18–20]. We used the normal overall SRS-22 values from the study by Daubs et al. and did not distinguish by race/ethnicity [18].

Results

Thirty-nine participants completed the questionnaire. Two families refused to participate and one was dropped from the study because of a parental language barrier. Mean age at the time of enrollment was 13 years (range 11–15). The average length of time participants had worn a brace before the study was 15.4 months (range 4–39 months). Mean curve magnitude at initiation of bracing was 29° (range 23° – 38°). Participants self-identified average daily number of hours they wore their brace. Overall, 30 of 38 participants (79%) reported wearing the brace 10 or more hours per day.

Overall, participants scored well on the SRS-22r (Table 5). Although the mean scores in Function and Self

Table 1
Part II: Attitude to scoliosis.

How often do the following bother you about your scoliosis?	1 = never, n (%)	2 = rarely, n (%)	3 = sometimes, n (%)	4 = often, n (%)	5 = always, n (%)	No response, n (%)
Appearance of your shoulders	24 (67)	8 (22)	4 (11)	0 (0)	0 (0)	3
Appearance of your ribs	31 (86)	1 (3)	2 (6)	2 (6)	0 (0)	3
Appearance of your hips	21 (58)	6 (17)	5 (14)	3 (8)	1 (3)	3
Back Pain	10 (28)	10 (28)	11 (31)	3 (8)	2 (6)	3
How you look in clothing	16 (44)	8 (22)	6 (17)	3 (8)	3 (8)	3
Ability to do daily activities	18 (50)	8 (22)	7 (19)	1 (2)	2 (6)	3
Ability to play sports	23 (66)	4 (11)	3 (9)	3 (9)	2 (6)	4

Table 2
Part III: Challenges of bracing.

Situational challenges to brace compliance	n	%
In which of the above situations do you find it the MOST challenging to wear your brace?		
1. When you're at school	7	19
2. When you're at home	0	0
3. While sleeping	4	11
4. Staying with friends	3	8
5. Playing sports with friends or family (recreational)	2	6
6. At sports practices/games/meets (organized sports)	5	14
7. While traveling	2	6
8. During the winter	0	0
9. During the summer	10	28
10. While at summer camp	3	8
No response	3	
In which of the following above situations do you find it LEAST challenging to wear your brace?		
1. When you're at school	5	14
2. When you're at home	14	39
3. While sleeping	10	28
4. Staying with friends	1	3
5. Playing sports with friends or family (recreational)	0	0
6. At sports practices/games/meets (organized sports)	1	3
7. While traveling	0	0
8. During the winter	5	14
9. During the summer	0	0
10. While at summer camp	0	0
No response	3	

Image Domains were statistically significantly different from controls, the differences did not exceed those for the minimum clinically important differences for this age group [17-21]. In the Function domain, 59% of patients described their activity level as “full activities without restriction” and 72% described their level of work/school activity at 100%. In the Pain domain, 37 of 39 patients reported no medication use for back pain. No patient missed work or school because of back pain in the 3 months prior to completing the questionnaire. Within the Self Image domain, 77% of patients stated their back condition did not affect their personal relationships.

Part II reported subject’s attitudes to their spinal deformity. The majority were either never concerned or rarely concerned by any aspect of their appearance, including their shoulders, ribs, or hips and appearance in clothing (Table 1). Fifty-six percent rarely or never experienced pain in the back. Part III focused on challenges to compliance. The three situations identified as consistently the most challenging to wear the brace were “during summer,” “while at school,” and during “sports practices/meets/games” (organized sports) (Table 2). Least challenging situations to wear the brace were “while at home” and “while sleeping.” Parts IV and V of the questionnaire inquired about specific motivations either to wear or not wear the brace. Ninety-four percent of patients stated “the

Table 3
Part IV and V: Motivations to wear and not to wear your brace.

How often do the following motivate you to wear your brace?	1 = never, n (%)	2 = occasionally, n (%)	3 = sometimes, n (%)	4 = often, n (%)	5 = always, n (%)	NR
Desire to avoid surgery	1 (3)	2 (5)	0 (0)	4 (11)	30 (81)	2
Desire to keep your scoliosis from getting worse	1 (3)	1 (3)	1 (3)	12 (32)	22 (59)	2
Desire to prevent back pain as an adult	2 (5)	3 (8)	10 (27)	6 (16)	16 (43)	2
Because my doctor tells me to	2 (5)	7 (19)	10 (27)	10 (27)	8 (22)	2
Because my parents tell me to	2 (5)	7 (19)	8 (22)	10 (27)	10 (27)	2
How often do the following motivate you NOT to wear your brace?						
Back pain while wearing the brace	17 (47)	5 (14)	8 (22)	4 (11)	2 (6)	3
Pain from your brace rubbing/causing pressure points	7 (19)	15 (41)	5 (14)	6 (16)	4 (11)	2
What the brace looks like under clothes	9 (24)	10 (27)	9 (24)	3 (8)	6 (16)	2
Inconvenience	6 (16)	10 (27)	8 (22)	7 (19)	6 (16)	2
Inability to get your brace on or off by yourself	29 (78)	4 (11)	1 (3)	1 (3)	2 (5)	2
What I'm afraid others will say about my brace	11 (30)	9 (24)	3 (8)	8 (22)	6 (16)	2
The things that I have actually heard others say about my brace or me while I'm wearing the brace	26 (70)	6 (16)	1 (3)	0 (0)	4 (11)	2

