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[Intervention Review]

Orthodontic treatment for deep bite and retroclined upper front teeth in children

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ABSTRACT

Background

A Class II division 2 malocclusion is characterised by upper front teeth that are retroclined (tilted toward the roof of the mouth) and an increased overbite (deep overbite), which can cause oral problems and may affect appearance.

This problem can be corrected by the use of special dental braces (functional appliances) that move the upper front teeth forward and change the growth of the upper or lower jaws, or both. Most types of functional appliances braces are removeable and this treatment approach does not usually require extraction of any permanent teeth. Additional treatment with fixed braces may be necessary to ensure the best result.

An alternative approach is to provide space for the correction of the front teeth by moving the molar teeth backwards. This is done by applying a force to the teeth from the back of the head using a head brace (headgear) and transmitting this force to part of a fixed or removable dental brace that is attached to the back teeth. The treatment may be carried out with or without extraction of permanent teeth.

If headgear use is not feasible, the back teeth may be held in place by bands connected to a fixed bar placed across the roof of the mouth or in contact with the front of the roof of the mouth. This treatment usually requires two permanent teeth to be taken out (one on each side).

Objectives

To establish whether orthodontic treatment that does not involve extraction of permanent teeth produces a result that is any different from no orthodontic treatment or orthodontic treatment involving extraction of permanent teeth, in children with a Class II division 2 malocclusion.

Search methods

Cochrane Oral Health's Information Specialist searched the following electronic databases: Cochrane Oral Health's Trials Register (to 10 January 2017), the Cochrane Central Register of Controlled Trials (CENTRAL) (the Cochrane Library, 2016, Issue 11), MEDLINE

Ovid (1946 to 10 January 2017), and Embase Ovid (1980 to 10 January 2017). To identify any unpublished or ongoing trials, the US National Institutes of Health Ongoing Trials Register (ClinicalTrials.gov) and the World Health Organization International Clinical Trials Registry Platform (apps.who.int/trialsearch) were searched. We also contacted international researchers who were likely to be involved in any Class II division 2 clinical trials.

Selection criteria

Randomised controlled trials (RCTs) and controlled clinical trials (CCTs) of orthodontic treatments to correct deep bite and retroclined upper front teeth in children.

Data collection and analysis

Two review authors independently screened the search results to find eligible studies, and would have extracted data and assessed the risk of bias from any included trials. We had planned to use random-effects meta-analysis; to express effect estimates as mean differences for continuous outcomes and risk ratios for dichotomous outcomes, with 95% confidence intervals; and to investigate any clinical or methodological heterogeneity.

Main results

We did not identify any RCTs or CCTs that assessed the treatment of Class II division 2 malocclusion in children.

Authors' conclusions

It is not possible to provide any evidence-based guidance to recommend or discourage any type of orthodontic treatment to correct Class II division 2 malocclusion in children. Trials should be conducted to evaluate the best management of Class II division 2 malocclusion.

PLAIN LANGUAGE SUMMARY

Orthodontic treatment for deep bite and retroclined upper front teeth in children

Background

Orthodontics is concerned with growth of the jaws and face, development of the teeth, and the way teeth and jaws bite together. Ideally, the lower front teeth bite in the middle of the back surface of the upper front teeth. When the lower front teeth bite further behind the upper front teeth than ideal, this is known as a Class II malocclusion. A Class II division 2 malocclusion is characterised by upper front teeth that are retroclined (tilted toward the roof of the mouth) and an increased overbite (vertical overlap of the front teeth), which can cause oral problems and may affect appearance.

This problem can be corrected by the use of special dental braces (functional appliances) that move the upper front teeth forward and change the growth of the upper or lower jaws, or both. These braces can be removed from the mouth and this approach does not usually require removal of any permanent teeth. Additional treatment with fixed braces may be necessary to ensure the best result.

An alternative approach is to provide space for the correction of the front teeth by moving the molar teeth backwards. This is done by applying a force to the teeth from the back of the head using a head brace (headgear) and transmitting this force to part of a fixed or removable dental brace that is attached to the back teeth. The treatment may be carried out with or without extraction of permanent teeth.

If headgear use is not feasible, the back teeth may be held in place by bands connected to a fixed arch placed across the roof of the mouth or in contact with the front of the roof of the mouth. This treatment usually requires two permanent teeth to be taken out from the middle of the upper arch (one on each side).

