OBSERVATIONS ON TWO CASES OF CHANGE IN THE DENTAL ARCH AND OCCLUSION DURING THE PERIOD OF CHANGING DENTITION

BY

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ABSTRACT

The object of this study was to know what changes take place on the dental arch during the changing dentition. For this purpose, two excellent cases were observed from six to twelve years of age, and the following results were obtained from its observation.

Enlargement of dental arch was observed till the shedding of the deciduous second molar. In the anterior segment, not only the increment of the arch width but also the labial inclination and/or movement of the permanent incisors was noted in conjunction with the eruption of these teeth. These tendencies were slightly observed during the eruption of the permanent canine.

In the buccal segment, the space for the permanent buccal teeth increased during the time of eruption of the permanent canine and first premolar, and this increase made it possible for these teeth to align normally.

INTRODUCTION

In pedodontic region, one of the most important objects is the guidance of the permanent dentition. In this country, however, there are over 18% of all children in need of orthodontic treatment1. The best way to meet this responsibility is by prevention. For that purpose, it is important to know the process of the alignment of the permanent teeth. Based on this point of view, the present study was undertaken to know what changes take place during the period of changing dentition. In this study, two excellent cases were observed for a period of 6 to 12 years of age.

MATERIALS AND METHODS

A longitudinal study was made on 305 Japanese elementary school children in Tokyo from 1963 to 1970. From these children, two cases were selected under the following conditions.

1) Normal occlusion in deciduous and permanent dentition.

2) No caries activity on the interproximal surface of the deciduous buccal teeth.

Study casts were made from alginate impressions semiannually for six years. An evaluation of alignment was made according to the methods described by Massler2, Lundström3, and Kirk4.

For the observation of changes on dental arch during the traditional dentition, following measurements were taken from dental casts of the individual series.

1) Mesiodistal crown-diameters of the deciduous and permanent teeth.

2) Eight dimensions on the dental arch:
   (1) Arch Circumference (I): The arch
distance from the mesial surface of the permanent first molar around the arch over the contact points and incisal edges in a smoothed curve to the mesial surface of the permanent first molar of the opposite side.

(2) Arch Circumference (II): The arch distance from the mesial surface of the deciduous canine (or permanent one) around the arch over the contact points and incisal edges in a smoothed curve to the mesial surface of the deciduous canine (or permanent canine) of the opposite side.

(3) Arch Length: The midline distance from a point midway between the central incisors to a tangent touching the mesial surfaces of the permanent first molars.

(4) Inter-canine Width: The distance between canines, the minimum breadth opposite the point of the cusp.

(5) Inter 6-molar Width: The distance between the deepest point of the lingual survival margin of the permanent first molars.

(6) Buccal Arch Length: The linear distance from the distal surface of the permanent lateral incisor to the mesial surface of the permanent first molar.

(7) I.D.-2d.: The linear distance from the lingual interdental papilla of the central incisors to the distal surface of the permanent lateral incisor.

(8) I.D.-6m.: The linear distance from the lingual interdental papilla of the central incisors to the mesial surface of the permanent first molar.

These measurements were made with a sliding caliper to an accuracy of 0.05 mm and with a fuse wire.

Finding and Discussion

Many reports have been made on the growing dentition[5-12]. However, most of these reports described the average growth. The present report is a longitudinal observation of the individual series of the dental arch, same as the reports of Sillman[10] and Sanin[12].

1. Dental Arch

Fig. 1 shows the dimensional changes on the dental arch. In maxilla of both cases, the arch circumference (I) increased with eruption of the permanent incisors, canines, and first premolars, and decreased thereafter. The arch length changed in the same manner as the arch circumference.

In mandible, the dimensional changes were in the same pattern as those in maxilla. However, the arch circumference (I) and arch length at the last observation were less than those at the beginning. These may occur by reason of the fact that the difference between the mesiodistal widths of the deciduous teeth and their successors in mandible is larger than that in maxilla.

Inter 6-molar width increased slightly before the emergence of the second premolar and decreased thereafter.

1) Anterior Segment

Fig. 2 presents the changing patterns in anterior segment. In both jaws, the inter-canine width and the arch circumference (II) increased in conjunction with the eruption of the permanent incisors. These findings are the same as those reported by Moorrees[13]. The inter-canine width increased during the eruption of the permanent incisors and no change after the emergence of the permanent canine. The amount of increment of the arch circumference (II) was larger than that of the inter-canine width. This suggests that the anterior teeth inclined and/or moved labially during the eruption of these teeth, as described by Higley[14], Iizuka[15], and Sasa[16].
On the Case 1 shown in Figs. 2 and 3-A, the arch circumference (I) and inter-canine width in maxilla increased at the shedding of the deciduous central incisor, and the slight crowding on the right side was noted at the emergence of the permanent lateral incisor. When the permanent canine appeared, this crowding was not observed. At this time, the circumference (I) was at the maximum.

