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Timing of emergence of the first primary tooth in preterm and full-term infants

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ABSTRACT

Variations in the timing of emergence of primary teeth are under strong genetic control, but there is also a significant contribution from external factors. The aim of this study was to evaluate the influence of preterm birth, birth weight and length, and feeding practices during the first 6 months of life on the timing of emergence of the first primary tooth.

Data on pregnancy duration, birth weight and length, feeding practice, time of emergence and first emerged primary tooth were collected by electronic questionnaires. The study included 409 parents and 592 children of both genders. The sample was divided into two groups according to pregnancy duration (<37 weeks and ≥37 weeks), three groups according to feeding practice (exclusively breastfed, exclusively bottle fed, and a combination of breast feeding and bottle feeding), three groups by birth length (<50, 50–53, >53 cm), and four groups by birth weight (<1500, 1500–2500, 2501–3500, >3500 g). Data were analyzed considering chronological and postmenstrual age—which is the gestational age plus the infant's chronological age at the month of emergence of the first primary tooth.

The mean time of first primary tooth emergence was 7.55 ± 2.67 months when chronological age was considered. The first emerged tooth in most cases was a lower incisor (82.33%). There was a statistically significant difference in the timing of the first tooth emergence between preterm and full-term groups when chronological age was considered ($p < 0.005$). However, no difference was found when age was adjusted. The age of emergence of the first tooth differed significantly when feeding, weight, and length groups ($p < 0.05$) were taken into account.

In conclusion, the study indicates that shortened gestational age and very low birth weight are predictors for later ages of emergence of the first primary tooth.

1. Introduction

Eruption is the phase of tooth development characterized by movement through the alveolar bone into the oral cavity. The timing of eruption of deciduous teeth is usually between 4 and 36 months. The typical order of tooth emergence is central incisor, lateral incisor, first molar, canine and second molar in the maxillary and mandibular arch (Al-Batayneh et al., 2015; Zadzińska et al., 2013).

There is a significant genetic contribution to the variation in the timing of emergence of primary teeth (Hughes et al., 2007; Pillas et al., 2010), but there is also a significant contribution from external factors (Holman and Yamaguchi, 2005; Sahin et al., 2008). Preterm birth and low birth weight are factors that can affect oral growth and development of the child (Seow, 1997). Consistent with this line of thought, dental development and tooth eruption may also be influenced by the above mentioned factors. Several studies have shown delayed first tooth eruption in preterm and low birth weight infants (Fadavi et al., 1992; Viscardi et al., 1994; Ramos et al., 2006), but when the age was corrected according to pregnancy duration, no delay was found in development and eruption.

Preterm birth is defined by World Health Organization as the birth of an infant that occurs before 37 weeks of pregnancy. The rate of preterm birth is 5–18% among different countries, with more than 60% of these cases occurring in Africa and South Asia (WHO, 2012). Low birth weight is defined as a weight at birth of less than 2500 g. If birth weight is less than 1500 g it is classified as very low weight. Low birth weight can be the consequence of preterm birth, or it can be secondary to small size for gestational age.

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Feeding practices in the first months of life in infants is considered a significant factor influencing development of dental occlusion and timing of the first primary tooth eruption according to several researchers. Viggiano et al. (2004) found a protective effect of breastfeeding to posterior cross-bite development. The literature however is inconclusive regarding different feeding practices and subsequent effects on the timing of tooth eruption. Holman and Yamaguchi (2005) reported that children who were not breastfed showed delayed eruption of the upper incisors while Sahin et al. (2008) reported generally delayed teething time in infants fed with formula or cow's milk, alone or when supplemented by breastfeeding.

The aim of our study was to evaluate the effects of different feeding practices, birth weight and length in preterm and full-term infants on the timing of first primary tooth emergence.

2. Materials and methods

This cross-sectional study was performed on sample of 592 children of both genders (313 males and 279 females). The study was approved by the Ethics Committee of the School of Dental Medicine University of Zagreb. Data on pregnancy duration, birth weight and length, feeding practices, time of emergence and first emerged primary tooth were collected by electronic questionnaires. Questionnaires were sent to parents via several parent organizations, including the parental society of preterm born children. Parents were instructed to provide information about week of pregnancy duration in which birth occurred (gestational age), as stated in their medical records. First primary tooth emergence time was recorded as child's age, in months, in which any part of hard tooth tissue emergence above gingiva was noticed.

