Prevalence of primary canine hypoplasia of the mandibular teeth

Stephen L. Silberman, DMD, DrPH Aaron Trubman, DDS, MPH
William K. Duncan, DDS, MSD Edward F. Meydrech, PhD

Abstract

The purpose of this study was to determine the prevalence of an uncommon lesion of the primary mandibular canines (primary canine hypoplasia), and its association with age, race, gender, dental caries, fluoridation status of the drinking water, breast-feeding, and geographic location. The study population comprised 2686 randomly selected children, black and white, 4 and 8 years old, who were enrolled in accredited private and public preschools and elementary schools in Mississippi. There were 1318 males and 1368 females, 1289 white children and 1397 black children, 1353 4-year-olds and 1333 8-year-olds. Results indicate that an association exists for race ($P = 0.0001$), gender ($P = 0.01$), and dental caries ($P = 0.0001$), but not for age ($P = 0.07$), geographic location ($P = 0.73$), fluoridation status of the water supply ($P = 0.145$), or breast-feeding ($P = 0.392$). The prevalence rate of primary canine hypoplasia was 33.2% for black children and 17.2% for white children. These data indicate that this lesion is significantly more prevalent in blacks than whites, and that teeth with this lesion have a greater probability of developing dental caries. (Pediatr Dent 13:356–60, 1991)

Introduction

The cervical half of the mesial aspect of the facial surface of the mandibular primary canine can develop a hypoplastic lesion that seems to be unique (Johnsen 1984; Brown and Smith 1986) and quite prevalent (Badger 1985; Brown and Smith 1986). The lesion has been referred to as either labial (Duncan et al. 1988) or facial (Brown and Smith 1986) hypoplasia of the primary canines, or as in this report, primary canine hypoplasia (PCH, Silberman et al. 1989). A recent report by Duncan et al. (1988) examined 334 black children 3–5 years old during a larger needs-assessment survey. Their findings indicate a prevalence of 37.1% for black males and black females, with no apparent differences between fluoridated and nonfluoridated communities. Duncan et al. (1988) reported that 26% of hypoplastic lesions had an associated carious lesion. This figure contrasts sharply with the reported 10.5% caries rate on all surfaces of the maxillary and mandibular canines on the 2163 children, 3–5 years old, examined during the larger Head Start needs assessment (Trubman et al. 1989). Silberman et al. (1989) compared the data reported by Duncan et al. (1988) with that of 37 white children examined at two Head Start centers during the same study. The prevalence noted for the white children was 11%. This isolated finding at one site may represent an aberration, or point to an important difference between races and/or cultures.

It is obvious that the sporadic documentation relating to PCH is not enough to explain demographic differences in prevalence, causality, prevention modalities, and relationships with dental caries (Johnsen 1984; Johnsen et al. 1984; Johnsen et al. 1986). To increase our knowledge of this lesion, we conducted a study to provide prevalence data for different age, gender and race cohorts; to examine the relationship of the lesion to caries, fluoridation, geographic location, and breast-feeding; to raise the awareness of the dental profession to recognize the problem and its scope; and to emphasize the importance of early detection, prevention, and treatment.

Methods and Materials

Primary canine hypoplasia has been described as a roughly circular or oblong white or brown area 1–5 mm in diameter with a flat or concave presentation (Johnsen et al. 1984; Skinner 1986; Silberman et al. 1989). The defect seems to exist in two forms: minimal hypoplasia consisting of brown, white, or yellow opaque areas with a smooth surface without pitting or loss of enamel; and obvious hypoplasia having a combination of pitting, invagination, missing enamel, or a rough-textured surface. In obvious hypoplasia, opaque areas may be present; however, there will be at least one other abnormality.

The study population included 4- and 8-year-old children, black and white, enrolled in accredited private and public preschools and elementary schools in Mississippi, U.S.A. Each classroom of children was considered a sampling unit. Letters were sent to all schools eligible to participate in the study. The samples, by age group and race, were selected randomly from a list of schools and sampling units agreeing to participate in the study. Lists of children in each sampling unit were obtained, and letters were sent to parents requesting

permission to examine their children. In addition, a questionnaire regarding the child's fluoridation, residence (rural or urban), and breastfeeding histories was included. For the purposes of this study, rural locations were defined as communities with a population less than 2500. The total sample available for this study was 2686 children. It is believed that the resulting sample sizes are sufficient for detecting differences among the groups. The contingency tables were analyzed using the Grizzle, Starmer, and Koch methodology (Grizzle et al. 1969) and the CATMOD procedure on Statistical Analysis System (SAS).