Fig. 3-B shows the alignment of the anterior teeth in the mandible of Case 1, and the slight crowding that appeared at the emergence of the permanent lateral inci-
sors. At this period, the lack of space for the permanent incisors was about 0.7 mm. After that, the space for the alignment of these teeth increased and the crowding disappeared. Additional space between the deciduous canine and the permanent lateral incisor on the left side appeared. It may be considered that the causal factors for this space are the increase on the anterior segment and the secondary space of the eruption of the permanent canine.

The decrease in the arch circumference (II) depended on the closure of the space in the anterior segment.

2) Buccal Segment

The linear distance from the distal surface of the lateral permanent incisor to the mesial surface of the first molar is called the buccal arch length\(^{17}\)). It is considered that this distance gives the available space for the permanent buccal teeth.

On the changing patterns of the buccal arch length shown in Figs. 4 and 5, the increase was mainly observed during the period of eruption of the permanent canine and first premolar, and the decrease was noted through the replacement of the deciduous second molar by the permanent successor. Broadbent\(^{18}\) reported the dimensional changes like these in the buccal arch length.

Fig. 6 shows the appearance of the alignment of the permanent buccal teeth on the left side of upper jaw of Case 1. The buccal arch length decreased at the cusp eruption of the permanent canine. At this time, I.D.-2d. increased slightly (Fig. 4-A). Therefore, it can be considered that
this decrease in the buccal arch length depended on the distal inclination of the permanent lateral incisor. The buccal arch length increased in conjunction with eruption of the permanent canine and first premolar. This increase made it possible for these teeth to align normally. Since the slight increment of ID.2d. was noted at the eruption of the permanent second premolar, the transient distal inclination and/or movement of the permanent lateral incisor took place. Therefore, if the crowding is present in the anterior segment, this distal movement of the lateral incisor may dissolve the anterior crowding during the replacement of the deciduous second molar by the permanent one. This finding is the same as reported by Moorrees311.

I.D.6m. increased before eruption of the second premolar. This is the same finding as described by Sillman109.

Fig. 7 shows the process of alignment of the buccal teeth in mandible on the right side of Case 1. The buccal arch length increased during the period of eruption of the permanent canine and first premolar. In this case, even though the amount of the leeway space, or the difference in the sum of crown diameters in buccal segment between the deciduous and the permanent
was 1.70 mm, the buccal arch length increased during the period of eruption of the permanent buccal teeth.

2. Occlusion

In the present report, the terminal planes of each case were vertical. In the case shown in Fig. 8, the cusp-to-cusp relationship of the permanent first molar remained till the shedding of the deciduous second molar, and the neutral molar relationship was observed thereafter. In this case, the permanent first molar migrated mesially by the amount of the difference between the crown diameter of the deciduous second molar and its permanent successor.

3. Prediction

In order to guide the dentition, it is important to predict the permanent dentition, especially the space needed for the permanent buccal teeth. Therefore, some prediction methods were applied to the present cases. Though there are many methods of mixed dentition analysis\(^{18-25}\), Moyers's method\(^{24}\) and Ono's method\(^{25}\) were tried in this study. As shown in Table 1, predictions by both methods were...
nearly the actual length. Predictions by Moyers’s method were slightly larger than those by Ono’s methods.

The maximum buccal arch length during the changing dentition in each case was 2 to 3 mm larger than the actual length. The increase of the buccal arch length during the changing dentition is useful in the guidance of the permanent buccal teeth, especially in the case of a premature loss of the deciduous buccal teeth. At present, however, it is difficult to predict this increase. Therefore, further study on this prediction of increase in the buccal arch length is necessary, as well as the prediction of the space for the permanent buccal teeth.

**Conclusion**

In order to know how the permanent teeth align normally, a longitudinal observation was made on individual series of two excellent dental arches, and following results were obtained:

Enlargement of dental arch was observed till the shedding of the deciduous second molar. In the anterior segment, not only the increment of the arch width but also the labial inclination and/or movement of the permanent incisors was noted in con-
Fig. 8. Changes in occlusion (Case 1-right)

junction with eruption of these teeth. These tendencies were slightly observed during the eruption of the permanent canine.

In the buccal segment, the space for the permanent buccal teeth increased during the time of eruption of the permanent canine and first premolar, and this increase made it possible for these teeth to align normally.

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REFERENCES

7) Clindl, L. M.: An analysis of serial models

<table>
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<td></td>
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<td>20.25</td>
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Ono (1): $Y=0.421(21)12 + 9.03$
Ono (2): $Y=0.573(21)12 + 9.02$
Moyer: 75% level
Buccal Arch Length: Maximum amount during the changing dentition


