ORIGINAL ARTICLE

Validity of the Demirjian method for dental age estimation for Southern Turkish children

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Abstract

Objective: The aim of this study was to evaluate the applicability of the Demirjian method for southern Turkish population.
Materials and Methods: Panoramic radiographs of 535 patients (276 females, 259 males aged from 10 to 18 years) selected retrospectively. Dental age was calculated using the Demirjian's method. Chronologic age was calculated by subtracting the date of the birth from the date of the panoramic radiograph after having converted both to a decimal age. The chronologic and dental ages were compared using the paired *t*-test.
Results: The mean difference between the chronologic and dental ages ranged from 0.02 to 0.79 years in females. These differences in females between the chronologic and dental ages were statistically significant in total ($P < 0.050$) and in G1 (10–10.90 years) ($P < 0.010$) and G2 (11–11.90 years) ($P < 0.001$). The mean difference between the chronologic and dental ages ranged from 0.04 to 0.85 years in males. These differences in males between the chronologic age and dental age were statistically significant in total ($P < 0.010$) and in G4 (13–13.90 years) G5 (14–14.90 years) G6 (15–15.90 years) groups ($P < 0.050$).
Conclusions: It is appropriate to use the Demirjian method in southern Turkish children; however, a revision is needed in some age groups.

Key words: Chronologic age, dental age, Demirjian method, Turkish population

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Introduction

Children with the same chronological age may show differences according to the developmental stages of different biological systems.[1] To determine the developmental stage of a child, several indices have been developed for a certain biological system, which use sexual maturity, somatic maturity, skeletal age, and dental age.[1] However, since dental maturity indicators exhibit less variability than other bone and skeletal tissues, which are more susceptible to exogenic factors, such as malnutrition or systematic diseases, they have received more attention and are thought to be more useful indices of maturation[2-4] Demirjian *et al*.[5] stated that there is a strong correlation exists between skeletal age and chronologic age.

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Demirjian's method, however, was formulated using French-Canadian children; it has become the most widely used dental age examination method all over the world. Numerous studies have tested the applicability of this method in various population, including Australian,[6] Brazilian,[7] British,[8,9] Caucasian American,[10] Chinese,[8,11] Dutch,[1] Malay,[3] and South Indian[12] and they concluded that applicability of the method varies with a population used which means the same method could produce a different result.

Although some studies[13-16] have tested the applicability of Demirjian method in many different Turkish population

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including eastern, northeastern, western-northern, to our knowledge, there is only one study in the literature evaluates the applicability of Demirjian method for southern Turkish population.[17] That study reported differences of 0.5–1.4 years in females and from 0.4 to 1.4 years in males.[17] Since various investigators have demonstrated differences between several ethnic groups, as well as between geographical areas or cities within the same country,[18] it is important to evaluate the methods applicability in each sub-population. Thus, the aim of this study was to evaluate the applicability of the Demirjian method for southern Turkish population and to discuss the findings with those of different regions within the country and population.

Materials and Methods

Panoramic radiographs of 535 patients (276 females, 259 males aged from 10 to 18) selected retrospectively from the archives of Akdeniz University, Faculty of Dentistry, and Department of Orthodontics. Selection criteria included no previous orthodontic treatment and having good quality of panoramic radiographs and all mandibular teeth present. Subjects with skeletal malocclusions including cross bite and sagittal malocclusions, systemic diseases affecting the growth and development of the teeth and tooth agenesis excluding third molars were excluded. Table 1 shows the distribution of the subjects by gender and age.

To ensure contrast enhancement of the tooth images, all assessments were performed by one investigator in a darkened room with a radiographic illuminator. Chronologic age was first recorded on a data collection sheet, and the dental age scores were tabulated later on a separate sheet in order to avoid the examiner bias at the time of collecting data.

Chronologic age was calculated by subtracting the date of the birth from the date of the panoramic radiograph after having converted both to a decimal age.

Dental age was calculated using the Demirjian's method. The development of each left permanent mandibular tooth, from the central incisor to the second molar on panoramic radiograph was rated on an 8-stage scale from A to H, and the criteria for the stages were given for each tooth separately. These individual stages were later converted into maturity scores, and the sum of the scores gave an evaluation of the subject's dental maturity, measured on a scale from 0 to 100. The dental maturity score of each subject was converted into dental age using standard tables for each gender separately. Chronological and dental ages of the samples were calculated by one researcher (B.K) to eliminate the inter-observer error.

Statistical method

Descriptive statistics was calculated for all measurements. Kolmogorov–Smirnov test was performed to test the normality of the data. Since the results of the Kolmogorov–Smirnov test showed normal distribution, parametric tests were performed. The chronologic and dental ages were compared using the paired *t*-test.

Totally, 50 out of 535 radiographs were randomly selected and re-examined 4 weeks after the initial examination by the same investigator to determine the measurement error. Examination of results using the paired *t*-and Houston tests showed no statistically significant differences between the two examinations ($P > 0.050$). All statistical analyses were conducted using SPSS version 17.0.0 (SPSS Inc., Chicago, IL, USA). Significance for all statistical tests was predetermined at $P < 0.050$.

Results

Table 2 shows the differences between the mean chronologic Age and estimated dental age using the Demirjian method for different age groups and total sample for males and females. The mean difference between the chronologic age and dental age ranged from 0.02 to 0.79 years in females. These differences in females between the chronologic and dental ages were statistically significant in total ($P < 0.050$), G1 (10–10.90 years) ($P < 0.010$) and G2 (11–11.90 years) ($P < 0.001$) groups. The mean difference between the chronologic and dental age ranged from 0.04 to 0.85 years in males. These differences in males between the chronologic and dental ages were statistically significant in total ($P < 0.010$) and in G4 (13–13.90 years) G5 (14–14.90 years) G6 (15–15.90 years) groups ($P < 0.050$).

