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Open versus closed surgical exposure of canine teeth that are displaced in the roof of the mouth (Review)

Parkin N, Benson PE, Thind B, Shah A



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TABLE OF CONTENTS

HEADER	1
ABSTRACT	1
PLAIN LANGUAGE SUMMARY	2
BACKGROUND	2
OBJECTIVES	3
METHODS	3
RESULTS	5
DISCUSSION	5
AUTHORS' CONCLUSIONS	5
ACKNOWLEDGEMENTS	6
REFERENCES	6
CHARACTERISTICS OF STUDIES	7
DATA AND ANALYSES	9
APPENDICES	9
WHAT'S NEW	10
HISTORY	10
CONTRIBUTIONS OF AUTHORS	10
DECLARATIONS OF INTEREST	10
INDEX TERMS	11

[Intervention Review]

Open versus closed surgical exposure of canine teeth that are displaced in the roof of the mouth

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ABSTRACT

Background

Palatal canines are upper permanent canine (eye) teeth that have become displaced in the roof of the mouth. They are a frequently occurring anomaly, present in 2% to 3% of the population. Management of this problem is both time consuming and expensive and involves surgical exposure (uncovering) followed by fixed braces for 2 to 3 years to bring the canine into alignment within the dental arch. Two techniques for exposing palatal canines are routinely used in the UK: one method (the closed technique) involves orthodontically moving the canine into its correct position beneath the palatal mucosa and the second method (the open technique) involves orthodontically moving the canine into its correct position above the palatal mucosa.

Objectives

To establish if clinical, patient centred and economic outcomes are different according to whether an 'open' or 'closed' technique is employed for uncovering palatal canines.

Search strategy

MEDLINE, EMBASE, the Cochrane Central Register of Controlled Trials (CENTRAL) and the Cochrane Oral Health Group's Trials Register were searched (to 29th February 2008). There were no restrictions with regard to publication status or language.

Selection criteria

Patients receiving surgical treatment to correct upper palatally impacted canines. There was no restriction for age, presenting malocclusion or the type of active orthodontic treatment undertaken. Unilateral and bilaterally displaced canines were included.

Trials including participants with craniofacial deformity/syndrome were excluded.

Data collection and analysis

Two review authors independently and in duplicate assessed studies for inclusion. The Cochrane Collaboration statistical guidelines were to be followed for data synthesis.

Main results

No studies were found that met the inclusion criteria.

Authors' conclusions

This review has revealed that currently, there is no evidence to support one surgical technique over the other in terms of dental health, aesthetics, economics and patient factors. Until high quality clinical trials with participants randomly allocated into the two treatment groups are conducted, methods of exposing canines will be left to the personal choice of the surgeon and orthodontist.

PLAIN LANGUAGE SUMMARY

Open versus closed surgical exposure of canine teeth that are displaced in the roof of the mouth

Canines in the upper jaw usually erupt in the mouth between the age of 11 to 12 years. In 2% to 3% of the population these teeth fail to erupt into the mouth and become lodged in the roof of the mouth (palate), they are then referred to as 'palatally impacted'. Their impaction can cause damage to the roots of neighbouring teeth and the damage may be so severe that these neighbouring teeth are subsequently lost. The tissue around these impacted canine teeth may undergo cystic change. Also, impaction of these teeth can lead to aesthetic problems.

Management of this problem is both time consuming and expensive and involves surgical exposure (uncovering) followed by fixed braces for 2 to 3 years to bring the canine into its correct position. Two techniques for exposing palatal canines are routinely used in the UK: One method (closed technique) involves surgically uncovering the tooth, gluing an attachment on the exposed tooth and repositioning the palatal flap. Shortly after surgery, an orthodontic brace is used to apply gentle forces to bring the canine into its correct position within the dental arch. The canine moves into position beneath the mucosa. An alternative method (open technique) is to surgically uncover the canine tooth as before, but instead of gluing an attachment on the exposed tooth, removing a window of tissue from around the tooth and placing a dressing (pack) to cover the exposed area. Approximately 10 days later, this pack is removed and the canine is allowed to erupt naturally. Once the tooth has erupted sufficiently for an orthodontic attachment to be glued onto its surface, orthodontic brace treatment is commenced to bring the tooth into line. The canine moves into its correct position above the mucosa.

This review has revealed that currently, there is no evidence to support one surgical technique over the other in terms of dental health, aesthetics, economics and patient factors. Until high quality clinical trials with participants randomly allocated into the two treatment groups are conducted, methods of exposing canines will be left to the personal choice of the surgeon and orthodontist.

