

A LONGITUDINAL STUDY OF FACIAL GROWTH IN RELATION TO GENERAL BODY HEIGHT DURING ADOLESCENCE

BY

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ABSTRACT

A roentgenographic cephalometric study using 24 boys and 27 girls have carried out for about 10 years duration of longitudinal examination. For a craniofacial criterion, sella-gnathion length was selected as a representative dimension in the structures.

The boys group showed relatively superior level in the amount of the annual increment covering the whole period of the study. Both the average circum-puberal growth peak of the body height and sella-gnathion length in boys were synchronized and each of them was found in between 12 and 13 years of age. On the other hand, in the girls group, the most of the cases indicate that the peaks of the sella-gnathion incremental maximum were synchronized or followed after the onset of the body height peak of the maximum.

At conclusion, the annual increment rate of the body height may be able to apply as a prediction tool of the craniofacial growth changes especially in the girls group.

One of the purpose of the growth study of the craniofacial complex in orthodontics is to find a practical clue for diagnosis of disharmonies and growth prediction of a certain given patient.

Accumulated number of the longitudinal studies on this line have been published by many research workers. Some of these studies were carried out with insufficient number of untreated examinees since continuous keeping of the same subjects for the studies is extremely difficult task by their individual or family circumstances.

There are inherent questions when an attempt is planed for accurate prediction method since human body is a pool of variabilities. In predicting the craniofacial growth, orthodontist must know the normal growth pattern of the persons who previously had no orthodontic treatment, and from these materials informations of the average growth pattern may be provided. However, these informations are not necessarily available for given individual growth prediction as there are many variations in their maturation

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Received for publication, March 18, 1968.

level and rate. In the present study, subjects with accelerated or retarded body height are avoided. Correlation between general body height and craniofacial growth will be illustrated for quick analysis in growth prediction. Thus, we may have more advantages and can make a positive step into the growth prediction since the data of body height and weight from beginning of their school age are obtainable.

MATERIALS AND METHOD

Since 1957, we have designed a longitudinal roentgenographic cephalometric study using 150 Japanese school children in Tokyo area including both sexes of 6 to 7 years of age. Thirty-five boys and 34 girls were remained in our hands for continuous examinations for 9 and 11 year-studies. Roentgenographic cephalograms were taken from these subjects biannually as well as hand and wrist films. Subjects with superaccelerated type even beyond 1 S.D. of the average rate of maturation and retarded type below 1 S.D. were eliminated from the present study since the general growth may possibly associate superacceleration or retardation in even facial and cranial growth. In the present study, 24 boys and 27 girls were selected as their general growth pattern represented by body height and weight which indicated the average level of maturation (Table 1).

Table 1.

occlusion growth type		Normal	Cl.-I	Cl.-II-1	Cl.-II-2	Cl.-III	Total
		Average	M. F.	12 9	7 7	3 5	
Super	M. F.	2 1	1 3	2	1	2 1	8 5
Under	M. F.	3 2					3 2
							69

Among 24 boys and 27 girls samples, 37 children were studied for 9 years and only 18 were studied for 11 years. Growth study by linear measurement was done on sella-gnathion as well as other dimensions which routinely used in orthodontics. However, in the present study we may only discuss about the changes in sella-gnathion length since it is presumed as one of the representative dimensions which may show the maximum absolute amount of growth²⁾ (Table 2).

Table 2. Increment at S-Gn.

Age	Male				Female			
	mean	s.d.	increment	t	mean	s.d.	increment	t
6	103.4	2.84			104.6	5.39		
7	107.2	3.36	3.8	+	106.4	4.05	1.8	-
8	110.1	3.48	2.9	+	109.0	4.02	2.6	+
9	113.0	3.89	2.9	+	112.2	4.05	3.2	+
10	115.6	4.11	2.6	+	114.9	4.40	2.7	+
11	118.6	4.39	3.0	+	117.9	4.91	3.0	+
12	122.0	4.72	3.4	+	121.2	5.03	3.3	+
13	126.6	4.92	4.6	+	123.8	4.64	2.6	-
14	130.7	5.18	4.1	+	125.6	4.65	1.8	-
15	133.2	5.49	2.5	-	127.0	4.70	1.4	-
16	135.2	4.10	2.0	-	126.0	4.44	-1.0	-
17	137.9	5.34	2.7	-	126.7	4.28	0.7	-

ANNUAL INCREMENT RATE IN SELLA-GNATHION LENGTH

In the Figures 1 & 2, annual growth of the sella-gnathion in boys and

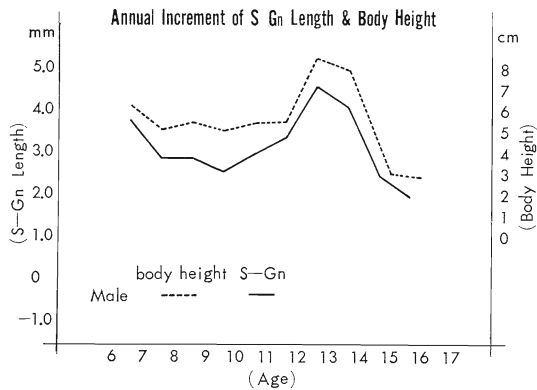


Fig. 1.

