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## A study on the chronology and sequence of eruption of primary teeth in Spanish children

### ABSTRACT

**Aim** The aim of this study is to determine the timing of primary teeth eruption in Spanish children, and to distinguish gender and arch differences.

**Materials and methods** A cross-sectional study was performed on primary teeth eruption in a sample of 1,250 children (623 girls and 627 boys) from the Region of Madrid aged between 3 and 42 months. The clinical emergence of teeth was taken to estimate the mean ages of primary teeth eruption. The *t* test was used to analyse gender and arch differences.

**Results** The process of primary dentition lasted 22.28 months, and statistically significant differences were found in the eruption of homologous contralateral teeth. The first molars and maxillary lateral incisors erupted earlier in girls than in boys, with no statistically significant chronological differences. The central incisors and second molars erupted first in the mandibular arch, while the lateral incisors, canines and first molars erupted first in the maxilla. A greater chronological difference was found between the lateral incisors, which erupted more than 8 months earlier in the maxilla than in the mandible.

**Conclusions** In the overall sample, the first tooth to erupt was the lower right central incisor at  $10.96 \pm 1.88$  months, and the last was the upper left second

molar, at  $33.24 \pm 4.35$  months, symmetry was found in the eruption of the deciduous teeth. The greatest chronological difference was observed in the lateral incisors, with the upper ones erupting more than 8 months before the lower ones. Although statistically significant gender differences were found, they were considered clinically irrelevant.

**Keywords** Chronology of eruption; Primary dentition; Primary teeth; Sequence of eruption; Tooth eruption.

## Introduction

Eruption of the primary dentition is a long process that is intimately related to the growth and development of the child [Barbería, 2001] and is defined as the movement of the tooth from its position within the alveolar process to a functional situation in the oral cavity [Choi and Yang, 2001]. Tooth eruption may be affected by many factors, such as gender, race, height, weight, or socioeconomic status, many of which have been the subject of research. One of the criteria used to evaluate dental maturity is the chronology and sequence of eruption. Many studies exist on the age of emergence of deciduous teeth in different populations, but there have been few on the Spanish population.

The aim of this study was to determine the mean ages and sequence of eruption of the primary teeth and standard deviations in a sample of children from the Region of Madrid, comparing the chronology of the deciduous dentition and analysing gender differences.

## Materials and methods

This cross-sectional study analysed 1,464 subjects (742 boys and 722 girls), all aged between 3 and 42 months, who were examined (one examination for each child) from May 2009 to June 2012 in various nurseries in the region of Madrid.

To be included in the study, all subjects had to fulfil the following criteria: under 42 months of age, full term, Spanish origin (Caucasian), with informed consent to participate in the study signed by the parents. We excluded from the study any individuals with the following:

- Birth defects affecting the orofacial area (cleft palate, cleft lip).
- Presence of syndromes or diseases that alter tooth eruption.
- Preterm children and / or low birth weight.
- Family history of tooth agenesis.
- Avulsion and/or extraction of teeth.

Consequently, after exclusion of 214 participants, the

TOOTH	MAXILLA					MANDIBLE				
	Right		Left		t test (p value)	Right		Left		t test (p value)
	Mean	SD*	Mean	SD*		Mean	SD*	Mean	SD*	
Central Incisor	14.88	2.90	14.92	2.84	0.84	10.96	1.88	12.31	2.52	0.00
Lateral Incisor	15.28	2.74	15.24	2.78	0.91	23.28	5.27	24.20	5.68	0.00
Canine	26.15	4.41	24.93	3.98	0.00	25.72	3.80	25.62	3.86	0.74
1st Molar	21.55	3.88	21.59	4.52	0.85	21.75	3.76	21.70	3.71	0.86
2nd Molar	32.81	4.37	33.24	4.35	0.13	32.41	4.48	32.49	4.35	0.77

\* Standard deviation

**TABLE 1**  
Mean ages of eruption (in months) of the complete primary dentition in the study sample.

study sample consisted of 1,250 subjects, 623 girls and 627 boys, aged between 3 and 42 months.

