A ROENTGENOCEPHALOMETRIC STUDY OF THE MANDIBLE OF JAPANESE CHILDREN

BY

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ABSTRACT

Growth of the mandible of the Japanese children was investigated through amount of annual change of the mandibular length which was defined by J. E. Harris on lateral cephalometric roentgenograms. Obtaining peculiarity of growth of the mandible in Japanese, a comparative study was done on growth of the mandible between Japanese and American. The materials used in the present study were 523 sheets of cephalometric roentgenograms of children which covered a range of ages from 6 to 12 years.

The mandibular length of the Japanese male sample, at each age, surpassed those of the Japanese female sample. The total growth increment from the ages of 6 to 12 years was 18.1 mm. in the Japanese male sample and 19.1 mm. in the female sample. The pronounced growth deceleration which was observed in the American sample as a preadolescent growth deceleration was irrecognizable in the Japanese sample. The similarity of the periodicity of the mandibular pattern which was elucidated between the male and female samples in the American, reported by J. E. Harris, was not observed in the Japanese.

The present study should be expanded to a higher range of ages, in order to have more available informations for mandibular growth prediction.

INTRODUCTION

Growth of the facial bones is closely concerned with orthodontic diagnosis, prevention, treatment plan, treatment and prognosis. Among the facial bones, only the mandible is regarded as a endochondral bone[1]. The manner of growth of the mandible, therefore, is different from that of the other facial membranous bones.

The studies on growth of the human mandible by means of seiral cephalometric roentgenograms have been reported by many investigators, e.g. Nanda[2], Björk[3], Sakamoto et al.[4], Harris[5] and Maj et al.[6].

Harris[5] (1962) has done a cross-sectional study on growth rate of the mandibular length of the children in Michigan, using serial headplates. He has demonstrated standard growth patterns, and indicated two interest-

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ing points as follows:

(1) In the female sample, a remarkable deceleration of growth rate of the mandibular length was observed between the ages of 8 and 9 years. On the other hand in the male sample, the deceleration was observed between the ages of 9 and 10 years.

(2) The periodicity of the growth pattern of the male sample was twelve months out of phase with the female sample.

The investigation which follows in Harris' method should be considered in a Japanese sample. The comparative study of mandibular growth between Japanese and other races may contribute much to successful orthodontic treatment of some kind of malocclusion, especially "Anterior Crossbite" which has been reported to be seen more in Japan than in the United States[7].

Materials

The materials used in the present study were the serial cephalometric roentgenograms of the children of an elementary school in Tokyo. These roentgenograms of an individual were taken twice every year, in spring and autumn. Since the present study dealt with annual growth, the headplates which were taken at the closer days to the birthday of an individual every years were selected. Table 1 demonstrates the distribution of the sample. The present study covered a range of the ages from 6 to 12 years. Throughout the study, 523 headplates were used.

Table 1. Distribution of Materials

Age in Years	6	7	8	9	10	11	12
Male	31	45	45	45	45	39	25
Female	22	40	41	41	41	38	25

Method

All tracings from the serial headplates were made according to Harris' method. Fig. 1 illustrates the method of deciding the mandibular length on the tracings. A line CD was drawn through each mid-point of cross-lines of the widest and narrowest parts of the condylar process. Where the line CD intersects the outline of the condylar head, the point A was determined. The point B was decided to be the farest point from the point A on the outline of the symphysis. The length of the line AB was measured in millimeter as the mandibular length. At each age, the mean and standard

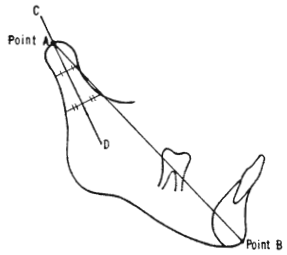

Fig. 1. The method deciding mandibular length by J. E. Harris.

deviation of the mandibular length were obtained for both the male and female samples. The significancies of difference between the values of each adjacent age, and between the male and female at each age were examined. Percentage increments of the mandibular length were computed for every year, using the following formula established by Nanda[2]:

$$\frac{Y_2-Y_1}{\frac{Y_1+Y_2}{2}}\times 100\,,$$

where Y_1 is the value at the beginning of each established stage and Y_2 is at the end of the stage.

