

Clinical and radiographic assessment of maxillary canine eruption status in a group of 11- to 14-year-old Irish children

Précis

In this study of 480 11- to 14-year-old Irish schoolchildren, 1.1% of the maxillary canines reviewed showed a potentially ectopic eruption position.

Abstract

Objective: The aim of this study was to investigate the prevalence of potentially ectopic maxillary canines and associated dental features in a group of 11- to 14-year-old children.

Participants: Examination took place of a normal distribution of Irish schoolchildren aged between 11 and 14 years in order to record the number of subjects with indications for radiographic investigation of potentially ectopic maxillary canines.

Methods: Those subjects identified subsequently underwent radiographic examination and the number of subjects with potentially ectopic maxillary canines was established. Correlations within the latter sub-sample with anomalous or missing laterals, type of occlusion and female:male ratio were investigated.

Results: A total of 480 children were screened. Of the children aged 11 to 14 years, 32 (6.6%) had clinical indications for radiographic examination of potentially ectopic maxillary canines according to the criteria that had been set out. There were 11 maxillary canines, in 10 subjects, that had an unfavourable position for eruption and were considered to be potentially ectopic, and so 1.1% of the maxillary canines reviewed in this study showed a potential ectopic eruption position.

Conclusions: The prevalence of potentially ectopic maxillary canines and associated dental features in an Irish population was found to be similar to those in other countries, and the practice of careful supervision and early diagnosis of any eruption disturbances of the permanent maxillary canines continues to be considered important due to the risks associated with their eruption.

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Introduction

Careful supervision and early diagnosis of any eruption disturbances of the permanent maxillary canines is considered important due to the risks associated with their eruption.¹⁻⁶ The problems associated with eruption disturbances are: retention of the primary canines; and, ectopic eruption with a palatal or sometimes buccal position. Ectopic eruption may also be associated with resorption of the adjacent incisor root.¹

Many authors have advocated palpation of the buccal surface of the alveolar process distal to the lateral incisor to investigate the position of the maxillary canine.⁷ A bulge of the alveolar process in the buccal sulcus in the region of the canine indicates a normally erupting canine and should be present from eight years,^{2,5,8} or at least at nine to ten years of age.^{1,6}

Ericson and Kurol, in a longitudinal study, investigated clinical methods for supervising the eruption of maxillary canines.⁹ It was found that positive palpation meant a good prognosis for eruption. The same authors found that in children aged ten years and younger, attempting to determine the path of eruption radiographically was generally of little value.⁹ In children aged 11 years and older, clinical signs of delayed or ectopic eruption were confirmed radiographically.

The frequency of maxillary canine impaction varies between 0.9% and 5.9%.^{10,11} It has been supposed that there are certain differences in the frequency of this anomaly between races. Montelius *et al.* found incidences of 1.7% for Chinese races and 5.9% for Caucasian races.¹¹

Ericson and Kurol carried out a clinical examination of 3,000 10- to 15-year-old children. A prevalence of 1.5% of ectopically erupting maxillary canines was found. Ectopically erupting canines were seen more frequently in girls than in boys. Some 20% of the crowns of ectopically positioned maxillary canines were situated buccal to the adjacent lateral incisor, and 80% were situated either in the line of the arch or palatal to the adjacent lateral incisors.¹²

Aims and objectives

The aim of this study was to investigate the prevalence of potentially ectopic maxillary canines and associated dental features with the objectives of:

1. Identifying the number of children from the sample with indications for radiographic examination of potentially ectopic maxillary canines.
2. Identifying the number of subjects who had potentially ectopic maxillary canines.
3. Investigating any correlation between potentially ectopic canines and:
 - I) anomalous and missing laterals;
 - II) female:male ratio; and,
 - III) type of occlusion.

The null hypotheses were stated as:

1. There is *not* an unusually high incidence of anomalous or missing lateral incisors in subjects with potentially ectopic maxillary canines.
2. There is *not* an unusually high incidence of potentially ectopic maxillary canines in female subjects.
3. There is *not* an unusually high incidence of Class II div 2 malocclusion in patients with potentially ectopic maxillary canine teeth.

Materials and methods

The sample

The subjects were all primary schoolchildren aged between 11 and 14 years from an area in the midlands of Ireland. This area was chosen as it was

considered to have an even socioeconomic mix of Caucasians, predominantly of Irish descent.

