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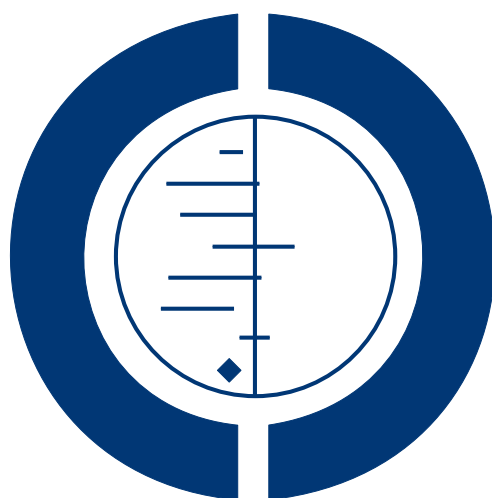
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Orthodontic treatment for deep bite and retroclined upper front teeth in children (Review)

Millett DT, Cunningham S, O'Brien KD, Benson PE, Williams A, de Oliveira CM



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[Intervention Review]

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

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ABSTRACT

Background

Correction of the type of dental problem where the bite is deep and the upper front teeth are retroclined (Class II division 2 malocclusion) may be carried out using different types of orthodontic treatment. However, in severe cases, surgery to the jaws in combination with orthodontics may be required. 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. In many cases this treatment does not involve taking out any permanent teeth. Often, however, further treatment is needed with fixed braces to get the best result. In other cases, treatment aims to move the upper first permanent molars 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 a part of a fixed or removable dental brace. This treatment may or may not involve the removal of permanent teeth. In some cases, neither functional appliances nor headgear are required and treatment may be carried out without extraction of any permanent teeth. Instead of using a headgear, in certain cases, the back teeth are held back in other ways such as with an arch across or in contact with the front of the roof of the mouth which links two bands glued to the 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 upper front teeth. It is important for orthodontists to find out whether orthodontic treatment only, carried out without the removal of permanent teeth, in children with a Class II division 2 malocclusion produces a result which is any different from no orthodontic treatment or orthodontic treatment only involving extraction of permanent teeth.

Objectives

To establish whether orthodontic treatment, carried out without the removal of permanent teeth, in children with a Class II division 2 malocclusion, produces a result which is any different from no orthodontic treatment or orthodontic treatment involving removal of permanent teeth.

Search methods

The following electronic databases were searched: the Cochrane Oral Health Group Trials Register (to 23 November 2011), the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2011, Issue 4), MEDLINE via OVID (1948 to 23 November 2011), and EMBASE via OVID (1980 to 23 November 2011). International researchers, likely to be involved in Class II division 2 clinical trials, were contacted to identify any unpublished or ongoing trials.

Selection criteria

Trials were selected if they met the following 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

Screening of eligible studies, assessment of the methodological quality of the trials and data extraction were to be conducted in duplicate and independently by two review authors. Results were to be expressed as random-effects models using mean differences for continuous outcomes and risk ratios for dichotomous outcomes with 95% confidence intervals. Heterogeneity was to be investigated including both clinical and methodological factors.

Main results

No RCTs or CCTs were identified 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.

PLAIN LANGUAGE SUMMARY

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

There is no evidence to recommend or discourage any type of orthodontic treatment to correct the type of dental problem in children where the bite is deep and the upper front teeth are retroclined (tilted toward the roof of the mouth).

It would be useful for an orthodontist to know the best way to treat a child with deep bite and retroclined upper front teeth. There are two main treatment options which orthodontists can use: a removable 'functional' brace, which fits both the upper and the lower teeth, followed by fixed braces or taking out teeth (usually two upper teeth) followed by fixed braces. At present, there is no evidence to show whether orthodontic treatment without taking out teeth in children with deep bite and retroclined upper front teeth is better or worse than orthodontic treatment involving taking out teeth or no orthodontic treatment.

