Prevalence of oral defects among neonatally intubated 3- to 5- and 7- to 10-year-old children

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Abstract

Greater prevalence of oral abnormalities was found in two groups of children (ages 3 to 5 and 7 to 10 years) who had been intubated neonatally and were of low birth-weight than in same-aged children of average birth-weight who had not been intubated at birth. These abnormalities included enamel defects, high vaulted and/or grooved palates, posterior crossbites, and palatal asymmetry. In addition, these children were judged to have poorer speech intelligibility and greater speech nasality than the comparison group children. Prematurity and intubation were confounded in this study, allowing the possibility that prematurity alone is the causal factor in these differential results. However, the finding of localized enamel defects among intubated 3- to 5-year-olds, and greater prevalence of high vaulted palates and palatal grooving among intubated subjects in both age groups, provide strong support for intubation as a cause of both the occurrence and duration of oral defects among neonatally intubated children. (Pediatr Dent 13:349–55, 1991)

Introduction

Low birth-weight, intubated neonates have been noted to exhibit a variety of oral defects. These include notching or concavity of the alveolar ridge (Boice et al. 1976; Duke et al. 1976; Wetzel 1980), localized dental defects (Boice et al. 1976; Krous 1980; Moylan et al. 1980; Seow et al. 1984; Seow et al. 1987; Seow et al. 1989; Wetzel 1980), palatal grooves (Erenberg and Nowak 1984; Molteni and Bumstead 1986; Saunders et al. 1976), and acquired high arched and cleft palate (Duke et al. 1976). However, no comprehensive study has been performed to date which systematically identifies each of these defects, and whether such defects persist into childhood.

The purposes of this study were to characterize the prevalence and/or magnitude of the following in neonatally intubated children in the late primary and early mixed dentition stages:

1. Enamel defects
2. High vaulted and/or grooved palate
3. Palatal depth and width asymmetry
4. Crossbites
5. Speech intelligibility and nasality, and to compare intubated children to age-matched, nonintubated children on these parameters.

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Both speech intelligibility and nasality are affected by palatal insufficiencies. Intelligibility, which refers to how well a speaker is understood by the listener, is influenced to a large degree by the speaker's ability to articulate (McWilliams et al. 1990; Wilson 1987). A measure of speech intelligibility was included because of the difficulty in articulation attributed to palatopharyngeal incompetence (Darley 1978). Vocal resonance contributes to the nasal quality of voice production (Morris and Spriestersbach 1978), and excessive nasal resonance results in hypernasality. Because hypernasality often accompanies palatal incompetence (Morris and Spriestersbach 1978), its assessment also was deemed relevant in the present context.

Materials and Methods

Sample Selection

Subjects were 3- to 5-year-old (N = 43) and 7- to 10-year-old (N = 47) low birth-weight children who had been intubated at birth in the Intensive Care Nursery of the Children's Hospital of Buffalo.

Comparison groups were age-matched children drawn from the patient pool at the Children's Hospital of Buffalo Dental Clinic. Comparison group children had not been intubated at birth, and were mainly full term and of approximately normal birth-weight. These comparison groups comprised 40 3- to 5-year-old children and 44 7- to 10-year-old children.

Medical records were used to identify children who had been both low birth-weight and neonatally intubated. Low birth-weight is generally considered to be 2500 g or less. Infants weighing 1500 g or less, referred to as very low birth-weight, have been shown to have different neonatal mortality rates than those weighing 1501 to 2500 g (van den Berg 1977). For the purposes of this study, an upper limit of 1650 g was used to define low birth-weight, to reflect differences in both technology and survival rates for the two age groups studied.

Parents of 123 low birth-weight, neonatally intubated 3- to 5-year-olds and 97 7- to 10-year-olds were contacted. Parents of 125 age-matched, mainly normal birth-weight children who had not been intubated (66 3- to 5-year-olds; 59 7- to 10-year-olds) were asked to participate in the study when their children were brought to the dental clinic for an appointment.