Aim

We carried out this Cochrane Review to find out if orthodontic treatment without the removal of permanent teeth had different effects than no orthodontic treatment or orthodontic treatment involving the removal of permanent teeth, in children with a Class II division 2 malocclusion.

Method

We searched the scientific literature up to 10 January 2017 and found no relevant studies to include in this review.

Results

There is no scientific evidence to show whether orthodontic treatment, carried out without the removal of permanent teeth, is better or worse than no orthodontic treatment or orthodontic treatment that involves taking out permanent teeth, in children with Class II division 2 malocclusion.

Author conclusions

There is currently no evidence to recommend or discourage any type of orthodontic treatment to correct the teeth of children whose bite is deep and whose upper front teeth are tilted towards the roof of the mouth. Research is needed.

BACKGROUND

Orthodontics is the branch of dentistry concerned with the growth of the jaws and face, the development of the teeth, and the way the teeth and jaws bite together. It also involves treatment of the teeth and jaws when they are irregular or bite in an abnormal way, or both. Teeth may not bite together correctly due to any combination of problems in the positioning of the teeth, jaws, lips, tongue or cheeks; these can be affected in some cases by a habit, such as thumb sucking, or by the way in which people breathe (Shaw 1991). The need for orthodontic treatment can be determined by looking at the effect any particular tooth position has on the life expectancy of the teeth or by the effect that the appearance of the teeth has on how people feel about themselves, or both (Shaw 1991).

Description of the condition

Ideally the lower front teeth bite in the middle of the back surface of the upper front teeth. When the lower front teeth bite further behind the upper front teeth than ideal, this is known as a Class II malocclusion. The upper jaw can be too far forward or, more usually, the lower jaw is too far back. The upper front teeth may stick out (Class II division 1 malocclusion) if the lower lip catches behind them or as a result of a habit, such as thumb-sucking (Shaw 1980). Management of prominent upper front teeth (Class II division 1 malocclusion) in children is the subject of a separate systematic review (Thiruvenkatachari 2013).

A Class II division 2 malocclusion is a type of orthodontic problem characterised by retroclined (tilted toward the roof of the mouth) upper front teeth and an increased overbite (vertical overlap of the front teeth), although there is variation in the severity of each of these (Bilgic 2015; Dimberg 2015; Millett 2012). Aesthetic impairments and trauma to the palatal or lower labial gingivae are frequently reported by people with this problem. Sometimes the deep overbite is so severe that the front teeth bite into the gums either behind the upper front teeth or in front of the lower front teeth producing damage (traumatic overbite) (Wragg 1990). The incidence of Class II division 2 malocclusion is reported to be about 10% within the UK population (Houston 1996), but prevalence of 18% has been reported in the Croatian population (Legovic 1999). Recent Swedish and Turkish studies have reported lower prevalence, from 1.8% to 4.7% (Bilgic 2015; Dimberg 2015). This type of malocclusion has a strong genetic link (Markovic 1992; Mossey 1999).

The appearance of the upper front teeth and the deep bite of the upper and lower front teeth are reasons why people with this type of problem seek orthodontic treatment (O'Brien 1993). Class II division 2 malocclusion is also associated with a greater percentage of upper permanent canines failing to erupt as a result of them following an abnormal pathway towards the palate/roof of the mouth (Al-Nimri 2005; Mossey 1999).

Correction of the Class II division 2 malocclusion may be carried out using several types of orthodontic (dental brace) treatment, but the evidence regarding management is weak and highly biased (Millett 2012). People with severe Class II division 2 malocclusions may require surgery to the jaws in combination with orthodontics.

Description of the intervention

In growing children, treatment may sometimes be carried out using special upper and lower dental braces (functional appliances) that can be removed from the mouth (Dyer 2001). They usually work by correcting the position of the upper and lower front teeth and modifying the growth of the upper or lower jaws, or both (growth modification). In many cases this treatment does not involve taking out any permanent teeth but often further treatment is needed with fixed braces to get the best result; such braces are glued to the teeth.

In other cases, treatment aims to move the molar teeth backwards to provide space for the correction of the front teeth. This may be carried out by applying a force to the teeth and jaws from the back of the head using a head brace (headgear) and transmitting this

force to part of a fixed or removable dental brace that is attached to the back teeth (Litt 1984). This treatment may or may not involve the removal of permanent teeth.

