Delayed primary tooth eruption in premature infants: relationship to neonatal factors

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Abstract

Previous studies suggest that primary tooth eruption (PTE) in preterm infants is related primarily to gestational age, but the impact of other neonatal factors has not been studied. In a prospective, longitudinal study, the timing and sequence of PTE were documented by a pictorial PTE record completed by the parents and by frequent oral exams in 14 preterm infants whose first tooth erupted at ≤ 10 months chronologic age (normal group) and 21 preterm infants whose first tooth erupted at > 10 months (late group). Initial eruption sequence in both groups was the same as full-term infants, with the two lower central incisors erupting first. PTE occurred significantly later in children with BW < 1000 g ($t = 3.4$, $P < 0.01$) or ≤ 30 weeks ($t = 2.41$, $P < 0.05$). Factors related to nutrition appeared to be important. Age at first tooth correlated significantly with age when full enteral feedings were attained, age when oral vitamin supplementation was started, and with average weight gain per day. Five neonatal factors (duration of oral intubation, birthweight, gestational age, age when full enteral feedings were attained, and apnea of prematurity) explained 44% ($R = 0.67$, $P < 0.05$) of the variability in age at which the first tooth erupted. Of that 44%, 77% was explained by a single factor, duration of oral intubation. These results suggest that factors related to severity of neonatal illness and postnatal nutrition as well as degree of prematurity affect timing of primary tooth eruption. (Pediatr Dent 16:23–28, 1994)

Introduction

Since the survival of low birthweight infants (< 2500 g) has improved dramatically in the past decade, attention is shifting to assess morbidity in survivors.[1-3] Although long-term follow-up studies have understandably focused primarily on neurodevelopmental outcome, a potential morbidity that has not been well examined is the impact of prematurity and its complications on normal development of the oral cavity and teeth.

Timing of primary teeth emergence has not been established for premature infant populations. It has been suggested that birth is the stimulus for tooth eruption and that eruption time is about the same in premature infants as for full-term infants.[4, 5] Delayed eruption was noted in premature infants in several cross-sectional studies[4, 6] and prospective, longitudinal studies.[7, 8] In these studies, delayed eruption was related to gestational age,[4, 6, 8] or low birthweight,[7] but the impact of other neonatal factors (e.g., oral intubation, nutrition, infections, and medications) was not examined.

The primary teeth normally develop from midgestation until the end of the first year of life.[5, 9] This process may be disrupted in preterm infants by nutritional deficiencies,[5, 9, 10] exposure to certain medications,[11] and traumatic oral manipulations.[12-16] It has been suggested that nutritional deficiencies in early postnatal life play a role in the development of defective or delayed dentition,[17, 18] but this has not been studied in a preterm population. It is well known however, that the fetal accretion rates of calcium and phosphorous[19] cannot be attained in the parenterally or enterally fed preterm infant.[20] Evidence of bone demineralization or "rickets of prematurity" has been reported to occur in as many as 30% of preterm infants.[20] Local traumatic factors—such as placing laryngoscopy blades and endotracheal tubes—also have been linked to defective dentition, particularly enamel hypoplasia.[12-16] The relationship of these factors to the timing of primary dentition eruption has not been studied prospectively.

We hypothesized that in healthy premature infants the primary teeth erupt during the same postconceptional age range as term infants, but in sick premature infants who had respiratory distress, infections, and other illnesses, eruption may be delayed due to factors such as prolonged periods of oral intubation and postnatal nutritional deficiencies. This initial report of a prospective, longitudinal study of primary teeth eruption in preterm infants presents findings on the relationship between the timing of first tooth eruption and neonatal and nutritional factors.

Methods

Sample

All eligible subjects were low birthweight, preterm infants (birthweight < 2500 g and gestational age $\leq$ 36 weeks) born at the University of Maryland Hospital, Baltimore, Md., and attended the Neonatal Intensive Care Follow-up Clinic at the University of Maryland. Infants with congenital oral anomalies such as cleft palate were excluded. Enrollment was restricted to residents of Baltimore City to control for fluoridated water access. Baltimore's water is fluoridated, but fluoridation varies in the rest of Maryland. Informed consent was obtained from the subjects' parents at the first follow-up clinic appointment at 3 months of age. The procedures, possible discomforts or risks, as well as possible benefits were explained fully to the infants' parents, and their informed consent was obtained prior to the investigation. The protocol was approved by the University of Maryland at Baltimore Human Volunteer Review Committee.

