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An Estimate of Craniofacial Growth in Class III Malocclusion

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ABSTRACT

Objective: To provide an estimate of growth in Class III malocclusion by means of the analysis of a large population of males and females.

Materials and Methods: The examined sample consisted of pretreatment lateral cephalometric records of 949 (492 females and 457 males) untreated Class III patients of Caucasian ancestry. Cephalometric dentoskeletal measurements at subsequent age periods in Class III subjects were compared with the population values from subjects included in the University of Michigan Growth Study (UMGS) at 11 consecutive age periods (from 6 through 16 years of age), in male and female groups separately.

Results: No difference was found between the Class III and normal groups for the sagittal position of the maxilla at any of the age intervals examined. Sagittal mandibular position and dimensions in Class III subjects were consistently larger than in normal subjects, with the interval of largest “increase” in mandibular length occurring on average 1 year later in both female and male Class III subject with respect to subjects with normal occlusion.

Conclusions: Increases in mandibular length were substantially larger in Class III subjects than in subjects with normal occlusion even during the more mature age interval (15 to 16 years). Lower anterior facial height was significantly larger in Class III individuals during the late developmental stages.

KEY WORDS: Class III malocclusion, Mandibular growth, Sagittal skeletal characteristics.

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INTRODUCTION Return to TOC

Information on growth in different types of malocclusions and dentoskeletal disharmonies is vital to plan orthodontic treatment properly, anticipate growth trends in patients with the same type of disharmony, and refer to adequate control data when evaluating treatment outcomes. Admittedly, the best method for studying facial growth and development is through the analysis of longitudinal data. The large North American growth studies have provided longitudinal data for untreated individuals with different types of malocclusion.[1–4] These samples consist, however, primarily of individuals categorized as having either normal occlusion or Class I or Class II malocclusions.

Longitudinal studies with sample sizes adequate to describe Class III craniofacial growth are available only for individuals of Asian ancestry.[5,6] No major investigations of untreated Class III malocclusion in populations of Caucasian ancestry have been performed. There are two main reasons for this deficiency in the literature: the relatively low prevalence of Class III malocclusion (especially in Caucasian populations) and the well recognized need for intervention both by the public and the dental professionals.

In 1986, Guyer et al[7] attempted to characterize Class III individuals at different developmental stages by studying lateral cephalograms of 144 Class III children between 5 and 15 years of age. The sample was divided into four groups according to chronological age and then compared to the Bolton Standards.[2] The investigators reported that the differences in craniofacial form between Class I and Class III individuals were present in all four age groups.

A study of similar methodology was performed by Battagel[8] on a Northern European Caucasian sample comparing 285 Class III subjects with 210 controls. Males and females were examined separately in each of the four age groups: 7–10 years, 11–12 years, 13– 14 years, and 15 years and older. With continued development, the Class III males demonstrated less forward growth of the maxilla and a more vertical growth pattern than their normal counterparts. Finally, the largest increment of change for mandibular length was between the last two age groups, suggesting peak growth at this age interval. The females presented a different growth pattern from the males. Relative to controls, the Class III females displayed more prominent mandibles, more proclined maxillary incisors, and similar lower anterior facial heights. The maximum change for facial characteristics occurred between the average ages 9.5 and 12 years but continued after the age of 15 years. This study highlighted the presence of a sexual dimorphism in Class III malocclusion that was confirmed recently by Baccetti et al.[9]

The largest cross-sectional Class III study to date was conducted by Miyajima et al[10] on a sample of 1376 Japanese females, 2.7 to 47.9 years of age. These females were organized into groups on the basis of the stage of dental development. The results were congruent with the conclusions of other Class III investigations. In Japanese Class III females, the maxilla assumed a retrusive position at an early developmental stage and retained a fairly constant anteroposterior relationship to the cranial base structures with continued development. Likewise, the mandible was protrusive early in development and became increasingly prognathic with age. Recently, Deguchi et al[11] used a rather large cross-sectional sample (562 subjects) as a control group in a long-term study on the effects of chincup therapy on Asian patients with Class III malocclusion. Three age periods were investigated (8, 13, and 17 years), with no differentiation between males and females. Both the ANB angle and the Wits appraisal worsened along with growth, mainly because of excessive mandibular growth in a forward direction.

