

Management of the Palatally Ectopic Maxillary Canine

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2016

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Introduction

The maxillary canine is second only to the mandibular third molar in its frequency of impaction with a prevalence of about 1.5%. Numerous sources in the literature suggest ectopic canines occur palatally, with a much greater frequency than they do buccally,¹ but the latter do not seem to have been studied as extensively, perhaps because a greater proportion of buccal canines appear to erupt naturally without active intervention. General Dental Practitioners and Orthodontists will commonly encounter this problem and need to be fully aware of how to manage this situation. Failure to diagnose and manage the ectopic upper canine efficiently can result in more complex remedial treatment becoming necessary, which would be costly in terms of clinical time for both the practitioner and patient. There is also the risk of damage occurring to adjacent teeth, which may lead to litigation claims.

The aetiology of ectopic palatal canines remains unclear, but is likely to be polygenic.^{2,3} This is supported by evidence that palatally ectopic canines occur more frequently than expected amongst family members. There is also a significant association with other dental anomalies which are often considered to have a genetic origin such as missing, malformed or diminutive lateral incisors, an absence of crowding and late developing dentitions.^{4,6} The majority of canines undergoing normal eruption should be palpable in the buccal sulcus by 10 to 11 years of age.⁷ Those maxillary canines erupting after approximately 12.3 years in girls and 13.1 years in boys may be considered to be late.⁸

Sequelae of Ectopic Canines

The main risk from ectopic canines appears to be root resorption of adjacent teeth, usually the incisors. There may be a higher prevalence of palatal canine impaction, as well as associated incisor root resorption, in patients where there has been previous impaction of an upper first permanent molar.⁹ Although not always of clinical significance, one study using cone-beam CT scanning detected root resorption in 66.7% of permanent lateral incisors adjacent to ectopic maxillary canines.¹⁰ It has been stated that root resorption of incisors by palatally

ectopic canines rarely starts after 14 years of age¹¹ and it occurs most frequently between 11 and 12 years.¹²

Other possible sequelae of ectopic canines are resorption of the canine crown, which is most likely to occur in adults, with quoted frequencies of up to 14%¹³ and cystic changes, the frequency of which is generally thought to be low.¹⁴

I. Diagnosis and Management

I.1 History and examination

Practitioners should suspect that a canine is ectopic if it is not palpable in the buccal sulcus by the age of 10-11 years, if palpation indicates an asymmetrical eruption pattern or the position of adjacent teeth implies a malposition of the permanent canine. The patient with an ectopic maxillary canine must undergo a comprehensive assessment of the malocclusion, including accurate localisation of the canine.

I.2 Radiographic examination¹⁵⁻²⁰

Radiographic procedures prior to the age of 10-11 years are usually of little benefit in terms of the knowledge gained.^{1,7}

The examination to localise the position of an ectopic canine usually involves taking two different radiographs and using the principle of parallax. Parallax is defined as *the apparent displacement of an object because of different positions of the observer*. In radiography this involves two radiographs being taken of the ectopic canine with the X-ray tubehead in two different positions. This shift in tubehead position can either be in the horizontal plane (horizontal parallax) or in the vertical plane (vertical parallax).¹⁹ Research has shown that the horizontal parallax technique is more reliable than vertical parallax in localizing unerupted canines.²⁰ It has been suggested that the reliability of the latter might be improved by increasing the tubehead angulation.¹⁸

1.2.1 Horizontal parallax

1. Upper Standard Occlusal (midline view) and Periapical (centred on the canine region)
OR
2. Two Periapicals (one centred on the upper central incisor and the other centred on the canine region)

1.2.2 Vertical parallax

1. Upper Standard Occlusal (midline view with X-ray beam aimed downwards) and a Panoramic Radiograph (X-ray beam aimed upwards at approximately 8° to the horizontal)
OR
2. Periapical (bisected angle technique with X-ray beam aimed downwards) and a Panoramic Radiograph (X-ray beam aimed upwards at approximately 8° to the horizontal)

More recently, cone beam computed tomography (CBCT) has become more widely available for imaging the maxillofacial region. Small field of view (FOV) CBCT can be used for the localisation of ectopic canines and the identification of root resorption in incisor teeth.¹⁰ However, this technique is typically associated with a higher overall effective dose of ionising radiation than conventional radiography. Current UK and European guidance, including the SEDENTEXCT guidelines, suggest that small FOV CBCT may be appropriate for the examination of ectopic canines in selected cases where conventional radiographs fail to provide adequate information to construct a treatment plan.¹⁶ The current British Orthodontic Society Orthodontic Radiographs Guidelines clearly state that there is no indication for the routine use of CBCT.¹⁵ Where there is any uncertainty about the undertaking of CBCT imaging, the opinion of a Specialist in Dental and Maxillofacial Radiology should be sought beforehand.

