

AGE ESTIMATION IN CHILDREN USING THE ERUPTION OF SECOND PERMANENT MOLARS

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Abstract: The age assessment is very important in forensic or in case of people who do not own an identification document. The age estimation based on teeth eruption may be a good method. This study was developed on a 1595 sample of schoolchildren aged 11 to 14 years from Bucharest. The main goal of this research was to analyze the eruption of the second molars and find some clinical principles for the age estimation. An eruption index (EI) with four successive distinct scores (0, 1, 2 and 3) was adapted and used in order to correlate the age with stages of the eruption of second molars. The EI mean values (\pm SE) for the entire sample were the following: 1.97 (\pm 0.03) for the right upper molar, 2.03 (\pm 0.03) for the left upper molar, 2.25 (\pm 0.03) for the left lower molar and 2.29 (\pm 0.03) for the right lower molar. There were many significant differences for the girls and boys as well, between the different age groups ($p < 0.05$).

Keywords: age estimation, molar, eruption, child, schools.

INTRODUCTION

Even if the migration of population decreased around the world due to the COVID-19 pandemic, it still remains an important phenomenon. The European Union (EU) is facing the migration as well, 2.4 million immigrants entering in the EU in 2018 only [1]. Due to migration and many other reasons (e.g. forensic) a lot of people who do not have an identification document require chronological age assessment. A lot of methods of identification based on dental age were proposed using both clinical examination and x-rays, such as different stages of teeth eruption, third molars position and periodontal ligaments, root development and apex formation [2].

The second molars appear at the final of the eruption process of the permanent dentition, between canines – premolars and the third molars. They can erupt from on 11 to 13 years and complete their roots between 14 and 16 years [3]. A lot of genetic, environmental, systemic or local factors such as

infection or dense overlying bone may influence the teeth eruption, including the second molars [4]. The second molars were previously used in age estimation, the x-ray exposure being the main procedure [5].

The main scope of this study is to propose some principles of age identification based only on clinical examination of different stages of second molars eruption.

MATERIALS AND METHODS

The data concerning teeth eruption were collected from the PAROGIM study, a clinical survey developed on a representative sample of schoolchildren from Bucharest schools. This cross-sectional study was conducted by a team from “Carol Davila” University of Medicine and Pharmacy, Faculty of Dental Medicine in collaboration with Bucharest Hospitals and Medical Services Administration and School Inspectorate of Bucharest.

This article is the first report of the PAROGIM study concerning teeth eruption.

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Study design

The study was developed on a sample of 1595 schoolchildren aged 10-17 years (5th to 8th grades) belonged of 59 Bucharest schools. EpiInfo public domain statistical software, version 3.2.2 (Centers for Disease Control and Prevention, Atlanta, Georgia, USA) was afterwards used for establish the main epidemiological coordinates: initial sample size (n = 1600), 58.000 total population of children from Bucharest middle schools (data from 2008), 95% confidence interval, and 2.4% estimation error. The sample represented 2.76% of total population of schoolchildren from Bucharest middle schools and was build using a single-stage cluster sampling method, individuals being stratified on grades (5th – 8th), Bucharest city regions [5] and presence of dental offices in schools. The classes of students were used as clusters the size for a single cluster was establish to be 25 (the number of schoolchildren per class recommended by the Romanian Ministry of Education in 2008). Thus, a database containing all classes from all middle schools from Bucharest was build. Initially, 64 classes were randomly selected according to the principles of stratification mentioned above and because the rate response was not high another 21 classes were reselected.

The clinical examinations

The children were examined in the schools in dental or in medical offices using standard examination kit: a plane mouth mirror, a common college forceps and a CPI dental probe. The examinations were performed using dental units when were possible (schools with dental offices) and two mobile chairs, one for the child and one for the examiner, and a

Riester ri-focus LED headlamp (Rudolf Riester GmbH, Tuttlingen, Germany) when clinical procedures were done in medical offices. All the examinations were performed by one experienced dentist who also was calibrated before the study. The Cohen’s kappa score for intra-examiner consistency ranged from 0.75 to 1.