Data collection was carried out under good lighting, with the help of a mirror, through inspection and palpation and considering a tooth to be erupted when any part of its crown had penetrated the mucosa and was visible in the oral cavity. The inspections were conducted by two examiners, and concordance tests were performed during an initial examination of the first 350 children, resulting in a Kappa index of 1. Name (initials), sex, birth weight, birth date, examination date, and the teeth present in the oral cavity were noted in a table specifically designed for this study.

With these data the mean ages of eruption of the primary teeth and standard deviations were obtained, from which the statistical significance was calculated using the t test for independent samples with a confidence interval of 95%, based on the SPSS Statistics 19 program (SPSS Inc, Chicago, IL, USA).

## Results

### Timing of eruption

The total duration of the eruption process of primary teeth in the study sample was 22.28 months. We broke this up into four distinct periods, separated by periods of time when no temporary teeth erupted, which we called 'inter-eruption' intervals. Thus, the timing found in our sample was as follows.

- First eruption period, with a duration of 4.32 months, when central incisors (upper and lower) and upper lateral incisors erupt.
- First inter-eruption interval, between emergence of the upper lateral incisors and maxillary first molars, with a duration of 9.39 months in the mandible and 6.27 months in the maxilla.
- Second eruption period, with a duration of 2.65 months, when the first molars (maxillary and mandibular) and mandibular lateral incisors erupt.
- Second inter-eruption interval, between emergence of mandibular lateral incisors and canines, with a duration of 3.34 months in the maxilla and 1.42 months in the mandible.
- Third eruption period, with a duration of 1.22 months,

when the maxillary and mandibular canines erupt.

- Third inter-eruption interval, between emergence of canines and second molars.
- Fourth eruption period, when the maxillary and mandibular second molars erupt, with a duration of 0.43 months in the maxilla. In the lower mandible, the second molars erupt symmetrically.

In our sample, the first primary tooth (the lower right central incisor) erupts during the first period (at 10.96 ± 1.88 months), just before the first birthday. In the fourth period, the last primary tooth (upper right second molar) erupts at 33.24 ± 4.35 months. We obtained the mean ages of eruption of each of the primary teeth during the total duration of primary dentition (Table 1). Small differences were observed between the two sides in the timing of contralateral homologous tooth eruption. Statistical analysis (t test) showed significant differences for the upper canine and lower central and lateral incisors. However, given the small age difference between the two sides, we considered that these differences were clinically insignificant and that the eruption process for the whole sample in both arches follows a symmetrical chronological pattern (Table 1).

In our sample, central incisors and second molars erupted first in the mandible, while canines, lateral incisors and first molars erupted first in the maxilla. The greatest chronological difference was observed between the lateral incisors, which erupted more than 8 months earlier in the maxilla than in the mandible.

Statistical analysis (t test) revealed significant differences

TOOTH	MAXILLA		MANDIBLE		t test (p value)
	Mean	SD*	Mean	SD*	
Central incisor	14.92	2.86	11.76	2.37	0.00*
Lateral incisor	15.25	2.75	23.77	5.52	0.00*
Canine	25.61	4.26	25.67	3.83	0.70
1st Molar	21.56	3.84	21.73	3.72	0.35
2nd Molar	33.02	4.46	32.44	4.41	0.00*

\* p < 0.05  
\* Standard deviation

**TABLE 2** Comparison of the mean ages of eruption of the primary dentition in each jaw.

TOOTH		Boys		Girls		t test (p value)
		Mean	SD*	Mean	SD*	
MAXILLA	Central incisor	14.93	2.79	14.88	2.94	0.07
	Lateral incisor	15.21	2.72	15.30	2.79	0.03*
	Canine	25.31	4.23	25.95	4.28	0.00*
	1st Molar	21.80	3.73	21.31	3.96	0.00*
	2nd Molar	32.73	4.50	33.37	4.37	0.00*
MANDIBLE	Central incisor	11.70	2.39	11.80	2.39	0.52
	Lateral incisor	23.76	5.46	23.76	5.56	0.00*
	Canine	25.31	3.82	26.10	3.80	0.00*
	1st Molar	22.00	3.60	21.47	3.82	0.00*
	2nd Molar	32.26	4.36	32.64	4.46	0.05*

