

◆ 증례

지연발육 상악 소구치의 맹출 유도

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Abstract

ERUPTION GUIDANCE OF MAXILLARY PREMOLARS WITH DELAYED DEVELOPMENT

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Premolars show the greatest variation in development and eruption. The present case report identified characteristics of eruption of maxillary premolars with delayed development. Multiple maxillary premolars with delayed development were found to have a palatal ectopic eruption pattern, which was self-corrected through eruption guidance by extraction of preceding primary teeth at the stage of root development when eruption force was maximal. In addition, delayed eruption due to delayed development was substantially improved by eruption guidance. Early erupted premolars with less than 1/3 of root development were induced to have normal root development using stabilizing appliance. The maxillary premolars with delayed development reported in the present study showed no complications such as impaction, space loss by delayed eruption, or insufficient root development. [J Korean Dis Oral Health Vol.13, No.1: 6-13, June 2017]

Key words : Delayed development, Maxillary premolar, Eruption guidance

I . Introduction

Each tooth has its own time and rate of development and calcification, and gradually moves toward the occlusal surface as it erupts¹⁾. Eruption rates of teeth are not constant, but rather they vary depending on the stage of tooth development^{2,3)}. According to the previous studies, the age of calcification of pre-

molars are 2 - 2.5 years and the crown formation is completed in 7 - 8 years^{4,5)}. Also, it has been found that premolars erupt when root formation is approximately 1/2 to 2/3 complete, and the eruption occurs at 10 - 12 years⁶⁻⁹⁾.

It has been known that times of premolar development or eruption are more variable compared to all other teeth. In particular, the eruption can be delayed by the late formation of teeth. Some previous studies reported to have delayed development of a premolar, however, the majority of the researches were constituted of mandibular premolars¹⁰⁻¹⁴⁾. Additionally, the studies on delayed development of

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premolars have focused on misdiagnosis such as congenital missing or orthodontic treatment procedures primarily of the mandibular second premolars. In contrast, only a few cases of delayed eruption of delayed developed premolars have been reported.

Hypodontia is often associated with other disruptions of the dental lamina and maxillofacial skeletal imbalances. Abnormal conditions such as tooth agenesis, microform teeth, delayed tooth development have been found to occur together frequently than would be expected by chance alone¹⁵. Moreover, numerous studies had reported associations between hypodontia and significant alterations in craniofacial morphology in nonsyndromic patients and craniofacial anomalies such as ectodermal dysplasia, Pierre Robin syndrome, Down syndrome¹⁶⁻¹⁹. Therefore, it is necessary to observe and treat delayed development premolars in patients with systemic diseases or syndromes with dental anomaly. This may reduce the need for orthodontic treatment due to delayed eruption and space loss.

The present study describes maxillary premolars showing delayed development, from development through eruption, as well as evaluation of the management of late or premature eruption caused by delayed

development. This study suggests that the results obtained from nonsyndromic patients can be applicable to syndromic patients who are frequently experiencing orthodontic problems due to dental anomalies .

II . Case reports

1. Case 1

A 10 years and 9 months old female in the mixed dentition were present with congenital missing of premolars and prolonged retention of 4 second primary molars. The initial panoramic radiograph revealed bilateral congenital agenesis of maxillary first premolars and mandibular second premolars, and bilateral delayed development of the maxillary second premolars. The tooth formation of all affected second premolars was delayed, compared to the adjacent canine, according to the classification of Moorees⁴ (Fig. 1A). Twenty-two month later, at age 12 years and 9 months, crown development of both maxillary second premolars were complete, and root formation had begun. And using computed tomography, the axis of the right second premolar was found to be more palatal directed than the left premolar (Fig. 1B).