Ethical approval was granted from the Health Sciences Faculty of Trinity College Dublin. An information and positive consent form was given to a parent or legal guardian of each child in advance of the initial screening examination.

Screening examination

Screening examinations were carried out at either the schools or within an orthodontic department in a local hospital. A data collection sheet was filled out to include the subject's age, gender and history of previous extractions. A clinical examination was carried out on the subjects, initially checking visually to see if the deciduous canines were present and if the permanent canines had erupted. Following this, there was careful palpation with the tip of a finger on the alveolar process in the canine region from both the palatal and buccal sides. The palpation of a bulge buccally was considered positive confirmation of a maxillary canine, while a smooth surface indicated an eruption disturbance. In addition, the lateral incisors were examined for:

- presence;
- state of eruption; and,
- size and morphology.

A clear plastic ruler was used to measure the mesiodistal width of the patient's lateral incisors. The maxillary lateral incisors were classified as 'small' when the mesiodistal width was equal to or smaller than that of its mandibular counterpart.

Radiographs and study models were indicated in all individuals with a non-palpable canine(s), or those with palpable canines who had a distinctive difference between left and right sides.

All subjects who were identified as having had one or both deciduous maxillary canines extracted were excluded from the study.

Radiographic examination

Radiographic examination involved the exposure of a ortho panoramic tomograph (OPT) and an anterior occlusal radiograph with the occlusal film held parallel to the maxillary plane and the tube at an angle of 60-65 degrees to the film. All radiographs were exposed using the same x-ray machines by the same investigator. The maxillary canines were then assessed as:

1. Palatal to the line of the arch.
2. Central to the line of the arch.
3. Buccal to the line of the arch.

This was done by using a combination of the information gathered clinically, and the principle of vertical parallax between the OPT and the anterior occlusal radiograph.

From the radiographs, the maxillary canines were then classified as having an unfavourable path of eruption if they were considered to be in the line of the arch or palatal to the line of the arch, and if they exhibited one or both of the following criteria:

1. The tip of the maxillary canine was mesial to the long axis of the adjacent incisor.
2. The angle formed between the long axis of the canine and the vertical axis of the OPT was greater than 30 degrees.

In the classic studies of Ericson and Kurol, the authors did not give details of the criteria they used to classify the path of eruption as favourable or unfavourable.^{12,15} The classification system adopted for this study was

TABLE 1: Age range of subjects who underwent screening examination

Age range	Male	Female	Total
11.1-12	37	29	66
12.1-13	176	174	350
13.1-14	33	28	61
14.1-15	2	1	3
Total	248	232	480

TABLE 2: Clinical status of eruption of permanent maxillary canines at initial examination

	Male N=248			Female N=232			Total N (%)
	Left	Right	N (%)	Left	Right	N (%)	
Erupted	196	192	388 78%	195	200	395 85%	783 81.6%
Bucally palpable	44	48	92 18.5%	28	28	56 12%	148 15.4%
Palatally palpable	1	5	6 12%	2	1	3 1%	9 0.9%
Not palpable	7	3	10 2.1%	7	3	10 2%	20 2.1%
Total	248	248	496 100%	232	232	464 100%	960 100%

developed from a review of the literature, which attempted to highlight those features that have been shown to influence the process of eruption of maxillary canines. For the purpose of this study, those canines considered to have an unfavourable path of eruption are described as being potentially ectopic maxillary canines.

The process of identifying radiographically the bucco-palatal position of the maxillary canines, and determining if their position was favourable or unfavourable, was tested by a second clinician and the inter-examiner agreement was evaluated.

Study models

Study models were obtained using irreversible hydrocolloid impressions. With the aid of these study models, the incisor relationship was classified and the maximum mesio-distal diameter of the upper and lower lateral incisors was measured with a pair of dividers and a stainless steel millimetre ruler. The upper lateral incisors were classified as:

1. Absent
2. Peg-shaped, with the mesio-distal width greatest at the cervical margin.
3. Small, with the mesio-distal width equal to or smaller than that of its mandibular counterpart.

Data collection and statistical analysis

The data were recorded in the SPSS 12 statistical programme file. The

TABLE 3: Maxillary canine position in the dental arch in the subjects who underwent radiographic investigation

	Palatal		In the line of the arch		Buccal		Erupted		Total	
	N	%	N	%	N	%	N	%	N	%
Maxillary canine – right	8	(13)	11	(18)	11	(18)	1	(2)	31	(50)
Maxillary canine – left	6	(10)	8	(13)	9	(15)	8	(13)	31	(50)
Total	14	(23)	19	(31)	20	(33)	9	(15)	62	(100)

programme was used to carry out measurements of variability, compile appropriate descriptive tables and carry out analysis of variance. Categorical variables were computed using chi-squared tests. A p-value of <0.05 was considered to be statistically significant.

