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Treatment of idiopathic scoliosis with side-shift therapy: an initial comparison with a brace treatment historical cohort

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Abstract A group of 44 patients with idiopathic scoliosis (mean age 13.6 years) with an initial Cobb angle between 20° and 32° received side-shift therapy (mean treatment duration 2.2 years). A group of 120 brace patients (mean age 13.6 years) with an initial Cobb angle in the same range (mean brace treatment 3.0 years) was the historical reference group. Failure was defined as an increase of Cobb angle greater than 5° within 4 months or a Cobb angle greater than 35° or a total increase of Cobb angle greater than 10°. The chance of success was not significantly different between the side-shift and the brace groups, whether tested for efficiency (66% vs 68%) or efficacy (85% vs 90%). The difference in the mean progression of the Cobb angle for the respective groups is small (for efficiency: 3° vs –2°, for efficacy: 2° vs –1°). Side-shift therapy appears to be a promising additional treatment for idiopathic scoliosis in adolescents with an inital Cobb angle between 20° and 32°.

Key words Side-shift · Idiopathic scoliosis · Treatment · Posture training

Introduction

Traditionally, conservative treatment of idiopathic scoliosis in adolescents consists of a brace and, in severe cases, an operation. Brace treatment has proved to influence positively the outcome of scoliosis as compared to the natural history [12, 14, 16, 20].

However, brace treatment has its drawbacks. Although psychopathology has not been found in braced scoliosis patients, the patients and their families experience the wearing of a brace not only as stressful and as a barrier to physical and social activities but also as detrimental to developing autonomy [6, 9]. These results were confirmed in an unpublished study in our clinic (Daamen 1988). Therefore, the search for a good alternative continues.

In the 1970s, electric stimulation of scoliotic curves was used, but this has now been discontinued [4, 13, 18]. In several scoliosis treatments, exercise is used as a part of the program [19]. In the beginning of the 1980s, Mehta introduced side-shift therapy [10]. This in an active form of autocorrection, in which the patient is taught to shift the trunk sideways over the pelvis in the direction opposite to the convexity of the primary curvature. In this way the primary curvature is, for a moment, corrected or even overcorrected by muscle contraction, as shown in Fig. 1. Side shift is used as a stand-alone treatment. According to Mehta, the frequent repetition of this maneuver can stabilize and even correct an early idiopathic scoliosis [10; Mehta, personal communication]. For 35 children with an initial Cobb angle of 15° to 42°, the Cobb angle had either decreased or remained unchanged in 71%. Based on these encouraging results, we introduced side-shift therapy in our clinic in 1985.

The results of the less taxing side-shift treatment were compared to the results obtained in a reference group of 290 patients who received brace treatment at our clinic [17]. The chance for success and failure for the two treatments as well as the progression of the Cobb angle were determined, in order to ascertain whether side-shift ther-

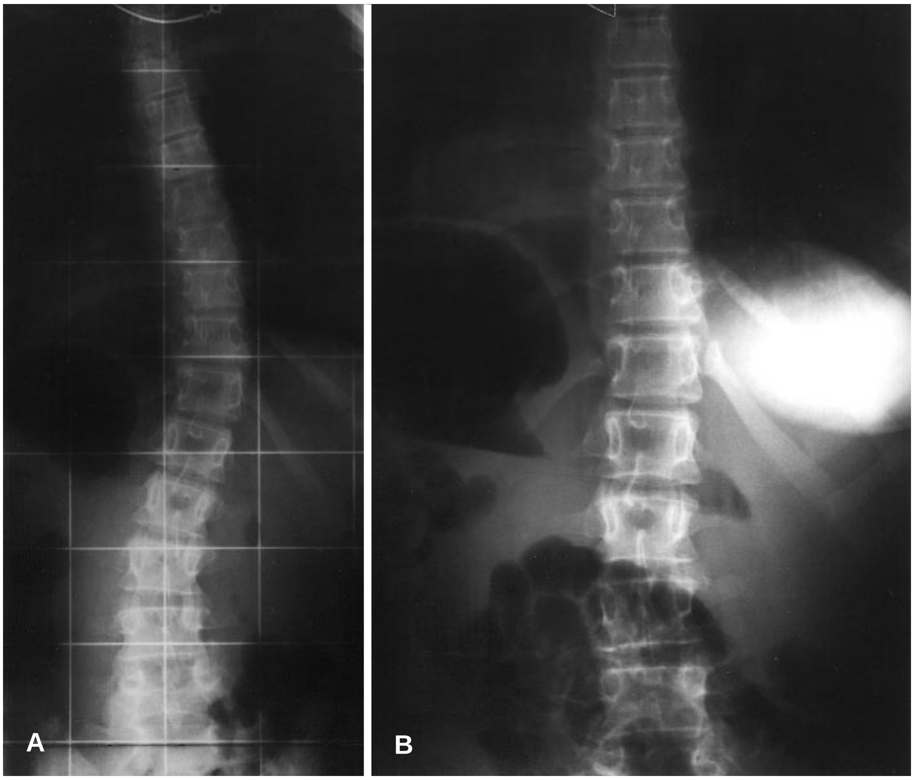

Fig. 1 **A** 14.7-year-old girl at the beginning of the side shift treatment **A** in her normal posture (Cobb angle = 32°), and **B** in the side-shift position (Cobb angle = 8°)

