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Original Article

Prevalence of hyperdontia, hypodontia, and concomitant hypo-hyperdontia

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KEYWORDS

Hyperdontia;
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Supernumerary;
Congenitally missing;
Dental anomaly

Abstract *Background/purpose:* Anomalies in human dentition are some of the most common occurrences of congenital abnormalities. Present study aimed to determine the prevalence of hypodontia, hyperdontia and concomitant hypo-hyperdontia (CHH) among patients attending the University of Nevada, Las Vegas (UNLV) School of Dental Medicine clinics.

Materials and methods: Retrospective search was conducted on patients' clinical notes in AxiUm™. Search included using keywords such as "hypodontia", "hyperdontia", "supernumerary teeth" and "congenitally missing". Panoramic radiographs were used to confirm the hyperdontia, hypodontia or CHH for patients attending the UNLV SDM clinics from 2010 to 2018. Collected data were analyzed using the chi-square test.

Results: 1101 patients were populated using the keywords. From these populated patients, 186 had hyperdontia, 23 hypodontia, and 3 presented with CHH. The distribution of males and females was 54.7% and 45.3% respectively. Hispanics, African Americans, Asians, Caucasians and ethnically unspecified patients represented 43.39%, 14.25%, 3.30%, 8.02%, and 31.13%, respectively, of those patients with a dental anomaly. Hyperdontia was most common amongst Hispanic patients with 39.24%, followed by the unspecified patients at 32.8% as well as amongst males at 56.45% (P value of 0.03). Unidentifiable supplemental teeth were overall the greatest in number with the lower right premolars, tooth 44, being the most common. This was demonstrated in the Hispanic patients whereas within the African American patients a 4th molar was in excess.

Conclusion: Hispanic patient population has a significant link to dental anomalies, specifically hyperdontia while the presence of the fourth molar was prominent among African American patients.

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Introduction

Embryology is a multifactorial process composed of numerous intricate steps. The alteration of any one of these steps can result in congenital abnormalities. Some of the more common forms of developmental issues can be found in the dentition.¹ Disruption in the complex sequences which guide tooth formation can result in anomalies of tooth size, location, composition and number.² In some people, these anomalies can manifest as an excess of teeth, missing teeth, and in rare cases, both.

Both a highly prevalent congenital disorder and dental abnormality, hypodontia is the occurrence of congenitally missing 1 to 6 teeth, excluding the third molars.¹ Worldwide hypodontia affects permanent teeth in 2.3–10% of the human population and appears to target specific types of teeth.¹ This preference of tooth type might be linked to ethnic backgrounds and genes more prevalent to specific groups. Possible genetic links can be found demonstrated across the U.S., where congenitally missing permanent teeth were confirmed to be significantly lower in American blacks than whites.³ A study involving children in Southern China found that the most commonly absent tooth was the mandibular incisor whereas a similar study conducted in Italy found missing mandibular second premolars to be the most common in their population.^{1,4} Research has connected the PAX9 and MSX1 genes to these non-syndromic cases of hypodontia.⁵ In contrast, researchers have yet to associate supernumerary teeth to non-syndromic genetic factors.⁵

Hyperdontia, or supernumerary teeth, is the presence of excess teeth either erupted or unerupted outside of the normal 32 permanent teeth or 20 primary teeth.⁶ In comparison to hypodontia, hyperdontia is a notably less prevalent dental anomaly. However, genetic factors appear to play a role in the development of hyperdontia as well. Whereas hypodontia was significantly more common among American whites, a significantly higher prevalence of hyperdontia was reported among American blacks.^{3,7} Also, hyperdontia was noted to be more common among males, and the degree of sex difference is more significant in African-Americans (AFRAM) who possesses fourth molars, followed by extra premolars.⁵

Even rarer is the condition called concomitant hypohyperdontia (CHH), which was initiated by Camilleri to explain the simultaneous presence of hypodontia and supernumerary teeth in the same individual.⁸ This is a unique dental anomaly as it characterizes opposite forces of nature acting concurrently.^{9–11} The prevalence of CHH was found to range from 0.002 to 0.7%, resulting in a lack of data and uncertainty in etiology.^{11,12} The present retrospective study aimed to determine the prevalence of these three aforementioned dental anomalies within the UNLV, SDM clinics and create a patient population to utilize for further etiology-related research.

