The Online
ANGLE ORTHODONTIST
An International Journal of Orthodontics and Dentofacial Orthopedics
78th Anniversary 1930–2008

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The Angle Orthodontist: **Vol. 70, No. 6, pp. 415–423.**

Resorption of Incisors After Ectopic Eruption of Maxillary Canines: A CT Study

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ABSTRACT

The purpose of the study was to analyze the extent and prevalence of resorption of maxillary incisors after ectopic eruption of the maxillary canines in a sample of subjects referred to an orthodontic specialist clinic for consultation. The subjects consisted of 107 children, 39 boys and 68 girls, between 9 and 15 years of age (mean 12.5 years), with 156 ectopically and 58 normally erupting maxillary canines. All children were subjected to a basic clinical and intraoral radiographic investigation. These radiographs were supplemented with computerized tomography (CT) of the upper alveolar bones in order to get more precise information on the positions and relationships between the maxillary canines and adjacent incisors and to evaluate resorptions on the roots of the incisors. The results showed that, relative to the roots of the adjacent incisors, the crowns of 21% the ectopically positioned canines were located to the buccal, 18% to the distobuccal, 27% to the lingual, 23% to the distolingual, 5% apically and 6% between the central and lateral incisors. Ninety-three percent of the ectopically positioned canines were in contact with the roots of the adjacent lateral incisor and 19% were in contact with the central incisor. The corresponding figures for the normally erupting canines were 49%. Resorptions on the roots of the incisors adjacent to the ectopically positioned canine occurred in 38% of the laterals and in 9% of the centrals. The resorptions were graded and tended to be extensive. Among the 58 resorbed lateral incisors, resorptions were slight in 31%, moderate in 9%, and severe with pulpal involvement in 60%. The corresponding figures for the 14 resorbed centrals were 36%, 21%, and 43%, respectively. About 60% of the resorptions involved the middle and apical thirds, the tip of the apex not included. On the sides with normally erupting canines, 3 lateral maxillary incisors were slightly or moderately resorbed distally. In all, 51 of the 107 subjects with ectopically erupting maxillary canines (48%) had resorbed maxillary incisors during the eruption of the maxillary canines. There were statistically significant correlations between ectopic eruption of the maxillary canine, contacts between the teeth and resorptions on the adjacent incisors. It was concluded that resorption on maxillary incisors after ectopic eruption of the maxillary canines is a more common phenomenon than previously reported and has to be considered in all cases with seriously diverging eruption of maxillary canines. It was also concluded that the resorptions of the roots of the incisors were caused by pressure during the eruption of the adjacent, aberrant canine. Finally, it was shown that CT scanning substantially increased the detection of root resorptions on incisors adjacent to ectopically erupting maxillary canines (about 50%). The sensitivity of intraoral films was low when diagnosing the resorptions, being calculated to 0.68.

KEY WORDS: Tooth, Incisor, Cuspid, Canine, Root, Resorption, Tooth eruption, Ectopic, Maxilla.

Accepted: April 2000. Submitted: March 2000.

INTRODUCTION Return to TOC

Resorptions on permanent maxillary incisors are a rare complication of ectopically erupting maxillary canines but, when they occur, they may lead to extractions, time-consuming and expensive orthodontic treatment, or both.[1,2] Early detection of canine impaction and diagnosis and assessment of the extent of resorptions is, therefore, of fundamental importance if preventive and early corrective measures are to be taken in order to reduce later complications.[3–6]

Resorption on the roots of the maxillary incisors is often difficult to diagnose on intraoral films or on orthopantomograms, especially when the dentine loss is located buccally or lingually.[1,7,8] This is primarily due to overlapping of the incisors by the ectopic canine but also due to the extent the resorption may have compared with the thickness of the root. Even resorptions to the pulp may be overlooked on intraoral films.[9]

By using tomography, the diagnostic accuracy can be substantially increased. In an earlier randomised study in children with ectopically erupting maxillary canines, we found that the number of diagnosed resorbed incisors was doubled with conventional tomography compared to intraoral films.[1] Resorptions occurred in 12% of the cases after ectopic eruption of maxillary canines, suggesting a total prevalence of 0.7% for resorbed lateral incisors in an 10- to 13-year age average group of schoolchildren.[1] However, due to the fact that conventional tomography does not completely blur out all disturbing structures, the inherent lack of sharpness of the conventional tomographic image makes the assessment of resorptions on teeth unsure, especially for detecting minor root resorptions.[10] A certain underestimation of the resorptions is likely with conventional tomography.

