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Factors affecting the timing of teething in healthy Turkish infants: a prospective cohort study

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Background. Teething is a developmental process and occurs over a broad chronological age range.
Objective. The objective of this study was to evaluate the effects of feeding pattern and growth parameters on teething time of healthy infants.
Methods. A total of 1200 term newborn infants followed up in Gazi University well-child clinic infants were evaluated, and their growth parameters, feeding patterns, and timing of the eruption of the first tooth were noted. The routine visit times of the clinic were chosen as the cut-off values for teeth eruption for logistic regression analysis for investigating factors that determine the timing of teeth eruption.
Results. Timing of the eruption of the first tooth ranged from 4 to 13 months. On the sixth month visit, 24.3%, and on the ninth month visit 84.5% of all infants had at least one tooth. Height-adjusted weight and height percentiles being less than 50, being fed by cow's milk or by formula in the first year, were independent factors negatively influencing teeth eruption by the sixth month, while all but height-adjusted weight percentiles being less than 50 had negative impact on tooth eruption by the ninth month.
Conclusion. Growth parameters and feeding pattern may be determinants of the timing of teeth eruption in healthy infants.

Introduction

Teething is a developmental process and occurs over a broad chronological age range. Genetic factors, gender and gestational age of the child, low birth weight, growth parameters, and nutritional status can influence eruption time of the primary teeth[1]. The first tooth of babies usually emerges by 4–10 months of age[2]. Mean eruption time is around 7.4 months ± 2.0 months in Turkish children, and emergence of the teeth later than two standard deviations (SDs) is accepted as 'delayed teething'[2,3]. Although delayed teething may be associated with several disease-related conditions such as hypopituitarism, hypothyroidism, and rickets, and syndromes like Down syndrome and cleidocranial dysplasia, 1% of healthy children may not have had their first tooth by 12 months of age[2,4]. Teething is viewed by parents as a significant event in the growth and development of a child, and they usually get concerned when their infants don't have a tooth by 9–10 months[5,6].

There are a limited number of studies performed about the teething time in healthy infants and, to our knowledge, the factors that might have an effect on it, like feeding pattern or growth parameters, are not extensively studied[6,7]. This study aims to evaluate the effects of feeding pattern and growth parameters on teething time in healthy term-born infants.

Materials and methods

The study was performed in Gazi University Hospital well-child clinic where about 1500 newborns start follow-up visits each year, with a total number of 20 000 babies being followed up. In this clinic, infants are seen six times (15th day, and 2nd, 4th, 6th, 9th, and 12th months) in the first year of life; three times (15th, 18th, and 24th months) in the second year; and once yearly thereafter until they are

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5. In each visit, their growth, development, and feeding patterns are noted. The recommendation in this clinic about infant feeding includes exclusive breastfeeding on the first six months and continuing breastfeeding until 2 years of age with appropriate complementary foods. Formula feeding is not recommended unless indicated medically, and feeding with cow's milk is discouraged until the infant is 12 months old.

A total of 1597 infants were born in our university in the year 2003. Premature, low-birth-weight infants, and infants with major congenital anomalies who were hospitalized in newborn intensive care unit were not included in the study as they are followed up in another clinics. A total of 397 infants (24.8%) were excluded from the study because they were not followed up regularly in our well-child clinics because of poor compliance or relocation of the family. The remaining 1200 term-born infants with normal birth weights who started their follow-up visits in the year 2003 and followed up regularly for at least 12 months or until they emerged their first teeth were included in the study. These infants were evaluated by a paediatrician and a pedodontist in each visit, and their growth parameters, feeding patterns, and timing of the eruption of the first tooth were noted. Tooth eruption was defined as having occurred if any tooth surface had pierced the alveolar mucosa. Gender, birth weight, birth height, weight and height percentiles in the follow-up visits, and feeding pattern in the first year of life (breast-feeding, cow's milk, formula) were evaluated as factors that might have influence on teething time. 'Being fed by cow's milk or formula' was described as being given cow's milk or formula solely or in addition to breast milk in the first year of life in contrast to our recommendations. We accepted that the infant is fed beyond our recommendations if he or she is given formula or cow's milk more than one feeding every day, at least 100 mL each, on the first 12 months of life.

