Studies on the Consecutive Survey of Succedaneous and Permanent Dentition in the Japanese Children

Part 9 Retarded Calcification of the Upper and Lower Second Premolars

by

Shoichi ANDO*, Akio SATO*, Yoshiki NAKAMURA*, Shoichi OSHIMA*, Yoshihiko SUZUKI* and Koichi AIZAWA*

1. Introduction

The authors have previously reported their findings of large differences, at the time of succedaneous eruptions, in the amount of roots between the teeth of normal replacement and those suffering from some kind of pathologic lesion[1, 2, 3].

In our study of some 300 individual dental radiographs taken serially for a period of 10 years, we noted that of those teeth which had been normally replaced, a pronounced degree of retarded calcification was apparent in the upper and lower second premolars as compared with other teeth. That is, in the initial examination of these radiographs (subjects ranging in postnatal age from 63 to 74 months) it was usual that, in the majority, the crowns of premolars had been clearly formed[4, 5, 6, 7, 18]. However, calcification of the upper and lower second premolars was observed to have been much retarded, some giving the impression of being mere traces. What was interesting here was the fact that, though calcification of the upper and lower second premolar roots was relatively more retarded, the length of roots at the time of eruption was more or less uniform.

2. Material and Method

By way of study material, 204 children consisting of 111 boys and 93 girls were selectively used, whose upper and lower second premolars had revealed a sufficient calcification prior to 86 postnatal months (normal calcification) or whose radiographs revealed mere traces of the said calcification at 63 to 74 postnatal months (retarded calcification). Cases of some kind of a suppurative lesion in the precursor teeth were carefully eliminated from the samples.

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Table 1 below gives a breakdown of the sample material.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Lower 2nd premolars</th>
<th>Upper 2nd premolars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>24 (30 teeth)</td>
<td>35 (54 teeth)</td>
</tr>
<tr>
<td>Female</td>
<td>27 (39 teeth)</td>
<td>11 (14 teeth)</td>
</tr>
</tbody>
</table>

In the consecutive measurements, notations such as R (length of crown) and C (degree of calcification) were employed and they were compared with data of normally replaced second premolars, the differential being indicated as R/C.

The method of measurement followed the one previously used[1, 2] by OSHIMA, NAKAMURA and others. That is, observational charts were prepared of the teeth in question and their root lengths were duly obtained. In tabulating the findings, the means and standard deviations of R/C for every survey year together with the period of bone eruption were given.

### 3. Findings

The second premolars of normal calcification and those in which calcification was retarded between 7 years of age and 14 years of age were compared on a yearly basis.

Tab. 1 Chronological date of the ratio of root-formation to crown between normal and retarded replacement (R/C), P2

<table>
<thead>
<tr>
<th>Sex</th>
<th>Normal</th>
<th>Retarded</th>
<th>(M±m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>n = 30</td>
<td>n = 39</td>
<td>n = 14</td>
</tr>
<tr>
<td>75</td>
<td>0.01±0.00</td>
<td>0.02±0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>84</td>
<td>0.04±0.01</td>
<td>0.07±0.00</td>
<td>0.01±0.01</td>
</tr>
<tr>
<td>96</td>
<td>0.19±0.02</td>
<td>0.20±0.02</td>
<td>0.06±0.03</td>
</tr>
<tr>
<td>108</td>
<td>0.48±0.04</td>
<td>0.46±0.05</td>
<td>0.20±0.05</td>
</tr>
<tr>
<td>120</td>
<td>0.83±0.05</td>
<td>0.84±0.04</td>
<td>0.42±0.07</td>
</tr>
<tr>
<td>132</td>
<td>1.20±0.07</td>
<td>1.25±0.05</td>
<td>0.63±0.08</td>
</tr>
<tr>
<td>144</td>
<td>1.51±0.07</td>
<td>1.55±0.04</td>
<td>1.00±0.10</td>
</tr>
<tr>
<td>156</td>
<td>1.76±0.04</td>
<td>1.73±0.04</td>
<td>1.34±0.09</td>
</tr>
<tr>
<td>168</td>
<td>1.88±0.04</td>
<td>1.78±0.03</td>
<td>1.57±0.06</td>
</tr>
</tbody>
</table>

