



Original Article

# Evaluation of Dental Age in Individuals of Different Ages with Unilateral Cleft Lip and Palate

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## ABSTRACT

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**Objective:** This study aimed to evaluate the dental age of unilateral cleft lip and palate (UCLP) patients aged 7–12 and 12–16 years using Demirjian's method and to compare these results with a control group.

**Methods:** We evaluated the panoramic radiographs of 54 individuals with UCLP and 54 age- and gender-matched individuals without UCLP (control). The UCLP and control groups were divided into two groups: 7–12 and 12–16 years of age. Their dental ages were determined using Demirjian's method. Dental ages of the cleft side and noncleft side were assessed separately and were also compared with those of the control group to assess potential asymmetric dental developments in the UCLP group.

**Results:** The chronological age was lower than the dental ages on both right and left sides in the control group ( $p < 0.01$ ). When age groups were evaluated separately, it was found that the chronological age was lower than the dental age in 7–12 year old individuals in the UCLP group ( $p < 0.05$ ), whereas it was less than the left and right dental ages in 7–12 ( $p < 0.01$ ) and 12–16 year old individuals ( $p < 0.05$ ) in the control group.

**Conclusion:** We detected no differences in dental age between UCLP patients and healthy controls, and lack of asymmetrical dental development in the mandibular teeth of either group. However, based on assessments performed using Demirjian's method, subjects' dental and chronological ages were incompatible.

**Keywords:** Unilateral cleft lip and palate, dental age, tooth development

## INTRODUCTION

Cleft lip and palate (CLP) is the most common congenital anomaly of the craniofacial region. Individuals with orofacial clefts often exhibit dental anomalies that originate from the development of dentition (1, 2).

Follow-up and treatment of the dentofacial region in CLP patients require multidisciplinary treatment planning starting from the early stages of development (3). Therefore, dental age determination is important for establishing the course of treatment in these patients. For orthodontists, determining the dental development is important for planning the treatment of various malocclusions related to maxillofacial growth; the ability to accurately estimate the phases and stages of tooth development can influence the course of pedodontic treatment. In general, dental age can be determined based on an assessment of tooth eruption or tooth formation (4-6). However, assessing tooth eruption is not a reliable way of determining dental age because it is affected by local factors such as the primary dentition.

The most commonly used method to estimate dental age is the system introduced by Demirjian et al. (4). Using panoramic radiographs from 2928 French–Canadian patients (1446 males and 1482 females), eight

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stages (A to H) were established for each tooth on the mandibular left side according to tooth development criteria, such as dentine clustering and pulpal wall formation. Each stage received a score, and the total scores were matched with the corresponding dental ages in a table in chronological order. According to the researchers, this system is useful for dental patients of age 3–17 years. The rationale for using only the left mandibular teeth in this system was attributed to the exact correspondence between the right and the left sides. Although this method is very easy to apply, it has generated conflicting opinions because of the potential for different outcomes in different ethnicities or even in different areas within the same geographical region (7-11).

During embryological development, tooth germ formation is closely related to CLP in terms of timing and anatomical position (12-14). Many previous studies have reported various anomalies in individuals with CLP such as delayed dental maturation, dental age retardation as opposed to individuals without cleft, and asymmetric dental development (15-19). A study on Brazilian children conducted by Topolski et al. (20) revealed a distinct incompatibility between dental and chronological ages in both the CLP and control groups, whereas no significant retardation in dental age was observed in CLP compared with the controls. In southern China, Lai et al. (21) reported that the incidence of asymmetric and delayed dental development was higher in children with CLP than in healthy individuals. They also demonstrated that delay in dental development may be greater in children with CLP as the number of missing teeth increases.

However, few studies have attempted to evaluate different age groups. In one study that investigated the correlation between chronological age and skeletal maturation of individuals with CLP, the authors underlined that skeletal development was found to be retarded in the early years (7-11 years) but approached that of the healthy individuals later in life (14-18 years) (22). These results raise the question of whether there is dental age deficiency between different age groups in Turkish individuals with UCLP.

Scientific determination of age plays a critical role in the diagnosis and treatment planning processes; hence, it is very essential in forensic medicine, pediatric endocrinology, and clinical dentistry (8). Recent studies have drawn attention to the relationship between CLP and developmental problems in later life (22). UCLP patients were also reported to be commonly associated with delayed dental development (18). Orthodontic and pedodontic treatments for children with CLP usually start at the early stages of childhood. Therefore, it is crucial to know the estimated eruption time and the time coinciding with teeth development. To the best of our knowledge, there is no study that evaluates dental age in Turkish UCLP patients. In light of this information, the present study aimed to estimate the dental age of unilateral CLP (UCLP) patients in two different age groups (7-12 and 12-16 years) using the Demirjian's method and to compare our findings with a control group of healthy individuals.