This investigation was designed to estimate the skeletal and dentoalveolar changes in untreated Class III individuals. The to date largest cross-sectional sample of lateral cephalograms of Caucasian subjects was collected to study Class III morphology at all developmental ages starting at 6 years and to draw inferences about typical growth in Class III individuals when compared with untreated subjects with normal occlusion.

MATERIALS AND METHODS Return to TOC

The parent sample consisted of 1549 pretreatment lateral cephalometric records of Caucasian Class III patients collected from 12 private orthodontic practices in Michigan and Ohio, from The University of Michigan Graduate Orthodontic Clinic, and from the Department of Orthodontics, The University of Florence, Italy. The age range for female subjects was between 3 years 6 months and 57 years 7 months. The age range for the male subjects ranged from 3 years 3 months to 48 years 5 months.

To be included in the final group, patients had to satisfy all of the following inclusion criteria:

1) European-American ancestry (Caucasian)

2) No orthopedic/orthodontic treatment prior to cephalogram

3) Diagnosis of Class III malocclusion

   a) Anterior cross-bite; every attempt made to exclude pseudocrossbites

   b) Accentuated mesial step relationship of the primary second molars

   c) Permanent first molar relationship of at least one half cusp Class III

   d) No congenitally missing or extracted teeth

In addition to these inclusion criteria, patients less than 5 years and 5 months and older than 16 years and 6 months of age were not considered in this investigation because too few subjects were scattered across many different age periods. The final sample comprised

949 subjects, 492 females and 457 males with Class III malocclusion.

Eleven age groups (from 6 years through 16 years) were identified, and cephalometric data at these age periods were compared with those of subjects included in the atlas derived from the University of Michigan Growth Study (UMGS).[1] Eighty-three individuals, 47 males and 36 females, with continuous attendance at the University School over the period ranging from their 6th to 16th birthdays were selected out of the total sample (N = 711) for this study. Most of the subjects had a normal occlusion, but overall there was a slight Class II tendency, no subject in the UMGS sample had a Class III occlusal relationship. The categorization according to age was performed in males and females separately on the basis of the significant sex differences in both Class III malocclusion and normal occlusion groups during the developmental ages.[9,12]

Cephalometric analysis

The descriptive cephalometric analysis required the digitization of 71 landmarks on the tracing of each cephalogram. A cephalometric analysis including measures adopted from the analyses of Steiner,[13] Jacobson,[14] Ricketts[15] and McNamara[16] was performed.

Statistical analysis

With the sample categorized according to the 11 age intervals, descriptive statistics for the cephalometric measures were calculated for each age group in male and female subjects separately (SPSS for Windows Version 12.0, SPSS, Inc., Chicago, Ill). All linear measurements were calculated at a standardized radiographic enlargement of 8% in both the Class III and normal occlusion samples.

Initially, sex differences were tested using Hotelling's T^2 test to see whether the differences between male and female subjects were significant with respect to the collection of cephalometric measures. The results of this test indicated significant differences and dictated that male and female groups should be analyzed separately, thus confirming previous data.[9,12] The Shapiro-Wilks test revealed normality of distribution for the cephalometric variables in each sex group at all time periods. Consequently, independent samples *t*-tests were used to identify significant differences ($P < .05$ and $P < .01$) between the means for Class III and normal subjects for each cephalometric variable at each age period.

The error of the method for the cephalometric measurements was evaluated by repeating the measures in 100 randomly selected cephalograms. Error was on average 0.6° for angular measures and 0.9 mm for linear measures.

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The results along with the statistical comparison of Class III vs normal groups at each age period in the two sexes are provided in Table 1.

