A retrospective cross-sectional study on the prevalence of hypodontia in a target population of Al-Jouf Province, Saudi Arabia

Arbaz Sajjad, Samia Subhani Sajjad[1], Nadeem Husain[2], Ahmed Maashi Al-Enezi

Abstract

Aim: The purpose of this retrospective study was to determine the prevalence of hypodontia and to ascertain the need of interdisciplinary treatment for ensuing esthetic and functional problems in a target population of Al-Jouf Province, Saudi Arabia. **Subjects and Methods:** Using a dental administration software tool, a total of 1267 patients who presented to the outpatient clinics of the Orthodontic and Prosthodontic Departments between March 2015 and January 2016 were identified. Of those, 694 were females and 573 were males. All permanent teeth were investigated, except third molars. **Results:** The prevalence of hypodontia was 6.1%. The difference between genders was not statistically significant ($P = 0.597$) although female hypodontia prevalence was higher than males (6.6% and 5.5%, respectively). The majority of patients had one or two missing teeth. There were no significant differences between right and left sides for any particular tooth. The most commonly missing teeth were mandibular second premolar (40.1%), followed by the maxillary lateral incisor (20.4%) and then the maxillary second premolars (12.6%). **Conclusions:** The prevalence of hypodontia in Al-Jouf Province, Saudi Arabia, was within the average values portrayed in the majority of the published literature. The majority of affected individuals had one or two missing teeth. None of the patients examined had more than four missing teeth. There were no significant differences in the distribution of hypodontia between the affected jaws according to gender. Although less prevalent, considerable cases of bilateral missing teeth were found in the present study which necessitates the need for urgent interdisciplinary intervention and management.

Keywords: Dental agenesis, hypodontia, permanent dentition, prevalence

Introduction

The first step in assessing patient's oral health before undertaking any clinical procedure is to do an inventory of the number of teeth present. Congenitally missing teeth are defined as those teeth that fail to erupt in the oral cavity and remain invisible in a radiograph, which implies that this is caused by disturbances during the early stages of tooth development.[1]

Hypodontia, a commonly used term to describe the absence of one to six teeth, is one of the most common dental developmental anomalies in human. The absence of more than six teeth is called oligodontia.[2]

Background

The congenital absence of teeth results from disturbances during the initial stages of tooth formation: Initiation and proliferation. Missing teeth may occur in isolation or as part of a syndrome. Isolated cases of missing teeth can be familial or sporadic. Familial tooth agenesis is transmitted as an autosomal dominant, autosomal recessive, or X-linked genetic condition.[3,4] A multitude of gene mapping studies has been conducted to grasp an understanding of the genetic processes involved in tooth agenesis. Some studies identified "a familial autosomal dominant point mutation in the MSX1 gene" as a culprit in the second premolar and third molar agenesis.[5] In other studies, "mutations in PAX9 genes were identified in individuals with oligodontia, affecting mostly the molars, suggesting the importance of the expression of that gene for the formation of the dentition."[6]

Departments of Prosthodontics and ²Orthodontics, Al-Jouf Dental Center, King Abdulaziz Specialist Hospital, Ministry of Health, Al-Jouf, Saudi Arabia, ¹Dentics Cosmetic Dental Clinics, Hyderabad, Telangana, India

Correspondence: Dr. Arbaz Sajjad,
P.O Box #1978, Sakaka 42421, Al-Jouf, Kingdom of Saudi Arabia.
E-mail: baaz911@gmail.com

According to Bolk's theory of terminal reduction, reduction of the distal element of a tooth group occurs more often than in mesially placed teeth due to the phylogenetic evolution of humans.

Therefore, the teeth most often missing are the second premolars, the maxillary lateral incisors, and the third molars.[7] Interestingly, an alternative to the terminal reduction theory has been presented by Garn *et al*. and later also documented by Nuvvula *et al*.,[8,9] which show an association of third molar agenesis along with missing teeth from other classes of teeth. According to them, the association between third molar agenesis and reduction in the number of other teeth fits the hypothesis of a field of variable intensity, which, in its greatest degree of expression, eliminates all four third molar teeth and a maximum number of other teeth.

A recently published systematic review reporting on the prevalence of hypodontia among different populations and ethnic groups found that there was a significant difference in the prevalence of hypodontia by continent, with the highest prevalence rates found in the African continent (13.4%) and the lowest prevalence rates in Latin America and Caribbean (4.4%).[10]

Rationale
The treatment of patients with tooth agenesis is a complex and protracted process, that involves oral surgeons, orthodontists, and prosthodontists,[11,12] and an expensive affair that cost dearly to the patient and their families. Therefore, financial assistance and adequate treatment facilities should be extended toward such patients.[13] Hence, investigating the prevalence of tooth agenesis is of significant clinical value in terms of early diagnosis and effective treatment planning. A review of the literature found no published studies investigating the prevalence and distribution of hypodontia in Al-Jouf Province.

