Original Article

An Epidemiological Study of Hyperdontia in American Blacks and Whites

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ABSTRACT

Objective: To test the null hypothesis that American blacks do not have a higher frequency of extra permanent teeth than whites.

Materials and Methods: Panoramic radiographs of adolescent orthodontic patients, either American whites (n = 1100) or American blacks (n = 600), were reviewed systematically.

Results: The frequencies of supernumerary incisors, premolars, and molars were each significantly more common in blacks. While incisors are the most common extra teeth in whites (and extra molars are least common), just the opposite ranking occurs in blacks. Overall, the odds ratio was 8.8 (95% confidence limits = 3.9, 20.0), confirming that American blacks are significantly more likely (almost 9 times more likely) to possess extra permanent teeth than American whites.

Conclusions: The hypothesis is rejected. Both the frequencies and the patterns of extra permanent teeth are significantly different in blacks and whites, suggesting different frequencies of the relevant (but unidentified) factors governing the developmental mechanisms that result in hyperdontia.

KEY WORDS: Supernumerary teeth; Malocclusion; Race differences; Sex differences

INTRODUCTION

Frequencies of hyperdontia are low compared to the opposite risk of congenitally missing teeth. On the other hand, supernumerary teeth can affect the normal position and eruption of adjacent teeth, often requiring clinical intervention.[1–4] Increased rates of hyperdontia among biologically related individuals suggest a genetic basis for supernumerary teeth.[5–7]

The causes of supernumerary teeth are poorly understood. The common suggestion of extra dental lamina ignores the fact that teeth develop from sites of ectodermal induction.[8] The amount of dental lamina is irrelevant if additional induction sites are not present.

Our clinical experience is that American blacks exhibit hyperdontia more often than American whites do. This could conceivably be related broadly to their greater crown and root dimensions and larger dental arches that, possibly, enhance the likelihood of more induction sites per morphogenetic field—so the fields and, thereby, the series of formative teeth are extended.[9] It does seem that extra teeth tend to develop at the end of a morphogenetic field.[10,11] The present study quantified the prevalence of supernumerary permanent teeth in contemporary adolescent samples of American blacks and whites.

MATERIALS AND METHODS

Routine panoramic radiographs of orthodontic patients were scrutinized in a standardized fashion, and each instance of a supernumerary tooth was recorded. Case selection criteria were (1) subjects were between 12 and 18 years of age, (2) subjects were either American blacks or whites by self-identification (other ethnic groups were omitted), and (3) on history and examination, no subject had a condition known to affect tooth number (notably, facial clefts, cleidocranial dysostosis, and Gardner syndrome). Two individuals with cleidocranial dysostosis were omitted from the study, and three instances of odontomes were excluded. All supernumerary teeth had crown and root morphologies consistent with their locations in the mouth (eumorphic teeth), at least with regard to cusp and root number.[12] The only emerged supernumerary teeth were some of the mesiodens.

The intent of omitting individuals younger than 12 years was to ensure that all teeth that were going to

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Table 1. Supernumerary Teeth by Tooth Type, Race, and Sex

Race	Sex	Teeth, n	Individuals, n	Frequency (Individuals)	95% Confidence Limits	
					L_1	L_2
Incisors						
Blacks	Males	7	5	0.0182	0.0024	0.0341
	Females	4	3	0.0092	0.0000	0.0196
	Males + females	11	8	0.0133	0.0042	0.0225
Whites	Males	1	1	0.0016	0.0000	0.0047
	Females	3	3	0.0064	0.0000	0.0137
	Males + females	4	4	0.0036	0.0001	0.0072
Blacks + whites	Males + females	15	12	0.0071	0.0031	0.0110
Premolars						
Blacks	Males	12	7	0.0255	0.0069	0.0442
	Females	8	5	0.0153	0.0020	0.0287
	Males + females	20	12	0.0200	0.0088	0.0312
Whites	Males	1	1	0.0016	0.0000	0.0047
	Females	0	0	0.0000	0.0000	0.0000
	Males + females	1	1	0.0009	0.0000	0.0027
Blacks + whites	Males + females	21	13	0.0076	0.0035	0.0118
Molars						
Blacks	Males	12	10	0.0365	0.0143	0.0587
	Females	12	6	0.0184	0.0038	0.0330
	Males + females	24	16	0.0267	0.0138	0.0396
Whites	Males	2	1	0.0016	0.0000	0.0047
	Females	2	1	0.0021	0.0000	0.0063
	Males + females	4	2	0.0018	0.0000	0.0043
Blacks + whites	Males + females	28	18	0.0106	0.0104	0.0225

form, notably third molars, were forming.[13] The upper age range was set at 18 years so that anamnestic and dental histories could reliably exclude the extraction of extra teeth. Resulting frequencies should reflect the general population prevalences for hyperdontia, although these frequencies could be somewhat elevated because hyperdontia, notably mesiodens, can affect the positions and orientations of adjacent teeth,[4,14,15] although population frequencies of such situations are low.