BACKGROUND

Canines in the upper jaw usually erupt in the mouth between the age of 11 to 12 years (Hagg 1986). In 2% to 3% (Thilander 1973) of the population these teeth fail to erupt into the mouth and become lodged in the roof of the mouth (palate), they are then referred to as 'palatally impacted'. Their impaction can cause damage to the roots of neighbouring teeth and the damage may be so severe that these neighbouring teeth are subsequently lost. The tissue around these impacted canine teeth may undergo cystic change. Also, impaction of these teeth can lead to aesthetic problems (Shafer 1983) owing to a gap in the dental arch in the area of the impaction and a shift of the upper dental midline.

The exact aetiology of palatally impacted canines is not known and many reasons have been cited (Bishara 1992). Possible causes are: missing or small lateral incisor teeth, a general lack of space

in the upper jaw, delayed or early shedding of the primary tooth, abnormal position of developing canine tooth, presence of cleft in the jaw, fusion of the tooth to the bone (ankylosis) and trauma to other teeth in the area. Positional abnormalities of canine teeth have been reported in families (Peck 1994; Peck 1996; Peck 1997) and therefore it is likely that genetics play an important role in their impaction.

At present, two surgical techniques are routinely used to uncover palatally impacted canines. A survey was carried out in the UK to investigate orthodontists' preference of surgical technique (i.e. open versus closed exposure) (Clark 1994). It was found that choice of technique was equally divided.

Following the surgical procedure, an orthodontic brace is used to bring the canine tooth into its correct position and this on

average takes around 2 to 3 years. One method (closed technique) involves surgically uncovering the tooth, gluing an attachment on the exposed tooth and repositioning the palatal flap (Lewis 1971). Shortly after surgery, an orthodontic brace is used to apply gentle forces to bring the canine into its correct position within the dental arch. The canine moves into position beneath the mucosa. An alternative method (open technique) is to surgically uncover the canine tooth as before, but instead of gluing an attachment on the exposed tooth, removing a window of tissue from around the tooth and placing a dressing (pack) to cover the exposed area. Approximately 10 days later, this pack is removed and the canine is allowed to erupt naturally (Clark 1971). Once the tooth has erupted sufficiently for an orthodontic attachment to be glued onto its surface, orthodontic brace treatment is commenced to bring the tooth into line. The canine moves into its correct position above the mucosa.

OBJECTIVES

To test the null hypothesis that there are no differences in the outcomes between using an open or closed surgical method to expose canines that have become displaced in the roof of the mouth.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised or quasi-randomised controlled clinical trials in which palatally impacted canines are surgically exposed and subsequently aligned using orthodontic braces.

Types of participants

Patients receiving surgical treatment to correct maxillary palatally impacted canines. There is no restriction for age, presenting malocclusion or the type of active orthodontic treatment undertaken. Unilateral and bilaterally displaced canines were included. Trials including participants with craniofacial deformity/syndrome were excluded.

Types of interventions

- Surgical exposure of palatally impacted canines with an open surgical technique.
- Surgical exposure of palatally impacted canines with a closed surgical technique.

The control was the untreated contra-lateral side for those studies where only unilateral impacted canines are included. A control

group is not necessary for all outcome measures because differences between the 'open' group and the 'closed' group are being tested.

Types of outcome measures

Differences between the 'open' and 'closed' groups were measured in terms of the following.

Primary outcome

Gum health as measured by loss of attachment of the gum from around the tooth, bleeding on probing, recession of the gum margin and crestal bone height.

Secondary outcomes

- Economic differences between the two groups as measured by length of time in theatre, duration of orthodontic treatment and number of orthodontic appointments.
- Patient response (pain/discomfort).
- Aesthetics of the treated canine compared to the untreated contra-lateral canine.

Search methods for identification of studies

For the identification of studies included or considered for this review detailed search strategies were developed for each database searched. These were based on the search strategy developed for MEDLINE but revised appropriately for each database. The subject search strategy used a combination of controlled vocabulary and free text terms based on the search strategy for MEDLINE (OVID), in conjunction with phases 1 & 2 of the Cochrane Sensitive Search Strategy for Randomised Controlled Trials (RCTs) as published in the *Cochrane Handbook for Systematic Reviews of Interventions* 4.2.6 (updated September 2006), Appendix 5b (Higgins 2006).