Female subjects

Significant differences between Class III and normal female subjects all throughout the examined age periods were related to smaller values for the angulation of the cranial base, larger values for SNB angle and total mandibular length, and smaller values for ANB angle. At age periods of 11, 12, and 13 years, Class III females presented also with smaller extent of the anterior cranial base. At ages from 11 through 15 years, a significant degree of extrusion of upper molars was found in Class III females, as well as a significantly larger lower anterior facial height at age of 16 years.

Male subjects

For the vast majority of the age periods examined, significant differences between Class III and normal male subjects replicated the differences found for the female samples. In addition to those, the upper incisors were significantly less erupted in the Class III male group at age 8 and 9 years. A significantly larger lower anterior facial height was present in Class III males at 14 and 16 years of age.

DISCUSSION Return to TOC

This investigation aimed to derive information about the dentoskeletal features of untreated subjects with Class III malocclusion throughout the developmental ages. The cephalometric records of a substantial number of untreated Caucasian subjects with Class III malocclusion (n = 949) were compared with those of untreated Caucasian subjects with normal occlusion at 11 age periods.

The cranial flexure angle was significantly smaller in Class III subjects than in normal occlusion subjects at all 11 age intervals, both in males and in females. The measurement for cranial flexure ranged between 121° and 124° for Class III subjects, whereas it ranged between 129° and 131° in subjects with normal occlusion. The presence of a reduced cranial flexure, and of a consequently advanced position of the glenoid fossa, is confirmed as an anatomical characteristic of Class III malocclusion throughout the various developmental ages.[17]

One of the most interesting and consistent outcomes of the present investigation was the observation that no statistical differences were found between Class III and normal occlusion subjects for the sagittal position of the maxilla at any age period, as measured by both SNA angle and Co-A. On the contrary, the sagittal position of the mandible as expressed by the SNB angle exhibited consistently larger values than the normal sample in both sexes at all developmental ages. The excess in the anteroposterior position of the mandible in Class III malocclusion appeared to range between 2.5° and 4.5°. Therefore, the significant differences between Class III and normal occlusion samples that were recorded for the sagittal intermaxillary discrepancy as measured by the ANB angle have to be ascribed to a significantly protruded position of the mandible rather than to a retruded position of the maxilla. These data are in agreement with previous observations derived from cross-sectional studies[7,8] and from small-sized groups of Class III individuals studied longitudinally.[18,19] The indication is that there is no evidence for a self-limiting tendency in sagittal skeletal characteristics of Class III malocclusion.

Because the major responsibility for the sagittal discrepancy during the development of Class III malocclusion appears to be related primarily to changes observed in the mandible, the analysis of total mandibular length (Co-Gn) at the subsequent age intervals becomes of particular interest (Figure 1). In the examined time span of 11 years, the increase in Co-Gn for the Class III females was about 30 mm, which means an average increase per year of about 2.7 mm. It is well known that mandibular growth is not linear across time, with the existence of a pubertal growth spurt during adolescence.[20] The greatest increase in mandibular length in the female Class III groups was recorded between the ages of 11 and 12 years (3.8 mm). When the female normal occlusion group is considered, the amount of increase in Co-Gn from 5.5 though 16.5 years of age was about 22 mm, which corresponds to an average yearly increase of 2 mm. The age interval with the greatest increase in total mandibular length was the interval between 10 and 11 years of age, when the increase in Co-Gn was 3.4 mm.

As for the male groups with Class III malocclusion, the overall increase in Co-Gn was about 32 mm, which corresponds to an average increase per year of 2.9 mm. The greatest increase in mandibular length was recorded between the ages of 13 and 14 years (5 mm). In the male normal occlusion group, the amount of overall increase in Co-Gn was about 26 mm, which corresponds to an average yearly increase of 2.4 mm. The age interval with the greatest increase in total mandibular length was the interval between 12 and 13 years of age, when the increase in Co-Gn was 4.2 mm.