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. There are many reasons why the teeth may not bite together correctly. These include the position of the teeth, jaws, lips, tongue and/or cheeks or may be due to a habit e.g. thumb sucking or the way people breathe ([Shaw 1991](#)). The need for orthodontic

treatment can be decided by looking at the effect any particular tooth position has on the life expectancy of the teeth or 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. This may be due to any combination of the jaw, tooth and/or lip position. 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 due to a habit (Shaw 1980). 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 (deep overbite). Aesthetic impairment and trauma to the palatal or lower labial gingivae are frequently reported by persons 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 a prevalence of 18% has been reported in the Croatian population (Legovic 1999). This malocclusion has a strong genetic linkage (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 persons with this type of problem seek orthodontic treatment (O'Brien 1993). There is also an increased likelihood with Class II division 2 malocclusion of having a greater percentage of upper permanent canines failing to erupt due to them going off course into the roof of the mouth (Al-Nimri 2005; Mossey 1999).

Management of prominent upper front teeth (Class II division 1 malocclusion) in children is the subject of a separate systematic review (Harrison 2007). Correction of the Class II division 2 malocclusion may be carried out by several types of orthodontic (dental brace) treatment or, in severe cases, 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 moving the upper front teeth forward 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; these braces are glued to the teeth. In other cases, treatment aims to move the upper first permanent molars 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 a 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.

In some cases, neither functional appliances nor headgear are required and treatment may be carried out without extraction of any permanent teeth (Selwyn-Barnett 1996).

In some cases, instead of using headgear, the back teeth are 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 two bands glued to the 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 upper front teeth (Paquette 1992).

In severe cases, particularly in adults, treatment may require a combination of dental braces and surgery to the jaws (Arvystas 1979) to correct the position of the teeth bite.

Why it is important to do this review

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 which is any different from no orthodontic treatment or orthodontic treatment involving extraction of permanent teeth. Combined orthodontic treatment and surgery to the jaws is not being considered in this review.

OBJECTIVES

To evaluate the effectiveness of:

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

- Dento-occlusal results of treatment, measured with the Peer Assessment Rating (PAR) index
- Cephalometric measurements (ANB change and front teeth inclination changes)
- Patient discomfort
- Gingival and temporomandibular joint (TMJ) symptoms
- Side effects
- Quality of life.

(2) Orthodontic treatment only for Class II division 2 malocclusion in children (< 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)
- Patient discomfort
- Gingival and TMJ symptoms
- Side effects
- Quality of life.

METHODS

Criteria for considering studies for this review

Types of studies

Trials were to be selected if they met the following criteria: 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

Trials were to be eligible for inclusion in the review if they had recruited patients (80% <= 16 years) receiving orthodontic treatment to correct deep bite and retroclined upper front teeth. Trials including patients with a cleft lip or palate or both or other cranio-facial deformity/syndrome were to be excluded as well as trials where patients 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

- The dento-occlusal results of treatment, measured with the Peer Assessment Rating (PAR) index.

Secondary outcomes

- The number of visits required to complete treatment and the duration of treatment
- Cephalometric measurements (ANB change and front teeth inclination changes)
- Patient discomfort
- Gingival and temporomandibular joint (TMJ) symptoms
- Side effects
- Quality of life.

For the first objective of this review, the number of visits required to complete treatment and the duration of treatment were not to be assessed.

Search methods for identification of studies

For the identification of studies included or considered for this review, we developed detailed search strategies for each database searched. These were based on the search strategy developed for MEDLINE (OVID) but revised appropriately for each database. The search strategy used a combination of controlled vocabulary and free text terms and was linked with the Cochrane Highly Sensitive Search Strategy (CHSSS) for identifying randomised trials in MEDLINE: sensitivity maximising version (2009 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* Version 5.1.0 (updated March 2011) (Higgins 2011). Details of the MEDLINE search are provided in [Appendix 3](#). The search of EMBASE was linked to the Cochrane Oral Health Group filter for identifying RCTs.