Other options do exist and may include fixed brace treatment without extraction of permanent teeth, with neither functional appliances nor headgear (Selwyn-Barnett 1996).

As an alternative to headgear, the back teeth can be held back in other ways such as with an arch across the roof of the mouth or in contact with the front of the roof of the mouth which links the two back teeth. Often in these cases, two permanent teeth are taken out from the middle of the upper arch (one on each side) to provide room to correct the position of the upper front teeth (Paquette 1992).

In severe cases, particularly in adults, treatment may require a combination of dental braces and surgery to the jaws to correct the position of the teeth and the bite (Arvystas 1979). Our review does not evaluate this treatment option, which is not generally used for children.

Why it is important to do this review

Cochrane Oral Health undertook an extensive prioritisation exercise in 2014 to identify a core portfolio of titles that were considered most clinically important to maintain on the Cochrane Library (Worthington 2015). The orthodontic expert panel identified this review as a priority title (Cochrane Oral Health priority review portfolio).

It is important for orthodontists to establish whether orthodontic treatment alone, carried out without the removal of permanent teeth, in children with a Class II division 2 malocclusion, produces a result that is any different from no orthodontic treatment or orthodontic treatment involving extraction of permanent teeth.

We did not consider combined orthodontic treatment and surgery to the jaws in this review.

OBJECTIVES

To evaluate the effectiveness of:

(1) orthodontic treatment only for Class II division 2 malocclusion in children (aged ≤ 16 years) versus no treatment in terms of:

- dento-occlusal results of treatment, measured with the Peer Assessment Rating (PAR) index;
- cephalometric measurements (A Point-Nasion-B Point (ANB) change and front teeth inclination changes);
- participant discomfort;
- gingival and temporomandibular joint (TMJ) symptoms;
- side effects;
- quality of life;

(2) orthodontic treatment only for Class II division 2 malocclusion in children (aged ≤ 16 years) that does not involve extraction of permanent teeth versus orthodontic treatment involving extraction of permanent teeth in terms of:

- dento-occlusal results of treatment, measured with the PAR index;
- number of visits to complete treatment;
- duration of treatment;
- cephalometric measurements (ANB change and front teeth inclination changes);
- participant discomfort;
- gingival and TMJ symptoms;
- side effects;
- quality of life.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised controlled trials (RCTs) and controlled clinical trials (CCTs) of orthodontic treatments to correct deep bite and retroclined upper front teeth in children.

Types of participants

We planned to include trials that recruited participants (80% aged ≤ 16 years) receiving orthodontic treatment to correct deep bite and retroclined upper front teeth.

We planned to exclude trials of participants with a cleft lip or palate, or both, or other craniofacial deformity/syndrome, and trials in which participants had received surgical treatment for their Class II malocclusion.

Types of interventions

Active interventions: orthodontic braces (removable, fixed, functional) or head braces with or without extraction of permanent teeth.

Control: no treatment or delayed treatment.

Types of outcome measures

Primary outcomes

- Dento-occlusal results of treatment, measured with the PAR index

Secondary outcomes

- Number of visits required to complete treatment and the duration of treatment (for objective 2)
- Cephalometric measurements (ANB change and front teeth inclination changes)
- Participant discomfort
- Gingival and TMJ symptoms
- Side effects
- Quality of life

Where appropriate, we planned to group outcome data into those measured post-phase I (growth modification phase) and post-phase II (fixed brace phase), to record and report post-retention outcomes and to consider examining outcome data reported at other time points.

Search methods for identification of studies

Electronic searches

Cochrane Oral Health's Information Specialist conducted systematic searches in the following databases for RCTs and CCTs:

- Cochrane Oral Health's Trials Register (searched 10 January 2017) (see Appendix 1);
- Cochrane Central Register of Controlled Trials (CENTRAL; 2016, Issue 11) in the Cochrane Library (searched 10 January 2017) (see Appendix 2);
- MEDLINE Ovid (1946 to 10 January 2017) (see Appendix 3);
- Embase Ovid (1980 to 10 January 2017) (see Appendix 4).

