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A new method to estimate dental age

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Abstract

Objective. The aim of this study was to evaluate the accuracy of Demirjian's method in estimating the dental age in Turkish children and to estimate the validity of Demirjian's standards for the studied population. ***Materials and methods.*** Panoramic radiographs of 756 northwestern Turkish children aged 5–13 years were examined. The new method for dental age estimation for both genders was studied to determine the relationship between dental age, chronological age and Demirjian's scores. Descriptive statistics were used and analysis of correlation was carried out between chronological age, dental age and Demirjian's scores. The difference between dental age and the chronological age was determined with the paired *t*-test. ***Results.*** The results showed that northwestern Turkish children had delays in dental maturity. The new method was applied to Demirjian's scores and dental age scales for both genders were obtained. The tables were used to adapt Demirjian's scores to dental age determination in Turkish children using the new formula. ***Conclusions.*** The developmental standards used by Demirjian are not suitable for northwestern Turkish children. The methods for determining dental development must have population-specific standards. The established gender-specific equations and the new tables are more appropriate for dental age assessment in northwestern Turkish children.

Key Words: *age estimation, dental age, Demirjian, developmental indicators*

Introduction

Age estimation plays an important role in forensic medicine, pediatric endocrinology, archeology and clinical dentistry [1,2]. The most commonly used developmental indicators include skeletal maturity (skeletal age), body height and weight (morphological age), sexual development (sexual age) and tooth development and eruption (dental age) [3]. Dental age is of particular interest to the pedodontist and orthodontist because it aids in diagnosis and treatment planning [1,2].

The two major approaches to dental age estimation are by using the age of tooth eruption and the pattern of tooth development. The age of tooth eruption has been widely accepted in the past, but is now considered to be imprecise, because eruption is an ongoing process that includes periods in the life of a child when no tooth eruption occurs. It is also affected by a number of local factors, such as the premature extraction of primary teeth or the crowding of permanent teeth. Alternatively, tooth development can be assessed over long periods of time using radiographs in a continuous pattern, using different stages of tooth formation as criteria [4]. Radiological methods are based on the evaluation of tooth development on x-ray images (extra-oral or intra-oral radiographs), i.e. assessing the extent of tooth mineralization from the moment when radiopaque spots become visible prior to tooth calcification until the tooth apex is closed. The method enables continuous evaluation of tooth development from birth until the completion of third molar teeth development [5].

Several methods have been described to determine dental development from radiographs [6–9]. The methods define the stages of tooth mineralization observed on radiographs and code them according

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to previously determined scores. In addition to the stages observed on radiographs, Gustafson and Koch [8] considered the time of eruption in their 'tooth development diagram'. Mörnstad et al. [9] used radiographs to measure crown heights, apex widths and root lengths. Most methods make use of panoramic radiographs for the assessment, although Moorrees et al. [6] made use of periapical radiographs. One widely used method for comparing different populations is the one described by Demirjian et al. [7] in 1973.

This technique is based on estimating both the extent of mineralized dental tissues and the shape of the pulp chamber of seven left permanent mandibular teeth. Each evaluated tooth is given a mark indicating a developmental stage (ranging from A–H; there is also an additional stage marked 0, meaning no signs of mineralization). Each of the stages is assigned a specific numeral value taken from gender-specific tables developed by Demirjian and colleagues [7,10]. The values obtained for the seven analyzed teeth are then summed up. The total score determines the dental age based on standardized tables or special percentile charts. The revised version of these standards was published in 1976 [10] and the data were derived from a reference sample of 4756 French Canadian children aged 2–20 years.

Although Demirjian's classification is a universal tool, knowledge of physiological and pathological factors affecting tooth development (genetic factors and the undeniable influence of environmental factors) emphasizes the need for standardized tables that are specific to particular populations. Moreover, developmental variability, which is a commonly observed feature, makes constant updates to the development standards used [11].