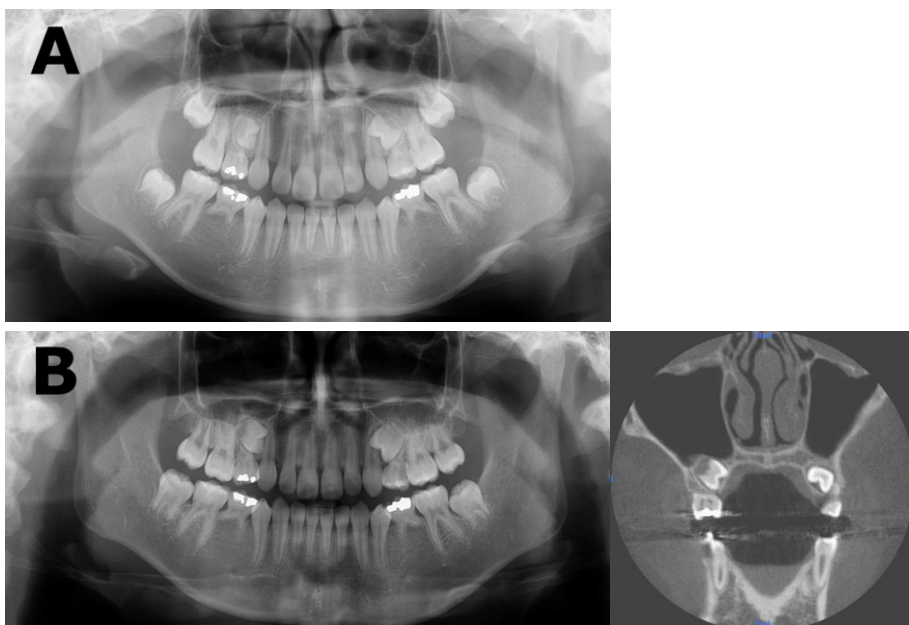


Fig. 1. (A) Initial panoramic radiograph of a 10 years and 9 months old female patient, showing the maxillary second premolars with delayed development and agenesis of maxillary first premolars and mandibular both premolars bilaterally. (B) At age 12 years and 9 months, both maxillary premolars showed slow development. The right panel displays a computed tomography image of the maxillary right second premolar showing palatal ectopic eruption pattern compared to the left premolar.

When the patient was aged 13 years and 5 months, both of the maxillary second primary molars were extracted to promote eruption rate of the premolar, and space maintainers were placed (Fig. 2A). After 4 months, at age 13 years and 9 months, the maxillary left second premolar showed eruption. On the contrary, the maxillary right second premolar had not

erupted even at 12 months after extraction of its preceding primary molar (Fig. 2B). The right second premolar erupted after performing of surgical exposure twice (Fig. 3A, 3B). After 2 months later, at age of 15 years and 1 month, both maxillary second premolars had reached the occlusal plane but showed the rotation of the crown (Fig. 3C).

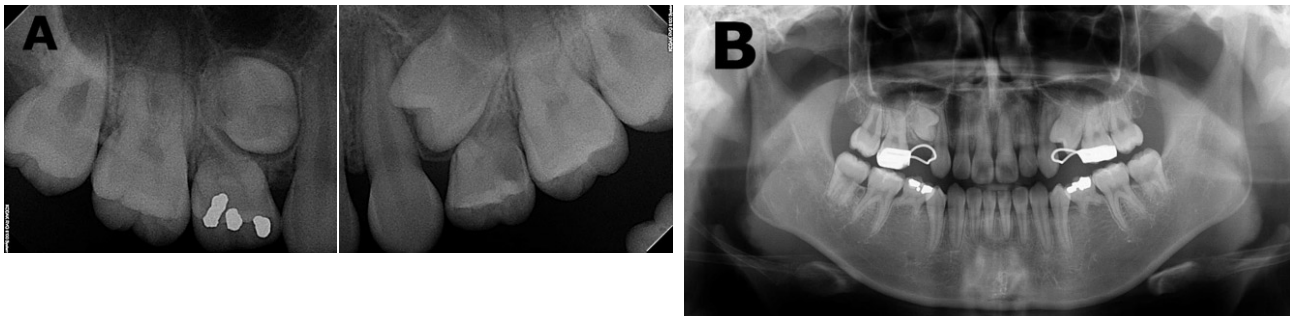


Fig. 2. (A) At age 13 years and 5 months, both maxillary second primary molars were extracted, followed by application of a space maintainer. (B) Four months after extraction of the primary molar at age 13 years and 9 months, the left second premolar began to erupt.