Electronic searches

We searched the following electronic databases:

- The Cochrane Oral Health Group's Trials Register (to 23 November 2011) (see [Appendix 1](#))
- The Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library*, 2011, Issue 4) (see [Appendix 2](#))
- MEDLINE via OVID (1948 to 23 November 2011) (see [Appendix 3](#))
- EMBASE via OVID (1980 to 23 November 2011) (see [Appendix 4](#))

The International Clinical Trials Registry Platform Search Portal (<http://apps.who.int/trialsearch>) was searched October 2011. The search strategy was refined by two review authors in conjunction with the Trials Search Co-ordinator of the Cochrane Oral Health Group.

Searching other resources

Handsearching of orthodontic journals is undertaken as part of the Cochrane worldwide handsearching programme which is coordinated by the US Cochrane Center. Results from handsearching are incorporated into the Cochrane CENTRAL Register of Controlled Trials which is published as part of the Cochrane Library. For a current list of journals and dates that have been handsearched see <http://us.cochrane.org/master-list>.

All first authors of trials were to be contacted in an attempt to identify any unpublished studies and clarify information about published trials (including missing data, method of randomisation, blinding and withdrawals). The references quoted in the included studies were to be screened for any further trials. There were no language restrictions. 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.

Data collection and analysis

Selection of studies

The titles and abstracts (when available) of all reports identified were scanned independently by two review authors. For studies appearing to meet the inclusion criteria, or for which insufficient data existed in the title and abstract to make a clear decision, the full report was obtained and assessed independently by two review authors independently to establish whether the inclusion criteria were met or not. Disagreements were to be resolved by discussion. Where resolution was not possible, a third review author was to be consulted. All studies meeting the inclusion criteria then were to undergo risk of bias assessment and data were to be extracted. Studies rejected at this or subsequent stages were to be recorded in the table of excluded studies, and reasons for exclusion recorded. The review authors were not to be blinded to author(s), institution or site of publication.

Data extraction and management

For each trial the following information was to be entered on a customised data collection form.

- The 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.

The primary outcome was to be the dento-occlusal result of treatment, measured with the Peer Assessment Rating (PAR) index. Secondary outcomes, where appropriate, would be the number of visits for treatment, treatment duration, relationship of the upper and lower jaws (A Point-Nasion-B Point), front teeth angle to the upper jaw and front teeth angle to the lower jaw, patient discomfort, gingival and jaw joint problems, side effects and quality of life. Harmful outcomes e.g. damage to the teeth or tooth decay were to be recorded and the results reported in descriptive terms. Where appropriate, outcome data would be grouped into those measured post-phase I (growth modification phase) and post-phase II (fixed brace phase) and, where available, post-retention outcomes would be recorded and reported. If outcome data were reported at other time points then consideration would be given to examining these as well.

Assessment of risk of bias in included studies

We planned to follow the recommended approach for assessing risk of bias in studies included in Cochrane reviews (Higgins 2011). We planned to use the two-part tool, addressing the seven specific domains (namely sequence generation, allocation concealment, blinding participants, blinding outcome assessors, incomplete outcome data, selective outcome reporting and 'other issues'). Each domain includes one or more specific entries in a 'Risk of bias' table. Within each entry, the first part of the tool involves describing what was reported to have happened in the study. The second part of the tool involves assigning a judgement relating to the risk of bias for that entry.

The domains of sequence generation, allocation concealment, incomplete outcome data and selective outcome reporting were each addressed in the tool by a single entry for each study. For blinding we used two entries because assessments needed to be made separately for a) patients and b) outcome assessor. Where the patients self-assessed the outcome to the trial we planned to note this. We assessed the final domain ('other sources of bias') as a single entry for studies as a whole.

We planned that at least two review authors would independently carry out the risk of bias assessment as part of the data extraction process.

After taking into account the additional information provided by the authors of the trials, we planned to group studies into the following categories.

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

We planned to complete a risk of bias table for each included study and to present the results graphically.

Measures of treatment effect

Risk ratios, the numbers needed to treat and corresponding 95% confidence intervals, were to be calculated for dichotomous data. The mean difference and 95% confidence intervals were to be calculated for continuous data. Fixed-effect models were to be used for all meta-analyses unless there were more than three trials included, in which case random-effects models would be used.