Nursery record

Medical records of enrolled subjects were reviewed for prenatal history, demographics (race, sex) and neonatal factors such as: 1) gestational age; 2) birthweight; 3) medical complications (e.g., infections, hyperbilirubinemia, apnea of prematurity, rickets); 4) medical therapy (e.g., oral or nasal intubation, medications such as aminoglycosides, diuretics, and calcium supplements); and 5) feeding history (e.g., age when full enteral feedings were attained, and type of formula or breastmilk).

Tooth record

Upon enrollment, each parent was given a pictorial eruption record.[21] The parents were instructed to mark the date a tooth edge broke through the gum[7] on the appropriate tooth on the picture form. Parents were encouraged to keep the form with their child's health and immunization record and to bring these with them to each clinic visit. The pictorial tooth eruption record was well accepted by parents and even those parents with minimal education demonstrated an understanding of how to use it.

Oral examinations

To assess accurate recording of tooth eruption, subjects also were examined by a pediatric dentist (RGA), who was unaware of the neonatal medical histories of the subjects. Exams were done during regularly scheduled visits to the follow-up clinic at 3, 6, 9, 12, 18, 24, and 36 chronological months. At each visit, the parents were interviewed concerning feeding practices (bottle feeding vs. breast feeding, introduction of solids, bedtime bottle and its contents, medications, and oral habits). The subjects were weighed at each visit. Teeth were examined without cleaning or drying while the child was held in a parent's lap. All the partially and completely erupted teeth were noted and recorded. The fully erupted teeth were examined for enamel hypoplasia, and opacities and defects were classified based on a modification of the dental enamel index (DDE Index).[22] The home tooth record was reviewed at each visit and information was transcribed to study data forms. This report includes data analysis of subjects who had been examined between ≥ 12 months and < 24 months of age.

Statistical analysis

Fisher exact test[23] and t-tests were used to explore differences between groups. Correlations were computed using Pearson's Correlation Coefficient. Maximum R-square for improvement was used for multiple regression with further improvement in R^2 required for continuation.[24] Results from the multiple regression were used to determine whether partial correlations should be generated. For all analyses a $P \leq 0.05$ was considered significant.

Results

Subjects

Of 45 infants initially enrolled, 10 infants were dropped from the oral aspects of the study because they were lost to follow-up before eruption of the first tooth. The 35 remaining subjects were examined serially until eruption of the first tooth or longer. Since the first tooth erupts between 24 and 40 weeks of age in the normal population,[25,26] subjects were considered to be delayed if their first tooth erupted after 40 weeks chronologic age. There were 14 subjects (40%) whose first tooth erupted between the 26th and 40th week chronologic age ("normal" group) and 21 subjects (60%) whose first tooth erupted after the 40th week ("late group"). (No tooth erupted in any child before the 26th week.) For 19 children, the exact date when the first tooth erupted was available, allowing further analysis of them. There were no significant differences in

Table 1. Comparison of neonatal and nutritional factors between "normal" and "late" groups (mean ± SD)

Variable	*Normal (N = 14)*		*Late (N = 21)*		*t*	*p*
	Mean	*SD*	*Mean*	*SD*		
Birthweight	1388	585	1161	474	1.26	NS
Gestational age	31	3	30	3	1.67	NS
Oral intubation (days)	9.6	26.1	17.2	21.2	1.22	NS
Age at full feedings (days)						
Chronologic age	17.8	10.7	43.5	39.1	4.81	≤ .05
Adjusted age	9.4	10.8	33.2	37.1	4.53	≤ .05
Start of vitamins (days)						
Chronologic age	19.2	14.0	33.9	33.3	2.25	NS
Adjusted age	10.8	12.5	23.5	31.6	1.86	NS
Weight gain per day (gms)	19.0	26.1	16.4	3.7	1.84	NS