Table 1. Subjects by age, race, and gender, with one or both mandibular canines

	White			*Black*			
Age	*Total*	*Male*	*Female*	*Total*	*Male*	*Female*	*Total*
4	461	231	230	888	452	436	1349
8	731	382	349	403	187	216	1134
Total	1192	613	579	1291	639	652	2483

Before the dental examinations, the three investigators (licensed dentists) participated in a standardization exercise in the use of the Simplified Hypoplasia Index (Silberman et al. 1990). During the examination, children were placed in a supine position and examined under a high-intensity portable dental light with a mirror and explorer. The labial surfaces of the 12 anterior teeth were examined and results were entered on a dental survey form containing two boxes for each tooth. Dental caries, restorations, and missing teeth due to caries were recorded in the upper box. The lower box was used to record the degree (minimal or obvious) and type (primary canine and linear) of hypoplasia, and its apparent involvement with caries and restorations.

Before this study was conducted, the protocol was reviewed and approved by the University of Mississippi Medical Center Investigational Review Board.

Results

Prevalence of Primary Canine Hypoplasia

Children included in this analysis to determine the prevalence of PCH included all children who had at least one mandibular canine present. Table 1 contains the distribution of subjects by age, race and gender. Subjects having one or more mandibular canines diagnosed as having PCH or related lesion (caries or restoration in the area of PCH) are described by age, race, and gender in Table 2. Black children in each age category had a significantly greater prevalence of PCH (35.0% in 4-year-olds; 29.3% in 8-year-olds) than white children (17.8% in 4-year-olds; 16.8% in 8-year-olds).

Association of PCH with Age, Gender, and Race

Univariate Chi-square analysis was used to detect associations between PCH and age, race, and gender. The respective *P*-values are all significant at 0.001, 0.001, and 0.025. Further analysis using the Grizzle, Starmer, and Koch methodology in the CATMOD procedure of SAS was performed (Table 3, see next page). The first model that was fit to the data included the three main efforts (age, race, gender), and all first- and second-order interactions. Since none of the interactions were statistically significant at the 0.05 level, a second model was fit omitting the interactions. These results indicate statistical significance for race ($P = 0.0001$) and gender ($P = 0.01$), but not for age ($P = 0.07$). Although these results differ from the univariate results, they are to be expected from this more complete analysis that takes each variable into account given the presence of the other two.

Table 2. Prevalence of primary canine hypoplasia by age, race, and gender

		Age					
		4		*8*		*Total*	
Race	*Gender*	*N*	*%*	*N*	*%*	*N*	*%*
White	Male	44	19.1	74	19.4	118	19.3
	Female	38	16.5	49	14.0	87	15.0
	Total	82	17.8	123	16.8	205	17.2
Black	Male	169	37.4	57	30.5	226	35.4
	Female	142	32.6	61	28.2	203	31.1
	Total	311	35.0	118	29.3	429	33.2
Both races	Male	213	31.2	131	23.0	344	27.5
	Female	180	27.0	110	19.5	290	23.6
	Total	393	29.1	241	21.3	634	26.6

In addition, the age association in the univariate analysis may be explained by the larger number of black subjects, who have a significantly higher prevalence of PCH in the age 4 group (Table 2).

Association of PCH With Rural/Urban Locations

Subjects for this analysis included all children whose parents completed the survey form and who gave a Mississippi location as the principal place of residence.

Univariate Chi-square analysis was used to detect an association between PCH and place of residence (rural

Table 3. Effect of age, gender, and race on primary canine hypoplasia

Source	Model 1 Results df	Chi-square	Probability	Model 2 Results df	Chi-square	Probability
Intercept	1	515.16	0.0001	1	548.56	0.0001
Age	1	2.79	0.0948	1	3.19	0.0743
Race	1	64.97	0.0001*	1	65.63	0.0001*
Age * race	1	0.70	0.4034	—	—	—
Gender	1	4.60	0.0320*	1	5.94	0.0148*
Age * gender	1	0.07	0.7907	—	—	—
Race * gender	1	0.34	0.5605	—	—	—
Age * race * gender	1	0.60	0.4393	—	—	—

*Statistically significant
— Not calculated

Table 4. Association of PCH with place of residence, fluoridation status of water supplies, and breast-feeding

	Primary Canine Hypoplasia N	%	Total Subjects
Urban	421	25.8	1627
Rural	138	26.6	*518
Fluoridated	361	27.1	1330
Nonfluoridated	198	24.3	†815
Breast-fed	100	23.9	419
Not breast-fed	502	25.9	‡1940

*$P = 0.730$, †$P = 0.145$, ‡$P = 0.392$.

or urban) during the first year of life (Table 4). The results indicate that no association ($P = 0.730$) exists.