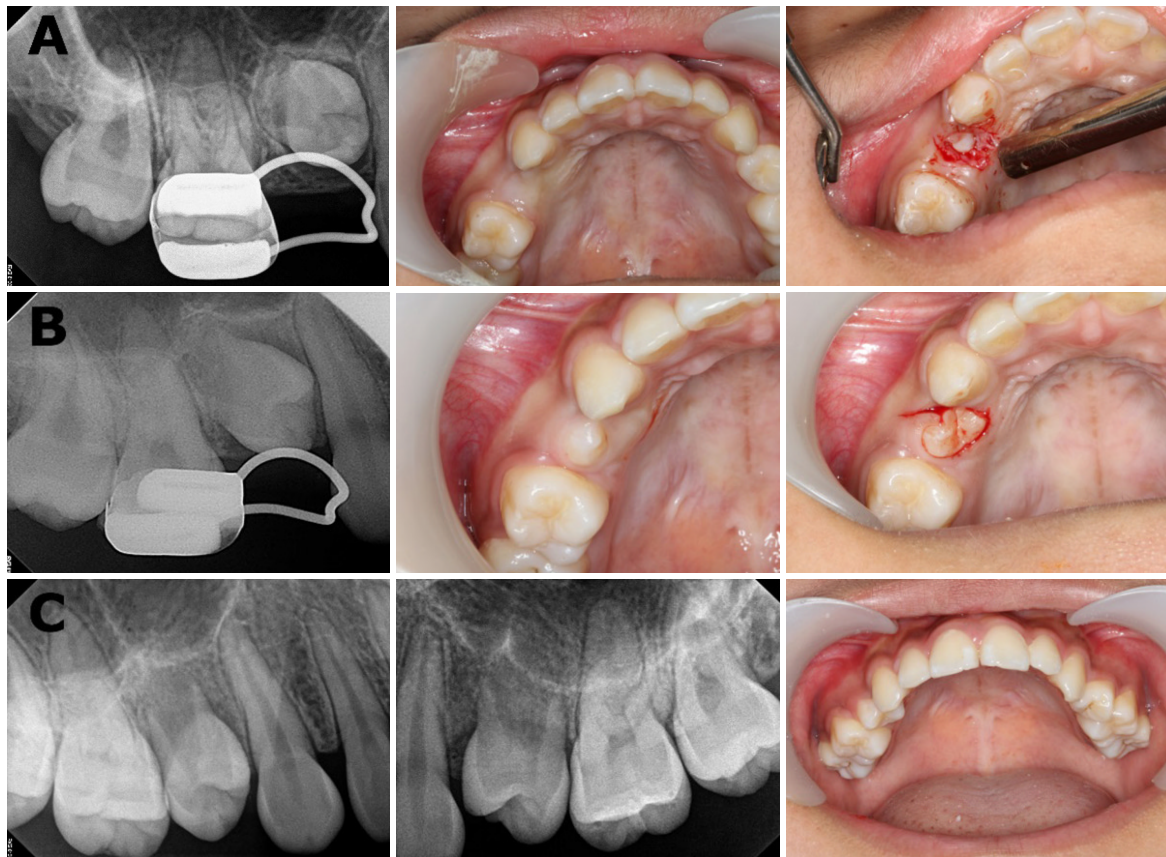


Fig. 3. (A) At age 14 years and 5 months. The first surgical exposure was performed to promote eruption rate and to correct the palatal ectopic position. (B) After 6 months, because only the buccal cusp was observed, surgical exposure was performed again. (C) Two months later, at the age of 15 years and 1 month, the crown was erupted.

2. Case 2

A 5 years and 5 months male patient in the early mixed dentition showed congenital missing maxillary and mandibular second premolars bilaterally, at the initial panoramic radiograph (Fig. 4A). At 9 years of age, the panoramic image revealed congenital missing of mandibular second premolars. In contrast, the calcification of the maxillary second premolars was suspected to be delayed, since the adjacent first premolar completed crown formation and the root formation had begun (Fig. 4B). At age 12 years and 5 months, in a computed tomography scan, both of the maxillary premolar roots formation had begun, and in addition, both premolars were found to be ectopically positioned to the palatal direction (Fig. 4C). At age 13 years and 11 months, premolar development on the right side was more advanced approximately in Moorrees stage R1/2. The maxillary right second primary molar was extracted to enable eruption of the premolar, and space maintainer was placed (Fig. 5A, 5B). One month later, the maxillary right second

premolar had begun eruption (Fig. 5C). Three months after that, the maxillary left second primary molar was extracted. The eruption of both premolars was complete at age 14 years and 11 months (Fig. 5D, 5E).

