PEDIATRIC DENTAL JOURNAL 15(1): 52–57, 2005

# A diagnostic proposal to support early treatment of ectopically erupting maxillary canines

Yo Taguchi, Hiroaki Kobayashi and Tadashi Noda

Division of Pediatric Dentistry, Department of Oral Health Science, Course for Oral Life Science,
Niigata University Graduate School of Medical and Dental Sciences
2-5274 Gakkocho-dori, Niigata 951-8514, JAPAN

**Abstract** Although early diagnosis is essential for the correction of ectopically erupting canines, it is difficult to determine whether the condition of a canine is within acceptable normal limits, particularly in children aged 10 years or younger. The purpose of the present study was to ascertain the appropriate time for a preventive procedures, such as extraction of the predecessor, in order to avert impaction of maxillary canines. Orthopantomograms of 225 normal children without dental anomalies were examined to compare the eruption stages of mandibular and maxillary canines. Sixty-four patients with 68 unerupted and/or impacted maxillary canines were examined. In normal children, mandibular canines exhibited earlier movement toward oral emergence than maxillary canines on the same side. This tendency was particularly prominent after exfoliation of the mandibular primary canine. In contrast, nearly half of the patients with anomalies were treated before oral emergence of the mandibular canine through simple procedures such as extraction of the primary canine or exposure of the affected canine. The present findings may provide a useful supplemental rule for early diagnosis and aid in decisions whether to treat ectopically erupting maxillary canines, particularly when the anomaly is obscure.

**Key words**
Diagnosis,
Disturbance of eruption,
Ectopic eruption,
Maxillary canine

## Introduction

Ectopic eruption of a maxillary canine is found in 1.5% to 2% of children during the mixed dentition period[1–3]. Although early diagnosis is essential for correction of disturbance of canine eruption, it is difficult to determine whether a condition is within acceptable normal limits, particularly in children aged 10 years or younger[4–6].

Pediatric dentists obtain orthopantomograms in daily practice for several reasons; not only suspicion of disturbance of eruption, but also dental injuries including bone fracture and confirmation of the number of the permanent teeth, and so on. It is not rare for maxillary ectopic canines to be detected unexpectedly. While these discoveries can be helpful, conclusive diagnoses should not be made nor treatment rendered based only on limited evidence.

Ericson *et al.*[7] showed that early extraction of a primary canine could change the path of eruption of a palatally erupting canine, in a longitudinal study. The less the top of the canine overlapped the root of the adjacent lateral incisor, the more the aberrant path of the ectopic canine could undergo spontaneous correction by one year after extraction of the primary canine. Although many authors recommend the same preventive procedure[1,2,4–7], it is often unclear to us whether the primary canine should be extracted in mild cases. Excessively early extraction of the primary canine loses the space for eruption of the buccal teeth even with insertion of a space maintainer.

In order to solve this difficult problem, Fernandez

Received on August 26, 2004
Accepted on November 26, 2004

Table 1 Distribution of control group by the developmental stage of mandibular canine

| Stage of mandibular canine | Number of estimated canine | Age (mean ± SD) | Range of age |
|---|---|---|---|
| 0 | 37 | 8y6m ± 6.5m | 7y 7m – 10y 0m |
| 1 | 140 | 8y9m ± 11.6m | 6y 6m – 11y 5m |
| 2 | 99 | 9y0m ± 10.3m | 7y 6m – 11y 1m |
| 3 | 45 | 9y7m ± 15.6m | 7y 7m – 11y11m |
| 4 | 127 | 9y9m ± 13.6m | 7y10m – 12y10m |
| 5 | 92 | 10y7m ± 14.0m | 8y 0m – 13y 3m |
| Total & Mean | 540 | 9y5m ± 14.9m | 6y 6m – 13y 3m |

