Difference in Bilateral Timing of Eruption of Permanent Teeth

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Abstract

The aim of this study was to obtain basic data that might serve as criteria in the diagnosis of delayed eruption of the permanent teeth. The synchronicity of the eruption of corresponding contralateral teeth was determined. Data were obtained on both the deciduous and permanent dentition based on records made every 2 months at the Department of Pediatric Dentistry of Tokyo Dental College. These data were then used to investigate bilateral differences in the timing of eruption of the permanent teeth. Over 80% of incisors, first molars, mandibular canines, and maxillary first premolars erupted within 4 months of their contralateral counterparts, while this occurred in 75% of maxillary canines, mandibular first premolars, and mandibular second molars, 70% of maxillary and mandibular second premolars, and 65% of maxillary second molars. Bilateral differences in the timing of permanent tooth eruption varied depending on type of tooth, and these differences tended to be smaller for teeth erupting at an earlier point in the order of eruption, and greater for those erupting at a later point. These results suggest that the failure of a contralateral tooth to erupt within 4 months of its counterpart might serve as a criterion in a diagnosis of suspected delayed eruption of a permanent tooth.

Key words: Bilateral differences — Timing of permanent tooth eruption — Bilateral — 4 months

Introduction

The goal of orthodontic treatment during the mixed dentition period is to ensure that maxillofacial and dental growth and development are as normal as possible. The smooth replacement of deciduous teeth by permanent teeth is important if the latter are to be healthy. Problems with eruption of the permanent teeth are categorized as temporal...
abnormalities (early or late eruption), or abnormal position or orientation. When the teeth erupt later than expected, it is generally known as delayed eruption\(^3\). Teeth exhibiting delayed eruption have been defined as those that have not erupted into the mouth, even when a considerable time after the standard timing of eruption has passed; those for which eruption is greatly delayed compared with the contralateral equivalent; or front teeth that erupt late and not in the normal order, eventually leading to abnormal dental occlusion and problems due to incomplete root formation\(^11\). It has been noted that it is difficult to differentiate between impacted and unerupted teeth based on a timescale during the growth period, and that teeth that do not erupt within their normal time frame for a variety of reasons, including tooth shape, position, axis, orientation, and space for eruption, should be regarded as impacted\(^6\). The timing of tooth eruption varies depending on the individual, and differentiating clinically between delayed eruption and impaction is not an easy task\(^5,9\). Impacted teeth also often cause resorption of the roots of the surrounding permanent teeth\(^1,8\) or their displacement, often affecting the occlusal relationship. The early diagnosis and appropriate treatment of delayed tooth eruption is therefore important in preventing them from causing such complications. When making clinical observations of permanent teeth, the eruption of the contralateral counterpart is often used as a criterion. Few studies have clearly addressed the issue of how much time must elapse after eruption of the corresponding tooth before delayed eruption should be suspected, however.

The purpose of the present study was to investigate the timing of permanent tooth eruption based on dental casts derived from the same individuals. The synchronicity of the timing of eruption of corresponding contralateral teeth was determined. We believe that such basic data might serve as criteria in diagnosing delayed eruption of the permanent teeth.

**Materials and Methods**

The study protocol was developed and implemented in compliance with the Helsinki Declaration and with the approval of the Ethics Committee of Tokyo Dental College (Approval No.619).

The study participants comprised children who had undergone a dental examination for 3-year-old at the Koishikawa Health Center in Bunkyo-ku (Tokyo) and children attending the Outpatient Clinic of the Department of Pediatric Dentistry of Tokyo Dental College. A total of 96 children (40 boys and 56 girls) born between December 1968 and January 1974 were enrolled. They were found to have normal deciduous dentition, with no fused, supernumerary, or congenitally missing teeth evident on clinical examination, including panoramic X-rays. None of them had lost a deciduous tooth early due to caries or trauma. At the beginning of the survey, there were 158 participants, with almost the same number of both sexes. Inclusion in the analysis required strict observance of 2-monthly hospital visits, however. This proved too difficult for some, which meant exclusion from the final study population.

Dental casts based on dental impressions obtained, where possible, at 2-monthly intervals during the deciduous dentition period, were examined. Records covering the period from the loss of the deciduous teeth to the eruption of the second molars were also used. Eruption was defined as where a tooth that had previously been absent was present on a model (Fig. 1). Some patients were lost to follow-up partway through, however, so the number of participants varied depending on type of tooth (Table 1). Age at which examination was carried out ranged from 5 years to 19 years 10 months. The timing of permanent tooth eruption was calculated separately for sex and type of tooth and expressed as the mean and standard deviation. Timing and order of permanent tooth eruption were determined together with bilateral synchronicity. The time between the eruption of a tooth on one side and the eruption of its con-
Bilateral Differences in Tooth Eruption

Trilateral counterpart was defined as the bilateral difference. In the statistical analysis, a t-test was used to compare the results between sexes. The Mann-Whitney test was used to compare bilateral differences for corresponding teeth between sexes. The Kruskal-Wallis test and Holm’s multiple comparison were used for comparisons between different types of tooth. The software of EZR (easy R) was used for the statistical analysis.