These data suggest a series of interesting considerations. First, the overall amount of increase in mandibular size is larger in Class III subjects than in normal occlusion subjects, both in males and in females. The amount of supplementary growth during the pubertal peak is also larger in Class III malocclusion subjects than in subjects with normal occlusion. Moreover, the interval that shows the greatest increase in mandibular dimensions is delayed by 1 year in both Class III females and males when compared with corresponding controls with normal occlusion. The evidence for a delayed growth spurt in mandibular dimensions was provided already in the cross-sectional study by Battagel,[8] and it was confirmed recently by using an indicator of skeletal maturity.[21] Finally, when the increase in Co-Gn during the most mature age intervals (15 to 16 years) is considered, it can be observed that Class III subjects still present with a substantial amount of increase in mandibular length (2.4 and 3.0 mm for Class III females and males, respectively), whereas normal occlusion subjects show a significantly smaller amount of “increase” in mandibular length at that age interval (1.5 and 2.0 mm for the females and the males, respectively). Therefore, the findings of the present investigation indicate that mandibular growth in Class III individuals of Caucasian ancestry is more pronounced, presents with a delayed peak during adolescence, and lasts longer than in subjects with normal occlusion.

As for the skeletal vertical relationships, the mandibular plane angle and upper anterior facial height did not show any significant differences between Class III and UMGS samples at any age interval. On the contrary, the Class III samples exhibited larger increases in lower anterior facial height when compared with controls at several specific age intervals: at 15 and 16 years of age for the female groups and at 13, 14, and 16 years of age in the male groups. As a general rule, it is confirmed that Class III subjects present with an excess in lower anterior facial height as a characteristic of late developmental ages.[9]

The differences between Class III and normal occlusion samples in dentoalveolar measurements were sporadic. The most consistent finding regarding the dental measurements was the evidence for larger values for the extrusion of upper molars in the Class III groups at various age intervals. This aspect may have contributed to the generally increased value for lower anterior facial height in Class III subjects in the more mature age groups.

CONCLUSIONS Return to TOC

- No difference was found for the sagittal position of the maxilla at any of the examined age periods.
- The interval of largest increase in mandibular length occurred on average 1 year later in both female and male Class III subject with respect to subjects with normal occlusion.
- During the more mature age interval (15 to 16 years), the increase in mandibular length in Class III subjects was substantially larger than in subjects with normal occlusion.

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TABLES Return to TOC

Table 1. Descriptive Statistics and Comparisons Between Class III and Class I Samples at Subsequent Age Periods (**P* < .05; ***P* < .01)[a]