The effect of gestational age on timing of first primary tooth emergence was examined by grouping subjects into two groups. According to pregnancy duration, preterm infants were considered those born before 37 weeks of pregnancy and full-term infants those born after 37 weeks of pregnancy.

Timing of the first primary tooth emergence was compared between subjects in different feeding practice groups. Infants were considered breastfed if they were exclusively breastfed for the first six months of life. Bottle fed infants were considered those who were exclusively bottle fed from birth. Those infants fed by a combination of both breastfeeding and bottle feeding were assigned to the third group.

The effect of birth weight was analyzed by grouping subjects according to four weight groups (<1500 g, 1500–2500 g, 2501–3500 g,>3500 g). Subjects were also categorized into three groups according to length at birth (<50, 50–53, >53 cm).

Data were analyzed according to chronological and postmenstrual age at the time of the first tooth emergence. Postmenstrual age was calculated by adding gestational age (in weeks) and infant's chronological age at first primary tooth eruption (months transferred to weeks using the mathematical formula: week = month × 4.34523809524). Weeks of postmenstrual ages were transferred to lunar months using formula: month = week × 0.230136986301.

Statistical analyses were carried out by IBM SPSS Statistics software Version 21.0 (Armonk, NY: IBM Corp.), with $p < 0.05$ set as the level of statistical significance. Independent samples *t*-tests and one-way ANOVA were used to compare data between different sample groups, and Pearson correlation coefficients were used for the comparison of two numerical (ordinal) variables. Multivariate linear regression models were used for the analysis of chronological and postmenstrual age at the time of the first tooth eruption as a dependent parameter with sex, birth weight and length, gestational age and feeding practice as predictor variables.

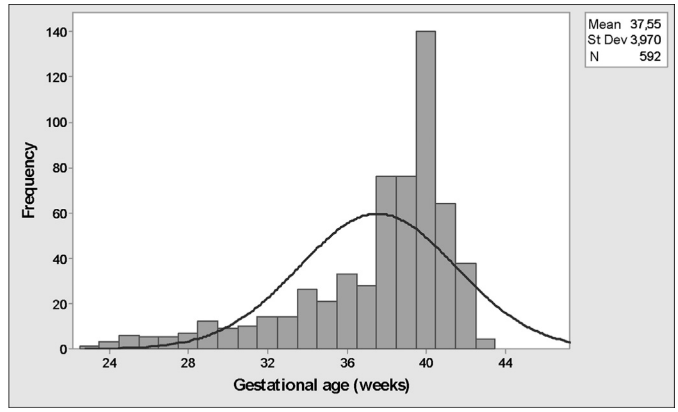

Fig. 1. Range of gestational ages presented in the study sample.

3. Results

The timing of emergence for the first tooth ranged from 2 to 18 months, mean 7.55 ± 2.67. Chronological age of eruption in different sample groups is shown in Table 1 and postmenstrual age in Table 2.

The mandibular central incisor was usually the first emerged tooth, in 82.33% of cases, while the maxillary central incisor was first in 17.67% of cases.

There was no significant difference in the timing of the first tooth emergence between males (53%) and females (47%) in both chronological and postmenstrual age groups ($p > 0.05$).

In the whole sample of 592 children, 194 (32.77%) were born preterm while 398 (67.23%) were born full term. The whole range of gestational ages presented in the sample is shown in Fig. 1.

A significant difference in the timing of the first tooth emergence was found between preterm and full term born infants when chronological age was considered ($p < 0.05$). When the age was adjusted according to gestational age, there was no significant difference ($p > 0.05$) in the timing of first tooth emergence between those two groups. The analysis of first emergence time pointed to a significant negative correlation with the gestational age of infants ($r = -0.358$, $p < 0.05$).