Table 4
Part VI: Interventions.

How challenging do you find wearing your brace in the following situations?	1 = I would wear my brace less, n (%)	2 = I would wear my brace the same as I currently do, n (%)	3 = I would wear my brace more, n (%)	NR
If my brace came in different colors or patterns.	4 (11)	21 (55)	13 (34)	1
There were more clothes that I could wear over my brace.	1 (3)	14 (37)	23 (61)	1
If I knew that I could contact the “brace maker” at any point with concerns about how my brace fits.	1 (3)	31 (84)	5 (14)	2
If I knew that I could contact my doctor at any point with concerns about how my brace fits.	1 (3)	33 (87)	4 (11)	1
If I had a friend/peer to talk to who currently wears a brace for scoliosis.	0 (0)	11 (29)	27 (71)	1
If I had someone to talk to who has worn a brace for scoliosis in the past.	0 (0)	18 (47)	20 (53)	1

Table 5
SRS-22r domain and total scores.

Domain	Mean (SD)	Normal ^a (SD)	p-value	MCID ^b
Function	4.61 (0.28)	4.41 (0.56)	<.0001	0.81
Pain	4.42 (0.52)	4.45 (0.68)	.721	0.45
Self-image	4.04 (0.53)	4.43 (0.60)	<.0001	0.98
Mental health	4.01 (0.74)	3.90 (0.79)	.359	n/a
Satisfaction with management	4.28 (0.77)			
Total	4.27 (0.38)			

MCID, minimum clinically important difference; SD, standard deviation.

^a Normal values for SRS-22r and MCIDs were calculated using previously published data and conversion factors [18–20].

desire to avoid surgery” often or always motivated them to wear their brace (Table 3). Ninety-two percent reported the “desire to keep their scoliosis from getting worse” often or always motivated them to wear their brace, and 59% responded similarly about their “desire to prevent back pain as an adult.” Fifty-four percent of respondents identified their parent’s instructions as often or always motivating, whereas only 48% identified doctor’s instructions as often or always motivating. Fear of what others might say was identified as often or always an impediment to compliance in 38%. There were a range of opinions as to whether or not the appearance of the brace worn beneath clothing was an obstacle. Only 24% of patients identified this factor as often, or always an impediment. Although nearly half of all participants (47%) stated that back pain was not an obstacle, 39% responded pain to be an obstacle sometimes, often, or always. Excessive pressure by the brace was frequent; only 19% reported that it never was an obstacle (Table 3).

Part VI of the questionnaire required subjects to rate six potential interventions that might promote compliance. Seventy-one percent of patients responded having a friend/peer to talk to who also currently wears a brace for scoliosis would promote brace wear (Table 4). Overall, 60.5% responded that having more clothes they could wear over their brace would be beneficial. Moreover, 34% identified the brace coming in different colors or patterns as a positive factor.

Discussion

The success of nonoperative management in prevention of surgery for AIS is ultimately dependent on the patient’s acquiescence. When hours of wear have been accurately measured, patient compliance with the prescription for bracing for AIS has been found to be poor [1,2,16]. Furthermore, adherence may decrease over time [2]. Previous authors have concluded that “routine bracing without efforts to maximize brace compliance are likely to be less effective than the BrAIST trial indicates” [3].

The aim of the present study was to determine the main factors that are reported by patients to motivate or impede

compliance with brace prescription for AIS. Such information could be particularly useful now that bracing is known to be effective and is “dose dependent.” If influences for compliance are understood, then there may be modifiable factors that could improve results.