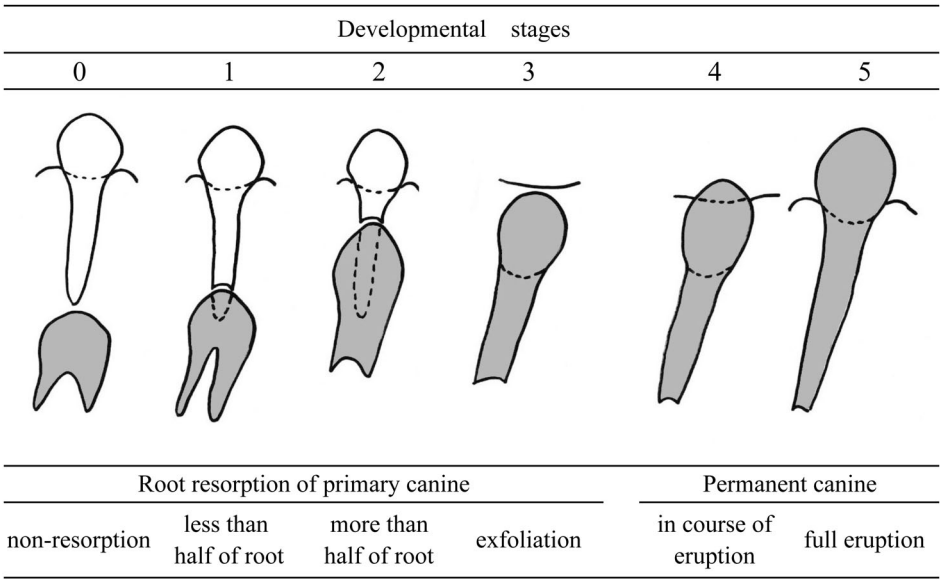


Fig. 1 Classification of the developmental stages according to the root resorption of primary canine and eruptive condition of the permanent canine

*et al.*[8] proposed a new diagnostic tool for early detection and treatment of ectopic canines on orthopantomograms. The cases in which the top of the canine still overlapped the root of the lateral incisor after complete development of the lateral incisor had high risk of ectopic canine eruption. In addition to their findings, there seems to be a relationship between the eruptive movements of maxillary and mandibular canines.

The purposes of the present study were to examine the relationship between eruptions of maxillary canines and the eruptive movement of mandibular canines and to make a new diagnostic proposal for early treatment of ectopically erupting maxillary canine, according to the state of development of the mandibular canine.

## Materials and methods

The subjects of the present study were divided into two pediatric groups without and with an ectopically erupting maxillary canine, the control group and the patient group respectively. In the control group, in order to compare stage of eruption of mandibular canine with that of maxillary canine, orthopantomograms were selected randomly from 225 children without disturbance of canine eruption (105 boys and 120 girls, range 6 to 13 years of age (mean = 9.5 years)). Inclusion in the study was limited to subjects who exhibited full eruption of eight maxillary

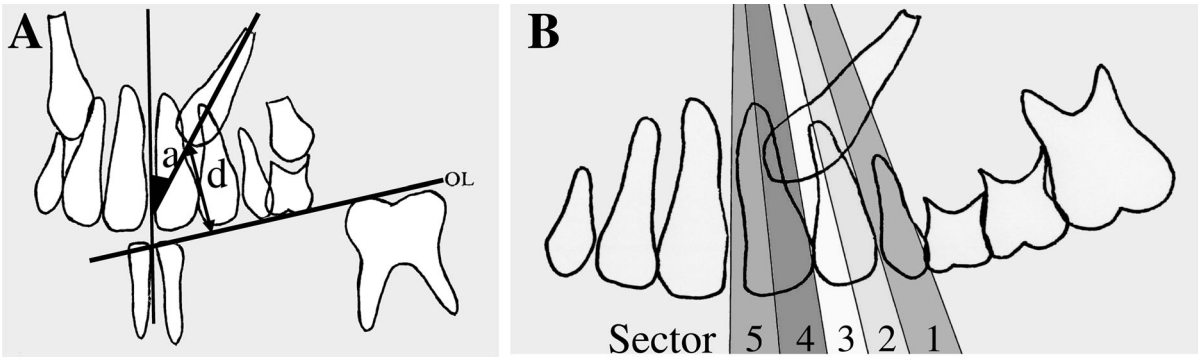


Fig. 2 Measurement of the crown top of ectopic maxillary canine on the orthopantomogram
The vertical length to occlusal line (OL) can be measured as (d) millimeters and the axial angulation to midline as (a) degrees. Ericson and Kurol's method[7] were modified.

and mandibular incisors. Moreover, clinical records indicated that the primary incisors and canines in the control subjects had not suffered any apical lesion following severe dental caries or undergone early extraction for alignment of the anterior incisors or abnormal root resorption due to the adjacent lateral incisor. Since the comparison was performed on both left and right sides in one orthopantomogram, and some subjects occasionally had serial radiographs obtained at different ages, the developmental stages of maxillary and mandibular canines on the 540 sides could be estimated. The distribution of such stages in the control group is shown in Table 1.

The developmental stage of the permanent canines was classified into six categories, with stages 0 to 3 defined by the extent of root resorption or exfoliation of the predecessor, and stages 4 and 5 by either partial or full eruption (Fig. 1).

