



ORIGINAL ARTICLE

# Maxillary lateral incisor agenesis; a retrospective cross-sectional study



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## KEYWORDS

Tooth agenesis;  
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**Abstract Objective:** This study aims to estimate the prevalence of congenitally missing lateral incisors in a sample of 2662 dental patients in Palestine.

**Methods:** A total of 2662 digital panoramic radiographs were retrospectively examined for the presence of congenitally missing permanent lateral incisors. The radiographs were obtained from the archival records of patients attending a local dental center at the city of Nablus in Palestine.

**Results:** The prevalence of missing lateral incisors among the examined population (n = 2662) was found to be 1.91%. Unilateral agenesis accounted for 66.6% of the total cases that showed at least one missing lateral incisor. Around 79% of the unilateral cases were on the left side while 21% were on the right side. Bilateral agenesis accounted for 33.3% of 34 cases that had at least one congenitally missing permanent maxillary lateral incisor.

**Conclusion:** The prevalence of missing maxillary lateral incisors in this study population was 1.91% which was within the range reported in different populations.

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## 1. Introduction

Dental agenesis is a common developmental anomaly in humans (Altug-Atac and Erdem, 2007; De Coster et al., 2008; Goya et al., 2008). Tooth agenesis refers to the developmental failure of a tooth and could be classified into anodontia or partial anodontia (Al-Ani et al., 2017; Rakhshan, 2015).

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Anodontia is the total absence of tooth development in primary, permanent or both dentitions. Partial anodontia is the lack of development and absence of one or more teeth. Partial hypodontia may be further subdivided into oligodontia which is the congenital absence of six or more teeth (third molars are not included) and hypodontia which is the congenital absence of fewer than six teeth (third molars are not included) (Hasiyiqin et al., 2017). Hypodontia is the most common form of tooth agenesis (Goya et al., 2008; Shimizu and Maeda, 2009). Prevalence of hypodontia varies between different ethnic groups from 2.8% to 11.3%, depending on the on the population studied (Shimizu and Maeda, 2009). It is more frequently observed in permanent dentition than in deciduous dentition with more frequency for the upper arch than the lower arch with the unilateral occurrence of agenesis being

more common than the bilateral (Polder et al., 2004). The most common teeth reported missing varies among different ethnicities. The maxillary lateral incisor was reported to be the most common in the Malaysian (Mani et al., 2014), Turkish (Altug-Atac and Erdem, 2007), Romanian (Bernadette et al., 2013), Mexican (Ledesma-Montes et al., 2016), Pakistani (Batool and Ahmed, 2016) and American (Muller et al., 1970) populations, while the mandibular second premolars were the most common in the Indian (Ajami et al., 2010) and European (Polder et al., 2004) populations. However, a higher incidence of missing mandibular incisors is observed in Chinese (Davis, 1987) Korean (Chung et al., 2008), and Japanese (Endo et al., 2006) populations than in Caucasian populations.

Tooth agenesis may occur in the form of an isolated familial or sporadic anomaly or in association with other genetic diseases like Cleft lip/palate, Down syndrome, Van der Woude syndrome, Ectodermal dysplasia, Hypohidrotic dysplasia, Incontinentia pigment, Witkop syndrome, Rieger syndrome, Holoprosencephaly (Shimizu and Maeda, 2009). In non-syndromic agenesis, gene mutations are said to be the cause. The mutations in genes responsible for tooth development are marked as PAX9, MSX1, and AXIN2 (Bailleul-Forestier et al., 2008; De Coster et al., 2008). In a case-control study of 306 unrelated Portuguese individuals, single nucleotide polymorphisms in the PAX9 gene were associated with a high risk of maxillary lateral incisor agenesis (Alves-Ferreira et al., 2014).

Congenitally missing lateral incisors whether unilateral or bilateral may affect the self-esteem and social relationships of the affected individual. Congenitally missing lateral incisors may cause a variety of esthetic and functional problems; their absence may cause a diastema between the central incisors, spacing between permanent incisor and canine, mesial migration of canines, midline shift in case of a unilateral missing tooth. Moreover, the treatment of congenitally missing lateral incisors is a complex and challenging process, which demands the interaction of several dental specialties.

Many studies evaluated the prevalence of congenitally missing lateral incisors among various populations and reported various results. The aim of this study was to estimate the frequency of congenitally missing lateral incisors among the general population attending a dental center in the city of Nablus. Given the scarcity of research about tooth agenesis among Palestinians, such study is needed. The knowledge gained from this study will assist dental practitioners to better understand tooth agenesis and design treatment plans that address the esthetic and functional needs of affected individuals and to improve quality of the provided treatment outcomes.

