

AN ALGORITHM OF AGE ESTIMATION IN CHILDREN USING THE ERUPTION SEQUENCE OF CANINES AND PREMOLARS

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Abstract: Forensic Odontology is a branch of dental science used in law administration and for justice procedures. Recognition of teeth and oral structures are very important in human identification process. Moreover, teeth eruption sequence can bring vital information about children's age. This study is a cross-sectional clinical survey conducted in Bucharest schools on a 1595 sample of pupils aged 11 to 14 years. The main goal of this report is to establish a link between canines and premolars eruption sequence and the children's age. An adapted version of the eruption index (EI) was used in this clinical survey. We found most of the differences in the eruption sequence at the age of 11. The EI scores varied from boys to girls as follow: for the upper canine from 1.53 to 1.83, for the upper first premolar from 2.40 to 2.58, and for upper second premolar from 1.80 to 2.02. For the lower teeth we also found some differences at the 11 years old children: the EI scores for the canine varied from 2.14 to 2.61, for the first premolar from 2.33 to 2.41, and for second premolar also varied from 1.69 to 1.73. In general, the eruption sequence presented different patterns for boys and girls which are also direct linked with the children's age.

Keywords: age estimation, canine, premolar, eruption, sequence, child.

INTRODUCTION

Forensic odontology brings information about peoples of different social class and origins, oral and dental structures – clinical aspects, normal anatomy or aspects of different anatomical variations, as well the implications of dental treatments in identification process [1]. It has also an important role in victim identification in major mass disasters, abuse, and organized crimes [2,3]. However, in addition to exact identification of the individuals which implies the existence of ante-mortem dental records a preliminary identification can be done analyzing some anatomical aspects of the teeth. One important method is the teeth identification. Another important item is the teeth eruption which is directly linked with the age of children and adolescents.

The eruption of the permanent canines and premolars has a lot of variations and dynamics in children between 10 and 15 years.

The main role of this study is to establish a link between canine-premolars eruption sequence, gender

and age of children and a quick reasoning used in the identification process.

MATERIALS AND METHODS

This data are also part of the PAROGIM study, the first major clinical survey of dental caries, gingivitis and oral hygiene, developed on children in Bucharest, Romania.

This paper is the second clinical report concerning teeth eruption.

Study design

The PAROGIM study was conducted in Bucharest schools from 2008 to 2009. All the details of this study design were previously reported, as were the outcomes of caries experience, epidemiology of gingivitis and the first report of dental eruption [4,5,6]. Briefly, 1595 schoolchildren aged 10-17 years (5th to 8th grades) from 59 Bucharest schools were included in this study. The study sample (2.76% of schoolchildren

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population from Bucharest middle schools) was built on clusters [one cluster = one class of pupils (N = 25)] and stratified on specific base principles [4,5]. Therefore, 75 classes of pupils were randomly chosen according to the stratification methodology. In order to build a real sample statistically representative on Bucharest city (58.000 total population of schoolchildren from Bucharest middle schools, 95% confidence interval and 2.4% estimation error: data from 2008), the 3.2.2 version of EpiInfo public domain statistical software (Centers for Disease Control and Prevention, Atlanta, Georgia, USA) was used.

Oral clinical examination

The oral examinations were performed in schools as follow:

- in schools’ dental offices, if was possible (schools with dental offices) using dental unit, a plane mirror and the CPI dental probe;
- in schools’ medical offices (schools without dental office) using two mobile chairs, one for the child and one for the examiner, a Riester ri-focus LED headlamp (Rudolf Riester GmbH, Tuttlingen, Germany) and the dental instruments mentioned above.

The examination team consisted of one experienced dentist as principal investigator and another person who recorded the data.

The teeth eruption was investigated using an adapted version of an eruption index (EI) used in other studies [7,8] and previously shown in the last clinical report of this study [6]. Broadly, the index has 4 scores: “0”, when is no clinical evidence of the tooth; “1”, when some parts of dental crown are visible but not the entire occlusal surface/incisal margin; “2”, when the entire occlusal surface/incisal margin is visible but not reached the occlusal plane; “3”, when teeth is completely erupted (the occlusal surface/incisal margin is part of the occlusal plane).

Ethical and legal aspects

This study had the approvals of the Ethics Committee of “Carol Davila” University, Bucharest Hospitals and Medical Services Administration and School Inspectorate of Bucharest. All clinical procedures and the model of the inform consent were approved by the Ethics Committee. Every pupil selected for this study had to own an informed consent signed by one of his parents.

Data recording and analysis

The clinical data were recorded on paper. Afterward, all the information were passed to a computer and analyzed using SPSS software, version 16 (SPSS Inc., Chicago, IL, USA).

