

Dental Maturation in Short and Long Facial Types

Is There a Difference?

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ABSTRACT

Objective: The purpose of this investigation was to study the relationship between vertical skeletal growth pattern and dental maturation in children with long or short anterior facial height.

Materials and Methods: The sample consisted of the records of 312 Dutch children (153 boys and 159 girls, aged 9–12.9 years, with a mean chronological age of 11.3 years). The subjects were selected according to their lower anterior facial height as a percentage of the total facial height. Two groups, one with long and the other with short anterior facial height, were formed for further comparison. Dental age, according to Demirjian's dental maturity score, was determined for each subject. The power of the study was 79% (2-sided test) and 87% (1-sided test).

Results: There was no statistically significant difference in dental age score between the two extreme groups. The subjects with short anterior facial height demonstrated a slight tendency toward more advanced dental age.

Conclusions: The difference in dental age between long and short facial types is not big enough to be clinically relevant.

KEY WORDS: Dental maturation; Facial type

INTRODUCTION

Maturation of various tissue systems (ie, bony age, tooth formation, subcutaneous fat thickness, and menarche in girls) has been used in the literature to describe the developmental stages of growing children. So far, there has been no consensus regarding the relationship between skeletal and dental age. Some researchers¹ reported a high correlation ($r = 0.83$), while others^{2,3} a much lower one ($r = 0.77$ and $r =$

0.46 respectively). Chertkow and Fatti⁴ examined the relationship between the sesamoid bone and the calcification of the cuspids and found a high correlation ($r = 0.8$) between them; however, their findings were questioned by others.⁵

One factor that might explain the different correlations the various studies observed between skeletal maturation and dental maturation or dental eruption could be the difficulty in assessing skeletal maturity, because many of the centers of ossification used to determine skeletal maturity exhibit a considerable variation in the timing of their onset. Sierra⁵ found a high correlation ($r = 0.7$ to $r = 0.8$) between dental calcification and skeletal age by using an eight-ossification-centers-method, while lower associations ($r = 0.3$ to $r = 0.7$) were recently reported in a Thai population.⁶

Hägg and Taranger found a low correlation ($r = 0.35$) between pubertal growth and dental eruption stages,⁷ whereas Vallejo-Bolanos and Espana-Lopez⁸ found a marked positive relationship between dental development and body growth. In addition, Chertkow⁹ observed a high correlation ($r = 0.88$) between pubertal age and the calcification stages of the lower canine.

Nanda¹⁰ observed some disparity in the timing of the facial adolescent growth spurt between subjects with skeletal open bite and those with deep bite. Subjects

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with skeletal open bite presented the onset of the adolescent growth spurt in the facial measurements earlier than those with deep bite. He suggested a possibility of delaying orthodontic treatment of patients with a skeletal deep bite because of a later onset of their growth spurt. According to him, the delay might be also beneficial for the retention, as a much shorter retention period might be required.

Janson et al¹¹ conducted the first study to investigate the influence of facial type on dental development in subjects of the same chronological age. They showed that long face subjects presented a tendency to have an advanced dental maturation in comparison to short face subjects, expressed by a mean difference in dental age of 6 months. However, the sample included in his study was rather small, and the two extreme groups were overlapping each other, which might have obscured the results.

The aim of the present study is to investigate the relationship between vertical skeletal pattern and dental maturation in children with long or short anterior facial height.

MATERIALS AND METHODS

Subjects

The sample consisted of the records of 312 patients from the archive of the Department of Orthodontics and Oral Biology, Radboud University Nijmegen Medical Center, Nijmegen, The Netherlands. The subjects were selected from an initial sample of 700 patients. Selection of the subjects was based on the lower face height measurement (ANS-Me) as a percentage of total face height (N-Me). The subjects had to meet the following inclusion criteria:

- Caucasian;
- Age between 9 and 12.9 years;
- No prior orthodontic treatment;
- No history of severe medical illness or syndrome;
- No more than one congenitally missing tooth (3rd molars excluded);
- Lateral cephalometric and panoramic radiographs of each patient prior to treatment available;
- Pretreatment records of the subjects taken between 1990–2000; and
- The ratio ANS-Me/N-Me lower or equal to 56% or higher or equal to 58%.

The selection of the cutoff points for the ratio ANS-Me/N-Me was based on both clinical experience and the literature.¹² With this selection, a sample could be established that consisted of subjects with either disproportionately small or large anterior face height without having the short and long face groups overlapping each other.

