

# The Sequence and Chronology of the Eruption of Permanent Canines and Premolars in a Group of Romanian Children in Bucharest

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## Abstract

**Aim:** The aim of this study was to determine the sequence and chronology of the eruption of permanent canines and premolars by gender in a group of Romanian schoolchildren from Bucharest. **Methods:** This retrospective study was conducted using the records of a sample of 2081 Caucasian children aged between 8 and 13 years who presented to the Paedodontic Clinic of the Faculty of Dental Medicine of UMF Carol Davila, Bucharest, and to the dental offices of two schools in Bucharest for consultation and treatment in the period 2006-2010. The resulting data were entered into a database and statistically analysed using the univariate analysis of variance to compare the differences in eruption times between tooth groups. **Results:** The permanent canines and premolars erupted between the mean times of 9.55 years of age (first lower premolar in girls) and 11.15 years of age (second lower premolar in girls). Eruption occurred earlier in girls than in boys in both dental arches with the exception of second premolars (girls: 11.15 years, boys: 11.05 years). The overall eruption sequence was first premolar, second premolar, and canine for the maxilla and first premolar, canine, and second premolar for the mandible. **Conclusions:** The overall results of this study are in accordance with data from many previous studies, with the exception of the sequence of eruption of upper canines and premolars in girls. The eruption sequence of premolars and permanent canines in the study group corresponded to type II described by Lo and Moyers (1953) in the maxilla and with type I described by Nolla (1960) in the mandible.

**Key Words:** Tooth Eruption, Chronology and Sequence; Permanent Canines; Premolars

## Introduction

Tooth eruption is a long and complex physiological process during which a tooth moves from the site in the jawbone where it developed until it comes into occlusion and becomes functional [1].

With the exception of third molars, the processes of tooth eruption and the development of the occlusion occur in the first 13 to 15 years of life. Both primary and secondary teeth erupt at a fairly specific age. However, there is variation and it is useful to know the age range when each tooth is due to erupt and the mean age of eruption [2-4].

That said, there is wide individual variability, especially for the permanent teeth. The timing of tooth eruption is influenced by various factors. These factors may be physiological (e.g., related to genetic, constitutional, geographic, gender, race, nutrition, climate, urbanisation), pathological systemic (related to various diseases such as endocrine

diseases), or local (such as local obstacles in the path of eruption and lack of space) [5,6].

The time and sequence of the eruption of permanent canines and premolars have been studied in many areas of the world. In Iran, Moslemi (2004) found that, with the exception of maxillary second premolars, the average age of eruption of permanent teeth in girls was lower than in boys, but that there was a wider range of variation in the eruption dates of second premolars in girls. In boys, the maximum range of variation in the eruption dates was seen in the mandibular right first premolar, followed by the maxillary left canine [3]. A study conducted in Croatia in 2000 found that the beginning of eruption of premolars in girls was slightly earlier than in boys but both maxillary and mandibular canines erupted earlier in boys [5].

When studying the emergence ages of permanent teeth in Flemish children, Leroy *et al.* (2003)

performed a comparison with the results obtained from studies for the eruption dates in girls in other countries during the previous two decades. Their findings are presented in *Table 1* [7].

Koch *et al.* (2001) in Denmark [1] and Pakkala *et al.* (1991) [8] in Finland, cited by Moslemi (2004) [3], have reported that Caucasians have a delayed time of eruption. Stewart *et al.* (1982) [9], cited by Moslemi, (2004) [3], suggested that Afro-Caribbeans have been shown to have an earlier eruption pattern when compared to other ethnic groups.

The order and chronology of the eruption of permanent teeth is a major factor in the development of the permanent teeth and in the establishment of a correct occlusion [10]. Adequate knowledge of the timing and pattern of tooth eruption is important for diagnosis and treatment planning in paediatric dentistry [10]. To the authors' knowledge, since 1982 there has been no study of the eruption dates of permanent canine and premolar teeth in Romanians and since 1973, no such study has been conducted in Bucharest. Conditions in Romania have changed since then; therefore, a further study was necessary [11-13].