The following databases were searched for relevant trials:

- MEDLINE (1966 to February 2008)
- EMBASE (1980 to February 2008)
- Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2008, Issue 1)
- Cochrane Oral Health Group's Trials Register (to February 2008).

Details of the search strategies are provided in [Appendix 1](#); [Appendix 2](#); [Appendix 3](#); and [Appendix 4](#).

Language

Databases were searched to include all languages and some non-English language papers were translated.

The reference lists of potential clinical trials were examined in an attempt to identify any additional studies. Authors of trial reports

and specialists in the field were written to concerning further published and unpublished studies.

Data collection and analysis

Study selection

Two review authors independently and in duplicate, in a non-blind fashion, examined the title, keywords and abstract of reports identified from electronic searching for evidence of three criteria:

- Is it a randomised or quasi-randomised clinical trial?
- Does it involve the surgical exposure of palatally impacted canine(s)?
- Is the gum health, cost, patient response or appearance assessed after completion of treatment?

If the report fulfils these three criteria or if one or both review authors are not able to assess this from the title, keywords or abstract then the full article was obtained.

Data extraction

Since the review was empty, this could not be done. For future included studies, data to collect would include:

- Type of surgical exposure
- Sample size and age
- Mean duration and follow up of study
- Outcome measures (gum health, cost, patient response, appearance).

Data extraction would then be carried out using a previously piloted form and two review authors would perform data extraction independently. Authors would then be contacted to provide missing data where possible.

Quality assessment

The following criteria were to be examined.

- (1) Method of allocation concealment. The criterion would be considered to be 'met' when the assignment of patients to treatment was randomised and the randomisation schedule was kept concealed to the researcher recruiting participants. When papers did not report such information, the criterion would be considered 'unclear'.
- (2) Protection against detection bias. The criterion would be considered to be 'met' when the researchers assessing outcome measures were kept 'blind', 'unclear' when it was not reported or 'unmet' when the researcher was not blind to the outcome.
- (3) Protection against attrition bias (drop outs, withdrawals, protocol deviation). At least 80% of patients who entered the trial should be included in the final analysis.

All were to be reported as:

- (A) Adequate
- (B) Unclear
- (C) Inadequate.

The global validity of the study was to be assessed using three categories:

- (1) Low risk of bias: all of the criteria met
- (2) Moderate risk of bias: one or more criteria partially met (coded as unclear); remaining criteria met
- (3) High risk of bias: one or more criteria unmet.

In addition the following methodological criteria were to be examined:

- (1) Sample size calculation reported
- (2) Comparability of groups at the start in terms of age, gender, position of canine, crowding/spacing of teeth and malocclusions. In addition, variation in the observation period after the intervention (particularly in terms of gum health) could be another factor in producing heterogeneity
- (3) Clear inclusion/exclusion criteria
- (4) Validity and reproducibility of the method of assessment.

Quality assessment of the included trials was to be undertaken independently and in duplicate by two review authors as part of the data extraction process.

Data synthesis

This could not be done.

For future included studies, all assessments of outcomes (and at all periods of follow up) will be recorded. Decisions on which outcome assessment timing to use from each study will be based on the most commonly reported timing of assessment among all included studies. Pooling of data and meta-analysis will only be carried out if there are sufficient similarities between studies in the types of participants, interventions and outcomes. Heterogeneity will be assessed by inspection of a graphical display of the estimated treatment effects from trials along with Cochran's test for heterogeneity undertaken prior to each meta-analysis. Heterogeneity will be investigated for aspects of study quality specified a priori as follows: randomisation, allocation concealment, blind outcome assessment and including/excluding unpublished literature. The association of these factors with estimated effects will be examined by performing random-effects metaregression analysis in Stata version 7.0 (Stata Corporation, USA), using the program Metareg. Alternatively, the latest edition of RevMan (RevMan 2008) may be used. Further potential sources of heterogeneity will be investigated as determined from the study reports, although these will be clearly identified as 'post hoc' analyses and the results treated with caution. A sensitivity analysis will be conducted for studies with low risk of bias. Subgroup analyses of degree of impaction at baseline and age at start of treatment will be performed.

Investigation of publication bias

This could not be done.

For future included studies, a funnel plot (plot of effect size versus standard error) will be drawn. Asymmetry of the funnel plot may indicate publication bias and other biases related to sample size, though may also represent a true relationship between trial size and effect size. A formal investigation of the degree of asymmetry will be performed using the method proposed by Egger 1997.

RESULTS

Description of studies

See: [Characteristics of excluded studies](#); [Characteristics of ongoing studies](#).