apy was equally successful as brace treatment in halting the progression of the primary scoliotic curve. Although we acknowledge the methodological limitations associated with an historical cohort study, this method can serve as an initial investigation to compare the efficacy and efficiency of side-shift therapy, as described by Mehta, with brace treatment.

Patients and methods

The many scoliosis patients who visit our clinic each year are randomly assigned to the staff members specialized in the treatment of scoliosis. Since 1985, scoliosis patients with initial Cobb angles less than 32° visiting M. A. P. K. received side-shift therapy. In the period from 1985 to 1995, 91 patients in total followed this treatment until the end of growth. Consecutive patients entering this form of treatment were eligible for the study. Radiographs were not available for four patients. Of the remaining 87 patients, 44 met the inclusion criteria given in Table 1. The patient had to be old enough to learn the shifting movements and to perform them independently once the training session was completed, and had also to still be in the growth period. Reasons for exclusion were congenital scoliosis (n = 1), starting side-shift therapy after having first been treated with a brace (n = 3), wearing a brace at night (n = 10), not meeting the age requirement (n = 7), starting side-shift therapy with an initial Cobb angle less than 20° (n = 17), starting side-shift therapy with an initial Cobb angle greater than 32° (n = 3), and stopping treatment within the first 4 months (n = 2). W.A.d.B. measured all the available radiographs.

Table 1 Inclusion criteria

Side-shift therapy as the only treatment method
Idiopathic scoliosis
10 years ≤ age ≤ 15 years
20° ≤ initial Cobb angle ≤ 32°
Treatment duration > 4 months

Patients received side-shift instruction from a physical therapist who had completed training instruction at the Scoliosis Unit at the Royal National Orthopaedic Hospital Trust (London). Before the patients were taught the specific movements associated with side-shift therapy, they were given exercises to improve the general posture, to make the muscles more limber, and to increase the muscle strength. Before the actual side-shift instruction began, the patients were also taught to tilt the pelvis backwards when sitting and standing as well as to stretch the spine, as almost all idiopathic scoliosis patients have a lordoscoliosis. In addition, patients learned to maintain their balance on a rocking board. During the actual side-shift training, patients had to maintain the side-shift position for 10 s before relaxing.

In general, patients had 10 to 12 half-hour sessions once a week to learn to side shift. To control whether side shifting really corrected the curvature, a radiograph was made in the shift position, and the Cobb angle was compared to that on the radiograph at the start of the treatment. Once patients showed proficiency in the side-shift method, they received a refresher session once every 4 months. Patients were instructed to remember to shift as often as possible during the day. As much as possible, side shifting was integrated into the daily living activities by creating optimal conditions. For example, the position of the child watching television was to be chosen so that the patient shifted “towards” the TV. Patients were motivated by giving information including feedback of the movements by mirrors, and parents were closely involved with the therapy. The patients in the reference group were consecutively

Table 2 Characteristics of the groups: mean values with SD in parentheses

	Side shift (*n* = 44; 2 M/42F)	Brace[a] (*n* = 120; 13 M/107F)
Age (skeletal) at start (years)	13.6 (1.2)	13.6 (1.3)
Cobb angle at start	26° (4°)	27° (4°)
Length of treatment (years)	2.2 (0.94)	3.0 (1.00)

[a] Styblo dataset [17]
[b] If skeletal age was not available chronological age was used (side-shift: 30 chronological age; brace: 8 chronological age)

braced patients with idiopathic scoliosis who visited our clinic between 1970 and 1982 [17]. They wore a brace 23 h a day. Of the 290 patients presented in that study, data needed for the analyses in the current study were missing for three patients. Of the remaining 287 patients, 120 met the last four inclusion criteria in Table 1. In that study, K.S. measured all the radiographs. The basic characteristics for both groups are given in Table 2.

The side-shift and the brace groups were compared using two measures for treatment outcome. The association between the type of treatment and the success and failures were tested using an odds ratio with a 95% confidence interval (CI). If the CI contains the value 1, the association is not significant. The comparison of the values of the Cobb angle at the start and end of the treatment between the two groups was evaluated using an analysis of variance with α set at 0.05.