The use of Demirjian's maturity scale has demonstrated differences between several international groups [1–3,12–15] as well as between geographical areas or cities within the same country [16,17]. This method has been previously tested in 419 northwestern [14], 900 northern [18] and 807 eastern Turkish children [19] and has been shown to be inaccurate. The following were the aims of this study:

- To evaluate the applicability of Demirjian's method for dental age estimation.
- To analyze sexual dimorphism of dental age in the studied group.
- To determine whether Demirjian's standards can be used to evaluate the dental age in a population of Turkish children.
- To evaluate the inter-relationship between chronological and dental age and, if necessary, develop a new method for evaluating the dental age in the Turkish population using Demirjian's scores.

Materials and methods

The procedure was fully explained to the parents of the children involved and their written consent was obtained prior to the investigation. In addition, ethical approval (2008/333) was obtained from the ethics committee of the Medical Faculty of Istanbul University.

Panoramic radiographs of 756 northwestern Turkish children of known chronological age and gender were selected. The orthopantograms were taken between January and April 2009. All radiographs were taken with a Planmeca Proline PM unit. The sample group consisted of 345 females and 411 males aged 5–13 years. The mean ages of the boys and girls were 9.49 ± 2.047 and 9.6 ± 1.939, respectively. Table I shows the distribution of panoramic radiographs by gender and age.

The following inclusion criteria were used for the study:

- No history of medical or surgical disease that could affect the presence and development of mandibular teeth.
- Clinical records contained a panoramic radiograph of adequate quality.
- Informed written consent had been obtained from the parents.

The following exclusion criteria were used for this study:

- Image deformity affecting mandibular permanent tooth visualization.
- Hypodontia or gross pathology.
- Agenesis of teeth.
- Systemic disease.

The chronological ages of the children were calculated as the difference between their date of birth and the date at which the radiograph was taken and this was converted to years with two

Table I. Distribution of samples based on age and sex.

Chronological age	Male		Female		Total	
5–5.9	19	4.6%	11	3.2%	26	3.9%
6–6.9	17	4.1%	16	4.6%	33	4.4%
7–7.9	35	8.5%	14	4.1%	49	6.5%
8–8.9	49	11.9%	53	15.4%	102	13.5%
9–9.9	73	17.8%	71	20.6%	144	19.0%
10–10.9	75	18.2%	63	18.3%	138	18.3%
11–11.9	73	17.8%	56	16.2%	129	17.1%
12–12.9	53	12.9%	42	12.2%	95	12.6%
13–13.9	17	4.1%	19	5.4%	36	4.7%
Total	411	100.0%	345	100.0%	756	100.0%

Table II. Mean chronological age, mean dental age (determined by using the Demirjian's standards) and differences between the ages in both genders.

	Chronological age (CA)	Dental age (DA)	DA − CA	*t*	*p*
Boys	9.32 ± 1.96	9.21 ± 1.7	−0.11 ± 1.04	2.12	0.035
Girls	9.38 ± 1.89	9.17 ± 1.99	−0.22 ± 1.1	3.678	0.0001

decimals. Patients were divided into 10 groups based on their chronological age. The first group, consisting of 5-year-olds, included children between 5.0–5.9 years of age. The next group included 6-year-olds and so on.

Dental age estimation

The dental age (DA) estimation method is based on the development of the seven left permanent mandibular teeth. Tooth formation is divided into eight stages. The criteria for the stages are individualized for each tooth and listed in a detailed written description and supplementary illustrations. Next, using standard tables (separate for boys and girls), each evaluated stage was assigned an appropriate numeral value. The values were then summed up and the total score indicated the dental age based on standardized tables. In this study, dental age was calculated with Demirjian's Dental Maturity CD-ROM Silver Platter Education 1994 (Norwood, MA).

Evaluation of the panoramic radiographs and reproducibility

In order to evaluate dental age with Demirjian's method, each panoramic radiograph was assessed twice by the same person to minimize evaluation error. The first evaluation was carried out using a light-box. The developmental stages of particular teeth, obtained in this way, were entered into a computer database. Then, the images were scanned and stored in a computer database, so that evaluation of calcifications could be carried out on a computer screen. This method enabled magnification of selected regions of interest to achieve a more accurate evaluation of developmental stages of teeth. The results from the second evaluation were compared to the initially recorded data. The differences between the first and the second evaluations never exceed one developmental stage. The lower developmental stage was chosen when disparities occurred.