No language, publication year or publication status restrictions were imposed.
Subject strategies were modelled on the search strategy designed for MEDLINE Ovid. Where appropriate, we combined these strategies with subject strategy adaptations of the highly sensitive search strategy designed by Cochrane for identifying RCTs and CCTs, as described in Chapter 6 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Lefebvre 2011).

Searching other resources

The following resources were searched for ongoing trials:

- US National Institutes of Health Trials Register (ClinicalTrials.gov; searched 10 January 2017) (see Appendix 5);
- World Health Organization International Clinical Trials Registry Platform (apps.who.int/trialsearch; searched 10 January 2017) (see Appendix 6).

We planned to contact all first authors of trials in an attempt to identify any unpublished studies and clarify information about published trials (including missing data, method of randomisation, blinding and withdrawals). We intended to screen the references cited in the included studies for any further trials. We wrote to international researchers potentially involved in Class II division 2 malocclusion clinical trials in an attempt to identify unpublished/ongoing RCTs or CCTs.
A separate search for the adverse effects of interventions used was not performed.

Data collection and analysis

Selection of studies

Two review authors (DTM and CMO or SC) independently scanned the titles and abstracts (when available) of all reports identified. When studies appeared to meet the inclusion criteria, or there was insufficient information in the title and abstract to make a decision, we obtained the full report and two review authors assessed it independently to establish whether the inclusion criteria were met or not. We planned to resolve any disagreements by discussion, consulting a third review author if necessary. We had planned to carry out 'Risk of bias' assessments of all studies meeting the inclusion criteria, to extract relevant data and to record all studies rejected at this or subsequent stages in a table of excluded studies, together with the reasons for exclusion. The review authors were not to be blinded to author(s), institution or site of publication.

Data extraction and management

For each trial, we planned to enter the following information on a customised data collection form.

- Year of publication, country of origin, setting and source of study funding.
- Details on the type of interventions including appliance type.
- Details of the participants including demographic characteristics, criteria for inclusion and exclusion, and sample size by study group.
- Details of the outcomes reported, including method of assessment and time intervals.

- Details of withdrawals by study group.
- Details of outcomes, including measures and timepoints.

Assessment of risk of bias in included studies

We planned for two review authors to independently assess random sequence generation, allocation concealment, blinding of participants, blinding of outcome assessors, incomplete outcome data, selective outcome reporting and 'other issues' for each study, using the 'Risk of bias' tool recommended for Cochrane Reviews (Higgins 2011). For blinding, we would have noted any outcomes where participants self-assessed. We would have categorised the overall risk of bias for each study as follows.

Risk of bias	Interpretation	Within a study	Across studies
Low risk of bias	Plausible bias unlikely to seriously alter the results	Low risk of bias for all key domains	Most information is from studies at low risk of bias
Unclear risk of bias	Plausible bias that raises some doubt about the results	Unclear risk of bias for one or more key domains	Most information is from studies at low or unclear risk of bias
High risk of bias	Plausible bias that seriously weakens confidence in the results	High risk of bias for one or more key domains	The proportion of information from studies at high risk of bias is sufficient to affect the interpretation of results

Measures of treatment effect

We planned to calculate risk ratios, the number needed to treat for an additional beneficial/harmful outcome and corresponding 95% confidence intervals, for dichotomous data, and the mean difference and 95% confidence intervals for continuous data. We would have used the fixed-effect model for all meta-analyses unless there were more than three trials included, in which case we would have used a random-effects model.

Assessment of heterogeneity

We planned to assess heterogeneity using Cochran's test and the I^2 statistic, which describes the percentage of total variation across studies that is due to heterogeneity rather than chance. We planned to assess clinical heterogeneity by examining the types of participants and interventions for all outcomes in each study.

Data synthesis

We planned to follow Cochrane statistical guidelines. We would have included only studies of similar comparisons reporting the same outcome measures in meta-analyses. We planned to analyse the data using Review Manager software (RevMan 2014).

Subgroup analysis and investigation of heterogeneity

We planned a subgroup analysis based on the age (stage of dental development) at which treatment was undertaken.

Sensitivity analysis

We planned to conduct sensitivity analysis based on risk of bias (i.e. including studies at low risk of bias only).