In this sample, there were 294 (49.66%) breastfed infants, 200 (33.78%) infants fed by combination of breastfeeding and bottle and 98 (16.55%) infants who were exclusively bottle fed. Exclusively breastfed infants had significantly earlier first tooth emergence times as compared to the bottle fed group, even after chronological age was considered ($p = 0.003$). However, this difference was insignificant when the age was adjusted. Significantly earlier emergence was recorded in exclusively breastfed children as compared to infants fed with a combination of breastfeeding and bottle ($p = 0.028$). There was no significant difference between the combination and bottle fed groups ($p > 0.05$). Lastly, no significant difference was noted between different feeding practice groups when the age was adjusted.

Analysis of the first tooth emergence time between groups of different birth weights showed significant differences in both chronological and postmenstrual age (Tables 1 and 2).

A significant difference in emergence age was found between sample groups with different birth length in chronological age, but this difference again became non-significant when the age was adjusted (Tables 1 and 2).

Linear general modeling in the analysis of the chronological age at the first tooth emergence pointed to birth weight as significant predictor, whereas sex, birth length, gestational age and feeding practice were not significant predictors (Table 3). In the analysis

Table 1
Chronological age of first tooth emergence in different sample groups.

	Chronological age of first tooth emergence (months)								p
	Count	Mean	SD	Minimum	Maximum	Percentile 25	Median	Percentile 75	
Sex[a]									
Male	313	7.35	2.45	2	16	6.00	7.00	9.00	0.145
Female	279	7.68	2.93	3	18	6.00	7.00	9.00	
Birth weight[b]									
<1500 g	60	10.22	3.26	4	18	8.00	10.00	12.00	**<0.001**
1500–2500 g	83	7.76	2.45	4	17	6.00	8.00	9.00	
2501–3500 g	254	7.43	2.47	2	15	6.00	7.00	9.00	
>3500 g	195	6.66	2.30	3	16	5.00	6.00	8.00	
Birth length[b]									
<50 cm	267	8.29	2.85	3	18	6.00	8.00	10.00	**<0.001**
50–53 cm	264	6.87	2.29	2	14	5.00	6.00	8.00	
>53 cm	61	6.84	2.68	3	16	5.00	6.00	8.00	
Gestational age[b]									
<37 weeks	194	8.44	2.91	3	18	6.00	8.00	10.00	**<0.001**
>37 weeks	398	7.05	2.45	2	16	5.00	7.00	8.00	
Feeding practice[b]									
Breastfed	294	7.15	2.35	3	15	6.00	7.00	8.00	**0.002**
Bottle fed	98	8.19	3.13	3	18	6.00	8.00	10.00	
Combination	200	7.69	2.84	2	17	6.00	8.00	10.00	

[a] Independent *t*-test.
[b] One-way ANOVA.

Table 2
Postmenstrual age of first tooth emergence in different sample groups.

	Postmenstrual age of first tooth emergence (months)								p
	Count	Mean	SD	Minimum	Maximum	Percentile 25	Median	Percentile 75	
Sex[a]									
Male	313	16.01	2.30	11	25	14.00	16.00	17.00	0.078
Female	279	16.37	2.69	11	25	14.00	16.00	18.00	
Birth weight[b]									
<1500 g	60	16.82	3.19	11	25	14.00	17.00	19.00	**0.019**
1500–2500 g	83	15.82	2.45	12	25	14.00	16.00	17.00	
2501–3500 g	254	16.37	2.46	11	24	15.00	16.00	18.00	
>3500 g	195	15.88	2.28	12	25	14.00	15.00	17.00	
Birth length[b]									
<50 cm	267	16.39	2.67	11	25	15.00	16.00	18.00	0.171
50–53 cm	264	15.99	2.27	12	24	14.00	16.00	17.00	
>53 cm	61	16.05	2.67	12	25	14.00	16.00	17.00	
Gestational age[b]									
<37 weeks	194	16.10	2.67	11	25	14.00	16.00	18.00	0.590
>37 weeks	398	16.22	2.41	12	25	15.00	16.00	18.00	
Feeding practice[b]									
Breastfed	294	16.19	2.33	12	24	15.00	16.00	17.00	0.897
Bottle fed	98	16.07	2.77	11	25	14.00	16.00	18.00	
Combination	200	16.21	2.61	11	25	14.00	16.00	18.00	

[a] Independent *t*-test.
[b] One-way ANOVA.

