Original Article

Longitudinal Cephalometric Changes in Incisor Position, Overjet, and Overbite Between 10 and 14 Years of Age

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Abstract: The purpose of this study was to evaluate the longitudinal growth changes in the incisor position, overjet, and overbite between 10 and 14 years of age. Serial cephalometric radiographs of 63 subjects (31 boys and 32 girls) were taken at the ages of 10, 11, 12, and 14. The effects of age and gender on the incisor positions, overjet, and overbite were investigated by means of variance analysis and least square difference (LSD) tests. The results show that the measurements of overbite, upper incisor-NA (mm), lower incisor-NB (mm), upper incisor-NA (angle), and the interincisal angle were affected by age. The results also show that the measurements of overbite, upper incisor-NA (mm), upper incisor-NA (angle) and upper incisor-SN (angle) were affected by gender. (*Angle Orthod* 2002;72:246–250.)

Key Words: Incisor positions; Overjet; Overbite; Longitudinal cephalometric changes.

INTRODUCTION

The position of the upper and lower incisors relative to each other and to their supporting bones is an important feature in case analysis, post treatment stability, and harmony and balance of the facial profile. Since the introduction of cephalometrics, incisor position in the sagittal plane has become a valuable tool in assessing a malocclusion.[1–3]

The determination of incisor position is a part of most cephalometric analyses. Several authors present specific measures of incisor position.[4–8] The mandibular incisors are believed to be the crux of case analysis.[2] Various norms describing the position of the lower incisors have been proposed and used to predict the stability of treatment results.[5,6,9–11]

Maxillary incisors play an important role as they provide the anterior guiding slope for protrusive excursions of the mandible.[12] The position and axial inclination of the upper and lower incisors also are important factors in determining facial esthetics.

The period between 10 and 14 years of age is a stage at which corrective orthodontic treatment is most frequently applied. Therefore, an evaluation of the changes in the incisor positions normally occurring during this period could provide valuable information for the treatment planning and the assessment of post-treatment stability.

The purpose of the present study was to investigate the longitudinal growth changes in the upper and lower incisor positions and overjet and overbite measurements between 10 and 14 years of age.

MATERIALS AND METHODS

Longitudinal cephalometric radiographs of 63 subjects (31 boys and 32 girls) were selected from the files of Orthodontic Department of Atatürk University Dental Faculty. The selection of subjects was based on normal growth and development, clinically acceptable occlusion and a history of no orthodontic treatment. Serial cephalometric radiographs were exposed annually at the ages of 10, 11, 13, and 14 years. The mean age of the sample at the beginning of this study was 10.18 $\pm$ 1.06 years for the boys and 9.94 $\pm$ 1.01 years for the girls. The mean age of the total sample was 10.06 $\pm$ 1.03 years.

The cephalometric radiographs were taken by standard methods. The cephalometric tracings were performed on acetate paper by a single investigator. The landmarks, reference lines and measurements used in the study are described in Figure 1. Four linear and five angular cephalometric measurements were used to assess longitudinal growth changes in the incisor positions, overjet, and overbite.

To determine the method error, 20 randomly selected cases were retraced and remeasured by the same examiner. The repeated measurements were tested with a paired *t*-test, and no statistically significant differences were found between