Table 2. Comparison of neonatal factors between "normal" and "late" groups

Variable	*Normal* (N = 14)		*Late* (N = 21)		*Fisher's Exact Test (2-tail)*
1. Race					
Black	11	(79%)	17	(81%)	0.99
White	3	(21%)	4	(19%)	
2. Gender					
Male	8	(57%)	8	(38%)	0.32
Gemale	6	(43%)	13	(62%)	
3. Size for gestational age					
LGA*	1	(7%)	0	(0%)	0.69
AGA*	9	(64%)	14	(74%)	
SGA*	4	(29%)	5	(26%)	
4. *Staphylococcus epidermidis* infection†					
Yes	2	(20%)	8	(66%)	0.04
No	8	(80%)	4	(33%)	

* LGA, large for gestational age; AGA, appropriate for gestational age; SGA, small for gestational age.
† The incidence of *Staphyloccus epidermidis* was confirmed in two of 10 normal subjects and eight of 12 late subjects. Data were not available for four normal subjects and nine late subjects.

neonatal or oral factors between the total (N = 35) sample and the subset (N = 19) sample (data not shown).

Comparisons between "normal" and "late" groups

There were no differences in birthweight or gestational age (GA) between groups (Table 1). Whether analyzed according to chronological age (CA) or age adjusted for prematurity [CA (weeks) — (40 - GA (weeks))], children in the late group were found to have begun full enteral feedings and oral vitamin supplementation at a significantly older age than the normal group. However, none of the infants had biochemical or radiologic evidence of "rickets of prematurity." Although there was a trend toward longer periods of intubation in the late group compared to the normal group, the difference was not significant, possibly because of the large range of intubation duration in both groups (Table 1). As shown in Table 2, there were no significant differences between groups for demographic variables such as sex or race, or neonatal factors such as size for gestational age. However, significantly more children whose first tooth erupted late had *Staphylococcus epidermidis* infections than the children whose first tooth erupted within the normal chronologic age range.

Several significant differences in oral factors were found (Table 3). Although both groups were followed for a similar length of time, children in the normal group had significantly more teeth at their last visit than children in the late group. The initial eruption sequence was the same in both groups with the two mandibular central incisors being the first to erupt. Whether the analysis was based on chronologic age or age adjusted for prematurity, both central incisors erupted significantly earlier in the normal group than in the late group. In one child in the late group enamel hypoplasia of the maxillary incisors was noted. There were no other enamel defects found in the erupted teeth examined.

Inter-relationships between key neonatal and oral variables

The first primary tooth erupted significantly later in children with birthweight < 1000 g ($t = 3.4$, $P \leq 0.01$) or gestational age ≤ 30 weeks ($t = 2.41$, $P \leq 0.05$). Because of this apparent association of delayed eruption to degree of prematurity, we determined whether this rela-

Table 3. Comparisons of oral variables between "normal" and "late" groups

Variable	*Normal* (N = 14) *Mean*	*SD*	*Late* (N = 21) *Mean*	*SD*	*t*	*P*
Month of visit	15.7	6.1	14.9	5.8	0.18	NS
Number of teeth at last visit	10.1	6.8	4.0	5.5	8.41	≤ .01
Time of eruption of tooth P (wks)*						
Chronologic age	35.5	4.8	51.6	6.8	32.94	≤ .0001
Adjusted age	26.7	4.9	41.2	4.8	38.22	≤ .0001
Time of eruption of tooth O (wks)*						
Chronologic age	34.9	4.8	51.6	5.9	38.25	≤ .0001
Adjusted age	26.5	4.9	41.4	4.2	42.45	≤ .0001
Eruption sequence						
Tooth P	1.4	0.5	1.3	0.5	0.16	NS
Tooth O	1.7	0.6	1.3	0.6	2.72	NS

*P and O refer to the right and left mandibular central incisors, respectively.

tionship was due to prematurity alone, or whether other related neonatal complications contributed to the delay in primary tooth eruption. Initial examination included the inter-relationship between nine variables, including those related to: 1) degree of prematurity (gestational age, birthweight); 2) neonatal complications (infections, duration of intubation, and apnea of prematurity); and 3) nutrition-related variables (age when full enteral feedings were attained, age when oral vitamin supplementation was started, and average weight gain per day).