The data were analysed using the statistical package (SPSS Inc., Chicago, IL, USA) 10.0 for Windows. The distribution of babies according to their feeding patterns, gender, and teething time was evaluated by descriptive methods. Chi-squared test was used to evaluate the effect of gender on teething on the sixth and ninth months. For stepwise binary logistic regression analysis, the routine visit times of our clinic were planned to be chosen as the cut-off values for teeth eruption (i.e., 6th, 9th, and 12th months), but as there were only five babies who erupted their first tooth after 12 months, the cut-off value of 12th month was not used in regression analysis. The factors that might affect teething time on the sixth and ninth months, namely birth height, birth weight, feeding patterns (breast milk, formula, and cow's milk), and height-adjusted weight percentiles in the subsequent visits were taken into consideration for the backward stepwise (conditional) logistic regression analysis. The ethics committee approved this study.

Results

Six hundred four (50.3%) of the 1200 infants were girls, and 596 (49.7%) were boys. Almost all (99.1%) of the babies in the newborn period and 86.6% on the sixth month were fed by breast milk exclusively or additional complementary foods. In spite of the feeding recommendations of our clinic, 53.0% and 17.8% of the babies were given formula and cow's milk, respectively, at any time during the first year.

Timing of the eruption of the first tooth ranged from 4 to 13 months. On the sixth month visit, 22.4% of girls and 26.3% of boys, and on the ninth month visit 84.2% of girls and 84.9% of boys had at least one tooth, the percentages being statistically similar between girls and boys ($P > 0.05$).

The distribution of teething times of the infants is demonstrated in Table 1.

Table 1. Teething time of the infants (%).

Teething time (months)	Number of children who erupted their first tooth (%)	Cumulative (%)
≤ 6	292 (24.3)	24.3
7–9	722 (60.2)	84.5
10–12	181 (15.1)	99.6
≥ 13	5 (0.4)	100
Total	1200 (100.0)	

Table 2. The results of logistic regression analysis about the factors which affect teething on the sixth and ninth months.

	On the sixth month			On the ninth month		
	OR	***P***	**CI (95%)**	**OR**	***P***	**CI (95%)**
Height-adjusted weight*	2.28	0.01	1.21–4.29	1.53	0.086	0.94–2.51
Being fed by cow's milk	1.87	0.002	1.24–2.81	1.95	0.0001	1.35–2.81
Being fed by formula	1.69	0.0001	1.29–2.22	1.68	0.002	1.21–2.33

*Height-adjusted weight percentiles less than 50% on the visits.
CI, confidence interval; OR, odds ratio.

A cumulative of 24.3%, 84.5%, and 99.6% of the infants had their first tooth until the end of the 6th, 9th, and 12th months, respectively. The third step of the logistic regression analysis, which is the last step that presents significant variables on tooth eruption on the sixth and ninth months, is shown in Table 2.

As shown in the table, height-adjusted weight percentiles being less than 50 on the visits, being fed by cow's milk or by formula were the independent determinants of teeth eruption by the sixth month, while all but height-adjusted weight percentiles being less than 50 were determinants by the ninth month negatively influencing the timing of teeth eruption. Birth weight [1.00; confidence interval (CI): 0.99–1.00; $P = 0.046$], birth height (0.96; CI: 0.90–1.04; $P = 0.21$), and breastfed (0.75; CI: 0.49–1.16; $P = 0.21$) were not significant determinants of teeth eruption by neither the sixth nor the ninth month.

Discussion

The normal eruption of deciduous teeth into oral cavity occurs over a broad chronological age[1]. The eruption of deciduous teeth usually begins by 4–10 months after birth, and the 20 deciduous teeth are almost completed by about 30 months of age[4,8].

Most of the studies in literature are focused on the 'delayed' eruption of teeth, which is defined as the emergence of a tooth more than two SDs from the mean of established norms for eruption times[3]. In a previous study performed in our unit, the mean eruption time of the deciduous teeth was found as 7.4 ± 2.0 months, and two SDs were calculated as 11.4 months[2]. Although it was not our main objective, we figured out that 5 of 1200 (0.4%) of our study population had 'delayed' eruption. On the follow-up, they were seen to have their teeth on the 15th month visit, and none of them had a chronic, genetic, or nutritional disease to explain this delay. This is parallel to the data that about 1% of normal children may not have erupted their first teeth by 12 months of age[9].

Variation in tooth eruption is believed to be multifactorial[1,10,11]. Focusing on the factors that influence the timing of 'normal' teeth eruption, gender, low birth weight, prematurity, growth parameters[5,12], and nutritional status are the factors that were demonstrated in previous studies[6,13,14].