	6 y					7 y					8 y				
	Class I		Class III		Significance	Class I		Class III		Significance	Class I		Class III		Significance
	Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Females															
n	24	—	13	—	—	31	—	57	—	—	36	—	73	—	—
S-N (mm)	67.2	2.6	66	3.6	NS	70.2	3.3	68.2	3.1	NS	69.2	2.8	68.1	3.2	**
Cranial Flexure (°)	129.6	5.0	123	5	**	130.2	4.6	121.5	5.8	**	130	4.8	122.7	5.5	*
Co-A (mm)	78.4	3.5	78.0	3.7	NS	78.9	3.2	78.2	3.9	NS	80.6	4.1	79.1	3.7	NS
SNA (°)	80.7	3.0	80.4	3.9	NS	81.9	3.0	80.8	3.3	NS	81.2	3.3	79.6	3.8	**
SNB (°)	76	3.5	79.7	2.2	**	76.3	3.1	79	3.1	**	76.7	3.3	79.1	3.7	**
ANB (°)	4.7	2.2	0.8	2.5	**	4.8	2.1	0.4	2.7	**	4.6	2.4	0.6	2.3	**
Co-Gn (mm)	96.8	3.9	100.6	4.8	**	98.8	4.2	103.2	5.7	**	101.7	4.5	106.6	5.2	**
MPA (°)	28.4	4.5	26.2	3.6	NS	28.3	3.7	26.1	4.0	NS	28.6	3.8	25.8	5.0	*
UFH (mm)	43.9	3.0	43.4	2.6	NS	45.1	2.8	46.2	2.6	NS	46.5	2.9	48.1	3.4	NS
LAFH (mm)	58.9	3.7	57.4	4.1	NS	60.8	3.9	59.4	4.7	NS	60.7	4.0	60.8	4.1	NS
U1-ANS (mm)	23.6	2.0	23.3	3.1	NS	23.2	3.2	23.6	2.6	NS	23.9	2.7	24.8	2.3	NS
U6-PP (mm)	NA	NA	NA	NA	—	16.6	2.6	17.4	1.9	NS	17.7	2.0	18.3	2.8	NS
L1-Me (mm)	34.6	2.1	34.4	2	NS	37.9	2.5	38.1	2.4	NS	36.4	2.1	36.5	2.3	NS
U1-SN (°)	93.3	9.2	93.6	9.5	NS	98.8	9.8	99.7	10.4	NS	104.3	7.4	101.3	7.9	NS
Males															
n	37	—	11	—	—	44	—	30	—	—	44	—	82	—	—
S-N (mm)	68.2	2.9	67.3	3.2	NS	70.7	3	69.4	3.0	NS	71.9	2.9	70.8	3.5	NS
Cranial Flexure (°)	129.3	5	120.5	5.2	**	129.7	4.9	119.7	4.7	**	129	4.8	121.5	4.5	**
Co-A (mm)	79.8	4.2	78.8	3.5	NS	80.9	3.2	78.8	4.2	NS	82.6	4.4	80.9	3.9	NS
SNA (°)	81.9	3.3	80.2	4.3	NS	80.7	3	80.6	3.9	NS	81	3.1	79.8	3.4	NS
SNB (°)	76.5	2.6	79.9	4.3	*	75.7	2.8	80.4	3.7	**	76.3	2.8	79	3.2	**
ANB (°)	5.3	2.2	0.4	1.8	**	5.0	2.2	0.2	2.6	**	4.8	2.2	0.8	2.1	**
Co-Gn (mm)	98.2	3.8	101.3	3.5	**	100.7	3.4	104.4	4.2	**	102.8	4.8	107.7	5.0	**
MPA (°)	28.3	3.9	25.6	2.7	NS	30.1	5.9	27	4.2	*	29.4	4.8	27.4	4.7	NS
UFH (mm)	44.1	3.0	43.8	2.8	NS	47.1	2.9	47.2	2.8	NS	47.4	2.7	48.4	3.4	NS
LAFH (mm)	59.6	3.4	58.4	4.1	NS	62.7	4.2	61.6	3.0	NS	63.7	4.2	62.4	4.8	NS
U1-ANS (mm)	24.7	2.2	25.9	3.0	NS	25.4	2.3	24.6	2.3	NS	26.3	2.2	25.1	2.9	*
U6-PP (mm)	—	—	—	—	—	17	2.4	17.3	1.7	NS	18.7	1.7	18.8	2.0	NS
L1-Me (mm)	35.6	2.4	34.9	2.4	NS	36.9	2.1	37.2	2.2	NS	38.1	2.2	37.9	2.4	NS
U1-SN (°)	93.9	8.2	94.1	10.3	NS	98.7	8.4	100.5	8.6	NS	102.9	6.7	100.8	8.0	NS

[a] NS indicates not significant.