Computed tomography (CT) eliminates the blurring problem of conventional tomography and increases the perceptibility of root resorption substantially.[7,11–14] These opinions were verified by a comparative investigation by us on subjects in whom extraction of resorbed incisors was done after the CT was performed. CT proved to be most effective in detecting root resorptions.[15] CT is also outstanding for assessing the positions of the teeth and their mutual relationship compared to other diagnostic methods and gives a good basis for clinical considerations when complications occur during eruption.[7,15]

The objectives of this study were to investigate, by computerized tomography, the positions of the maxillary canines in cases in which they were clinically suspected to erupt abnormally and to determine the prevalence and extent of incisor root resorption occurring during the ectopic eruption of the maxillary canines.

SUBJECTS AND METHODS Return to TOC

The subjects were all referred to an orthodontic specialist clinic for consultation because of the risks associated with ectopic eruption of the maxillary canines. After careful clinical investigation and primary intraoral radiographic examinations, the children demonstrating ectopic maxillary canines difficult to assess on the panoramic or intraoral films due to overlapping were selected for CT imaging of the upper alveolar bones. Altogether 107 children, 39 boys (36%) and 68 girls (64%), with ectopic eruption of 156 maxillary canines were investigated by CT. This number corresponds to about 90% of the referred children in a consecutive series of patients with ectopic canines during a period of 8 years. The age of the children varied between 9 and 15 years, with a mean of 12.5 years. Table 1 presents the distribution by sex and age of the children. Seven laterals were missing due to aplasia, 2 bilaterally and 3 unilaterally. Four of the missing laterals were on the ectopic side and 3 on the normal side.

Radiographic examinations

All 107 children were subjected to basic intraoral or panoramic radiographic investigations according to earlier recommendations.[1,2] From the basic radiographs, the following variables were analyzed:

1. *open* or *closed* apices
2. *inclination* to the midline[16]
3. degree of *vertical eruption* registered as the distance in mm from the canine cusp to the occlusal line[16]
4. mesial *migration* of the canine, mm to the midline.[16]

A Siemens Somatome Plus CT-scanner (Siemens AG, Germany) was used for the tomographies.[17] A bone algorithm for the middle ear (ultra high) was applied and the window width setting was approximately 3000 HU-units, the center value being 750–800. Filtration was performed according to the standard of the algorithm. The images of the objects on the screen and films were reconstructed from the raw data set.

Contiguous transverse CT scans with a slice thickness of 2 mm were exposed through the alveolar bone of the maxilla perpendicular to the long axis of the lateral maxillary incisors (Figure 1). Usually, 6 to 10 scans were obtained from the cervical region to the apex. The scans were documented with a Siemens laser camera on films. The enlargement (zooming factor) on the film was ×1.5 and the image resolution was about 0.3 mm.[17] We used 6 images on the film in order to get optimal resolution.

The scans were analyzed first on the monitoring screen and finally on the scans. All images were analysed scan by scan along the root of the upper incisors, and the positions of the canines and the presence of resorptions were documented bilaterally. The position of the canine was defined as the position of the buccal cusp of the canine relative to the adjacent tooth. The resorptions were graded in 4 categories as follows:

No resorption—intact root surfaces. The cementum layer may be lost (Figure 1).

Slight resorption—up to half of the dentine thickness to the pulp (Figure 1).

Moderate resorption—resorption midway to the pulp or more, the pulp lining being unbroken (Figure 2).

Severe resorption—the pulp is exposed by the resorption (Figure 3).

For a detailed description of the tomographic procedure and the accuracy of CT in imaging root resorptions on maxillary incisors, the reader is referred to Ericson and Kurol.[15]

Statistical analyses

The SPSS computer program was used for the statistical analyses.[18] Relationships of data were studied by the chi-square test with Fisher's exact test. Differences in means between 2 groups were studied by Student's *t*-test with n−2 degrees of freedom; *n* indicates number; *x,* mean value, and; *SD,* standard deviation

RESULTS Return to TOC

There were no differences in the frequency of the occurrence of the ectopic position of tooth 13 and 23. Among the boys and girls the number of ectopic maxillary canines (156) was consistent with the sex distribution within the sample (Table 1). Among the boys, 58 canines (74%) were ectopically positioned. Among the girls, 98 canines (72%) were ectopically positioned.

