Relationship between Sequence of Exchange of Intact Dentition and Malocclusion

by

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Introductory

In the present study, the author has attempted at looking into the possible states of the succedaneous teeth following the eruption which exchanged for intact deciduous teeth (with particular reference to malposed teeth) and also a relationship between the time interval in their exchange and the occurrence of malocclusions. For the purposes specified, he selected 4,357 intact deciduous teeth out of 6,400 oral models, obtained from 400 individuals, collected over a period of eight years, twice every year. The studies were carried out in regard to the following six items:

1) Sequence and time in which intact deciduous teeth are shed.
2) Sequence and time in which succedaneous teeth erupt.
3) Intervals of exchange and their average time
4) Irregular eruption of succedaneous teeth after intact deciduous teeth have been lost.
5) Intervals of exchange of intact deciduous teeth for succedaneous teeth and their occasional subsequent irregular eruption.
6) Kind of irregularities that occur after the exchange period.

Findings and Considerations

1. Sequence of the Shedding Period of Intact Deciduous Teeth

   a. In men the order is found from lower deciduous central incisor 6.76 yrs. ± 0.03 yrs.), lower deciduous lateral incisor (7.28 yrs. ± 0.04 yrs.), upper deciduous central incisor (7.32 yrs. ± 0.05 yrs.), upper deciduous lateral incisor (8.17 yrs. ± 0.06 yrs.), lower deciduous canine (9.72 yrs. ± 0.06 yrs.), upper first deciduous molar (9.89 yrs. ± 0.08 yrs.), lower first deciduous molar (10.18 yrs. ± 0.10 yrs.), upper deciduous canine (10.26 yrs. ± 0.07 yrs.), lower second deciduous molar (10.86 yrs. ± 0.15 yrs.) to upper second deciduous molar (10.89 yrs. ± 0.09 yrs.). In women the order is from lower deciduous central incisor (6.52 yrs. ± 0.02 yrs.), lower deciduous lateral incisor (6.99 yrs. ± 0.04 yrs.), upper deciduous central incisor (7.01 yrs. ± 0.04 yrs.), upper deciduous lateral incisor (7.69 yrs. ± 0.05 yrs.), lower deciduous canine (8.91 yrs. ± 0.05 yrs.), lower first deciduous molar (9.47 yrs. ± 0.09 yrs.), upper first deciduous molar (9.52 yrs. ± 0.08 yrs.) upper deciduous canine (9.55 yrs. ± 0.06 yrs.), lower second deciduous molar (10.58 yrs. ± 0.12 yrs.) to upper second deciduous molar (10.69 yrs. ± 0.09 yrs.).

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b. When a comparison is struck between men and women, it is found that the shedding takes place much earlier in the latter. Some significance is observed between the two periods with the exception of upper and lower second deciduous molars.

c. Although there is noticed a certain difference between the right and the left of jaws in the same sex, this is not sufficient to constitute any significance.

d. When the average age of the shedding period is compared with the survey of ENISHI\textsuperscript{1} (women only), the age calculated by the author involves a significant difference statistically. In comparison with the survey of HELLMAN\textsuperscript{2} (men and women) the average age for the incisor group is found to occur later while that for the buccal teeth group starts earlier. No statistical significance has been found in this respect.

2. Sequence of Eruption of Succedaneous Teeth

a. With reference to the above order, in men it is from lower central incisor (7.27 yrs. ± 0.03 yrs.), lower lateral incisor (7.89 yrs. ± 0.05 yrs.) simultaneously with upper central incisor (7.89 yrs. ± 0.05 yrs.), upper lateral incisor (9.01 yrs. ± 0.06 yrs.), upper first premolar (10.47 yrs. ± 0.09 yrs.), lower canine (10.54 yrs. ± 0.06 yrs.), lower first premolar (10.91 yrs. ± 0.10 yrs.), upper canine (11.31 yrs. ± 0.05 yrs.), upper second premolar (11.42 yrs. ± 0.09 yrs.) to lower second premolar (11.50 yrs. ± 0.14 yrs.). In women the order starts from lower central incisor (7.05 yrs. ± 0.03 yrs.), lower lateral incisor (7.55 yrs. ± 0.03 yrs.), upper central incisor (7.56 yrs. ± 0.04 yrs.), upper lateral incisor (8.46 yrs. ± 0.04 yrs.), lower canine (9.63 yrs. ± 0.05 yrs.), lower first premolar (10.14 yrs. ± 0.09 yrs.), upper first premolar (10.17 yrs. ± 0.08 yrs.), upper canine (10.43 yrs. ± 0.06 yrs.), upper second premolar (11.25 yrs. ± 0.08 yrs.) to lower second premolar (11.28 yrs. ± 0.10 yrs.).