\* p < 0.05  
\* Standard deviation

FIG. 3 Comparison of the mean ages of eruption of primary teeth by gender.

for the incisors (central and lateral) and second molars (Table 2). Gender comparisons in the chronology of eruption of primary teeth showed in boys earlier eruption of the canines, lower central incisors, and second molars. Both the upper and lower first molars and maxillary lateral incisor erupted first in girls. Eruption of the mandibular lateral incisors was similar in both sexes. Statistical analysis (t test) showed that these differences were significant for all primary teeth except for the upper and lower central incisors and lower lateral incisors (Table 3).

**Sequence of eruption**

The sequence of eruption of primary teeth for each arch separately was found to be as follows.

- Mandible: central incisor, first molar, lateral incisor, canine and second molar.
- Maxilla: central incisor, lateral incisor, first molar, canine and second molar.

We found the following sequence for all the primary teeth: mandibular central incisor, upper central incisor, upper lateral incisor, maxillary first molar, mandibular first molar, mandibular lateral incisor, maxillary canine, mandibular canine, mandibular second molar and

maxillary second molar. These sequences were found for both sexes and both sides (Fig. 1).

**Discussion**

Comparative analysis of studies on the chronology and sequence of eruption of primary teeth is difficult because each study uses a different methodology. While some authors compare the number of erupted teeth at a certain age, others use different methods to obtain the mean ages of eruption of primary teeth.

Most of the samples studied do not exceed 1,000 individuals in both transverse and longitudinal studies [Gupta et al., 2007; Hulland et al., 2000; Lumbau et al., 2008; Al Jasser and Bello, 2003; Ramirez et al., 1994; Saleemi et al., 1994; Hitchcock et al., 1984; Magnusson, 1982; Shuper et al., 1985; Kaul et al., 1992; Hägg and Taranger, 1986; Holman and Yamaguchi, 2005; Singh et al., 2004; Folayan et al., 2007]. Some had larger samples [Choi and Yang, 2001; Holman and Jones, 2003; Yun, 1957; Baghdady and Ghose, 1981; Nyström, 1982; Psoter et al., 2003], and Brook et al. [1972] studied both primary and permanent dentition in 4,873 subjects. Our sample size is similar to that found in most other studies.

In timing of eruption, we observed large differences in our sample in comparison with the studies reviewed, especially for the lower lateral incisors. In our sample, the lower lateral incisors emerged much later, so the lower first molars erupted before them. This result was different to those reported in the literature reviewed. In addition, the subjects in our sample showed later eruption ages of primary teeth than those reported in the literature. Regarding differences in primary dentition eruption between the two arches, we observed that teeth in the maxilla erupted earlier than those in the mandible, except for the central incisor and second molar. We found significant differences in the case of the central and lateral incisors, and the second molars.

Regarding gender differences, most of the studies that observe differences point to earlier eruption in males [Choi and Yang, 2001; Gupta et al., 2007, Al Jasser and Bello, 2003; Ramirez et al., 1994; Hithcock et al., 1984; Baghdady and Ghose, 1981; Oziegbe et al., 2008; Rajic