Findings

Table 2 demonstrates the resultant data from measurement of the mandibular length and the calculation of the data at each age by sex. Significant differences of each adjacent group of ages were found in the samples. Significant sex differences were, likewise, found except at the age of 12 years.

Table 2. Summary of Data: Mandibular Length

Age in Years	Male			S*	S**	S*	Female		
	Number of Materials	Mean mm.	S.D. mm.				Number of Materials	Mean mm.	S.D. mm.
6	31	97.6	4.2		+		22	94.6	3.8
7	45	100.2	4.5	+	++	+	40	97.4	4.2
8	45	103.3	4.8	++	++	++	41	100.4	4.2
9	45	106.4	4.7	++	++	++	41	103.2	4.4
10	45	108.9	4.9	+	++	++	41	106.0	5.0
11	39	111.8	5.9	+	+	+	38	108.7	5.5
12	25	115.7	6.3	+	—	++	25	113.7	5.4

S*: Significancy of difference between values of each adjacent age.
S**: Significancy of difference between male and female.
S* and S** are signified by ++ (in the level of significance 1%) and + (in the level of significance 5%)

Figures 2 and 3 show the growth curve of the mandibular length in the Japanese male and female samples, respectively. The arithmetical progressive growth curve of the mandible were observed from the ages of 6 to 11 years, while the acceleration of growth curve were observed from the ages 11 to 12 years in both samples. At each age, the values of the male sample surpassed those of the female sample. The total growth increments from the ages of 6 to 12 years were 18.1 mm. in the male sample and 19.1 mm. in the female.

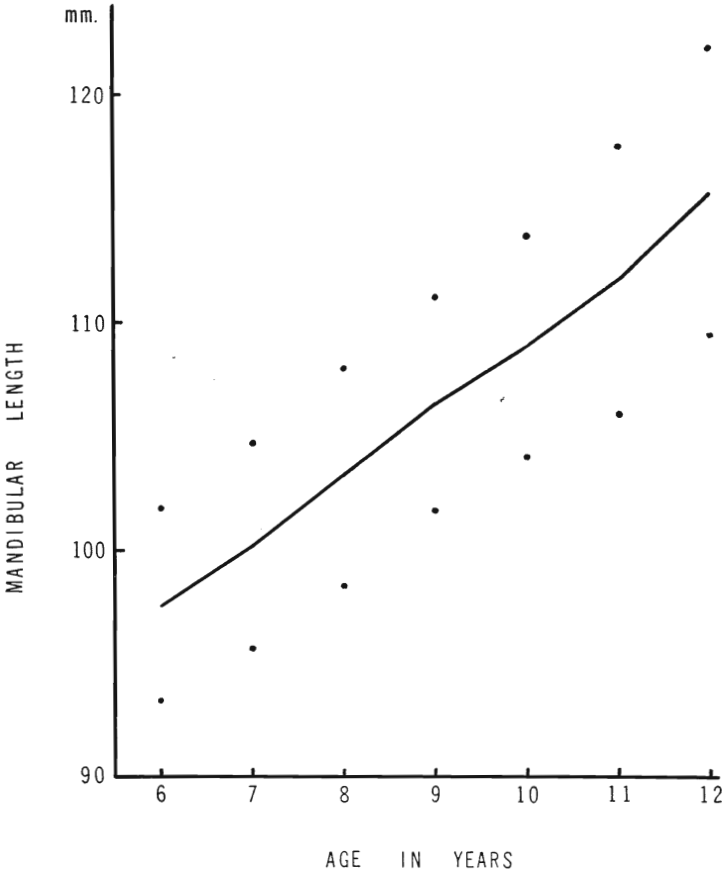

Fig. 2. The growth curve of the mandible of the Japanese male sample with a range of 1 standard deviation.