Table 1. Extended

9 y					10 y					11 y				
Class I		Class III		Signifi-	Class I		Class III		Signifi-	Class I		Class III		Signifi-
Mean	SD	Mean	SD	cance	Mean	SD	Mean	SD	cance	Mean	SD	Mean	SD	cance
31	—	65	—	—	35	—	45	—	—	30	—	34	—	—
71.9	2.9	68.8	3.6	**	70.7	2.7	69.7	3	NS	73.3	2.7	70.6	3.6	**
129.8	4.6	122.4	5.0	**	129.7	4.5	121.5	4.2	**	129.9	4.8	123.3	4.1	**
82.4	4.2	81.7	3.4	NS	83.4	3.8	82.0	3.5	NS	85.3	3.2	83.9	3.7	NS
80.5	3.2	80	3.4	NS	80.7	3.7	81.4	3.4	NS	81.1	3.8	79.9	4	NS
76.5	3.4	79.5	3.5	**	76.7	3.5	81	3.5	**	77.3	3.9	79.8	3.4	**
4.0	2.6	0.5	2.4	**	3.8	3.1	0.4	2.5	**	3.8	2.2	0.1	2.2	**
102.9	4.6	108.5	5.8	**	105.5	4.7	111.7	5.7	**	108.9	4.1	114	4.7	**
28.4	4.9	25.3	5.1	**	28.9	4.2	26.9	3.7	NS	28.8	4.7	27.8	4	NS
48.2	3.0	48.7	3.5	NS	49.8	3.5	49.6	2.6	NS	50.4	3.2	51.9	4.1	NS
61.3	4.4	61.2	5.2	NS	62.5	4.7	62.3	4.2	NS	62.9	4.4	64.4	4.9	NS
25	2.5	25.4	2.6	NS	25.8	2.7	25.4	2.6	NS	26.4	2.6	27.7	3.2	NS
18.5	1.8	19.3	2.4	NS	19.1	2	20.2	1.9	NS	20	1.8	21.8	2.3	**
37.4	2.5	36.9	2.4	NS	38.6	2.6	37.3	1.9	NS	39.1	2.6	39.1	3	NS
105.3	6.4	102.8	7.6	NS	105.5	7.1	106	6.7	NS	105.1	6.9	104.5	7.2	NS
46	—	65	—	—	45	—	42	—	—	43	—	34	—	—
72.6	3.2	70.4	3.6	**	71.6	2.5	69.9	3.2	NS	74.8	2.8	71.5	3.5	**
129.6	4.6	120.5	4.7	**	129.2	4.7	121.5	5.8	**	128.9	4.8	122	5.3	**
84.4	4.0	82.7	3.8	NS	86.3	3.7	86.0	3.4	NS	88.9	4.2	87.8	3.9	NS
80.6	3.0	80.1	3.4	NS	80.7	3.9	81.3	3.2	NS	80.8	3	80.1	3.8	NS
76.4	2.5	79.4	3.2	**	76.6	3.4	81.1	3.7	**	76.5	2.6	79.5	3.2	**
4.2	1.9	0.7	2.2	**	4.1	3	0.6	2.6	**	4.3	1.9	0.6	2.2	**
104.6	4.8	109.7	5.9	**	107	4.4	112.9	5.8	**	109.5	4.1	115.7	5	**
29.5	5.5	26.3	4.7	**	29.6	5	27.3	5	NS	29.1	4.7	27.3	5.2	NS
48.8	2.9	49.5	3.6	NS	50	3	50.5	2.5	NS	51.5	3.3	52.7	3	NS
64.4	4.1	63.2	4.3	NS	65.9	4.7	64.8	5.1	NS	67.2	4.6	66.7	5.5	NS
27.4	2.4	25.8	2.6	**	28.4	2.1	27.1	2.7	*	27.3	2.6	27.9	2.9	NS
19.5	2.1	19.3	2.4	NS	20.2	2.3	20.8	2.3	NS	21.1	2.2	22.1	2.3	NS
39.2	2.3	38.4	2.8	NS	40.3	2.3	38.7	3.2	NS	41.3	2.6	39.7	2.2	**
105.8	6.2	103.6	5.4	NS	103.9	8.5	105.3	6.9	NS	104.6	5.7	102.2	5.5	NS