Procedures

Informed consent was obtained after the nature of the procedures and possible discomforts, risks, and benefits had been explained fully to each subject's parent. Maternal and neonatal medical histories were obtained from medical records. A questionnaire which included a history of childhood diseases, medications taken, finger habits, and any learning or developmental difficulties was completed by each parent. Children with any subsequent history of intubation, developmental difficulties, facial abnormalities, neural dysmorphologies, or constant finger habits were excluded from the study.

Each subject was audiotaped so that speech intelligibility and nasality could be evaluated. The recordings were analyzed by a licensed speech pathologist using standard methods used routinely in the City of Buffalo Public School system. The speech pathologist was blind to group membership (i.e., intubated vs. comparison). Intelligibility was scored from 1 (poor) to 5 (excellent). Nasality was scored on a scale of 1 (hyponasal) to 5 (severely hypernasal).

A dental examination was performed to determine the presence of any enamel defects, high vaulted palate and/or palatal grooving, or crossbite. Teeth which exhibited surface irregularities (i.e., irregular contour or furrowing) upon clinical observation were considered to have enamel defects. A high vaulted palate was determined during the clinical exam, based on observation of a high palatal configuration relative to palate size. A palatal groove was defined as a narrow channel located at or near the palatal midline (Figs 1 and 2). Subjects were also examined for presence of any type of crossbite.

Alginate impressions were made using pediatric stock trays. Stone models were fabricated subsequently and used to measure palatal asymmetry. These models also were used to validate clinical assessments of high vaulted palate and palatal grooving. Asymmetry was measured using a three-dimensional rectangular Cartesian coordinate system with respect to a fixed plane (Seow et al. 1985). Comparison of values from reference points on contralateral sides of the stone models was used to indicate discrepancies of the arch form in two dimensions: width and depth. The reference points for the 3- to 5-year-olds were located on the lingual or palatal margin of the central and lateral incisors and second primary molars. Reference points for the 7- to 10-year-olds were located correspondingly on the gingiva of the central and lateral incisors, canines, and 6-year molars. Measurements were obtained by locating the midpoint of the widest aspects of the tooth and reflecting this point to the gingival margin. Width asymmetry was determined by first measuring the distance between

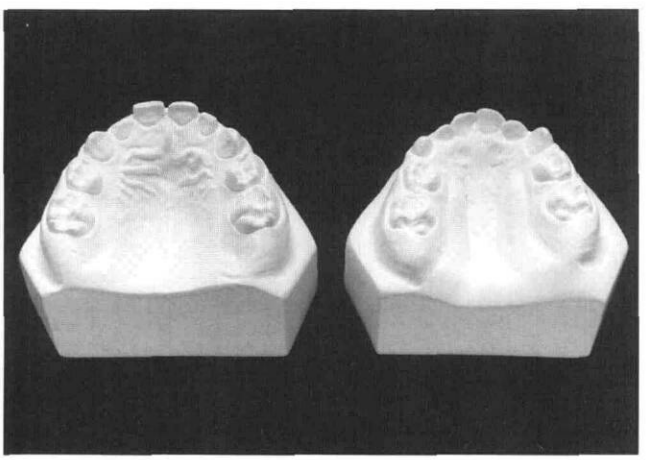

Fig 1. Maxillary casts depicting normal palate of nonintubated child age 3 years, 9 months (left) and high vaulted, grooved palate of intubated child age 4 years, 3 months (right).

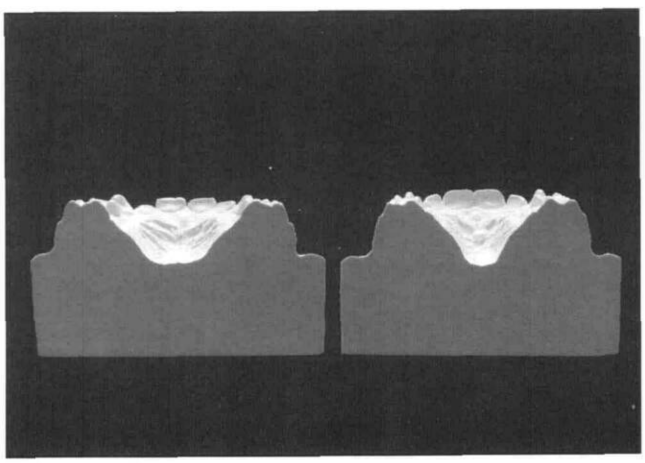

Fig 2. Cross-section of maxillary casts depicting normal palate of nonintubated child ag 3 years, 11 months (left) and grooved palate of intubated child age 4 years, 3 months (right).