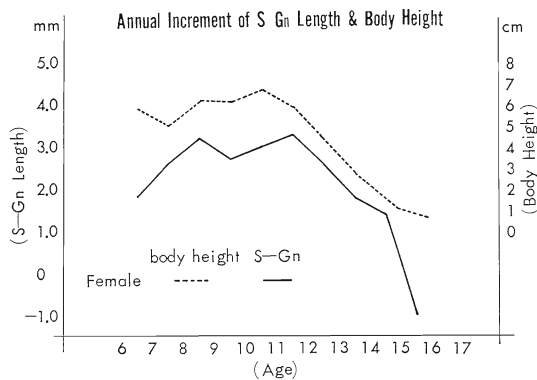


Fig. 2.

girls groups are separably shown as solid lines. In general, amount of the annual increment in sella-gnathion length in the boy group indicates superior level than that of the girl group throughout the 9 and 11 years duration of the examination. After 15 years of age, the boy group indicates continuous growth, while the girl group in average shows little increment.

In the boy group, the annual incremental level in average was prominently decreased through 6 to 7 years period. Contrary, in the girl group, sella-gnathion dimension increases during 6 to 8 years period. Then, after this stage the incremental levels are the same in both groups from 8 to 9 through 11 to 12 years periods.

At the onset of the circumpuberal growth, the peak of sella-gnathion length may be found in between 12 to 13 years of age with the average level of 4.6 mm in the boy group. However, girl group showed the peak one year prior to the boy sample with 3.3 mm level in average. For both boy and girl groups, the sella-gnathion growth decreased immediately after the growth peak.

NATURE OF ANNUAL INCREMENT OF THE BODY HEIGHT

The body height increments in boy and girl groups are illustrated as dotted lines in the Figures 1 & 2. In the boy group prepuberal growth acceleration may be started at the stage of 11 years until the peak which corresponds to the age between 12 to 13 years with more than 8.0 mm increase annually. Post maximal deceleration may be followed afterwards. In the girl group, prepuberal growth maximum may be formed as a plateau shape which indicates a gradual increase of the body height between 8 and 9 years to 10 and 11 years. This means that, as far as the body height is concerned, the circumpuberal growth maximum in body height in the girl sample is about 2 years prior to that of the boy.

COMPARISON OF THE AVERAGE ANNUAL INCREMENTAL LEVEL BETWEEN BODY HEIGHT AND SELLA-GNATHION GROWTH

In the body sample, the nature of the annual incremental curves of both body height and sella-gnathion are almost parallel to each other except the time of preschool age. Prepuberal deceleration and acceleration which are also called as circumpuberal growth spurt coincided as shown in the Figure 1. The peaks are found between 12 and 13 years of age.

In the girl sample, the nature of annual incremental curves of both body height and sella-gnathion are not the same as seen in the boy group. This may be a characteristic in the girl group. Prepuberal growth maximum is illustrated as a plateau which complete one year prior to the indication

of the circumpuberal growth peak in the body height. The deceleration tendencies in both sella-gnathion and body height may be identical after the age of 11 and 12 years period.

RELATIONSHIP BETWEEN SELLA-GNATHION AND BODY HEIGHT
IN THE INDIVIDUALS

Figure 3 shows a case of a boy, No. 65. A typical V shape peak in the annual increment was not found in the body height as was found in the average growth group sample. The puberal maximum in body height was observed at the period of between 10 to 12, also. The prepuberal acceleration of the body height as sella-gnathion length was initiated at $9\frac{1}{2}$ years of age. At conclusion, this case indicated that the prepuberal growth spurt and the puberal growth maximum were well synchronized.

However, Figure 4 indicates that in a girl, case No. 68, the same situations were found with something subtle different from that was found in

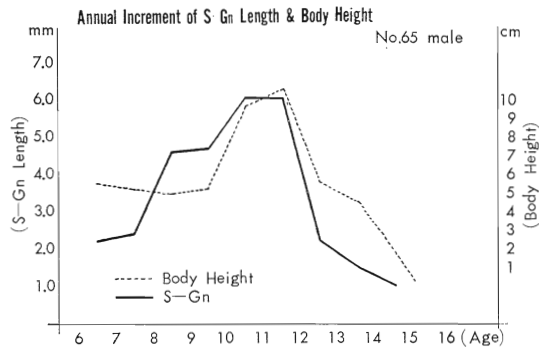


Fig. 3.

