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Dental maturity amongst various vertical and sagittal facial patterns

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ORIGINAL ARTICLE

Dental Maturity Amongst Various Vertical and Sagittal Facial Patterns

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ABSTRACT

Objective: To compare the mean dental maturity amongst three vertical facial patterns (short, average and long anterior facial heights) and also amongst two sagittal facial patterns (skeletal class I and II) in orthodontic patients.

Study Design: Cross-sectional analytical study.

Place and Duration of Study: The Aga Khan University Hospital, Karachi, from August to October 2008.

Methodology: Data was retrospectively retrieved from pretreatment orthodontic records of patients who visited the orthodontic clinic. The sample was divided into three vertical groups, namely short, average and long anterior facial types, and two sagittal groups, namely skeletal class I and II. Dental development was assessed using the Demirjian's system. One way ANOVA and independent sample t-test were used to find any difference in dental maturity amongst vertical and sagittal facial patterns, respectively.

Results: There was no statistically significant difference in dental maturity amongst the three vertical facial patterns ($p=0.111$) and also amongst the two sagittal groups ($p=0.975$). Statistically significant gender dimorphism ($p < 0.001$) was seen amongst boys and girls for dental maturity with girls being more advanced than boys in their dental development.

Conclusion: Dental maturation in the three vertical and the two sagittal groups showed no statistically significant difference in our studied population sample and thus need no variations in treatment initiation timings. However, girls should be treated earlier as they are dentally more advanced than boys.

Key words: *Dental maturation. Facial type. Vertical facial pattern. Sagittal facial pattern.*

INTRODUCTION

The concept of physiological age is based on the assessment of various maturity indicators like skeletal age, sexual maturity, morphological age, dental age etc. The importance of dental age in diagnosis and evaluation of treatment results of pediatric endocrinopathies and in forensic dentistry is also evident.[1] Different views regarding the association amongst dental maturity and skeletal maturity have also been cited in the literature, with some researchers proposing a weak correlation and some a strong one.[2-5]

Various methods have been devised for determining the dental age of an individual based on either the tooth eruption stages or the tooth calcification stages. However, tooth calcification has been proven as a more reliable criterion for determining the dental age.[1] Demirjian *et al.* proposed a method for determining dental age using the mandibular left quadrant (central incisor to second molar) on an orthopantomograph and the method devised by him has been used by many researchers in their valued works.[1,3,6,7]

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Influence of facial type on dental development has been studied and long face subjects with skeletal open bites have been seen to present a tendency towards an advanced dental age than short face subjects having a deep skeletal bite.[7] While comparing vertical growers with horizontal growers, subjects with vertical growth patterns have been seen to mature dentally earlier than horizontal growers.[8] Contrary results were found, suggesting that subjects with long facial height are delayed in their dental development than short face subjects, in a Caucasian population studied in Netherlands.[6] Regarding the sagittal facial patterns, no study has been found comparing dental maturity in skeletal class I, II and III. However, skeletal class II subjects have shown an earlier eruption of maxillary second molars.[9] In different populations gender dimorphism has been seen for dental maturity with some showing girls as dentally more advanced than boys[10] and others vice versa.[2]

Having the knowledge of the dental developmental pattern amongst different facial types in a particular population can help an orthodontist in various ways, especially during treatment planning for fixed orthodontic treatment. In patients belonging to a particular facial pattern with delayed dental maturity, orthodontic treatment may be started at a later stage and a shorter retention period after orthodontic treatment may be required.

The aim of this study was to compare the mean dental maturity amongst subjects with short, average and long anterior facial height and amongst subjects of skeletal class I and II in orthodontic patients at a tertiary care hospital in Karachi.

METHODOLOGY

A cross-sectional analytical study was conducted using data from pretreatment orthodontic records of patients who visited the orthodontic clinic, from June 2002 to June 2008. The inclusion criteria were subjects of Pakistani origin, aged between 7-17 years and having no prior history of orthodontic treatment. Patients having craniofacial syndromes were excluded.

NCSS PASS was used to calculate the sample size using means and standard deviations from a pilot study done by the principal examiner on a sample of 60 subjects (20 in each vertical group i.e. short, average and long facial patterns). A sample size of 264 gave the power of > 80%.

The sample was divided into three vertical and two sagittal groups; short, average and long for the vertical patterns, and skeletal class I and II for the horizontal patterns. Lower anterior facial height was measured from anterior nasal spine (ANS) to menton (Me) and total anterior facial height from nasion (N) to Me. Ratio of lower anterior facial height to total anterior facial height (LAFH/TAFH) was used to divide the sample into short, average and long groups with ratios of < 55%, 56-58% and > 59% respectively. ANB angle was used to group the skeletal class I and II subjects (ANB=0-4^{o} and ANB > 4^{o} respectively). Pretreatment orthopantomographs were examined by a single investigator and individual teeth (central incisor to second molar) in the mandibular left quadrant were assigned a maturity stage based on Demirjian's[1] method for determining the dental age. The maturity stages were converted into maturity scores based on separate conversion tables for boys and girls.[1] The individual maturity scores were added to achieve a total maturity score. The total maturity score was then converted to dental age using the Demirjian's tables.[1]

The total dental maturity scores were compared using one way ANOVA amongst the three vertical facial patterns namely short, average and long anterior facial types. Independent sample t-test was used to compare dental maturity scores amongst the two horizontal groups i.e. skeletal class I and II and to assess the gender dimorphism. P-value of < 0.05 was considered to be significant.