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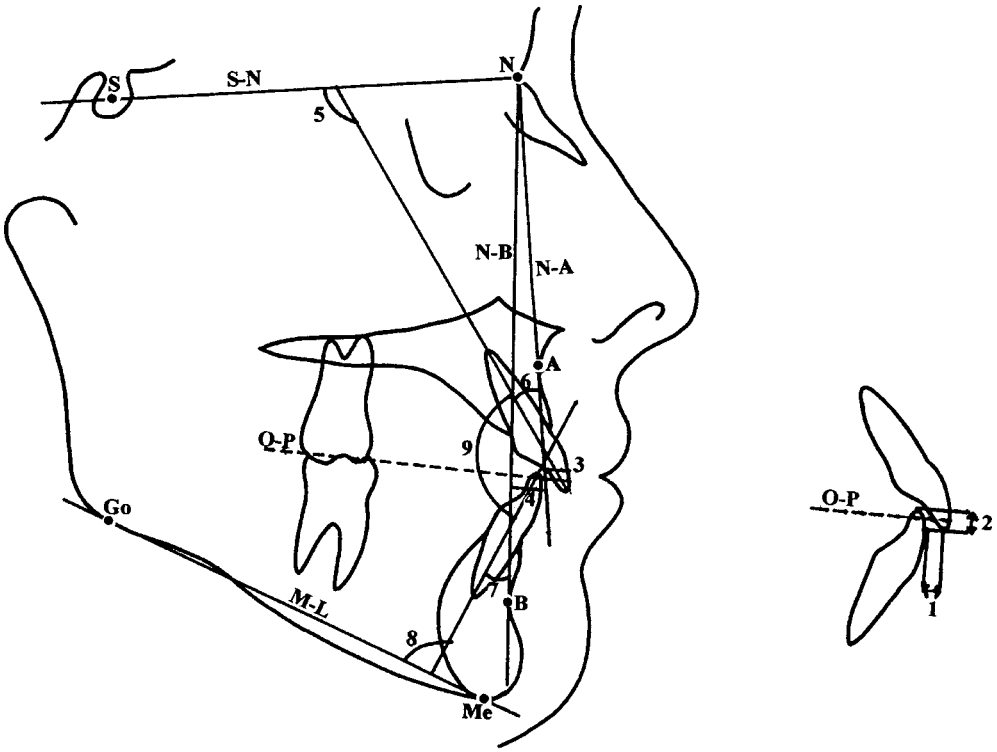

FIGURE 1. Cephalometric measurements used in this study. Linear measurements: (1) Overjet: the horizontal distance (mm) between the buccal surface of the mandibular central incisor and the incisal tips of the maxillary central incisor; (2) Overbite: the vertical distance (mm) between the incisal tips of the maxillary and mandibular central incisors; (3) Maxillary central incisor-NA: the horizontal distance (mm) between the buccal surface of the maxillary central incisor and N-A line; and (4) Mandibular central incisor-NB: the horizontal distance (mm) between the buccal surface of the mandibular central incisor and N-B line. Angular measurements: (1) Maxillary central incisor-SN: the angle (deg) between the long axis of the maxillary central incisor and S-N plane; (2) Maxillary central incisor-NA: the angle (deg) between the long axis of the maxillary central incisor and N-A line; (3) Mandibular central incisor-NB: the angle (deg) between the long axis of the mandibular central incisor and N-B line; (4) Mandibular central incisor-MP: the angle (deg) between the long axis of the mandibular central incisor and the mandibular plane (Go-Me); and (5) interincisal angle: the angle (deg) between the long axis of the maxillary central incisor and long axis of the mandibular central incisor.

the two sets of measurements. The Student's *t*-test was used to determine if the groups were homogeneous with regard to age.

Descriptive statistics including the means and standard deviations were calculated separately for each gender on an annual basis. A variance analysis was used to assess the effects of age and gender on the longitudinal growth changes in the incisor positions, overjet, and overbite. A least square difference (LSD) test was applied to the measurements where F values were found to be statistically significant.

RESULTS

No statistically significant difference existed between the chronological ages of the genders at the beginning of this study according to the Student's *t*-test, ($t = .904$).

Descriptive statistics, including the means and standard deviations, were determined for each age group from 10 to 14 years of age for both genders, and are shown in Table 1 for boys and in Table 2 for girls. The results of the variance analysis are presented in Table 3. As can be seen, overbite (mm), maxillary incisor-NA (mm), maxillary incisor-NA (angle), and the interincisal angle measurements were significantly affected by age. On the other hand, overbite (mm), maxillary incisor-NA (mm), maxillary incisor-SN (angle), and maxillary incisor-NA (angle) measurements were affected by gender.

