Three-year results of bracing in scoliosis

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We treated 107 patients with idiopathic scoliosis with the Boston brace. The primary correction was good in all the curve patterns. The follow-up time after weaning averaged 3 years. The best final result was achieved in thoracic and lumbar curves (mean 2°). The final correction was worse in patients with an initial curve less than 30° when compared with the patients with larger curves. Except the double major curves, there was a positive correlation between the primary correction, duration of the treatment, and the final result. The results in 14 patients with bracing for 12 hours daily did not differ from the remainder. Progression of the initial curve more than 5° after the treatment was noted in 24 patients. Three patients were operated on later because of progression. We conclude that bracing can prevent progress of scoliosis.

Slight correction of scoliosis after bracing has been shown in several studies (Keiser and Shufflebarger 1976, Carr et al. 1980, Laurnen et al. 1983, Willner 1984, Bassett and Bunnell 1986). Initial correction of the curve has been achieved with different types of braces (Carr et al. 1980, Udén and Willner 1983, Bassett et al. 1986). Laurnen et al. (1983) found that the Boston brace was effective in curve patterns with apex up to Th 6. However, there is a tendency for the correction to be lost during the first years after the treatment (McCollough et al. 1981, Hassan and Bjerkreim 1983, Bassett et al. 1986). It has been stated that improvement after bracing is best in the thoracolumbar and double major curve patterns (Bassett et al. 1986). On the other hand, Duval and Lamireu (1985) have shown that thoracic and double major curves tend to be more progressive than thoracolumbar and lumbar curves. Willner (1984) found equal primary correction in the thoracic and lumbar scolioses.

Indications for bracing with curves up to 40–45° is generally accepted. Prospective studies, evaluated with nontreated controls, have not been performed; also the natural history of curves of less than 40° is incompletely known. Miller et al. (1984) suggested that bracing perhaps was not necessary for a large proportion of patients because of the nonprogressive nature of mild curves. We calculated the results of the bracing and the behavior of different curve patterns during the treatment.

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Patients and methods

During 1979–83, 162 patients (149 girls and 13 boys) with adolescent idiopathic scoliosis were treated with the Boston brace at our hospital. The mean age of the patients was 15 (10–17) years when the treatment began. The distribution of the curve patterns was 37 percent thoracic, 16 percent thoracolumbar, 17 percent lumbar, and 30 percent double major curves (Table 1). Patients with

Table 1. Behavior of different curve patterns. Values are degrees of the curve at the start of treatment T, in brace B, at weaning W, and final result R

	N	T	B	W	R
Thoracic	60	35	22	27	33
Thoracolumbar	25	36	21	31	36
Lumbar	28	37	26	33	35
Double curves	49	40	26	33	41

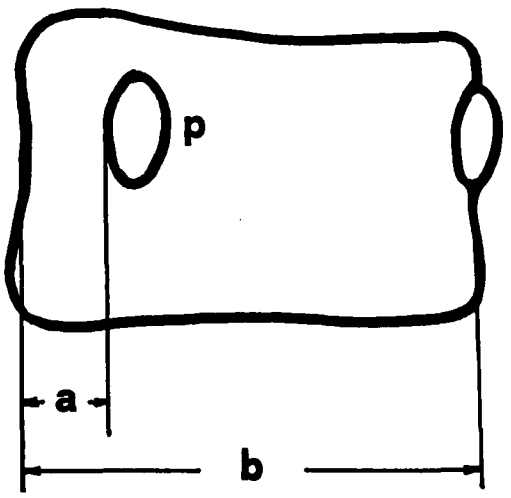

Figure 1. Rotation of the apical vertebra: 100a/b
p = pedicle

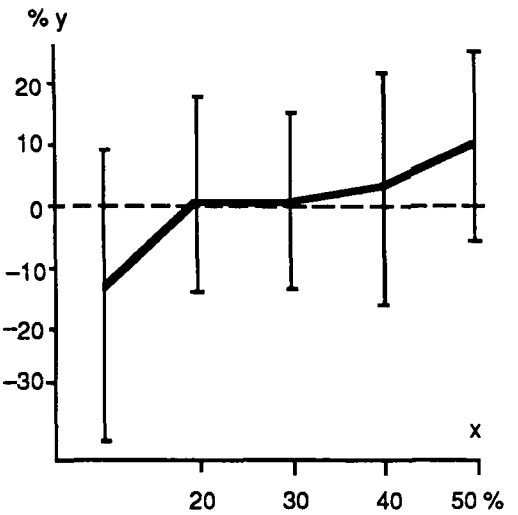

Figure 2. Correlation between the primary correction in brace (x) and the final result (y). $r = 0.396$ ($P < 0.001$).