The main goals of clinical examinations were prevalence and intensity of dental caries, prevalence and intra-oral distribution of periodontal diseases such as gingivitis, and teeth eruption. An eruption index (EI) previously used in other studies [2, 6] was adapted and used in this clinical survey in order to assess the second molars eruption. Thus, the scores are the following (Fig. 1):

- Score 0: the second molar is not visible in the oral cavity (the tooth did not erupt);
- Score 1: some parts of the second molar occlusal surface are visible (e.g. one or more dental cusps) but not the entire surface;
- Score 2: the second molar is partially erupted, the entire occlusal surface is visible and somewhere between the cervix and the occlusal surface of the first molar;
- Score 3: the second molar is fully erupted and its occlusal surface is in line with the occlusal surface of the first molar.

Ethical and legal aspects

This study had the approvals of the Bucharest Hospitals and Medical Services Administration and School Inspectorate of Bucharest. The clinical protocol of this study and the model of the informed consent were approved by the Ethics Committee of “Carol Davila” University. Every students enrolled in this study received the inform consent in order to be signed by his parents or legal tutor.

Data recording and analysis

Clinical data were recorded in a paper form especially designed for this study. Afterward, the information were entered into a computer and processed using SPSS software, version 16 (SPSS Inc., Chicago, IL, USA). Differences between the age subgroups for girls and boys were tested in pairs using nonparametric Mann-Whitney tests.

RESULTS

Almost half of the students enrolled in this study were boys. The age of children ranged from 10 to 17 years but we selected the 11 – 14 years interval

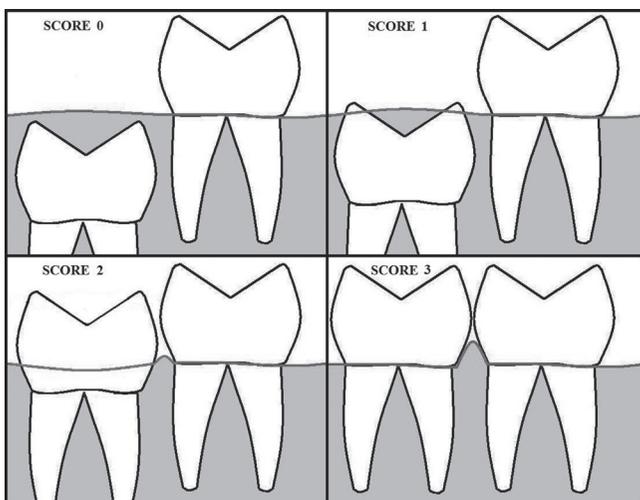


Figure 1. The scores for the eruption index used in this study: 0, 1, 2 and 3.

Table 1. Characteristics of the schoolchildren enrolled in the PAROGIM study (data analyzed in this study)

Characteristics	n	%
Girls	833	52
Boys	762	48
Age (years)*		
11	330	21
12	397	25
13	381	24
14	418	26

*The rest of 4% had 10, 15, 16 and 17 years.

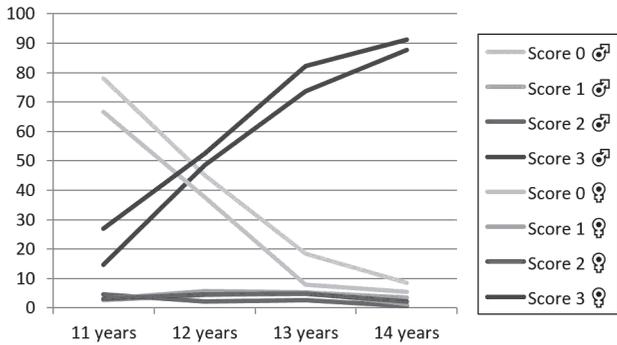


Figure 2. Eruption scores for 17 (right upper molar) for girls and boys.