The treatment was classified as a success or failure according to the following failure criteria:

1. Non-compliance
2. Progression of the Cobb angle > 5° within a 4-month period
3. Progression of the Cobb angle > 10° during treatment
4. Cobb angle > 35° during or at the end of treatment

The failures per treatment type are given in Table 3.

The second outcome measure was the progression of the Cobb angle between the start and the end of treatment. For the side-shift group, the mean (SD) Cobb angles at the start of treatment and at the end of treatment were 26° (±4°) and 28° (±7°), respectively; for the brace group the Cobb angles were 27° (±4°) and 25° (±9°), respectively.

During treatment, ten patients were classified as a side-shift failure. Brace treatment was then started. At the end of the brace treatment, seven had a progression of less than 10° in the Cobb angle at the end of growth. The remainig three patients had progressions of 11°, 14°, and 15°.

Table 3 Number (percentage) of patients per failure type for each method of treatment. The patients were classified as failure according to the first criterion met in the order given below

Failure	Side shift	Brace[a]
Non-compliance	2 (4.5%)	29 (24.2%)[b]
Progression > 5° in 4 months	8 (18.2%)	unknown
Progression > 10° during treatment	4 (9.1%)	6 (5.0%)
Cobb angle > 35° during or at end of treatment	1 (2.3%)	3 (2.5%)
Total	15 (34.1%)	38 (31.7%)

[a] Styblo dataset [19]
[b] Seven had bad compliance; 22 had partial compliance

Results

The first analysis was carried out under the assumption of intention to treat; therefore, non-compliance (and thus also only partial compliance) was considered to be a failure. The percentages of success/failure for each group are given in Table 4. There was no difference in the chance of success between the side-shift and the reference brace treatment groups as tested by odds ratios (OR = 1.12; 95% CI: 0.54, 2.32).

To test for efficacy, only the results obtained with good compliance are used. However, for one definition of failure there were no comparable data in the reference set (progression of the Cobb angle greater than 5° within 4 months). The values given in Table 4 are obtained if the success rate is calculated based on failure being defined as progression greater than 10° during treatment and a Cobb angle greater than 35° at the moment that treatment was

Table 4 The relative success/failure of the two methods of treatment under the assumption of intention to treat (efficiency) and with non-compliant cases removed (efficacy)

	Side shift	Brace[a]
Efficiency		
N	44	120
Success	65.9%	68.3%
Failure	34.1%	31.7%
Efficacy		
N	34	91
Success	85.3%	90.1%
Failure	14.7%	9.9%

[a] Styblo dataset [17]
[b] Cases of non-compliance and cases for which there were no comparable data in the Styblo data set (progression of the Cobb angle greater than 5° within 4 months) have been removed

Table 5 Mean progression in Cobb angle per group (efficiency) and with non-compliant cases removed (efficacy)

	Side shift	Brace[a]
Efficiency		
N	44	120
Mean (SD) Cobb angle	2.6° (6.4°)	–1.5° (7.9°)
Range	–19° to 14°	–22° to 31°
Efficacy[b]		
N	34	91
Mean (SD) Cobb angle	1.5° (6.6°)	–1.3° (8.2°)
Range	–19° to 14°	–22° to 31°

[a] Styblo dataset [17]
[b] Cases of non-compliance and cases for which there were no comparable data in the Styblo data set (progression of the Cobb angle greater than 5° within 4 months) have been removed

stopped. According to the odds ratio test, there was no significant difference in the success rates between the side-shift treatment group and the reference brace treatment group (OR = 1.57; 95% CI: 0.49, 5.07)

In the second method for testing treatment outcome, the progression of the Cobb angle between the start and end of treatment is used. To test the intention to treat, all cases in each group were used. The means and the ranges of the progression of the primary curve are given in Table 5. The difference in mean progression between the groups was small (and less than the accuracy of the measurement, which is 5°), and the range in both groups was great (33° or more). An analysis of variance revealed that the mean progression in the Cobb angle in the side-shift treatment group (Table 5) was significantly different from that in the brace treatment group [$F(1,162) = 9.52$, $P = 0.002$].

The difference in the efficacy of the two treatments was tested by excluding cases with non-compliance and the cases in the side-shift group for which there were no comparable data in the reference group data set (Table 5). An analysis of variance revealed that there was no significant difference in the progression of the Cobb angle (Table 5) between the two groups [$F(1,123) = 3.18$, n.s.].

Discussion

This study compared side-shift therapy to brace treatment for scoliosis patients with an initial Cobb angle between 20° and 32°. Brace treatment for idiopathic scoliosis is the gold standard to which every new therapy is compared. The results of the brace treatment reported here are comparable to those found in the literature [7, 14, 20]. There was no significant difference in the success rates in either efficiency or efficacy between the side-shift treatment and brace treatment. The difference in the mean progression of the Cobb angle from the start to the end of treatment between the two therapies is less than 5°. Taking the measurement error into consideration, the clinical significance of this slight difference seems negligible. These results suggest that the less taxing side-shift therapy should be considered as a possible treatment for patients with an initial Cobb angle between 20° and 32°.