Table 1: The distribution of the subjects by gender and age

Group (years)	Female	Male	Total
G1 (10-10.9)	21	24	45
G2 (11-11.9)	46	24	70
G3 (12-12.9)	55	50	105
G4 (13-13.9)	63	63	126
G5 (14-14.9)	29	36	65
G6 (15-15.9)	20	26	46
G7 (16-16.9)	22	21	43
G8 (17-17.9)	20	15	35
Total	276	259	535

Table 2: The differences between the mean chronologic age and estimated dental age using the Demirjian method for different age groups for males and females

Group	Mean CA years	Mean DA years	Mean difference	*P*
G1 (10-10.9)				
Female	10.44±0.34	11.24±1.14	−0.79	0.004
Male	10.41±0.32	10.62±1.28	−0.22	0.403
Subtotal	10.42±0.33	10.91±1.24	−0.49	0.100
G2 (11-11.9)				
Female	11.35±0.34	12.02±0.98	−0.67	0.000
Male	11.46±0.36	11.50±1.02	−0.04	0.865
Subtotal	11.39±0.35	11.84±1.02	−0.45	0.001
G3 (12-12.9)				
Female	12.42±0.32	12.65±1.20	−0.23	0.156
Male	12.46±0.31	12.40±1.26	0.06	0.733
Subtotal	12.44±0.32	12.53±1.23	−0.10	0.408
G4 (13-13.9)				
Female	13.36±0.31	13.43±1.28	−0.07	0.680
Male	13.32±0.29	13±1.16	0.32	0.034
Subtotal	13.34±0.30	13.21±1.24	0.13	0.247
G5 (14-14.9)				
Female	14.26±0.33	14.28±1.60	−0.02	0.954
Male	14.32±0.30	13.78±1.35	0.54	0.021
Subtotal	14.29±0.31	14±1.48	0.29	0.117
G6 (15-15.9)				
Female	15.40±0.35	15.25±1.65	0.15	0.671
Male	15.27±0.30	14.42±1.58	0.85	0.009
Subtotal	15.33±0.32	14.78±1.64	0.54	0.024
G7 (16-16.9)				
Female	16.38±0.30	15.91±1.68	0.47	0.231
Male	16.18±0.23	15.57±1.94	0.61	0.166
Subtotal	16.28±0.28	15.74±1.80	0.54	0.062
G8 (17-17.9)				
Female	17.29±0.32	17.40±1.87	−0.11	0.797
Male	17.17±0.21	16.80±2	0.37	0.480
Subtotal	17.24±0.28	17.14±1.93	0.10	0.767

CA=Chronological age; DA=Dental age

Discussion

There have been several different methods described to determine dental age. Among all methods used to assess dental age, the method of Demirjian and Goldstein,[19] based on the calcification stage of the seven left mandibular teeth, was widely used in teaching and clinical practice because it is one of the simplest and most practical methods to predict age and maturation.[20,21] However, it was based on a large sample of 1446 males and 1482 females, all of the individuals were French-Canadians.[19]

Because Demirjian and Goldstein[19] reported that the possibility that the standards they obtained may not be valid in other population, numerous studies including Australian,[6] Brazilian,[7] British,[8,9] Caucasian American,[10] Chinese,[8,11] Dutch,[1] Malay,[3] South Indian,[12] and Turkish[13,14] have been conducted to determine the applicability of Demirjian's method in various populations.

Although there are some studies evaluating validity of the Demirjian method for dental age estimation for Turkish children,[13-16] these studies used the northern and northeastern and western populations of Turkey. Because dental maturation could be varied across different climatic regions of the same country,[18] these could have different characteristics from the southern population. The only one study that evaluated the validity of Demirjian method for dental age estimation for Southern Turkish children, reported that Demirjian's standards are not suitable for all age groups of southern Turkish children, a new table is necessary for evaluating this population.[17] In agreement with these findings, statistically significant results have been found in this study as compared to the Demirjian's norms.

In the present study, both genders were overestimated in dental maturity for a few of the age groups (G1 [10–10.90 years] and G2 [11–11.90 years] in female groups, G4 [13–13.90 years] G5 [14–14.90 years] and G6 [15–15.90 years] in male groups). The result is not in accordance with other studies conducted in other regions of Turkey.[13,14] The results of the study clearly show that there is a difference in dental age estimation with southern Turkish population and populations of other areas. Although Nur *et al.*[14] showed significant differences between northeastern Turkish children and French-Canadians in almost all groups, our results showed very similar results compared with the French-Canadian population.

Selecting panoramic radiographs from archives for studies like this requires great care. Subjects with systemic diseases affect the growth and development of the teeth and tooth agenesis excluded from the study because dental anomalies like hypodontia could affect tooth development and eruption.[22,23] In addition, malocclusions such as cross bite and sagittal skeletal discrepancies might affect the dental development as reported by some authors.[24,25] In the present study, care was taken while selecting the patients so that none had posterior cross bite and skeletal sagittal malocclusions.

There have been several factors that might affect the dental development between different population even within the same country. This wide range might be due to the ethnic differences, climate, nutrition, socioeconomic level, urbanization age structure of the study samples, sample size, statistical methods.[12,26-28]

Conclusions

Statistically significant differences were found in the chronological and dental ages assessed by Demirjian's method for the southern Turkish sample.

Dental age was significantly over-predicted in the 10 and 11 years age groups in females and under-predicted for 13–15 years age groups for males.

It is appropriate to use the Demirjian method in southern Turkish children; however, a revision is needed in some age groups.

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