* Postnatal Mons.
Tab. 2  Chronological date of the ratio of root-formation to crown between normal and retarded replacement (R/C), $P_2$

$$\text{(M±m)}$$

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th></th>
<th>Retarded</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male n=54</td>
<td>Female n=42</td>
<td>Male n=14</td>
<td>Female n=23</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td>0.03±0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>75</td>
<td>0.07±0.01</td>
<td>0.08±0.01</td>
<td>0.01±0.00</td>
<td>0.02±0.01</td>
</tr>
<tr>
<td>84</td>
<td>0.24±0.02</td>
<td>0.26±0.03</td>
<td>0.03±0.02</td>
<td>0.09±0.02</td>
</tr>
<tr>
<td>96</td>
<td>0.47±0.03</td>
<td>0.48±0.04</td>
<td>0.14±0.03</td>
<td>0.25±0.03</td>
</tr>
<tr>
<td>108</td>
<td>0.71±0.04</td>
<td>0.81±0.04</td>
<td>0.36±0.04</td>
<td>0.52±0.05</td>
</tr>
<tr>
<td>120</td>
<td>0.98±0.03</td>
<td>1.09±0.05</td>
<td>0.59±0.05</td>
<td>0.85±0.06</td>
</tr>
<tr>
<td>132</td>
<td>1.30±0.04</td>
<td>1.36±0.05</td>
<td>0.88±0.07</td>
<td>1.21±0.07</td>
</tr>
<tr>
<td>144</td>
<td>1.52±0.03</td>
<td>1.60±0.04</td>
<td>1.14±0.07</td>
<td>1.48±0.05</td>
</tr>
<tr>
<td>156</td>
<td>1.64±0.03</td>
<td>1.70±0.03</td>
<td>1.35±0.06</td>
<td>1.63±0.03</td>
</tr>
</tbody>
</table>

* Postnatal Mons.

Tab. 3  Ratio of root length to crown at bone eruption, $P_2$

$$\text{(M±m)}$$

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th></th>
<th>Retarded</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Postnatal mons.</td>
<td>125±3</td>
<td>126±2</td>
<td>144±4</td>
<td>132±2</td>
</tr>
<tr>
<td>R/C</td>
<td>0.96±0.06</td>
<td>0.98±0.05</td>
<td>0.98±0.05</td>
<td>0.96±0.05</td>
</tr>
</tbody>
</table>

Tab. 4  Ratio of root length to crown at bone eruption, $P_2$

$$\text{(M±m)}$$

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th></th>
<th>Retarded</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Postnatal mons.</td>
<td>128±2</td>
<td>127±2</td>
<td>139±4</td>
<td>131±3</td>
</tr>
<tr>
<td>R/C</td>
<td>0.86±0.03</td>
<td>0.89±0.04</td>
<td>0.71±0.06</td>
<td>0.83±0.05</td>
</tr>
</tbody>
</table>
basis (Tables 1, 2). Moreover, postnatal months at the time of bone eruption and these R/C ratios were contrasted (Tables 3, 4).

As is revealed by Table 5, even at the final examination (171 to 182 postnatal months) the root formation in calcification retarded teeth was yet unperfected in many cases.

With regard to the lower second premolars, there was no statistical difference between means of normal and calcification-retarded ones at $t(a = 0.01)$. On the other hand, a slight statistical difference was attested to between these two groups of teeth at $\alpha = 0.05$.

Similarly, there was found no sex difference either between the upper and lower second premolars or between respective periods of bone eruption.

### 4. Summary and Discussion

As is shown by Figs. 1 to 4, those second premolars in which calcification was retarded at the initial examination (63 to 74 postnatal months) kept up the same trend in subsequent examination and their root formations were markedly less than normal, the tendency being more pronounced with boys. With boys, these teeth were found to have attained to relatively poor roots even at the final stage of our study (171 to 182 postnatal months). Therefore, it may be reasonably assumed that the same trend would be more or less carried into the subsequent stage of development even though we lack concrete data to substantiate the assumption. Generally speaking, the chronological assessment of the development of individual teeth should be comprehensively made by taking into consideration such factors as the physical stature, weight[8], girdle of chest, bone age[9, 10, 11], sex maturity[12], as well as local factors including pathologic lesions of the root of precursor teeth[13, 14, 15] and effect of dental extraction [16]. Concerning the amount of root formation and eruption of teeth, GRON[17] maintains that the degree of root formation has closer bearings on the eruption of teeth than postnatal or bone age and when a root has been formed.