Calculating accuracy

Accuracy of dental age estimation was defined by how closely chronological age could be predicted and was measured as the difference between chronological age and dental age. The chronological age was subtracted from the dental age and a positive result indicated an over-estimation (acceleration of the dental development), zero meant that dental age and chronological ages were identical and a negative result indicated an under-estimation (delayed dental development).

Statistics

The intra-class correlation coefficient test was used to determine the reliability for boys and girls separately. The results were analyzed using the NCSS 2007 software. The calculations were done for boys and girls separately. Descriptive statistics (mean and standard deviation) were used and analysis of correlation was carried out between chronological age, dental age and Demirjian's scores. The difference between the dental age and the chronological age was determined with the paired *t*-test.

For each gender, the correlation between the dental age, the chronological age and Demirjian's scores was identified. A scatter plot was drawn up (for male and female subjects) to verify how these measures were related to each other mathematically. A cubic relationship was determined and a new formula was developed. According to the distribution equation a new method for evaluating the dental age in a population of Turkish children was established. The new method was applied to Demirjian's scores and dental age scales for both genders were established. A table was produced to adapt Demirjian's scores to dental age in Turkish children. The difference between the dental and chronological ages were evaluated statistically at the $p < 0.05$ level.

Results

The intra-class correlation coefficient test revealed a high level of reliability of the maturity scores. The coefficients of reliability were found to be between 0.895–0.929 for boys and 0.892–0.929 for girls. The distribution of samples according to age and sex is presented in Table I. Table II shows the difference between the dental ages estimated based on Demirjian's Standards (DA) and chronological age (CA). Dental maturity was under-estimated in both genders when compared with the reference samples ($p = 0.035$; $p = 0.0001$). The mean differences for boys and girls were -0.11 ± 1.04 and -0.22 ± 1.1, respectively.

The mean difference between the dental and the chronological ages ranged from 1.08 to -0.84 years in boys and from 0.69 to -0.66 years in the girls. For both genders, statistically significant differences were found between the estimated dental ages using Demirjian's standards and the chronological ages (Tables III and IV). Among the boys, the 5–8.9

Table III. Differences between the dental age determined by using Demirjian's standards (DA) and chronological age (CA) among girls.

		CA		DA		DA−CA		95% Confidence Interval of the difference			
Age	*n*	Mean	SD	Mean	SD	Mean	SD	Upper	Lower	*t*	*p*
5–5.9	11	5.40	0.77	6.09	0.94	0.69	0.72	1.18	0.21	−3.19	0.01
6–6.9	16	5.95	0.48	6.44	0.63	0.49	0.68	0.85	0.13	−2.88	0.011
7–7.9	14	6.74	0.40	7.00	0.56	0.26	0.5	0.55	0.02	−1.98	0.07
8–8.9	53	7.83	0.54	7.75	0.92	−0.08	0.76	0.29	−0.14	0.72	0.475
9–9.9	71	8.87	0.58	8.70	1.14	−0.16	0.87	0.37	−0.04	1.58	0.119
10–10.9	63	9.75	0.42	9.41	1.29	−0.34	1.06	0.61	0.07	2.54	0.014
11–11.9	56	10.66	0.39	10.04	1.43	−0.62	1.28	0.96	0.28	3.62	0.001
12–12.9	42	11.68	0.43	11.36	1.48	−0.32	1.4	0.75	−0.12	1.47	0.148
13–13.9	19	12.60	0.28	11.94	1.68	−0.66	1.53	1.45	−0.13	1.78	0.094

year-old age group showed over-estimation, and delay in dental development was found in the 9–13.9 year-old age group (Table III). Among the girls, the 5–7.9 year-old age group showed over-estimation, and delay in dental development was seen in the 8–13.9 year-old age group (Table IV). Girls with advanced and delayed ages comprised 11.8% and 88.2%, respectively. The percentages of boys with advanced and delayed ages were 29.2% and 70.8%, respectively.