Association of PCH with Optimally Fluoridated Water Supplies

Subjects for this analysis included all children whose parents completed the survey form and who gave a Mississippi location as the principal place of residence.

Univariate Chi-square analyses were performed on the data to determine whether any relationship exists between caries experience associated with PCH lesions and the fluoride status of the community. The analyses were performed by age (4- or 8-year olds), and tooth (left or right primary mandibular canine). The results reveal no statistical association between caries formation in areas of hypoplasia, and the fluoridation status of the community, regardless of age or tooth. The *P*-values range from 0.147 and 0.121 for left and right mandibular canines respectively in 4-year-olds, to 0.906 and 0.603 for left and right mandibular canines respectively in 8-year-olds.

Association of PCH With Breast-Feeding

Subjects for this analysis included all children whose parents returned the survey form and who indicated that their child had been breast-fed.

Univariate Chi-square analysis (Table 4) reveals no statistically significant relationship between PCH and the breast-feeding ($P = 0.392$).

Association of PCH With Dental Caries

To determine whether any association exists between PCH and dental caries, the data were analyzed using the factors of age (4- and 8-years-old) and hypoplasia (presence or absence), and employing the Grizzle, Starmer, and Koch Methodology in the CATMOD procedure of SAS.

The first model fit included the two main effects (age and hypoplasia) and the first-order interaction (age x hypoplasia). The results indicate that the two main effects as well as the interaction are statistically significant (Table 5, see next page). The univariate Chi-square results indicate that the hypoplasia factor is significantly related to the dental caries experience ($P = 0.0001$), but that age is not ($P = 0.543$).

Primary canine hypoplasia has been described in this report as existing in two forms, minimal and obvious. To determine whether minimal and obvious hypoplasia differ in their relation to dental caries experience and age, the data were analyzed using the univariate Chi-square test. The results (Table 6, see next page) indicate a statistical association exists ($P = 0.016$). In this analysis, the percentage distribution of the minimal form of hypoplasia remains constant for both ages. To test the relation of the obvious form of hypoplasia with caries experience, an additional Chi-square test was performed without the presence of the minimal form of hypoplasia in the analysis. The resulting Chi-square indicates a stronger association between the obvious form of hypoplasia and the caries experience ($P = 0.004$).

Discussion

These results indicate that PCH is an ubiquitous oral lesion. It is found in approximately 17% of white children and 33% of black children. These figures are consistent with figures reported by Duncan et al. (1988) on black Head Start children and by Silberman et al. (1989) on white Head Start children. When these data were subjected to statistical analysis, the results indicated that a significant difference existed for race. This association of race with PCH is clear and consistent; black

children are more likely to develop the lesion than white children.

Gender seems to be a factor in the development of PCH, since these data indicate that males, regardless of race, are more likely to develop PCH. The relationship of PCH with the gender factor is significant, but not as strong as with race.

Determining whether age was a factor in the development of PCH was somewhat difficult. The first statistical test indicated a significant difference between 4- and 8-year-olds. However, additional analysis indicated that there were no differences because of age. These apparently disparate results can be accounted for since the first test, a univariate Chi-square, did not take into account the presence of the other two variables, gender and race. The second analysis accounted for the three variables and indicated that age was not a factor in the development of PCH. Furthermore, a greater number of black subjects, who have a significantly higher number of PCH lesions than white subjects are found in the age 4 group. This distribution apparently skewed the results of the Chi-square analysis, but had little effect on the second analysis performed with the Grizzle, Starmer, and Koch methodology. These data seem to indicate that age is not associated with the development of PCH.

These data do not support any relationships between PCH and the place of residence during amelogenesis or the fluoridation status of the community. The lesion was equally prevalent in rural and urban settings, and optimally and nonoptimally fluoridated communities.

Table 5. Effect of age and hypoplasia on caries experience: Model 1 results

Source	*df*	*Chi-square*	*Probability*
Intercept	1	462.81	0.0001
Age	1	10.03	0.0015
Hypoplasia	1	168.35	0.0001
Age * hypoplasia	1	4.03	0.0446

Table 6. Association of degree of hypoplasia with caries experience

Age	*Minimal PCH*	*Obvious PCH*	*Caries Experience*	*Total*
4	330	165	100	595
8	183	67	74	324
Total	513	232	174	919

$P = 0.016$ for the full 2x3 table

$P = 0.004$ for the obvious X caries experience

In addition, these data indicate that the presence or absence of optimally fluoridated water supplies had no effect on the development of dental caries in areas of PCH. This is particularly important to dental care providers in fluoridated communities where the prevalence of caries is low. If a patient has PCH, the risk of developing dental caries is not affected by the presence of an optimally fluoridated water supply; thus, the need for preventive measures for these children is not reduced. Indeed, greater diligence may be needed in optimally fluoridated communities, since the development of dental decay in a PCH lesion may not be anticipated or expected.