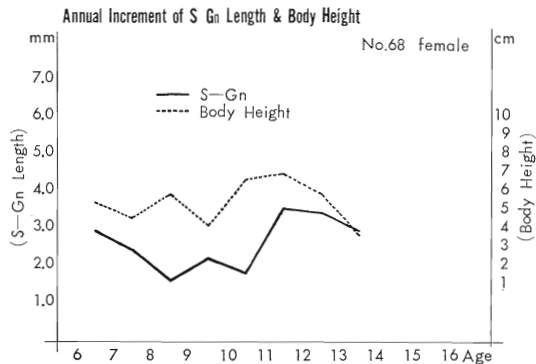


Fig. 4.

the previous case of a boy. In general, the curves of the sella-gnathion and the body height increment correspond to each other except the fact that at $8\frac{1}{2}$ to $9\frac{1}{2}$ years of age the body height shows a prepuberal deceleration whereas the sella-gnathion length indicated it at the time of $9\frac{1}{2}$ to $10\frac{1}{2}$ years of age. This may implicate that prepuberal and/or puberal phenomena of the sella-gnathion may be shown later than the body height which is probably one of the characteristic nature of the sella-gnathion growth in the female.

In Table 3, a comparison was made concerning the onset of the puberal growth maximum of the sella-gnathion length and the body height in both sexes. As is shown in the Figure 4, the formula of $S-Gn=B.H.$ means that

Table 3. Comparative Growth Spurt Ratio between S-Gn Length & Body Height (Average Growth Group)

	S-Gn→B.H.	S-Gn=B.H.	B.H.→S-Gn
Male	9	5	10
Female	2	11	14

the onset of the growth maximum of the sella-gnathion and the body height is almost the same. $S-Gn→B.H.$ means that the onset of the sella-gnathion acceleration was prior to that of the body height. In the male group, 9 cases out of 24 indicated that the sella-gnathion growth was accelerated before the onset of the body height and only 5 cases were synchronized and, 10 subjects were the type of $Body\ Height→S-Gn$. While the female group indicated that 50% (14 cases out of the 27 subjects) fall into the type of $B.H.→S-Gn$ and only 2 cases showed $S-Gn→B.H.$ type. This nature would be indicative of the clinical application for the growth prediction especially for the female patients that the sign of the body height maximum may give a clue for growth spurt of the sella-gnathion which may occur coincident or a little later than the body height spurt.

COMMENT

Utilizing serial cephalometric roentgenograms of 15 caucasians, Nanda³⁹⁾ concluded that "both the growth curves and the relative increment curves show that the growth of the face tends to have its circumpuberal maximum slightly later than that for the general body height". Findings of the present study are not necessarily equal to this statement; some implications may be given for the analysis of this difference between two studies.

1. Ethnical difference of material used—Nanda used caucasians, in the present study, we used Japanese.

2. Sample size—Nanda used 10 males and 5 females, while we used 24 males and 27 females.

3. General growth pattern—No special comments of this matter were given in Nanda's materials. The materials we used was selected when the examinees show average or within + or -1 S.D. range in their general body height and weight.

CONCLUSIONS

An analysis of the growth patterns of the human craniofacial complex was made using sella-gnathion length as one of the representative dimensions in the face. Serial cephalometric roentgenograms of 51 persons (24 males, 27 females) were taken biannually for over 9 and 11 years from 6 or 7 years of age. These subjects were selected when their general growth pattern of body height and weight were assumed to be of average range of maturation or within + or -1 S.D. range.

The result of this investigation are as follows:

1. In this sample, the boys showed relatively superior level in the amount of the annual increment of sella-gnathion length covering the period of 9 and 11 years longitudinal study.

2. Average circumpuberal growth peak of the body height and sella-gnathion length in boys were well synchronized statistically. And it was found around between 12 and 13 years of age in average. However, the detail comparison of these two natures in the individual cases indicates that the onset may be evenly scattered and not always synchronized.

3. In the girl group, in most of cases (25 cases out of 27) indicate that the peaks of sella-gnathion incremental maximum are synchronized or followed after the onset of the body height peak.

4. At conclusion, the annual increment rate of the body height may be able to apply as a prediction tool of the craniofacial growth study if sella-gnathion growth is recognized as one of the representative dimensions of the structures.

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