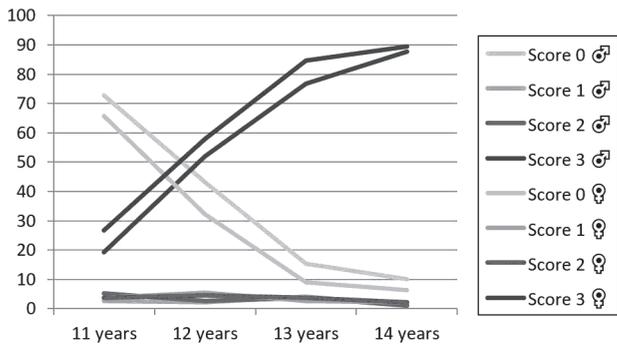


Figure 3. Eruption scores for 27 (left upper molar) for girls and boys.

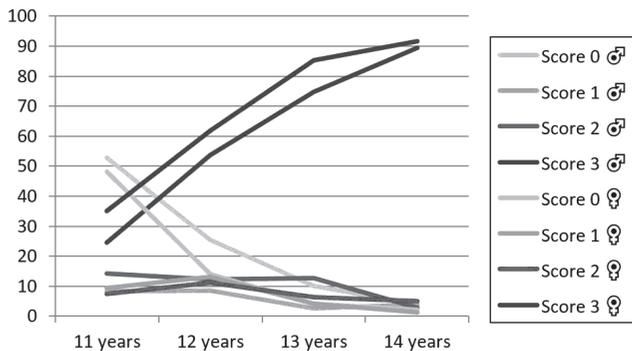


Figure 4. Eruption scores for 37 (left lower molar) for girls and boys.

for the data analysis presented in this paper. Therefore, the final number of students selected for the eruption analysis was 1526. Further details are shown in the Table 1.

The scores for the second molars EI varies from 11 to 14 years for both, girls and boys and are graphically exposed in Figures 2 – 5. However, we also had some missing data related to second molars eruption but they did not influence the main results (Table 2). The mean values of the second molars EI are shown in table 3. Many differences of EI can be observed between different subgroups ($p < 0.05$).

DISCUSSION

We used a different version of the EI than other studies. We took into account only four stages of the tooth eruption: 0 – the tooth is not visible in the oral cavity, 1 – only parts of occlusal surface are visible, 2 – entire occlusal surface is visible but the tooth did not reach the occlusal plane and 3 – the tooth is completely erupted (reaches the occlusal plane). This makes the EI simpler and the time for examination shorter. Other authors used different variants of the EI. Alves *et al.* split the score 2 in two: occlusal surface with less and more than half of the crown exposed [7]. Marques *et al.* divided the score 0 in: occlusal surface covered with alveolar bone and with oral mucosa only [2].

Our data (variation of the percentages and means values of the EI) lead to the fact that the eruption of the second molars begins from 11 years, continues its evolutions and ends around the age of 14. Even if we found a small percent (near 10%) at the age of 13 with no presence of second molars (EI = 0, especially upper molars), most of the authors consider that the eruption has already began at that age [3, 4]. However, as we noticed from the beginning, a lot of general or local factors can influence the teeth eruption [3].

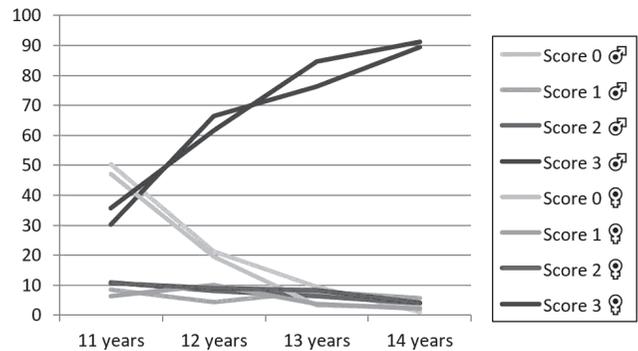


Figure 5. Eruption scores for 47 (right lower molar) for girls and boys.