Gender is reported to have either no effect on the timing of normal teeth eruption[6,7] or a minimal but significant effect either in favour of boys[2,15,16] or girls[3]. In our study, we observed no gender effect on the timing of teething.

Low-birth-weight and prematurely born children were shown to have a delayed tooth eruption pattern on the first 24 months of life[13]. As our study design considered only the infants who were term and had normal birth weight, our data are not available to evaluate these factors. In our population, we did not observe a relationship between birth weight, birth height, and teething time. Shuper *et al.*, and Haddad and Correa also reported that no statistically significant correlation was found between number of erupted primary teeth, and birth weight and length[7,17].

Several hormones and mediators that are related to growth have effect on teeth eruption. Human growth hormone (hGH) is known to affect growth and tooth eruption. It has been suggested that the periodontal ligament is influenced by a diurnal–nocturnal rhythm in hGH secretion[18–20]. Tooth eruption is also

regulated by some cytokines, including epidermal growth factor and transforming growth factor beta, interleukin-1, colony-stimulating factor-1, and eicosanoids[1,21]. Considering these data, one can suggest that growth parameters may have an effect on the teething process. This suggestion is supported with some but not all of the previous studies[12–14,17,22–26]. Infante and Owen, Lozy *et al*., and Tanguay *et al*. demonstrated the relationship between a child's general somatic growth and primary teeth eruption[12,14,23]. Haddad and Correa also concluded that primary teeth eruption is highly influenced by the height of the child[17]. On the other hand, among Swedish boys and girls during their first year of life, although the group with a larger increase in height had a larger number of teeth, the difference was not significant[25]. Besides, a study about timing and sequence of eruption of primary teeth in healthy Australian children showed no significant relationship to growth parameters[26]. In our study, the height-adjusted weight percentiles at the follow-up visits seemed to be effective on the sixth month visit, but not on the ninth month. The infants whose height-adjusted weight percentiles were below 50% erupted their teeth later than the sixth month of age more commonly when compared to others (odds ratio: 2.28). This result may suggest that growth parameters in the early months of life when growth rate is fastest may affect the teething time.

In this study, there was a significant correlation of timing between teeth eruption and feeding patterns. When we compared the teething time of the infants given formula or cow's milk with the others, we observed that infants who had been fed by cow's milk were 1.87 and 1.95 times more likely not having a tooth by the sixth and ninth months, respectively. Formula-fed infants also tended to be influenced negatively, odds ratios being 1.69 and 1.68 on the sixth and ninth months, respectively. This finding suggests a possible relation between feeding patterns and teething time. There are very few studies demonstrating that breastfeeding affects teething time of the infants. Holman and Yamaguchi reported that partial breastfeeding, defined as breastfeeding in addition to formula and other foods, had no effect on tooth emergence, but children who were not breastfed at all showed delayed emergence of the upper incisors[6]. In our study, which included a larger sample of infants, almost all infants were fed by breast milk; therefore, we could not evaluate the effects of not being fed by breast milk on the teething time; but our study demonstrates that although remains in normal ranges, feeding with formula or cow's milk instead of or in addition to breastfeeding delays teething time. If this finding will be confirmed by other studies, it will identify another advantage of breast milk, in addition to many other known positive effects on infant health.

With the results of our study, it can be concluded that growth parameters and feeding patterns are the independent determinants of timing of the 'normal' teeth eruption in the term-born, healthy infants.

What this paper adds

- Height-adjusted weight percentiles of less than 50 negatively influenced teeth eruption on the sixth month.
- Being fed by cow's milk or by formula in the first year negatively influenced teeth eruption on the sixth and ninth months.

Why this paper is important to paediatric dentists

- It is important for a paediatric dentist to have knowledge on the factors which may affect the timing of tooth eruption. This paper adds some new information about the effect of feeding pattern and growth parameters on teething time which a paediatric dentist would like to know.

References

1 Suri L, Gagari E, Vastardis H. Delayed tooth eruption: pathogenesis, diagnosis, and treatment. A literature review. *Am J Orthod Dentofacial Orthop* 2004; **126**: 432–445.

2 Baykan Z, Sahin F, Beyazova U, Ozcakar B, Baykan A. Experience of Turkish parents about their infants' teething. *Child Care Health Develop* 2004; **30**: 331–336.

3 Rasmussen P, Kotsaki A. Inherited retarded eruption in the permanent dentition. *J Clin Pediatr Dent* 1997; **21**: 205–211.