The correlation matrix presents the inter-relationships between these variables (Table 4). Numbers above the diagonal in the table pertain to zero-order correlations and those below, to partial correlations with the variable duration of intubation removed. Age at first tooth was significantly correlated with gestational age (r = -0.57), duration of oral intubation (r = 0.63), age when full enteral feedings were attained (r = 0.56), and age when oral vitamin supplementation was started (r = 0.61). Average weight gain per day was correlated significantly with age at first tooth (r = -0.57). Average weight gain per day, which reflected both neonatal and postneonatal nutritional intake and growth, did not correlate significantly with most neonatal factors.

To determine the relative contribution of these variables to delayed primary tooth eruption, a multiple regression was conducted on the data from the patients for whom the exact date of first tooth eruption was known (N = 19), with number of weeks from birth to first tooth serving as the dependent variable and the eight other variables from the correlation matrix serving as predictors. Five factors (duration of oral intubation, birthweight, gestational age, age when full enteral feedings were attained, and apnea of prematurity) explained 44% ($R = 0.67, P \leq 0.05$) of the variability in age at which the first tooth erupted. Of that 44%, 77% was explained by a single factor, duration of oral intubation. Since number of days of oral intubation accounted for a substantial majority of the explained variance in the regression, partial correlations were generated between the independent variables and age at first tooth with duration of intubation removed. Significant partial correlations fell into two groups of inter-related variables: 1) gestational age, birthweight, and apnea of prematurity; and 2) infection number, age when full feedings were attained, and age when vitamin supplementation was started (Table 4).

Discussion

This study confirms previous findings[4, 7–9] that children with birthweights < 1000 g or gestational age ≤ 30 weeks are at increased risk for delayed eruption of the first primary tooth. However, in 40% of the prematurely born children in this study, the first tooth erupted during the usual chronologic age range,[25,26] while in the remaining 60% of the sample, the first tooth erupted late. Eruption was still significantly delayed in the latter group even when ages adjusted for prematurity rather than chronologic ages were used in analyses. These results differ importantly from previous studies. In the cross-sectional study of Seow et al.[4] and the prospective study of Golden et al.,[8] delayed primary teeth eruption in premature infants was no longer apparent when data were analyzed using corrected rather than chronologic ages, suggesting that postconceptional age alone determines timing of primary tooth eruption. In these studies[4, 8] and others[7] tooth eruption was related only to a measurement of prematurity (gestational age or birthweight). In contrast to this study, differences between normal and late erupters were not analyzed and the contributions of other neonatal factors were not evaluated.

These results suggest that other complications of prematurity and nutritional factors contribute to delayed eruption of the first primary tooth. Analyses of

Table 4. Intercorrelation between variables. Zero-order correlations above the diagonal and significant partial correlations below the diagonal (days of intubation removed)*

	1st T	*Int*	*WGPD*	*GA*	*BW*	*AP*	*Inf#*	*FF*	*Vit*
Age at first tooth (1st t)	**1.00**	.63†	– .57†	– .57†	– .37	– .35	.54	.56†	.61†
Days of intubation (Int)		**1.00**	– .19	– .76†	– .52†	– .18	.40†	.58†	.61†
Weight gain/day (WGPD)			**1.00**	.22	.27	.01	– .18	– .21	.21
Gestational age (GA)				**1.00**	.71†	– .11	– .47†	– .59†	– .52†
Birthweight (BW)				.56†	**1.00**	.33†	– .25	– .46†	– .32
Apnea of prematurity (Ap)				– .66†	– .68†	**1.00**	.04	– .17	– .19
Number of infections (Inf#)							**1.00**	.86†	.87†
Age at full feeding (FF)							.88†	**1.00**	.93†
Age at start of vitamins (Vit)							.79†	.91†	**1.00**

* Due to incomplete data, all N are not equal; † Significant, $P \leq 0.05$.

intercorrelations between neonatal and oral factors indicated that factors related to degree of neonatal illness (duration of oral intubation) and nutritional factors (age when full enteral feeding was attained, age when oral vitamin supplementation was started, and average weight gain/day) correlated significantly with age of first tooth eruption. Multiple regression analysis indicated that the most significant factor related to delayed eruption of the first tooth is duration of oral intubation. Determining partial correlations confirmed the impact of duration of intubation. Removing this variable when determining partial correlations reduced the number of significant correlations between variables (Table 4).