### Aim

The aim of this study was to determine the sequence and chronology of the eruption of permanent canines and premolars by gender in a group of Romanian schoolchildren from Bucharest.

### Methods

This cross-sectional, retrospective study was carried out on dental records of 2081 Caucasian children aged between 8 and 13 years.

The study sample was selected by one author (I-VF) from all the patients in this age band who attended the Paedodontic Clinic of the Faculty of Dental Medicine within the Carol Davila

University of Medicine and Pharmacy, Bucharest, Romania, over a five-year period and from the children who attended two primary schools in Bucharest, in one of which one of the authors (SEF) works. Prior to the study, written consent was obtained from the management of the Dr. Victor Gomoiu Children's Hospital, under whose authority the dental offices in the respective schools were operating, and from the board of management of the Faculty of Dental Medicine. Because no clinical examinations or interventions were required and no children are identified in this study, the management of the Faculty of Dental Medicine and the Children's Hospital advised that it was unnecessary to seek approval for the study from an ethics committee.

The following inclusion and exclusion criteria were applied:

Inclusion criteria:

- All dental records of healthy Caucasian children aged between 8 and 13 years who presented for consultation and treatment in the first author's dental office (surgery) in the Paedodontic Clinic of the Faculty of Dental Medicine.
- All dental records of the healthy Caucasian children, aged between 8 and 13 years, who presented for consultation at the dental offices of the two schools.
- All the children who had complete dental records at the beginning of the study.

Exclusion criteria:

- Children with systemic diseases that may have influenced tooth eruption.
- Children with local conditions that may have influenced tooth eruption.
- Children younger than 8 years or older than 13 years.
- Foreign children or Romanian children who were not Caucasian.

**Table 1.** Canines and premolars emergence ages for girls (after Leroy *et al.*, 2003) [7]

Country Tooth	Belgium	Dominican Republic	Japan	Sweden	Denmark	Finland	Northern Ireland
C (upper)	10.99	10.6	10.3	10.76	10.90	11.3	11
PM1 (upper)	10.37	9	9.3	10.31	10.54	10.9	10.48
PM2 (upper)	11.35	10.2	10.3	10.99	11.46	11.9	11.23
c (lower)	9.74	9	9.2	9.53	9.80	10.1	9.89
pm1 (lower)	10.25	10.5	9.7	10.26	10.37	10.8	10.36
pm2 (lower)	11.37	11.2	10.4	11.18	11.39	11.5	11.37

- Children with incomplete dental records.

The following data were then collected by three of the authors from the dental records of the patients: gender, date of birth, date of consultation, the presence of (erupted) premolars and permanent canines, type of tooth. These teeth were recorded as upper canine—CU, first upper premolar—PU1, second upper premolar—PU2, lower canine—CL, first lower premolar—PL1, second lower premolar—PL2. An erupted tooth was defined as a tooth penetrating the gingiva with any part of its crown and becoming visible in the oral cavity.

When analysing the resulting data, the variables taken into account were: age, sex, tooth type, and dental arch. Taking into account the fact that most of the time symmetrical and homologous teeth erupt simultaneously, the study did not take into account on which side of the arch (left or right) a particular tooth was located. Instead, as in previous studies in other countries, similar teeth on the left and right sides were observed as pairs [7,14-17]. The age of eruption of a tooth was considered to be equal to the median age of patients with 50% of the teeth of that type erupted.

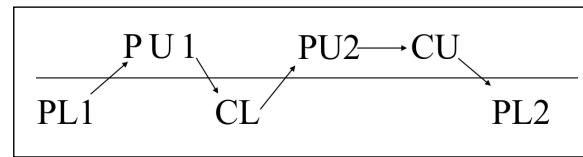
Data were entered into statistical software (Statistical Package for Social Sciences version 15; SPSS Inc, Chicago, USA). The univariate analysis of variance was used to compare the differences in median eruption dates between tooth groups (CU, PU1, PU2, CL, PL1 and PL2 for overall eruption dates and also for girls as a separate group and boys as a separate group). Statistical significance was set at the 95% probability level and data were analysed using the statistical software.