Results

Table 2 and Fig. 2 show the timing of permanent tooth eruption. A comparison
between sexes revealed that the mandibular canines erupted significantly earlier in girls than in boys. No significant difference was observed in any other type of tooth.

The order of permanent tooth eruption in the maxilla was as follows: first molars, central incisors, lateral incisors, canines, first premolars, second premolars, and second molars (canines and first premolars exhibited an only 0.04-month difference in boys, whereas they erupted at the same time in girls); that in the mandible was central incisors, first molars, lateral incisors, canines, first premolars, second premolars, and second molars.

Table 3 and Fig. 3 show bilateral differences in timing of permanent tooth eruption in each type of tooth. A comparison of these bilateral differences revealed no significant differences between sexes. An investigation of bilateral differences for each type of tooth in the maxilla revealed a significant difference between the central incisors and second molars. In the mandible, significant differences were observed between the central incisors and the first premolars, second premolars, first molars, or second molars; between the lateral incisors and the first premolars or second premolars; and between the canines and the first premolars or second premolars.

A percentage-based comparison of whether eruption had occurred bilaterally in each type of tooth at 2-month intervals was also per-
Table 3  Bilateral differences in timing of permanent tooth eruption by tooth type (Unit: months)

|                | Male                  | Female                | Male                  | Female                |
|----------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                | Right | Left | Right | Left | Right | Left | Right | Left | Right | Left |
| Mean S.D.      | Mean S.D.  | Mean S.D.  | Mean S.D.  | Mean S.D.  | Mean S.D.  | Mean S.D.  | Mean S.D.  | Mean S.D.  | Mean S.D.  | Mean S.D.  | Mean S.D.  |
| U1             | 88.00  | 9.36  | 86.90  | 9.90  | 88.39  | 7.83  | 88.79  | 7.72  | 76.36  | 6.76  | 76.79  | 6.61  |
| U2             | 99.75  | 9.36  | 99.20  | 9.40  | 98.18  | 8.89  | 98.57  | 8.80  | 86.11  | 8.38  | 85.96  | 8.33  |
| U3             | 128.51 | 11.39 | 129.18 | 11.66 | 127.25 | 12.70 | 127.17 | 12.40 | 116.22 | 11.18 | 115.85 | 11.20 |
| U4             | 129.28 | 12.09 | 129.33 | 11.67 | 127.33 | 13.40 | 127.15 | 13.05 | 125.13 | 11.82 | 125.49 | 11.87 |
| U5             | 140.23 | 12.75 | 139.97 | 13.31 | 139.77 | 16.82 | 140.54 | 19.45 | 137.00 | 14.27 | 136.73 | 14.30 |
| U6             | 79.90  | 10.66 | 80.67  | 10.74 | 83.05  | 11.55 | 83.20  | 12.77 | 78.73  | 7.64  | 78.04  | 7.23  |
| U7             | 155.28 | 12.49 | 154.11 | 12.26 | 153.74 | 17.19 | 153.91 | 17.71 | 143.51 | 13.04 | 143.14 | 10.76 |

Fig. 3  Difference in timing of permanent tooth eruption

Equivalent figure was 92.6% for mandibular lateral incisors, 86.5% for maxillary central incisors, 86.5% for maxillary lateral incisors, 80.9% for mandibular canines, 75.0% for maxillary canines, 74.5% for mandibular first premolars, 80.4% for maxillary first premolars, 70.0% for mandibular second premolars, 70.3% for maxillary second premolars, 89.4% for mandibular first molars, 84.0% for maxillary first molars, and 74.4% for mandibular second molars. Maxillary second molars with eruption having taken place bilaterally within 4 months in 65.9%, and within 6 months in 75.6%.
formed. The smallest mean bilateral difference was exhibited by the mandibular central incisors, at 1.02 ± 1.19 months for boys and 1.50 ± 1.58 months for girls, with eruption having taken place bilaterally within 4 months in 99.0% of cases. The equivalent figure was 92.6% for the mandibular lateral incisors, 86.5% for the maxillary central incisors, 86.5% for the maxillary lateral incisors, 80.9% for the mandibular canines, 75.0% for the maxillary canines, 74.5% for the mandibular first premolars, 80.4% for the maxillary first premolars, 70.0% for the mandibular second premolars, 74.4% for the mandibular second molars.