Because there appeared to be a relationship in previous studies between an increased incidence of enamel defects of the maxillary incisors and oral intubation, it was suggested that local trauma caused by laryngoscopy blades or pressure from endotracheal tubes disrupted normal dentition development.[12-16] However, laryngoscopy blades and endotracheal tubes do not traumatize the developing mandibular incisors. Since the requirement for prolonged mechanical ventilation is associated with an increased incidence of other neonatal complications such as patent ductus arteriosus, air leak, bronchopulmonary dysplasia, and infections,[27] these results suggest that the factor duration of intubation more likely represents the severity of illness in premature infants rather than a causative factor in delaying first primary tooth eruption.

Postnatal weight gain also was significantly correlated with age of first tooth eruption. Infante and Owen[17] and Delgado et al.[18] related timing of primary teeth eruption to growth in children and suggested that nutritional status may be a significant factor affecting the emergence of the primary dentition. Although Fadavi and coworkers[6] did not find a significant correlation between duration of intubation and delayed eruption, they did find a significant correlation between the number of teeth present at different ages of prematurely born children and somatic growth. Average weight gain/day reflects both neonatal and postneonatal nutrition. When comparing the normal and late erupters, the late group attained full enteral feedings and started oral vitamin supplementation at an older age than the normal group. Therefore, it appears that nutrition is important for the normal development and eruption of the primary dentition in premature infants, as well as being important in the recovery from neonatal respiratory illness[2, 28] and neurodevelopmental outcome.[1]

Conclusion

We propose that the first primary tooth erupts at the usual chronologic age in healthy premature infants, but eruption may be delayed in premature infants who require prolonged mechanical ventilation for neonatal illness and/or who experience inadequate nutrition. These at-risk infants should be followed closely and their oral health monitored during the eruption period of the primary dentition.

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Patient's style of presentation can alter physician's diagnosis

Physicians give three different views of varying methods of describing the same symptoms

A physician's diagnosis can be affected by the manner in which a patient describes symptoms, according to a study published in a recent issue of the AMA's *Archives of Internal Medicine.*

Brian G. Birdwell, MD, Oklahoma University Health Sciences Center, and colleagues, conducted a clinical trial to assess the influence of the patient's presentation style on the physician's approach to evaluating chest pain.

The researchers concluded: "Although physicians may evaluate patients who have the same history word for word and the same laboratory data and whom they regard as having nearly identical likelihoods of coronary artery disease (CAD), the physician's ultimate diagnostic approach can be profoundly affected by the patient's presentation style."

Forty-four internists were assigned to one of three treatment groups. Two groups used videotapes of the same actress performing the role of a patient in a scripted physician-patient interview in two distinct styles. One group saw a "histrionic" (e.g., dramatic) characterization (HV), the other a "businesslike" portrayal (BV). The third group read a verbatim transcript of the interview (T).

The researchers write: "Half of the BV group chose cardiac diagnoses, primarily CAD and dysrhythmia, whereas less than a third chose functional diagnoses. In contrast, 73%of the HV group listed a functional diagnosis (mostly panic attack and anxiety), whereas a cardiac diagnosis was mentioned by only 13%. The T group was relatively balanced among gastrointestinal (36%), cardiac (36%), and functional (29%) diagnoses."

Among the possible reasons for the different diagnoses, the researchers write: "If the businesslike woman was seen as part of a population of people unlikely to bring functional complaints to her physician, then her complaint of chest discomfort as a smoker with a high cholesterol level was seen as likely to represent cardiac disease. If the histrionic woman was seen as part of a population of people who frequently present themselves to physicians of many kinds, then her complaint would be less likely to represent angina and more likely to be of functional origin, regardless of other considerations of CAD prevalence."

The study concludes: "Patient presentation can substantially affect physicians' assessments of symptoms, estimates of disease likelihood, and use of diagnostic tests. Although some may argue that a patient's style of reporting his or her symptoms *should* influence a physician's evaluation of chest pain, current prediction rules do not incorporate this variable. More research is needed to determine whether variations in diagnostic approach based on the patient's presentation style are appropriate or biased."