A total of 1700 individuals were studied (1100 whites, 600 blacks). Data were collected at the Department of Orthodontics, College of Dentistry, University of Tennessee, Memphis, along with community orthodontists' offices. These nominal data were analyzed using the Fisher exact test.[16] All tests were evaluated at an alpha of .05 as two-tailed tests. Odds ratios and their 95% confidence limits were calculated as described by Agresti.[17] Other statistics are as described by Fisher and van Belle.[18]

RESULTS

In this study of 1700 adolescents, there were 64 supernumerary teeth distributed across 39 individuals (Table 1). The number of extra teeth per person ranged from 1 to 8: 25 cases had but 1 extra tooth, 10 cases had 2 extra teeth, 1 case had 3, 2 cases had 4, and 1 case had 8 extra teeth (1 extra premolar and molar per quadrant). Most hyperdontic teeth were fourth molars distal to the third molars (28/64; 44%), followed by premolars (21/64; 33%) and then incisors (15/64; 23%). There was no supernumerary canine in the sample. All supernumerary teeth were wholly separate elements; none were fused or geminated with an adjacent tooth.[19]

Incisors

There were 15 supernumerary incisors in 12 people, all located in the maxilla, although tuberculate and conical forms were not distinguished.[20] Of these, 10 teeth were mesiodens (between the maxillary central incisors) and the other 5 were in the region of the lateral incisors. Two blacks had two mesiodens each, and one black had a left-right pair of supernumerary lateral incisors. Each of the four whites had just one supernumerary incisor.

Overall, the prevalence of supernumerary incisors was 0.71% (ie, 12 individuals in 1700), but this was appreciably higher in blacks (8 people; 1.33%) than whites (4 people; 0.36%), which is significant statistically ($P = .03$ by the Fisher exact test). The odds ratio is 3.70, with 95% confidence limits of 1.1 and 12.3, meaning that the odds of incisor hypodontia in blacks are 3.7 times the odds in whites. With these small

Table 2. Supernumerary Teeth, Combining Tooth Types[a]

Race	Sex	Teeth, n	Individuals, n	Frequency (Individuals)	95% Confidence Limits	
					L_1	L_2
Blacks	Males	31	22	0.0803	0.0481	0.1125
	Females	24	14	0.0429	0.0209	0.0650
	Males + females	55	36	0.0600	0.0410	0.0790
Whites	Males	4	3	0.0047	0.0000	0.0101
	Females	5	4	0.0086	0.0002	0.0170
	Males + females	9	7	0.0064	0.0017	0.0111
Blacks + whites	Males	35	25	0.0275	0.0169	0.0382
	Females	29	18	0.0227	0.0123	0.0331
	Males + females	64	43	0.0253	0.0178	0.0328

[a] These individual counts differ from Table 1 because a person with multiple supernumerary tooth types is counted only once here.

numbers, there was no suggestion of a sex predilection (blacks: 3 females, 5 males; whites: 3 females, 1 male).

Canines

There was no instance of a supernumerary tooth in the canine region in either jaw (0/1700 persons).

Premolars

There were 21 supernumerary premolars distributed across 13 individuals. These teeth were distributed as nine people with one extra premolar, one with two, two with three, and one with four extra premolars. Nine teeth were maxillary, and 12 were mandibular. The odds were similar for males (7/741; 0.94%) and females (6/959; 0.63%) but significantly higher among blacks (12/600; 1.83%) than whites (1/1100; 0.09%) with $P < .0001$. The odds ratio is 22.43 with confidence limits of 2.9 and 172.9, meaning that blacks were more than 20 times as likely as whites to have one or more supernumerary premolars. (Confidence limits are large because the event is so uncommon overall.) Of note, the four instances of multiple supernumerary premolars were all in blacks.

