EVALUATION OF DENTAL MATURITY USING THE DEMIRJIAN'S METHOD IN ROMANIAN CHILDREN

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Abstract: Demirjian's method is the most frequently used method of dental maturity estimation. The aim of this study was to assess the accuracy of the method in a sample of Romanian children. The study was conducted on X-rays of 126 children with ages ranging from 5 to 15 years old. Dental age was determined and t-tests were used to assess the difference between dental age and chronological age within each age category. The boys in our study have advanced dental age in all age groups, while the girls have only in the age categories 7 to 8 years, 9 to 10 years and 11 to 12 years. The results of our study show that the method is appropriate for Romanian children and that these standards are applicable only in certain age groups. Further research is required on a larger sample.

INTRODUCTION

Dental development and the eruption process are part of the general development of the child, being an indicator of maturity.(1) Several approaches have proven to be valuable in estimating dental age in children. The assessment of dental age, by observing the degree of mineralization of the teeth being formed on OPG radiographs, is a method with a high degree of safety, unlike the moment of eruption, gingival emergence. This method is not influenced by local factors, such as dental ankylosis, dental migrations with loss of space, orthodontic abnormalities, dental destruction with premature loss of temporary teeth etc.(2,3) Thus, the degree of mineralization of the teeth, as a development process, is used in determining the dental age.(4) By calculating the difference between dental and chronological age and comparing it with standard values, we obtain information about an early or delayed eruption (5), without the need for additional radiographs with patient irradiation.

The clinical importance of knowing the dental age of a patient (which often does not correspond with chronological age) is of particular interest to orthodontists and pediatric dentists for planning the treatment of various types of malocclusion in relation to maxillofacial development.(6) It is essential to start treatment during the optimal period of growth in order to obtain the ideal correction of skeletal discrepancies. Orthodontic treatment can be initiated later in patients with delayed dental age leading to a shorter duration of treatment and more stable results over time. Knowing the dental age is useful for the use of functional appliances and the correct planning of orthognathic surgery and serial extractions.(7)

AIM

The aim of this study was to obtain the dental age based on OPG radiographs using the Demirjan's method and to evaluate the applicability of the method on a Romanian children population and to compare our results with studies on other populations from various other countries.

MATERIALS AND METHODS

In this cross-sectional study, the orthopantomographs of 126 healthy children (59 boys and 67 girls) with no history of congenital and systemic disorders from the cities of Târgu-Mureș and Brașov, central Romania, were reviewed and the dental age was determined using the Demirjian's method. The ages ranged from 5 to 15 years old. All graphs were analysed and scored by one examiner using the Demirjian's method to obtain dental age.

Subjects were divided into 2 groups, first based on gender. They were further divided into 5 groups, each corresponding to a 2-year age range.

The inclusion criteria were:
- only children from central Romania
- 5 to 15 year-old
- healthy children with no history of congenital and systemic disorders
- good quality radiographs
- no missing left permanent mandibular teeth

The chronological age (CA) is the actual age of the patient and was calculated for each subject using the date on which the X-ray was taken and the date of birth of the patient. It was then converted into a decimal number.

The estimation of the dental age (DA) was performed following the Demirjan's method which uses the degree of development of the seven mandibular teeth (except for the third molar). Every tooth was assigned a rating from "A" to "H". The stages were next transformed to scores with the use of specific to gender conversion tables. A total maturity score, was then calculated for each tooth .The score was converted into dental age using standard tables developed by the authors. The dental development stages according to Demirjian are (8):

Stage A: The onset of calcification is detected at the superior level of the crypt with the feature of an inverted cone or cones. No fusion of these calcification points is noticed.(8)

Stage B: The unification of the calcified points results into one or several cusps which form a unite a defined occlusal

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surface.(8)

     Stage C: Enamel development is finished at the occlusal surface; the process of dentine deposition has begun and the pulp chamber is shaped in as a curve at the occlusal border.(8)

     Stage D: The crown is completely formed, until the cemento-enamel junction. The root formation is visible in the form of a spicule.(8)

     Stage E: The pulp chamber walls form straight lines. The crown height is larger than the root length. In molars, the development of the radicular bifurcation has the aspect of a semi-lunar shape.(8)

     Stage F: The walls of the pulp chamber form an isosceles triangle. The apex has the shape of a funnel. The crown height is equal or smaller than the root length.(8)

     Stage G: The apical end of the root canal is still partially open. The root canal walls are parallel.(8)

     Stage H: The roots apex is completely closed and the periodontal membrane has a uniform width.(8)

     All panoramic radiographs were in digital format so that they could be analysed under magnification.