each reference point and the median palatal raphe. The difference between these measurements on contralateral sides, at each reference point, was used as the measure of palatal width asymmetry. Depth asymmetry was determined by first locating the midpoint on a line between each reference point and the raphe and then measuring the vertical distance to the palate. The difference between these measurements on contralateral sides, at each reference point, was used as the measure of palatal depth asymmetry. All measurements were obtained with the aid of a Vidicom Qualifier® 1210 (Optical Gauging Products, Rochester, NY), which permits measurements accurate to within .001 mm.

Results

Sample

Parents of 91 neonatally intubated children (43 3- to 5-year-olds; 47 7- to 10-year-olds) agreed to participate in the study. This represented 41% of invited, eligible children. Demographic information collected on the children included race and gender. The majority were Caucasian (59%), with both genders approximately equally represented (54% male). These breakdowns did not differ for the 3- to 5-year-old and 7- to 10-year-old age groups. Mean birth weights and gestation ages were 992.6 ± 196.0 g (range 595–1247 g) and 28.9 ± 2.7 weeks (range 25–36 weeks) for the 3- to 5-year-olds, and 1044.1 ± 288.2 g (range 537–1616 g) and 28.7 ± 2.6 weeks (range 22–33 weeks) for the 7- to 10-year-olds. The younger age group had been intubated orotracheally for an average of 18.3 ± 21 days (range 1–99 days) and orogastrically for an average of 55.6 ± 31 days (range 6–169 days). Seven- to 10-year-olds had been intubated orotracheally for an average of 26.4 ± 31.4 days (range 0–99 days) and orogastrically for an average of 52.4 ± 27.4 days (range 0–99 days).

Parents of 84 age-matched children (40 3- to 5-year-olds; 44 7- to 10-year-olds) consented to participate. This represented 44% of those contacted. Of the children included in these comparison groups, 56% were Caucasian and 51% were male. These breakdowns also did not differ significantly between age groups.

The 3- to 5-year-old comparison group included four twin siblings of subjects in the intubated group. Excluding these children, the mean birth-weight was 3465.0 ± 425.4 g (range 2781–4264 g), and all had been born full term. The four twin siblings of intubated children had been born less than full term (two at 31 weeks and two at 34 weeks gestation) and were low birth-weight (range 1350–1769 g).

The mean birth-weight for the 7- to 10-year-old comparison group subjects was 3485.9 ± 495.4 g (range 1814–4173 g), and all had been born full term.

Phase I: 3- to 5-Year-Old Children

Oral Defects

Chi-square analyses were performed to test for group differences in frequency of oral defects. Results (Table 1) indicated a significantly greater prevalence of enamel defects, high vaulted palate, palatal grooving, and crossbites in low birth-weight, neonatally intubated children. None of the comparison group subjects showed signs of enamel defects, compared to 27% of the intubated subjects (N = 11). Moreover, the location of the defect was limited to the incisal one-third of the maxillary left central incisor in all cases. Sixty-three per cent of the intubated subjects (N = 26) showed clinical signs