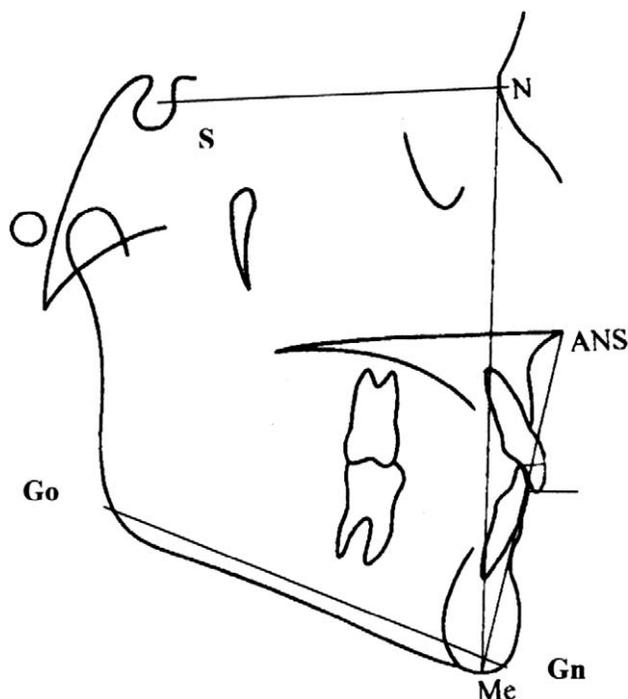


Figure 1. Cephalometric landmarks and measurements used to describe vertical characteristics of the subjects included in the present study.

Methods

The following cephalometric landmarks and measurements were used to describe the subjects' vertical facial characteristics (Figure 1):

Landmarks:

- ANS—anterior nasal spine;
- N—nasion;
- Me—menton;
- S—sella;
- Go—gonion;
- Gn—gnathion; and
- Incisal edges of the upper and lower incisor.

Measurements:

- LAFH—lower anterior face height, anterior nasal spine to menton (ANS-Me);
- TAFH—total anterior face height, nasion to menton (N-Me);
- ANS-Me/N-Me—the percentage of lower anterior face height (ANS-Me) to total anterior face height (N-Me);
- Overbite—the vertical distance from the incisal edge of the upper incisor to the incisal edge of the lower incisor;
- Mandibular plane angle according to Steiner—the angle between the S-N plane and the Go-Gn plane; and

- SN/Go-Gn—sella-nasion to gonion-gnathion angle.

Each lateral cephalogram was traced on acetate paper by one examiner. Landmarks defined in x-y coordinate system (Figure 1) were digitized by means of a digitizer.

Dental Age Assessment

The panoramic radiographs (OPT) were used to assess the dental maturity. The system of dental age assessment as described by Demirjian and co-workers^{13,14} formed the basis for the assessment. Maturity scores based on seven teeth on the left side of the mandible were recorded. For every tooth, eight stages are determined. Each stage is allocated a numerical score derived from standard tables, boys and girls separately. The total score of the seven teeth constitutes the patient's maturity score.

If needed, the total dental maturity score can be converted into a dental age by using a table of standards for boys and girls. If one tooth was missing, the contralateral tooth was assessed instead. The scores were determined by one examiner and calibrated through regular exercises on the panoramic radiographs using the Demirjian CD-ROM.

Measurement Error

Fifteen randomly chosen cephalograms were retraced after a 30-day interval. The method error for both the locating and digitizing of the landmarks was calculated by the Dahlberg's¹⁵ Formula ($Se = \sqrt{\sum d^2/2n}$, where d is the difference in measurements of cephalometric values on two different occasions and n is the number of double recordings).

For the ratio ANS-Me/N-Me $\times 100$ (ranging from 50–67), the error for retracing was 0.4. For the angular measurements (SN/Go-Gn ranging from 17°–50°), the error for retracing was 0.4°. Dental maturity was reassessed in 15 randomly selected subjects after a 30-day interval. The intraexaminer reliability in dental age assessment was $r = 0.97$.

Statistical Analysis

Means and standard deviations were calculated for the whole group. Regression analysis was used to explain dental age from the facial height ratio, sex, and chronological age. The differences in dental age between the two extreme groups (ie, the short face and the long face facial types) were established. From the clinical point of view, at least a half-year difference between the study groups was considered to be significant.

Finally, the face height ratio was explained from the

TABLE 1. Overall Characteristics of Study Sample

Subject Characteristics ^a	Mean (SD)	Range
Chronological age, y	11.3 (1.0)	9 to 12.9
Dental age, y	11.9 (1.3)	8.4 to 15.5
Age difference, ^b y	0.6 (1.1)	–3.1 to 3.8
Overbite, mm	3.6 (2.4)	–3 to 8
SN/Go-Gn angle, ^c degree	32.6 (6.6)	17 to 50
ANS-Me/N-Me ratio, ^c $\times 100$	58.0 (2.7)	50 to 67

^a Study sample included 312 subjects, 159 female and 153 male subjects.

^b Difference in years between the dental age and the chronological age.

^c SN/Go-Gn angle, sella-nasion to gonion-gnathion angle; ANS-Me/N-Me, percentage of lower anterior face height to total anterior face height.

TABLE 2. Comparison of Two Extreme Groups: Ratio <56 and ≥ 59

Patient Characteristics	Short Face (n = 69)	Long Face (n = 107)
	Mean (SD)	Mean (SD)
ANS-Me/N-Me ratio, ^a $\times 100$	54.5 (1.2)	61.0 (1.5)
Dental age, y	12.1 (1.2)	11.6 (1.2)
Chronological age, ^b y	11.4 (0.8)	11.0 (1.0)
Age difference, ^c y	0.7 (1.0)	0.6 (1.0)
Overbite	4.7 (1.6)	2.1 (2.5)
SN/Go-Gn angle, ^a degree	28.6 (5.0)	36.6 (6.1)

^a ANS-Me/N-Me, percentage of lower anterior face height to total anterior face height; Sn/Go-Gn angle, sella-nasion to gonion-gnathion angle.

