A meta-analysis of the efficacy of non-operative treatments for idiopathic scoliosis
Rowe D E, Bernstein S M, Riddick M F, Adler F, Emans J B, Gardiner-Bonneau D

Authors' objectives
To examine the effect of three variables on the effectiveness of non-operative treatments for idiopathic scoliosis: the type of treatment, the level of maturity, and the criterion for failure. The effect of the type of brace used, and the duration of bracing on the success of the treatment were also examined.

Searching
The bibliography from the most recent edition of Campbell's Operative Pediatric Orthopedics (date of issue not stated) was searched. The authors do not provide details of any other sources searched or the strategies used.

Study selection
Study designs of evaluations included in the review
The authors do not state that any specific designs were included or excluded.

Specific interventions included in the review
Eight-, 16-, and 23- hour bracing (Charleston Brace, Thoracolumbosacral Orthosis Braces, and Milwaukee Brace), lateral electrical surface stimulation (LESS), and observation.

Participants included in the review
Juveniles (children aged 9 years or less), immature adolescents (10 to 13 years old, who had a Risser sign of 2 or less), mature adolescents (older than 13 years old, who had a Risser sign of 3 or 4), who were being treated non-operatively for idiopathic scoliosis were included.

Outcomes assessed in the review
Failure of treatment and the proportion of successes (as defined by the criterion in that specific study) were assessed.

How were decisions on the relevance of primary studies made?
Each study was reviewed by two committee members and the chairman of the Prevalence and Natural History Committee of the Scoliosis Research Society.

Assessment of study quality
The following criteria were used to assess the validity of the primary studies:

- the criteria used to select and reject the participants;
- the description of the braces used;
- the design of the study (with regard to randomisation, blinding, inclusion of a control group, and participation of an independent observer);
- the level of significance;
- the criteria for weaning;
- the duration of the follow-up;
- progression factors;
testing of compliance; and

the duplication of end point variables.

The highest possible score was 42 points. The quality assessment of the articles was carried out by two committee members and the chairman of the Prevalence and Natural History Committee of the Scoliosis Research Society. The assessors were permitted to see the authors names, but were asked to confine their evaluation to the 'Materials and Methods' and 'Results' sections in an effort to avoid being biased by the authors' interpretations.

**Data extraction**

Data extraction sheets were used to record the following information: the type of treatment; the numbers of male and female patients; description of the curve; the level of the apex; the spinal balance (or imbalance); the progression factor; the duration for which the brace was worn each day; the age of the patient; the magnitude of the curve at the times of diagnosis, bracing, weaning from the brace, and latest follow-up; the initial Risser sign; and the need for an operation.

**Methods of synthesis**

*How were the studies combined?*

The number of failures of treatment, and the mean proportion of success, were determined for each study. The studies were then combined in a meta-analysis, using weighted means adjusted for the sample size.

*How were differences between studies investigated?*

Categorical and regression analyses were used to examine the relationships between the following variables:

- outcome (proportion of successes to failures);
- the type of treatment (bracing, LESS or observation);
- the level of maturity (juvenile, immature adolescent, mature adolescent or mixed); and
- the criterion for failure (3, 5, 6 or 10 degrees of progression, or unspecified).

Homogeneity between the studies was assessed using the Q test. Additional analyses were performed to determine the individual contribution of each variable in terms of its predicative power, and the degree of unexplained variance. Z-tests were performed for those variables shown to be significant contributors, in order to determine which specific categorical groupings within the variable differed from each other. The Bonferroni method was used to protect the level of alpha during multiple, pairwise comparisons performed on the same set of data.

**Results of the review**

Twenty studies were included in the review. There were 13 studies (n=1,459) of bracing, 6 studies (n=322) of LESS, and one study (n=129) of observation.