The aim of this study was to investigate the prevalence of hypodontia in Al-Jouf Province; Saudi Arabia, which serves a mainly rural population. To achieve this, records of patients who fulfilled the selection criteria were drawn from a pool of target patient population of Specialist Dental Center, Al-Jouf, and the data were collected and statistically analyzed.

Subjects and Methods

Study design and settings
This retrospective study examined the records of 1267 Saudi patients during (March 2015 – January 2016) at the Specialist Dental Center of Al-Jouf Province, Saudi Arabia. The study population was natives of urban and rural areas of Al-Jouf region who reported to the OPD clinic of the Orthodontic and Prosthodontic Departments. The sample size was calculated using *Z* statistics and Epi Info™ – StatCalc module based on known prevalence estimates from previously published literature.

This was primarily a descriptive, cross-sectional, prevalence study retrospective in nature. This study type allows us to get a "snapshot" of the pattern of prevalent teeth agenesis conditions across the population of Al-Jouf. It is also cheap and less time-consuming and less labor intensive.

A dental administration software tool (CS R4 Clinical+® by Carestream Dental LLC, Atlanta, GA, USA) was used to identify 1267 patients in the hospital database. The primary data consisted of the patient's medical history, the clinical oral status, and a digital panoramic radiograph. All permanent teeth, except third molars, were investigated using digital panoramic radiographs. A total of two observers were assigned to examine each digital panoramic radiograph. A tooth was recorded as congenitally missing when no trace could be found on the panoramic radiograph. Treatment records from the patient's files were checked to confirm that the tooth had not been extracted due to caries, periodontal disease, or trauma. Over a period of 1 month, the data were recorded. Data obtained from panoramic radiographs and patients' records were recorded according to gender, age, type and number of missing teeth, maxillary versus mandibular agenesis, right versus left side.

Selection of participants
Inclusion criteria
- Patients of Saudi Arabian origin
- No history of medical problem
- No history of any syndrome/developmental anomaly
- Presence of digital panoramic (full-mouth) radiograph with good quality
- Age between 9 and 30 years (delayed development of premolars can occur which leads to the uncertainty whether they are congenitally missing or not).

Exclusion criteria
- Nonnative origin
- Any syndrome
- Any history of systemic diseases, tooth extractions, trauma
- Poor image quality of panoramic radiographs.

Statistical methods
All descriptive and comparative analyses were performed using the Statistical Package for the Social Sciences (Version 20.0, SPSS Inc., Chicago, IL, USA). To test the difference between male and female patients, maxillary versus mandibular agenesis, right versus left side, and unilateral versus bilateral, Chi-square test was employed. The level of significance was set at $P < 0.05$.

Results

The final dataset comprised 1267 patients of Arabic origin, of which 1125 had no missing permanent teeth. The mean age at initial presentation for treatment was 16.77 years (standard deviation = 3.5 years). All patients below 9 years of age were excluded from the study. The age group associated with the greatest prevalence of hypodontia was 18 years, followed by 15 years [Table 1]. A total of 46 female and 32 male patients examined had hypodontia bringing the total to 78 patients. The female hypodontia prevalence was higher than males (6.6% and 5.5%, respectively) although difference between genders was not statistically significant. The overall prevalence was found to be 6.1% of the total sample population [Table 2].

In 78 patients, a total of 142 teeth were missing (87 in females [61.3%] and 55 in males [38.7%]). The average number of missing teeth per patient was 1.82% (females - 1.8%; males - 1.7%). Of all the examined patients, 63 had one to two missing teeth, 5 had three missing teeth, and 10 had 4 missing teeth. None of the patients examined had more than four missing teeth [Table 3]. Moreover; the prevalence of patients who had missing 1–2 teeth was significantly higher (4.9%) when compared to the prevalence of patients missing at least four teeth (0.8%).

The most commonly missing teeth were mandibular second premolar (38.8%), followed by maxillary lateral incisor (21.1%) and then the maxillary second premolars (15.4%) [Figure 1]. On the other hand, there were no significant differences between right and left sides for any particular tooth [Table 4]. Hypodontia in the maxilla was 59.1% and in the mandible was 40.9%. The difference was statistically significant ($P < 0.05$).

