



Radiographic Study of Prevalence and Distribution of Hypodontia in a Pediatric Orthodontic Population in Kanpur City

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Abstract

Purpose: This study's purpose was to determine prevalence and distribution of hypodontia in a pediatric orthodontic population in **Kanpur City**

Methods: A total of 607 dental records (radiographs, cast models, and photographs) from 5- to 11-year-old patients of an interceptive orthodontics clinic were studied for agenesis of permanent teeth. Patients with hypodontia of the third molars and syndromes of cleft lip or palate were excluded. Data were analyzed using t tests ($=.05$) and Pearson's chi-square ($P=.001$).

Results: Hypodontia affected 25 patients (~4%): 13 with unique and 12 with multiple tooth agenesis. Females were more affected than males (1.5:1). A total of 40 teeth were missing: permanent maxillary lateral incisors (40%); mandibular second premolars (~23%); maxillary second premolars (15%); permanent mandibular lateral incisors (15%); and permanent mandibular second molars (~8%). The maxilla was more affected (55%) vs the mandible (45%). Symmetrical hypodontia was exhibited by the maxilla, whereas the left premolar region was most affected in the mandible.

Conclusion: The most affected tooth was the permanent maxillary lateral incisor, followed by the mandibular second premolar; symmetry was noted for hypodontia in the maxilla, and an inverse correlation was found between the maxillary and mandibular hypodontia.

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Hypodontia (congenital lack of teeth, or dental agenesis) is the most common developmental anomaly in humans^{1,2} It may present as an isolated trait, although it is frequently associated with other anomalies such as cleft lip/palate, anomalies in tooth shape or size, enamel hypoplasia, delayed formation or eruption of other teeth, crowding, malposition, malocclusion, and altered craniofacial growth, with aesthetic and functional consequences.²⁻¹²

Hypodontia may occur as an isolated condition, with the absence of 1 to 5 teeth. When 6 or more teeth are absent, the term oligodontia is used.^{1,13} It may essentially be considered a

reflection of normal variation or, alternatively, it may occur as syndromic hypodontia associated with a systemic condition or with one of the large number of clinically recognized syndromes.²

The reported prevalence of permanent teeth, excluding third molars, varies from approximately less than 1% to 13% (Table 1).^{7-12,14-22} There are several agenesis patterns, which affect genders differently. Absences in the primary dentition have a lower prevalence, usually involving primary maxillary lateral incisors and are often followed by the absence



of the succedaneous or other permanent tooth.²³

Ethnic variations in hypodontia patterns have also been described. For Caucasian populations, the most common permanent teeth missing are the mandibular premolars followed by the maxillary lateral incisors and maxillary second premolars (Table 1). For Asian populations, permanent mandibular incisors are frequently most affected maxillary lateral incisors and maxillary second premolars (Table 1). For Asian populations, permanent mandibular incisors are frequently most affected.²⁴

Hypodontia is a complex trait, with variable expressivity. It generally has a genetic cause and seldom is produced by environmental factors such as infection, trauma, chemical substances, or radiation therapy. To date, the mutation spectra of nonsyndromic tooth agenesis in humans have revealed defects mainly in 2 genes that encode transcription factors, MSX1 and PAX9.25-27 Mutations in the transcription factor PAX9 have been shown to be responsible for molar oligodontia; in the transcription factor, MSX1 have been responsible for selective posterior agenesis. Both are unrelated

to isolated incisor hypodontia, where mutations in TGF α have been found responsible.^{2,24}

The aim of this study was to determine prevalence and distribution of hypodontia in a pediatric orthodontic population in **Kanpur City**

Methods

Dental records that included comprehensive radiographs (panoramic, occlusal, and periapical radiographs), intraoral photographs, and dental casts of 607 patients attending the Interceptive Orthodontics Clinic, **Kanpur City**, were studied for agenesis of permanent teeth, with previous approval from the clinic's Dentistry Bioethics Committee. Records were analyzed by a trained observer, and observations were confirmed by reviewing dental charts and history.

Agenesis of third molars was not included, and patients with syndromes or cleft lip or palate were excluded. Patients were 5 to 11-years-old. When agenesis was diagnosed and the initial evaluation age was 5-years-old, a follow-up panoramic radiograph at 10-years-old was used to confirm diagnosis. This study group was composed mainly of children of mixed ethnicity, with American Indian, African, and Spanish ethnic backgrounds.