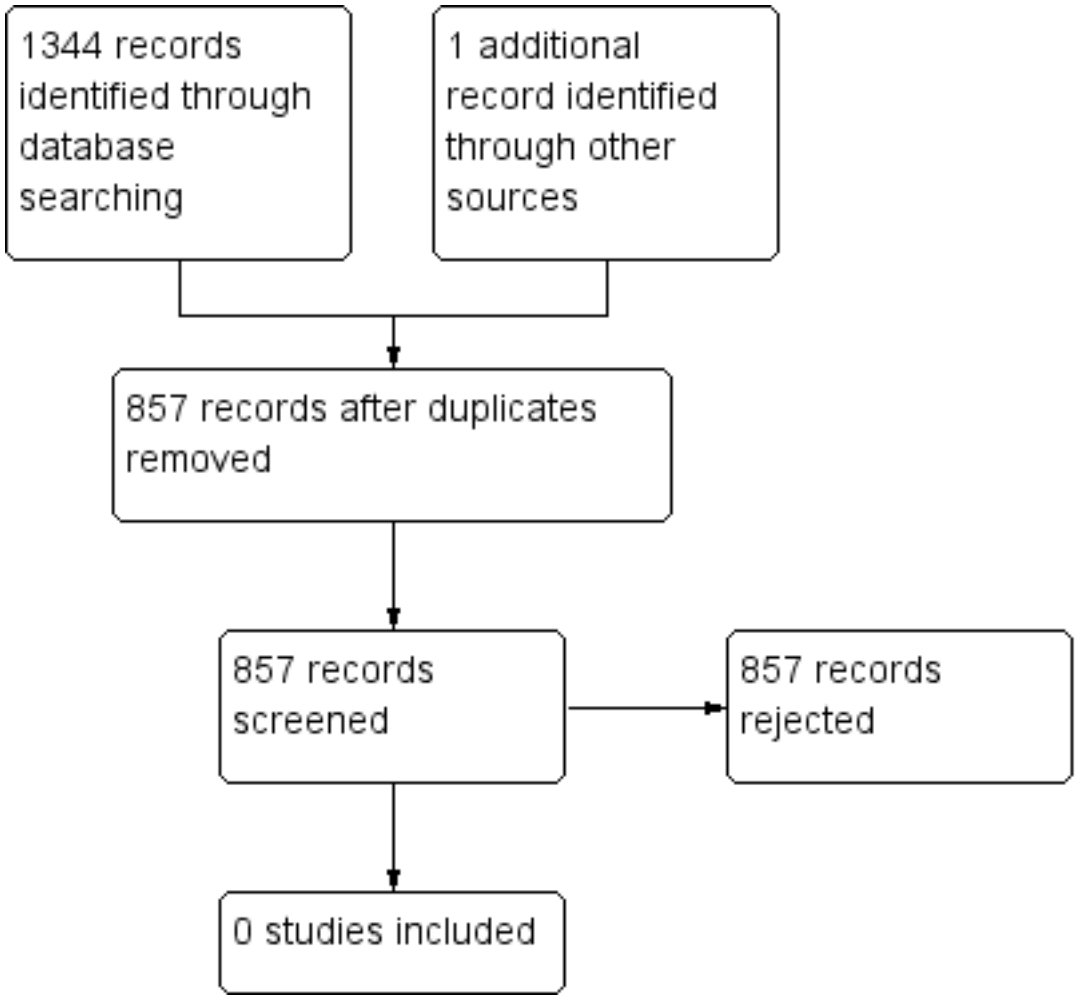
RESULTS

Description of studies

Results of the search

Through our searches and enquiries, we identified 856 references that were potentially relevant to our review. Two review authors (DTM and CMO or SC) screened these records and rejected them all. We were also involved in a trial that we mentioned in the previous version of this review, but this was discontinued due to difficulties with patient recruitment (Cunningham 2011). Therefore, we were unable to identify any RCTs or CCTs for inclusion in this review (Figure 1).

Figure 1. Study flow diagram



Risk of bias in included studies

No RCTs or CCTs were included in this review.

Effects of interventions

No RCTs or CCTs were included in this review.

DISCUSSION

We found no RCTs or CCTs assessing i) orthodontic treatment without the removal of permanent teeth versus no treatment or ii) orthodontic treatment involving removal of permanent teeth versus treatment without the removal of permanent teeth. It is therefore not possible to provide any evidence-based guidance to clinicians and patients with respect to the management of this malocclusion in children.