Materials and methods

Patient population

A retrospective search was conducted in AxiUm™ using keywords such as “hypodontia”, “hyperdontia”,

“supernumerary teeth” and “congenitally missing”. Inclusion criteria for the patient population encompassed patients seen at UNLV, School of Dental Medicine clinics from the years 2010–2018 who were 6–88 years old. The youngest patient with an anomaly was an 8-year-old with hyperdontia and the oldest was a 66 years' old who also exhibited hyperdontia. The mean age was 19.39 amongst females and 19.91 amongst the males. Using these parameters, the search resulted in 2680 entries. The duplicate entries were removed, resulting in a sample size of 1101 patients, of which 556 (50.5%) were female and 545 (49.5%) were male. Patient race was determined by the category patients chose on their screening forms. Patients who did not reported the race section of these forms were categorized as “Other/Unspecified” in this study.

Anomaly identification

Panoramic radiographs were then used to confirm the presence of hyperdontia, hypodontia, or concomitant hypohyperdontia. Hyperdontia was noted in patients with supernumerary teeth visible in the radiographs. Hypodontia was noted only when it was evident no mineralization had taken place. Multiple panoramic radiographs were used from patients' files to determine whether a tooth was extracted or congenitally missing. Clinical notes were used to supplemental diagnosis of hypodontia. When collecting data from the panoramic radiographs, 4th molars were categorized as supernumerary 3rd molars. Mesiodens and other unidentifiable supernumerary teeth were marked as “unidentifiable supplemental tooth”, and their location in the arch was noted. The teeth were numbered using the Universal Notation System. Patients with anomalies due to genetic syndromes or those with missing or undiagnosable panoramic radiographs were excluded from the study (Fig. 1). The results of the collected data were then analyzed using the chi-square test.

Results

From this UNLV, SDM sample population of 1101, one of three dental anomalies was identified in 212 patients, as can be seen in the data collection flowchart (Fig. 1). From the 212 patients that exhibited dental anomalies, 23 (10.84%) had hypodontia, 186 (87.74%) had hyperdontia, and 3 (1.42%) had CHH (Fig. 1). Within the genders, dental anomalies appeared to be more prevalent in men than women, with 96 (45%) female cases and 116 (55%) male cases (Table 1). The population sample consisted of patients with Hispanic, African American, Asian, Caucasian, and Other/Unspecified ethnicities, representing 52.23%, 5.18%, 1.45%, 4.27%, and 36.87%, respectively.

From the sample population, 23 patients presented strictly with congenitally missing teeth, resulting in a 2.09% prevalence of hypodontia. As mentioned previously, hypodontia comprised 10.84% of the dental anomalies among those who presented with them. The combined total of congenitally missing teeth among these 23 patients was 34 teeth. The arch most affected by hypodontia was the maxilla. The most commonly missing teeth by tooth type were the second premolars, followed by the incisors and

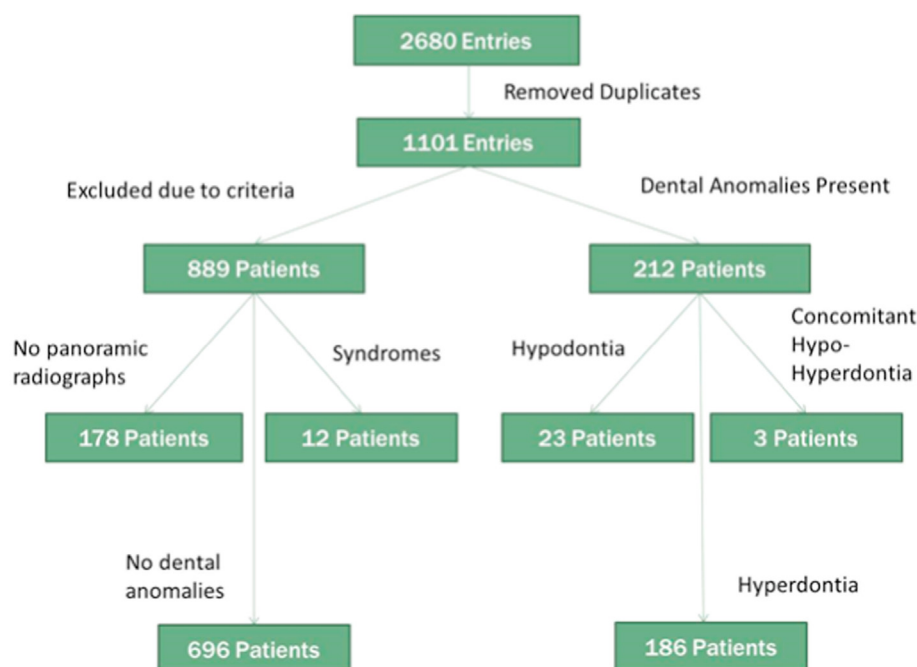


Figure 1 Descriptive data collection flowchart.