When assessed from the panoramic or intraoral films, no statistically significant differences were found between the boys and the girls concerning the closure of the apices of the maxillary canines, the inclination of the canines to the midline or the vertical eruption. Similarly, no differences in the mesial migration of the canines between the 2 sexes were observed on the panoramic films or on the CT scans. No side differences were found, therefore, the right and left sides were pooled for the following analyses.

Positions

The positions of the ectopically erupting canines imaged on CT scans are presented in Table 2. Relative to the roots of the maxillary incisors, the main cusp of the canine was located to the buccal in 33 of the cases (21%), distobuccal in 28 (18%), lingual in 42 (27%) and to the distolingual in 36 (23%). Six canines were located apical to the lateral (4%), 1 apical to the central (1%), and 10 (6%) between the central and lateral incisors. There was no statistically significant difference between the sexes concerning the positions of the cusps of the canines *vis-à-vis* the adjacent incisors.

Contact relationships

Most of the erupting maxillary canines were in contact with the maxillary incisors at some level of the roots. The contact situations on the sides with the normally erupting canines are shown in Table 3. Forty-nine percent of the canines were in contact with the root of the lateral incisors (distally); while in 51% no contact was established at the time of the investigation. In 3 sides with aplasia, 2 canines touched the central incisor distally. Thirty-four (58%) of the canines with normal positions in the jaw had erupted to the oral cavity.

The contact relationships between the erupting ectopically positioned maxillary canines and adjacent incisors are shown in Table 4. Ninety-three percent of the canines were in contact with the adjacent lateral incisor and 19% with the central incisor. Of the 40 canines with the most mesial migration (Table 2), 30 were touching the root of the central incisor (Table 4). The contact relationships are illustrated in Figures 1–6.

Resorptions

The lateral incisors were the teeth most affected and were more resorbed than the central incisors. On the 156 sides with ectopically positioned maxillary canines, 72 incisors were resorbed, which included 58 lateral incisors (38%) and 14 central incisors (9%) (Table 5). One of the canines was partly erupted. Resorptions occurred only on the lateral incisor in 51 sides, only on the central incisors in 7 sides, and on both incisors in 7 sides.

The distribution of the resorbed teeth by age was analyzed (Table 5). Resorptions were most common at the age of 11 and 12, but severe resorptions with pulp involvement were already found at the age of 9. No significant correlation between age, sex, and resorptions was found. The prevalence of root resorption followed the sex and age distributions within the sample.

In the 58 sides with *normally* erupting maxillary canines, slight or moderate resorptions were observed on 3 lateral incisors out of 55 (3 aplasia) (3%). The lesions were situated distally in the middle on the cervical third of the root and adjacent to the normally erupting canine (Figure 7). No central incisor was affected.

The occurrence and extent of the root resorptions are shown in Tables 6 and 7 and illustrated in Figures 1–7. Fifty-eight of the 152 lateral maxillary incisors (38%) and 14 of the 156 central maxillary incisors (9%) showed resorptions on the roots close to the crown of the ectopically erupting maxillary canines. In 7 sides, both the lateral and central incisors were resorbed. In all, 51 of the 107 subjects (48%) had unilateral or bilateral resorbed maxillary incisors of different severities on the laterals or the centrals or on both (Figure 3). The correlation between ectopic eruption and resorption on the adjacent incisor was highly significant (X^2 = 20.8, P < .001).

The location and extent of the resorptions on the roots showed great variations with mainly severe, deep resorptions (Tables 6 to 8). Thus, 60% of the resorptions on the lateral incisors and 43% of the centrals had pulpal involvement. The lesions occurred all over the root, but apical and middle third involvement was the most common pattern occurring 64% of the time on the lateral incisor and 57% on the central (Table 8). The distribution of the resorption on the roots of the incisors was in agreement with the positions of the crowns of the ectopic canines (Tables 2 and 7). There was a highly significant correlation between crown-root contacts and resorptions (X^2 = 41.0, P < .001).