Results

Sample size and age range

Four subjects were identified at initial examination as having had one or both of their deciduous maxillary canines extracted as a consequence of dental caries and were excluded from the study. Subsequently, a total of 480 subjects underwent the initial screening examination. Some 248 males and 232 females were examined. The ages ranged from 11 to 14 years, with a mean age of 12.6 years for males and females (Table 1).

Of the 480 subjects who underwent the initial screening examination, a total of 32 (6.6%) had clinical indications for radiographic examination according to the criteria that had been set out. Of the 32 subjects, 12 (37.5%) were female and 20 (62.5%) were male.

Clinical status of eruption of permanent maxillary canines at initial examination

A total of 783 (81.6%) of the permanent maxillary canines were erupted at the time of examination. Twenty (2.1%) were not palpable at initial examination. Nine (0.9%) were palpable palatally and 148 (15.4%) were palpable buccally. The distribution of clinical eruption status of canines between males and females was statistically significant (p = 0.001) (Table 2).

Maxillary canine position in the dental arch in subjects who underwent radiographic investigation

One of the subjects who underwent radiographic examination was found to have aplasia of both maxillary canines. A total of 32% of the canines examined radiographically were buccally positioned as determined clinically and radiographically, 30.5% were in the line of the maxillary arch and 22.5% were palatally positioned (Table 3).

Distribution of favourable/unfavourable maxillary canine position in the subjects who underwent radiographic investigation

One of the 32 subjects who underwent radiographic investigation had aplasia of the maxillary canines. Of the remaining subjects investigated, 21 had maxillary canines that were considered to have a favourable position for eruption.

There were 11 maxillary canines, in 10 subjects, that had an unfavourable

TABLE 4: Distribution by sex of favourable/unfavourable maxillary canine position

		Male	Female	Total
Eruption position	Favourable	17	9	26
Left	Unfavourable	2	3	5
Eruption position	Favourable	17	8	25
Right	Unfavourable	2	4	6
Total		38	24	62

position for eruption and were considered to be potentially ectopic. Excluding the case with aplasia of the maxillary canines, 1.1% of the maxillary canines showed a potential ectopic eruption position. Six of the ten subjects with canines identified as unfavourable were female and four were male. This was considered not to be statistically significant ($p = 0.091$). We therefore can accept the null hypothesis that there is *not* an unusually high incidence of potentially ectopic maxillary canines in female subjects.

Three of the maxillary canines with an unfavourable position were in subjects aged 11 years and seven were in subjects aged 12 years (Table 4).

Inter-examiner agreement

The process of identifying the buccopalatal position of the maxillary canines and determining if their position was favourable or unfavourable was tested by a second clinician using the criteria set out under 'Radiographic examination' in our materials and methods, and the inter-examiner agreement was evaluated. There was 100% agreement on the buccopalatal position of the maxillary canines. There was 98% agreement on the favourable/unfavourable position of the maxillary canines, with an initial disagreement over one of the maxillary canines in the 32 subjects who underwent radiographic examination.

Clinical status of permanent maxillary lateral incisors at initial examination

Of the maxillary lateral incisors in the 480 subjects examined, 12 (1.25%) were missing, 108 (11.25%) were peg shaped and 67 (6.9%) were small. The distribution of lateral incisor anomalies was not statistically significant between males and females (p value = 0.25).

Clinical status of permanent maxillary lateral incisors in those subjects with potentially ectopic maxillary canine(s)

In subjects identified with potentially ectopic maxillary canines, none had missing maxillary lateral incisors, but in the 10 subjects identified, 10 out of the 20 lateral incisors (50%) presented as small, or peg shaped (anomalous). Six of the 11 (55%) maxillary lateral incisors adjacent to potentially ectopic canines were small or peg shaped (anomalous).

The prevalence of missing or anomalous maxillary lateral incisors adjacent to potentially ectopic canines was not significantly greater than the prevalence in those without ectopic canines ($p=0.45$). However, due to the small numbers in the subgroup with potentially ectopic canines, the power to detect a significant difference between the groups was only 11%.