AUTHORS' CONCLUSIONS

Implications for practice

There is no scientific evidence to establish whether orthodontic treatment that does not involve the removal of permanent teeth is better or worse than no orthodontic treatment or orthodontic treatment involving extraction of permanent teeth, in children with Class II division 2 malocclusion.

Implications for research

There is a need for randomised controlled trials to investigate the management of Class II division 2 malocclusion in children. This is, however, complicated by a number of factors including low prevalence, ethical issues with randomisation to different modes of treatment or to a control group, and difficulties with recruitment, even in multicentre studies (Millett 2012; Cunningham 2011). As recommended previously in a review of cohort studies and case series, standardised criteria with regard to the definition of Class II division 2 malocclusion should be specified in any study (Millett 2012). Future trials should be designed, conducted and reported according to the criteria of the Consolidated Standards of Reporting Trials (CONSORT) guidelines.

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* *Indicates the major publication for the study*

DATA AND ANALYSES

This review has no analyses.

APPENDICES

Appendix 1. Cochrane Oral Health's Trials Register search strategy

From March 2014, searches of Cochrane Oral Health's Trials Register were undertaken using the Cochrane Register of Studies and the search strategy below:
1 orthodontic*:ti,ab
2 (function* and appliance*):ti,ab
3 (remova* and appliance*):ti,ab
4 (fix* and appliance*):ti,ab
5 (orthodontic* and (extract* or remov*)):ti,ab
6 (band* or brace* or wire*):ti,ab
7 (function* and device*):ti,ab
8 (remova* and device*):ti,ab
9 (fix* and device*):ti,ab
10 ((intraoral or "intra oral" or intra-oral or extraoral or "extra oral" or extra-oral) AND (device* or appliance*)):ti,ab
11 "activator appliance*":ti,ab
12 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11
13 "deep bite*":ti,ab
14 (increase* and bite*):ti,ab
15 (overbite* or over-bite* or "over bite*" or overjet* or over-jet* or "over jet*"):ti,ab
16 (("class 2" or "class II" and malocclusion) and ("division 2" or "division II")):ti,ab
17 ((teeth or tooth) AND (retro-clin* or retroclin*)):ti,ab
18 ("short face syndrome*"):ti,ab
19 #13 or #14 or #15 or #16 or #17 or #18
20 #12 and #19
Previous searches of Cochrane Oral Health's Trials Register were performed using the Procite software and the search strategy below: (orthodontic* or (function* and appliance*) or (remova* and appliance*) or (fix* and appliance*) or (orthodontic* and (extract* or remov*)) or (band* or brace* or wire*) or (function* and device*) or (remova* and device*) or (fix* and device*) or ((intraoral or "intra oral" or intra-oral or extraoral or "extra oral" or extra-oral) AND (device* or appliance*)) or "activator appliance*") AND ("deep bite*" or (increase* and bite*)) or (overbite* or over-bite* or "over bite*" or overjet* or over-jet* or "over jet*") or (("class 2" or "class II" and malocclusion) and ("division 2" or "division II")) or ((teeth or tooth) AND (retro-clin* or retroclin*)) or ("short face syndrome*")

Appendix 2. Cochrane Central Register of Controlled Trials (CENTRAL) search strategy

#1 MeSH descriptor Orthodontics explode all trees
#2 ((appliance* in All Text near/5 function* in All Text) or (appliance* in All Text near/5 remova* in All Text) or (appliance* in All Text near/5 fix* in All Text))
#3 (orthodontic* in All Text and (band* in All Text or brace* in All Text or wire* in All Text))
#4 (orthodontic* in All Text and (extract* in All Text or remov* in All Text))
#5 (orthodontic* in All Text and (headgear* in All Text or "head gear*" in All Text or head-gear* in All Text or facemask* in All Text or "face mask*" in All Text or face-mask* in All Text or chin-cap* in All Text or chincap* in All Text or "chin cap*" in All Text or "face bow*" in All Text or facebow* in All Text or face-bow* in All Text))
#6 ((device* in All Text near/5 function* in All Text) or (device* in All Text near/5 remova* in All Text) or (device* in All Text near/5 fix* in All Text))