4 Psoter WJ, Morse DE, Pendrys DG, Zhang H, Mayne ST. Median ages of eruption of the primary teeth in white and hispanic children from Arizona. *Pediatr Dent* 2003; **25**: 257–261.

5 Hulland SA, Lucas JO, Wake MA, Hesketh KD. Eruption of the primary dentition in human infants: a prospective descriptive study. *Pediatr Dent* 2000; **22**: 415–421.
6 Holman DJ, Yamaguchi K. Longitudinal analysis of deciduous tooth emergence: IV. Covariate effects in Japanese children. *Am J Phys Anthropol* 2005; **126**: 352–358.
7 Shuper A, Sarnat H, Mimouni F, Mimouni M, Varsano I. Deciduous tooth eruption in Israeli children. A cross-sectional study. *Clin Pediatr (Phila)* 1985; **24**: 342–344.
8 Leung AKC. Teething. *Am Fam Physician* 1989; **39**: 131–134.
9 Ashley MP. It's only teething. A report of the myths and modern approaches to teething. *Br Dent J* 2001; **191**: 4–8.
10 Lewis AB, Garn SM. The relationship between tooth formation and other maturational factors. *Angle Orthod* 1960; **30**: 70–76.
11 Robinow M. The eruption of the deciduous teeth (factors involved in timing). *J Trop Pediatr Environ Child Health* 1973; **19**: 200–205.
12 Infante PF, Owen GM. Relation of chronology of deciduous tooth emergence to height, weight and head circumference in children. *Arch Oral Biol* 1973; **18**: 1411–1417.
13 Fadavi S, Punwani IC, Adeni S, Vidyasagar D. Eruption pattern in the primary dentition of premature low-birth-weight children. *J Dent Child* 1992; **59**: 120–122.
14 Lozy ME, Reed RB, Kerr GR, *et al*. Nutritional correlates of child development in southern Tunisia. IV. The relation of deciduous dental eruption to somatic development. *Growth* 1975; **39**: 209–221.
15 Choi NK, Yang KH. A study on the eruption timing of primary teeth in Korean children. *ASDC J Dent Child* 2001; **68**: 244–249.
16 Nyström M, Peck L, Kleemola-Kujala E, Evalahta M, Kataja M. Age estimation in small children: reference values based on counts of deciduous teeth in Finns. *Forensic Sci Int* 2000; **110**: 179–188.
17 Haddad AE, Correa MS. The relationship between the number of erupted primary teeth and the child's height and weight: a cross-sectional study. *J Clin Pediatr Dent* 2005; **29**: 357–362.
18 Leache BE, Maranes Pallardo MJP, Martinez MMR, Gonzalez MJP. Tooth eruption in children with growth deficit. *J Int Assoc Dent Child* 1988; **19**: 29–35.
19 Rochiccioli PE, Tauber MT, Uboldi R, Coude RX, Morre M. Effect of overnight constant infusion of human growth hormone (GH)-releasing hormone-(1-44) on 24-h GH secretion in children with partial GH deficiency. *J Clin Endocrinol Metab* 1986; **63**: 1100–1105.
20 Bozzola M, Tettoni K, Locatelli F, *et al*. Postnatal variations of growth hormone bioactivity and of growth hormone-dependent factors. *Arch Pediatr Adolesc Med* 1996; **150**: 1068–1071.
21 Wake M, Hesketh K, Lucas J. Teething and tooth eruption in infants: a cohort study. *Paediatrics* 2000; **106**: 1374–1379.
22 Hitchcock NE, Gilmour AI, Gracey M, Kailis DG. Australian longitudinal study of time and order of eruption of primary teeth. *Community Dent Oral Epidemiol* 1984; **12**: 260–263.
23 Tanguay R, Buschang PH, Demirjian A. Sexual dimorphism in the emergence of deciduous teeth: its relationship with growth components in height. *Am J Phys Anthropol* 1986; **69**: 511–515.
24 Viscardi RM, Romberg E, Abrams RG. Delayed primary tooth eruption in premature infants: relationship to neonatal factors. *Paediatr Dent* 1994; **16**: 23–28.
25 Lysell L, Magnusson B, Thilander B. Time and order of eruption of primary teeth. *Odontol Rev* 1962; **13**: 217–234.
26 Barrett MJ, Brown T. Eruption of deciduous teeth in Australian aborigines. *Aust Dent J* 1966; **11**: 43–50.