Dental age assessment in Caucasian subjects with third molar agenesis

Elham S. Abu Alhaija, Aftima A. Derbash and Susan N. Al-Khateeb

Department of Preventive Dentistry, Faculty of Dentistry, Jordan University of Science and Technology, Jordan

Background: Delayed dental development has been linked with tooth agenesis. Research aimed at dental age estimation in subjects with third molar agenesis has been minimal.

Objectives: To investigate the association between dental stage of development and third molar agenesis.

Materials and methods: A total of 700 orthopantomograms (OPTs) were obtained for this study. The age of the subjects ranged from 10 to 16 years (13.66 ± 1.50 years). The subjects were divided into two groups of which group 1 consisted of 350 patients (175 females and 175 males) with third molar agenesis and group 2 (control group) had all third molars present. The control group matched the study group for gender and chronological age (CA). Dental age (DA) was estimated from the OPTs using the Demirjian method for all included subjects.

Results: The mean CA and DA in the third molar agenesis group were 13.81 ± 1.60 years and 13.72 ± 1.65 years, respectively ($p > 0.05$). The mean CA and DA in the control group were 13.51 ± 1.38 years and 14.50 ± 1.12 years, respectively ($t = 18.25$, $p > 0.000$). CA-DA difference between the two groups was highly significant ($t = 12.43$, $p > 0.000$). Gender differences were not detected. Furthermore, no differences were noted in dental age compared with chronological age in cases of unilateral versus bilateral third molar agenesis or in one jaw versus two jaws ($p > 0.05$).

Conclusions: Dental development was delayed in subjects with third molar agenesis but the delay in dental age was not affected by the severity or site of agenesis.

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Elham S. Abu Alhaija: elham@just.edu.jo; Aftima A. Derbash: senan844@yahoo.com;   Susan N. Al-Khateeb: susank@just.edu.jo

Introduction

Dental agenesis, or missing teeth, has been associated with delayed dental development and eruption.[1-4] The third molar is the most commonly missing tooth in humans, followed by the second premolars and maxillary lateral incisors, with an agenesis prevalence reported to range from 1.0 to 51.1% within different races.[5-6]

Few studies have investigated whether an association exists between non-syndromic hypodontia and dental development.[1,3,4,7,8] Delayed dental development has been linked with tooth agenesis in general.[1,3,8] Dhamo et al.[8] reported a lower dental age in children with hypodontia. The delay varied in dental age from 0.37 to 0.52 years in the groups displaying hypodontia compared with groups displaying a full complement of teeth. The difference in development was most pronounced for the lower second premolars, lower first premolar and lower second molars. However, others have reported a non-significant difference of dental development in children with hypodontia and their matched controls.[7]

Garn et al.[9] showed an association between third molar agenesis and delay in cusp calcification and alveolar eruption of mandibular posterior teeth, most notably the second molar. It was suggested that the agenesis of the third molar may be an extreme expression of a factor affecting the timing of tooth formation, resulting in a delay in development of the remaining teeth as well.[9]

Baba-Kawano et al.[6] reported that patients with at least one missing third molar showed a generalised delay in dental development and eruption.

Many methods have been introduced to identify dental age,[10-15] which can be determined by the time of emergence or the stage of tooth formation.[11] Tooth formation has many advantages over emergence when used to evaluate dental maturity, including the ability to study the majority of teeth in one radiographic examination. Tooth emergence is only a short phase of the process of tooth eruption, which limits the number of teeth available for estimation. Alternatively, an advantage of evaluating tooth eruption is its simplicity and ease of use.[16] Using the formation and calcification of teeth to determine dental age is reported as a much more accurate, precise, and reliable indicator of dental maturity.[12]

A commonly-used dental maturity scaling system is the method developed by Demirjian in 1973 on a sample of French-Canadian children.[12] A knowledge of tooth eruption times allows the orthodontist to begin treatment at an appropriate stage and reduce orthodontic treatment time. According to current knowledge, there have been few studies conducted to investigate the association between dental development and third molar agenesis. Accordingly, the aim of the present study was to investigate the association between the stage of dental development and third molar agenesis by applying the Demirjian method.