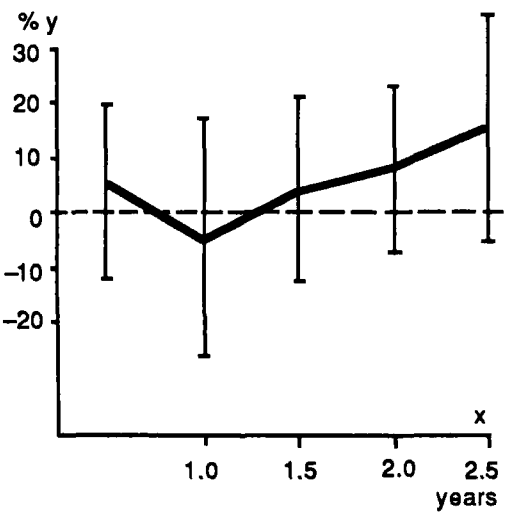

Figure 3. Correlation between the duration of treatment (x) and the final result (y). $r = 0.258$ ($P < 0.05$).

curve angles between 25° and 40° were selected for treatment. In double major curves, up to 50° was accepted. Patients with more than 5° of progression during 6 months of observation were also included.

The Boston thoracic brace was used in patients with apex at Th10 or higher, and the Boston lumbar brace when the apex was lower than Th10. The brace was adjusted at the hospital and checked at the outpatient visits at 4–6 months' intervals. The weaning was started when the growth had ceased, after which the patients gradually gave up the brace during a 6-month period.

The curve angles were measured from plain radiographs according to Cobb. Rotation of the apical vertebra was determined by the modified method of Perdriolle and Vidal (1985) shown in Figure 1.

The Student's *t*-test was used.

Results

Twelve patients interrupted the treatment. The follow-up time of at least 1.5 years after the weaning was fulfilled for 107 patients. Duration of treatment for these patients was 1.5 (0.5–4) years, and the mean follow-up time was 3 (1.5–7) years. The average correction was 2° in thoracic and lumbar curves (Table 1). Thoracolumbar curves remained unchanged, and double major curves deteriorated 1°. The primary brace correction correlated with the final result (Figure 2). In primary curves, there was also a positive correlation between the duration of the treatment and the final result (Figure 3). Rotation of the apical vertebra correlated with the degree of the scoliotic curve and remained unchanged before and after the treatment.

Progression of the curve more than 5° was noted in 24 patients (Table 2). Three of these were operated on. The duration of treatment of these 24 patients did not differ from the rest. However, the mean follow-up time was 7 months longer

Table 2. Change of the initial curve at the final check. – corrected, + progressed

Degrees	Number of patients
−20 > −15	1
−15 > −10	4
−10 > − 5	17
− 5 > 0	29
+ 5 < 0	32
+10 < +5	18
+15 < +10	5
+20 < +15	1

($P < 0.01$) than for the patients with no progression of the initial curve.

Fourteen patients with an initial curve of less than 30° had a worse final correction than the patients with a curve over 30° ($P < 0.05$). There was no correlation between the age of the patients at the start of the treatment and the final result.

Fourteen patients were noted to have worn the brace only 12 hours a day. Their results did not differ from the remainder with full-time bracing.

Discussion

In adolescent idiopathic scoliosis, curves between 25° and 45° have generally been considered suitable for brace treatment (Carr et al. 1980, Laurnen et al. 1983, Rudicel and Renshaw 1983). Slight permanent correction using the Milwaukee brace has been reported by Keiser and Shufflebarger (1976) and Mellencamp et al. (1977). More modern constructions, such as the Boston and Wilmington braces (Laurnen et al. 1983, Bassett et al. 1986), have also proved to be effective in scoliosis with the apex up to Th6.

Jonasson-Rajala et al. (1984) and Bassett et al. (1986) described good primary correction in brace. We noted that the primary correction in brace correlated with the final improvement. Carr et al. (1980) have also reported that the initial correction in brace correlated with the long-term results of the treatment. According to Bassett et al. (1986), the final correction was best in thoracolumbar curves treated with the Wilmington brace. We found the worst final result in double major curves, which may be due to the insufficient flexibility of these curves in brace.

The age of the patient is known to correlate with the incidence of progression of the scoliotic curve (Lonstein and Carlson 1984). However, as in our material, no correlation has been found between the age of the patients and the final correction (Rudicel and Renshaw 1983).

An interesting subject of discussion has been the effect of part-time bracing. Green (1986) found in his prospective study equal final results after part-time bracing when compared with 23-hour bracing. Our results are in agreement with his report. It may be that in practice true brace compliance is substantially less than estimated clinically and by the patient (Houghton et al. 1986). More prospective studies are needed to ascertain whether bracing of 12 to 16 hours daily or only at night is sufficient in treating scoliosis.

As has been shown in earlier studies (Hassan and Bjerkreim 1983, Bassett et al. 1986), the possible progression of the scoliosis after bracing can be seen only after several years. Thus, the importance and preventive effect of conservative treatment on the natural history of idiopathic scoliosis remains to be fully established.

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