However, it must be noted that there are two methodological considerations that could have influenced the findings. Since a different investigator measured each treatment group, it is theoretically possible that a systematic measurement error contributes to the results found. Secondly, compliance for both treatments is difficult to assess. Under the assumption of intention to treat, there is no distinction between partial and total non-compliance; hence, the higher percentage of non-compliance in the brace group. The 24% non-compliance in the brace group is much lower than what has been reported in the literature [5, 8]. Nevertheless, not wearing the brace would have been easier to judge than whether the patient remembered to ‘side shift’ while doing homework or watching television. In addition, we do not know how much shifting is necessary to be beneficial.

We limited the side-shift therapy to patients with initial Cobb angles less than 32°, because the effectiveness of the therapy had not yet been fully documented. If the failure criteria were reached, the patient was fitted with a brace, either to wear in bed at night or 23 h a day. The stringent criteria that we used to identify failure means that ‘failure for the side-shift therapy’ is not equivalent to failure for the treatment of scoliosis. As reported earlier, the patients classified as failures for side-shift therapy due to the increase in the Cobb angle during the treatment all had a final progression in the Cobb angle that was 15° or less; seven patients had a progression at the end of growth that was less than 10°.

All therapies for idiopathic scoliosis are symptomatic. The treatment attempts to inhibit further progression by correction of the curvature. Brace treatment applies an external force on the scoliosis and is a form of passive therapy. With side-shift therapy, the spine is actively corrected by the patient’s active muscle contraction. Electrostimulation evokes a muscle contraction that corrects the scoliosis during the application of the electric current [1, 2]. However, electrostimulation is restricted to only a few thoracic muscle groups and is a passive form of correction. In contrast, the muscle contraction side-shift therapy is active, and more synergistic muscle groups are involved.

According to Mehta [10], side-shift therapy works as follows. The scoliotic curvature develops above the base of an oblique (or tilted) stack of two or three vertebrae. This is the target zone for deforming forces, and the resulting imbalance leads to the scoliosis. During the shift to the side, the deforming forces are opposed and the stack of vertebrae moves back toward the midline vertical. In our opinion the exact mechanism of side-shift therapy is still unknown. Whether the repetitive autocorrection diminishes growth-plate disturbances of the vertebral body or whether reduced proprioceptive dysfunction is corrected by the side-shift treatment remains unclear. Birbaumer et al. reported that with biofeedback scoliosis patients could be trained to correct body posture [3]. Ten of the 15 scoliosis patients who underwent the biofeedback treatment had a decrease in the post-treatment Cobb angle. Based on limited follow-up data that showed that the Cobb angle remained stable after the biofeedback device was no longer used, the authors propose that the postural correction requires no conscious effort by the patients. It seems reasonable to assume that side-shift therapy could also result in such an automatized postural correction.

Shirado et al. [15] compared dynamic weight transfer in the frontal plane during side-shift movements, as described by Mehta, in patients with idiopathic scoliosis to that in normal controls. They found impaired weight transfer to the concave side of the curvature in the scoliosis patients. The role of the abnormal pattern in dynamic weight shift in the development of scoliosis has not yet been elucidated. Although it is not clear whether the disturbance in weight transfer is a cause or a result of the scoliosis, side-shift therapy might be effective not only in correcting the curvature but also in improving the abnormal weight shift pattern.

A difficult issue is the question of whether side-shift therapy influences the natural history in a positive way. With our data, it was not possible to determine with certainty whether the side-shift treatment positively influenced the natural history. It would have been easier to detect the influence of the side-shift treatment if we had chosen patients with Cobb angles above 32°, since the risk of progression is more pronounced in larger angles [11]. Only one prospective study was found that compares the effect of treatment (an underarm brace) with observation [12]. The success rate, as determined by survivorship analysis, differed significantly between the two methods (34% for observation only vs 74% for brace treatment). In that study, the brace and the observation populations had the same age and initial Cobb angle as in our study, and the definition of failure was comparable. Based on the findings in the Nachemson et al. study [12], it is possible to infer that, since in our study there is no difference between the efficacy of the brace treatment and the side-shift therapy, it is most likely that the side-shift therapy positively influenced the natural history. A prospective study that compares side-shift therapy to treatment solely by observation is needed to investigate whether this in fact is the case.

Conclusion

Side-shift therapy should be considered as an additional treatment for idiopathic scoliosis in adolescents with an initial Cobb angle between 20° and 32°.

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