Meta-analysis of immediate changes with rapid maxillary expansion treatment

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CRD summary
The authors of this review concluded that the greatest changes resulting from rapid maxillary expansion treatment were immediate dental and skeletal transverse changes, and that few vertical and anteroposterior changes were statistically significant or clinically important. It is not possible to determine how reliable these conclusions are because of poor reporting of the review methods.

Authors’ objectives
To evaluate immediate transverse, anteroposterior and vertical dental and skeletal changes produced by rapid maxillary expansion (RME).

Searching
The authors searched the following databases (inception to last quarter of 2004 or December 2004, or January 2005): MEDLINE and PubMed, MEDLINE In-Process and Other Non-Indexed Citations, LILACS, EMBASE Excerpta Medica, ISI Web of Science and all databases in EBM Reviews (the Cochrane Database of Systematic Reviews, ACP Journal Club, DARE and the Cochrane CENTRAL Register); the search terms were reported. The reference lists of selected articles were checked for additional relevant publications.

Study selection
Study designs of evaluations included in the review
Clinical trials were eligible for inclusion in the review.

Specific interventions included in the review
Although inclusion criteria for the interventions were not explicitly reported, it was clear that studies evaluating the effects of RME were eligible for inclusion. The studies had to have used no surgical or other treatments that would affect the RME effects during the expansion phase. The included studies evaluated Hyrax and Haas expansion appliances.

Participants included in the review
Inclusion criteria relating to the participants were not specified. Where reported, the age of the participants in the included studies ranged from 5 to 17.8 years (mean age: 8.3 to 8.9).

Outcomes assessed in the review
Studies reporting immediate changes in dental and skeletal measurements made from cephalometric radiographs and/or dental casts after the RME active expansion phase were eligible for inclusion. The review assessed 24 different measures of dental and skeletal changes.

How were decisions on the relevance of primary studies made?
Reviewers independently selected studies according to the inclusion criteria, with any disagreements resolved by consensus. The authors did not state how many reviewers performed the selection.

Assessment of study quality
The validity of the selected studies was assessed according to 19 specified criteria relating to study design, outcome measurement and statistical analysis. The validity scores were converted to a percentage of the maximum possible score. The authors did not state how many reviewers performed the validity assessment.
Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the extraction. Data on the key characteristics of the included studies were extracted.

Methods of synthesis
How were the studies combined?
The studies were combined in a meta-analysis and pooled estimates of immediate changes during activation of the RME appliance were calculated, along with 95% confidence intervals (CI). A fixed-effect model was used to pool homogeneous studies and a random-effects model to pool heterogeneous studies.

How were differences between studies investigated?
The authors stated that they assessed heterogeneity but did not state how it was assessed. Some differences between the studies were apparent from the tabulated data.

Results of the review
Fourteen studies (n=335) were included in the review. The sample size ranged from 7 to 34. No details of the study designs were reported.

None of the included studies met more than half of the items on the validity checklist (validity scores ranged from 34 to 50%), and all had problems regarding sample selection, description and statistical approach.

Main transverse dental changes were as follows:
maxillary intermolar width, 6.74 mm (95% CI: 4.59, 8.89, p<0.05); maxillary intercanine width, 5.35 mm (95% CI: 4.31, 6.39, p<0.05); maxillary intermolar angle, 3.1 degrees (95% CI: -2.08, 8.27); maxillary interincisal apex width, 3.9 mm (95% CI: 3.3, 4.49, p<0.05); midline diastema, 2.98 mm (95% CI: 2.77, 3.2, p<0.05); mandibular intermolar width (buccal-buccal), 0.53 mm (95% CI: -0.07, 1.14).

Main vertical and anteroposterior dental changes were as follows:
maxillary molar cusp to palatal plane, 0.53 mm (95% CI: 0.24, 0.82); overjet, 1.29 mm (95% CI: 1.02, 1.56, p<0.05); maxillary incisor-sella nasion (SN) plane, -0.86 degrees (95% CI: -1.02, -0.7, p<0.05); interincisal angle, 2.31 degrees (95% CI: -0.62, 5.25).

Main transverse skeletal changes.
The only statistically significant changes were nasal cavity width (intercondylye width) and left jugale-right jugale (interalveolar width) landmarks of 2.14 mm (95% CI: 1.56, 2.72) and 2.73 mm (95% CI: 1.84, 3.62), respectively.

Main vertical and anteroposterior skeletal changes.
The only statistically significant changes observed were changes in the mandibular plane of 1.65 degrees (95% CI: 1.4, 1.9) to the palatal plane and 1.97 (95% CI: 1.75, 2.19) degrees to the SN plane. The angulation of the palatal plane with respect to the SN plane was not significant (0.30 degrees; p>0.05).

Authors’ conclusions
The greatest changes resulting from RME in the studies analysed were dental and skeletal transverse changes. Few vertical and anteroposterior immediate changes were statistically significant, though they probably were not clinically important.

CRD commentary
The review question was supported by inclusion criteria relating to the outcomes; criteria related to the participants,
interventions and study designs were more vague. Multiple electronic databases and reference lists were searched but it was unclear if selection was limited by language of publication, thus the potential for foreign language studies to be missed cannot be ruled out. The validity of the included studies was assessed according to a predefined checklist. However, there were no details of the study design, study duration, or what outcome data (versus control group or before-and-after data) were reported. Although methods were used to minimise reviewer error and bias in the selection of studies, it was unclear what attempts were made to minimise error and bias in the data extraction and validity assessment processes.

The authors reported that they conducted a meta-analysis but provided very little detail of the methods they used: for example, it was not clear how many studies (or number of patients) were pooled for each outcome, which model (fixed-effect or random-effects) was used, or if significant statistical heterogeneity was present. Consequently, the conclusions of the review should be treated with some caution.

Implications of the review for practice and research
Practice: The authors stated that clinicians will have to consider their experience, the opinion of experts, and the limited evidence on RME to decide whether to use this treatment on patients.

Research: The authors stated that there is a need for further research to determine if the changes in intracondylar width shown in this review persist in the longer term.

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