## Results

1. The children demonstrated a fairly balanced distribution by gender, with a slight preponderance of boys—1075 (51.7%) compared to girls 1006 (48.3%).
2. The mean age of the children was 10.43 years (SD=1.44 years), with the mean age for the girls 10.44 years (SD=1.45 years) and for the boys 10.42 years (SD=1.44 years).
3. The median eruption dates are listed in Table 2.
4. The sequence of eruption of premolars and permanent canines was as follows:

- Girls (Figure 1)

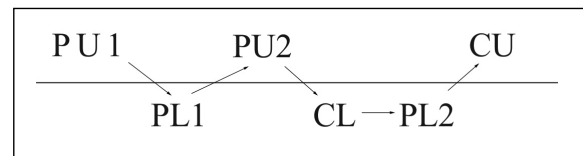
- o Maxilla: PU1 – PU2 – CU
- o Mandible: PL1 – CL – PL2



**Figure 1.** The eruption sequence of premolars and permanent canines sequence in girls.

- Boys (Figure 2)

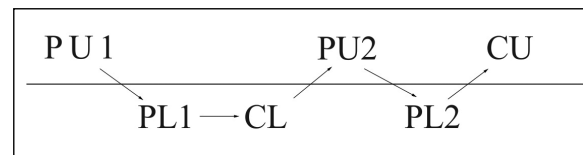
- o Maxilla: PU1 – PU2 – CU
- o Mandible: PL1 – CL – PL2



**Figure 2.** The eruption sequence of premolars and permanent canines sequence in boys.

- Overall (Figure 3)

- o Maxilla: PU1 – PU2 – CU
- o Mandible: PL1 – CL – PL2



**Figure 3.** The overall eruption sequence of premolars and permanent canines.

**Table 2.** Median eruption dates (age in years)

Tooth	Girls	Boys	Overall
Upper canine (CU)	11.01	11.08	11.07
First upper premolar (PU1)	9.57	9.68	9.60
Second upper premolar (PU2)	10.91	10.43	10.61
Lower canine (CL)	9.86	10.14	10.56
First lower premolar (PL1)	9.55	9.91	9.57
Second lower premolar (PL2)	11.15	11.05	11.06

The overall differences between different eruption ages were statistically significant ( $P$ -values between 0.015 and <0.001) with the exception of: PU1 – PL1 ( $P=0.59$ ), PU2 – PL2 ( $P=0.96$ ), CL – PL1 ( $P=0.19$ ), and PL1 – PL2 ( $P=0.91$ ). Also, in

girls there was no statistically significant difference between CU and PU2 ( $P=1.00$ ) and between CL and PL1 ( $P=1.00$ ), whereas in boys there was no statistically significant difference between CL and PL1 ( $P=0.303$ ) and between CL and PL2 ( $P=0.948$ ).

### Discussion

A retrospective study of the sequence and chronology of the eruption of permanent teeth has the advantage of good accessibility to the patients' consultation records. However, the most accurate method to estimate the age of tooth eruption would have been to examine children clinically in a longitudinal study. Unfortunately, this is difficult because of the high rate of patients' dropout in the Paedodontic Clinic at the Faculty of Dental Medicine within the Carol Davila University of Medicine and Pharmacy, Bucharest, and the complicated bureaucracy to obtain approval to carry out consultations in schools.

The study sample selected by one of the authors (I-VF) may be considered representative both quantitatively (large number of patients) and qualitatively for the population of Bucharest, because it was composed of patients from the Paedodontic Clinic, which receives children from all areas of the city, and from various social groups and students from two schools which are located in neighbourhoods with average living standards.

In the statistical calculations, the median age of eruption was used because this method was considered more appropriate to this type of retrospective study, which does not directly observe the moment when tooth eruption commences [18].

