Short-term anteroposterior treatment effects of functional appliances and extraoral traction on class II malocclusion: a meta-analysis
Antonarakis GS, Kiliaridis S

CRD summary
This review investigated the effects of removable functional appliances (activators or twin block), extra-oral traction, or combination appliances in growing patients with Class II malocclusion. The authors concluded that all interventions showed an effect. Lack of reporting of review methods and study validity, small sample sizes and differences between studies, mean that these conclusions may not be reliable.

Authors' objectives
To evaluate, using lateral cephalograms, the short-term anteroposterior skeletal and dental effects of treatment with functional appliances and/or extra-oral traction in growing patients with Class II malocclusion.

Searching
The following databases and journals were searched: MEDLINE; the Cochrane Library; Web of Science; EMBASE; Google Scholar Beta; Extenza; African Journals Online; Bandolier; Evidence-Based Medicine; Latin America and Caribbean Center on Health Sciences Information; Bibliografia Brasileira de Odontologia; and ChinaInfo. Search terms were reported, but search dates were not. Online full text of the American Journal of Orthodontics and Dentofacial Orthopedics, the European Orthodontic Journal, and the Angle Orthodontist were scanned. Reference lists of retrieved articles were also searched.

Study selection
Prospective clinical trials, of a minimum nine months duration, that compared removable functional appliances and/or extra-oral traction treatment for Class II malocclusion in growing patients with an untreated control group were eligible for inclusion. Studies were included if they reported pre- and post-treatment cephalometric values and changes referring to the maxilla (expressed by sella-nasion, A point (SNA)), mandible (expressed by sella-nasion, B point (SNB)), intramaxillary relationship (expressed by A point, nasion, B point (ANB)) and overjet. Studies that used Herbst and Frankel appliances were excluded. Studies had to be of medium or high-quality (see validity assessment below).

The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
Validity assessment was assessed using a method that considered study design, sample size and prior estimate of sample size, selection description, withdrawals (drop-outs), valid methods, confounding factors, method error analysis, blinding in measurement, and adequate statistics (method described in a cited reference). The studies were described as being of low, medium and high quality.

The authors did not state how many reviewers performed the validity assessment.

Data extraction
Arithmetic means of changes and standard deviations were calculated for all outcomes for each type of appliance and results annualised to standardise the variation in duration of the studies. Authors were contacted for missing data.

The authors did not state how data were extracted or how many reviewers performed the data extraction.
Methods of synthesis
Weighted mean differences between the treatment and control groups, based on the random-effects model, with the 95% confidence intervals were calculated. $\chi^2$ and $I^2$ statistics were calculated to test the presence of heterogeneity (only $I^2$ was reported).

Results of the review
Nine studies (n=670 participants) were included in the review. Sample size ranged from 10 to 74 participants.

Twin block was evaluated in three studies (n=125 treated patients), activators in four studies (n=106 treated patients), extra-oral traction in two studies (n=82 treated patients) and combination appliances five studies (n=75 treated patients). There were a total of 282 untreated participants in control groups. The treatment duration in the included studies varied from nine to 24 months.

Treatment effect on the maxilla: When compared to the control group, the twin block group showed a mean decrease in sella-nasion, A point (SNA) of 1.03 degrees (p=0.02), and the extra-oral traction group showed a mean decrease of 1.01 degrees (p<0.00001). No significant change was seen for the other interventions.

Treatment effect on the mandible: When compared to the control group, activators showed a mean increase in sella-nasion, B point (SNB) of 0.66 degrees (p=0.04); the twin block group showed a mean increase of 1.53 degrees (p<0.0001), and the combination group showed a mean increase of 1.05 degrees (p<0.00001). No significant change for the extra-oral traction was found.

Treatment effect on the intermaxillary relation: When compared to the control group activators showed a decrease in ANB (A point, Nasion, B point) of 0.92 degrees (p<0.00001); the twin block group showed a mean decrease of 2.61 degrees (p<0.00001), the extra-oral traction group showed a mean decrease of 1.38 degrees (p<0.00001), and the combination group showed a mean decrease of 1.8 degrees (p<0.00001).

Treatment effects on overjet: When compared to the control group activators exhibited a mean reduction of 3.88mm (p<0.00001); the twin block group showed a mean decrease in overjet of 6.45mm (p<0.00001), and the combination group a mean of 4.37mm (p<0.00001). No significant change in overjet was shown for the extra-oral traction group.

Heterogeneity among studies was variable.

Cost information
Not provided.

Authors' conclusions
In growing patients with class II malocclusion intermaxillary changes were evident in all appliance and/or extra-oral traction groups. Antero-posterior treatment response was most evident in one of the two jaws for activators and combination appliances (mandible) and for extra-oral traction (maxilla); and in both jaws for the twin block group.

CRD commentary
This meta-analysis addressed a well-defined question in terms of participants, interventions, outcomes and study design. Several relevant databases were searched, but the restriction to peer-reviewed journal publications did not provide reassurance that all relevant data were included. The authors did not state how the studies were selected, data extracted or validity assessed, so reviewer error and selection bias cannot be ruled out. Little information was provided on the characteristics of the included studies, so the generalisability of review findings could not be judged. Although validity was assessed, results were not reported, which made it difficult to evaluate the reliability of results. Pooling appeared to have been appropriate statistically, but potential sources of heterogeneity were not explored. Given the limitations and the small number of patients included in the analysis, the authors' conclusions should be interpreted with caution.

Implications of the review for practice and research
Practice: The authors suggested it was important to consider the clinical rather than the statistical significance of the review results.

Research: The authors did not state any research implications.

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