The LSD test was applied to determine the differences between the age groups and the results are presented in Table 4. According to these results, significant growth changes were found in overbite (mm), maxillary incisor-NA (mm), mandibular incisor-NB (mm), maxillary incisor-NA (angle), and interincisal angle measurements between 10 and 14 years of age. All of these measurements, except for maxillary incisor-NA (angle), demonstrated a significant increase with age. The most pronounced age-related increases occurred in the maxillary incisor-NA (mm), and mandibular incisor-NB (mm) measurements.

DISCUSSION

The findings of this study indicate that there were statistically significant changes in the positions and axial incli-

TABLE 1. The Mean and Standard Deviations of the Male Subjects from 10 to 14 Years of Age

	Male (n = 31)							
	Age 10		Age 11		Age 12		Age 14	
Measurements	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Linear (mm)								
Overjet	2.29	0.96	2.35	0.95	2.45	0.87	2.27	1.14
Overbite	3.16	1.88	3.83	2.00	3.85	1.84	3.64	1.84
Maxillary incisor—NA	3.90	1.40	4.30	1.37	4.64	1.72	6.21	2.04
Mandibular incisor—NB	4.93	1.69	5.19	1.78	5.46	1.76	5.67	2.01
Angular (°)								
Maxillary incisor—SN	98.41	6.74	98.41	6.94	93.30	6.49	97.50	7.04
Maxillary incisor—NA	18.43	5.97	18.16	6.62	18.29	6.60	16.45	6.77
Mandibular incisor—NB	23.67	5.95	23.93	5.37	24.12	5.52	23.56	5.83
Mandibular incisor—MP	93.14	4.68	93.33	4.94	93.77	4.62	93.79	5.95
Interincisal angle	134.88	8.68	134.30	8.46	134.43	8.29	136.95	9.62

TABLE 2. The Mean and Standard Deviations of the Female Subjects from 10 to 14 Years of Age[a]

	Female (n = 32)							
	Age 10		Age 11		Age 12		Age 14	
Measurements	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Linear (mm)								
Overjet	1.71	1.13	2.03	1.03	1.30	1.30	2.04	1.14
Overbite	2.48	1.82	2.70	1.54	3.04	1.51	2.92	1.65
Maxillary incisor—NA	4.79	1.75	5.39	1.62	5.54	1.76	4.77	2.09
Mandibular incisor—NB	4.81	1.59	5.15	1.91	5.09	1.96	5.23	2.31
Angular (°)								
Maxillary incisor—SN	100.87	5.04	101.64	4.58	101.65	4.83	101.31	5.34
Maxillary incisor—NA	21.43	5.40	22.04	4.91	21.65	5.17	21.29	5.24
Mandibular incisor—NB	23.67	5.45	23.37	5.76	23.50	5.90	22.92	6.97
Mandibular incisor—MP	93.93	5.58	93.95	5.20	94.20	5.61	94.20	6.10
Interincisal angle	132.42	7.73	132.54	7.33	132.95	7.91	133.96	9.41

[a] n indicates number of patients; SD, standard deviation; and mm, millimeters.

TABLE 3. The Results of Variance Analysis

Measurements	Age	Sex	Age × Sex
Linear (mm)			
Overjet	1.21	3.09	1.51
Overbite	5.88***	4.30*	0.87
Maxillary incisor—NA	15.55***	7.90**	1.12
Mandibular incisor—NB	7.31***	0.29	1.16
Angular (°)			
Maxillary incisor—SN	1.09	5.13*	1.00
Maxillary incisor—NA	3.96**	7.34**	1.95
Mandibular incisor—NB	0.77	0.10	0.29
Mandibular incisor—MP	0.68	0.19	0.09
Interincisal angle	4.80**	1.18	0.62

* $P < .05$, ** $P < .01$, *** $P < .001$.

nations of the upper and lower incisors between 10 and 14 years of age. Significant gender differences were also found particularly in the positions and axial inclinations of the upper incisors.