The patient group included 64 Japanese children with 68 ectopic canines, treated in the Pediatric Dental Clinic of Niigata University Medical and Dental Hospital. In the patient group with ectopic maxillary canines, the above classification was used to estimate the stage of development of the mandibular canine on the affected side. The diagnosis of an aberrant path of eruption was based on periapical radiographs or orthopantomograms of the patients taken during routine assessments of oral health, according to the following criteria provided in our previous report[9].

1. There was a direct cause that apparently obstructed the eruption path of the affected canine: odontoma or dentigerous cyst of the canine region, or supernumerary tooth in the lateral incisor region.
2. We measured the vertical length to the occlusal line (d) and the axial angulation to the midline (a) of the canine, which determined the status of the affected canine (Fig. 2A). According to Ericson and Kurol's method[7], on an orthopantomograms, occlusal line was defined as the line connecting the midpoint of both mandibular central incisors and the mesial cusp top of the mandibular first molar. When the difference between each side was beyond 5 mm in length to the occlusal line or more than five degrees in axial angulation to the midline, the canine was diagnosed as having an aberrant path of eruption.
3. To what extent the cusp tip of the canine overlapped the adjacent lateral or central incisor root was estimated (Fig. 2B). The method of sector classification[7] was most useful for determining whether the path of eruption was normal bilaterally. In Sector 1, on an orthopantomograms, the cusp tip of the affected canine was situated distally to the root of the lateral incisor. The affected canine in Sector 2 was overlapped on the distal half of the root of the lateral incisor and that in Sector 3 was on the mesial half of them. In the same way, Sector 4 and 5 was classified by the position of the canine on the root of the central incisor. When the cusp tip was situated in Sector 2 to Sector 5, the canine could easily be diagnosed as anomalous.

The cases were excluded from analysis when their mandibular primary canines had undergone early extraction for alignment of the anterior incisors or abnormal root resorption due to the adjacent lateral incisor.

A *t*-test and test of independence were used to

Table 2 Comparison of developmental stage of mandibular canine with that of maxillary canine in normal cases

| | | Stages of maxillary canine | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | | 1 | | 2 | | 3 | | 4 | | 5 | | Total | |
| Stages of mandibular canine | 0 | 30 | 81.1% | 7 | 18.9% | | | | | | | | | 37 | 100% |
| | 1 | 78 | 55.7% | 56 | 40.0% | 5 | 3.6% | 1 | 0.7% | | | | | 140 | 100% |
| | 2 | 17 | 17.2% | 44 | 44.4% | 30 | 30.3% | 6 | 6.1% | 2 | 2.0% | | | 99 | 100% |
| | 3 | 3 | 6.7% | 14 | 31.1% | 21 | 46.7% | 7 | 15.6% | | | | | 45 | 100% |
| | 4 | 3 | 2.4% | 26 | 20.5% | 41 | 32.3% | 19 | 15.0% | 38 | 29.9% | | | 127 | 100% |
| | 5 | 1 | 1.1% | 4 | 4.3% | 27 | 29.3% | 11 | 12.0% | 30 | 32.6% | 19 | 20.7% | 92 | 100% |
| Total | | 132 | | 151 | | 124 | | 44 | | 70 | | 19 | | 540 | |

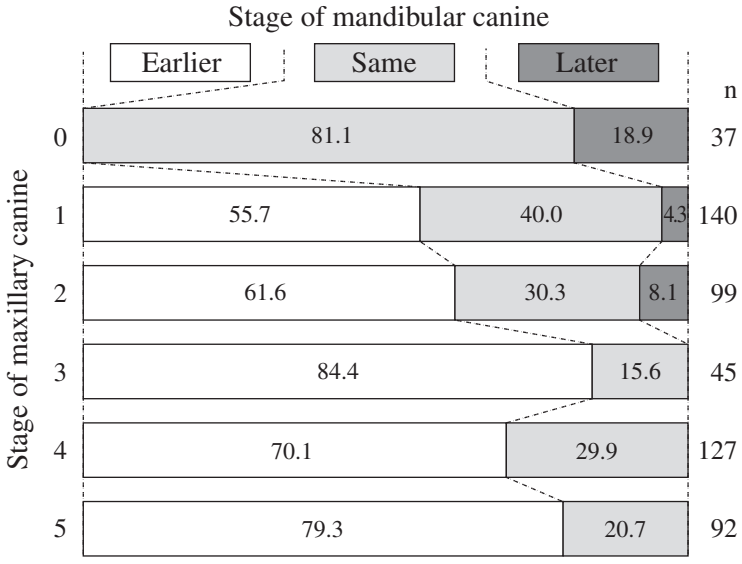


Fig. 3 Concurrent developmental stages in the maxillary and mandibular canines

Earlier: mandibular canines exhibiting an earlier stage than their maxillary counterparts at each stage
Same: mandibular canines showing a same stage as maxillary canines
Later: mandibular canines showing a later stage
The values were calculated from Table 2.

determine the statistically significance of differences between the patient and the control groups.