3. Case 3

A 13 years and 10 months old male patient was presented with delayed eruption of the maxillary left first premolar. The initial panoramic radiograph revealed delayed development of the maxillary left first premolar corresponding to Moorrees stage Cr3/4 and almost exfoliation of the primary molar (Fig. 6). Thus, the primary molar was extracted, and a space maintainer was placed. Eight months after extraction of the primary molar, the buccal cusp of the left first premolar was observed (Fig. 7A, 7B). However, it was at Moorrees stage Ri and showed immature root development, so that complications such as mobility by immature root formation was concerned. Thus, it became necessary to stabilize this immaturely erupt-

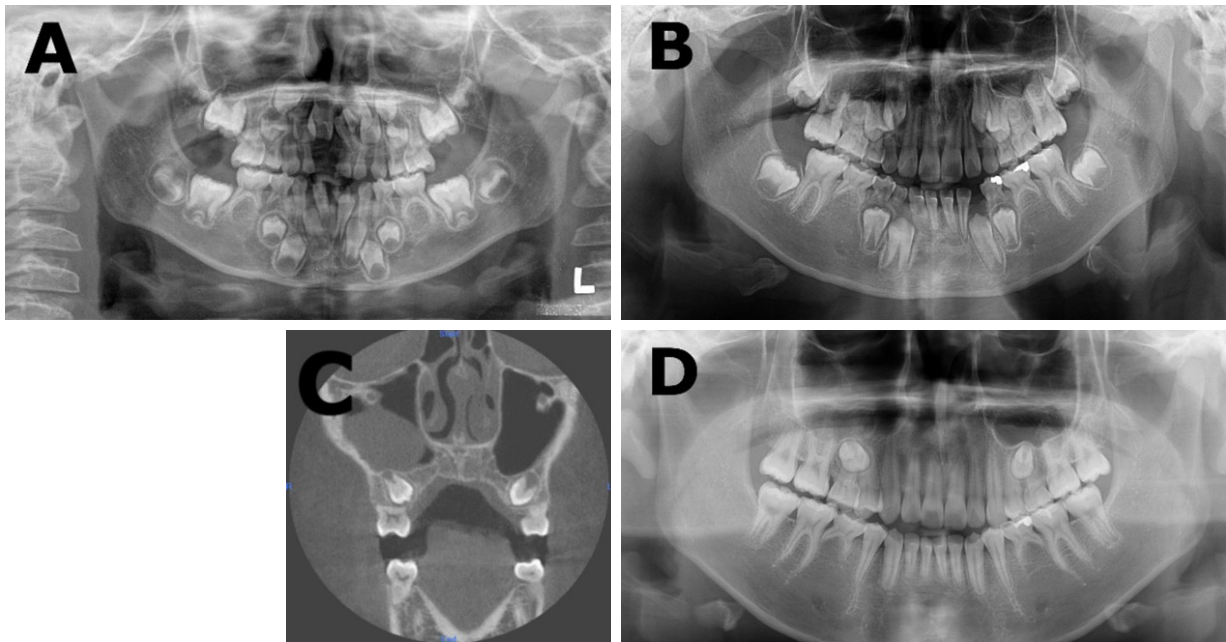


Fig. 4. (A) At age 5 years and 5 months. (B) At 9 years of age. Crown calcification of the maxillary second premolars was observed bilaterally. (C) At age 12 years and 5 month, computed tomography imaging showed palatal ectopic eruption with delayed development of the maxillary second premolars. (D) At age 13 years and 5 months, the panoramic radiograph showed complete crown formation of the both maxillary premolars.