The largest differences between estimated and chronological ages for both genders were seen in the 5–5.9 year-old age group. Among girls, the biggest difference was seen in the 11–11.9 and the 13–13.9 year-old age groups. Among boys, the largest difference was seen in the 6–6.9 and 12–13.9 year-old age groups. For ages 5, 6, 10 and 11 among girls and 5, 6, 7, 8, 11, 12 and 13 among boys a statistically significant difference was noted between the dental age and the chronological age. These results confirm that Demirjian's method is not suitable for northwestern Turkish children.

Comparing results in Turkish children with the reference samples showed that northwestern Turkish children were generally delayed in dental maturity. To develop a new method for evaluating northwestern Turkish children, a scatter plot was drawn (for male and female subjects) (Figures 1 and 2) to verify how the different factors (dental age, chronological age and Demirjian's scores) were related mathematically (Tables V and VI). Significant correlations between them were found (Table VII). Based on the distribution equation a new formula for calculating the dental age was established as shown below:

- Boys: D Score = (185,37) + (4,04)*(CA) + (13,35)*(CA)^2 + (-0,71)*(CA)^(3)
- Girls: D Score = (326,57) + (180,20)*(CA) + (5,39)* (CA)^2 + (-0,062)*(CA)^(3)

By using the new formula, the dental and chronological ages and the difference between the ages were calculated for both genders. No statistically significant differences were observed, which indicates the consistency of the new method (Table VIII).

Scores calculated with the formula and dental age scales for both genders were obtained. The tables were developed to apply Demirjian's scores to the

Table IV. Differences between the dental age determined by using Demirjian's standards (DA) and chronological age (CA) among boys.

		CA		DA		DA−CA		95% Confidence Interval of the difference			
Age	*n*	Mean	SD	Mean	SD	Mean	SD	Upper	Lower	*t*	*p*
5–5.9	19	5.19	0.82	6.27	0.70	1.08	0.96	1.61	0.54	−4.32	0.001
6–6.9	17	5.98	0.48	7.00	0.61	1.02	0.51	1.29	0.76	−8.29	0.0001
7–7.9	35	6.93	0.61	7.51	0.66	0.59	0.59	0.79	0.38	−5.85	0.0001
8–8.9	49	7.99	0.59	8.27	1.02	0.27	0.82	0.51	0.04	−2.33	0.024
9–9.9	73	8.83	0.43	8.73	0.77	−0.1	0.61	0.25	−0.04	1.44	0.154
10–10.9	75	9.83	0.53	9.63	1.12	−0.2	0.96	0.42	−0.02	1.83	0.071
11–11.9	73	10.67	0.47	10.18	1.05	−0.49	0.99	0.73	0.26	4.26	0.0001
12–12.9	53	11.65	0.42	10.81	1.23	−0.84	1.13	1.15	0.53	5.42	0.0001
13–13.9	17	12.51	0.41	11.67	1.29	−0.84	1.27	1.54	0.14	2.58	0.022

Table V. Distribution of median values of obtained scores plotted against score sums based on Demirjian's scores for boys and the relationship between these measures.

	R^2	F	p
Linear	0.775	1407.20	0.0001
Logarithmic	0.799	1625.13	0.0001
Quadratic	0.806	846.69	0.0001
Cubic	0.810	579.03	0.0001
Compound	0.749	1220.08	0.0001
S	0.803	1670.52	0.0001
Growth	0.749	1220.08	0.0001

dental age of Turkish children by using the new formula (Tables IX and X).

Discussion

The Demirjian eight-stage method is one of the principal methods used for dental age estimation. It is one of the simplest, most practical and most widely used methods [20]. Although Demirjian developed a modified scoring system for cases with missing teeth, which is based on four teeth, we preferred to adhere to the original method which is based on seven mandibular teeth.

Several previous studies [1,11,18,21–25] have found that Demirjian's original method over-estimates dental age when applied to populations other than the one it is based on. To a lesser degree, under-estimation has also been reported [25–27].