At the beginning of this study, we hypothesized that breast-feeding placed pressure on the labial cortical plate of bone, resulting in the development of PCH. The analyzed data do not support breast-feeding as a factor in the development of PCH. A study by Skinner and Hung (1989) supports this conclusion; the authors hypothesize that the lesion is not produced until the sixth month of life (Skinner and Hung 1989).

The presence of PCH seems to increase the risk of a tooth becoming carious. Analysis of these data indicated that a significantly greater number of teeth with PCH developed dental caries than teeth without PCH ($P = 0.0001$). Although an increase in caries is expected with age, a significant increase is not. The significant result from the Grizzle, Starmer, and Koch analysis can be attributed partially to the fact that it took into account the presence of hypoplasia, and partially to the differences in the rates of hypoplasia by race seen in the two age groups.

Since PCH exists in two forms, minimal (generally an opaque lesion with a smooth tooth surface) and obvious (noted by the roughened surface of the tooth), both were tested against caries experience. The results seem to indicate that children with either minimal or obvious PCH are at greater risk of developing dental caries. However, since the proportion of 4- and 8-year-old children with minimal hypoplasia remained constant, and the proportion of children with obvious hypoplasia decreased from age 4 to age 8, we reasoned that the risk of developing caries might be related to the presence of the obvious form of PCH. The data were subjected to further analysis resulting in an even stronger association between obvious PCH and dental caries. This cross-sectional study cannot conclude that children with obvious hypoplasia are at greater risk of developing caries than those with minimal hypoplasia; nor is it possible to describe the two lesions as distinct. Yet the data do suggest that there is a strong possibility that those with obvious hypoplasia are at greater risk and that, while it may be caused by a similar set of circumstances as those causing minimal hypoplasia, the factors leading to the

development of the hypoplasia may be more intense (e.g., more trauma, more fever, poor nutrition, thinner cortical layer of bone).

The factors associated with the development of PCH appear to be the subject's race to a greater degree and gender to a lesser degree (although significant). Regardless of the race or gender of the child, the position of the canine and the thickness of the cortical plate of bone are probably important in the development of the lesion. It may be that black and male children have a predisposition to a more labial placement of the tooth bud than white and female children. In addition, a nutritional deficiency resulting in a thinness or perforation of the bone (Skinner and Hung 1986) may have been more prevalent among children who developed the lesion.

The position of the tooth in the crypt and the thickness of bone seem to be important in the etiology of PCH, regardless of which of the two major hypotheses is considered. In fact, the principal differences in the hypotheses vary mainly with regard to the timing of the events that cause the lesion. The first hypothesis holds that the lesion develops at approximately 6 months of age (Skinner and Hung 1989). If this is so, then the lesion may be related to the nutritional status of the child, while the trauma may be self-inflicted as a result of habits, or physiological developments (e.g., teething, sucking, sleeping position) seen in children at this stage of life. However, if the lesion develops perinatally, then the lesion may be related to the nutritional status of the mother, while the traumatic event may be related to the forceps, the mode and length of delivery, or the condition of the umbilical cord.

Conclusions

1. Primary canine hypoplasia is more common than believed previously.
2. Two of the factors associated with the presence of PCH are race and gender.
3. The lesion affects black children about twice as frequently as it affects white children.
4. There is a statistical association between having the lesion and developing dental caries in the area of the lesion.
5. There is a strong statistical association between having obvious PCH and developing caries in the area of the lesion.
6. PCH is not associated with place of residence, fluoridation status of the water supply, or breastfeeding.

In conclusion, because of the large distribution of this lesion in the population and concomitant increased risk of developing caries, preventive modalities need to be developed. A longitudinal study to verify these cross-sectional results and to test methods directed toward preventing dental caries, (e.g., sealants) would be beneficial.

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Dr. Silberman is professor, Department of Diagnostic Sciences and director, Dental Ecology Division; Dr. Trubman is associate professor, Department of Diagnostic Sciences; Dr. Duncan is associate professor and chairman, Department of Pediatric Dentistry; all are at the School of Dentistry, University of Mississippi, Jackson, MS. Dr. Meydrech is professor, Department of Preventive Medicine and director, Division of Biostatistics at the School of Medicine, University of Mississippi, Jackson, MS. Reprint requests should be sent to Dr. Stephen L. Silberman, University of Mississippi School of Dentistry, Department of Diagnostic Sciences, Dental Ecology Division, 2500 North State Street, Jackson, MS 39216.

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