^b Age range 9 to 12.9 years.

^c Difference in years between the dental age and the chronological age.

SN/Go-Gn angle or overbite by multiple regression analysis, correcting for sex and age.

RESULTS

Based on the total of 312 subjects, the regression analysis did not find a significant relationship between facial height and dental age ($P = .6$ after correction for sex and chronological age).

The means and standard deviations of the total sample of 312 patients are presented in Table 1.

To demonstrate that there is no significant influence of face height on dental age, two extreme groups were compared: short face ratio <56 and long face ratio ≥ 59 . The results of the comparison are presented in Table 2. The age discrepancy, represented by the age difference (ie, the difference between the dental and the chronological age), was almost equal for both groups: 0.6 years for the long face patients and 0.7 years for the short face patients. The above result, therefore, confirmed that there was no significant difference in the dental age between the two extreme groups. The power of the study was 79% (2-sided test) and 87% (1-sided test).

TABLE 3. Comparison of Two Extreme Groups: Ratio <56 and ≥59

Subject Characteristics	Short Face	Long Face
	Height (n = 24) Mean (SD)	Height (n = 55) Mean (SD)
ANS-Me/N-Me ^a	54.3 (1.3)	60.9 (1.4)
Dental age, y	11.4 (1.1)	11.0 (1.0)
Chronological age, ^b y	10.5 (0.4)	10.3 (0.5)
Age difference, ^c y	0.9 (1.0)	0.7 (0.9)
Overbite	4.5 (1.3)	2.1 (2.4)
SN/Go-Gn angle, ^a degree	29.3 (4.6)	36.8 (6.0)

^a ANS-Me/N-Me, Percentage of lower anterior face height to total anterior face height; SN/Go-Gn, sella-nasion to gonion-gnathion angle.

^b Age range 9 to 11.0 years.

^c Difference in years between the dental age and the chronological age.

Table 2 also demonstrates a large difference in overbite and SN/Go-Gn angle between the long facial height and the short facial height groups. Regression analysis showed that the facial height ratio can be explained from both the overbite ($r = 0.38$) and SN/Go-Gn angle ($r = 0.46$), after correction for sex and age ($P < .00005$).

When we limited the age range of the two extreme groups from 9–12.9 years to 9–11.0 years, our findings were somewhat different. There was a slight tendency toward more advanced dental age in the short facial height group, which is exactly the opposite to the findings of Janson et al¹¹; however, the results were not statistically significant (Table 3).

The same tendency was observed when we changed the ratio into <55 and ≥60, age range 9–11.0 years.

DISCUSSION

The method of Demirjian et al^{13,14} is a reliable and convenient method to determine the dental age using a scoring system based on objective criteria. The intraexaminer reliability in dental age assessment in the present study was very high.

The maturity standards of Demirjian are based on a sample of French-Canadian children. It has been shown that different patterns of dental maturation exist between various population groups,^{16,17} so that the standards of dental age determination may need to be adjusted for the specific population studied. However, because in the present study two groups of the same population were compared, possible differences in dental development between Dutch and French-Canadian children would have equally influenced the two groups.

The findings of the present study showed no significant differences in dental development between the

short face and the long face skeletal types. This is contrary to previous findings. Although Janson et al¹¹ found statistically significant difference between the two vertical facial types, the sample he used was rather small to draw reliable conclusions. Moreover, the skeletal open bite and deep bite groups included in their study were overlapping each other. Thus, two subjects with exactly the same vertical parameters could have been assigned to two extreme groups: the open bite and the deep bite group. We believe that a clear-cut definition of the short and long face groups, excluding the subjects with hybrid vertical characteristics, is crucial in this type of study.

One might wonder whether the discrepancy between the findings of the present study and those of Janson et al¹¹ might have been caused by the age differences between the samples of both studies. Hägg and Matsson¹⁸ showed a high accuracy of the Demirjian method for younger age groups, while the accuracy of the method became less in older children. It is possible that in younger age groups the differences in dental maturity between the two skeletal types are more pronounced; therefore, within a few years, the “catch-up” process would obscure those differences. However, when we limited the sample of the present study to include only the subjects whose age range was 9–11.0 years, the results were contradictory to those quoted in the literature. There was a slight tendency toward a more advanced dental age in the short face group and not in the long face group.

To avoid any possible influence of secular trend,¹⁹ care was taken to include only those patients who were seen at our department in the period 1990–2000. However, the sample may have differed from the sample of Janson et al¹¹ in this respect and thus may have influenced the outcome of both studies.

CONCLUSIONS

- No statistically significant differences in dental age were present between the subjects with short anterior facial height and long anterior facial height.
- Subjects with short anterior facial height presented a slight tendency toward a more advanced dental age than those with long anterior facial height.

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