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Table 1. REPORTED PREVALENCE AND DISTRIBUTION OF HYPODONTIA STUDIES THAT INCLUDE RADIOGRAPHS AND EXCLUDE SYNDROMIC PATIENTS OR AGENESIS OF THIRD MOLARS

Author	Year	Sample	Country	Prevalence (%)	Most affected tooth
Bäckman and Wählin ⁵	2001	739	Sweden	7	Mandibular second premolar
Thilander et al. ⁶	2001	4,724	Colombia	3	Mandibular second premolar
Nordgarten et al. ¹³	2002	1,000	Norway	11	Mandibular second premolar
Silva Meza ⁷	2003	668*	Mexico	3	Permanent maxillary lateral incisor
Albashaireh and Khader ⁸	2006	1,045	Jordan	6	Mandibular second premolars
Endo et al. ⁹	2006	3,358*	Japan	9	Mandibular second premolars
Gábris et al. ¹⁰	2006	2,219*	Hungary	15	Permanent maxillary lateral incisor
Iglesias et al. ¹⁴	2007	97	Venezuela	6	Permanent maxillary lateral incisor
Sisman et al. ¹⁵	2007	2,413	Turkey	8	Permanent maxillary lateral incisor
Clavano Küchner et al. ¹¹	2008	975	Brazil	5	Mandibular second premolars
Maatouk F et al. ¹⁶	2008	262	Tunisia	13	Mandibular second premolars
Yamaguchi et al. ¹⁷	2008	3,683*	Japan	6	†
Chung et al. ¹⁸	2008	1,622	Korea	11	Permanent mandibular lateral incisor
Goya et al. ¹⁹	2008	2,072	Japan	9	Mandibular second premolars
Rølling and Poulsen ²⁰	2009	8,138	Denmark	7	Mandibular second premolars
Peker et al. ²¹	2009	†	Turkey	†	Permanent maxillary lateral incisor
Celikoglu et al. ²²	2010	3,341*	Turkey	5	Permanent maxillary lateral incisor
Medina	2010	607*	Venezuela	4	Permanent maxillary lateral incisor

A total of 85 patients presented with tooth number alteration (hyperdontia and hypodontia). Of these, agenesis of permanent teeth excluding third molars was confirmed in 33 cases, which narrowed to 25 when syndromic or cleft-lip palate patients were excluded (3 for ectodermal dysplasia, 3 for cleftlip palate, 1 for Gorlin syndrome, and 1 for congenital rubella).

Variables studied were: age; gender; affected tooth; affected jaw; and symmetry. Statistical treatment of data included descriptive statistics (charts percentages), t test significance at the 0.05 level, and Pearson's correlation test, 2-tailed, significant at the 0.001 level. All data were analyzed with SPSS 13 software (SPSS Inc, Chicago, Ill).

Results

Of the 607 patients, 25 presented with hypodontia for a prevalence of approximately 4%. The sample's mean age was 8.20 for males and 8.40 for females. Females were more affected than males, with a ratio of 1.5:1.

The absence of 40 teeth was recorded in 13 patients presenting with 1 missing tooth, and 12 presented with multiple absences. The mean for missing teeth varied between genders (1.50 for males and 1.67 for females). Unique tooth hypodontia was found in 5 females and 8 males; 10 females had 2 missing teeth, 1 male had 3 missing teeth, and 1 male had 4 missing teeth. None of the studied subjects had 5 or more missing permanent teeth. Distribution showed no statistically significant difference between genders, location, or affected tooth (t test; $P \leq 0.05$).

A total of 22 teeth were missing in the maxilla. The permanent maxillary lateral incisor was most affected. When compared to overall prevalence, this difference was not statistically significant (t test; $P \leq 0.05$), but when analyzed according to affected jaw, the difference was statistically significant at the 0.001 level. In the mandible, 18 teeth were missing, with the second premolar most affected. Whichever tooth was affected in the maxilla, lateral incisor, or premolar, symmetry was observed with statistical significance at the 0.001 level. In the

mandible, symmetry was not significant, with the left side most affected (Table 2).

Negative or inverse correlation was found between hypodontia affecting the maxilla or mandible, with statistical significance at the 0.001 level. This indicates that when one jaw was affected, the opposing jaw most likely was not.