Materials and methods

The study was reviewed and approved by the Research Ethical Committee (IRB) at Jordan University of Science and Technology (JUST). The study was retrospective in nature and was performed on existing radiographs that had been taken for routine diagnostic purposes as part of comprehensive orthodontic treatment. Orthopantomograms (OPTs) with missing third molars in either right or left sides, upper or lower jaw, unilateral or bilateral were included in the sample. Records of 3000 patients available in the archives of the Dental Teaching Clinics of JUST were screened for third molar agenesis. A total of 700 OPTs were collected (350 with third molar agenesis and 350 with all third molars present which served as a control series). Selected subjects were of Caucasian origin (white Jordanians), whose chronological age ranged between 10 and 16 years at the time the OPT was taken. The radiographs were of diagnostic quality and of patients without syndromes or relevant serious medical abnormalities. There were no missing teeth

apart from third molars. Patients aged 10 through 15 years in the study groups were included only if a future OPT was available to confirm the absence/presence of third molars.

The patients' chronological age in months was determined from case data and converted into a decimal age. The OPTs of these patients were examined in a standard manner under subdued lighting conditions, standardised screen brightness and resolution.

The subjects were divided into two groups:

Group 1: Third molar agenesis

The group consisted of 350 subjects with third molar agenesis (175 females and 175 males). The group's average age was 13.81 ± 1.60 years. The distribution of the subjects according to the site and jaw of missing third molar is seen in Table I.

Group 2: Third molar presence (control group)

This group consisted of 350 subjects (175 females and 175 males). This group's average age was 13.51 ± 1.38 years.

Dental age was assessed from the OPTs for all subjects using the Demirjian method. The dental development of all available mandibular teeth on the left side was evaluated and categorised into Demirjian stages.[12,17] The measurements were carried out by the same investigator (A.A.) over a period of one month.

Error of the method

Twenty OPTs were randomly selected and dental stages were re-scored after an interval of two weeks to test intra-examiner reliability using the kappa test. The results of the kappa values were above 92%, which indicated a substantial agreement between readings.

Statistical analysis

Data analysis was carried out using the Statistical Package for Social Science (SPSS) computer software (SPSS 17.0, SPSS Inc., IL, USA). Descriptive statistics (means and standard deviation) for CA and estimated DA in the studied groups were calculated. Paired sample t-test was used to detect differences between CA and estimated DA in each group. An independent t-test and one-way ANOVA test were applied to detect the effect of gender and severity of agenesis on DA. Significance was pre-determined at the 0.05 level.

Table I. Distribution of subjects according to the side and jaw of missing third molar.

Variable		Number	Total
Side of 3rd molar agenesis			
	Unilateral	117	350
	Bilateral	233	
Jaw of 3rd molar agenesis			
	Upper jaw	139	350
	Lower jaw	100	
	Both	111	

Results

The estimated mean DA in the total sample

The means and standard deviations (SD), standard errors (SE), and *p* values of CA and estimated DA in the missing third molar and control groups are presented in Table II.

No significant difference was found between DA and CA in group 1. Dental development was ahead of the chronological age by one year in group 2 (t = 18.25, *p* < 0.000). The difference between the mean differences of CA and DA (CA-DA) was significant between group 1 (0.09 year) and group 2 (-1.00 year) (t = 12.43; *p* < 0.000).

No differences were detected between CA and estimated DA either in females or in males in the third molar agenesis group (*p* > 0.05). Both females and males in the control group showed advanced DA compared to CA (t = 12.69, *p* < 0.000; t = 13.10, *p* < 0.000), respectively.

The means and mean standard errors (SE) of the difference between CA and estimated DA (CA-DA) according to the severity of third molar agenesis are presented in Table III.

No differences were detected in DA compared with CA in unilateral versus bilateral and one jaw versus two jaws third molar agenesis.

Discussion

In the present study, the association between third molar agenesis and dental maturation was investigated using the Demirjian method of ascertaining dental development. It is believed that this is the first study to investigate the association between third molar agenesis in particular and the estimation of DA using OPTs.

The subjects included in the study were aged 10–16 years so that third molar calcification could be detected on the radiograph. This age range provided a high likelihood that the third molars would be present and, at the same time, allowed the calculation of the DA in the other developing teeth. Subjects older than 16 years of age at the time of OPT acquisition were not included in the study since Demirjian's method was designed for subjects up to the age of 17 years.[12]

It has been found that third molar calcification usually begins at 7–9 years of age in the maxilla, and between 8–10 years in the mandible.[18-19] However, Barnett[20] and Richardson[21] reported that third molar development could be as late as 14 or 15 years of age. Therefore, patients aged 10 through 15 years were included only if a future OPT was available to confirm the absence/presence of the third molars.