Figure no. 1. Demirjian's scoring on an OPG in the case of an 8.1-year-old girl
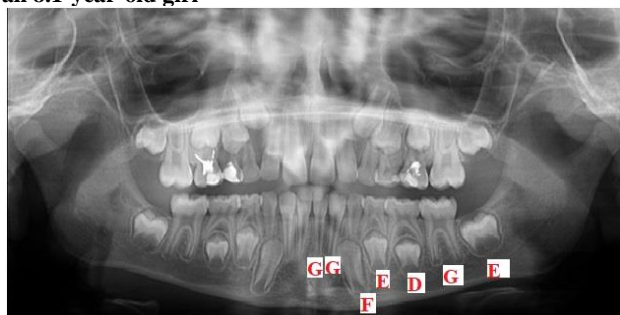
RESULTS

     To compare the chronological age with the dental age of the children, the T Excel Test from the Microsoft Excel program was used.

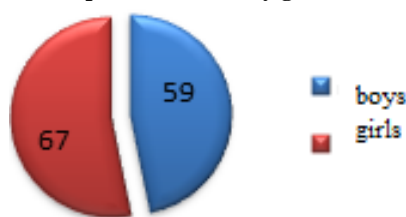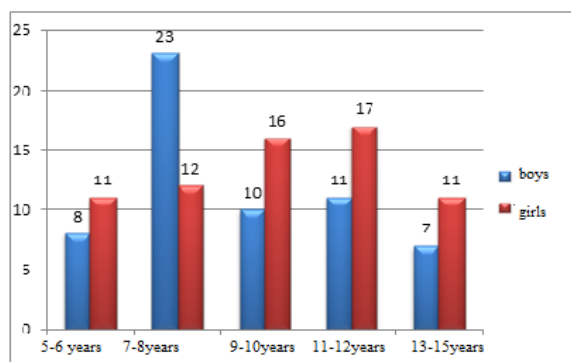**Figure no. 2. Sample distribution by gender**

Figure no. 3. Sample distribution by age

     Tables no. 1 and 2 show the comparison between dental age (obtained using the Demirjan index) and chronological age in girls and boys, by age groups.

Table no. 1. Comparison between chronological and dental age in girls

Age Groups	Nr of Patients	Mean CA	Mean DA	Mean Diff.	Dispersion of CA	Dispersion of DA	P
5-6 years	11	6.32	6.21	-0.11	0.118	0.176	0.20141
7-8 years	12	8.15	8.33	0.17	0.145	1.047	0.52340
9-10 years	16	10.10	10.52	0.41	0.381	1.418	0.07811
11-12 years	17	11.79	12.62	0.82	0.219	1.625	0.00631
13-14 years	11	13.98	13.88	-0.10	0.343	0.287	0.36195

Table no. 2. Comparison between chronological and dental age in boys

Age Groups	No. of Patients	Mean CA	Mean DA	Mean Diff.	Dispersion of CA	Dispersion of DA	P
5-6 years	8	5.61	6.08	0.46	0.324	0.413	0.05496
7-8 years	23	7.81	8.36	0.54	0.284	0.202	**0.00003**
9-10 years	10	10.17	10.57	0.40	0.535	1.945	0.15845
11-12 years	11	11.69	12.70	1.00	0.250	0.670	**0.00001**
13-14 years	7	14.18	14.20	0.02	0.188	0.677	0.91586

     An overestimation of dental age was observed in 3 age groups (7-8 years, 9-10 years, 11-12 years) in the case of girls. The remaining 2 age groups (5-6 years and 13-14 years) having an underestimated dental age (figure no. 4). In the case of boys, an overestimation of dental age is observed in all age groups (figure no. 5).

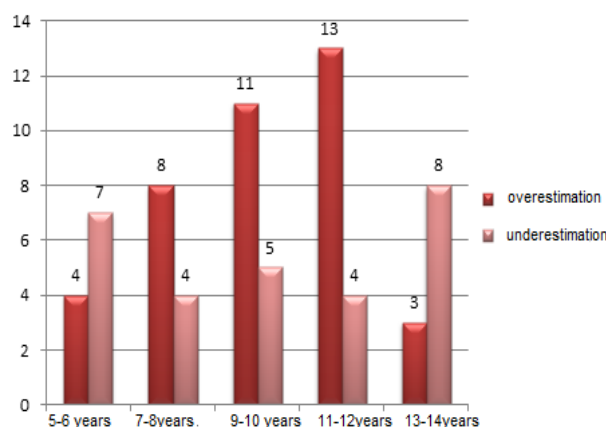**Figure no. 4. Graphic representation of the over- and under-estimation of dental age in girls**

Table no. 3. Comparison between the chronological age and the dental age of the group of patients

	Nr. of patients	Mean CA	Mean DA	DA-CA	P
Girls	67	10.20	10.50	0.31	0.00566577
Boys	59	9.39	9.92	0.53	0.00000006