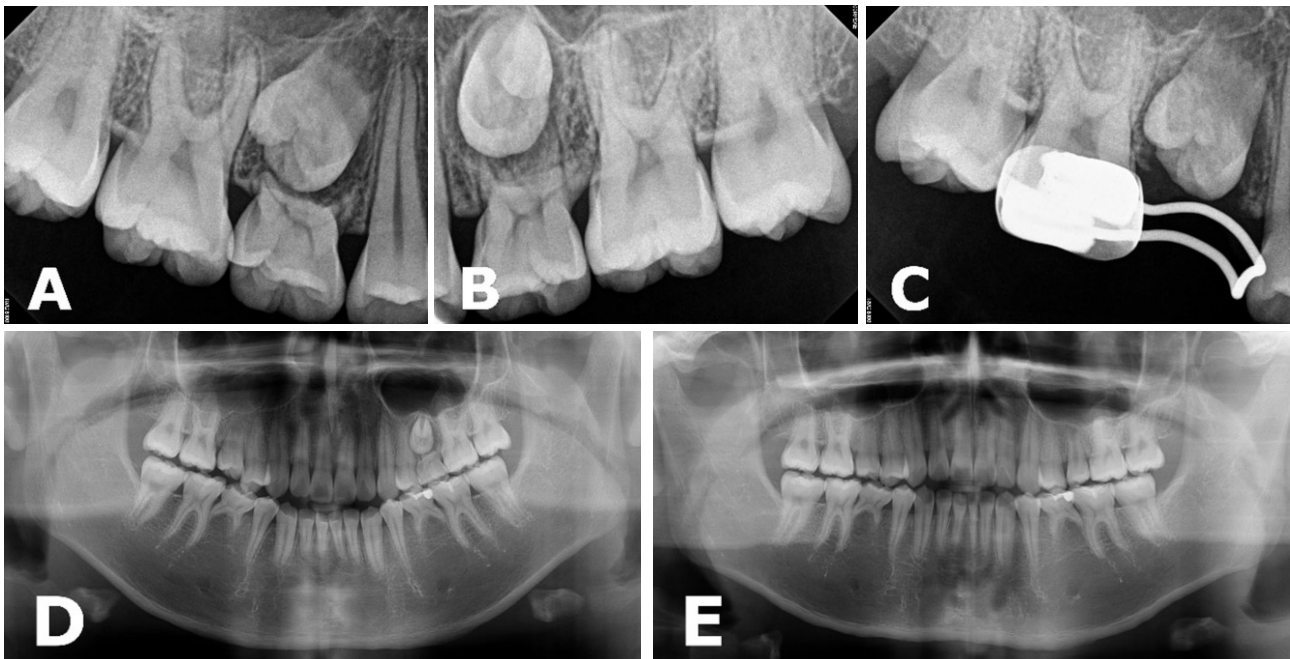


Fig. 5. (A), (B) At age 13 years and 11 months, eruption of the maxillary right second premolar through the bone was near to completion. The right second primary molar was therefore extracted, and a space maintainer was applied. (C) At age 14 years, the right premolar began eruption. (D) At age 14 years and 3 months, the eruption of the maxillary left second premolar was observed, and the left second primary molar was extracted. (E) At age 14 years and 11 months, the eruption was completed.

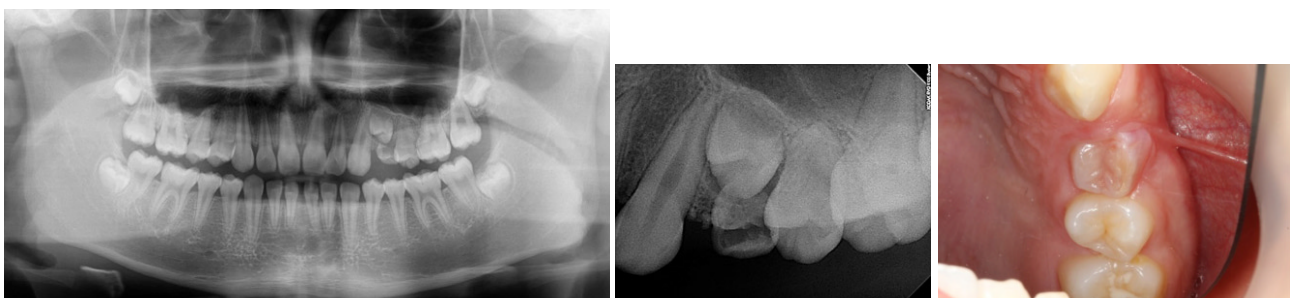


Fig. 6. At age 13 years and 10 months, initial radiographic examination revealed delayed development of the maxillary left first premolar. The maxillary left first primary molar was almost exfoliated.