To rule out measurement error 33 cephalograms and orthopantomographs were re-evaluated after one month by the principal investigator and paired samples t-test was used to determine the measurement error for determining the LAFH/TAFH ratio, ANB angle and dental maturity.

RESULTS

The study sample consisted of a total of 264 subjects (111 males and 153 females) with 88 subjects each in short, average and long facial height groups. The skeletal class I and II groups consisted of 132 subjects each in the two horizontal groups.

The mean chronological age, range and standard deviation was determined for the sample. A comparable chronological age in all the groups (p=0.285 using one-way ANOVA for the three vertical groups and p=0.571 using independent samples t-test for the two horizontal groups) confirms that there was no significant difference in the chronological ages of the sample being studied, indicating a uniform baseline data.

The orthopantomographs of the subjects were evaluated and maturity scores were obtained. Table I shows the dental maturity amongst the vertical and horizontal facial patterns and depicts no statistically significant difference in dental maturity amongst the three vertical groups (p=0.111). The dental maturity scores when compared amongst skeletal class I and class II subjects also give a statistically non significant difference (p=0.975).

Table I: Dental maturity and dental age across the various vertical and sagittal facial patterns.

Facial pattern		Mean dental maturity ± SD	p-value	Mean dental age ± SD	p-value
Vertical patterns[a] (n=264)	Short (n=88)	96.20 ± 3.22		13.22 ± 2.17	
	Average (n=88)	95.50 ± 4.57	0.111	12.94 ± 2.17	0.281
	Long (n=88)	94.85 ± 4.81		12.68 ± 2.33	
Sagittal patterns[b] (n=264)	Skeletal class I (n=132)	95.51 ± 4.60	0.975	13.03 ± 2.29	0.516
	Skeletal class II (n=132)	95.52 ± 3.95		12.86 ± 2.16	

[a]*One way ANOVA for comparison amongst vertical patterns.*
[b]*Independent samples t-test for comparison amongst sagittal patterns.*
Level of significance ≤0.05; SD: Standard Deviation.

To compare dental maturity across the two extreme borders of short and long facial pattern subjects', 40 cases from the extreme end of short facial height group and 40 from the extreme end of long facial height group were analyzed using Independent samples t-test. The results showed a statistically non significant difference amongst dental maturity for the two extreme groups as shown in Table II.

Table II: Chronological age and dental maturity across the extreme short and long facial patterns.

Facial pattern		Mean chronological age ± SD	p-value	Mean dental maturity ± SD	p-value
Vertical Patterns[a] (n=80)	Short (n=40)	12.50 ± 1.74	0.255	96.36 ± 3.26	0.151
	Long (n=40)	11.99 ± 2.17		95.03 ± 4.78	

[a]*Independent samples t-test for comparison amongst the extreme vertical patterns.*
Level of significance ≤0.05; SD: Standard Deviation.

Subjects at different chronological age stages (8-10 years, 11-13 years and 14-16 years) were compared for dental maturity amongst various vertical and horizontal facial patterns and the results are shown in Table III. No statistically significant difference was seen amongst the three vertical and horizontal facial patterns across the three age groups.

Table III: Dental maturity across various facial patterns for different chronological age stages.

Age stage	Facial patterns			Dental maturity mean ± SD	p-value
8-10 years (n=70)	Vertical facial patterns	Short	(n = 17)	91.81 ± 2.64	0.067
		Average	(n = 24)	92.93 ± 2.62	
		Long	(n = 29)	90.43 ± 5.06	
	Sagittal facial patterns	Skeletal class I	(n = 36)	91.60 ± 3.34	0.961
		Skeletal class II	(n = 34)	91.64 ± 4.53	
11-13 years (n=139)	Vertical facial patterns	Short	(n = 52)	96.76 ± 2.42	0.542
		Average	(n = 41)	96.20 ± 2.30	
		Long	(n = 46)	96.58 ±2.52	
	Sagittal facial patterns	Skeletal class I	(n = 65)	96.82 ± 2.43	0.184
		Skeletal class II	(n = 74)	96.28 ± 2.40	
14-16 years (n=51)	Vertical facial patterns	Short	(n = 18)	98.75 ± 1.36	0.352
		Average	(n = 21)	99.05 ± 1.38	
		Long	(n = 12)	99.44 ± 0.85	
	Sagittal facial patterns	Skeletal class I	(n = 28)	98.95 ± 1.28	0.603
		Skeletal class II	(n = 23)	99.14 ± 1.28	

[a]*One way ANOVA for comparison amongst vertical patterns.*
[b]*Independent samples t-test for comparison amongst Sagittal patterns.*
Level of significance ≤0.05; SD: Standard Deviation.