Figure no. 5. Graphic representation of the over- and under-estimation of dental age in boys
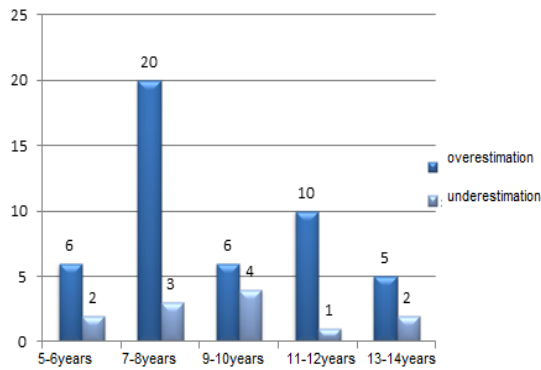
The mean difference between dental age and chronological age on the total number of patients was 0.53 years in boys and 0.31 years in girls (table no. 3), and statistical tests showed that the difference between them is statistically significant (p <0.001, alpha = 0.05). The differences between chronological age and dental age ranged from 0.02 to 1.00 years in boys and -0.11 to 0.82 years in girls. The smallest age difference was found in the age group 13-15 years in both genders, namely 0.02 years in boys and -0.10 years in girls. We found statistically significant differences (p <0.001) in girls in the age group 11-12 years, a difference of 0.82 years. In the case of boys there was a difference of 0.54 years in the age group 7-8 years and a difference of 1.00 years and in the group 11-12 years. No increase or decrease in age-related differences can be observed.

DISCUSSIONS

Estimating the growth and development of children from a medical and dental point of view is of great value.(8,9) Tooth formation is widely used to assess growth and maturity. There are several methods that allow both age prediction and maturity estimation.(10) Demirjan's method is one of the simplest, most practical and widely used.(11) Its graphs are an attempt to provide international ways to assess dental maturity in children.(10)

Dental development varies between populations around the world, but even between areas of the same country.(12) This study was done to compare the estimated dental age of a group of children in central Romania with that of Canadian children of French origin from Demirjan's study.

Compared to the standard tables of the Demirjan method, the boys in our study have advanced dental age in all age groups, while girls only in the age categories 7-8 years, 9-10 years and 11-12 years. The average difference was 0.31 years in girls and 0.53 years in boys. The results of the current study are similar with other studies conducted by Ogodescu et al. on children in Romania, where girls have significantly higher dental age in the age groups 5.5-6.4 years and 11.5-14.4 years.(13) The studies conducted by Ogodescu (13) revealed that boys had a higher dental age in all groups, except for the limit ones (6.6-7.4 years and 13.5-14.4 years) (13), while our study found higher values at all ages.

We also compared the results of our study with studies conducted in other countries on a Caucasian population, but also with Indian and Black populations. There are several studies in which dental age is lower than the chronological age. Compared to the standard values of the Demirjan's method, a study of Turkish children in the Anatolian Region showed a delayed dental age of -0.38 years in the entire study group with 0.33 in girls and 0.48 in boys.(14) In a group of Dutch children, Leurs showed that dental age was lower than chronological by -0.6 years in girls and -0.4 in boys.(6) Similar data with lower dental age were reported in Sudan on a study by Rizig who found an underestimation of the age of 1.42 years in girls and 0.70 years in boys.(15) On the population of North China studies showed that the Demirjan's method underestimated dental age by -0.47 years in boys and -0.63 years in girls.(16) Overestimation of dental age has been reported frequently in specialized studies.(17)

Results of studies with advanced dental age were obtained in groups in the Nordic countries. In case of Sweden the differences were between 0.4 and 1.8 years in boys and between 0.5 and 1.8 years in girls.(18) In the case of Norway, the differences were 0.2 years for boys and 0.3 years for girls (19) while in case of Finland the differences were 0.7 boys and 0.9 years for girls.(20) In Eastern Europe, a number of the studies were done, including in Poland and Serbia. Poland both boys and girls showed advanced dental age (21), same case with Serbia where there was an advance of 0.45 years for boys and 0.42 years for girls.(22)

Outside Europe, the data also show an increase in dental age as follows: Iranian children presented an advance of 0.15 years in girls and 0.21 years in boys (23), the population in western China an advance of 1.25 years for girls and 1.3 years for boys (24), the western part of the population of Saudi Arabia and increase between 0.64 and 1.44 for girls and between 0.66 and 0.77 for boys.(25)

According to the authors this overestimation can be partially explained by the advanced development observed in the last 35 years. Other differences between populations can be explained by environmental factors such as socio-economic status, nutritional status, eating habits and lifestyle.(26) We need to consider that any difference between the standard population and the study groups may be due to several variables, including method accuracy, examiners subjectivity, group age, group size, statistical approach, and individual biological or socioeconomic variations.(14)

CONCLUSIONS

Dental maturity indices are the most useful and reliable indicators of development, showing the least variability and not being influenced by exogenous factors.

The Demirjian's method is a frequently used, non-invasive, simple and practical method that clearly defines the stages of tooth development, allowing a correct estimate of dental age, using OPG radiographs, without the need for further investigation. Estimating the dental age by the Demirjian's method allows the appreciation of the degree of maturity, allowing the choice of the optimal moment to initiate the orthodontic and pedodontic treatment. These findings show the need for new specific standards and an additional research on a larger sample size.

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