Bracing was significantly more successful than both LESS (p<0.0001) and observation (p<0.0001) for the treatment of idiopathic scoliosis. The weighted mean proportion of success was 0.92 for bracing, 0.39 for LESS, and 0.49 for observation only. LESS was not significantly more effective than observation alone. The outcome of treatment was significantly affected (p<0.0001) by the level of maturity; the weighted mean proportion of success was 0.60 for juvenile, 0.57 for immature, 0.88 for mixed, and 0.99 for mature adolescents. Curves were less likely to progress as the level of maturity increased. The criterion for failure also significantly affected (p<0.0001) the outcome: the weighted mean proportion of success was 0.22 for 3 degrees, 0.76 for 5 degrees, 0.56 for 6 degrees, 0.67 for 10 degrees, and 0.97 for unspecified curve progression. The best-fit regression model included all three variables.

An analysis of bracing treatments alone showed that the type of brace had a significant effect on the outcome (p<0.0001), although this effect was small compared with the effects of other variables. The weighted mean proportions of success were 0.99 for the Milwaukee brace, 0.60 for the Charleston brace, and 0.90 for all other types of
braces. The Charleston brace was significantly less successful than the Milwaukee brace and all other types of braces (p<0.001). The Milwaukee brace was significantly more successful than all other types of braces (p<0.0001). The outcome was also significantly affected (p<0.0001) by the level of maturity: the weighted mean proportion of success was 0.60 for juvenile, 0.71 for immature, 0.88 for mixed, and 0.99 for mature adolescents. The duration for which the brace was worn was also a significant variable (p<0.0001; 0.60, 0.62 and 0.93 for bracing for 8, 16 and 23 hours/day, respectively). The criterion for failure also significantly affected (p<0.0001) the outcome: the weighted mean proportion of success was 0.77 for 5 degrees, 0.68 for 6 degrees, 0.78 for 10 degrees, and 0.97 for unspecified curve progression. The best-fit regression model included all four variables.

Further analyses were conducted with the braces subdivided according to the form of treatment: Charleston braces, Milwaukee braces, other braces that were worn for 23 hours/day, and braces that were worn for 16 hours/day. The weighted mean proportions of success were 0.99 for the Milwaukee brace, 0.91 for the other braces that were worn for 23 hours/day, 0.62 for braces that were worn for 16 hours/day, and 0.60 for the Charleston brace. All of the pairwise comparisons were shown to be significant (p<0.0001), except for that between the Charleston brace and the braces that were worn for 16 hours/day. The type of brace and duration of daily treatment were confounded making the regression analysis problematic.

Bracing was finally compared with observation only. The outcome in this analysis was significantly affected by the type of brace and the daily duration of wear. The outcome associated with the Milwaukee brace was significantly better than that associated with all other types of braces and that of observation only (p<0.0001). Braces that were worn for 23 hours/day were significantly more successful than those worn for 8 or 16 hours/day, or observation only (p<0.0001).

**Authors' conclusions**
This meta-analysis demonstrated the effectiveness of bracing, compared with LESS and observation, for the treatment of idiopathic scoliosis. The use of the Milwaukee brace or another thoracolumbosacral orthosis for 23 hours/day, was found to effectively halt progression the curve. Bracing for 8 or 16 hours/day was found to be significantly less effective than bracing for 23 hours/day. The level of patient maturity, and the criteria for failure, were also found to have a significant effect on the outcome of treatment.

**CRD commentary**
This systematic review was clearly presented. The literature search used in the review was, however, limited as it only used one information source. The keywords used in the search were not provided, thus making it difficult to repeat the authors' search strategy, and to comment further on its validity. There was also no indication of the time period covered by the search, and so it is unclear how many relevant studies may have been missed from the review. Very little information was given about the studies included in the review, or their design, although the studies were quality assessed by three individuals. The lack of information provided about the included studies, and the limited literature search, should be considered carefully when interpreting the results of the review and the authors' conclusions.

**Bibliographic details**

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Adolescent; Age Factors; Arthrodesis; Braces; Child; Disease Progression; Electric Stimulation Therapy; Evaluation Studies; Regression Analysis; Research Design; Scoliosis /classification /therapy; Treatment Outcome

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.