Table 1 Distribution of the hyperdontia, hypodontia, and concomitant hypo-hyperdontia by ethnicity and gender.

Ethnicity	Hypodontia		Hyperdontia		CHH		Total
	Female	Male	Female	Male	Female	Male	
Hispanic/Latino	10	6	33	40	1	2	92 (43.4%)
Caucasian	0	0	9	8	0	0	17 (8%)
Asian	0	0	1	6	0	0	7 (3.3%)
African American	2	0	11	17	0	0	30 (14.1%)
Other (mixed or unidentified ethnicity)	3	2	27	34	0	0	66 (31.1%)
Total	15	8	81	105	1	2	212 (100%)

first premolars. The specific tooth that exhibited hypodontia the most was the left maxillary second premolar. The prevalence of hypodontia in the sample population was highest amongst the Hispanic/Latino patients and almost twice more common in women than men. Both of these findings were established to be of statistical significance (Table 1).

From the 212 patients that exhibited a dental anomaly, 186 (87.74%) were found to have hyperdontia with 300 teeth found to be in excess. Hyperdontia was especially prominent amongst Hispanic patients which made up 73 (39.24%) of the cases. This was found to be statistically significant. It was also more common in male Hispanics than females, however not at a substantial value. In terms of teeth that could be specified, the lower premolars, were the most significantly common site (Table 2). A single tooth in excess was noted in 120 patients, two teeth in excess in 45 patients, 3–9 teeth in 20 patients, and only one patient with ten or more teeth in excess. A remarkably high occurrence of 4th molars was found amongst the African American patients. A total of thirty-six 4th molars were identified in the patient population.

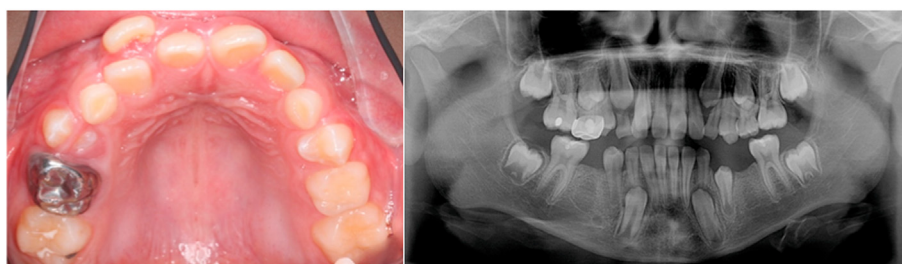
Concomitant hypo-hyperdontia (CHH) was found to be present in 3 of the 212 patients (Fig. 2). All patients of the patients with CHH are of Hispanic/Latino roots. Two of the patients were male, and one of the patients was female. From the three patients, one of the male patients exhibited two congenitally missing teeth, and one supernumerary tooth. In contrast, the other two patients had one missing tooth and one supernumerary tooth. It would be challenging to state which teeth were affected the most as there were not enough patients with CHH to discern this information. It does appear, however, that two of the patients had congenitally missing 2nd premolars, which was found to be the most commonly missing tooth among Hispanic patients.

Discussion

Globally, the prevalence of hypodontia varies amongst different countries depending on the studied population.^{13,14} As previously stated, a meta-analysis showed that the prevalence varied in the world from 2.2% to 10.1%.¹

Table 2 Distribution of the hyperdontia and hypodontia according to the tooth type and location.

	Location	Maxillary			Mandibular		
Hyperdontia	Anterior	Central incisor:	Left	4	Central incisor:	Left	1
			Right	2		Right	5
		Lateral incisor:	Left	13	Lateral incisor:	Left	5
			Right	12		Right	5
		Canine:	Left	1	Canine:	Left	4
			Right	4		Right	6
	Premolars	First:	Left	2	First:	Left	29
			Right	2		Right	37
		Second:	Left	6	Second:	Left	20
			Right	4		Right	28
	Molars	First:	Left	0	First:	Left	0
			Right	0		Right	1
Second:		Left	0	Second:	Left	0	
		Right	2		Right	0	
Third:		Left	11	Third:	Left	7	
		Right	9		Right	9	
Hypodontia	Anterior	Central incisor:	Left	0	Central incisor:	Left	0
			Right	1		Right	2
		Lateral incisor:	Left	3	Lateral incisor:	Left	0
			Right	4		Right	1
		Canine:	Left	0	Canine:	Left	0
			Right	0		Right	1
	Premolars	First:	Left	3	First:	Left	0
			Right	2		Right	0
		Second:	Left	5	Second:	Left	4
			Right	3		Right	3
	Molars	First:	Left	0	First:	Left	0
			Right	0		Right	1
		Second:	Left	0	Second:	Left	0
			Right	0		Right	0
		Third:	Left	0	Third:	Left	0
			Right	0		Right	0