Table 3 shows values of the annual growth increments and annual percentage growth increments of the mandibular length. The values of both the annual growth increments and the annual growth percentage

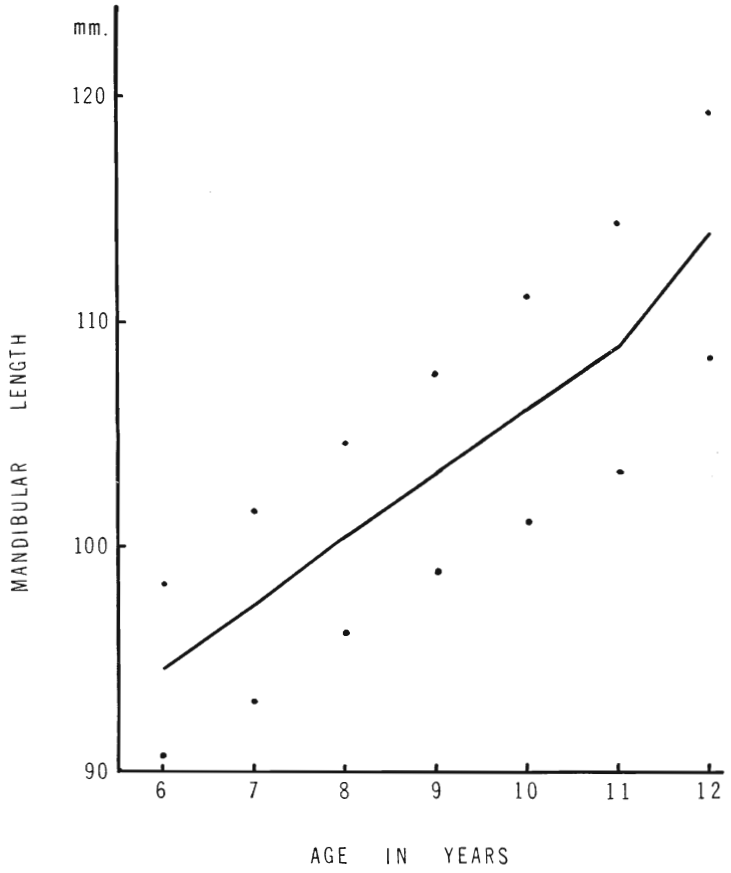

Fig. 3. The growth curve of the mandible of the Japanese female sample with a range of 1 standard deviation.

Table 3. Summary of Data: Annual Growth Increments and Annual Percentage Growth Increments

Range of Ages in Years	Male		Female	
	Increments mm.	Percentage Increments	Increments mm.	Percentage Increments
6— 7	2.6	2.6	2.8	2.9
7— 8	3.1	3.0	3.0	3.0
8— 9	3.1	3.0	2.8	2.8
9—10	2.5	2.3	2.8	2.7
10—11	2.9	2.6	2.7	2.5
11—12	3.9	3.4	5.0	4.5

increments in the male sample are more variable than those in the female sample.

Figure 4 illustrates the curves of the annual percentage growth increments of the mandibular length in the male and female samples. Acceleration of growth began at the stage between the ages of 10 and 11 years in the male sample, on the other hand, in the female sample it was found between 11 and 12 years of age. The degree of annual variation of the male sample was higher but the level of acceleration was lower than those of the female sample.

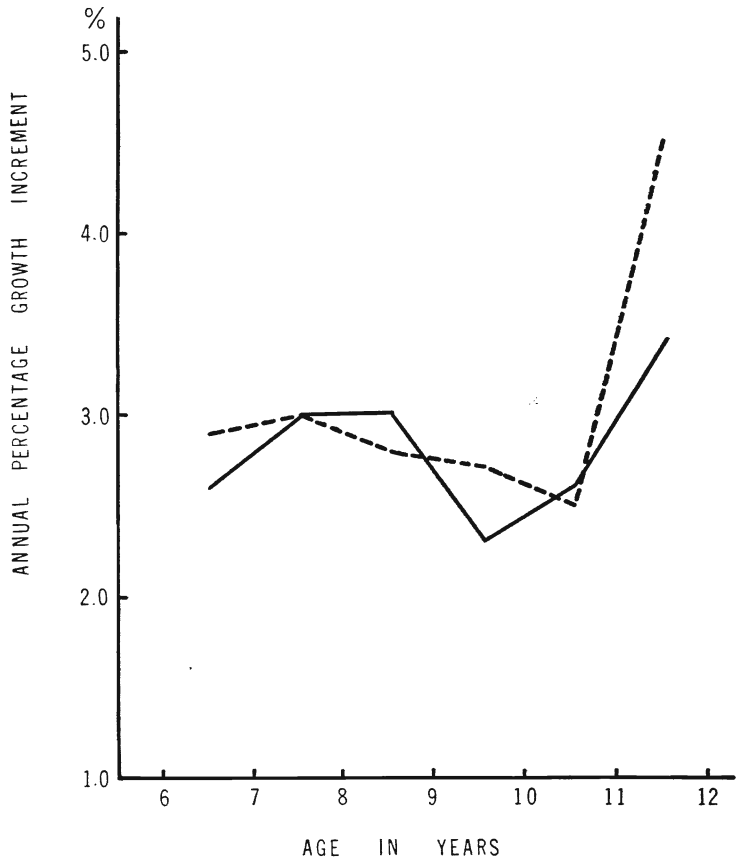

Fig. 4. The curves of annual percentage growth increments of the Japanese samples.