In the present study, for the majority of participants, desire to avoid surgery and to prevent curve progression were the main motivators for compliance. Our findings are similar to the study by Morton and colleagues, in which the statement “I am afraid that I will need surgery if I do not wear the brace” elicited the most consistently positive responses [16]. In the current study, 43% of patients identified their desire to prevent back pain as an adult as a factor that “always” motivated them to wear the brace. The question was included because the authors had hypothesized that concern for back pain could be a potential motivator to adhere to brace prescription. Subjects in this study had not been informed by the treating surgeon that back pain is a natural result of scoliosis, so it is unknown why many reported it as a major motivator. The majority of the girls reported that advice given by the surgeon and by their parents had little influence on their decision to comply with bracing. However, the treating physician routinely took time to explain to each patient the treatment options, rationale for bracing, and the risk of development of “surgical curves” in the absence of high compliance. The responses would seem to reflect the ability of young adolescents to process key medical information, especially the rationale for medical/interventional treatment. Of note, the work was conducted after the publication of the BrAIST study, the publication of which may have positively influenced both patient and surgeon behavior [1].

The results of the SRS-22r in this study are consistent with previous research and serve to again demonstrate that girls who are braced for AIS often do not have a significantly different health profile from that of the healthy adolescent [5,14]. Patients were coping well. These results suggest that bracing for AIS may have less impact on well-being than believed by some previous investigators [7,9,11–13]. Along with other published reports, this suggests that “part-time” bracing for 16–18 hours per day may have minimal effect on the quality of life of girls with AIS [5,6,14]. In contrast, brace prescription for 22 hours per day does seem somewhat detrimental to quality of life during treatment [7,9,11–13]. Brace prescription of 16 hours per day has been shown to be effective, and patients who are prescribed 23 hours per day do not seem to wear the device more [1,2]. The previously cited research along with that by Danielsson and colleagues and our results may serve to reassure patients and parents that bracing for scoliosis, especially when prescribed 16 hours per day, is a temporary state of affairs that allows the majority of girls to function well while under treatment and will have no lasting ill effects [8,10].

Only 24% of the girls in this study reported that wearing a brace to school was a major obstacle. Although responses

to this question may have been influenced by the prescribed hours of wear, the results suggest that especially for those girls who wish to remain active in sports or other activities, wearing the brace to school and removing it for after school activities may be acceptable. Future studies may address this issue in particular.

Most of the patients reported at least some problems with comfort while wearing their brace. This might suggest that communication with the orthotist and education for orthopedic surgeons on appropriate critical analysis of brace fabrication and fit are potential sources of improved compliance.

Our study had limitations. The questionnaire piloted in this study has not been validated. Our intention was to design a questionnaire that would be relatively easy to comprehend and which would be consistently interpreted by the study population. Responses to certain questions such as those regarding perception of deformity may potentially have been biased by patient expectations, satisfaction with treatment. In a similar study, the Brace Beliefs Questionnaire was administered by Morton and colleagues to 124 patients [16]. The Brace Beliefs Questionnaire was used before treatment and the objectives of that study were somewhat different from ours. We sought to address specific factors including attitude to bracing and other potential circumstances that may affect compliance during treatment. For these reasons, it was necessary to develop a new line of inquiry. The questionnaire was completed by the participants during the clinic visit. The questions were specifically designed to inquire into those social and physical factors that would be of greatest concern to girls of this age group. Ours was a cross-sectional study, with potential for selection bias. The questionnaire was not administered prior to treatment so we do not know the preexisting attitudes and baseline SRS-22r scores in our study cohort. Mean time from initiation of bracing was 15 months, which is generally close to the half-way point in medical/interventional treatment. It is possible that patient attitudes and chief concerns change during the period of time they are braced, which could explain the observed decline in compliance. Future longitudinal studies could investigate this. SRS-22 scores may be affected by demographic factors [21]. For our study group, it would not have been meaningful to segregate results by demographic profile or race. All of the subjects were girls from the same geographic locality. With the numbers of subjects this study, we could not categorize the results by race or culture. Therefore, our results may not necessarily apply to all racial, cultural, and socioeconomic groups. Our center is located in a temperate climate zone, and there could be seasonal variation in responses to certain questions and in brace compliance.

No brace timer was used, and hours of wear were self-reported. Monitoring of compliance was performed by the primary caregivers. The present study was not designed to assess the accuracy of the patient's or primary caregiver's

estimates of compliance. In the study by Morton et al., estimates of adherence by orthotists, treating physicians, and parents were found to be inaccurate. Although it would be useful to relate actual hours of wear with attitudes to bracing, this was not our primary purpose. Future studies with larger patient cohorts could investigate this. The Boston brace was the only brace used. The Boston brace and similar styles are the most commonly prescribed braces in the United States, so our findings should be applicable to most clinical practices. It is possible that other styles of brace might produce different results, especially to questions regarding appearance in brace and comfort. Wearing the brace to school was optional. Patients were told to select the 16 daily hours of wear, which suited them best. This may have influenced the responses to acceptability of wearing the brace to school.

Conclusions

The findings of our study serve to improve understanding of motivations and perceived obstacles to brace wear for female patients with AIS. Future studies may determine if the main influences identified in this study, such as peer support, may be used to improve compliance.

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