Tooth development is an accurate measure of chronologic age that seems to be independent of exogenic factors such as malnutrition or disease.[22] However, age estimates based on dental methods have shortcomings related to the differences between populations[12,23-25] and different estimation methods used.[10-15] The most widely used, Demirjian's method, was initially performed on a French-Canadian population. It has been proven that Demirjian's method tends to overestimate dental age in both boys and girls.[26] However, the well-defined and reproducible stage of dental development of seven mandibular teeth and the great number of different populations on which the method has been applied makes Demirjian's classification adaptable and suitable for age estimation.[27]

To overcome shortcomings in the present study, all selected subjects were of white Jordanian origin (Caucasian) and all OPTs were evaluated by one well-trained researcher (A.A.) experienced in using the Demirjian[12] method.

Table II. The means, standard deviation (SD), mean differences and standard error (SE), and *p* values of the chronological and estimated dental ages in the study groups.

	Females			Males					
	Chronological age Mean (SD)	Dental age Mean (SD)	Mean Difference (SE)	Chronological age Mean (SD)	Dental age Mean (SD)	Mean Difference (SE)	Chronological age Mean (SD)	Dental age Mean (SD)	Mean Difference (SE)
Group 1	13.79 (1.59)	13.63 (1.33)	0.16 (0.10)	13.82 (1.62)	13.81 (1.99)	0.01 (0.01)	13.81 (1.60)	13.72 (1.65)	0.09 (0.07)
Group 2	13.58 (1.26)	14.55 (1.01)	0.96 (0.08)***	13.43 (1.50)	14.46 (1.23)	1.04 (0.08)***	13.51 (1.38)	14.50 (1.12)	-1.00*** (0.06)

*** *p* < 0.001

Table III. The means and standard errors (SE) of the difference between chronological and estimated dental ages (CA-DA) according to the severity of third molar agenesis.

Missing third molar (N)	CA-DA difference Mean (SE)	Significance
Side of third molar agenesis		
Unilateral (117)	0.07 (0.12)	NS
Bilateral (233)	0.10 (0.08)	
Jaw of third molar agenesis		
Upper arch (139)	-0.03 (0.11)	NS
Lower arch (100)	0.25 (0.14)	
Upper and lower arches (111)	0.10 (0.09)	

Although the third molar agenesis group showed no difference between DA and CA, they were regarded as delayed in dental development when compared with the control group. The results were in agreement with those reported by Ruiz-Mealin et al.,[4] who suggested that the development of permanent teeth in children with dental agenesis is delayed when compared with a matched control group. In addition, Tunç et al.[3] reported a significant delay in dental development (three months) in a group of non-syndromic patients with mild to moderate hypodontia when compared with a control group. The short delay in the latter study could be attributed to the younger age range of the studied group compared with the age range used in the present study. It has been reported that older patients with dental agenesis had greater delays in tooth formation than patients in a younger age range.[4]

The present study found no significant differences in dental development with regards to gender, which supports results reported in previous studies.[4,28]

There was no significant difference in DA assessment between the groups exhibiting unilateral and bilaterally missing third molars. This finding was in agreement with Tunç et al.,[3] who reported that no correlation was observed between the differences in DA and CA and the severity of hypodontia. However, the present results did not agree with earlier reports that the severity of molar agenesis affects the magnitude of developmental delay.[1,4] The differences between the results could be attributed to the different ethnicity and methods of DA estimation.

The findings of the present study may be applied by orthodontists to more accurately diagnose and treatment plan cases. Much orthodontic treatment involves waiting for the development and eruption of teeth, especially the second molars. If a patient is missing one or more of their third molars, orthodontic treatment could be extended due to the delayed development and eruption of second molars. Furthermore, orthodontic treatment may involve the extraction of second molars to allow the third molars to erupt. Third molar agenesis should be considered in subjects with delayed dental development.

Conclusions

1. DA was delayed in subjects with third molar agenesis.

2. DA was not affected by the severity or site of agenesis.

3. Gender differences were not detected in DA estimation of subjects with third molar agenesis

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Corresponding author

Elham S. Abu Alhaija
Department of Preventive Dentistry
Faculty of Dentistry
Jordan University of Science and Technology
P.O. Box 3030
Irbid, 22110
Jordan

Email: elham@just.edu.jo

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