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DENTAL MATURATION IN PATIENTS WITH UNILATERAL POSTERIOR CROSSBITE

Aim: *To investigate whether there is a difference in dental maturation between patients with a skeletal unilateral crossbite and a control sample (individuals with an Angle Class I and no crossbite) and to compare the dental maturation on the right and left posterior segments in both samples.* ***Materials and Methods:*** *The sample consisted of 101 Turkish individuals (53 boys and 48 girls, 8 to 13 years of age, mean age 10.90 ± 1.62 years). These subjects were divided into two groups: unilateral posterior crossbite (23 boys and 28 girls, mean age 10.87 ± 2.01 years) and control (25 boys and 25 girls, mean age 10.93 ± 1.14 years). Each subject's dental age (according to Demirjian's dental maturity score) was determined with an orthopantomogram. A difference of 6 months at a significance level of* $P < .05$ *was considered clinically significant, so the power of the statistical test was 85%.* ***Results:*** *No sexual dimorphism was detected for the chronological or dental age in either group. In both groups, the dental ages determined from Demirjian and Goldstein's tables were more advanced than the chronological ages. Dental age did not differ significantly between sides. Subjects with a posterior crossbite had a tendency for a delayed dental maturation compared to the control individuals. A difference of about 1 month was observed between the right and left sides in the crossbite and control groups.* ***Conclusion:*** *The difference in dental age between the crossbite and control groups was big enough to be clinically relevant. No significant side differences in either group were detected.*
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Key words: *crossbite, dental age, dental maturation*

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Examining the formation and eruption of the teeth in periapical or panoramic radiographs can be used to assess the physiologic maturity of an individual without resorting to hand-wrist radiographs.[1] Dental maturity can be determined via the various stages of tooth formation and eruption.[1–9] Dental eruption is influenced by various factors such as crowding, extractions, ankylosis, ectopic positions, and persistence of primary teeth. Emergence into the oral cavity usually occurs when 75% of the root formation is complete. Tooth formation is thought to be a more reliable criterion for determining dental maturation than tooth eruption.[3,4] As such, the Demirjian et al[10] analysis is based on tooth mineralization.

Tooth maturation is a multifactorial phenomenon. Although Garn et al[11] thought that genes, hormones, and calories play a role in dental development, Demirjian[12] indicated that dental maturation is largely environmentally influenced.

Differences in the dental development between various Angle Classes have not yet been investigated. Only Janson et al[13] and Jamroz et al[14] evaluated the dental maturation in patients with short and long faces. These studies were based on the fact that Nanda[15] evidenced a difference in the timing of the adolescent growth spurt when comparing subjects with either a skeletal open or deep bite. Janson et al[13] showed that subjects with a long face have in principle a dental

maturation advanced by 6 months in comparison to short-face subjects. However, according to Jamroz et al,[14] the difference in dental age between patients with long and short facial configurations is not enough to be clinically significant.

In patients with a unilateral posterior crossbite, the buccal cusps of the maxillary teeth occlude lingually to the buccal cusps of the corresponding mandibular teeth.[16] Crossbites are associated with asymmetric muscular function, ie, the muscle activity level in maximum occlusion and during chewing on the crossbite side is lower compared to the noncrossbite side and the controls.[17] In children with unilateral posterior crossbites, the two condyles occupy a different position in their fossae.[18] This asymmetric morphology and function reflects a dissimilar development of the mandible. The background of this investigation is that this asymmetric development and bite force might affect the dental development and tooth eruption.

MATERIALS AND METHODS

This investigation was designed as a cross-sectional study. The material consisted of 101 patients (53 boys, 48 girls) of the Orthodontic Department, Faculty of Dentistry, Erciyes University. Their age ranged from 8 years to 13 years with a mean age of 10.90 ± 1.62 years (boys 10.93 ± 1.40 years, girls 10.87 ± 1.81 years).

Unilateral posterior prossbite proup

Fifty-one patients (23 boys, 28 girls) met the following selection criteria:

- Unilateral posterior crossbite involving at least two posterior teeth
- Caucasian
- Mandibular dental midline deviation of at least 1 mm to the crossbite side
- No functional deviation of the mandible
- No systemic disease or developmental or acquired craniofacial or neuromuscular deformity
- No previous orthodontic treatment
- No signs or symptoms of TMD (temporomandibular disorder)
- No missing teeth (excluding third molars)
- No caries lesions, extensive restorations, or pathologic periodontal status
- Pretreatment records taken between 2004 and 2007

Control group

Fifty subjects (25 boys, 25 girls) met the following selection criteria:

- Normal transversal posterior occlusion
- Caucasian
- Angle Class I, normal overjet and overbite, and coincidence of both dental midlines
- Good facial symmetry
- No missing teeth (excluding third molars)
- No significant medical history
- No previous trauma or orthodontic, prosthodontic, or surgical treatment
- Pretreatment records taken between 2004 and 2007

All orthopantomograms were assessed in a dark room with a radiographic illuminator to ensure contrast enhancement. Tooth mineralization was rated according to the method described by Demirjian et al[10] (eight stages, Table 1).