In order to determine the differences between the conventional intraoral radiograph and the CT scan in diagnosing root resorption on incisors adjacent to ectopically erupting maxillary canines, the diagnostic outcomes for the 2 methods were compared. The injuries to the incisor roots were grouped as “resorbed” or “not resorbed” and include all maxillary incisors adjacent to an ectopic canine with radiographs of good quality for the 2 techniques. This included 180 lateral and 186 central incisors (Tables 9 and 10). The CT scans revealed significantly more resorption injuries than the intraoral films for both the lateral and central incisors (X^2 test, P < .001). The number of resorptions discovered increased by 53% for the lateral and even more for the central incisors (Table 10). Of 34 laterals with severe resorptions on CT scans only, 12 (35%) were given the same grading when assessed by intraoral films and 10 severe resorptions detected by CT scanning were not discovered at all (30%, Figure 4). Assuming the CT scanning technique gives the true incidence of resorption,[15] the sensitivity and specificity of intraoral films in diagnosing resorptions on maxillary incisors adjacent to ectopically positioned canines were calculated for the laterals and the central incisors together to 0.69 (sensitivity) and 0.90 (specificity), respectively.

DISCUSSION Return to TOC

The subjects in the analyzed sample were not strictly randomized, but were composed of children referred by general dental practitioners for specialist orthodontic treatment. In this respect, our results are representative but diverge from an average school population of the same age because the selection and complexity of our material included more severe cases.

There were no statistically significant sex differences in the analyzed factors. Compared to an average child population,[1,4] disturbances in the eruption of the maxillary canines were significantly more common among the girls than among the boys of the same age groups, which is consistent with other reports.[2,9,16,19,20] It is noteworthy that buccal ectopic eruptions do not cause resorption more frequently than palatal ones.

No correlation between resorption on the incisors and the age of the children was found. Severe resorption exposing the pulp was already seen at the age of 9, with the peak frequency between 11 and 12 years of age. This is consistent with earlier reports.[2,21,22] Most of the root resorptions were advanced and without clinical signs or symptoms when diagnosed, which is also in agreement with other studies.[19,20,22] The findings underline the importance of early supervision of the maxillary canine germ and the eruption path of the canine to avoid complications in cases with problems in eruption. The unerupted canine frequently moves more mesially with time, increasing the risk of resorptions.[2,6,15] Early extraction of the deciduous canine has been effective in reducing the incidence of unerupted displaced canines provided that normal space conditions are present[2,5,6,23,24] and we recommend it as the first treatment step in young individuals with ectopically erupting maxillary canines. In 78% of cases, the palatally displaced maxillary canine changed its deviant eruptive path to a normal eruptive path within 12 months after extraction of the adjacent deciduous canine.[5]

The CT method has been proven to be most effective in revealing the presence and degree of root resorptions on teeth adjacent to ectopically erupting maxillary canines.[15] The technique facilitates observations of even minor loss of dentine on the roots of the teeth.[7,11,15,25] The number of children with resorbed roots in this material was consequently high (48%) compared with earlier studies performed with other radiographic techniques.[1,2,19] However, the use of CT is probably not the only explantation for the high prevalence of resorbed roots in the study. The sampling and structure of the material, with many complicated cases, may also have an impact on the results. Notwithstanding this, the study indicates that resorptions on maxillary incisors after ectopic eruption of maxillary canines is more common than previously reported[2,4] and is underestimated by referring practitioners.

The resorptive cavities were mainly located on the middle and apical thirds of the root and mostly buccally (42%) or lingually (40%), which is in accordance with earlier findings and may lead to diagnostic mistakes due to overlapping when ordinary radiographic methods are used.[4,7,9,14,21,25]