A possible source of error can occur when gathering data from patient files, because this technique does not take into account how advanced the eruption of each tooth was. However, the use of the univariate analysis of variance method and the great number of patients should have meant that results were very close to reality.

The time of emergence of teeth is determined by specific methods based on data collected from population-wide samples. The process of eruption is influenced in individuals by wide physiological variability and, as described in the introduction to this paper, depends on heredity, constitution, geographic factors, sex, race, nutrition, climate, and urbanisation [5,6]. In the literature, different populations have been assessed to determine the average time of the eruption of their permanent teeth. In the

current study, although the period during which the permanent teeth erupted was similar in both sexes (with the exception of the third molars, between 6 and 12 years of age), the order of eruption was different. Most differences have been recorded in children over the age of 10 years and in the order of eruption of canines and second premolars [19].

According to Massler and Schour (1941) [20], Lo and Moyers (1953) [21], and Okuya (1950) [22] (cited by Zarnea, 1983) [19], there are two types of dental eruption sequence of permanent premolars and canines:

- Type I—maxillary 4 (first premolar)-3 (canine)-5 (second premolar) and mandibular 3-4-5, and
- Type II—maxillary 4-5-3/mandible 3-4-5.

Nolla (1960) [23] (cited by Zarnea, 1983) [19] considered that there are three possible patterns:

- Type I—maxillary 4-3-5/mandible 4-3-5,
- Type II—maxillary 3-4-5/mandible 3-4-5 (4 and 5 almost simultaneously), and
- Type III—maxillary 3-4-5 (4 and 5 almost simultaneously)/mandible 3-4-5 [19].

The current study's results reveal some agreement and some disagreement with those of previous ones. They confirm earlier studies of the eruption of permanent teeth for most of the maxillary teeth. In the Romanian sample whose results are reported in this paper, both for boys and girls upper canines erupted after the premolars, although there was not a statistically significant difference. This finding was in contrast to those of some previous studies, which reported that the upper canines erupted at times between those of the two upper premolars [24-26]. However, it was in agreement with the results of three other studies [27-29].

Zarnea (1992) reported that more than 18 different patterns of eruption of the canines and premolars are described in the literature [19]. The findings of the last study of eruption patterns in Bucharest [13] were confirmed in part by the results of the present study. Thus, the results of the study did not confirm that the eruption of upper first premolar occurs earlier than that of the lower ones. Also, the results differed with respect to the second lower premolars, which erupted later than the upper second premolars [19]. However, in the current study, differences in eruption times between lower premolars and upper premolars were not statistically significant.

Compared with data reported by Leroy *et al.* (2003), eruption ages for girls found in the current study were within the range found in the other stud-

ies [Table 1] [7]. As far the eruption sequence was concerned, it was similar only to that of the Dominican Republic, where the explanation could be the existence of mixed European–African population with a strong Latin influence. For the mandible, the eruption sequence was different from all the studies presented in Table 1.

### Conclusions

The overall results of this study are in accordance with data from many previous studies, with the exception of the sequence of eruption of upper canines and premolars in girls. The eruption sequence of premolars and permanent canines in the study group corresponded to type II described by Lo and Moyers (1953) [21] in the maxilla and with type I described by Nolla (1960) [23] in the mandible.

### Acknowledgement

This study was supported financially by Carol Davila University of Medicine and Pharmacy,

Bucharest, Romania, as well as by the authors.

### Contributions of each author

- I-VF was responsible for selection of the study sample, collection of data from the study group, drafting the paper, compiling the database, graphic illustrations, English translation, accessing papers for the literature review and discussion.
- AMR was responsible for collection of data from the records of the study group, coordination of the study, drafting the paper, accessing papers for the literature review and discussion.
- SEF was responsible for collection of data from the records of the study group and obtaining the necessary approvals.
- CH was responsible for the statistical analysis.

### Statement of conflict of interests

As far as the authors are aware, there are no conflicts of interest.

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