2. Treatment

Radiographic examination should be carried out initially to confirm the position of the unerupted canine. Patient and parent counselling on the various treatment options is essential.

2.1 Interceptive treatment by extraction of the primary canine²¹⁻²⁵

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In carefully selected cases, where the ectopic permanent canine is not severely displaced, there is some evidence that interceptive extraction of the adjacent primary canine can result in an improvement in the position of an ectopic permanent canine.

- The patient should be aged between 10-13 years, with better results reported in the absence of crowding.
- The need to space maintain (or even create additional space), requires consideration.
- If radiographic examination reveals no improvement in the ectopic canine's position 12 months after extraction of the primary canine, alternative treatment options should be considered.

2.2 Surgical exposure²⁶ and orthodontic alignment

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- The case is not considered to be suitable for interceptive extraction of the primary canine.
- The patient should be willing to wear fixed orthodontic appliances.
- The patient should be well motivated and have good dental health.
- The degree of malposition of the ectopic canine should not be so great that orthodontic alignment is impractical (e.g. close proximity to the midline, above the apices of the adjacent teeth, horizontal angulation).
- The likelihood of success decreases with age in adults.²⁷

2.3 Surgical removal of the palatally ectopic permanent canine

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- This treatment option should be considered if the patient declines active treatment and/or is happy with their dental appearance.
- Surgical removal of the ectopic canine should be considered if there is radiographic evidence of *early* root resorption of the adjacent incisor teeth (but exposure and alignment of the ectopic canine is usually indicated in cases where *severe*

root resorption of an incisor tooth has occurred necessitating the extraction of the incisor).

- The best results are achieved if there is good contact between the lateral incisor and first premolar or the patient is willing to undergo orthodontic treatment to substitute the first premolar for the canine.
- The possible risk of damaging the roots or the neurovascular supply of adjacent teeth during the act of surgically removing the impacted canine should be assessed and discussed with the patient.

carry out a careful clinical examination of the patient on a regular basis to ensure the unerupted canine does not represent a risk to the patient's well-being. No guidance currently exists as to how frequently radiographic checks should be carried out.

B> 2.4 Transplantation²⁸⁻³¹

- Transplantation is not normally considered unless other possible active (or interceptive) treatment has failed or is felt to be inappropriate.
- This treatment option **can** be considered if the patient is unwilling to wear orthodontic appliances or the degree of malposition is too great for orthodontic alignment to be practical.
- There should be adequate space available for the canine and sufficient alveolar bone to accept the transplanted tooth.
- The prognosis should be good for the canine tooth to be transplanted with no evidence of ankylosis. The best results are achieved if the ectopic canine can be removed with minimal trauma and before closure of the apex.
- Depending on the stage of root formation (*i.e.* >3/4 root formed), the transplanted canine may require root canal therapy to be commenced within 10 days following transplantation.

C> 2.5 No active treatment/leave and observe

- The patient does not want treatment or is happy with their dental appearance.
- There should be no evidence of root resorption of adjacent teeth or other pathology.
- Ideally, there should be good contact between the lateral incisor and first premolar or the primary canine should have a good prognosis.
- Severely displaced palatally ectopic canines with no evidence of pathology may be left *in-situ*, particularly if the canine is remote from the dentition. If the ectopic canine is left *in-situ*, then, as with any unerupted tooth, the practitioner providing continuing care for the patient should

Explanatory Notes

Treatment planning for patients with palatally ectopic maxillary canines is not straightforward due to the large number of patient factors and orthodontic considerations, which must be taken into account. It is strongly recommended that practitioners seek the opinion of a specialist prior to initiating any of the above treatment options.