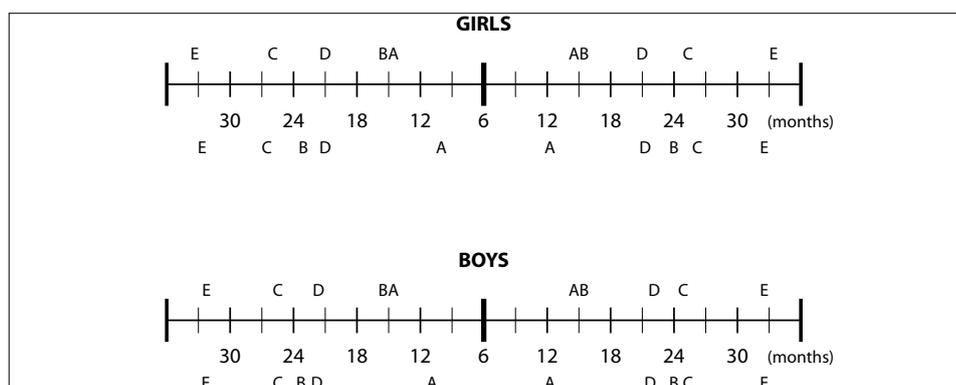


FIG. 1 Sequence of eruption of maxillary and mandibular primary teeth in both sexes and on both sides.

- A Central incisor
- B Lateral incisor
- C Canine
- D First molar
- E Second molar

et al., 1999; Psoter et al., 2003; Holman and Jones, 1998]. Others, however, note earlier eruption in girls [Magnusson, 1982], except for the upper central incisor and the canine, although significant differences were only observed for the lower central incisor and second molar. Finally some studies found no differences between the sexes [Saleemi et al., 1994; Yun, 1957; Nystrom et al., 2000; Bambach et al., 1973; Brook and Barker, 1972].

Regarding symmetry of eruption, we found that most of the reviewed authors [Choi and Yang, 2001; Gupta et al., 2007; Kaul et al., 1992; Singh et al., 2004; Baghdady and Ghose, 1981] found no differences in emergence of the homologous contralateral teeth and accepted symmetry in primary dentition eruption. In some studies [Oziegbe et al., 2008], eruption took place slightly earlier on the right side than the left, especially in boys, although the difference was not statistically significant. Other studies such as Lysell et al. [1962] observed earlier eruption on the left side, except for the lower canines, but no statistically significant differences were found. In our sample, we observed that the lower incisors emerged first on the right side, and the upper canine emerged first on the left side, with statistically significant results. However, given the small time difference between the two sides, we consider these differences to be of little relevance. The eruption sequence in our sample differed to that found in the rest of the literature. Most of the reviewed studies agree that the sequence of eruption of primary teeth most frequently observed is: lower central incisor, upper central incisor, upper lateral incisor, lower lateral incisor, maxillary first molar, mandibular first molar, upper canine, lower canine, mandibular second molar and maxillary second molar. However, in our study sample, the sequence of eruption of primary teeth was: lower central incisor, upper central incisor, upper lateral incisor, maxillary first molar, mandibular first molar, lower lateral incisor, upper canine, lower canine, mandibular second molar and maxillary second molar.

## Conclusions

1. In our sample, the first tooth to erupt was the lower right central incisor at  $10.96 \pm 1.88$  months. The last primary tooth to emerge was the second upper left molar at  $33.24 \pm 4.35$  months.
2. In our sample, the central incisors and second molars erupted earlier in the mandibular arch, while canines, incisors and first molars emerged earlier in the maxilla. The greatest chronological difference was observed in the lateral incisors, with the upper ones erupting more than 8 months before the lower ones.
3. No differences were found in the eruption of homologous contralateral teeth.
4. Regarding gender differences in the timing of the eruption of the primary dentition, statistically significant results were obtained for almost all the deciduous

teeth, except for the central incisors. However, these differences were not considered clinically relevant, except for the lower canines and upper second molars where the difference was greater, with earlier eruption in males.

5. The eruption sequence obtained in our sample was: lower central incisor, upper central incisor, maxillary lateral incisor, maxillary first molar, mandibular first molar, lower lateral incisor, maxillary canine, lower canine, lower second molar and upper second molar.

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