Table 1. Frequency of defects by group, 3- to 5-year-olds

	Intubated		*Comparison*	
	N	%	N	%
1. Enamel defect•				
Yes	11	(26.8)	0	(0.0)
No	30	(73.2)	40	(100.0)
2. High vaulted palate•				
Yes	26	(63.4)	4	(10.0)
No	15	(36.6)	36	(90.0)
3. Grooved palate†				
Yes	6	(14.6)	0	(0.0)
No	35	(85.4)	40	(100.0)
4. Crossbite†				
Yes	9	(22.0)	2	(5.0)
No	32	(78.0)	38	(95.0)
5. Speech intelligibility•,‡				
Poor	5	(11.6)	0	(0.0)
Fair	17	(39.5)	2	(5.0)
Good	19	(44.2)	34	(85.0)
Very good	2	(4.7)	2	(5.0)
Excellent	0	(0.0)	2	(5.0)
6. Speech nasality§				
Hyponasal	0	(0.0)	0	(0.0)
Normal	13	(31.0)	18	(45.0)
Mildly hypernasal	23	(54.8)	20	(50.0)
Moderately hypernasal	6	(14.3)	2	(5.0)
Severely hypernasal	0	(0.0)	0	(0.0)

• Chi-square analysis significant at $P < 0.01$.

† Chi-square analysis significant at $P < 0.05$ (note, however, that results of this analysis are not reliable, due to low expected cell frequencies).

‡ Data collapsed to "poor or fair" vs. "good, very good, or excellent" for analysis, due to low expected cell frequencies.

§ Data collapsed to "normal" vs. "mildly or moderately hypernasal" for analysis, due to low expected cell frequencies.

of high vaulted palate (Figs 1 and 2), compared to 10% of the comparison group subjects (N = 4). Six of the intubated subjects with high vaulted palates also exhibited palatal grooves (Fig 2), whereas no comparison group subject showed signs of palatal grooving. Nine intubated subjects (22%) presented with crossbites, compared to two of the comparison group children (5%). In all cases, these were unilateral posterior nonshift crossbites which included all erupted posterior teeth.

Speech Characteristics

Table 1 indicates the breakdown of speech intelligibility and nasality by group. Chi-square analyses were conducted to test for group differences on these variables. Because of low expected frequencies, speech intelligibility categories were combined from the original 5-point scale to a dichotomy ("poor or fair"; "good, very good, or excellent"), and the mild and moderate hypernasality categories were combined for statistical purposes. No subject was judged to be either hyponasal or severely hypernasal. Chi-square analysis revealed a significant difference between groups in speech intelligibility. Intubated subjects were significantly more likely to have had their speech intelligibility judged to be poor or fair than were those in the comparison group (51% vs. 5%, respectively). There was no significant group difference in speech nasality.

Palatal Asymmetry

Table 2 reports mean palatal width and depth, as well as mean asymmetry in these two dimensions. Palatal width was calculated as the sum of left and right measurements from contralateral reference points to the median palatal raphe. Asymmetry was calculated as the absolute difference between these measurements. Because a preliminary analysis revealed a significant group difference in palatal width ($F_{3,61} = 6.25$, $P < 0.01$), a measure of proportional width asymmetry was calculated by dividing asymmetry by total palatal width. This provided a measure of palatal asymmetry relative to palate width.

Multivariate analysis of variance indicated significant group differences in proportional width asymmetry ($F_{3,61} = 6.72$, $P < 0.01$). Univariate results revealed a difference at the molar region only ($F_{1,61} = 13.14$, $P < 0.01$). The mean absolute difference between right and left width measurements (relative to palate width) was .05 mm for intubated and .02 mm for comparison group subjects, indicating significantly greater asymmetry for intubated subjects.

Depth at the mean palatal raphe was used as the measure of palatal depth; depth asymmetry was calculated as the absolute difference between right and left depth measurements at each reference point. Analysis of variance indicated no significant difference between the two groups in palatal depth asymmetry ($F_{3,61} = 1.12$, $P > 0.05$).