The prevalence rates of hypodontia in the maxilla and mandible were 5.7 and 5.5% ($n = 1267$ $P = 0.05$), respectively. The difference between hypodontia in the maxilla and the mandible in males was 5.5% and 4.1%, respectively, whereas in females, it was 5.7% and 6.6%, respectively, and no statistically significant difference was observed with $P > 0.05$ (Chi-square statistic = 1.533; $P = 0.464$). In males, there were no differences between the right and left sides, whereas in females, it was 5.9% and 6.4%, respectively. This difference was not statistically significant $P > 0.05$ (Chi-square statistic = 0.144; $P = 0.930$) [Table 5].

Discussion

The data for this retrospective study were based on residents of Al-Jouf region of Saudi Arabia seeking treatment at the Specialist Dental Center. Currently, there are no published studies investigating the prevalence and distribution of hypodontia in Al-Jouf Province.

Table 1: Distribution of hypodontia by age

Age	Number of cases with hypodontia	Prevalence (%)
9	3	3.8
11	3	3.8
12	1	1.3
13	6	7.7
14	5	6.4
15	11	14.1
16	10	12.8
17	6	7.7
18	13	16.7
19	8	10.3
20	4	5.1
21	2	2.6
23	4	5.1
24	1	1.3
30	1	1.3
Mean=16.77	SD=3.5	

Level of significance (*P*<0.05). SD: Standard deviation

Table 2: Distribution of hypodontia in the affected population by gender

Gender	Number of cases with hypodontia	Prevalence (%)	P
Male	32	5.5	0.597*
Female	46	6.6	
Total	78	6.1	

Level of significance (*P*<0.05)

Table 3: Distribution of numbers of missing teeth among patients with hypodontia

Number of missing teeth	Number of patients, *n* (%)	Female, *n* (%)	Male, *n* (%)
1	35 (2.7)	16 (1.2)	19 (1.5)
2	28 (2.2)	20 (1.6)	8 (0.6)
3	5 (0.4)	3 (0.2)	2 (0.1)
4	10 (0.8)	6 (0.5)	4 (0.3)

The Chi-square statistic is 5.604 (*P*=0.468)

Since orthodontic treatment is unavailable in most of the private dental clinics of Jouf, patients in need of interdisciplinary treatment are mostly referred to the Specialist Dental Centre. Therefore, no bias was expected in the selection of patients.

The aim of the current study was to investigate the occurrence of congenitally missing permanent teeth in patients referred to the Specialist Dental Center of Al-Jouf Province, Saudi Arabia, which serves a mainly rural population of 440,009 and growing. The minimum age of the selected
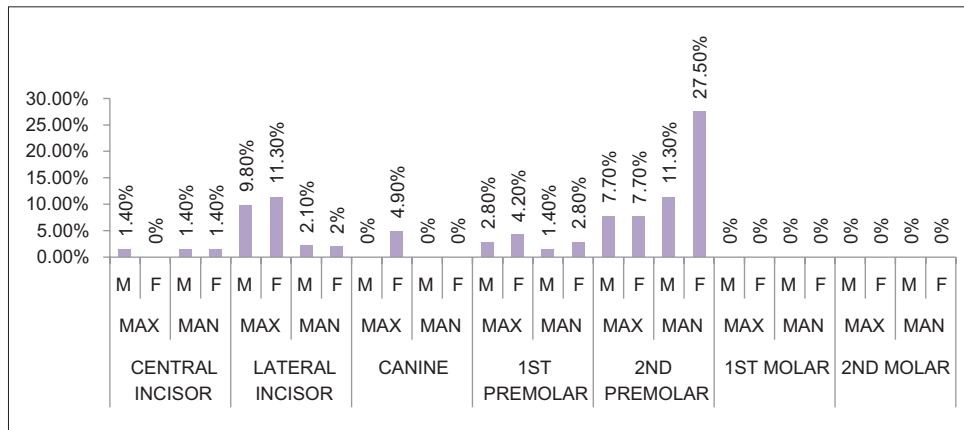
Figure 1: Frequency distribution (%) of the type of missing teeth according to arch and gender (*n* = 142). Max = Maxilla; Mand = Mandible; M = Male; F = Female

Table 4: Frequency of missing teeth in relation to right and left sides for a particular tooth in both arches

Mandible				Maxilla			
Left side		Right side		Left side		Right side	
Tooth#	*n* (%)	Tooth#	*n* (%)	Tooth#	*n* (%)	Tooth#	*n* (%)
31	2 (1.4)	41	2 (1.4)	21	1 (0.7)	11	1 (0.7)
32	4 (2.8)	42	1 (0.7)	22	15 (10.5)	12	15 (10.5)
33	0	43	0	23	4 (2.8)	13	3 (2.8)
34	3 (2.1)	44	3 (2.1)	24	5 (3.5)	14	5 (3.5)
35	28 (19.7)	45	27 (19.0)	25	11 (7.7)	15	11 (7.7)
36	0	46	0	26	0	16	0
37	0	47	0	27	0	17	0