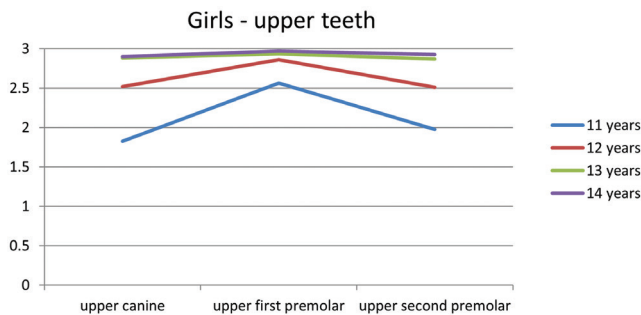


Figure 1. The eruption sequence for the girls upper teeth (canine, first and second premolar).

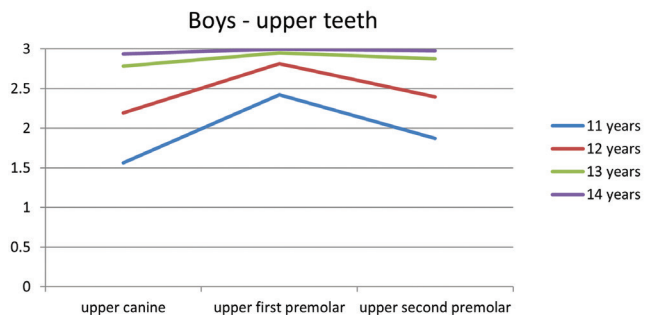


Figure 2. The eruption sequence for the boys’ upper teeth (canine, first and second premolar).

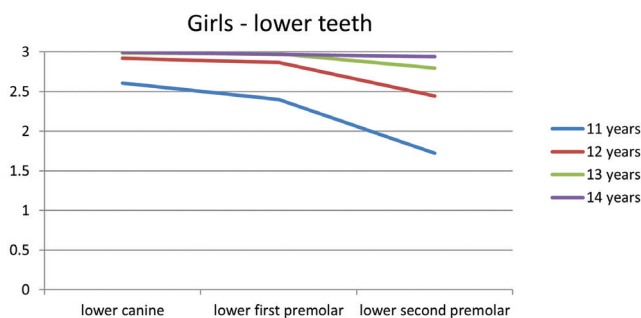


Figure 3. The eruption sequence for the girls’ lower teeth (canine, first and second premolar).

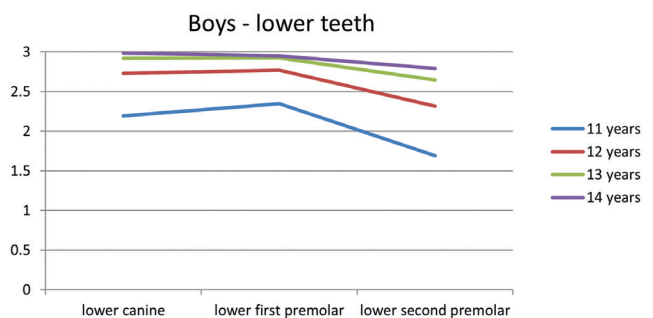


Figure 4. The eruption sequence for the boys’ lower teeth (canine, first and second premolar).

RESULTS

The characteristics of the 1595 pupils included in this study were the followings (data already published) [4,5,6]:

- 833 (52%) were girls and 762 (48%) were boys;
- Age: 330 (21%) from 11 years, 397 (25%) from 12 years, 381 (24%) from 13 years and 418 (26%) from 14 years; the rest of 4 % (10, 15, 16 and 17 years)

were excluded.

The mean values of the EI scores (\pm SE) were exposed on gender and age in tables 1 to 4. The eruption sequence of the canines and premolars was analyzed on gender and age and led to different patterns. The results are graphically shown in figures 1 to 4. The means values of EI scores of every tooth from the charts were also a mean between the value of the right and the left tooth. The small differences between the right and the left teeth have no clinical relevance.

Table 1. The eruption scores for the 11 years children (boys and girls)

Eruption scores for 11 years old children (mean value \pm SE)						
	Upper canine	Upper first premolar	Upper second premolar	Lower canine	Lower first premolar	Lower second premolar
Girl						
Left	1.83 (\pm 0.10)	2.58 (\pm 0.07)	1.93 (\pm 0.10)	2.60 (\pm 0.07)	2.39 (\pm 0.09)	1.71 (\pm 0.01)
Right	1.82 (\pm 0.10)	2.55 (\pm 0.07)	2.02 (\pm 0.10)	2.61 (\pm 0.07)	2.41 (\pm 0.08)	1.73 (\pm 0.11)
Boys						
Left	1.60 (\pm 0.11)	2.44 (\pm 0.09)	1.94 (\pm 0.11)	2.14 (\pm 0.09)	2.36 (\pm 0.09)	1.69 (\pm 0.11)
Right	1.53 (\pm 0.10)	2.40 (\pm 0.08)	1.80 (\pm 0.11)	2.25 (\pm 0.09)	2.33 (\pm 0.09)	1.69 (\pm 0.11)

Table 2. The eruption scores for the 12 years children (boys and girls)