#7 ((intraoral in All Text near/5 appliance* in All Text) or (intra-oral in All Text near/5 appliance* in All Text) or ("intra oral" in All Text near/5 appliance* in All Text) or (extraoral in All Text near/5 appliance* in All Text) or ("extra oral" in All Text near/5 appliance* in All Text) or (extra-oral in All Text near/5 appliance* in All Text) or (intraoral in All Text near/5 device* in All Text) or (intra-oral in All Text near/5 device* in All Text) or ("intra oral" in All Text near/5 device* in All Text) or (extraoral in All Text near/5 device* in All Text) or ("extra oral" in All Text near/5 device* in All Text) or (extra-oral in All Text near/5 device* in All Text))
#8 "activator appliance*" in All Text
#9 (#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8)
#10 ((deep in All Text near/3 bite* in All Text) or (increas* in All Text near/3 bite* in All Text))
#11 (overbite* in All Text or over-bite* in All Text or "over bite*" in All Text or overjet* in All Text or over-jet* in All Text or "over jet*" in All Text)
#12 (("class II" in All Text near/3 malocclusion* in All Text) or (("class 2" in All Text near/3 malocclusion* in All Text) and ("division II" in All Text or "division 2" in All Text)))
#13 ((teeth in All Text near/3 retro-clin* in All Text) or (teeth in All Text near/3 retroclin* in All Text) or (incisor* in All Text near/3 retro-clin* in All Text) or (incisor* in All Text near/3 retroclin* in All Text))
#14 "short face syndrome*" in All Text
#15 (#10 or #11 or #12 or #13 or #14)
#16 (#9 and #15)

Appendix 3. MEDLINE Ovid search strategy

1. exp Orthodontics/
2. (appliance$ adj5 (function$ or remova$ or fix$)).mp.
3. (orthodontic$ and (brace$ or band$ or wire$)).mp.
4. (orthodontic$ and (extract$ or remov$)).mp.
5. (orthodontic$ and (headgear$ or "head gear$" or head-gear$ or facemask$ or "face mask$" or face-mask$ or chincap$ or "chin cap$" or
chin-cap$ or "face bow$" or face-bow$ or facebow$)).mp.
6. (device$ adj5 (function$ or remova$ or fix$)).mp.
7. ((appliance$ or device$) adj5 (intraoral or "intra oral" or intra-oral or extraoral or "extra oral" or extra-oral)).mp.
8. (activator adj appliance$).mp.
9. or/1-8
10. ((deep or increase$) adj3 bite$).mp.
11. (overbite$ or over-bite$ or "over bite$" or overjet$ or over-jet$ or "over jet$").mp.
12. ((("class II" or "class 2") adj3 malocclusion$) and ("division 2" or "division II")).mp.
13. ((teeth or incisor$) adj3 (retro-clin$ or retroclin$)).mp.
14. "short face syndrome$".mp.
15. or/10-14
16. 9 and 15

The above subject search was linked to the Cochrane Highly Sensitive Search Strategy (CHSSS) for identifying randomised trials in MEDLINE: sensitivity-maximising version (2008 revision), as referenced in Chapter 6.4.11.1 and detailed in box 6.4.c of *The Cochrane Handbook for Systematic Reviews of Interventions* (Lefebvre 2011).

1. randomized controlled trial.pt.
2. controlled clinical trial.pt.
3. randomized.ab.
4. placebo.ab.
5. drug therapy.fs.
6. randomly.ab.
7. trial.ab.
8. groups.ab.
9. or/1-8
10. exp animals/ not humans.sh.
11. 9 not 10

Appendix 4. Embase Ovid search strategy

1. exp Orthodontics/
2. (appliance$ adj5 (function$ or remova$ or fix$)).mp.
3. (orthodontic$ and (brace$ or band$ or wire$)).mp.
4. (orthodontic$ and (extract$ or remov$)).mp.
5. (orthodontic$ and (headgear$ or "head gear$" or head-gear$ or facemask$ or "face mask$" or face-mask$ or chincap$ or "chin cap$" or chin-cap$ or "face bow$" or face-bow$ or facebow$)).mp.
6. (device$ adj5 (function$ or remova$ or fix$)).mp.
7. ((appliance$ or device$) adj5 (intraoral or "intra oral" or intra-oral or extraoral or "extra oral" or extra-oral)).mp.
8. (activator adj appliance$).mp.
9. or/1-8
10. ((deep or increase$) adj3 bite$).mp.
11. (overbite$ or over-bite$ or "over bite$" or overjet$ or over-jet$ or "over jet$").mp.
12. ((("class II" or "class 2") adj3 malocclusion$) and ("division 2" or "division II")).mp.
13. ((teeth or incisor$) adj3 (retro-clin$ or retroclin$)).mp.
14. "short face syndrome$".mp.
15. or/10-14
16. 9 and 15