Molars

Particularly when they form distal to the normal teeth, extra molars often go undetected in routine dental examinations.[21] There were 28 supernumerary molars, all located distal to third molars. Most of these (20/28) occurred in the maxillary tuberosity rather than in the mandible. Just two instances of extra molars occurred in whites, and in both situations, there was a left-right pair of maxillary fourth molars. The prevalence in whites was 0.18%, which is significantly lower than the 2.67% (16/600) found in the sample of American blacks. The difference is highly significant ($P < .0001$), with an odds ratio of 15.04 and confidence limits of 3.5 and 65.6.

Tooth Types Combined

As supposed from the black-white differences for the individual tooth types, the overall frequencies are appreciably higher in American blacks. Ignoring the number of hyperdontic teeth per person, 6.00% of the American blacks examined exhibited at least one supernumerary tooth (Table 2). This contrasts with the prevalence of 0.64% in the white sample. The difference is highly significant ($P < .0001$), with an odds ratio of 8.80 (confidence limit: 3.86, 20.05), meaning that the odds of these American blacks exhibiting hyperdontia is roughly nine times that of the odds of the whites.

Ignoring multiple occurrences within subjects, the frequency of hyperdontia was higher in males than females (72% vs 28%), which is roughly 3 to 1. This sex difference is driven by the predominance of males with hyperdontia in the sample of blacks (20 males, 12 females) since the overall frequency is so low in whites (3 males, 4 females).

Not only is the prevalence of permanent tooth hyperdontia higher in blacks than whites, the typical number of extra teeth is higher (Figure 2): the average number of supernumerary teeth observed here in blacks with hyperdontia is 1.7 teeth vs 1.3 teeth per case in whites. (This difference is not significant, primarily because so few whites had hyperdontia.)

Associations Among Tooth Types

With 64 supernumerary teeth distributed among 39 individuals, it is evident that a person with one extra tooth is likely to have another (Figure 2). Bilateral symmetry accounts for several instances of multiple teeth. There were 14 people with at least two supernumerary teeth, and of these, there were 15 left-right pairs of homologous supernumerary teeth: nine people with one pair, one person with two pairs (upper and lower M4s), and one person with four pairs (an extra premolar and molar in each quadrant). In other words,

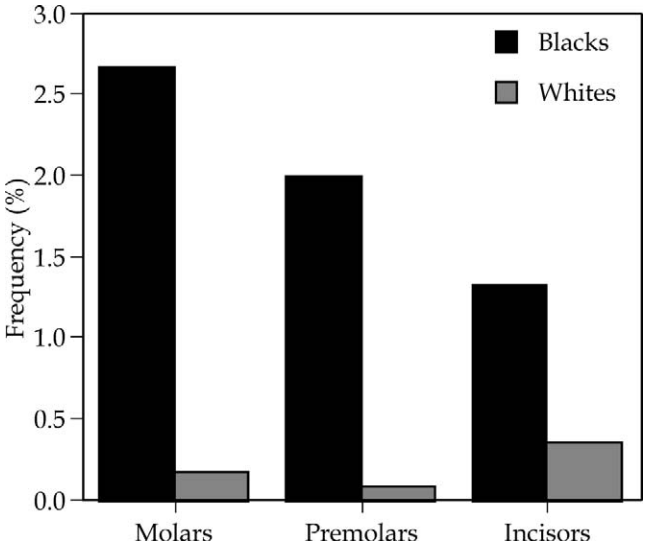

Figure 1. The prevalence of supernumerary teeth, graphed here according to tooth type, is significantly higher in American blacks than whites. The data for blacks show that the frequencies of hypodontia increase mesially to distally, whereas the opposite occurs for whites.

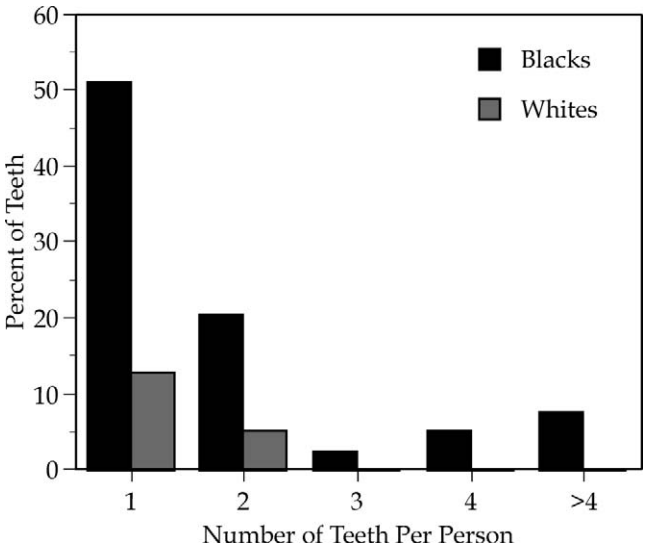

Figure 2. Percentage distributions of extra teeth (number per person) in the subset of the sample in whom hypodontia occurred.

about half of the supernumerary teeth (30/64) were due to bilateral development of extra teeth.