Table 1. Extended

	12 y					13 y					14 y				
	Class I		Class III		Significance	Class I		Class III		Significance	Class I		Class III		Significance
	Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Females															
n	27	—	56	—	—	29	—	52	—	—	25	—	523	—	—
S-N (mm)	71.6	2.9	71.4	3.8	NS	72.2	3	70.8	2.9	*	72.7	2.8	71.9	4	NS
Cranial Flexure (°)	130.4	5.2	123	5.1	**	130.3	4.7	122.6	5.5	**	130.4	4.8	122.8	6.1	**
Co-A (mm)	88.5	4.0	87.4	3.6	NS	88.9	4.2	87.0	3.9	NS	89.6	3.8	88.7	4.2	NS
SNA (°)	81.4	3.6	80.3	4.1	NS	81	3.8	80.8	3.4	NS	81.3	3.5	80.7	4	NS
SNB (°)	77.4	3.4	79.8	3.9	**	77.5	3.9	80.9	2.9	**	77.9	3.8	80.8	3.9	**
ANB (°)	3.7	2.4	0.5	2.5	**	3.5	2.4	−0.2	2.7	**	3.4	2.5	−0.1	2	**
Co-Gn (mm)	111.2	3.9	117.8	4.7	**	113.5	4.2	120.9	4.5	**	114.7	3.8	124	5.3	**
MPA (°)	28.1	5.2	26.9	6.3	NS	26	4.3	25.3	4.6	NS	24.8	5.8	26.9	5.5	NS
UFH (mm)	51.7	3.5	53	3.9	NS	52.3	3.2	52.8	3	NS	53.1	3.6	52.8	3.1	NS
LAFH (mm)	64.2	3.8	66.3	5.1	NS	65.1	4.3	66.3	5.2	NS	67.1	4.8	69.1	6.2	NS
U1-ANS (mm)	26.6	2.6	28.1	3.3	*	27.2	2.5	27.4	3	NS	28.8	2.9	29.9	3.3	NS
U6-PP (mm)	20.6	1.7	21.5	2.2	NS	21.9	2.2	22.6	2.2	NS	22.3	1.9	24.8	2.4	**
L1-Me (mm)	39.7	2.1	39.4	2.8	NS	40.7	2.5	38.9	3.1	**	40.8	2.5	41.1	3.3	NS
U1-SN (°)	104.2	6.7	105.1	5.8	NS	103.9	5.6	105.4	5.8	NS	104	6.2	104.6	6.8	NS
Males															
n	44	—	44	—	—	43	—	51	—	—	39	—	42	—	—
S-N (mm)	74.9	3.2	73.7	3.3	NS	76	3.6	73.5	3.8	**	77	3.9	75.5	3.3	NS
Cranial Flexure (°)	129.3	4.8	121.8	4.2	**	129.2	5.3	122.1	5.5	**	129.1	5.2	121.1	5.2	**
Co-A (mm)	90.6	4.1	88.7	3.5	NS	92.4	4.2	89.7	4.1	NS	93.6	3.7	91.9	4.0	NS
SNA (°)	81.2	3.3	80.3	4.2	NS	81.2	3.4	80.5	3.8	NS	80.7	3.4	81	4.6	NS
SNB (°)	77.3	2.7	80.2	3.5	**	77.5	3	79.8	3.2	**	77.5	2.9	79.9	3.3	**
ANB (°)	3.9	2.1	0.1	2.5	**	3.7	2	0.8	2.4	**	3.4	2	0.4	2.4	**
Co-Gn (mm)	112.8	4.2	118.5	3.4	**	117	4.8	122.2	5.1	**	120	5.5	127.2	6.2	**
MPA (°)	29.4	5.5	27.8	4.7	NS	29	5.1	27.5	4.3	NS	27.7	5.8	26.6	5	NS
UFH (mm)	52.2	3.4	53.4	3.7	NS	54.3	3.5	55.3	3.6	NS	55.7	3.9	56.4	3.7	NS
LAFH (mm)	68	4.9	69	5.5	NS	68.9	5.4	72.1	6	**	71.1	5.5	72.9	6.1	NS
U1-ANS (mm)	26.4	2.8	28.5	3.5	NS	27	2.7	27.8	2.9	NS	30	2.2	29.7	3	NS
U6-PP (mm)	22	2	23.1	2.6	*	22.8	2.3	24.4	2.8	**	23.7	2.5	25.1	2.5	*
L1-Me (mm)	41.7	2.6	40.8	2.9	NS	42.6	3.1	42.3	3.2	NS	44	3.3	43.2	3.4	NS
U1-SN (°)	104	5.5	104.9	5.6	NS	103.3	5.9	103.2	6.1	NS	102.6	6	104.2	6.5	NS

