Case Report

Inverted maxillary second primary molar and permanent successor teeth: X-ray photographic evaluations

Rena Okawa, Kazuhiko Nakano, Ryota Nomura, Kazuyo Fujita,
Naofumi Kamakura, Michiyo Matsumoto and Takashi Ooshima

Department of Pediatric Dentistry, Osaka University Graduate School of Dentistry
1-8 Yamada-oka, Suita, Osaka 565-0871, JAPAN

Abstract A 10-year-and-4-month old girl was shown to have inverted maxillary right second primary molar and permanent successor teeth, after being referred to our clinic for examination of an unerupted maxillary right second primary molar. Orthopantomograph images taken at the age of 7Y4M showed an impacted maxillary second primary molar and ambiguous tooth germ of its permanent successor, while images obtained at the age of 10Y4M exhibited the tooth germ of the permanent successor in a position on top of the impacted primary molar. Orthopantomographs were obtained twice during the next year, which showed development of the second premolar. The dental age of the entire dentition, except for the maxillary right second premolar, at 7Y4M was considered to be consistent with her chronological age, whereas it was approximately 6 months to 1 year behind of chronological age when determined at the age of 10Y4M, 11Y4M, and 12Y3M. The dental age of the permanent second premolar gradually increased, however, remained approximately 4 years behind chronological age. At 12Y3M, computed tomography examinations were performed to clarify the three-dimensional positions of the second primary molar and its permanent successor. At that time, the impacted primary molar was located close to the inferior part of the maxillary sinus, while the tooth germ of the permanent successor was located in the apex region of the adjacent first permanent premolar and first permanent molar. We decided to carry out the periodical examinations to observe the maxillary right second primary molar and premolar.

Key words

Computed tomography,
Impacted tooth,
Inversion,
Second premolar,
Second primary molar

Introduction

Impaction is defined as a condition in which a tooth fails to erupt into a normal functional position within a normal age range and the condition is generally found with permanent teeth, while impaction of primary teeth is considered to be rare¹⁾. The most predominant sites of impaction of primary teeth are reported to be the maxillary and mandibular second primary molar regions, and ankylosis is considered to be a possible etiologic factor²⁾. The frequency of tooth impaction in primary dentition in a study of

9,128 Japanese children aged 3 to 8 years old was reported to be approximately 0.1%³⁾.

There is a limited number of reports describing cases of impacted primary molars with inversion of the permanent successors^{4–12)}. The age distribution of those cases ranged from 5 to 20 years old, and most were observed with the mandibular second primary molar and its permanent successor, though the maxillary second primary molar and its permanent successor were occasionally involved. In addition, some studies have noted complaints of pain in the affected areas by the patients^{5,7,12)}, though no signs or symptoms are generally reported in most cases^{4,6,8–11)}.

Recently, computed tomography (CT) has been

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widely applied for diagnoses in the field of general dentistry, as it can demonstrate the three-dimensional relationships of the teeth. In the present report, a case of a 10-year-old girl with an impacted primary molar located in a position inferior to its permanent successor with delayed development is presented. Images obtained by CT as well as in conventional X-ray photographic examinations were used to elucidate the location of both teeth in the affected region.

Case Report

A girl aged 10Y4M was referred to the Clinic of Pediatric Dentistry of Osaka University Dental Hospital for consultation in regard to an unerupted maxillary right second primary molar. There was nothing unusual about her medical and dental history. Her parents were informed of the presence of the impacted tooth by a general practitioner 3 years prior to coming to our clinic. An orthopantomograph taken at that time was also brought to us, which exhibited an impacted maxillary right second primary molar with an ambiguous tooth germ in the position

of its permanent successor (Fig. 1A). The patient was also referred to an orthodontic specialist, who applied a space maintainer to prevent mesial inclination of the adjacent first permanent molar.