Table 3
Multivariate regression with chronological age of first tooth emergence as dependent parameter and sex, birth weight, birth length, gestational age and feeding practice as independent variables.

Chronological age of first tooth emergence	Standardized coefficients	t	95.0% Confidence interval		p
	Beta		Lower bound	Upper bound	
(Constant)		16.90	9.08	11.47	<0.001
Sex	0.05	1.14	−0.18	0.67	0.254
Birth weight	−0.33	−5.33	−1.30	−0.60	**<0.001**
Birth length	−0.01	−0.21	−0.47	0.38	0.836
Gestational age	−0.01	−0.22	−0.72	0.57	0.824
Feeding practice	−0.02	−0.42	−0.30	0.19	0.674

Table 4
Multivariate regression with postmenstrual age of first tooth emergence as dependent parameter and sex, birth weight, birth length, gestational age and feeding practice as independent variables.

Postmenstrual age of first tooth emergence	Standardized coefficients	*t*	95.0% Confidence interval		*p*
	Beta		Lower bound	Upper bound	
(Constant)		26.89	14.87	17.21	0.000
Sex	0.05	1.15	−0.17	0.66	0.249
Birth weight	−0.15	−2.25	−0.74	−0.05	**0.025**
Birth length	−0.05	−0.84	−0.59	0.24	0.403
Gestational age	0.15	2.38	0.14	1.41	**0.017**
Feeding practice	−0.01	−0.19	−0.26	0.22	0.848

of the postmenstrual age, apart from birth weight, gestational age was also a significant predictor (Table 4).

4. Discussion

Although parental reports of primary tooth emergence timing actuate reasonable doubt in relation to accuracy and reliability, Hughes et al. (2007) showed in their study that parental reports may provide useful and accurate date for further analyses. This manner of collecting data offers advantages over clinical examinations for large cohort studies and is easier to manage.

It has been shown in several studies that dental development and timing of tooth eruption may be delayed in preterm and low birth weight infants (Seow et al., 1988; Seow, 1997; Harris et al., 1993). Preterm and low birth weight infants comprise approximately 6% of all live births (Seow, 1997).

In this study we analyzed differences in timing of the first tooth emergence between preterm and full-term infants. Significant differences were shown when chronological age was considered. However, it is important to note that in preterm children, their chronological age does not respond to their biological age because of shortened gestational age. The range of gestational ages in our sample was from 23 to 43 weeks (Fig. 1). When the age at first tooth emergence was adjusted according to gestational age, there were no significant differences between groups. Similar results were presented in studies of Ramos et al. (2006) and Seow et al. (1988). In a study of premature infants with very low birth weight, Neto and Falcão (2014) showed delayed eruption time of the first tooth in chronological and corrected age groups as compared to full term children.

Preterm infants are prone to many serious medical problems and complications that usually require a variety of medical interventions in the neonatal period. Preterm born infants are at increased risk of infections and often have respiratory distress syndrome which requires treatment with oxygen ventilation through an oro- or nasotracheal tube (Paulsson et al., 2004). Viscardi et al. (1994) analyzed the relationship of delayed primary tooth eruption to neonatal factors in premature infants. The results of that study suggested delayed eruption of the first tooth, even after chronological age was adjusted. Five neonatal factors, including duration of oral intubation, birth weight, gestational age, enteral feeding and apnea, explained 44% of the variability in the age at first tooth eruption. Duration of oral intubation was the most important factor according to the study results.

In this study, preterm children were more often bottle fed then full term children ($p < 0.05$), probably due to frequent medical complications in the neonatal period. Breastfeeding and bottle feeding involve different mechanisms and oro-facial muscle activity, which could be one possible reason for the different growth patterns of jaws, dental arch development and tooth eruption. In the present study, there was a significant difference in chronological age of first primary tooth eruption between breastfed and bottle fed infants. When the age was adjusted, there were no significant differences found between sample groups of different feeding practices. Folayan and Sowole (2013) reported similar results and concluded that breastfeeding and its duration did not affect the timing of eruption of the first deciduous teeth. Contrary to this, several studies reported delayed upper incisor eruption in infants who were not breastfed (Holman and Yamaguchi, 2005). Furthermore, no delay in the timing of tooth eruption was found between