The search identified 191 publications of which 163 were excluded after reviewing the abstract. Full articles were obtained for the remaining 28. Fifteen of these full articles were foreign and six required translation. All retrieved articles were excluded.

Risk of bias in included studies

No studies were included.

Effects of interventions

None of the studies fulfilled the criteria to be included in the review.

DISCUSSION

Despite extensive searching of the literature, it is disappointing that no studies could be identified that met the inclusion criteria. Most studies were retrospective and random allocation of participants was not found in any study.

Other evidence (from excluded studies)

There has been an unsystematic review by Burden 1999. He concluded that there was no evidence to support either technique, the primary outcome measure in his review was periodontal health. There was only one study (Wisth 1976a) that directly compared closed and open techniques. Thirty-four participants received an open exposure and 22 patients received a closed exposure. It was found that the mean duration of treatment was 4 months longer in the closed group and it was reported that this was likely due to lack of direct vision of the canine from when it was exposed to when it was brought into the line of the arch. The closed group appeared

to have less periodontal damage in terms of loss or attachment and bone levels. The study however was retrospective, pretreatment equivalence was not established (in terms of participants' age or severity of canine displacement) and therefore the risk of selection and detection bias was high.

Schmidt 2007 conducted a study that evaluated differences in periodontal health, root length and aesthetics in 16 participants with unilaterally palatally displaced canines and six participants with bilaterally displaced canines. All were exposed using an open technique and the canines were allowed to erupt autonomously before being brought into their correct position with braces. Outcomes were compared to the contra-lateral untreated canine (control teeth) and also to data obtained from an earlier study (Woloshyn 1994). In the Woloshyn study, all palatally displaced canines received a closed exposure. Both studies found that the roots of the impacted canine and adjacent lateral incisor were slightly shorter than those of the contra-lateral canine and that the treated canine could be visually identified from the untreated canine in 70% to 80% of cases. Woloshyn also found significant differences in probing depths and crestal bone height when comparing treated with untreated canines; this was not found in the Smidh study. It was concluded that the overall consequences to the impacted canine with this technique seem better than with a closed technique, however consequences to the lateral incisor were similar with both techniques. This is in contrast to findings of other authors (Becker 1983; Crescini 2007; Kohavi 1984; Quirynen 2000). These authors reported excellent periodontal health following alignment of canines using a closed technique. Importantly, all these mentioned studies (including that by Schmidt), are retrospective and findings therefore score low in terms of evidence.

There has been one prospective study investigating "patients' perception of recovery after exposure of impacted teeth" (Chaushu 2005). A direct comparison was made between open and closed techniques. Sixty participants were enrolled, 25 received a closed exposure and 32 an open exposure, there was no random allocation. Questionnaires were given to the patient following surgery to assess participant's perception of recovery in four main areas: pain, oral function, ability to participate in routine daily activities and 'other symptoms' such as bad taste, bleeding or swelling. The comparison revealed that patients receiving an open exposure had a longer recovery time in all areas except 'ability to participate in routine activities'. However since the participants were not randomly allocated, the risk of selection bias is high. If one group had more severely impacted canines, this would have a bearing on the results.

AUTHORS' CONCLUSIONS

Implications for practice

This review has revealed that currently, there is no evidence to sup-

port either the open or the closed technique for exposing palatally ectopic canines to be clinically superior in terms of dental health, aesthetics, economics and patient factors.

Until high quality randomised clinical trials are conducted, methods of exposing canines will be left to the personal choice of the surgeon and orthodontist.

Implications for research

There is a high need for randomised clinical trials on this subject, the current literature provides very weak evidence.

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Schmidt 2007 *{published data only}*

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Wisth 1976b *{published data only}*

Wisth PJ, Norderval K, Boe OE. Periodontal status of orthodontically treated impacted maxillary canines. *Angle Orthodontist* 1976;**46**(1):69-76.

References to studies awaiting assessment

Moriera 1978 *{published data only}*

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Parkin 2004 *{unpublished data only}*

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Lewis 1971

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Ling 2007a

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of excluded studies *[ordered by study ID]*

Caminiti 1998	No information regarding randomisation. Buccally and palatally displaced canines
D'Amico 2003	Consecutively treated participants
Gaulis 1978	No information about randomisation, uncontrolled
Schmidt 2007	Consecutively treated participants, split-mouth design but technique compared to historical alternative technique
Wisth 1976a	Not clear how participants were allocated or if the trial was prospective
Wisth 1976b	Cohort study

Characteristics of ongoing studies *[ordered by study ID]*

Parkin 2004

Trial name or title	Surgical exposure of palatally ectopic canines
Methods	
Participants	81 randomly allocated into 2 treatment groups
Interventions	Open exposure, closed exposure
Outcomes	Unavailable at present
Starting date	2004
Contact information	nicolaparkin@hotmail.com
Notes	

DATA AND ANALYSES

This review has no analyses.