In an analysis of the methods of intraoral periapical radiography, only 50% of the resorptions were clearly seen in the dental films and in only 20% of the resorbed incisors was the area of resorption projected free in the periapical film.[7] When orthopantomography was used to reveal the resorbtions, the accuracy was even lower[8,13,14] Assuming CT scanning gives the true image of the resorption,[15] the sensitivity of the intraoral X-ray method was only 68%, which in most cases is inadequate for treatment planning. Therefore, when overlapping between the canine and the adjacent incisor occurs in the conventional radiographs, tomography should be considered. A typical candidate for resorption of the lateral incisors during ectopic eruption of the maxillary canines is a child approximately 11 to 12 years of age with a well-developed canine root, erupting medially to the long axis of the adjacent incisor and inclined 25° or more to the midline of the jaw.[16] By following our guidelines for clinical digital palpation and stepwise radiological examination presented in earlier publications, harmful situations can be detected in time to take adequate measures.[1,2,16,24]

The mechanism of the root resorption following maleruption and the factors involved in the process are not clear.[2] The resorptions may be caused by physical pressure due to the migration of the misplaced, erupting canine.[19,26] At eruption of the maxillary canine, the alveolar barrier of the adjacent incisor will be temporarily resorbed[9,15] and the normal protective layer of cementoblasts and collagen fibers will disappear and open up for the dentinoclasts.[15,22]

Others have stressed the role of the dental follicle in the process of root resorptions.[2,27] So far, there has been no convincing support for this theory. The high frequency of close contacts between the crowns of the ectopically positioned canines and the resorption cavities on the adjacent incisors found in this material indicates that the resorption is mainly caused by contact relations and physiological pressure after the eruption of the canine. Prominent parts of the canine crown like the main cusp, lingual cusp or the outer limbus seem to be the active structures. The roll of the dental follicle in the root resorption process is probably of less importance. However, that question should and will be further analyzed.

CONCLUSIONS Return to TOC

This study of 107 children with 158 ectopically erupting maxillary canines has shown that resorption on roots of adjacent incisors due to the eruption of the canine:

1. Occurs more frequently than previously reported; in this sample, 48% of the children had resorbed incisors.

2. May occur early in life; already at the age of 9, with a peak frequency between 11 and 12 years of age (51%).

3. Occurs more commonly on maxillary lateral incisors (38%) but also appears on central incisors (9%).

4. Is usually advanced when diagnosed; in the laterals 60% and in the centrals 43% were resorbed to the tooth pulp.

5. Most often appears on the middle and apical third of the root of the injured incisor (64% of the cases in this study), and appears just as commonly on the buccal and the lingual root surfaces (40%).

6. Is equally common in boys and girls with ectopic erupting canines.

7. Occurs close to the aberrant canines, indicating a relationship between resorption and pressure from an ectopically erupting canine.

8. Is visualized about 50% more often by CT scanning than by intraoral X-rays. The sensitivity of conventional intraoral X-rays is thus low compared with CT in diagnosing resorption on upper incisors adjacent to ectopically erupting canines.

Clinical and radiological supervision of ectopically erupting maxillary canines with early diagnosis of resorption injuries or situations where resorption may occur is therefore of importance to avoid late complications and tomography is indicated for selected cases.

ACKNOWLEDGMENTS

We are grateful to statistician Birgit Ljungqvist, PhD, for statistical advice.

REFERENCES Return to TOC

1. Ericson S, Kurol J. Radiographic examination of ectopically erupting maxillary canines. *Am J Orthod Dentofacial Orthop.* 1987; 91:483–492.

2. Kurol J, Ericson S, Andreasen JO. The impacted maxillary canine. Andreasen JO, Kölsen-Pedersen J, Laskin DM, eds. *Textbook and Color Atlas of Tooth Impactions.* 1st ed. Copenhagen, Denmark: Munksgaard. 1997;125–175.

3. Williams BH. Diagnosis and prevention of maxillary cuspid impaction. *Angle Orthod.* 1981; 51:30–40.

4. Ericson S, Kurol J. Radiographic assessment of maxillary canine eruption in children with clinical signs of eruption disturbance. *Eur J Orthod.* 1986; 8:133–140.

5. Ericson S, Kurol J. Early treatment of palatally erupting maxillary canines by extraction of the primary canines. *Eur J Orthod.* 1988; 10:283–295.

6. Jacobs SG. Reducing the incidence of unerupted palatally displaced canines by extraction of deciduous canines. The history and application of this procedure with some case reports. *Austr Dent J.* 1998; 43:20–27.

7. Preda L, La Fianza A, Di Maggio EM. et al. The use of spiral computed tomography in the localization of impacted maxillary canines. *Dentomaxillofac Radiol.* 1997; 26:236–241.