## METHODS

### Subjects

The study was conducted using panoramic radiographs obtained for routine dentistry procedures (e.g., tooth extraction, filling and/or root canal, orthodontic treatment) from individuals with UCLP admitted to the Center for Oral and Maxillofacial Medicine of Medipol Mega Hospitals, the İstanbul Medipol University School of Dentistry, and the Ankara University School of Dentistry for treatment. The study was approved by the İstanbul Medipol University School of Dentistry ethics committee (approval number: 543)

Inclusion criteria for the study were as follows:

1. Subjects did not exhibit any other congenital anomalies or syndromes in the craniofacial region other than unilateral UCLP;
2. Subjects had not undergone orthodontic treatment/orthognathic surgery prior to the acquisition of panoramic radiographs;
3. Subjects did not have any congenitally missing mandibular teeth or extracted mandibular teeth other than the third molars on the right and left sides.

We used GPower 3.1.0 software package (Universität Düsseldorf, Düsseldorf, Germany) to determine the number of individuals included in the study, and we further performed a power analysis. Based on a previous study, an expected effect size of  $r=0.5$  was used in the power calculation (18). Sample size calculation was based on the ability to detect significant differences in dental age at  $\alpha=0.05$  error probability (critical  $t$ : 1.66023; noncentrality parameter  $\delta$ : 2.52487). According to power analysis, a sample size of 51 patients for each group would allow for a power  $>80\%$  (actual power: 0.8058986) with an allocation ratio ( $N_2/N_1$ )=1. Therefore, a total of 108 panoramic radiographs were analyzed, 54 from UCLP patients (37 males, 17 females; mean age  $12.12\pm 2.13$  years) and 54 from patients without CLP (37 males, 17 females; mean age,  $12.13\pm 2.13$  years). The CLP patients included in the study were age- and sex- matched with the individuals without CLP, with a maximum chronological age difference of 2 months for each pair. The distribution of cleft sides in individuals with UCLP by gender is shown in Table 1.

The UCLP and control groups were divided into two chronological subgroups: 7-12 and 12-16 years of age. We distinguished the two groups based on the fact that permanent dentition is generally completed at 12 years of age. Because panoramic radiographs are not routinely taken for individuals under seven years of age, we accepted this lower age limit for this study. Patients older than 16 years of age were not included in the study because the Demirjian's method accepts that dental development is already completed in girls by that age.

### Assessment of Dental Age

To use Demirjian's method to determine the dental age of patients participating in the study, the patients' chronological ages

were first calculated in years and months. All assessments were performed by two researchers who were blinded to the patients' clinical condition. The maxilla was excluded from the radiographs acquired to conceal the cleft side, facilitating objectivity in measurements.

Unlike Demirjian's method, the present study evaluated the teeth on both sides instead of only focusing on the left one. This allowed us to establish differences in the dental age between the CLP and healthy patients, and consequently determine whether patients exhibited mandibular asymmetric dental development or not. In addition to determining dental age in individuals with CLP, we compared the right and left sides in healthy individuals. Demirjian et al. (4) suggested the exact agreement between the left and right sides as the reason for using solely mandibular left-hand teeth for determining tooth age. Accordingly, we used the left mandibular teeth to compare CLP individuals with the control group. In addition, we compared the left side of the control group with the cleft side and the noncleft side of the CLP patients.

**Table 1.** Distribution of the cleft side by age and sex in individuals with unilateral cleft lip and palate

	Age	Gender	Right	Left
UCLP	7-12	Male	4	18
		Female	3	4
	12-16	Male	4	11
		Female	4	6
	Total		15	39

**Statistical Analysis**

The data obtained in this study were analyzed using The Statistical Package for Social Sciences version 21.0 software (IBM Corp.; Armonk, NY, USA). Intraclass correlation coefficient (ICC) was calculated to assess the agreement between the two observers' measurements. After performing normality tests on the data obtained, we used the Mann-Whitney U test for intergroup comparisons and the Wilcoxon signed rank test for intragroup comparisons.

**RESULTS**

For interobserver reliability, ICC was calculated as 0.90 and reliability was found to be high.