Assessment of heterogeneity

Heterogeneity was to be assessed 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. Clinical heterogeneity was to be assessed by examining the types of participants and interventions for all outcomes in each study.

Data synthesis

The Cochrane Collaboration statistical guidelines were to be followed. Only if there were studies of similar comparisons reporting the same outcome measures was meta-analysis to be attempted. The data were to be analysed using RevMan and reported according to Cochrane Collaboration criteria.

Subgroup analysis and investigation of heterogeneity

A subgroup analysis was to be carried out on the age (stage of dental development) that treatment was undertaken.

Sensitivity analysis

Sensitivity analysis was to be used based on risk of bias (including low risk of bias studies only).

RESULTS

Description of studies

No randomised controlled trial or controlled clinical trial was identified.

Risk of bias in included studies

No randomised controlled trial or controlled clinical trial was identified.

Effects of interventions

No randomised controlled trial or controlled clinical trial was identified.

DISCUSSION

No randomised controlled trials or controlled clinical trials were identified so it is not possible to provide any evidence-based guidance to clinicians and patients with respect to the management of this malocclusion in children. The review authors were aware of an ongoing randomised controlled trial comparing extractions of upper premolars (with/without anchorage reinforcement) followed by fixed appliance therapy versus a two-phase treatment with a functional appliance (Twin Block) followed by a phase of fixed appliance therapy (Cunningham 2006). Unfortunately that trial has been discontinued due to patient recruitment difficulties. This review will be updated in the light of the findings of future trials.

AUTHORS' CONCLUSIONS

Implications for practice

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

Implications for research

There is the need for randomised controlled trials to investigate

the management of Class II division 2 malocclusion in children. 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 Group's Trials Register search strategy

(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 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 randomized 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*, Version 5.1.0 [updated March 2011] ([Higgins 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 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 Oral Health Group filter for identifying RCTs in EMBASE via OVID:

1. random\$.ti,ab.
2. factorial\$.ti,ab.
3. (crossover\$ or cross over\$ or cross-over\$).ti,ab.
4. placebo\$.ti,ab.
5. (doubl\$ adj blind\$).ti,ab.
6. (singl\$ adj blind\$).ti,ab.
7. assign\$.ti,ab.
8. allocat\$.ti,ab.
9. volunteer\$.ti,ab.
10. CROSSOVER PROCEDURE.sh.
11. DOUBLE-BLIND PROCEDURE.sh.
12. RANDOMIZED CONTROLLED TRIAL.sh.
13. SINGLE BLIND PROCEDURE.sh.
14. or/1-13
15. ANIMAL/ or NONHUMAN/ or ANIMAL EXPERIMENT/
16. HUMAN/
17. 16 and 15
18. 15 not 17
19. 14 not 18

WHAT'S NEW

Last assessed as up-to-date: 28 November 2011.

Date	Event	Description
28 November 2011	New search has been performed	Methods updated. Electronic searches updated November 2011. No new trials identified for inclusion

HISTORY

Protocol first published: Issue 2, 2006

Review first published: Issue 4, 2006

Date	Event	Description
5 January 2009	Amended	Minor addition to Discussion.
12 September 2008	Amended	Converted to new review format.
12 September 2008	New search has been performed	Electronic searches updated to June 2008.

CONTRIBUTIONS OF AUTHORS

This review was conceived by Declan Millett (DTM), Kevin O'Brien (KOB) and Susan Cunningham (SJC). The protocol was written by DTM, KOB and Cesar 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), Trials Search Co-ordinator for the Cochrane Oral Health Group, who undertook the electronic searches. Handsearching was undertaken by DTM, SJC, CMO, Philip Benson (PB), KOB and Alison Williams (AW). Screening of the search results was undertaken by DTM and CMO. Appraisal of the quality of papers, data extraction, analysis and interpretation of data were undertaken by DTM, SJC, CMO, PB, KOB and AW. DTM, CMO, SJC and KOB wrote the review.

DECLARATIONS OF INTEREST

None known.

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

The methods section of this review has been updated 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