8. Krennmair G, Lenglinger FX, Traxler M. Imaging of unerupted and displaced teeth by cross-sectional CT scans. *Int J Oral Maxillofac Surg.* 1995; 24:413–416.

9. Ericson S, Kurol J. Incisor resorption caused by maxillary cuspids. A radiographic study. *Angle Orthod.* 1987; 57:332–346.

10. Sprawls P Jr. *Physical Principles of Medical Imaging.*. ISBN 0–944838–54–5. Madison, Wisc: Medical Physics Publishing. 1993;

11. Ericson S, Kurol J. CT diagnosis of ectopically erupting maxillary canines—a case report. *Eur J Orthod.* 1988; 10:115–120.

12. Peene P, Lamoral Y, Plas H. et al. Resorption of the lateral maxillary incisor: Assessment by CT. *J Comput Assist Tomogr.* 1990; 14:427–429.

13. Schmuth GPF, Freisfeld M, Köster O, Schüller H. The application of computerized tomography (CT) in cases of impacted maxillary canines. *Eur J Orthod.* 1992; 14:296–301.

14. Elefteriadis JN, Athanasiou AE. Evaluation of impacted canines by means of computerized tomography. *Int J Adult Orthod Orthognath Surg.* 1996; 11:257–264.

15. Ericson S, Kurol J. Incisor root resorptions due to ectopic maxillary canines imaged by computerized tomography. A comparative study in extracted teeth. *Angle Orthod.* 2000; 70:92–99.

16. Ericson S, Kurol J. Resorption of maxillary lateral incisors caused by ectopic eruption of the canines. A clinical and radiographic analysis of predisposing factors. *Am J Orthod Dentofacial Orthop.* 1988; 94:503–513.

17. *Operating manual: Somatome Plus/Plus-S. Image Quality Guide.* Erlangen, Germany: Siemens AG. 1995;1–50.

18. Nie N, Hull CH, Jenkins JG, Steinbrenner K, Bent DH. *Statistical package for the Social Sciences.* 2nd ed. New York, NY: MacGraw–Hill; 1975.

19. Sasakura H, Yoshida T, Murayama S, Hanada K, Nakajima T. Root resorption of upper permanent incisor caused by impacted canine. An analysis of 23 cases. *Int J Oral Surg.* 1984; 13:299–306.

20. Brin I, Becker A, Zilberman Y. Resorbed lateral incisors adjacent to impacted canines have normal crown size. *Am J Orthod Dentofacial Orthop.* 1993; 104:60–66.

21. Rimes RJ, Mitchell CN, Willmot DR. Maxillary incisor root resorption in relation to the ectopic canine: a review of 26 patients. *Eur J Orthod.* 1997; 19:79–84.

22. Knight H. Tooth resorption associated with the eruption of maxillary canines. *Br J Orthod.* 1987; 14:21–31.

23. Bishara SE. Clinical management of impacted maxillary canines. *Semin Orthod.* 1998; 4:87–98.

24. Jacobs SG. The impacted maxillary canine. Further observations on aetiology, radiographic localization, prevention/interception of impaction, and when to suspect impaction. *Austr Dent J.* 1996; 41:310–316.

25. Freisfeld M, Dahl IA, Jäger A, Drescher D, Schüller H. X-ray diagnosis of impacted upper canines in panoramic radiographs and computed tomographs. *J Orofac Orthop.* 1999; 69:177–184.

26. Brown WA. Resorption of permanent teeth. *Br J Orthod.* 1982; 9:212–220.

27. Bidwell JP, Fey EG, Marks SC Jr. Nuclear matrix-intermediate filament proteins of the dental follicle/enamel epithelium and their changes during tooth eruption in dogs. *Archs Oral Biol.* 1995; 40:1047–1051.