We are therefore unable to reject the null hypothesis that there is *not* an unusually high incidence of anomalous or missing lateral incisors in subjects with potentially ectopic maxillary canines (Table 5).

TABLE 5: Clinical status of permanent maxillary lateral incisors in subjects with potentially ectopic maxillary canines.

	Male			Female			Total	
	Left	Right	N	Left	Right	N	N	(%)
Missing	0	0	0	0	0	0	0	
Peg-shaped	2	2	4	0	0	0	4	(20%)
Small	1	1	2	2	2	4	6	(30%)
Normal	1	1	2	4	4	8	10	(50%)
Total	4	4	8	6	6	12	20	(100%)

Distribution of incisor classification

The distribution of incisor classification in patients with potentially ectopic canines did not differ significantly from the distribution in those without ectopic canines ($p = 0.43$). However, due to the small numbers in the subgroup with potentially ectopic canines, the power to detect a significant difference between the groups was only 25%.

We are therefore unable to reject the null hypothesis that there is *not* an unusually high incidence of Class II div 2 malocclusion in patients with potentially ectopic maxillary canine teeth.

Discussion

In this study of Irish schoolchildren aged between 11 and 14 years, 783 (81.6%) of the permanent maxillary canines were erupted at the time of examination. One of the 480 subjects was found to have aplasia of both the maxillary canines.

Radiographic investigation was indicated in all individuals with a non-palpable canine(s), or those with palpable canines who had a distinctive difference between left and right sides. Of the 480 subjects who underwent the initial screening examination, a total of 32 (6.6%) had clinical indications for radiographic examination according to the criteria that had been set out.

Compared to similar studies, the smaller number of subjects who underwent radiographic examination in the present study may be explained by the fact that the mean age was higher in the sample compared to the Ericson and Kurok study.¹² It is therefore more likely that some of the sample would have reached a stage of dental development that would have precluded the need to have radiographic examination at the time of clinical examination.¹³

The greater number of peg-shaped and small maxillary lateral incisors detected in our study may be explained by the fact that the teeth were measured with a clear plastic ruler. Brin and Becker used a sliding calliper or, when access was difficult, a pair of dividers and a ruler.¹⁴ This method of examination is likely to have been more accurate and less likely to overestimate the numbers of anomalous lateral incisors.

In this study, the maxillary canines were classified as having an unfavourable path of eruption if they were considered to be in the line of the arch or palatal to the line of the arch, and if they exhibited one or both of the following criteria:

1. The tip of the maxillary canine was mesial to the long axis of the adjacent incisor.
2. The angle formed between the long axis of the canine and the vertical axis of the OPT was greater than 30 degrees.

There were 11 maxillary canines, in 10 subjects, that had an unfavourable

position for eruption and were considered to be potentially ectopic. Excluding the case with aplasia of the maxillary canines, 1.1% of the maxillary canines in this sample showed a potentially ectopic eruption position.

Ericson and Kurol carried out a clinical examination on 3,000 10- to 15-year-old children.¹⁵ A prevalence of 1.5% of ectopically erupting maxillary canines in the subjects was found. Ectopically erupting canines were seen more frequently in girls than in boys.

The smaller number of potentially ectopic maxillary canines in our sample may be due to the fact that canines that were determined as being positioned labial/buccal to the line of the arch were not included, as it was considered that these buccally displaced maxillary canines were likely to erupt, albeit delayed, in a buccally displaced position. This is unlike the findings in the Ericson and Kurol studies where maxillary canines that were determined to be positioned labial to the line of the maxillary arch were included in the group of potentially ectopic maxillary canines.^{12,15}

In the current study, six of the ten subjects with canines identified as unfavourable were female and four were male. This was considered not to be statistically significant (p value = 0.091). Although significant associations between the incidence of potentially ectopic canines and gender were not confirmed in this population, the results are not conclusive due to inadequate power. Likewise, significant associations between the incidence of potentially ectopic canines and anomalous or missing adjacent maxillary lateral incisors or incisor classification were not confirmed in this population due to a lack of power.

Conclusions

In this cross sectional survey of a sample of Irish schoolchildren aged between 11 and 14 years, 1.1% of the maxillary canines showed a potentially ectopic eruption position. The prevalence of potentially ectopic maxillary canines and associated dental features in this study were found to be similar to those in other studies and the practice of careful supervision and early diagnosis of any eruption disturbances of the permanent maxillary canines continues to be considered important due to the risks associated with their eruption.¹⁻⁶

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