The above subject search was linked to adapted version of the Cochrane Embase Project filter for identifying RCTs in Embase Ovid (see http://www.cochranelibrary.com/help/central-creation-details.html for information):

1. Randomized controlled trial/
2. Controlled clinical study/
3. Random$.ti,ab.
4. randomization/
5. intermethod comparison/
6. placebo.ti,ab.
7. (compare or compared or comparison).ti.
8. ((evaluated or evaluate or evaluating or assessed or assess) and (compare or compared or comparing or comparison)).ab.
9. (open adj label).ti,ab.
10. ((double or single or doubly or singly) adj (blind or blinded or blindly)).ti,ab.
11. double blind procedure/
12. parallel group$1.ti,ab.
13. (crossover or cross over).ti,ab.
14. ((assign$ or match or matched or allocation) adj5 (alternate or group$1 or intervention$1 or patient$1 or subject$1 or participant$1)).ti,ab.
15. (assigned or allocated).ti,ab.
16. (controlled adj7 (study or design or trial)).ti,ab.
17. (volunteer or volunteers).ti,ab.
18. trial.ti.
19. or/1-18
20. (exp animal/ or animal.hw. or nonhuman/) not (exp human/ or human cell/ or (human or humans).ti.)
21. 19 not 20

Appendix 5. US National Institutes of Health Trials Register (ClinicalTrials.gov) search strategy

(orthodontic and ("deep bite" or overbite or overjet or "over bite" or "over jet"))
(orthodontic and ("class II division II" or "class 2 division 2"))

Appendix 6. WHO International Clinical Trials Registry Platform search strategy

orthodontic and "deep bite" or orthodontic and overbite or orthodontic and overjet or orthodontic and "over bite" or orthodontic and "over jet"
orthodontic and class II division II
orthodontic and class 2 division 2

WHAT'S NEW

Last assessed as up-to-date: 10 January 2017.

Date	Event	Description
3 July 2017	New citation required but conclusions have not changed	No studies are included in this review
10 January 2017	New search has been performed	New search conducted

HISTORY

Protocol first published: Issue 2, 2006

Review first published: Issue 4, 2006

Date	Event	Description
28 November 2011	New search has been performed	Methods updated. Electronic searches updated November 2011. No new trials identified for inclusion
5 January 2009	Amended	Minor addition to Discussion.
12 September 2008	New search has been performed	Electronic searches updated to June 2008.
12 September 2008	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

This review was conceived by Declan Millett (DTM), Kevin O'Brien (KOB) and Susan Cunningham (SC). The protocol was written by DTM, KOB and Cesar M de Oliveira (CMO). The review was co-ordinated by DTM and CMO. DTM and CMO developed the search strategy with the help of Anne Littlewood (Sylvia Bickley in the original review), Information Specialist for Cochrane Oral Health, who undertook the electronic searches. DTM, SC, CMO, Philip E Benson (PEB), KOB and Alison Williams (AW). undertook handsearching. DTM and CMO or SC undertook screening of the search results. DTM, CMO, SC and KOB wrote the review.

DECLARATIONS OF INTEREST

Declan T Millett: none known.

Susan J. Cunningham: at the time of completing the update for this work (July 2017), Susan is a Trustee of the British Orthodontic Society and a member of Council of the European Orthodontic Society.

Kevin D O'Brien: none known.

Philip E Benson: none known.

Cesar M de Oliveira: none known.

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

The methods section of this review has been updated from the protocol in line with the latest version of the *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0 (updated March 2011) (Higgins 2011). 'Quality assessment' of included studies has been changed to 'Assessment of risk of bias of included studies'.

INDEX TERMS

Medical Subject Headings (MeSH)

*Orthodontic Appliances, Functional; Malocclusion, Angle Class II [*therapy]; Orthodontics, Corrective [*methods]

MeSH check words

Child; Humans