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TABLE 1. Distribution of Maxillary Canines According to Sex and Age in a Sample of 107 Children with Ectopically Positioned Canines Uni- or Bilaterally Shown on CT Scans

		Ages (yrs)		Ectopic Canines			Normally Positioned Canines	Total Canines
	Number	Range	x ± SD	Unilaterally	Bilaterally	All		
Boys	39	9–15	13.4 ± 3.1	20	38	58	20	78
Girls	68	9–15	12.0 ± 1.8	38	60	98	38	136
Total	107	9–15	12.5 ± 2.5	58	98	156	58	214

TABLE 2. The distribution of 156 Ectopic Maxillary Canines in Relation to the Maxillary Incisors in 107 Children.[A] The Positions of the Canines are Defined as the Position of the Tip of the Buccal Cusp of the Canines Relative to the Adjacent Incisor Shown on CT Scans

	Position Relative to Canine Lateral			Position Relative to Canine Central				
Sex	Buccal Distobuccal	Lingual Distolingual	Apical	Buccal Distobuccal	Lingual Distolingual	Distal	Apical	Total
Boys	22	18	2	2	10	4	—	58
Girls	34	36	4	3	14	6	1	98
Total	56 (36%)	54 (35%)	6 (4%)	5 (3%)	24 (15%)	10 (6%)	1	156

[A] Aplasia of 4 lateral incisors.

TABLE 3. The Contact Relationship Between the Maxillary Incisors and 58 Normally Erupting Maxillary Canines Shown on Transverse CT Scans

	Contact		
Teeth	No	Yes	Number
Laterals[A]	28 (51%)	27 (49%)	55
Centrals	56 (81%)	2 (3%)	58

[A] 4 aplasia of 3 lateral incisors.

TABLE 4. Contact Relationships Between the 156 Ectopically Erupting Maxillary Canines and Adjacent Incisors Assessed on Transverse CT Scans

	Contact	
Teeth	No	Yes
Laterals[A]	11 (7%)	141 (93%)
Centrals	126 (81%)	30 (19%)

[A] 4 aplasia.

TABLE 5. Distribution of Resorptions on 72 Maxillary Incisors, 14 Centrals and 58 Laterals, Adjacent to Ectopically Erupting Maxillary Canines Related to Age

Teeth	Age (years) 9	10	11	12	13	14	15	N
Resorptions on laterals								
Slight, <midway to the pulp		2	3	5	1	4	3	18 (31%)
Moderate, ≥midway to the pulp		1	2		1		1	5 (9%)
Severe, pulp exposed	3	6	11	9	3	2	1	35 (60%)
Resorptions on centrals								
Slight, <midway to the pulp			2	1	1		1	5 (36%)
Moderate, ≥midway to the pulp			1	1		1		3 (21%)
Severe, pulp exposed	1		1	1	1		2	6 (43%)
Total	4 (8%)	9 (13%)	20 (27%)	17 (24%)	7 (10%)	7 (10%)	8 (11%)	72

TABLE 6. Resorptions on the Roots of the Maxillary Incisors Adjacent to 156 Ectopically Positioned Maxillary Canines Shown on Transverse CT Scans

Teeth	Root Resorption No	Slight	Moderate	Severe	Total
Laterals[A]	94 (62%)	18 (12%)	5 (3%)	35 (23%)	152[A]
Centrals	142 (91%)	5 (3%)	3 (2%)	6 (4%)	156

[A] 4 aplasia cases.

TABLE 7. Main Location of the Resorptions on the Roots of 72 Maxillary Incisors Adjacent to the 156 Ectopically Erupting Maxillary Canines Shown on Transverse CT Scans

Teeth	Location of Root Resorption Buccal	Distobuccal	Distal	Distolingual	Lingual	Apical	Total
Laterals[A]	15 (26%)	9 (16%)	1 (2%)	12 (21%)	11 (19%)	10 (17%)	58
Centrals	—	—	5	5	3	1	14

[A] 4 aplasia.

TABLE 8. Main Location of the Root Resorptions Relative to the Root Height on 72 Maxillary Incisors Adjacent to Ectopically Erupting Maxillary Canines

Incisor	Location of Root Resorption Cervical third	Middle third	Apical[A] third	Apical tip	Total
Laterals	3 (5%)	25 (43%)	12 (21%)	18 (31%)	58
Centrals	1	6	2	5	14

[A] Not including the apical tip.