**Figure 2** An example of concomitant hypo-hyperdontia case.

Accordingly, it was expected that during this study hypodontia would be the most prevalent, of the three dental anomalies, amongst UNLV, SDM patients. Earlier researchers have stated that hypodontia is not only the most common dental anomaly, but the most common "human malformation".³ However, the data collected in our study contradicted this expected pattern.

In the present study, it was concluded that the most commonly missing teeth were maxillary premolars, followed by the lateral incisors and mandibular premolars. These results come into agreement with a previous meta-analysis conducted in the type of missing teeth but not the order of

prevalence. This could be due to the lack of reported hypodontia cases and difficulty of identifying the anomaly without proper evidence.¹⁵ Another explanation for the difference in affected tooth is genetic and ethnic factors. The study conducted in southeastern U.S. comparing hypodontia between white and black Americans took into account a 10% genetic overlap between the two populations.³ White Americans had a significantly higher prevalence of hypodontia with the maxillary lateral incisors most at risk.³

Hypodontia is the result of atypical genetic control such as a lack of signaling during tooth development.³ The two genes, MSX1 and PAX9, are transcription factors linked to

congenitally missing teeth.³ Research has associated the MSX1 gene with premolars and PAX9 with molars, indicating that varying levels of expression among these genes in different populations can result in the variability of affected teeth.³

In this study, we found hyperdontia to be the most prevalent dental anomaly within our patient population. According to Peker et al., the prevalence of hyperdontia ranges from 0.1 to 3.8%, which vastly differs from our findings of 16.89% from the sample population.¹⁶ The present finding comes into agreement with a previous study conducted in Mexico city which stated that hyperdontia was the most common dental anomaly among their patient population.¹⁷ These results are quite similar to those seen in our study and may be attributed to Hispanic/Latino patients comprising more than half of our sample population. In accordance with previous research, hyperdontia was more evident in male than female patients.¹⁷

Present investigation showed a high prevalence of hyperdontia in the mandibular premolar region which is in agreement with a previous study which indicated that 34.3% of supernumerary teeth cases were observed in the mandibular premolar area.¹⁶ The presence of the fourth molar is prominent among American blacks which comes into agreement with a previous study that indicated that American blacks are 15 times more likely to possess fourth molars.⁷

Over the years, innumerable theories have been proposed in attempts to explain the occurrence of supernumerary teeth.¹¹ One such theory, referred to as “the dichotomies of the tooth bud,” explains that a tooth bud might split into two separate and not necessarily equal parts, resulting in an excess tooth.^{11,18} Another theory, “atavism,” suggests that the cause of supernumerary teeth is due to the body’s attempt at restoring teeth that were lost during evolution and has since been disproven.^{11,19} The most accepted theory by researchers is based on the hyperactivity of dental lamina.¹¹ The dental lamina gives rise to cells, which then proliferate and create the enamel organ, a structure that, in turn, dictates the size and form of a tooth. These cells which precede the enamel organ have the ability to proliferate multiple times, permitting the creation of excess teeth.¹¹

As mentioned previously, concomitant hypo-hyperdontia is the rare occurrence of both hypodontia and hyperdontia in a single patient.⁸ In this study, three cases of CHH were identified and all three of the cases were amongst Hispanic/Latino patients. This high prevalence of all three cases being found in Hispanic/Latino patients indicates that there may be a correlation between ethnic backgrounds and the occurrence of CHH. This might suggest a possible genetic involvement between different ethnicities and dental anomalies.

Within the limitations of the present investigation, there was a significantly high prevalence of hyperdontia among Hispanic/Latino patients. The unusual amount of supernumerary 4th molars among African-American patients. Further research involving gene isolation from patients with dental anomalies can help shed better light on their etiological causes outside of syndromic conditions.

Declaration of competing interest

The authors have no conflicts of interest relevant to this research.

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