Eruption scores for 12 years old children (mean value \pm SE)						
	Upper canine	Upper first premolar	Upper second premolar	Lower canine	Lower first premolar	Lower second premolar
Girl						
Left	2.55 (\pm 0.07)	2.85 (\pm 0.04)	2.46 (\pm 0.08)	2.92 (\pm 0.03)	2.87 (\pm 0.04)	2.45 (\pm 0.08)
Right	2.49 (\pm 0.07)	2.87 (\pm 0.04)	2.56 (\pm 0.07)	2.92 (\pm 0.03)	2.86 (\pm 0.04)	2.44 (\pm 0.08)
Boys						
Left	2.30 (\pm 0.08)	2.83 (\pm 0.04)	2.46 (\pm 0.08)	2.71 (\pm 0.05)	2.75 (\pm 0.05)	2.33 (\pm 0.08)
Right	2.09 (\pm 0.09)	2.80 (\pm 0.05)	2.33 (\pm 0.08)	2.75 (\pm 0.05)	2.79 (\pm 0.05)	2.30 (\pm 0.08)

Table 3. The eruption scores for the 13 years children (boys and girls)

Eruption scores for 13 years old children (mean value \pm SE)						
	Upper canine	Upper first premolar	Upper second premolar	Lower canine	Lower first premolar	Lower second premolar
Girl						
Left	2.87 (\pm 0.04)	2.95 (\pm 0.02)	2.85 (\pm 0.04)	2.99 (\pm 0.00)	2.98 (\pm 0.01)	2.76 (\pm 0.05)
Right	2.89 (\pm 0.03)	2.92 (\pm 0.03)	2.89 (\pm 0.03)	2.98 (\pm 0.01)	2.97 (\pm 0.02)	2.83 (\pm 0.05)
Boys						
Left	2.82 (\pm 0.04)	2.94 (\pm 0.03)	2.91 (\pm 0.03)	2.93 (\pm 0.03)	2.93 (\pm 0.03)	2.57 (\pm 0.07)
Right	2.75 (\pm 0.05)	2.96 (\pm 0.02)	2.84 (\pm 0.04)	2.91 (\pm 0.03)	2.92 (\pm 0.03)	2.72 (\pm 0.06)

Table 4. The eruption scores for the 14 years children (boys and girls)

Eruption scores for 14 years old children (mean value \pm SE)						
	Upper canine	Upper first premolar	Upper second premolar	Lower canine	Lower first premolar	Lower second premolar
Girl						
Left	2.93 (\pm 0.02)	2.97 (\pm 0.02)	2.93 (\pm 0.02)	3 (\pm 0.00)	2.97 (\pm 0.01)	2.90 (\pm 0.03)
Right	2.87 (\pm 0.03)	2.97 (\pm 0.01)	2.92 (\pm 0.02)	3 (constant)	2.97 (\pm 0.01)	2.88 (\pm 0.03)
Boys						
Left	2.91 (\pm 0.03)	3 (constant)	2.89 (\pm 0.04)	2.98 (\pm 0.01)	2.94 (\pm 0.03)	2.79 (\pm 0.05)
Right	2.96 (\pm 0.02)	3 (constant)	2.96 (\pm 0.02)	2.99 (\pm 0.00)	2.96 (\pm 0.02)	2.79 (\pm 0.05)

DISCUSSION

Our study revealed in detail the eruption sequence of canines and premolars on the 11-14 years age interval. The eruption sequence of canines and premolars are very important because is different from girls to boys and from upper maxillary to mandible which can bring some useful information in forensic. Summarizing the all 4 figures we can say that the eruption sequence of the upper teeth is the same for both, girls and boys: 1 – upper first premolar, 2 – upper second premolar and 3 – upper canine. The eruption sequence for the lower teeth differed from that of the upper teeth and presented one major difference from girls to boys: the canine and the first premolar eruptions are reversed.

The lower teeth eruption sequence can lead to vital information in preliminary identification such as the age. The differences from the eruption sequence are more visible at the age of 11. Afterward, they tend to fade (the age lines become flatter – see figures 1 to 4) as the children age. Therefore, at the age of 14 almost all the three teeth are completely erupted (score 3). Comparing girls to boys, it can be observed that girls' teeth erupt before boys'.

The eruption sequence that we found in this study is the following:

- upper teeth, boys and girls: first premolar → second premolar → canine
- lower teeth:
 - girls: canine → first premolar → second premolar
 - boys: first premolar → canine → second premolar

We found in our study one difference in eruption sequence comparing with other authors and studies [9,10] – the lower first premolar erupted before the canine in boys. This is one difference between boys and girls concerning teeth chronology in eruption. Moreover, girls also presented earlier teeth eruption on the 11 to 14 age interval.

In conclusion, we can say that the canines-premolars eruption sequence can be an important element in primary identification in children because presents different patterns for girls and boys.

Conflict of interest

The authors declare that they have no conflict of interest.

Acknowledgment

In this article, all authors have an equal contribution as the first author.

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