—— Male, - - - - Female

Discussion

What is the most suitable and reliable method for understanding of growth of human dento-facial-cranial complex, which is one of the complicated organ from both the morphological and functional points of view? All studies on growth and development in human may be more or less accompanied by the methodological problems. Making a fixed basis for measurement or evaluation of direction and amount of growth, the metallic implant method might be considered to be one of the best aids to the study.

On the other hand, the simple and reliable method for better understanding of the growth is desirable for the orthodontic profession. The method presented by Harris to measure mandibular growth may be, therefore, useful for the clinical application for orthodontics.

Figure 5 contrasts the mean mandibular growth in the Japanese and American samples between the ages of 6 and 12 years. An annual variation of amount of growth in the American sample is more than that in the Japanese sample. The comparison of the values of the mandibular length between the Japanese and American samples may be unavailable due to the difference of their geometrical mechanisms of cephalometers.

Figure 6 shows the comparison of the curve of the annual percentage growth increments of the Japanese and American samples. The pronounced deceleration of growth was represented in both the American male and female samples. However, such pronounced deceleration could not be observed in Japanese. The acceleration which may be considered as adolescent growth spurt was recorded in the Japanese both samples and the American male sample, especially that in the latter was more particular. The corresponding spurt was not observed in the American female sample, so far as the range of the ages in the present materials. The similarity of the periodicity of the mandibular growth patterns which was elucidated between the male and female samples in American was not found in Japanese.

The mandibular growth increments in the Japanese female sample during the range of the ages from 6 to 12 years surpassed that in the male sample. This finding perfectly coincided with that in American. These observations resulted from the difference of the degree of preadolescent deceleration between the female and male samples. In the Japanese male sample, preadolescent deceleration of growth were, however, smaller than that in the American. In the Japanese female sample, only gradual deceleration was observed before adolescent spurt. That is to say, preadolescent deceleration of growth in the Japanese samples was irrecognizable. The cause and effect of these findings may become subjects of further studies.

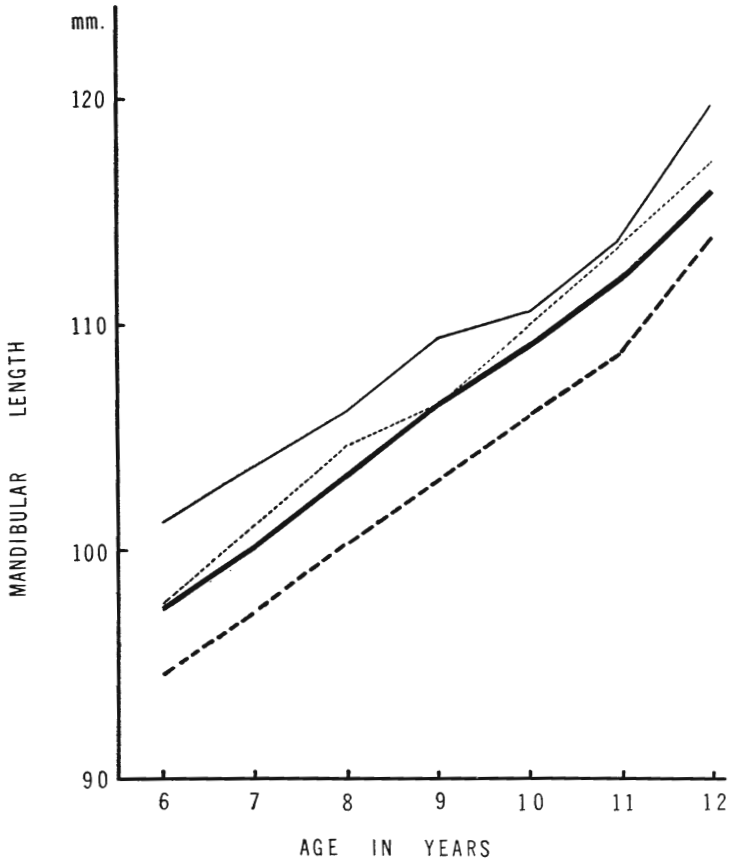

Fig. 5. Comparison of the growth curve of the mandibular length of the Japanese and American samples in both male and female.
——— Japanese male, ——— American male
- - - - - Japanese female, ... American female