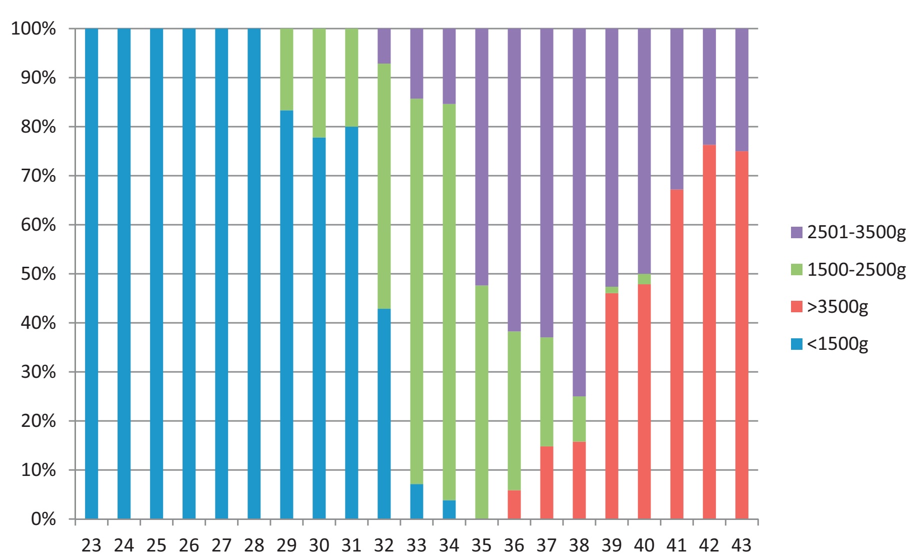

Fig. 2. Proportion of weight groups in different gestational ages.

infants fed with formula or cow's milk instead of, or in addition to breastfeeding (Sahin et al., 2008).

Low birth weight is usually a consequence of preterm birth (Fig. 2), but some other reasons are possible, such as intrauterine growth restriction. In our study sample, all infants born in the range from 23 to 28 weeks of gestation were in very low birth weight group (<1500 g). Infants born from 29 to 31 weeks had either very low or low birth weight (1500–2500 g), while infants weighted more than 2500 g if they were born after 32 weeks. Those with even higher weight (>3500 g) were born after 36 weeks of gestation (Fig. 2). In our study, delayed emergence was found in the group of very low birth weight in both chronological and post-menstrual age groups, which is in concordance with the results of Neto and Falcão (2014). Ramos et al. (2006) noticed significantly delayed eruption in children with lower birth weights in chronological but not in corrected age groups. Seow et al. (1984) compared eruption time between low and normal birth weight infants and concluded that the first tooth eruption occurred significantly earlier in the normal birth weight group. Our results support the conclusion that delayed emergence time in very low birth weight children could be related to reduced gestational age. This might also implicate that the clinical threshold for premature birth (less than 37 weeks) might not be significant as a threshold for an influence on deciduous tooth development and eruption. However, this finding could also reflect a systemic delay in prenatal growth and development and other factors not included in our study such as oral intubation, enteral feeding and apnea (Viscardi et al., 1994).

There was no significant difference in timing of first tooth emergence between males and females in our study. This result is in agreement with the findings of similar studies in different populations (Liversidge and Molleson, 2004; Woodroffe et al., 2010). However, there are reports about earlier emergence of primary teeth in boys (Zadzinska, 2002; Hägg and Taranger, 1986; Infante, 1974; Tanguay et al., 1984; GunaShekhar and Tenny, 2010; Oziegbe et al., 2008) and about earlier emergence of primary teeth in girls (Kaul and Pathak, 1992) so sexual dimorphism of primary tooth emergence is still controversial.

In conclusion, the study indicates that shortened gestational age and very low birth weight are predictors for later ages of emergence of the first primary tooth. Given the fact that timing of deciduous teeth emergence is important in pediatric dentistry, orthodontics, forensic investigations and anthropology, more accurate age calculation is needed in preterm-born children when there is evidence of deviation from normal range of emergence time.

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