Maxillary incisors became more upright and moved forward relative to the N-A line with age, especially in male subjects. Interincisal angle and overbite increased with age due to the changes in the positions and axial inclinations of the upper incisors. However, the overjet showed no significant change in this age period. The axial inclinations of the lower incisors were more stable than the upper incisors in both sexes between 10 and 14 years of age.

Bishara[13] investigated longitudinal cephalometric standards from 5 years of age to adulthood. In both sexes, he found that the maxillary incisor-SN (angle), mandibular incisor-MP (angle), maxillary incisor-A-pog (mm) and mandibular incisor-NB (mm) measurements increased with age,

TABLE 4. The Results of Least Square Difference (LSD) Test[a]

Parameters	Age 10 1	Age 11 2	Age 12 3	Age 14 4	Mean Differences 1–2	1–3	1–4	2–3	2–4	3–4
Linear (mm)										
Overbite	2.82	3.27	3.45	3.28	0.44*	0.62*	0.46*	NS	NS	NS
Maxillary incisor—NA	4.35	4.84	5.09	5.49	0.49*	0.74*	1.14*	0.24*	0.64*	0.40*
Mandibular incisor—NB	4.87	5.17	5.28	5.45	0.30*	0.40*	0.58*	NS	0.28*	NS
Angular										
Maxillary incisor—NA	19.93	20.10	19.97	18.87	NS	NS	NS	NS	1.23*	1.09*
Interincisal angle	133.65	133.42	133.69	135.46	NS	NS	1.80*	NS	2.03*	1.76*

[a] mm indicates millimeter; NS, not significant.
* $P < .05$.

while the interincisal angle decreased with age. In our study, maxillary incisor-NA (mm), mandibular incisor-NB (mm), and the interincisal angle measurements showed significant increases with age, whereas maxillary incisor-SN (angle) and mandibular incisor-MP (angle) measurements remained stable during the study period.

Forsberg[14] and Behrents[15] reported that maxillary incisors became more upright with age in both sexes, which is in agreement with our findings. Forsberg[14] also found that the mandibular incisors in male subjects have a tendency to procline, but found no change in the interincisal angle in both sexes. However, Behrents[15,16] observed no changes in the interincisal angle in female subjects, but a decrease in male subjects. Neither of them found any changes in overbite.[14,15]

These results are in contrast to the findings of the present study where we found that the mandibular incisors in girls have a tendency to remain stable. However, the interincisal angle and overbite showed statistically significant increases in both boys and girls.

Bishara et al[17] noted that, on the average, the incisors tend to be upright in male subjects and to very slightly incline labially in female subjects. However, Watanabe et al[18] reported that the incisor proclined in both boys and girls between 8 and 15 years. In the present study, we found that the upper and lower incisors tended to be upright in both sexes.

Bishara et al[19] studied facial and dental changes between 25 and 46 years of age, and found that the positions and axial inclinations of the upper and lower incisors, overjet, and overbite did not change during this period. They also found that only interincisal angle showed a significant change at a significant level of $P < .05$.

On the other hand, Sinclair and Little[20] reported that the overjet and overbite increased significantly from 9 to 13 years of age, whereas from 13 to 20 years of age these changes reversed and decreases in overjet and overbite were noticed. In the present study, overbite measurement showed significant increase with age, while no significant change in the overjet measurement was found.

CONCLUSIONS

This study demonstrated significant changes in the positions and axial inclinations of the upper and lower incisors relative to each other and to their supporting bones between 10 and 14 years of age. There were also significant gender differences, especially in the positions and axial inclinations of the upper incisors. The maxillary incisors became more upright and moved forward with age, especially in male subjects, whereas the axial inclinations of the mandibular incisors in general remained very stable in both sexes during this age period. Interincisal angle and overbite showed significant increases with age. However, no significant change in the overjet was found.

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