One of the most important phases in growing process may be the peak of velocity of growth or the peak of percentage growth increments[8]. These peaks seem to result from adolescent spurt of growth. The period of the peak velocity may give more available informations for a characteristic of growth of individuals. Therefore, the present study should be expanded to a higher range of ages, namely, to the period about the peak of velocity in late maturers. Since the conclusive purpose of investigations on growth consists in prediction of a individual growth pattern, longitudinal studies may contribute greatly to make advances in this field of dentistry and medicine.

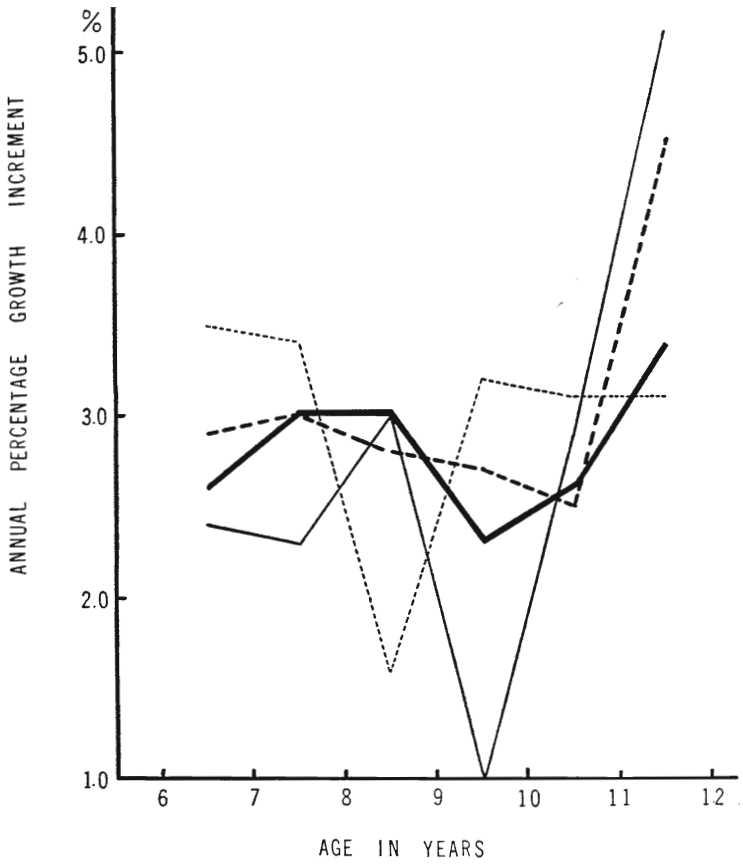

Fig. 6. Comparison of the curves of annual percentage growth increments between the Japanese and American samples.
——— Japanese male, ——— American male
----- Japanese female, ... American female

Functional and esthetic good occlusion seems to be resulted from harmony of growth and development of whole structures concerning occlusion. For further investigation, the relation of growth between the mandible and the other cranio-facial structures should be taken into consideration. Likewise, the study of growth of body height may contribute to predict mandibular growth.

Conclusion

Growth of the mandible in the Japanese children was observed through amount of annual change of the mandibular length which was defined by J. E. Harris on lateral cephalometric roentgenograms. Obtaining peculiarity

of growth of the mandible in Japanese, a comparative study was done about growth of the mandible between Japanese and American, and the findings were as follows:

(1) The mandibular length of the Japanese male sample, at each age, surpassed those of the Japanese female sample.

(2) The total growth increment from the ages of 6 to 12 years was 18.1 mm. in the Japanese male sample and 19.1 mm. in the Japanese female sample.

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(4) The similarity of the periodicity of the mandibular growth patterns which was elucidated between the male and female samples in the American was not observed in the Japanese.

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