## Results

The distribution of developmental stage of maxillary canines in the normal group is shown in Table 2, by stage of development of mandibular canines. As the later developmental stages of mandibular canine emerged, most of maxillary canines began to reach the earlier stages. For example, when a mandibular canine was in stage 3, 84.4% of maxillary canines were in stage 0 to 2, while the remaining 15.6% were in stage 3. The result for each stage is graphically illustrated in Fig. 3.

Although 29 of 68 ectopic canines (43%) were aligned within the dentition after simple treatment such as extraction of the predecessor and/or exposure of the canine (Table 3), orthodontic traction was needed in 49% of the cases. Eight of ectopic canines (8%) were removed.

Concerning the ectopic position of the affected canines, the vertical length of the cusp tip of the crown was greater in cases of removal (23.8 millimeters) than that in the other cases. Axial angulation was the most prominent feature in cases

Table 3 Distribution of treatments and the conditions of ectopic canines

| Treatment | Number of ectopic canine | Age at the first treatment | Vertical length (millimeters) | Axial angulation (degrees) |
|---|---|---|---|---|
| Simple cases | 29 | 10y5m ± 1y4m | 14.9 ± 3.9 | 20.0 ± 9.5 |
| Traction cases | 33 | 11y7m ± 1y8m | 16.8 ± 5.8 | 32.3 ± 20.8 |
| Removal cases | 6 | 11y0m ± 1y9m | 23.8 ± 3.1 | 58.3 ± 20.2 |
| Total & Mean | 68 | 11y2m ± 1y7m | 16.6 ± 5.4 | 29.3 ± 19.8 |

** $P<0.01$ (Simple cases vs Traction cases; Traction cases vs Removal cases; Simple cases vs Removal cases; Simple cases vs Removal cases)

Table 4 Distribution of treatments and the sectors of ectopic canines

| Treatment | Sector | | | | | Total |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| Simple cases | 11 | 15 | 2 | 1 | 0 | 29 |
| Traction cases | 8 | 8 | 12 | 4 | 1 | 33 |
| Removal cases | 2 | 1 | 2 | 1 | 0 | 6 |
| Total | 21 | 24 | 16 | 6 | 1 | 68 |

Table 5 Treatment types of ectopic maxillary canines according to the developmental stage of mandibular canines on the affected side

| Treatment | Stages of mandibular canine | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | |
| Simple cases | 1 (3.4%) | 2 (6.9%) | 5 (17.2%) | 5 (17.2%) | 12 (41.4%) | 4 (13.8%) | 29 (100.0%) |
| Traction cases | 0 | 2 (6.1%) | 4 (12.1%) | 1 (3.0%) | 3 (9.1%) | 23 (69.7%) | 33 (100.0%) |
| Removal cases | 0 | 1 (16.7%) | 0 | 0 | 0 | 5 (83.3%) | 6 (100.0%) |
| Total | 1 | 5 | 9 | 6 | 15 | 32 | 68 |

$\chi^2 = 28.3$, $P<0.01$

of removal (58.3 degrees), as in cases of traction (32.3 degrees). There was no significant relationship between treatment and sector of the ectopic canine (Table 4).

The developmental stages of mandibular canines on the affected side in the patient group were also examined at the beginning of treatment (Table 5). In the cases aligned by simple treatment, stages 0 to 3 occupied about a half of those cases and the treatment of approximately 90% of them was started prior to full eruption of the mandibular canine. However, of the cases in which traction was needed, nearly 70% were in stage 5 (after full eruption of mandibular canine) on the same side of mandibular canine. Out of six cases of removal of an ectopic canine, five mandibular canines were in stage 5 and only one was in stage 1.

## Discussion

The present retrospective study revealed that, in cases of removal of ectopic canines, the teeth were too far off in position and angulation to correct. The same was true in cases of traction, although the ectopic condition was more moderate than in the cases of removal. These findings indicate that it is essential for pediatric dentists not to overlook the early signs of such anomalies. However, chronological age seems not to be a reliable indicator for early detection, since development of the dentition is

differs markedly among individuals.