Determination of dental maturity scores and dental age

In children, dental age is defined according to scores of tooth mineralization.[19] These scores were recorded for all seven teeth on the left and right side of both jaws separately for boys and girls.[20] The total score of all teeth constitutes the dental maturity of each segment. This score can be converted directly into a specific dental age by using the standard table for boys and girls.

Table 1 The eight stages of tooth development according to Demirjian et al[10]

Stage A	Mineralization of single occlusal points without fusion.
Stage B	Fusion of mineralization points; the contour of the occlusal surface is recognizable.
Stage C	Enamel formation has been completed at the occlusal surface, and dentin formation has commenced. The pulp chamber is curved, and no pulp horns are visible.
Stage D	Crown formation has been completed to the level of the amelocemental junction. Root formation has commenced. The pulp horns are beginning to differentiate, but the walls of the pulp chamber remain curved.
Stage E	The root length remains shorter than the crown height. The walls of the pulp chamber are straight, and the pulp horns have become more differentiated than in the previous stage. In molars, the radicular bifurcation has commenced to mineralize.
Stage F	The walls of the pulp chamber form an isosceles triangle, and the root length is equal to or greater than the crown height. In molars, the bifurcation has developed sufficiently to give the roots a distinct form.
Stage G	The walls of the root canal are parallel, and the apex is partially open. In molars, only the distal root is rated.
Stage H	The root apex is completely closed (distal root in molars). The periodontal membrane surrounding the root and apex is uniform in width throughout.

Table 2 Descriptive statistic values of the chronological and dental age of patients for investigated groups

		Chronological age (y)					Dental age (y)				
Groups	n	Mean	SD	SE	Min	Max	Mean	SD	SE	Min	Max
Unilateral cross bite											
Male	23	10.88	1.76	0.37	8.00	13.92	11.38	2.55	0.53	7.40	16.00
Female	28	10.87	2.22	0.42	7.25	14.50	11.44	2.78	0.53	6.70	15.80
Total	51	10.87	2.01	0.28	7.25	14.50	11.42	2.65	0.37	6.70	16.00
Control sample											
Male	25	10.99	1.02	0.20	7.92	12.50	14.06	4.00	0.80	8.63	26.93
Female	25	10.88	1.27	0.25	8.08	12.92	13.89	1.67	0.33	10.03	15.80
Total	50	10.93	1.14	0.16	7.92	12.92	13.97	3.03	0.43	8.63	26.93

n = sample size; SD = standard deviation; SE = standard error; Min = minimum; Max = maximum.

Statistical analysis

All statistical analyses were performed using SPSS software (Statistical Package for Social Sciences for Windows 10.1). Means, standard deviations, and errors of chronological and dental age were calculated for each segment in the crossbite and control group separately for each sex. A paired-sample *t* test was used to compare the dental age values of the left and right sides in the control group and the crossbite and noncrossbite side in the crossbite group. Dental age between crossbite and control patients was compared with the independent sample *t* test.

From a clinical research–planning perspective, a difference of at least 6 months between two variables was considered significant. Taking 6 months as clinically significant at a level of $P < .05$ with a sample size of 50, the power of the statistical test was 85%.[21]

A single investigator (A.Y.) assessed all dental maturity scores and ages. Dental maturity was reassessed in 15 randomly selected individuals after a 30-day interval. The reliability in dental age assessment was $r = .94$.

Table 3 Descriptive statistic values and statistical comparisons of the variations of the dental age (in years) from one side to the other

	Unilateral crossbite							Control						
	Crossbite side			Control side				Right side			Left side			
Groups	Mean	SD	SE	Mean	SD	SE	*P*	Mean	SD	SE	Mean	SD	SE	*P*
Maxilla	11.41	2.92	0.41	11.34	2.80	0.39	NS	13.39	2.22	0.31	13.29	2.15	0.33	NS
Mandible	11.41	2.63	0.37	11.50	2.59	0.36	NS	13.28	1.74	0.25	13.25	1.80	0.25	NS

SD = standard deviation, SE = standard error, NS = not significant.