b. As in the previous case, the eruption in women takes place much earlier than in men. This finding corresponds with those of other researchers.

c. There has been noticed no significant difference between the right and the left of jaws within the same sex.

d. When the author's findings are contrasted with those of OKAMATO\textsuperscript{3}, TSUTSUMI\textsuperscript{4,5}, these are somewhat late in eruption with the exception of certain teeth. Compared with those of HELLMAN, the author's figures are later for the incisor group and earlier for the lateral teeth group. The figures collected by the author seem to erupt later than those by HURME (given by TSUTSUMI).

3. Time Intervals in Exchange and their Average Time

A. Time intervals in exchange:

a. The majority of exchange takes place within 0–0.5 year and the next group falls in 0.5–1.0 year. The majority in men is lower central incisor with 94.2% and the minority is upper canine with 44.53%. On the other hand, in women the majority is lower central incisor with 94.87% and the majority for upper canine being 49.11%.

b. Within a period of 0.5–1.0 year, more than 90% of teeth are more or less exchanged. However, upper lateral incisors, canines and lower canines are rare in men while upper lateral incisors and canines are rare in women.

c. The shortest interval for the exchange is 0–1.0 year and the longest one sometimes requires four and half (4.5) years before the completion of exchange.

d. Although the difference in sex is by no means pronounced, the exchange sets in somewhat earlier in women than in men.

B. Average time of exchange periods:

a. In the numerical order the following average time are given:
180

<table>
<thead>
<tr>
<th>Man</th>
<th></th>
<th>Women</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower central incisor (0.52 yr.)</td>
<td>Lower central incisor (0.53 yr.)</td>
<td></td>
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</tr>
<tr>
<td>Upper 2nd premolar (0.53 yr.)</td>
<td>Upper central incisor (0.55 yr.)</td>
<td></td>
<td></td>
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<tr>
<td>Upper central incisor (0.57 yr.)</td>
<td>Upper 2nd premolar (0.56 yr.)</td>
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<td></td>
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<tr>
<td>Upper 1st premolar (0.58 yr.)</td>
<td>Lower lateral incisor (0.56 yr.)</td>
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<tr>
<td>Lower lateral incisor (0.61 yr.)</td>
<td>Upper 1st premolar (0.65 yr.)</td>
<td></td>
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</tr>
<tr>
<td>Lower 2nd premolar (0.64 yr.)</td>
<td>Lower 1st premolar (0.67 yr.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower 1st premolar (0.73 yr.)</td>
<td>Lower 2nd premolar (0.70 yr.)</td>
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</tr>
<tr>
<td>Lower canine (0.82 yr.)</td>
<td>Lower canine (0.72 yr.)</td>
<td></td>
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</tr>
<tr>
<td>Upper lateral incisor (0.84 yr.)</td>
<td>Upper lateral incisor (0.77 yr.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper canine (1.05 yrs.)</td>
<td>Upper canine (0.88 yr.)</td>
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<td></td>
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</tbody>
</table>

b. The above table enables one to conclude that the median value for men is from 0.52 year to 1.05 years and from 0.53 year to 0.88 year for women respectively.
c. These figures definitely establish the fact that the average exchange period in men is of longer duration than in women.
d. When a comparison is taken between upper and lower jaws, it is found that longer intervals occur in central incisor, lateral incisor and canine of the upper jaw, and in the first and second premolars of the lower.
e. With reference to the difference in sex, upper canine, upper lateral incisor, lower canine and lower first premolar of men have the larger median values. On the other hand, the larger median values are found in upper canine, upper lateral incisor, lower canine and lower second premolar of women.