Table 2. Mean palatal measurements (mm) by group, 3- to 5-year-olds

	Intubated (N = 35)		*Comparison* (N = 30)	
	Mean	*SD*	*Mean*	*SD*
Palatal width•				
Central	5.63	0.74	6.17	0.75
Lateral	14.94	2.14	14.74	1.27
Molar	24.02	2.22	25.33	2.69
Palatal depth				
Central	0.48	0.25	0.56	0.34
Lateral	1.12	0.97	0.85	0.46
Molar	9.33	1.54	9.17	2.16
Palatal width asymmetry†				
Central	0.37	0.27	0.28	0.28
Lateral	0.63	0.74	0.39	0.36
Molar	1.16	0.87	0.55	0.43
Palatal width proportional asymmetry•,‡				
Central	0.07	0.01	0.05	0.01
Lateral	0.04	0.01	0.03	0.00
Molar	0.05	0.01	0.02	0.00
Palatal depth asymmetry•				
Central	0.25	0.40	0.23	0.24
Lateral	0.26	0.23	0.46	0.58
Molar	0.97	0.73	1.07	0.87

• Significant group difference, $P < 0.01$.

† Asymmetry calculated as the absolute difference between right and left measurements.

‡ Proportional asymmetry (i.e., palatal asymmetry relative to palate width) calculated as the absolute difference between left and right width measurements, divided by total palatal width.

Phase II: 7- to 10-Year-Old Children

Oral Defects

Chi-square analyses were conducted to test for group differences in frequency of oral defects among 7- to 10-year-olds. Results (Table 3, see next page) indicated a greater prevalence of high vaulted palate, palatal grooving, and crossbites among neonatally intubated children. Sixty-two per cent of the intubated subjects (N = 29) showed clinical evidence of high vaulted palate, compared to 9% of the comparison group subjects (N = 4). Eleven of the intubated subjects with high vaulted palates also exhibited palatal grooving, whereas no comparison group subject presented with palatal grooves. Twenty-one per cent of the intubated children had crossbites (n = 10), compared to only one comparison group subject. As with the 3- to 5-year-olds, all crossbites were unilateral posterior nonshift in nature. No subject in either group showed evidence of enamel defects.

Speech Characteristics

Table 3 presents group frequencies for speech intelligibility and nasality. Only two subjects, both intubated, had speech intelligibility scores judged to be only "fair." Because of low expected frequencies, these subjects were excluded from the data analysis. A Chi-square analysis indicated a significant group difference in intelligibility ratings among those rated "good," "very good" or "excellent." Speech was rated as only "good" twice as often for intubated subjects as for comparison group children (59% vs. 30%).

Because of low expected frequencies, mild and moderate hypernasal groups were combined for statistical purposes (as with the 3- to 5-year-olds, no subject was judged to be either hyponasal or severely hypernasal). Chi-square analysis indicated a significant group difference in speech nasality, with comparison group subjects more likely to have had the nasality of their speech judged to be "normal" (62% vs. 39%).

Table 3. Frequency of defects by group, 7- to 10-year-olds

	Intubated		Comparison	
	N	%	N	%
1. Enamel defect				
Yes	0	(0.0)	0	(0.0)
No	47	(100.0)	44	(100.0)
2. High vaulted palate•				
Yes	29	(61.7)	4	(9.0)
No	18	(38.3)	40	(91.0)
3. Grooved palate•				
Yes	11	(23.4)	0	(0.0)
No	36	(76.6)	44	(100.0)
4. Crossbite†				
Yes	10	(21.3)	1	(2.3)
No	37	(78.7)	43	(97.7)
5. Speech intelligibility†,‡				
Poor	0	(0.0)	0	(0.0)
Fair	2	(4.9)	0	(0.0)
Good	24	(58.5)	12	(30.0)
Very good	9	(21.9)	15	(37.5)
Excellent	6	(14.6)	13	(32.5)
6. Speech nasality†,§				
Hyponasal	0	(0.0)	0	(0.0)
Normal	17	(38.6)	23	(62.2)
Mildly hypernasal	23	(52.3)	12	(32.4)
Moderately hypernasal	4	(9.0)	2	(5.4)
Severely hypernasal	0	(0.0)	0	(0.0)

• Chi-square analysis significant at $P < 0.01$.

† Chi-square analysis significant at $P < 0.05$.

‡ Subjects judged to be "fair" were eliminated from Chi-square analysis due to low expected cell frequencies.

§ Data collapsed to "normal" vs. "mildly or moderately hypernasal" for analysis, due to low expected cell frequencies.