ed tooth¹⁵⁾. The space maintainer was kept in place without fabricating additional devices because the wire at the palatal side of the applied space maintainer was found to obstruct the erupting tooth (Fig. 7C, 7D). After 15 months, approximately 1/2 of the root development of the maxillary left first premolar was complete, and the device was removed. Thereafter, normal root development was observed (Fig. 7E, 7F).

III. Discussion

Calcification of the maxillary premolars begins at approximately 2 - 3 years of age, and crown formation of maxillary premolars is usually completed at 7 - 8 years of age^{5,21)}. Also, the age of maxillary premolar eruption is 10 - 11 years old⁹⁾. However, the patients in the present study were found to have delayed development and crown formation was not

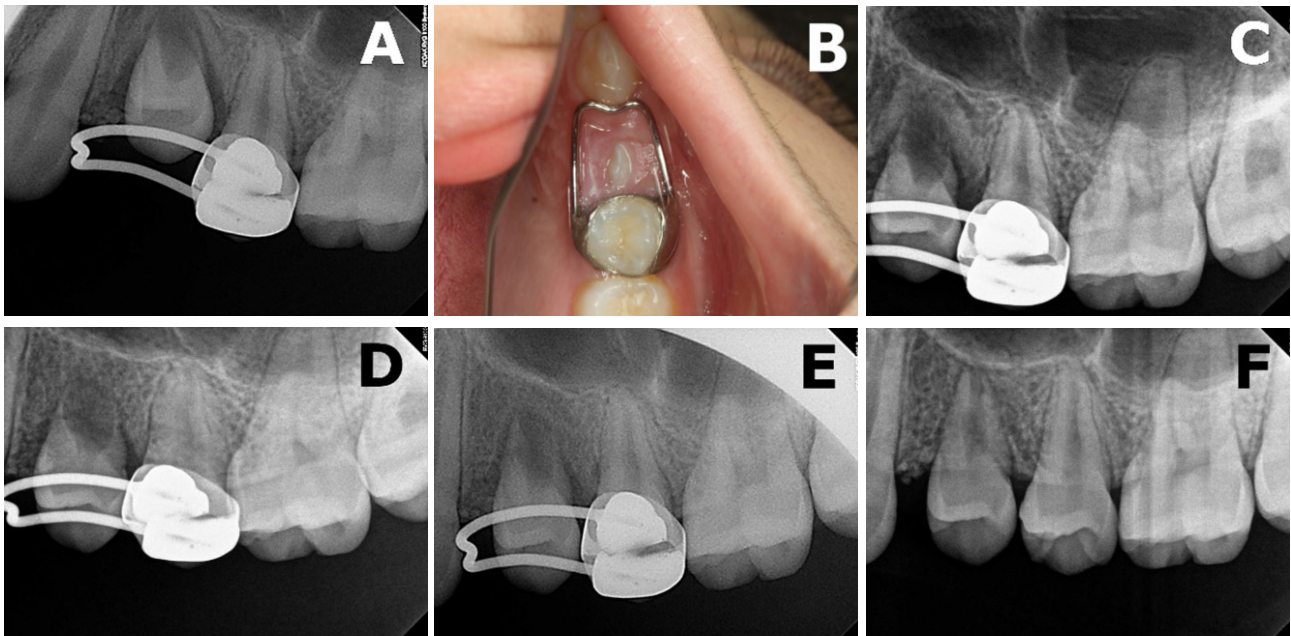


Fig. 7. (A), (B) At age 14 years and 6 months. The maxillary left first premolar had begun eruption. (C) 2 months later, showing initiation of the root formation. (D) At age 14 years 9 months. (E) At age 15 years and 9 months. The tooth formation stage was R1/2 at detection, and the space maintainer was therefore removed. (F) 1 year later, the tooth formation stage was Rc at detection.

complete until 12 – 13 years of age. According to a study on Korean children, the eruptive movement of the premolars within the bone start at the age of 9 – 10 years when root formation is initiated and oral emergence takes place at the age of 10 – 11 years⁶⁾. In the present study, all 5 premolars had delayed in eruption beyond the mean value according to the chronologic age.