APPENDICES

Appendix 1. MEDLINE (OVID) search strategy

1. Tooth, Impacted/
2. Tooth, Unerupted/
3. ((tooth or teeth) adj6 impact\$).mp. [mp=ti, ot, ab, nm, hw]
4. ((tooth or teeth) adj6 unerupt\$).mp. [mp=ti, ot, ab, nm, hw]
5. (((tooth or teeth) adj6 ectopic\$) or ((tooth or teeth) adj6 displac\$)).mp. [mp=ti, ot, ab, nm, hw]
6. TOOTH ERUPTION ECTOPIC/
7. or/1-6
8. ((maxilla\$ or upper or (roof adj4 mouth) or palate) and (canine\$ or cuspid\$ or (eye adj (tooth or teeth))))).mp. [mp=ti, ot, ab, nm, hw]
9. 7 and 8
10. (surgery or surgical\$).mp. [mp=ti, ot, ab, nm, hw]
11. 9 and 10

Appendix 2. EMBASE (OVID) search strategy

1. ((tooth or teeth) adj6 impact\$).mp [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
2. ((tooth or teeth) adj6 unerupt\$).mp [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
3. (((tooth or teeth) adj6 ectopic\$) or ((tooth or teeth) adj6 displac\$)).mp [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
4. 1 or 2 or 3
5. ((maxilla\$ or upper or (roof adj4 mouth) or palate) and (canine\$ or cuspid\$ or (eye adj (tooth or teeth))))).mp [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
6. 4 and 5
7. (surgery or surgical\$).mp [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
8. 6 and 7

Appendix 3. CENTRAL search strategy

- #1. Tooth, Impacted/
- #2. Tooth, Unerupted/
- #3. ((tooth near impact*) or (teeth near impact*)) [in ti, ab, kw]
- #4. ((tooth near unerupt*) or (teeth near unerupt*)). [in ti, ab, kw]
- #5. (tooth near ectopic*) or (teeth near ectopic*) or (tooth near displac*) or (teeth near displac*) [in ti, ab, kw]
- #6. TOOTH ERUPTION ECTOPIC/
- #7. #1 or #2 or #3 or #4 or #5 or #6
- #8. ((maxilla* or upper or (roof near/4 mouth) or palate) and (canine* or cuspid* or "eye tooth" or "eye teeth")). [in ti, ab, kw]
9. 7 and 8

10. (surgery or sugical*) [in ti, ab, kw]
11. 9 and 10

Appendix 4. Cochrane Oral Health Group's Trials Register search strategy

((("tooth, impacted" or "tooth, unerupted" or "impact* tooth" or "impact* teeth" or "unerupt* tooth" or "unerupt* teeth" or ((tooth or teeth) and ectopic*) or ((tooth or teeth) and displac*)) AND ((maxilla* or upper or (roof AND mouth) or palate) AND (canine* or cuspid* or "eye tooth" or "eye teeth"))))

WHAT'S NEW

Last assessed as up-to-date: 9 June 2008.

10 June 2008	Amended	Converted to new review format.
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HISTORY

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CONTRIBUTIONS OF AUTHORS

Conceiving, designing and co-ordinating the review (Nicola Parkin (NP)).

Developing search strategy and undertaking searches (NP, Philip Benson (PB)).

Screening search results and retrieved papers against inclusion criteria (NP, PB, Anwar Shah (AS), Bikram Thind (BT)).

Appraising quality (NP, PB).

Extracting data from papers (NP, PB).

Writing to authors for additional information (NP).

Data management for the review and entering data into RevMan (NP).

Analysis and interpretation of data (NP, PB).

Writing the review (NP).

Providing general advice on the review (PB, BT, AS).

DECLARATIONS OF INTEREST

Nicola Parkin is currently the lead investigator of a grant aided clinical trial entitled 'Surgical exposure of palatally ectopic canines: A randomised clinical study'.

INDEX TERMS

Medical Subject Headings (MeSH)

Cuspid [*abnormalities]; Palate; Tooth Eruption, Ectopic [*surgery]

MeSH check words

Humans