Table 4. Mean palatal measurements (mm) by group, 7- to 10-year-olds

	Intubated (N = 27)		Comparison (N = 32)	
	Mean	SD	Mean	SD
Palatal width•				
Central	6.97	1.34	7.61	1.79
Lateral	17.57	2.78	19.30	2.91
Canine	23.40	2.58	25.87	2.67
Molar	27.98	2.60	30.16	2.93
Palatal depth				
Central	0.34	0.24	0.48	0.38
Lateral	1.10	0.95	0.99	0.87
Canine	4.44	1.21	4.06	1.70
Molar	11.06	2.16	11.94	1.44
Palatal width asymmetry†				
Central	0.64	0.47	0.43	0.35
Lateral	0.72	0.51	0.84	0.50
Canine	0.67	0.64	0.81	0.56
Molar	0.81	0.97	0.99	0.88
Palatal width proportional asymmetry‡				
Central	0.09	0.06	0.06	0.05
Lateral	0.04	0.03	0.04	0.03
Canine	0.03	0.02	0.03	0.02
Molar	0.03	0.03	0.03	0.03
Palatal depth asymmetry•				
Central	0.15	0.14	0.19	0.18
Lateral	0.52	0.66	0.39	0.36
Canine	0.65	0.45	0.50	0.32
Molar	0.92	0.63	0.89	0.75

• Significant group difference, $P < 0.05$.

† Asymmetry calculated as the absolute difference between right and left measurements.

‡ Proportional asymmetry (i.e., palatal asymmetry relative to palate width) calculated as the absolute difference between left and right width measurements, divided by total palatal width.

Palatal Asymmetry

Table 4 reports mean palatal width and depth, and mean width and depth asymmetry. Palatal width and depth were calculated in the same manner as for the 3- to 5-year-olds. Width and depth asymmetry were calculated as before, as the absolute difference between contralateral measurements at each reference point. As a preliminary analysis again revealed a significant group difference in palatal width ($F_{4,54} = 3.13$, $P < 0.05$), proportional width asymmetry was calculated by dividing width asymmetry at each reference point by total palatal width.

Multivariate analyses of variance revealed no significant palatal asymmetry differences between the two groups in either proportional width ($F_{4,54}$= 2.29, P > 0.05) or depth ($F_{4,54}$= 1.17, P > 0.05).

Comparative Results Between Age Groups

Comparing results for the 3- to 5-year-old and 7- to 10-year-old age groups, a consistency is observed among the various findings. Intubated subjects in both age groups demonstrated greater prevalence of high vaulted palate, palatal grooving, and posterior crossbite, and speech was judged to be less intelligible than that of comparison group subjects. One exception to the consistency in results is the absence of enamel defects in the 7- to 10-year-old children. One likely explanation for this difference is the loss of traumatized primary teeth by the older children. Other disparities include the finding of group differences in palatal proportional width asymmetry in the molar region for the 3- to 5-year-olds only, and a group difference in speech nasality for the 7- to 10-year-olds only. The reasons for these differential findings are unclear.

Discussion

This research substantiates earlier case reports of oral defects in low birth-weight, neonatally intubated children. It also demonstrates that these defects persist at least 10 years into childhood. The consistency of oral defects between the two independently examined groups suggests that some alteration occurs in the oral cavity as a result of intubation.

Examination of palatal defects (i.e., high vaulted palate, palatal grooving, crossbite, and palatal asymmetry) was used to determine whether palatal deformation occurs among intubated neonates. These defects could result from the trauma of intubation, as the palatal bones in a 28-week-old fetus are spongy and connective tissue interspersed at the midline forms a weakened palatal configuration. Because functional demands of the oral cavity dictate, to a large extent, the nature of palatal formation (Moss 1971), intubation may contribute to the oral configuration by forcing the palate to accommodate the tubes. The pressure of the tube(s) on the developing palate could cause high vaults, grooving, and/or a constriction of the palate. Some support for this supposition has been provided by two recent studies (Ash and Moss 1987; Ginoza et al. 1989). These researchers were able to reduce or prevent palatal groove formation in intubated neonates through the use of a protective device placed between the palate and the orotracheal tube.