Various investigators have applied and modified this method for their own populations. Investigators have used Demirjian's method in populations from several ethnic backgrounds and geographical areas and have shown that there are differences in dental formation between these groups [1–3,12–17]. Therefore, the aim of this study was to evaluate the suitability of Demirjian's method for assessing dental maturation in northwestern Turkish children. In our study, the mean difference between dental age and chronological age ranged from 1.08 to –0.84 years

Table VI. Distribution of median values of obtained scores plotted against score sums based on Demirjian's scores for girls and the relationship between these measures.

	R^2	F	p
Linear	0.744	994.91	0.0001
Logarithmic	0.783	1237.16	0.0001
Quadratic	0.765	663.47	0.0001
Cubic	0.795	441.11	0.0001
Compound	0.699	797.79	0.0001
S	0.793	1316.78	0.0001
Growth	0.699	797.79	0.0001

Table VII. Correlation between dental age, chronological age and Demirjian's scores.

		Chronological age	
		Boys	Girls
Dental age	r	0.849	0.840
	p	0.0001	0.0001
Demirjian's score	R	0.880	0.862
	p	0.0001	0.0001

in boys and from 0.69 to –0.66 years in girls. This study group showed significantly more delayed dental maturity. Mentes et al. [14] have also found delays in dental maturation in northwestern Turkish children. In contrast, Tunc and Koyuturk [18] reported that northern Turkish children were significantly more advanced in dental maturity compared to Demirjian's French-Canadian sample. Additionally, Celikoglu et al. [19] showed significantly more advanced dental maturity in an eastern Turkish population. The difference may be due to the sample sizes in the different studies. The greatest mean difference was 1.08 years, compared with 0.73 years in the study by Mentes et al. [14], 1.44 years in the study by Tunc and Koyuturk [18] and 1.9 years in the study by Celikoglu et al. [19].

In this study, the differences between the dental age and the chronological age were statistically significant in the 5, 6, 7, 8, 11, 12 and 13 year-old age groups for boys and 5, 6, 10 and 11 year-old age groups for girls. The mean differences observed in this study group were 0.11 ± 1.04 for boys and 0.22 ± 1.1 for girls. Swedish boys differed by 0.4–1.8 years and girls by 0.5–1.8 years [22]. In contrast, the mean difference for Dutch boys was 0.4 years and for girls it was 0.6 years [28]. A sample of Norwegian children had smaller mean differences, 0.2 years for boys and 0.3 years for girls [13]. In Belgium, the mean differences were reported as 0.14 years for boys and 0.04 years for girls [5]. In Saudi Arabia, mean differences were reported as 0.2–1.2 years for boys and 0.08–1.3 years for girls [29].

A possible explanation for the differences between Turkish children and other populations compared to the French-Canadian children may be differences between ethnic groups and different geographical areas. Differences found between the standard

Table VIII. Mean chronological age, mean dental age (determined by using the new formula) and differences between the ages in both genders.

	Chronological age (CA)	Dental age (DA)	DA−CA	t	p
Boys	9.32 ± 1.96	9.31 ± 1.75	−0.01 ± 0.91	0.21	0.833
Girls	9.38 ± 1.89	9.38 ± 1.64	0.00 ± 0.92	0.058	0.954

Table IX. Scores calculated with the new formula and dental age scales for Turkish male children.