Table 1. Extended

15 y					16 y				
Class I		Class III		Signifi-cance	Class I		Class III		Signifi-cance
Mean	SD	Mean	SD		Mean	SD	Mean	SD	
19	—	31	—	—	9	—	14	—	—
73.6	2.7	72.1	3.4	NS	73.6	3.7	73.8	4.8	NS
130.2	4.2	121.9	4.3	**	131.1	4.1	124.3	6.9	*
90.5	4.0	89.1	3.3	NS	91.7	3.8	90.2	4.4	NS
81.8	3.5	80.5	3.7	NS	81.8	3.7	81.1	3.1	NS
78.9	3.9	81.4	3.4	*	78	3.7	81.6	4.4	**
2.9	2.7	−0.9	2.8	**	2.6	2.4	−1.1	2.6	**
116.7	4.7	126.7	5.4	**	118.2	3.8	129.1	7.2	**
24.6	4.1	24.1	5	NS	25.8	5.1	26.3	4.3	NS
52.9	3.1	54.6	3.7	NS	53.7	4.1	54.7	3.6	NS
66.4	5.1	68.4	4.8	*	66.3	5	69.6	5.6	*
27.8	3.2	29	3.1	NS	28.7	2.8	28.7	3.2	NS
22.9	2.1	24.6	2.2	**	23.7	2.1	25.1	2.2	NS
40.8	3	39.7	2.8	NS	40.5	2.6	40.7	2.7	NS
103.7	7.1	105	6.6	NS	103.1	6.5	106.9	6.6	NS
33	—	32	—	—	23	—	24	—	—
77.8	3.8	75.6	4.2	*	79.7	3.6	76.9	3.4	**
129.2	5.4	120.7	5.4	**	128.9	5.9	122.8	5.5	**
95.1	3.8	93.2	5.2	NS	96.0	3.8	94.4	3.9	NS
80.9	3.2	82	4.4	NS	81.4	4.4	81.8	4.5	NS
77.8	3.2	80.8	3.4	**	78.2	3.9	81.5	4.4	**
3.3	4.5	0.2	3.7	**	3.2	2.3	0.3	3.2	**
123.8	4.4	129.3	4.2	**	124.8	5.2	133.3	6.8	**
28.5	6.2	26.4	5.1	NS	28.7	5.2	27.3	5.6	NS
56.4	3.8	56.3	3.6	NS	57.1	3.7	56.5	4.5	NS
73.4	6.1	72.4	5.4	NS	76	5.9	77.9	5.9	*
30.8	2.7	29.9	2.8	NS	31.6	3.1	30.9	3.4	NS
25.2	2.9	25.4	2.9	NS	26.7	3	27.4	2.6	NS
45.1	3.2	43.6	2.9	NS	47.3	2.8	45.3	2.9	*
103.6	6.2	106.3	6.3	NS	105.2	6.4	107.3	6.6	NS

FIGURES Return to TOC

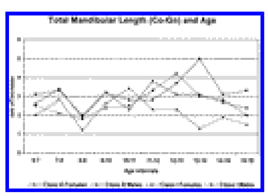

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FIGURE 1. Average differences between subsequent age periods for Total Mandibular Length (Co-Gn) in females and males with Class III malocclusion and normal occlusion

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