Section 2.1

Clinical inspection and buccal palpation of the alveolus in the canine region are recommended annually from the age of eight years. Initial research appeared to indicate that the interceptive isolated extraction of the associated primary canine, if successful, was a very cost-effective and simple method of correcting ectopic permanent canines.²¹ This original study found that 78% of palatally ectopic canines reverted to a normal path of eruption following the extraction of the primary canine, although success appeared to reduce as the degree of malposition increased. A later investigation appeared to confirm this finding, although the success rate was found to be slightly lower (62%).²² Subsequently further research has been published, but where two systematic reviews then still failed to find sufficiently robust scientific evidence to support the extraction of the primary maxillary canine to facilitate the eruption of the permanent successor.^{23,24} However, further research advocating this intervention technique has been recently published.²⁵

Further well-reported randomised controlled trials are required to enable clinicians to fully assess the effectiveness of this clinical intervention. However, it seems reasonable for clinicians to consider interceptive extraction of the primary canine, in carefully selected cases, provided the patient/parent understands that surgical exposure and orthodontic treatment may ultimately be required, and that the evidence supporting this interceptive technique is not conclusive.

Section 2.2

Much of the evidence supporting surgical exposure and orthodontic alignment as a treatment approach

is derived from case studies. However, many years of clinical experience has shown that surgical exposure and orthodontic alignment of a palatally ectopic canine can be a highly successful treatment approach. As with all orthodontic treatment the cooperation and motivation of the patient is paramount. An additional reason to consider treatment is in cases where there are other dental anomalies present, such as hypodontia, or there are teeth with a poor long term prognosis. Irrespectively, the general dental health should be good since the treatment time is often prolonged. When comparing open versus closed exposure techniques, there is currently no clear evidence to support one surgical technique over the other in terms of dental health, aesthetics, economics and patient factors,³² although repeat surgery is more common with the closed exposure technique.²⁶ It is generally agreed that the optimal time for surgical exposure and orthodontic alignment is during adolescence.^{27,33-35}

Section 2.3

Surgical removal of the ectopic canine is most often considered when dental aesthetics are acceptable with good contact between the lateral incisor and the first premolar. It is also considered when the canine is severely malpositioned, when alignment and transplantation is not being considered and in cases where there are pathological changes and/or its retention would impede orthodontic tooth movement. If necessary, fixed orthodontic appliances can be used to bring the first premolar forward to simulate a canine tooth: mesio-palatal rotation of the premolar, placement of buccal root torque and/or grinding of the palatal cusp, can also help to improve aesthetics. Clinical experience would indicate that there is a large variation in the life-expectancy of retained deciduous canines.

Section 2.4

Transplantation is sometimes considered for grossly displaced ectopic maxillary canines or when prolonged orthodontic treatment is unacceptable to the patient. Early studies revealed disappointing long-term results when this approach was adopted with a high frequency of root resorption occurring. More recent studies using a meticulous atraumatic

surgical technique and stabilisation of the transplanted tooth with a sectional archwire for six weeks have reported better results.³¹ However, the long-term (> 5 years) prognosis of transplanted palatally ectopic canines has yet to be evaluated, although for other teeth it can be as high as 90%.^{29,30}

Acknowledgements

We would like to acknowledge, with grateful thanks, everyone who has helped us in the production of this guideline, especially the suggestions and assistance of Mrs Laura Mitchell and her colleagues on the Clinical Standards Committee of the Faculty of Dental Surgery, Royal College of Surgeons of England, as well as the Chairs and previous members of this, and related Committees, who have also helped us in the past. During the updating of this Guideline, we also corresponded with Dr Nicola Parkin, Consultant Orthodontist, and Mr Eric Whaites, Senior Lecturer / Honorary Consultant in Dental and Maxillofacial Radiology, and we are extremely grateful to them both for their helpful suggestions.

Further Reading

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Levels of Evidence

1++	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++	High quality systematic reviews of case control or cohort studies High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+	Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2-	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

Grades of Recommendations

A	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; <i>or</i> A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; <i>or</i> Extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; <i>or</i> Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; <i>or</i> Extrapolated evidence from studies rated as 2+

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