Score	Age	Score	Age	Score	Age	Score	Age	Score	Age
451	5	624	7	785	9	900	11	940	13
459	5.1	633	7.1	792	9.1	904	11.1	942	13.1
468	5.2	641	7.2	799	9.2	907	11.2	944	13.2
476	5.3	650	7.3	806	9.3	911	11.3	946	13.3
485	5.4	659	7.4	813	9.4	914	11.4	948	13.4
493	5.5	667	7.5	820	9.5	917	11.5	949	13.5
502	5.6	675	7.6	826	9.6	920	11.6		
511	5.7	684	7.7	832	9.7	923	11.7		
519	5.8	692	7.8	839	9.8	925	11.8		
528	5.9	700	7.9	845	9.9	927	11.9		
537	6	709	8	851	10	929	12		
546	6.1	717	8.1	856	10.1	931	12.1		
554	6.2	725	8.2	862	10.2	932	12.2		
563	6.3	733	8.3	867	10.3	933	12.3		
572	6.4	740	8.4	872	10.4	934	12.4		
581	6.5	748	8.5	877	10.5	935	12.5		
589	6.6	756	8.6	882	10.6	935	12.6		
598	6.7	763	8.7	887	10.7	937	12.7		
607	6.8	771	8.8	891	10.8	939	12.8		
616	6.9	778	8.9	896	10.9	941	12.9		

Table X. Scores calculated with the new formula and dental age scales for Turkish female children.

Score	Age	Score	Age	Score	Age	Score	Age	Score	Age
432	5	649	7	813		921	11	969	13
444	5.1	659	7.1	820	9.1	925	11.1	970	13.1
456	5.2	668	7.2	827	9.2	928	11.2	970	13.2
468	5.3	678	7.3	833	9.3	932	11.3	971	13.3
480	5.4	687	7.4	840	9.4	935	11.4	971	13.4
491	5.5	696	7.5	846	9.5	939	11.5	971	13.5
503	5.6	704	7.6	852	9.6	942	11.6		
514	5.7	713	7.7	858	9.7	945	11.7		
525	5.8	722	7.8	863	9.8	947	11.8		
536	5.9	730	7.9	869	9.9	950	11.9		
547	6	738	8	874	10	953	12		
558	6.1	746	8.1	880	10.1	955	12.1		
569	6.2	754	8.2	885	10.2	957	12.2		
579	6.3	762	8.3	890	10.3	959	12.3		
590	6.4	770	8.4	895	10.4	961	12.4		
600	6.5	778	8.5	900	10.5	963	12.5		
610	6.6	785	8.6	904	10.6	964	12.6		
620	6.7	792	8.7	909	10.7	966	12.7		
630	6.8	800	8.8	913	10.8	967	12.8		
640	6.9	807	8.9	917	10.9	968	12.9		

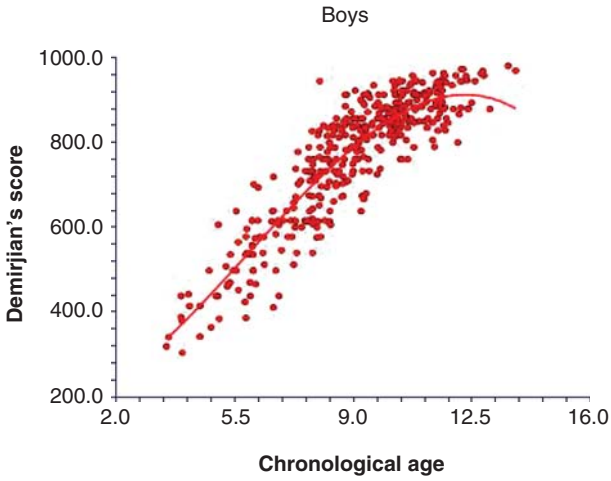

Figure 1. Distribution of median values of obtained scores plotted against score sums based on Demirjian's scores for boys and the relationship between these measures.

population and any sample population can be attributed to variables such as precision of the study method, age structure of the sample, sample size, statistical approach and biological variation of individual children [1].

Hägg and Mattson [30] reported that Demirjian's method has a high degree of reliability and precision, particularly in younger children. However, the largest discrepancy between dental and chronological ages that we observed was in the 5–5.9 year-old age group in both genders. This result was in accordance with other Turkish studies by Mentes et al. [14] and Tunc and Koyuturk [18], as well as studies by Maber et al. [1] and by Rozylo-Kalinowska et al. [11]. In contrast, Celikoglu et al. [19] reported the largest difference in the 12–12.9 year-old age group in girls and 11–11.9 year-old age group in boys. This may be due to difficulty in predicting growth in younger children.