No significant difference was detected between chronological and dental ages on the cleft and noncleft sides in the UCLP group. However, chronological age was found to be lower than dental age on both the left and right sides in the control group ( $p < 0.01$ , Table 2).

No significant difference was found between the UCLP and control groups in terms of chronological age or between dental age (cleft and noncleft sides) in the UCLP group and left-side dental age in the control group (Table 3).

When age groups were evaluated separately, we found that chronological age was lower than dental age (cleft side and noncleft side) in the UCLP group aged 7–12 years ( $p < 0.05$ ), whereas chronological age was lower than the left and right dental ages in the control group aged 7-12 ( $p < 0.01$ ) and 12–16 years ( $p < 0.05$ ) (Table 4).

**Table 2.** Intragroup comparison of chronological and dental ages in the unilateral cleft lip and palate and control groups

		n=54		Kruskal-Wallis H		
		Mean±SD	Min.	Max.	H	p
UCLP	Chronological Age	12.12±2.13	7.83	16.08	2.3	0.309
	Dental Age (cleft side)	12.55±2.17	7.60	16.00		
	Dental Age (noncleft side)	12.64±2.15	7.80	16.00		
Control	Chronological Age	12.13±2.13	8.00	16.08	9.3	0.009**
	Dental Age (right)	13.16±2.38	8.20	16.00		1-2
	Dental Age (left)	13.19±2.40	8.20	16.00		1-3

Min: minimum; Max: maximum; SD: standard deviation (Kruskal-Wallis H test; \*\* $p < 0.01$ )

**Table 3.** Comparison of chronological age and dental age in unilateral cleft lip and palate and control groups

		n=54			Mann-Whitney U	
		Mean±SD	Min.	Max.	z	p
Chronological Age	UCLP	12.12±2.13	7.83	16.08	-0.06	0.951
	Control	12.13±2.13	8.00	16.08		
Dental Age	UCLP (cleft side)	12.55±2.17	7.60	16.00	-1.54	0.123
	Control (left)	13.19±2.40	8.20	16.00		
	UCLP (noncleft side)	12.64±2.15	7.80	16.00	-1.48	0.138
	Control (left)	13.19±2.40	8.20	16.00		

Min: minimum; Max: maximum; SD: standard deviation (Mann-Whitney U Test)

**Table 4.** Intragroup comparison of chronological and dental ages for the 7-12 and 12-16 year age subgroups in the unilateral cleft lip and palate and control groups

			n	Mean±SD	Min.	Max.	Kruskal-Wallis H				
							H	p			
UCLP	7-12	Chronological Age	29	10.44±1.02	7.83	11.83	6.9	0.031*	1-2		
		Dental Age (cleft side)	29	11.23±1.77	7.60	14.60			1-3		
		Dental Age (noncleft side)	29	11.26±1.72	7.80	14.60					
	12-16	Chronological Age	25	14.06±1.22	12.00	16.08			0.246	0.884	-
		Dental Age (cleft side)	25	14.08±1.50	10.80	16.00					
		Dental Age (noncleft side)	25	14.24±1.33	11.60	16.00					
Control	7-12	Chronological Age	29	10.46±1.03	8.00	11.92	12.03	0.002**			1-2
		Dental Age (right)	29	11.74±2.04	8.20	15.20					1-3
		Dental Age (left)	29	11.79±2.16	8.20	15.70					
	12-16	Chronological Age	25	14.06±1.23	12.00	16.08			6.7	0.033*	1-2
		Dental Age (right)	25	14.82±1.53	11.60	16.00					1-3
		Dental Age (left)	25	14.81±1.48	11.60	16.00					

Min: minimum; Max: maximum; SD: standard deviation (Kruskal-Wallis H test; \*\*p<0.01)

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**Table 5.** Sex-based comparison of chronological age and dental age between the unilateral cleft lip and palate and control groups in individuals aged 7-12 and 12-16 years