The orthopantomograph taken before the first visit to our clinic identified the tooth germ of the permanent successor located on top of the impacted maxillary right second primary molar (Fig. 1B). The

Fig. 2 Occlusal X-ray photograph taken at the first visit (10Y4M)

Fig. 1 Orthopantomograph taken by general practitioner prior to coming to our clinic
(A) 7Y4M. (B) 10Y4M. Black and white arrows indicate the maxillary right second primary molar and maxillary right second premolar, respectively.

Fig. 3 Orthopantomographs taken at periodical examinations
(A) 11Y4M. (B) 12Y3M. Black and white arrows indicate the maxillary right second primary molar and maxillary right second premolar, respectively.

Fig. 4 CT images of horizontal sections

Serial sections are shown from the superior (A) to inferior (I) positions. Images (A) to (I) represent 2.5-mm intervals. Black and white arrows indicate the maxillary right second primary molar and maxillary right second premolar, respectively.

Fig. 5 CT images of frontal sections

Serial sections are shown from the front (A) to rear (I) positions. Images (A) to (I) represent 2-mm intervals. Black and white arrows indicate the maxillary right second primary molar and maxillary right second premolar, respectively.

orthodontic specialist changed the orthodontic appliance. Based on occlusal X-ray photograph images taken at the first visit to our clinic, the permanent successor was considered to be located in a slightly mesial position as compared to the impacted primary tooth, though no bucco-lingual dislocation of those two teeth was identified (Fig. 2). We diagnosed the present case as a maxillary second primary molar and its permanent successor in inverted positions.

Orthopantomographs were obtained twice over the next year, both of which showed development of the maxillary right permanent second premolar (Fig. 3). The orthodontic specialist also changed the orthodontic appliance. At 12Y3M, we decided to use CT to clarify the three-dimensional positions of the second primary molar and its permanent successor. Figure 4 shows CT images of horizontal sections, in which the permanent successor can be observed in the inferior position. Both teeth were located nearly within the dental arch, while there was a horizontal gap between them. As for the frontal sections (Fig. 5), both teeth were identified in the images of the same sections, indicating that there was no frontal gap.

Furthermore, the impacted primary molar was shown to be located in a slightly mesial position in the sagittal sections (Fig. 6). The impacted primary molar was located near the inferior part of the maxillary sinus (Figs. 5, 6). Next, three-dimensional images were generated by reconstructing the CT data, with four representative images showing an inclination of 30 degrees presented in Fig. 7. The tooth germ of the permanent successor was shown in the apex region of the adjacent first permanent premolar.

Dental age was calculated using the method described by Haavikko¹³⁾, which has been shown to be valid for application in Japanese subjects¹⁴⁾. The dental age of the entire dentition, except for the maxillary right second premolar, at 7Y4M was consistent with the chronological age of the patient, while that was approximately 6 months to 1 year behind her chronological age when analyzed using orthopantomographs taken at 10Y4M, 11Y4M and 12Y3M (Table 1). In addition, the root of the permanent second premolar gradually developed, however, its dental age remained approximately 4 years behind chronological age.

Fig. 6 CT images of sagittal sections

Serial sections are shown from the mesial (A) to distal (I) positions. Images (A) to (I) represent 1-mm intervals. Black and white arrows indicate the maxillary right second primary molar and maxillary right second premolar, respectively.

Fig. 7 Three-dimensional images generated by reconstruction of CT data

The images are shown from the frontal (A) to lateral (D) views. The bottom images are modified versions of the top image in each panel, obtained by removal of adjacent tissues, except for the tooth structure.