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### Tab. 5 Root-perfection at final examination

<table>
<thead>
<tr>
<th>Tooth</th>
<th>Normal</th>
<th></th>
<th>Retarded</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>$P_2$</td>
<td>30</td>
<td>39</td>
<td>4</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>39</td>
<td>14</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>$P_2$</td>
<td>54</td>
<td>42</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>42</td>
<td>14</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

Note: * Postnatal mons.; 171–182

In each of the columns a denominator gives the number of teeth under observation and a numerator indicates the numbers of perfected teeth.
by 3/4, a tooth erupts clinically. According to Havvikko[18], the bone eruption is
distinguished from the clinical eruption of teeth and though admitting certain variations
among teeth, a root has been formed by 1/2 at bone eruption and 3/4 at clinical
eruption. The authors hold the view[1] that the average root at the period of normal
replacement process is about 1/2 of what will be at perfection and roughly corre-
sponds to the long diameter of crown. Even if normal calcification is retarded, the
amount of root formation at bone eruption is more or less normal as long as the
precursor suffers from no pathologic lesion of some kind. In other words, even with
successors in which retarded calcification is observed the bone eruption will take
place when the amount of root formed comes to correspond to the length of crown.
This is equally true of the mandible and maxilla.

The mean period of bone eruption of calcification-retarded premolars is as late
as 19 months in boys and 6 months in girls. This discrepancy is more pronounced in
the mandible than in the maxilla.

Hitherto, the growth pattern of human teeth by Massler and Schour[4] has
been accepted as standard. According to this growth pattern, the crown of first pre-
molar begins its calcification in 1 1/2 to 2 years reaching the perfection in 5 to 6 years,
while that of second premolar begins in 2 to 2 1/2 years and reaches the perfection in 6
to 7 years. Therefore, both the beginning and perfection of first premolar is sooner
by one year.

In our present study, however, not a few of the samples in the initial examination
(5 yr. 3 mos. to 6 yr. 2 mos.) were observed to reveal mere traces of calcification of
their roots. On the other hand, no retarded calcification of first premolars to such a
great degree was noted. In addition, a large measure of variation was observed relative
to the degree of calcification of upper and lower second premolars. It follows
then that the above standard data do not necessarily represent reliable information
in clinical environment. The study material of Massler and Schour is not exactly
known and they have drawn on the previous data by Logan and Kronfled[19]. The
latter based their findings on the corpses of children and, for this reason, they cannot
be said to be consecutive or vertical in any sense. Sato and others[20, 21] pointed out
that it was not proper to cite these data as if standard.

On the other hand, the vertical study by Garn, Lewis and Polacheck[6] estab-
lished the existence of large individual variations in the eruption of mandibular pre-
molars and molars, and also pointed lack of recognition of this fact at large. Other
investigators including Fanning[15], Havvikko[18], Kaneda[22], Wada[23], Sato[5]
all used consecutive samples. However, because of different methods of study and
various ways of presenting their data by these researchers, it is not possible to col-
late our own data directly with theirs.
Fig. 1 Comparative Diagram of the Root-formation between Normal and Retarded Replacement M±m

Fig. 2 Comparative Diagram of the Root-formation between Normal and Retarded Replacement M±m
Fig. 3 Comparative Diagram of the Root-formation between Normal and Retarded Replacement M ± m

Fig. 4 Comparative Diagram of the Root-formation between Normal and Retarded Replacement M ± m
Fig. 5 Serial radiograms of the retarded replacement

5ys. 3 mons.  
6ys. 3 mons.  
8ys. 3 mons.  
10ys. 3 mons.  
12ys. 3 mons.  
13ys. 3 mons.  
5ys. 11 mons.  
6ys. 11 mons.  
8ys. 11 mons.  
10ys. 11 mons.  
12ys. 11 mons.  
14ys. 11 mons.

[S]: E, F. Female  
[S]: S, M. Male
5. Conclusions

10-year consecutive radiographs of nearly 300 juvenile subjects collected and housed by the Department of Radiology, Nihon University School of Dentistry, were selectively used to study variations between the amount of normal and retarded calcification of the upper and lower second premolars. The following were salient conclusions obtained as a consequence.

1. The amount of root formation of second premolars in which retarded calcification was apparent particularly from 63 to 74 postnatal months was much less than normal.

2. When these calcification-retarded premolars were compared in terms of the periods of bone eruption, the upper premolars were as late as 19 months in boys and 6 months in girls. With the lower premolars, it was as late as 11 months in boys and 4 months in girls respectively.

3. In common with the upper and lower premolars, the crown-to-root ratio (C/R) at bone eruption gave no statistical difference between the normal and retarded groups.

4. At the final examination after 10 years, calcification-retarded premolars in girls attained more or less to the normal root perfection, whereas those in boys revealed many cases which failed to attain to the normal degree of root perfection. In other words, in the presence of calcification retardation the second premolars in boys take a longer time for the perfection of their roots than in girls.

References