				n	Mean±SD	Min.	Max.	Mann Whitney U					
								z	p				
UCLP	7-12	Chronological Age	M	22	10.58 ±0.89	7.83	11.83	-0.867	0.386				
			F	7	10.01±1.33	8.33	11.58						
		Dental Age (cleft side)	M	22	11.46±1.52	8.10	14.40			-1.12	0.261		
			F	7	10.53±2.41	7.60	14.60						
		Dental Age (noncleft side)	M	22	11.20±1.46	8.40	14.40			-1.07	0.284		
			F	7	10.90±2.37	7.80	14.60						
	12-16	Chronological Age	M	15	13.78±1.15	12.00	16.00			-1.5	0.113		
			F	10	14.47±1.26	12.50	16.08						
		Dental Age (cleft side)	M	15	14.40±1.10	11.60	15.70					-1.48	0.138
			F	10	14.60±2.02	10.80	16.00						
		Dental Age (noncleft side)	M	15	14.08±1.12	11.60	15.70					-1.31	0.191
			F	10	14.49±1.63	11.80	16.00						
Control	7-12	Chronological Age	M	22	10.61±0.89	8.00	11.92	-0.765	0.444				
			F	7	10.00±1.35	8.33	11.66						
		Dental Age (Right)	M	22	11.95±1.81	8.20	15.20			-0.587	0.557		
			F	7	11.09±2.73	8.20	14.60						
		Dental Age (Left)	M	22	12.02±1.97	8.20	15.70			-0.613	0.541		
			F	7	11.09±2.73	8.20	14.60						
	12-16	Chronological Age	M	15	13.78±1.17	12.00	15.92			-1.52	0.127		
			F	10	14.49±1.26	12.50	16.08						
		Dental Age (Right)	M	15	14.43±1.72	11.60	16.00					-1.85	0.064
			F	10	15.41±.98	13.50	16.00						
		Dental Age (Left)	M	15	14.51±1.70	11.60	16.00					-1.21	0.228
			F	10	15.27±.99	13.50	16.00						

Min: minimum; Max: maximum; SD: standard deviation; M: male; F: female (Mann-Whitney U test)

Sex-based comparisons of the age groups revealed no significant differences in terms of chronological or dental ages in the UCLP and control groups (Table 5).

## DISCUSSION

Although there are many studies in literature that have investigated the correlation between CLP and tooth development, to the best of our knowledge, no studies have been conducted in the Turkish population. In general, previous studies have indicated that there can be differences between ethnicities with respect to dental age or development or both (7-11). Therefore, our study aimed to assess the correlation between dental age of patients and asymmetric dental development in different age groups and to compare our findings with individuals without CLP.

Although delays in dental development in children with CLP was reported to decrease after the age of nine, several studies have shown that this delay may be greater for permanent teeth in older age groups (23, 24). Therefore, we set 12 years as the limit (an inclusion criterion) because permanent dentition is completed by that age. Nonetheless, future studies could be planned to explore different age intervals to reveal more detailed information.

Tan et al. (18) investigated dental development in Singaporean children with UCLP and found that dental age was delayed by 0.55 years compared with the control group, and that asymmetrical dental development was significantly more common in these patients. Asymmetric delays in dental development observed in these individuals were primarily attributed to genetic factors, malnourishment, and insufficient space for tooth growth on the cleft side, as well as reduced blood circulation due to fibrous tissue formation following surgical repair of the cleft and consequent developmental damage to the dental buds. Eerens et al. (16) compared hypodontia, dental age, and asymmetric tooth development between 54 individuals with CLP, 63 of their siblings without cleft, and 250 unrelated individuals without cleft. According to the results of the study, the prevalence of hypodontia and asymmetric tooth development was significantly higher in individuals with CLP and their siblings than in individuals in the control group. No significant difference in dental age was revealed among the three groups. This underlines a close correlation between cleft formation and dental development. In the present study, there was no difference in the dental ages between the right and left sides in individuals with UCLP or those in the control group (Table 2).

Despite the fact that we identified a small degree of dental age retardation on the cleft and noncleft sides in the UCLP group compared with that on the left side in the control group, the difference was not significant (Table 3). Hazza'a et al. (17) reported a significant deviation in dental age between individuals with unilateral and bilateral CLP compared with individuals with no cleft. The authors found that the proportion of dental age retardation was significantly greater in males than in females. According to the researchers, environmental and postnatal developmental factors such as nutritional problems, recurrent respiratory infec-

tions, and surgical procedures cause retardation in tooth development in individuals with CLP. Moreover, many genes related to tooth development have been implicated to the development of craniofacial structures. This suggests that genetic mutations that cause CLP may also cause dental development disorders. Altuğ et al. (25) reported that the frequency of the *MSX1* c.\*6C>T polymorphism was higher in individuals with CLP and in patients with congenital absence of maxillary lateral teeth than in the normal population; hence, it was speculated that the two conditions may be related.