Based on Chi-square test, significant difference between maxillary and mandibular arches. #The signification is *P*=0.0001

Table 5: Distribution of the number of missing teeth with respect to the affected jaws and sides

Affected jaw/side	Female, *n* (%)	Male, *n* (%)	Total, *n* (%)
Maxilla	40 (5.7)	32 (5.5)	72 (5.7)
Mandible	46 (6.6)	24 (4.1)	70 (5.5)
Right side	41 (5.9)	29 (5.0)	70 (5.5)
Left side	45 (6.4)	28 (4.8)	72 (5.7)

The Chi-square statistic is 1.679 (*P*=0.946)

patients was 9 years as it has been documented that in some individuals, delayed development of premolars take place, which leads to the uncertainty whether they are congenitally missing or not. Wisth *et al.*,[14] who found that this uncertainty could be resolved when recruiting individuals at 9 years; thus, the probability of a false-positive diagnosis of missing teeth due to tooth buds with a late onset of mineralization was negligible.

The findings of this study were in line with other populations within the Gulf region.[10,15] The general prevalence of hypodontia in females (6.6%) and males was (5.5%), but the difference was not statistically significant (*P* > 0.005).

The higher prevalence of hypodontia in female patients could be attributed to biological factors.[5,16] Furthermore, the fact that females are more conscious about their looks and esthetics whereas rural males tend to ignore it and as such are not too keen to seek treatment due to particular cultural and traditional mindset cannot be ruled out. However, the literature does not confirm this as some studies on orthodontic patients showed a higher prevalence in females,[16-18] whereas others did not find any such difference,[19] and some studies even reported greater prevalence rates in male orthodontic patients.[20-22]

The average number of missing teeth for each patient was 1.82%. Almost 81% of affected patients had one or two missing teeth. This is in agreement with other populations within the same region.[15] Al-Emran *et al.*[23] found that hypodontia prevalence among the Saudi male school children was 4% whereas Afify and Zawawi[24] have reported a very high prevalence (25.7%) of congenitally missing teeth in the western region of Saudi Arabia. Almost 20% of affected patients had at least 3–4 missing teeth and this fact alone represents a clinical dilemma with respect to management of the ensuing functional and esthetic problems.

The most frequently missing tooth was the mandibular second premolar (40.1%), followed by the maxillary lateral incisor (20.4%) and then the maxillary second premolars (12.6%). This finding is consistent with other previously reported data and is in agreement with the general consensus that the most distal tooth of any particular type is the most likely to be affected.[15,22] However, in some studies, the most distal tooth agenesis (i.e., third molar agenesis) is also associated with missing teeth from other classes of teeth.[8] In contrast, Nuvvula *et al.*[9] documented a rare case which they claim has never been reported in the literature showing agenesis of three third molars and the mandibular central incisors along with the presence of a midline supernumerary tooth (hypohyperdontia) whereas several studies found that the most frequently missing tooth is the maxillary lateral incisor.[25,26] Others reported that mandibular lateral incisor is the most commonly affected tooth, particularly among Asians.[20] These differences could be due to ethnicity or the result of recruiting patients from clinical settings which were different from the general population. For example, missing maxillary lateral incisor could be more frequently found in orthodontic patients than in the general population.[27]

The concern that the results could have been influenced by a couple of confounding variables was addressed. One was that more females sought to attend the outpatient clinics than males, and the other concerned the generalizability of the findings as most of the patient records were drawn from the Orthodontic and Prosthodontic Departments. Investigating the prevalence from general population will result in more realistic results.

In the present investigation of hypodontia among orthodontic and prosthodontic patients, it was found that the frequency of missing teeth according to site and gender corresponded to known population indices of hypodontia.

A multidisciplinary team of orthodontists, prosthodontists, and oral surgeons with a relevant background in the management of patients with dental agenesis along with acceptable treatment protocols must, therefore, be established in Al-Jouf region. There is a great need for an ecological, epidemiological study that would shed more light on the population traits and possible geographic variation of hypodontia in this region.

Conclusion

The prevalence of hypodontia in a target population of Al-Jouf province was 6.1%, which was found to be in line with the findings of most of the published population studies. The most commonly missing teeth were mandibular second premolars, followed by maxillary lateral incisors. The majority of affected individuals had one or two missing teeth. None of the patients examined had more than four missing teeth.

There were no significant differences in the distribution of hypodontia between the affected jaws according to gender.

Conflicts of interest
There are no conflicts of interest.

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