The greatest mean bilateral difference was exhibited by the maxillary second molars, at 3.94 ± 3.78 months for boys and 4.87 ± 5.54 months for girls, with eruption having taken place bilaterally within 4 months in 65.9% of cases and within 6 months in 75.6%.

Discussion

A clinical diagnosis of delayed eruption is made with reference to the mean age for eruption of the tooth concerned and the degree of tooth root formation. One study investigating the relationship between deciduous molars and succedaneous permanent teeth found that root resorption of the deciduous molars was complete and the tooth lost when the succedaneous permanent teeth were half to three-quarters formed. Another study comparing eruption and developmental status in the bilateral dentition noted that panoramic X-ray evidence was important in the early detection of problems with eruption.

1. Timing of permanent tooth eruption

No major differences were observed between the present results and those reported by the Japanese Society of Pediatric Dentistry in terms of the timing and order of eruption of the permanent teeth. In terms of sex differences, a study by the Japanese Society of Pediatric Dentistry found that all the teeth, with the exception of the maxillary first molar, tended to erupt earlier in girls than in boys. This tendency was also corroborated in another study by Iwasawa. In the present study, a comparison between sexes revealed that the maxillary and mandibular central incisors and first molars tended to erupt slightly earlier in boys than in girls, and that all other types of tooth tended to erupt earlier in girls, but this difference was only significant for the mandibular canines.

2. Bilateral differences in eruption

An earlier study investigating teeth other than the second and third molars by observing the status of permanent tooth eruption in the same individual twice a year over 8 years found no bilateral difference in the timing of eruption in either sex.

A study by the Japanese Society of Pediatric Dentistry found that bilateral differences were observed only in the maxillary central incisors and mandibular canines in boys. In the present study, we evaluated successive data obtained every 2 months from the period of the deciduous dentition to that of the permanent dentition. This allowed us to determine individual laterality, which would not have been possible with a cross-sectional study. Over 80% of the maxillary and mandibular central incisors, lateral incisors, first molars, mandibular canines, and maxillary first premolars erupted bilaterally within 4 months, as did 75% of the maxillary canines, 74.5% of the mandibular first premolars, 70.3% of the maxillary second premolars, 70.0% of the mandibular second premolars, and 74.4% of the mandibular second molars. The greatest bilateral difference was exhibited by maxillary second molars, which erupted bilaterally within 4 months in 65.9% of cases, and within 6 months in 75.6%. There tended to be a smaller bilateral difference for teeth erupting at an earlier point in the order of eruption, and a greater bilateral difference for those erupting later in the order.
3. Delayed eruption and impaction

One study collected clinical statistics and reported that incomplete permanent tooth eruption was most common between the ages of 9 and 15 years, and occurred most frequently in the maxillary canines, central incisors, and mandibular second premolars, with the canines often requiring traction \(^{(1)}\). Abnormalities in the eruption of the maxillary canines may cause resorption of the roots of adjacent teeth \(^{(2,10)}\), so diagnostic criteria for their early discovery are important. The mean bilateral differences identified in this study were \(2.60 \pm 2.57\) months for the maxillary central incisors in boys and \(2.18 \pm 2.48\) months in girls; \(3.13 \pm 3.40\) months for the maxillary canines in boys and \(3.40 \pm 3.31\) months in girls; and \(4.00 \pm 4.58\) months for the mandibular second premolars in boys and \(3.12 \pm 2.87\) months in girls. Within 4 months of eruption on one side, the contralateral counterpart had erupted in 86.5% of the maxillary central incisors, 75.0% of the maxillary canines, and 70.0% of the mandibular second premolars. Attention should be paid if a tooth has not erupted within 4 months of its contralateral counterpart, particularly if that type of tooth is known to be prone to impaction or delayed eruption. In such cases, treatment for delayed eruption and impaction should be considered.

**Conclusion**

Bilateral differences in the timing of permanent tooth eruption varied depending on type of tooth. These differences tended to be smaller for teeth erupting at an earlier stage, and greater for teeth erupting at a later stage. In the maxilla, the order of eruption was first molars, central incisors, lateral incisors, canines, first premolars, second premolars, and second molars; while in the mandible it was central incisors, first molars, lateral incisors, canines, first premolars, second premolars, and second molars. Excluding the second premolars and second molars, which come late in the order of eruption, over 75% of teeth had erupted bilaterally within 4 months. These results suggest that the failure of a tooth to erupt within 4 months of its contralateral counterpart might serve as a criterion in the diagnosis of suspected delayed eruption of a permanent tooth.

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