Age was over-estimated for the majority of children, especially in the 5–8.9 year-old age groups for boys and in the 5–6.9 year-old age groups for girls. The age was under-estimated for the majority of children with the greatest difference in the 11–13.9 year-old age groups for boys and 10–11.9 year-old age groups for girls. Mani et al. [4] found a significant difference in the 10–12 year-old age groups for boys and in the 9–11 year-old age groups for girls. Similar findings have also been noted by others [31,32]. However, Eid et al. [3] found the over-estimation to be greater in older children and Koshy and Tandon [2] found a greater over-estimation in the 12–15 year-old age groups. Some studies show a higher rate of over-estimation immediately prior to onset of pubertal changes, which probably reflects a sudden growth spurt of dental tissues in addition to overall growth. It is also a well-established fact that puberty begins earlier in girls, which may explain the over-estimation in younger age groups for girls compared to boys. Furthermore, varying degrees of under-estimation of age for both boys and girls in older age groups also indicates that dental growth is not a steady and uniform process, but that it is associated with peri-pubertal growth fluctuations [4]. In addition, this delay in the older age groups (11–13.9 year age groups for boys and 10–11.9 year age groups for girls) may be attributed to a number of factors including environmental, genetic and social factors.

The available standards were tested for the study population, based on work by Frucht et al. [21], who devised two gender-specific equations for calculating dental age in a southwest German population.

In the present study, two gender-specific equations were developed on the basis of the cubic relationship between dental age, chronological age and Demirjian's scores. The new method was applied to Demirjian's

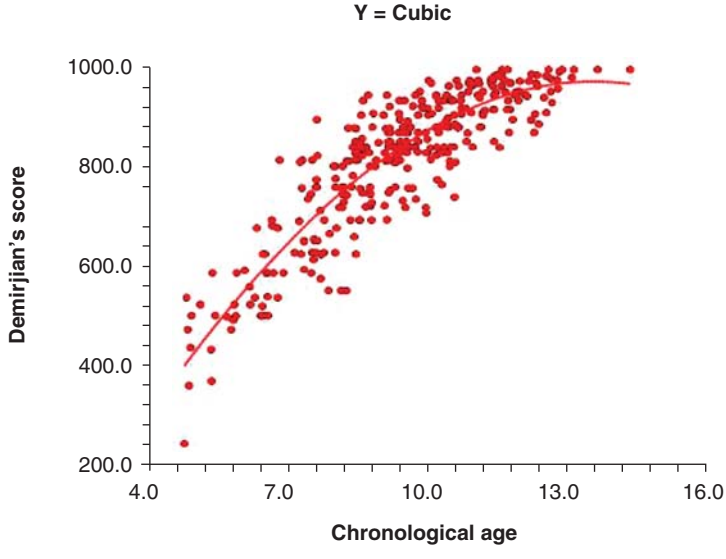

Figure 2. Distribution of median values of obtained scores plotted against score sums based on Demirjian's scores for girls and the relationship between these measures.

scores and dental age scales for both genders were established. A table was created to apply Demirjian's scores to the evaluation of dental age in Turkish children.

All of the subjects in the present study were undergoing dental treatment or orthodontic follow-up and were not selected at random; therefore, the group may not be representative of the general population. For epidemiological purposes, the study group should have been larger [2]. However, our study group was almost as extensive as the one examined by Demirjian during the preparation of the original score tables and larger than that of many other studies [2,5,13,33]. The sample size in this study provides a satisfactory starting point for future research.

Few studies have been conducted to determine the applicability of Demirjian's method to Turkish children. Previous studies on dental age of Turkish children have only reported on the inaccuracy of Demirjian's method. Our study is the first that suggests a new formula. Our results and proposed formulas are a starting point for the future preparation of complete tables to adapt Demirjian's scores to the dental age of Turkish children.

- Using our approach, the standards established would allow accurate evaluation of dental age in accordance with Demirjian's standards.
- There is a need to create representative databases for each population.
- Different databases for various populations may be used to create international dental development curves.

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