Several examinations are available for early detection of ectopic eruption of maxillary canines[4–6]. Around 10 years, non-palpability of a buccal bulge in maxillary canine region generally calls for a radiograph. Comparing conditions of maxillary primary canines on the two sides is also helpful for diagnosing this anomaly. Moreover, it has been reported that other dental anomalies are associated with disturbance of eruption of maxillary canines, such as dental agenesis or malformation of the lateral incisor and other teeth, and ectopic eruption of the first molar[10–13]. Based on the above, it can be determined whether a radiograph should be taken. However, when signs of an ectopically erupting canine are obscure on the radiograph, it is difficult to ascertain whether the X-ray findings are within acceptable normal limits, particularly in children aged 10 years or younger.

In the present study, the normal patterns of eruption of maxillary and mandibular canines were examined, and earlier emergence of mandibular canines was found. From the beginning of treatment in patients, most of the cases that could be corrected by a simple procedure such as extraction-only of the primary canine or exposure of the canine started their treatment before full eruption of mandibular canine on the affected side. Moreover, treatment was in nearly half of those cases begun prior to oral emergence of mandibular canines. These findings suggest that preventive extraction of the maxillary predecessor should be considered when the mandibular primary canine has already exfoliated, even if signs of eruption disturbance of the maxillary canine are uncertain.

Fernandez *et al.*[8] examined the typical pattern of eruption of the maxillary canine and its relation to root development of the adjacent lateral incisor in 554 orthopantomograms. They concluded that overlapping of the canine and lateral incisor when the incisor has completed development might be a sign of eruptive disorders of the canine, and suggested preventive measures to avoid impaction. In addition to their suggestion, the present results provide a useful supplementary rule for early diagnosis and for decision whether and when to treat ectopically erupting maxillary canines, particularly when the anomaly is obscure. At a minimum, a preventive treatment should be performed prior to full eruption of the mandibular canine.

## References


1) Dachi, S.F. and Howell, F.V.: A survey of 3,874 routine full-mouth radiographs: II. A study of impacted teeth. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* **14**: 1165–1169, 1961.
2) Thilander, B. and Jakobsson, S.O.: Local factors in impaction of maxillary canines. *Acta Odontol Scand* **26**: 145–168, 1968.
3) Grover, P. and Lorton, L.: The incidence of unerupted permanent teeth and related clinical cases. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* **59**: 420–425, 1985.
4) Ericson, S. and Kurol, J.: Longitudinal study and analysis of clinical supervision of maxillary canine eruption. *Community Dent Oral Epidemiol* **14**: 172–176, 1986.
5) Ericson, S. and Kurol, J.: Radiographic assessment of maxillary canine eruption in children with clinical signs of eruption disturbance. *Europ J Orthod* **8**: 133–140, 1986.
6) Kurol, J., Ericson, S. and Andreasen, J.O.: The impacted maxillary canine. *In:* Textbook and Color Atlas of Tooth Impaction. 1st ed. (Andreasen, J.O., Petersen, J.K. and Laskin, D.M. eds.). Munksgaard, Copenhagen, 1995, pp. 125–165.
7) Ericson, S. and Kurol, J.: Early treatment of palatally erupting maxillary canines by extraction of the primary canines. *Europ J Orthod* **10**: 283–295, 1988.
8) Fernandez, E., Bravo, L.A. and Canteras, M.: Eruption of the permanent upper canine: A radiographic study. *Am J Orthod Dentofac Orthoped* **113**: 414–420, 1998.
9) Taguchi, Y., Kobayashi, H. and Noda, T.: The palatally displaced canine in Japanese children. *Ped Dent J* **10**: 155–159, 2000.
10) Becker, A., Smith, P. and Behar, R.: The incidence of anomalous maxillary lateral incisors in relation to palatally-displaced cuspids. *Angle Orthod* **51**: 24–29, 1981.
11) Bjerklin, K. and Kurol, J.: Ectopic eruption of maxillary first permanent molars and association with other tooth and developmental disturbances. *Europ J Orthod* **14**: 369–375, 1992.
12) Peck, S., Peck, L. and Kataja, M.: The palatally displaced canine as a dental anomaly of genetic origin. *Angle Orthod* **64**: 249–256, 1994.
13) Pirinen, S., Arte, S. and Apajalahti, S.: Palatal displacement of canine is genetic and related to congenital absence of teeth. *J Dent Res* **75**: 1742–1746, 1996.