Table 1 Chronological and dental ages

Chronological age (years)	Dental age (years)				
	Entire dentition except for UR5* [mean $\pm$ standard deviation]	UR5*	UL5*	LR5*	LL5*
7Y4M	7.42 $\pm$ 0.57	ND**	8.5	8.5	8.5
10Y4M	9.51 $\pm$ 0.63	5.6	9.7	9.6	9.6
11Y4M	10.77 $\pm$ 0.32	6.1	10.5	10.7	10.7
12Y3M	11.13 $\pm$ 0.39	6.6	11.3	11.5	11.5

*: UR5, maxillary right second molar; UL5, maxillary left second molar; LR5, mandibular right second molar; LL5, mandibular left second molar

** : ND, corresponding tooth not clearly identified

Discussion

To our knowledge, this is the first report that describes a case with an inverted maxillary second primary molar and its permanent successor using CT, which has become widely used for various diagnoses in the field of dentistry, as well as conventional X-ray photographic examinations. In the present case, CT images and three-dimensional images constructed from obtained CT data enabled us to clearly recognize the location, direction, and shape of the primary molar and its permanent successor, which allowed development of an appropriate treatment plan.

The etiology of the impacted maxillary right second primary molar in the present case remains to be elucidated. Ankylosis of the tooth is possible, though no pertinent information regarding the tooth condition prior to visiting our clinic is available. Gündüz *et al.*¹²⁾ reported a case with a deeply impacted second primary molar, in which the affected tooth was embedded within the maxillary sinus bone and the impacted second premolar was located near the inferior wall of the maxillary sinus. In that case, both impacted teeth were carefully removed and the second primary molar was found to be ankylosed, while a minor communication between the affected tooth and the maxillary sinus was also noted. With those results in mind, we will continue careful observations of the transitional location of the impacted maxillary second primary molar.

It is interesting to consider the etiology of the inverted positions of the primary and permanent teeth in the present case. The position of the permanent tooth germ during its developmental stage has been estimated in the field of developmental biology¹⁵⁾. The anlage of the premolar presumably appears on the lingual side of the mesiolingual cusp of the primary molar, then moves to the lingual side of the crown of the primary molar during its root formation. Next, its position shifts to the distal side of the cervical area when the primary molar begins to erupt, after which it occupies the root furcation and begins the process of calcification. This etiology and the form of the tooth was grounds that the tooth germ was not a supernumerary tooth.

We speculated that the second primary molar might have been ankylosed when the anlage of the permanent successor was located above its occlusal surface, thus the anlage would not have been able to move in the direction of the primary molar. As a result, the permanent successor remained over

the top of the crown of the second primary tooth, possibly preventing its eruption. Development of the affected permanent second premolar was not initiated until the age of 7 in the present case and the anlage of the premolar was located near the oral cavity when the ankylosed primary molar changed its location to a relatively inferior position.

There are several studies describing impacted primary teeth, among which several cases with both inverted primary and permanent teeth have been reported⁴⁻¹²⁾. Treatments for such inverted primary and permanent teeth can be classified into four types; both teeth are extracted^{7,11,12)}, only the permanent successor is extracted^{6,9)}, only the second primary molar and a supernumerary tooth are extracted¹⁰⁾, and the second primary molar and its permanent successor are observed periodically⁸⁾. For the present patient, we decided to observe the second primary molar and its permanent successor periodically, because we were able to recognize both the development of the maxillary right permanent second premolar and the change of second primary molar in position. Final result of the case that the second primary molar and its permanent successor are observed periodically is not reported. Therefore we will keep observing till the development of the permanent successor stops.

In the present case, the dental age of the second premolars, except for the maxillary right second premolar, was consistent with the dental age of the entire dentition, except for the maxillary right second premolar, whereas the dental age of the maxillary right second premolar was approximately 4 years behind the dental age of the entire dentition. There is another case similar to ours, in which the second premolar could not be identified in an examination conducted at the age of 6Y6M and calcification of its crown was completed by the age of 13Y3M⁸⁾.

In summary, CT examinations as well as conventional evaluations clearly showed a maxillary second primary molar and its permanent successor in inverted positions. Periodical observations of this rare case continue at the time of writing, as the permanent successor is demonstrating tooth development.

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