

Results of Treatment of Idiopathic Scoliosis with the Charleston Bending Orthosis

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The authors present a preliminary retrospective review of the treatment of 32 patients with idiopathic scoliosis with the Charleston bending thoracolumbosacral orthosis (TLSO), a new, low-profile spinal orthosis. At the onset of treatment, the patients' mean age was 12.5 years and the mean Risser stage was 0.4. Females achieved menarche at an mean of 1.8 months after starting orthotic treatment. Single structural curves were treated in all patients. At this time, 2 patients have failed treatment, their curves progressing 12° and 8°, respectively. An additional 11 patients have successfully completed treatment, having reached skeletal maturity with no more than 5° of curve progression. Their mean curve change was a 2.2° decrease. The other 19 patients remain under treatment. The Charleston bending TLSO is worn only during nighttime sleeping hours. It is well tolerated, with excellent patient compliance and low psychological stress, and it may be as successful at curve control as other orthoses. Experience with more patients and longer follow-up is needed. [Key words: Idiopathic scoliosis, orthotic treatment, spinal orthosis, part-time orthotic treatment]

ORTHOTIC THERAPY FOR idiopathic scoliosis can be difficult for immature patients of juvenile and adolescent age.^{2,11} Although the benchmark for orthotic treatment has been the Milwaukee brace, recently there has been a trend toward lighter-weight, low-profile orthoses; results with this latter type of brace have been encouraging.^{1,3,7,9,12} Furthermore, studies comparing the results of full-time orthotic treatment with part-time treatment have shown that, at least statistically, part-time orthosis wear can produce results comparable with full-time wear.^{4-6,10}

In the mid 1980s, the Charleston bending thoracolumbosacral orthosis (TLSO) was developed. This is a low-profile, anterior-opening, lightweight, thermoplastic orthosis. It is easily applied and removed by the patient and is worn only during nighttime sleeping hours. The orthosis bends the trunk, and therefore the spine, toward the convexity of the structural curve being treated. This corrects or "overcorrects" a scoliotic curve. No other pads or relief areas are used in the orthosis.

This article presents the preliminary results of treatment of idiopathic scoliosis with the Charleston bending TLSO at the Newington Children's Hospital from January 1986 to August 1989.

MATERIALS AND METHODS

Forty-six patients (42 females and 4 males) were treated. Criteria for treatment selection and, therefore, inclusion in this study are listed in Table 1. Fourteen patients were excluded from the study for reasons described in Table 2. The remaining 32 patients constituted the study group. All patients were instructed to wear the orthosis only while in

bed at night. Follow-up occurred on an outpatient basis every 4 to 6 months, with a clinical history, physical examination including height and weight, and a single posteroanterior radiograph of the entire spine being obtained. The authors measured all curves using Cobb's method. The major structural and compensatory curves were measured, the Risser stage was determined, the compensation of the spine was measured, and apical vertebral rotation was noted. A measurement error of $\pm 3^\circ$ was accepted. Thus, curve progression or regression was defined as any curve with a change of at least 4° . Treatment failure was defined as curve progression of 6° or more.

Orthotic treatment was discontinued at the end of skeletal growth, as determined by the completion of excursion of the iliac apophysis with at least partial fusion to the ilium and no change in height over a 9-month period. Compliance was determined by patient and parental interviews at each outpatient visit. The interview was given by both a physician and a nurse from the outpatient department. To confirm compliance, all patients were contacted by telephone at the time of preparation of this study. A patient who wore the orthosis at least 80% of the time was considered to be compliant with the treatment program.

RESULTS

Of the 32 patients in the study group, 30 were female and 2 were male. The mean age at the onset of treatment was 12.5 years. The average Risser stage at onset of treatment was 0.4. The female patients achieved menarche at a mean time of 1.8 months after the onset of orthosis treatment.

All patients had single major structural curves. There were 16 thoracic curves (apex, T8-T10), 11 thoracolumbar curves (apex, T12 or

Table 1. Criteria for Inclusion in the Study

Diagnosis of idiopathic scoliosis
Curve progression of at least 5° for a curve of $25-29^\circ$, or a curve of at least 30° but $< 40^\circ$, with or without evidence of progression
Treatment only with the Charleston bending TLSO
Skeletal immaturity at the time of orthosis initiation, designated by the iliac apophysis having less than 50% excursion (Risser 2)
Patient cooperation, requiring compliance of $> 80\%$ of the time treated
Treatment with the orthosis for at least 12 months
Curve having an apex caudal to T7
Single structural curve

Table 2. Patients Eliminated from the Study

Two patients had complete noncompliance for medical reasons: discomfort from multiple abdominal scars
cystic fibrosis requiring multiple hospital admissions
Eight patients have been treated for less than 12 months
Two patients were treated with another orthosis prior to initiating the Charleston bending TLSO
Two patients were noncompliant

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L1), and 5 single lumbar curves (apex, L2-L4). The mean curve magnitude at the onset of treatment was 29.6° (range, 25-35°).