4. Maldevelopment of Succedaneous Teeth of Intact Deciduous Teeth
   a. The frequency of maldevelopments seen in connection with the succedaneous teeth is found to be $23.66\% \pm 0.64\%$.
b. The frequency for men is $22.41\% \pm 0.91\%$ and that for women is $24.87\% \pm 0.91\%$, no significant difference being noticed between the two.
c. The breakdown of frequencies for each jaw is as follows:

<table>
<thead>
<tr>
<th>Men</th>
<th></th>
<th>Women</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper jaw</td>
<td>26.97% ± 1.35%</td>
<td>30.93% ± 1.35%</td>
<td></td>
</tr>
<tr>
<td>Lower jaw</td>
<td>17.64% ± 1.18%</td>
<td>18.05% ± 1.19%</td>
<td></td>
</tr>
</tbody>
</table>

As can be known from these figures above, there is a significant difference between upper and lower jaws in both sexes, with the prominent occurrences in upper jaw.
d. Statistically it is determined that maldevelopments take place more frequently in the anterior teeth region of both sexes.
e. In terms of each tooth, upper central incisors in men suffer from maldevelopments most frequently with $38.01 \pm 3.27\%$, the infrequent occurrence being in lower central incisors with $10.63\% \pm 3.27\%$. Likewise, in women the most frequent occurrence is in upper lateral incisors with $36.06\% \pm 2.93\%$, next is in upper central incisors with $36.04\% \pm 2.93$ and the least is in lower central incisors with $13.25\% \pm 2.22\%$.
f. With reference to the occurrence of maldevelopments, no significant difference has been found between sexes. The same applied to the right and left.
g. When a tooth in the upper jaw is contrasted with one that is in the identical position in the lower jaw, the upper teeth show a higher frequency than the lower in common to men and women. An exception applies to the 2nd premolars in women. However, there exists no significant difference except the central incisor ($7.00>3$) in men.
and central incisor (5.98 > 3), lateral incisor (3.44 > 3) and canine (5.25 > 3) in women.

5. Time Intervals between the Exchange of Deciduous and Succedaneous Teeth
   a. The longest and the shortest of the median values for the exchange of each
tooth are 1.05 years for upper canines and 0.52 year for lower central incisors respectively.
   However, the frequency of maldevelopments is not influenced by the length of time in
exchange.
   b. But when a tooth exchanges over a long period well beyond the median value,
it tends to some maldevelopment in most cases.
   c. The above statement is particular true in regard to upper canines and lower
premolars which have a long exchange interval.

6. Classification of Maldevelopments seen Subsequent to the Exchange
   a. The cases of frequent occurrence include the distal rotation (8.19% ± 0.41%),
mesial rotation (8.08% ± 0.41%), labial inclination (3.21% ± 0.26%), lingual version
(2.04% ± 0.22%) and Labial transposition (1.45% ± 0.17%). Others show quite low
frequency percentages. With reference to the mesial rotation, there is found no significant
difference between upper and lower jaws whereas the reverse in true of the distal rotation
between the two. Upper distal rotation is more frequent than in the lower with 3.98
> 3 from men and 4.48 > 3 for women respectively. There is found a significant
differences between the two.
   Cases of the labial inclination are found to a larger extent in women than in men
with a significant difference of 3.57 > 3. When upper jaw is compared with lower,
more cases occur in the former in common to men and women. No significant
difference has been determined concerning the lingual version in terms of sexes, upper
and lower jaws. In regard to the labial version a comparison between upper and lower
jaws gives 3.62 > 3 for men 2.63 > 3 for women respectively.
   b. Classification of maldevelopments for each tooth
   (i) Mesial rotation :
   (Men)
   Upper central incisor 11.31% ± 2.13% (Maximum)
   Upper 1st premolar 1.08% ± 0.76% (Minimum)
   (Women)
   Lower lateral incisor 13.18% ± 2.11% (Maximum)
   Upper 1st premolar 5.15% ± 1.59% (Minimum)
   (ii) Distal rotation :
   (Men)
   Upper 1st premolar 18.38% ± 2.85% (Maximum)
   Lower central incisor 2.89% ± 1.17% (Minimum)
   (Women)
   Upper 2nd premolar 13.46% ± 2.73% (Maximum)
   Lower central incisor 1.28% ± 0.73% (Minimum)
   (iii) Labial inclination :
   (Men)
   Upper central incisor 14.48% ± 2.37% (Maximum)
   (Women)
   Upper central incisor 19.82% ± 2.68% (Maximum)
   (iv) Lingual inclination :
   Cases of the lingual inclination are comparatively rare and a few occurrences have
been found in the anterior and premolar regions.