Several studies have reported that delay in dental development may be greater in children with CLP because of the increasing number of missing teeth (13, 21). According to Lai et al. (21), the etiology of hypodontia alone cannot explain dental delays in children with cleft, because delays in tooth formation have been observed in both cleft and noncleft subjects without hypodontia. Furthermore, Topolski et al. (20) state that the etiologic factors of delayed dental development of individuals with clefts seem to be the same factors responsible for the occurrence of dental anomalies in these individuals, as well as for the manifestation of the cleft itself. However, and although the authors did not observe delayed dental development in the individuals with CLP, this study excluded subjects with agenesis in the mandible. Therefore, the notable absence of delayed dental development in our study and the study by Topolski et al. (20), as opposed to other studies performed in literature, may be explained by this exclusion criterion.

On the other hand, Pöyry et al. (15) evaluated 131 Finnish children with and without CLP using Demirjian's method and found that 3-9 year old children had a 6-month delay in tooth development, a delay that decreased to 2 months in 8-14 year old children. According to their study, a 2-month delay was also detected in children with cleft lip alone, whereas the authors reported 6.5 and 7 months delays in individuals with UCLP and bilateral CLP, respectively. In our study, we divided the UCLP patients into two age groups: 7-12 and 12-16 years, and we did not observe any differences in dental age between the UCLP and control groups (Table 4). Our findings further revealed no association between dental age and sex in these age groups (Table 5). A recent study has identified retardation of dental age compared with the control group after analyzing the dental age of 108 children with UCLP using Demirjian's and Willems' methods (19). However, both methods revealed discrepancies in determining chronological age, particularly in sex-based comparisons.

Although several previous studies have reported delays in dental development, we failed to detect a significant difference between UCLP and control subjects (15, 17, 18, 21). In line with our findings, Topolski et al. (20) have also reported no significant retardation in dental age in CLP patients compared to control subjects. Furthermore, the authors underline that the differences observed in their study may be explained by the methodological design adopted pertaining to the selected sample size, pairing of the sample, blinding, number of examiners and number of radiograph evaluations per examiner. In addition, we believe that one of the main reasons propelling these differences may

be attributed to ethnic and racial differences among study populations. Although the method developed by Demirjian et al. (4) allows a user-friendly determination of the dental age, their model is based on data obtained from French–Canadian children. Consequently, this disputes the applicability and reliability of the method in other ethnicities and has triggered a great deal of controversy in current literature (7-11). Studies conducted in Turkey that investigated dental age in different regions have suggested that Demirjian's method is not a reliable model in the Turkish population. For instance, Özveren & Serindere (11) used the Willems' and Demirjian's methods to assess the dental ages of children in the Aegean region and reported that Demirjian's method was less reliable than the Willems' method in determining the participants' dental age. In addition, Sen Tunç & Koyutürk (8) in their study on children from Northern Turkey and Çelikoğlu et al. (9) in their study on children from Eastern Turkey have both stated that Demirjian's method provided exaggerated results in Turkish children; thus, it may not be suitable for this population. Similarly, we also found that chronological age was lower than the dental age in the control group, and assessments performed in age subgroups showed that chronological age was significantly lower than dental age in individuals with UCLP aged 7-12 years and in control subjects aged 7-12 and 12-16 years.

One of the main limitations of the present study was the unbalanced distribution of gender among groups that can be considered as a prevalent confounding factor. The retrospective nature of our study allowed us to use the panoramic radiographs of patients admitted to our hospital. However, data obtained from a more balanced sample could reflect related differences in a more accurate manner. Our study included 108 individuals, 54 with UCLP and 54 healthy controls. Considering the notable statistically non-significant retardation of dental age in individuals with UCLP, further studies with larger study groups that also investigate individuals with bilateral CLP will be beneficial. In addition, further studies with equal numbers of subjects are required to reach definitive conclusions.

## CONCLUSION

Based on the results of this study, there was no asymmetric mandibular tooth development detected on the cleft or noncleft side in individuals with UCLP. Moreover, we found no differences in the 7-12 year age group, 12-16 year age group, or between the sexes while comparing the dental ages of these individuals with those of individuals without cleft.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the Ethics Committee of Istanbul Medipol University School of Dentistry (approval number: 543).

**Informed Consent:** Written informed consent was obtained from the patients who participated in this study.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept - E.C. ; Design - E.C. ; Supervision - A.T.A., A.P.M.; Materials -A.T.A., A.P.M.; Data Collection and/or Processing

- E.C., C.A.; Analysis and/or Interpretation - E.C., C.A.; Literature Search - E.C., C.A., A.T.A., A.P.M.; Writing Manuscript - E.C.; Critical Review - A.T.A.

**Conflict of Interest:** The authors have no conflict of interest to declare.

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