Thus far, 2 of 32 patients have failed treatment and the Charleston bending TLSO has been discontinued. One patient had an 18° curve at age 11 years, which progressed to 28° over the ensuing 16 months. At that time (patient age, 12 years, 4 months), Charleston bending TLSO treatment was initiated. After 20 months, at age 14 years, the patient's curve was maintained at 27°. Then, over the next 5 months, the patient's curve progressed to 40°. Her treatment was changed to another type of low profile TLSO and she is currently wearing that orthosis on a full-time basis with apparent reasonable curve control. The second patient who failed Charleston bending TLSO treatment had a curve of 25° at age 9 years, 6 months. Her curve progressed to 32° over the next 13 months, and, therefore, at age 10 years, 7 months, Charleston bending TLSO treatment was initiated. After 16 months, at age 11 years, 11 months, her curve was maintained at 32°. At her next outpatient visit, 4 months later (at age 12 years 3 months), her curve had progressed to 40°. She was also placed in a different type of low profile TLSO and is wearing it full-time. Her curve also appears to be reasonably controlled.

Eleven patients had reached maturity and completed treatment at the conclusion of this preliminary study. These patients had an average age at diagnosis of 12 years, 3 months with an average curve magnitude of 17.5°. After a mean period of 17 months, their curves had progressed to an average of 28.9° and treatment was initiated. The average Risser sign was stage 1 at the onset of treatment and their menarche began at an average of 4 months after brace delivery. The mean length of treatment was 19.6 months. At the time of orthoses discontinuation, the mean curve magnitude was 26.7°, a mean decrease of 2.2°. All 11 patients had curve progression halted and 3 of 11 had improved their curve magnitude by greater than 3°. Before treatment, these 11 patients had an average curve progression of 1.3° per month and during treatment they had an average curve regression of 0.1° per month. Their compensatory curves increased minimally, an average of 0.8°, during their treatment period. Spinal decompensation showed no change in 6 of 11 skeletally mature patients. Two patients improved their decompensation by an average of 1 cm, but the remaining 3 patients increased their decompensation by an average of 0.9 cm. Four of 11 patients have had postmaturity follow-up averaging 9 months. The curve magnitudes at follow-up in 3 of the 4 are equal to the curve magnitudes at the time of orthosis treatment initiation $\pm 3^\circ$. The fourth patient still shows 4° of improvement of her curve at 12 months postmaturity follow-up.

Excluding the 2 treatment failures and including the 11 patients who have completed treatment, 8 of 30 "successful" patients in the study group have decreased their curve magnitudes by an average of 7° during treatment. The remainder have shown no significant change ($\pm 3^\circ$). Pretreatment curve progression for this group averaged 1.0° per month, whereas posttreatment regression averaged 0.1° per month. In this group, a mean progression of 0.8° occurred in the compensatory curve, whereas the overall magnitude of the major structural curves decreased an average of 1.1°.

DISCUSSION

Because of the small number of patients and the relatively short time period, no definitive conclusions can be formulated from these preliminary data. Based on the age, sex, curve pattern, and curve magnitude of our patient population, we would have predicted that approximately 60% of the group would have had significant curve progression if left untreated.⁸ Most studies in the literature describing the results of

treatment of idiopathic scoliosis with other types of orthoses report a failure rate of 15-20%.^{1,3,9,12} Eliminating the 19 patients in our study group who are still under treatment, 2 of 13 or 15% have failed treatment and shown progression. The trend, therefore, seems to indicate that the Charleston bending TLSO may be equally as effective as other forms of orthotic treatment.

The advantages of the Charleston bending TLSO are several. The orthosis is only required at night and therefore does not encumber the child at school or during other daytime activities. It may, therefore, produce less psychological stress in this juvenile and adolescent population. The orthosis appears to be well tolerated and it is our impression that patient compliance is better than with other types of spinal orthoses. It is somewhat more adjustable than other rigid orthoses and thus far has required replacement (because of being outgrown) less often than with other orthoses.

This study is a retrospective, preliminary review. Experience with more patients, followed for longer time periods, is needed. Until that experience is available, this method of treatment appears worth pursuing.

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