The result of independent sample t-test to assess any gender dimorphism amongst the dental maturity scores depicts a statistically significant ($p < 0.001$) difference with girls being more advanced in their dental development (mean dental maturity was 93.94±4.02 for males and 96.65±4.11 for females). The mean chronological ages for male and female subjects were 12.00±1.75 and 12.20±2.06 years (p=0.427) respectively, showing a uniform baseline data with no statistically significant difference in the chronological ages of males and females.

A statistically insignificant difference was seen amongst the initial and the second set of readings for LAFH/TAFH ratio (p=0.099), ANB (p=0.768) and dental maturity (p=0.239), thus giving a good intra-examiner reliability for these measurements.

DISCUSSION

Demirjian's method for determining the dental maturity, used in the present study,[1] is a reliable and reproducible method, as a strong correlation is seen for intra-examiner reliability. Dental maturity scores were converted to dental age using conversion tables as the latter is clinically applicable and more easily recognizable.[7] The conversion table used to convert dental maturity to dental age has been developed on a French-Canadian population, and differences in dental maturity patterns in various populations have been reported.[11-14] However, its applicability in this study is valid as dental age was not compared with chronological age, and the difference amongst theirs' and the present scores of dental age would have affected all the groups equally.[6]

The results of this study showed that there was no statistically significant difference in dental maturity amongst the three vertical facial patterns. Jamroz *et al.* in their study on dental maturation in short and long facial types, also found no statistically significant difference in dental age scores between the two groups.[6] However, subjects with short anterior facial height demonstrated a slight tendency toward more advanced dental age. Results of the present study also show that the short facial pattern subjects are advanced by six months in their dental age when compared to the long facial pattern group. Taking into consideration the treatment time, a difference of six months in dental age is reported to be clinically significant in the literature,[6] the results of the present study, though statistically insignificant, depict a clinically significant difference.

Janson *et al.* studied the dental developmental pattern in a sample of 40 white subjects, (20 males and 20 females), exhibiting the most extreme vertical facial types, using the Demirjian's method.[7] The skeletal open bite and deep bite subjects presented a mean dental age of 120.48 and 114.00 months respectively and this difference was statistically and clinically significant. They concluded that skeletal open bite subjects presented a slight tendency to have an advanced dental maturation, expressed by dental age, as compared with skeletal deep bite subjects. These results are in contrast to the present one as in this sample, short vertical facial height subjects were dentally slightly more advanced when compared with long facial height group. The results of Janson *et al.* however, cannot be generalized as the sample used was rather small.[7] Similarly, it has been reported that skeletal open bite subjects reach their adolescent growth spurt earlier than skeletal deep bite subjects.[15]

In the present study, no statistically significant difference was seen amongst skeletal class I and II subjects regarding their dental maturation. However, in the literature skeletal class II subjects have been reported to show an earlier eruption of maxillary second molars as compared to class I subjects.[9] Suda *et al.*[16] conducted a study on skeletal class III Japanese patients to assess the relationship between formation and eruption of maxillary teeth and skeletal pattern of maxilla.[16] He divided the sample into 2 groups: a maxillary retrusion (MR) group, characterized by a small SNA angle and a short palatal length, and a control group in which those values were in the normal range for patients of Japanese descent. He found no significant difference in the rate of formation for the maxillary and mandibular teeth between the two groups. However, the eruption of the maxillary second molars was delayed in the maxillary retrusive group as compared with the control group. The class III sample was limited here for which reason it was not included in this study and it is recommended to conduct a study including a skeletal class III sample in the local population.

Statistically significant gender dimorphism was seen amongst boys and girls in our study sample with girls being more advanced in their dental development. Al-Emran and Zhao *et al.* also reported girls to be more advanced in their dental development as compared to boys.[10,17] Zhao *et al.* studied dental maturity in a group of children born in Chengdu from 1972 to 1988, using the Demirjian's system and also reported girls to be more advanced in their dental maturity than boys, especially during 7-14 years of age, incorporating the root development stages ($p < 0.05$).[10]

Hagg and Taranger investigated pubertal growth spurt and dental, skeletal, and pubertal development in a prospective longitudinal study of 212 randomly selected Swedish children by means of maturation level indicators suitable for use in clinical orthodontics.[2] They reported boys to be more advanced in their dental development in relation to pubertal growth spurt. In contrast, the present study reports girls to be more advanced in their dental development.

Patients having craniofacial syndromes were excluded in this study to control for any confounding factors for variations in dental development as various syndromes may either result in a delayed or advanced dental maturity.[18-20]

Based on the present study, it is suggested that there is no need in alteration of treatment initiation timings for the short, average and long facial height subjects, as well as for skeletal class I and II subjects, as there are no statistically significant differences in dental maturity amongst the above mentioned groups. However, girls should be treated earlier than boys as they are statistically more advanced in their dental development.

CONCLUSION

The results suggest no statistically significant difference in dental maturation and dental age amongst the three vertical and the two sagittal facial patterns respectively. Statistically significant gender dimorphism was seen for dental development amongst males and females with females being more advanced in their dental development.

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