Palatal constriction also could be responsible for the high percentage of posterior crossbites observed among intubated subjects, as this constriction may have prevented appropriate interdigitation of the arch.

Intelligibility and nasality measures were used to determine speech differences between neonatally intubated, low birth-weight and like-aged, normal birth-weight children. A vaulted or grooved palatal configuration may result in the inability of the tongue to meet the palate correctly. Such a configuration could hinder the production of normal speech sounds, contributing to hypernasality and poorer speech intelligibility.

All subjects who had been intubated also had been born prematurely. It could therefore be argued that prematurity, rather than intubation per se, is the causal factor in the high prevalence of oral defects among intubated subjects. (Analyses of variance, using oral factors as independent variables, revealed significant relationships between enamel defects [3- to 5-year-olds only], high vaulted palate, palatal grooving, crossbite [7- to 10 year-olds only], and speech intelligibility and both birth-weight and gestation age. The presence of oral defects and lower speech intelligibility were associated with lower birth-weight and gestation age.) Because prematurity and intubation are confounded in this design, research results must be interpreted with caution. For example, motor development, including speech achievement, tends to be slower for prematurely born infants (Egland 1970), and language skills have been shown to be retarded in preschool children who were both small for gestation age and born prematurely (Matilainen et al. 1988). Mineral deficiencies have also been cited in the pathogenesis of enamel defects in very low birth-weight infants (Seow et al. 1989). Nonetheless, several of the present findings suggest a causal relationship between intubation and prevalence of oral defects. Localized enamel defects observed in the 3- to 5-year-olds, but absent in the 7- to 10-year-olds, provide the strongest evidence of defects occurring as a result of intubation. These defects are unlikely to have been caused by developmental factors, as they were located, in all cases, at the incisal one-third of the maxillary left central incisor. If they had been the result of developmental or nutritional factors, then other teeth and locations on teeth should have been affected. Further, at a gestational age of 29 weeks (the mean age at birth for both intubated groups) the incisal aspects of the maxillary anterior teeth are still quite malleable and easily distorted by trauma. Since none of the 7- to 10-year-olds showed evidence of enamel defects, development of the permanent teeth does not appear to be affected. The high percentage of intubated subjects with high vaulted palates, relative to comparison groups subjects, is also noteworthy, as vaulted palates would not be expected to have occurred as a result of prematurity alone. Palatal grooving, observed in 15 and 23% of the 3- to 5-year-old and 7- to 10-year-old intubates, respectively, but absent among comparison group subjects, also suggests that intubation contributes to groove development.

Conclusions

These results indicate that low birth-weight, neonatally intubated children have a higher prevalence of oral defects than normal birth-weight cohorts who had not been intubated at birth. Although the confounding of prematurity and intubation cannot be resolved, one explanation for these differential findings is trauma sustained to the oral cavity by orotracheal and/or orogastric intubation. (To determine the role of length of intubation in the prevalence of oral defects, independent t-tests were conducted within each intubated group, comparing mean length of intubation for those with and those without the following: enamel defects [3- to 5-year-olds only], high vaulted palate, grooved palate, and crossbite. The only statistically significant difference to emerge was for crossbite among 7- to 10-year-olds; those with crossbites had been intubated for shorter time periods than those without crossbites [$P < 0.01$]. Speech differences by length of intubation also were tested by conducting independent t-tests comparing mean length of intubation of subjects rated "normal" vs. those rated "hypernasal" and those with poor or fair speech intelligibility vs. those with good, very good, or excellent intelligibility. No statistically significant differences were found. Therefore, oral defects and speech characteristics do not appear to be influenced by length of intubation.) The abnormalities reported herein included enamel defects, high vaulted palate, palatal grooving, posterior crossbite, poorer speech intelligibility and, to a lesser extent, speech nasality and palatal asymmetry. Because many of these defects persist at least 10 years into childhood, protection from such potential trauma is recommended.

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