(v) Mesial inclination:
This case is also of rare occurrence and just a few developments in the anterior teeth region have been noted.

(vi) Distal inclination:
Practically no case of the distal inclination is found. The reason may be attributed to the number of samples collected.

(vii) Labial version:

\[
\begin{align*}
\text{(Men)} & \\
\text{Upper canines} & 10.27\% \pm 1.80\% \\
\text{(Women)} & \\
\text{Upper canines} & 5.36\% \pm 1.23\% \\
\end{align*}
\]

(viii) Lingual version:
Fairly high frequency is found in the upper and lower lateral incisors in common to both sexes.

\[
\begin{align*}
\text{(Men)} & \\
\text{Lower lateral incisor} & 8.36\% \pm 1.63\% \\
\text{(Women)} & \\
\text{Upper lateral incisor} & 6.32\% \pm 1.48\% \\
\end{align*}
\]

(iv) Transposition:
Cases of transferred teeth are not found may be due to the number of samples collected.

c. Maldevelopments for each tooth
(i) Rotation (mesial, distal) is noticed both for upper and lower.
(ii) Of the maldevelopments of upper central incisors, the highest is the labial inclination with 38.09\% \pm 5.30\% for men and 55.00\% \pm 5.56\% for women respectively. In regard to lower central incisors, the highest maldevelopment is the mesial rotation with 59.09\% \pm 3.32\% for men and 58.06\% \pm 8.86\% for women respectively.
(iii) The lingual version is most frequently noticed with reference to lower lateral incisors.

(iv) It has been established that upper canines in common to either sex are most susceptible to the labial version.

(v) Cases of distal rotation are frequently found in upper 1st premolars in common to either sex.

(vi) The distal rotation is much frequently found in connection with upper 1st and 2nd premolars, and likewise the mesial rotation is frequently found in lower 1st and 2nd premolars.

(vii) It is an interesting fact that the cases of distal rotation as described in (v) are concentrated on upper premolars, while those of mesiol rotation as described in (vi) are more or less concentrated on lower premolars.

d. Relations between respective exchange intervals
(i) When an interval of exchange is of long duration, most cases of maldevelopment are found in upper canines, with lower 1st and 2nd premolars coming up next in order. And the labial version occupies the prominent rank in the former and buccal versions and lingual inclinations in the latter.

(ii) However, the labial version of upper canines is liable to an occurrence irrespective of the length of exchange intervals. An exception was observed in women
within 1.5 to 2.0 years and 3.5 to 4.0 years.

(iii) The fact that the lingual version of lower lateral incisors tends to take place even if an exchange interval is shorter than that of upper lateral incisors, can be ascribed to the locational relation of these teeth. Therefore, it is not to be influenced by the length of exchange intervals.

The findings of the present study given above can be summarized as follows: When an exchange interval lasts longer, it is liable to give rise to various maldevelopments on the part of succedaneous teeth. For this reason, it is imperatively necessary that dentists should try to find out the period most fit for exchange and exercise efforts to induce the early completion of exchange. This will prove useful in checking possible occurrence of maldevelopments and thus lead to the prevention of malocclusion.

A part of the foregoing paper was read before 1959 General Session of Japan Orthodontic Society held in Hokkaido from July 11th to 12th.

References

2) HELLMAN, M.: Nutrition, Growth and Dentition, Dental Cosmos, 65, 34 (1923)