Table 4 Statistical comparison of the dental age (in years) in the two studied groups

		Maxilla				Mandible			
Groups	n	Mean	SD	SE	*P*	Mean	SD	SE	*P*
Crossbite	51	11.32	2.83	0.40	***	11.49	2.62	0.37	***
Control	50	13.36	2.20	0.31		13.25	1.73	0.24	

n = sample size, SD = standard deviation, SE = standard error, ***$P < .001$.

RESULTS

Table 2 shows the descriptive statistics of the chronological and dental age for both groups and sexes, separately and combined. The dental age had a tendency to be more advanced in both sexes of the control group as compared with the crossbite group. No sexual dimorphism was detected for chronological and dental age in the investigated groups. When the combined groups are evaluated, the mean dental age of the control and the crossbite group was 13.97 ± 3.03 years and 11.42 ± 2.65 years, respectively. In both groups, the dental age as determined by Demirjian and Goldstein's[20] tables was slightly advanced as compared to the chronological age.

The mean, standard deviation, standard error, and the statistical results are presented in Table 3. There were no significant differences in the dental age between sides or jaws of both groups.

Table 4 shows the statistical comparisons of the dental age between the crossbite and control group. Significant differences were determined for both jaws ($P < .001$) in both groups. Tooth maturation was delayed 2.04 years in the maxilla and 1.77 years in the mandible in the crossbite group as compared to the control group. This finding is statistically and clinically significant.

DISCUSSION

Age estimation by means of tooth development has long been used. After all, tooth development corresponds well with chronological age because it is only slightly affected by exogenic factors such as malnutrition or systematic diseases.[22,23]

The differences among populations, methods, and observers are important shortcomings of research related to maturity indicators. To overcome some of these limitations, all subjects in the present study were Turkish Caucasians and all orthopantomograms were evaluated by one skilled observer. In their study, Jamroz et al[14] included only individuals who were seen between 1990 and 2000 to avoid any possible influence of a secular

trend.[24] Similarly, here, only patients whose orthopantomograms were taken between 2004 and 2007 were evaluated.

In the literature, a range of classifications for evaluating tooth mineralization is found. Such classifications were presented by Nolla,[4] Kullman et al,[22] Gleiser and Hunt,[25] and Moorrees et al.[26] However, some of these identify a large number of stages that are difficult to delimit from one another. The Demirjian et al[10] classification distinguishes only four stages of crown development (stages A to D) and four stages of root development (stages E to H). This system uses no numeric identification so as to not imply that the different stages represent processes of the same duration. All the stages are defined by changes of shape. In their study, Dhanjal et al[27] concluded that the Demirjian et al[10] method performed best not only for intra- and interexaminer agreement but also for the correlation between chronological and developmental age. Because of all these reasons, this classification was selected for this study.

Table 2 allows a more detailed comparison of the sample. The boy control group was on average chronologically 1 month older than the boy crossbite group; similarly, the dental age was higher. Liversidge et al[28] (British), Hagg and Matsson[29] (Swedish), Loevy and Goldberg[30] (Caucasian American), Nystrom et al[31] (Finnish), and Leurs et al[32] (Dutch) showed that the French–Canadian dental age standards derived by Demirjian et al[10] could not be considered suitable for the respective populations. This was also true for the present study. Therefore, population-specific dental age standards in a big sample with the methodology of Demirjian et al[10] must be developed.

Proffit and Fields[33] indicated that deviations of tooth maturation or eruption on the two sides of a dental arch are frequent. They claimed that the difference normally amounts to only a few months. In this study, no significant side differences in the crossbite and control group were observed (Table 3). An approximate 1-month variation between both sides in the crossbite and control group became apparent.

The significant difference in dental development between individuals of the crossbite and control group could be explained with their individual genetic background,[34] which mutually influences facial and dental development.

The present sample ranged in age from 8 to 13 years with a mean age of 10.90 ± 1.62 years. Hagg and Matsson[29] indicated that Demirjian's method was highly accurate for younger age groups but was inaccurate in older children. Thus, it cannot be excluded that the somewhat older children in the present evaluation have obscured possible differences in the dental maturity.

CONCLUSION

From this study, the following conclusions were drawn:

- No significant differences in the dental age on either side were present between crossbite patients and control individuals.
- The crossbite patients presented a tendency for a delayed dental maturation as compared to the control individuals.

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