Maxillary molar distalization with noncompliance intramaxillary appliances in Class II malocclusion: a systematic review

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CRD summary
The authors found that non-compliance intramaxillary appliances distalised molars, but caused unavoidable loss of anchorage. Buccal and palatal appliances appeared comparable, except palatal appliances caused less tipping. Friction-free palatal appliances may enhance molar distalisation, but increased tipping. Given numerous methodological weaknesses in the review, including indirect comparisons and failure to address heterogeneity, these conclusions do not appear to be reliable.

Authors' objectives
To assess the effectiveness of non-compliance intramaxillary appliances for class II malocclusion.

Searching
PubMed (using the Related Articles function), the Cochrane Library and the following online journals were searched: the American Journal of Orthodontics and Dentofacial Orthopedics; the European Journal of Orthodontics; and Angle Orthodontist. Search terms were reported. The search was limited to published studies.

Study selection
Prospective and retrospective studies of intramaxillary non-compliance molar distalisation appliances, using conventional anchorage designs for class II malocclusion in growing patients, were eligible for the review. Eligible studies had to report outcomes of molar crown distal movement and at least one of the following: molar distal tipping; molar vertical movement; incisor or premolar mesial movement, tipping and/or vertical movement. Studies were required to include at least ten participants, have a maximum follow-up of 12 months. Studies also had to report relevant details of the following: cephalometric values before, during and after treatment (with means and standard deviations); method error analysis (retracing radiographs using Dahlberg's formula); appliance used; and study design. Studies involving additional appliances or bony anchorage were excluded, as were case studies and case series.

The mean age of participants at the start of the included studies ranged from 11 to 15 years. Most participants had second molars present (where stated). A wide range of intra-oral intra-maxillary appliances was used, with either buccal and/or palatal force application and either friction or friction-free (sliding) mechanisms. Nearly all studies used two premolars for anchorage. Treatment duration varied from three to 11 months.

The authors did not state how the papers were selected for the review.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
Data were analysed on the assumption that no significant tooth movement would occur without treatment over a period of less than a year, and that the standard deviation for baseline measurements would be equal to any methodological error. Mean changes from baseline and 95% confidence intervals (CIs) were calculated for each outcome in each study group, taking to account methodological error.

The authors did not state how the data were extracted for the review.

Methods of synthesis
Studies were combined to calculated the weighted mean difference (WMD) from baseline and associated 95% confidence interval, using a random-effects model. Studies were subgrouped by type of appliance (buccal or palatal). It
was also planned to subgroup studies by friction and friction-free mechanisms, but there were insufficient studies of friction-free mechanisms.

**Results of the review**

Thirteen studies were included in the review (n=305 patients): one RCT (n=20), seven prospective studies (n=113) and five retrospective studies (n=172 patients). Sample sizes ranged from 10 to 50 patients.

**Overall treatment effects:** When all studies were pooled, for molars the weighted mean difference from baseline was 2.9mm (95% CI 2.4 to 3.3) for distal movement and 5.4° (degrees) (95% CI 4.0 to 6.8) for distal tipping. For incisors, the weighted mean difference was 1.8mm (95% CI 1.7 to 2.0) for mesial movement and 3.6° (95% CI 2.4 to 4.8) for mesial tipping. For premolars, the weighted mean difference was 1.7mm (95% CI 1.2 to 2.2) for mesial movement.

Vertical movements were mostly extrusive for incisors and premolars (incisor extrusion WMD 0.4mm, 95% CI 0.2 to 0.6; premolar extrusion WMD 1.1mm, 95% CI 0.6 to 1.5). All these findings were significantly different from baseline measures. For molars, the direction of effect of vertical movements was inconsistent across studies.

**Treatment effects of buccal and palatal acting appliances:** For most outcomes, buccal and palatal appliances had similar effects, except for tipping. For molars, the weighted mean difference from baseline for distal tipping was 8.3° (95% CI 7.3 to 9.3) for buccal appliances and 3.6° (95% CI 2.4 to 4.7) for palatal. For incisors, the weighted mean difference from baseline for mesial tipping was 5.0° (95% CI 4.4 to 5.7) for buccal appliances and 2.9° (95% CI 1.5 to 4.3) for palatal. For incisors, the weighted mean difference from baseline for mesial tipping was 5.0° (95% CI 4.4 to 5.7) for buccal appliances and 2.9° (95% CI 1.5 to 4.3) for palatal. For premolars, the weighted mean difference from baseline for mesial tipping was 7.0° (95% CI 5.9 to 8.2) for buccal appliances and not statistically significant (WMD 0.1, 95% CI: -3.1 to3.2) for palatal.

**Authors’ conclusions**

Non-compliance intramaxillary appliances distalised molars, but caused unavoidable loss of anchorage. Buccal and palatal appliances appeared comparable except that palatal appliances caused less tipping. Friction-free palatal appliances may enhance molar distalisation but increased tipping.

**CRD commentary**

The objectives and inclusion criteria of the review were clear and relevant sources were searched for studies, although as only two databases were searched some studies may have been missed. The restriction to published studies meant that the review may have been subject to publication bias. It was not stated whether the search was limited by language. It was unclear whether steps were taken to minimise the risk of reviewer bias and error in the processes of study selection and data extraction, such as having more than one reviewer make decisions independently. It did not appear that study validity was assessed.

Few details were reported about individual studies (e.g. selection methods, design, withdrawals). It is questionable whether the methods used to combine the data were appropriate for uncontrolled studies, or whether it was valid to assume that no significant tooth movement would have occurred without the intervention. The authors noted that the clinical and methodological characteristics of the primary studies varied widely (e.g. the appliances, types of attachment and outcomes measures used). Marked statistical heterogeneity between the studies was evident in some of the forest plots. These factors suggested that the studies may not have been suitable for pooling. Also, it did not appear that statistical heterogeneity was formally assessed. The authors’ conclusions about the comparative efficacy of appliances were based on indirect comparisons with high potential for confounding, and their conclusions about friction-free devices did not appear to derive from analyses reported in the review.

Due to numerous methodological weaknesses in the review, including indirect comparisons and failure to address heterogeneity, the authors’ conclusions do not appear reliable.

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

**Practice:** The authors stated that non-compliance intramaxillary appliances for molar distalisation should not be prescribed in every case of poor patient compliance. In patients with an already increased overjet, the appliance may
exacerbate the problem.

Research: The authors stated that studies (preferably RCTs) are needed to investigate the stability of changes effected by non-compliance intramaxillary appliances for molar distalisation. Failing randomised evidence, the authors recommended using double recordings with analysis adjusted for the error of the method, as in the current review.

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