Previous reports have described that the diagnosis of congenitally missing second premolars was related to missing or delayed development of other teeth²²⁻²⁴⁾. In addition, the patients with dental agenesis tended to have higher rates of ectopic eruption and abnormal teeth²⁵⁾. In present cases 1 and 2, also showed congenital absence of other premolars, and the premolars with delayed development tended to show ectopic eruption. Thus, these findings coincide well with the previously reported findings that congenitally missing teeth is associated with other dental anomalies.

Among various factors affecting times of tooth eruption, previous studies have shown the correlation with the height of residual alveolar bone, any ectopic eruption pattern of the tooth germ and the presence or absence of a soft tissue barrier^{26,27)}. In case 1, the

maxillary left second premolar erupted 6 months after extraction of the preceding primary tooth, whereas the maxillary right second premolar completed eruption after 22 months including performance of surgical exposure twice. In comparison to the patient in case 1 showing a similar alveolar bone height and ectopic position, the premolar eruption rate of the patient in case 2 was much higher. Although the right premolars in Cases 1 and 2 were both identified approximately as developmental stage R1/2, the root length of the premolar in Case 2 was slightly longer than that of Case 1. This was supposed that even slight differences in root length could result in large variations in eruption rate. Although there are limitations to evaluating root length based solely on a 2-dimensional radiograph, the difference between the root length of Case 1 and 2 could be detected. Thus, these findings suggest that for the eruption after extraction of preceding primary teeth, it is necessary to evaluate the root length, not only the height of residual alveolar bone, any ectopic eruption pattern of the tooth germ and the presence or absence of a soft tissue barrier.

In contrast, delayed tooth development was also

associated with immature tooth eruption. In case 3, the tooth formation stage was Ri at detection and the immature tooth eruption may be attributed by the close positioning of the tooth germ to the alveolar crest. Thus, comprehensive evaluation of both root development and residual alveolar bone may therefore be necessary to evaluate the expected time of eruption of teeth with delayed development.

Methods of eruption guidance include periodic monitoring, space maintenance, surgical exposure, orthodontic traction, a combination of surgical exposure and orthodontic traction, and autotransplantation²⁸⁾. In cases 1 and 2, the eruption guidance was conducted when the eruptive movement was at peak to compensate for late eruption due to delayed development. Interestingly, in present study, the premolars with delayed development tended to erupt when roots were less than half-length. It was implied that the eruption guidance affects the eruption rates or premolars with delayed development have properties of fast eruption.

Limitations of this study included the potential for further orthodontic treatment due to the congenital agenesis or the rotation of the delayed development premolars at the cases 1 and 2, even though the ectopic position was self-corrected. However, it cannot be ruled out that the impaction of the delayed developed premolars is possible due to the prolonged retained primary molars²⁹⁾. Moreover, patients who have dental anomalies due to systemic syndrome such as Pierre Robin syndrome and Down syndrome, behavioral management is a big challenge. And as a result orthodontic treatment is difficult. For this reason, eruption guidance performed in this study was the meaningful treatment for patients who have other dental anomalies and syndromic diseases.

In the present study, follow-up began when crown formation of delayed developing maxillary premolars noted and ended when the teeth were fully erupted. This article demonstrates the value of a flexible and cautious approach to delayed development tooth.

IV. Summary

The present study intended to identify eruption characteristics and complications of maxillary premo-

lars with delayed development. Maxillary premolars with delayed development tended to have delayed eruption with palatal ectopic position, or early eruption due to the closed position of the tooth germ to the alveolar crest. In this study, preceding primary teeth were extracted and space maintainers were applied. The use of space maintainers resulted in the eruption of the premolars with delayed development and self-correction of their positions. Additionally, normal root development was induced by stabilization of the teeth that showed early eruption. The treated maxillary premolar teeth with delayed development showed mild ectopic eruption but no other complications, including impaction, space loss, and insufficient root development.

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