TABLE 9. Relationship Between the Assessment of Resorptions on the Roots of the Lateral Incisors Adjacent to Ectopically Erupting Maxillary Canines

Intraoral Films	Assessment of Resorption CT Scanning No Resorption	Resorption	Total
No resorption	118	30	148
Resorption	6	26	32
Total	124	56	180

TABLE 10. Relationship Between the Assessment of Resorptions on the Roots of the Central Incisors Adjacent to Ectopically Erupting Maxillary Canines

Assessment of Resorption			
	CT Scanning		
Intraoral Films	No Resorption	Resorption	Total
No resorption	172	8	180
Resorption	1	5	6
Total	173	13	186

FIGURES Return to TOC

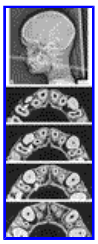

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FIGURE 1. (A) Topogram of the head showing the cutting direction through the anterior part of the maxilla perpendicular to the long axis of the maxillary incisors. Eight contiguous cuts are marked. (B-E) Contiguous CT scans through the upper alveolar process. Slice thickness 2 mm. Beam direction perpendicular to the long axis of the maxillary lateral incisors. The crown of the ectopically positioned canine 13 is buccal to and in contact with 12 (B-E). Slight resorptions are present in 12 at the contact area in the middle part of the root of 12 (arrows). The apex of 12 is intact (E). 23 is erupting normally (B-E). The dental follicle of 23 is widened and 22 partly lacks the lamina of the alveolus (B,C). There is contact between the 2 teeth distally to 22, but the root contour is intact (B)

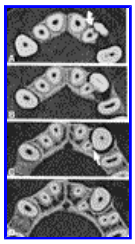

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FIGURE 2. (A-D) 23 is erupting buccally to the root of 22. Moderate resorptions are present in the middle and apical thirds of the root of 22 within the contact zone between 22 and 23 (arrows). The resorption cavity extends about midway to the pulp. The apex is intact

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FIGURE 3. (A-B) Intraoral periapical films of ectopically erupting 13. The root contours of 12 and 11 are overlapped by 13 and difficult to assess. (C,D) CT scans of the same case. The crown of 13 is situated lingually to 12 and distally to 11. Root resorptions are severe on the root of 12 and moderate on 11 (arrows). In 12, the pulp is exposed. The apices of 12 and 11 are partly resorbed

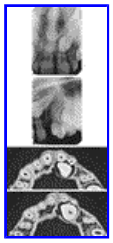

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FIGURE 4. (A,B) Intraoral periapical films of ectopically erupting 23. The crown of 23 is overlapping 21 and 22. The root contours and the alveolar lamina of 21 and 22 look intact. (C,D) CT scans of the region of interest showing resorption lingually on the root of 22 (arrows). A thin wall of healthy dentine protects the pulp (arrow). There is no resorption on the root of 21. The injury is located in the middle part of the root of 22

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FIGURE 5. (A,B) Intraoral periapical films of ectopically erupting 13 overlapping 12. The apical part of 12 is resorbed. (C) CT scans of the same region showing a 13 situated lingually to 12 in contact with the root of 12. The apical half of 12 is resorbed. The cusp of 13 is in contact with 12. 23 is erupting normally. (D) Photograph of 12 after extraction; lingual view showing the total extent of the resorption

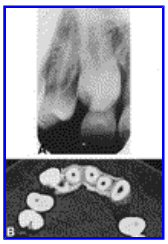

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FIGURE 6. (A) Intraoral periapical films of an ectopically erupting 13. The crown of 13 overlaps 12. The root of 12 is difficult to assess but signals resorption in the middle of the root. The apical third looks intact. (B) CT scan through the middle of the root of 12. Note 13 located to the buccal of of 12 and in contact with the root of 12. Resorption to the pulp is seen in the contact zone between the 2 teeth (arrow).

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FIGURE 7. Intraoral films of 22 at the time of eruption of 23 into the oral cavity (A,B). In the middle of the root of 22 there is a vast resorption cavity (A, arrow). Six months later (B) the cavity is organized. 22 responded normally to tests. (C) A CT scan through the root of 22 at the 6 months follow-up shows that the resorption reached the pulp. The crown of 23 is now located almost normally in the dental arch and the resorption on the root of 22 has ceased. The resorption cavity is almost organized. Tooth 23 probably caused the injury to the root of 22 in an earlier ectopic position. Later, the path of eruption of the maxillary canine has been spontaneously corrected

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