Mandibular changes produced by functional appliances in Class II malocclusion: a systematic review
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CRD summary
This review evaluated the efficiency of functional appliances in enhancing mandibular growth in Class II patients. The authors concluded that most studies showed a clinically significant supplementary elongation in total mandibular length following treatment, and the Herbst appliance showed the greatest efficiency. Limitations of the review and the included studies suggest that this conclusion should be viewed with caution.

Authors' objectives
To determine the efficiency of functional appliances in enhancing mandibular growth in Class II patients.

Searching
MEDLINE (January 1966 to January 2005) and the Cochrane Controlled Trials Register were searched for articles written in English; the search terms were reported.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs), controlled clinical trials (CCTs), meta-analyses, and prospective and retrospective longitudinal studies were eligible for inclusion. The duration of follow-up in the included studies ranged from 6 to 32 months.

Specific interventions included in the review
Studies that compared functional appliances with no treatment were eligible for inclusion. The interventions evaluated were the Activator, Bass appliance, bionator appliance, functional regulator of Frankel, mandibular anterior repositioning appliance and twin-block appliance. The daily duration for which functional appliances were worn ranged from 11.5 hours to full time; some were not worn during meal times and sporting activities.

Participants included in the review
Studies that evaluated Class II growing patients were eligible for inclusion. The participants in the included studies were aged from 8.4 to 13.6 years.

Outcomes assessed in the review
Studies that used cephalometric analysis to determine mandibular dimensions were eligible for inclusion. Studies that used articulare for the measurement of mandibular body length or ramus height were excluded. Most of the included studies reported on annual mandibular change.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
The validity of each study was categorised as low, medium or high, based on the following characteristics: study design; sample size and use of sample size calculation, withdrawals and drop-outs, method error analysis, blinding in measurement, and use of adequate statistics. Two independent reviewers assessed the validity of the included studies.

Data extraction
Two independent reviewers extracted the data from each included study. Any differences were resolved through discussion. Data were extracted on mandibular sagittal position (SNB), total mandibular length (Co-Gn or Co-Pg), mandibular ramus length (Co-Go) and mandibular body length (Go-Gn, Go-Me or Go-Pg). For studies lasting 9 or more months, mandibular change was annualised to give an annual mean difference between the treated and untreated groups.
The coefficient of efficiency was also calculated by dividing the supplementary elongation of the mandibular during the treatment phase by the number of months of active treatment. A statistically significant difference between the treatment groups had to be greater than 2.0 mm to also be considered clinically significant.

Methods of synthesis
How were the studies combined?
The results of the included studies were tabulated and combined in a narrative.

How were differences between studies investigated?
Differences between the studies were apparent from the tables of included studies and were discussed in the narrative. The influence on the treatment results of skeletal maturity at the start of functional appliance use was considered.

Results of the review
Twenty-two studies (n=1,763) were included: 4 RCTs (n=364) and 18 CCTs (2 prospective and 16 retrospective; n=1,399). The included studies provided 34 treatment and 26 control groups.

Six studies (4 RCTs and 2 CCTs) were considered to be of medium/high quality, 13 studies were considered medium quality, and 3 studies were considered low quality.

The amount of supplementary mandibular growth varied across the included studies. Functional appliances were shown to have a statistically significant supplementary elongation of total mandibular length in 22 out of 33 samples, mandibular ramus height in 12 out of 17 samples, and mandibular body length in 8 out of 23 samples. When treatment duration was taken into account, 20 out of 33 samples reported clinically significant supplementary growth in total mandibular growth with active treatment compared with control. None of the RCTs showed a clinically significant change in mandibular length following functional appliance use.

The average efficiency coefficient for functional jaw orthopaedics was 0.16 mm per month. The greatest efficiency coefficient was shown with the Herbst appliance (0.28 mm per month; based on 4 samples), followed by the twin-block appliance (0.23 mm per month; based on 7 samples). Only one study found a clinical and statistical change in mandibular position in relation to the cranial base.

Authors' conclusions
The quality of the included studies varied with 4 RCTs and 3 CCTs showing higher than average methodological quality. The majority of included studies reported a clinically significant supplementary elongation in total mandibular length following active treatment with functional appliances. The short-term amount of supplementary mandibular growth appears to be significantly larger when the functional treatment is performed at the adolescent growth spurt. None of the RCTs found a clinically significant supplementary mandibular growth. The Herbst appliance showed the highest coefficient of efficiency (0.28 mm per month), followed by the twin-block (0.23 mm per month).

CRD commentary
The review question was supported by defined inclusion criteria. The search was not comprehensive and was limiting to English language articles, thus it is likely that some relevant studies might have been missed. It is not clear whether methods were used to minimise reviewer error and bias in the selection of studies, although appropriate methods were used in the validity assessment and data extraction processes. There were limited details about the participants evaluated in the included studies, although this may in part be due to limitations in the reporting of studies rather than a weakness of the review itself. However, the details presented on each included study did highlight differences across the included studies, suggesting that the decision to combine the results in a narrative was appropriate.

A limitation of this review is that the results were generally presented for samples, rather than individual studies, thus it is possible that the results of some outcomes might have been overstated. Subgroup analyses were also based on few studies, and this was not taken into account in the conclusion. Furthermore, the authors did not adequately account for the study design and validity assessment in their presentation of the results. Given the aforementioned limitations, the authors' conclusion should be viewed with caution, particularly since the authors did not adequately emphasise that the
review itself, being based predominantly on retrospective studies, is unable to provide reliable evidence.

**Implications of the review for practice and research**

**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that an RCT is needed to evaluate the effect of functional appliances used at the pubertal growth spurt.

**Funding**

Not stated.

**Bibliographic details**


**Indexing Status**

Subject indexing assigned by NLM

**MeSH**

Malocclusion, Angle Class II /therapy; Mandible /growth & development; Orthodontic Appliance Design; Orthodontic Appliances, Functional; Orthodontics, Corrective /instrumentation; Quality of Health Care; Treatment Outcome

**AccessionNumber**

12006003419

**Date bibliographic record published**

14/12/2006

**Date abstract record published**

01/12/2008

**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.