DISCUSSION

The causes of supernumerary teeth are poorly understood. At its simplest, a tooth forms from the induction of a site along the dental lamina by the ectoderm.[8] Occasionally, genetically modulated conditions occur in which too many teeth are initiated, notably in cleidocranial dysostosis, where the teeth can be profligate.[22] At the other extreme, genetic defects that cause various forms of ectodermal dysplasia result in oligodontia.[23] In between these extremes, most cases of abnormal tooth number have no ascertained etiology.

Recent work shows that some genes modulate the risk of hypodontia, notably PAX9, MSX1, and MSX2, but there is considerable variable expressivity for each of these genes.[24,25] Unfortunately, there appears to be no candidate gene for nonsyndromic hyperdontia as assessed in the present study.

Several observations suggest a genetic basis for hyperdontia.[9] One of the most suggestive features is the increased occurrence among biologically related persons.[7,26,27] Frequencies also appear to differ significantly among racial groups, although these data are meager.[28,29] Several studies have, however, found different prevalences between males and females.[1,29,30] Reports also show hyperdontia in both the primary and permanent dentitions of the same persons. Strong evidence comes from the observation of major gene effects, notably cleidocranial dysostosis[31] and Gardner syndrome,[32,33] showing that the developmental mechanism for initiating extra teeth is largely a matter of pattern extension, adding dental elements that form under the usual formative mechanisms.[34]

Conjectured causes of hyperdontia generally involve two ideas: first, extra tooth may fission off from a normal tooth (tooth gemination[35]). Clear cases of gemination (from the same Latin root as for *twin*) are well known.[10,12] For example, the development of paramolar tubercles as independent dental elements buccal to the molars is a seemingly obvious example,[36] although most of these are physically fused with the parent tooth. There was no instance here of any of the erupted normal teeth or radiographic evidence of the supernumerary teeth with compromised or abnormal morphology that would be suggestive of gemination. The considerable difference in the developmental stage of a supernumerary tooth compared to the adjacent tooth generally argues against fission as the common cause of hypodontia. Also, one supposes that geminated teeth develop physically quite close to one another because they form within the same dental sac. A second idea invokes hyperactivity of the dental lamina,[29,37] but details of what ''hyperactivity'' of this band of mesenchyme might be are wanting. With the benefit of the recent advances in understanding the reciprocal ectoderm-mesenchyme interactions of biochemical signaling,[38,39] it is evident that tooth initiation begins with signals from the ectoderm. Hyperdontia somehow entails the proliferation of such sites.

The goal of this study was to compare the prevalences of supernumerary teeth in American blacks and whites. Results are summarized in Figure 1, showing (1) that hyperdontia is several-fold more common in blacks for each of the three tooth types and (2) that

the pattern of extra teeth differs between these races. Conventional wisdom has been that "it is well known that supernumerary teeth occur more frequently in the premaxilla than in other areas of the jaws."[20] This often-repeated inference stems from the narrow focus on Caucasians in the literature[1,21,40–42]; it certainly is contradicted by the present sample of American blacks, in whom additional molars (eumorphic fourth molars) constitute the most prevalent expression of extra permanent teeth. Indeed, this contrast is the more obvious because terminal molars are the least common sort of hyperdontia in whites, which leads to the rather dramatic odds ratio of 15. That is, the odds of encountering a fourth molar in an American black are about 15 times greater than the odds in an American white. Generalities in the literature, founded on well-studied Caucasian groups, should not be extrapolated to other ethnic groups without evidence.

While beyond the scope of this study, hyperdontia evidently develops partly independently of the risk of congenital absence.[43–45] That is, hyperdontia is not protective of hypodontia. Two cases occurred here (both in whites) in which congenitally missing third molars occurred in conjunction with hyperdontia in other tooth types.

CONCLUSIONS

- American blacks have significantly higher prevalences of hyperdontia for each tooth group, and the average number of extra teeth is likewise higher.
- Hyperdontia is more common in males, and the degree of sex difference is greater in blacks.
- While mesiodens are the predominant extra tooth form found in whites, blacks are most likely to possess fourth molars, followed by extra premolars, and with comparatively low frequencies of supernumerary incisors.

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