Table 2. Valid vs. missing data related to second molars eruption

Second molar	n	Valid data		Missing data	
		%	n	%	
17 (right upper second molar)	11 years girls/boys	159/151	95/93	9/11	5/7
	12 years girls/boys	197/188	97/97	7/5	3/3
	13 years girls/boys	190/190	100/99.5	0/1	0/0.5
	14 years girls/boys	239/179	100/100	0/0	0/0
27 (left upper second molar)	11 years girls/boys	161/151	96/93	7/11	4/7
	12 years girls/boys	199/185	97.5/96	5/8	2.5/4
	13 years girls/boys	190/190	100/99.5	0/1	0/0.5
	14 years girls/boys	239/179	100/100	0/0	0/0
37 (left lower second molar)	11 years girls/boys	160/155	95/96	8/7	5/4
	12 years girls/boys	199/188	97.5/97	5/5	0.5/3
	13 years girls/boys	190/190	100/99.5	0/1	0/0.5
	14 years girls/boys	239/179	100/100	0/0	0/0
47 (right lower second molar)	11 years girls/boys	159/155	95/96	9/7	5/4
	12 years girls/boys	200/188	98/97	4/5	2/3
	13 years girls/boys	190/190	100/99.5	0/1	0/0.5
	14 years girls/boys	239/179	100/100	0/0	0/0

Table 3. The eruption scores of second molars on gender and age subgroups

Schoolchildren category		EI-17	EI-27	EI-37	EI-47
		mean (± SE)			
Girls	11 years	0.91 (± 0.1)*	0.9 (± 0.1)*	1.28 (± 0.1)*	1.35 (± 0.1)*
	12 years	1.71 (± 0.1)†‡	1.90 (± 0.09)†‡	2.22 (± 0.08)†‡	2.14 (± 0.08)†‡
	13 years	2.61 (± 0.06)§	2.64 (± 0.06)*	2.73 (± 0.05)§	2.75 (± 0.05)§
	14 years	2.79 (± 0.05)*	2.75 (± 0.05)	2.86 (± 0.03)‡	2.84 (± 0.04)‡
	Total	2.09 (± 0.04)	2.14 (± 0.04)	2.35 (± 0.04)	2.34 (± 0.04)
Boys	11 years	0.56 (± 0.09)*	0.71 (± 0.09)*	1.11 (± 0.1)*	1.21 (± 0.11)*
	12 years	1.52 (± 0.1)†‡	1.63 (± 0.1)†‡	1.95 (± 0.09)†‡	2.2 (± 0.09)†‡
	13 years	2.32 (± 0.08)§	2.42 (± 0.08)§	2.52 (± 0.07)§	2.49 (± 0.07)§
	14 years	2.68 (± 0.06)‡	2.66 (± 0.07)‡	2.78 (± 0.05)‡	2.82 (± 0.04)‡
	Total	1.82 (± 0.05)	1.91 (± 0.05)	2.13 (± 0.04)	2.22 (± 0.04)
-	TOTAL	1.97 (± 0.03)	2.03 (± 0.03)	2.25 (± 0.03)	2.29 (± 0.03)

Mann-Whitney tests: *significant differences compared to 12 age subgroup (p < 0.05); †significant differences compared to 11 age subgroup (p < 0.05); ‡significant differences compared to 13 age subgroup (p < 0.05); §significant differences compared to 14 age subgroup (p < 0.05).

Our study also reinforced the principles that lower second molars erupt earlier than the upper second molars and both erupt earlier at girls. The intermediate EI scores (1 and 2) were less often observed maybe because the eruption process can be fast, more important being the start moment of the eruption. However, if all second molars reach the occlusal plane we cannot estimate the exact age. The presence of a third molar cannot help in this case but it can tell as at most that the age is over 18 years. However, that can be obvious in many cases. The absence of the third molars is not relevant for the age estimation because the prevalence of the third molar agenesis is often found (6 to 41%) [8].

Our data also showed some differences in bilateral timing of eruption of second molars but they were not statistically confirmed and do not have any clinical significance. Bilateral differences in teeth eruption were also found in other studies. Makino *et*

al. for example showed that the upper second molars displayed the greatest bilateral differences in their eruption [9].

In conclusion we can say that:

- if all second molars are not visible, but all first molars are present the age are more chances to be between 7 and 11 years; more information can be brought by the canines and premolars in this case;

- if the occlusal surface of a second molar is not entire visible or did not reach the occlusal plane there are more chances that the age be between 11 and 13 years –girls have more chances to have 11-12 years and boys 12-13 years.

Conflict of interest

The authors declare that they have no conflict of interest.

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