Discussion

Hypodontia is the most common developmental anomaly in man and may cause malocclusion and other functional and esthetic problems. Prompt diagnosis of congenitally missing teeth in children allows comprehensive treatment planning that includes all growth stages. Treatment should favor proper occlusal development, avoiding malocclusions and maintaining the child's self-esteem, and should be performed by a multidisciplinary team in which the pediatric dentist has upmost importance²⁸

The epidemiology of hypodontia is very variable, depending on ethnic and geographic backgrounds. Large population studies may have been performed without radiographic evaluation, so underestimation of congenitally missing teeth is possible. Meta-analyses have been performed, including studies with large samples from different time periods and radiographic evaluation^{1,29}. In these analyses, it is evident that mostly studies performed on Caucasian populations have met the selection criteria, and the publication of data regarding other ethnic groups is relatively scarce. Although clinicians may have the impression of increased prevalence of hypodontia in the past few decades, there is not enough evidence to support the theory that this observation is associated with an evolutionary trend or rather that it results from more careful diagnostic screening.^{1,2,29}

The present study was performed on a sample taken from an interceptive orthodontics clinic where patients had complete orthodontic records. The results may be biased, and generalization is not possible, although prevalence was within that reported for the general population, as described by Sisman et

al.¹⁵ and lower than reported in other Venezuelan samples.¹⁴ When compared with other studies performed in orthodontic populations, the prevalence is lower than that reported by Endo et al. (~9%),⁹ Gábris et al. (~15%),¹⁰ Sisman et al. (~8%),¹⁵ and Yamaguchi (~6%);¹⁷ similar to Celikoglu et al. (~5%);²² and higher than Silva-Meza (~3%).⁷

For the general population, reported prevalence of hypodontia varies between geographic locations, being lower for Latin-America when compared with Europe or Asia (Table 1). In a meta-analysis performed by Polder et al.,¹ the population in North America was less affected

than the European or Australian populations. Ethnic patterns have been reported in the prevalence and distribution of agenesis, although differences have failed to provide statistical significance.^{8,9}

Most studies conclude that prevalence of hypodontia is higher in females, disregarding ethnicity and geographic location, but only Nordgarten et al.¹³ and Sisman et al.¹⁵ found this difference to be statistically significant for some teeth. The mean number of congenitally missing teeth was higher in females (~2%) than in males

Table 2. DISTRIBUTION OF AFFECTED TEETH WITH AGENESIS

Area	No. of teeth	%	Affected tooth	No. of teeth	%	Side	No. of teeth
Maxilla	22	55*	Lateral incisors †	16	40‡	Right	7
				Left	9		
			Premolars †	6	15	Right	3
				Left	3		
Mandible	18	45*	Lateral incisors	6	15	Right	4
				Left	2		
			Premolars	9	23	Right	3
						Left	6
			Molars	3	7	Right	2
						Left	1
Total absent teeth				40			

A negative or inverse correlation was found between hypodontia in both jaws. Statistical significance at the 0.001 level demonstrated that agenesis was present either in the maxilla or the mandible. This could be related to differential genetic background that may cause tooth alterations. Mutations in transcription factors PAX9 and MSX1 have proved responsible for molar agenesis, and isolated incisor hypodontia is associated with mutations in TGFα.^{2,24-26}

Children with hypodontia may tend to have a poorer oral health-related quality of life, according to the results of Locker et al.³² Not only do they present with malocclusion and functional problems, but self esteem related with qualitative assessment of esthetics may also be affected, especially when anterior teeth are missing. Treatment planning that includes

tooth replacement and/or orthodontic space closure is a complex process that must consider the patient's overall characteristics.^{28,33} The esthetic significance of missing anterior teeth becomes obvious in the early mixed dentition, presenting a challenge for the interdisciplinary team²⁸ that must plan and perform treatment based on expected long-term stability of outcome, and must also consider the patient's and parents' views and concerns regarding their clinical condition. Further research emphasizing long-term results and cost-benefit analyses is needed.

Conclusions

1. The prevalence of hypodontia in the orthodontic group studied was approximately 4%, with the most affected tooth being the permanent maxillary lateral incisor, followed by the mandibular second premolar.



2. Symmetry was noted for hypodontia in the maxilla, while the left side was most affected in the mandible and an inverse correlation was found between hypodontia affecting the maxilla or the mandible.

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