## 2. Materials and Methods

This is a retrospective, descriptive, cross-sectional study of 2662 digital panoramic radiographs. The radiographs were obtained from the archival records of the patients attending the Basma private dental center from the year 2013–2016. These radiographs were examined to reveal evidence of congenitally missing permanent maxillary lateral incisors. The inclusion criteria involved high quality radiographs of patients that were 15 years of age and above as by this time all the permanent teeth would have erupted. The exclusion criteria were the following; patients with any systemic anomaly, ectodermal

dysplasia, cleft lip/palate, Down's syndrome and a history of previous orthodontic treatment, extraction of a tooth due to trauma, periodontal or pathological reasons. Ambiguous radiographs of subjects with no proper record of date of birth and poor quality image were excluded. The radiographs were taken using Carestream 8100 digital x-ray machine and images were processed with its software. The panoramic images were examined by two experienced examiners in a standardized manner under good lighting conditions, standardized screen brightness and resolution. The absence of a tooth was considered congenital, if it did not show up on the radiograph, and anamnestic data confirmed that the tooth was not extracted or lost by trauma. Ethical approval for the study was obtained from the IRB committee at the faculty of dentistry in The Arab American University-Palestine (2017/April/C/1). Data were processed and analyzed using IBM SPSS Statistics V. 22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). The chi-square test was used to reveal any differences in the distribution of lateral incisor agenesis when stratified by gender, location (left or right), and being unilateral or bilateral. A p-value of  $< .05$  was considered statistically significant.

## 3. Results

Of the 2662 patients, 1410 were males (53%) and 1252 were females (47%) (Table 1); the mean age was 33 years, ranging from 15 to 65 years. A total of 51 cases with at least one missing permanent lateral incisor were found, 27 (52.9%) were females and 24 (47.1%) were in males (Table 2). The prevalence of missing lateral incisors in males was 1.7% and in females was 2.1%. Chi-square test revealed no significant association between gender and maxillary lateral incisor agenesis ( $P > .05$ ) (Table 3). The prevalence for missing maxillary lateral incisors in all the cases was 1.91% (Table 2). Bilateral agenesis occurred in 33.3% of the affected cases, being less common than those that displayed unilateral agenesis (66%). Non-parametric chi-square test reveals that unilateral agenesis is significantly ( $P < .05$ ) higher compared to bilateral agenesis (Table 4). Twenty-seven cases (1.01%) or (79.4% out of the 34 cases that had unilateral impaction) were on the left side of the

**Table 1** Gender distribution of the sample population.

Gender	No.	%
Male	1410	53
Female	1252	47
Total	2662	100

**Table 2** Association between agenesis and gender.

	Normal	Impacted	Total	p-value
	n (%)	n (%)	n (%)	
<i>Gender</i>				
Male	1386 (98.2)	24 (1.7)	1410 (100)	.393
Female	1225 (97.8)	27 (2.1)	1252 (100)	
Total	2611 (98.09)	51 (1.91)	2662 (100)	

**Table 3** Association between missing lateral incisor side and gender.

	Right	Left	Bilateral	Total	
	n (%)	n (%)	n (%)	n (%)	p-value
<i>Gender</i>					
Male	4 (17.4)	13 (56.5)	6 (26.08)	23 (100)	.582
Female	3 (10.7)	14 (50)	11 (39.2)	28 (100)	
Total	7 (13.7)	27 (52.9)	17 (33.3)	51 (100)	

**Table 4** Prevalence of unilateral and bilateral missing laterals.

	n (Prevalence%)	p-value
Unilateral	34 (1.277)	.017
Bilateral	17 (0.638)	
Total	51 (1.91)	

**Table 5** Prevalence of right and left missing laterals.

	n (Prevalence%)	p-value
Right	7 (0.26)	.001
Left	27 (1.01)	
Total	34 (1.277)	

maxillary arch, while the other 7 cases (0.26%) or (20.6% of the 34 cases) were on the right side. Non-parametric chi-square test revealed significant ( $P < .05$ ) difference in the prevalence of right or left maxillary lateral incisor agenesis (Table 5).

#### 4. Discussion

Various studies assessed the prevalence of congenitally missing teeth among different study populations. The prevalence of missing maxillary lateral incisors in our study was 1.91% which falls within the range 0.79% to 2.6% reported by other studies. [Batool and Ahmed \(2016\)](#), studied the frequency of missing maxillary lateral incisors, they examined 364 patients attending a dental hospital in Islamabad in Pakistan. They reported that 1.6% of the study population had congenitally missing Permanent maxillary lateral incisors. [Mani et al. \(2014\)](#) retrospectively assessed the prevalence and patterns of tooth agenesis from orthopantomograms of 834 healthy Malay children aged 12–16 years who attended the Dental Clinic of Universiti Sains Malaysia. They reported the prevalence of missing upper lateral incisors to be 1.7%. [Pinho et al. \(2005\)](#), investigated the panoramic radiographs of 16,771 Portuguese dental patients and reported that 219 (1.3%) were found to have missing upper lateral incisors. Another study in Portugal ([Coelho et al., 2012](#)) assessed the prevalence of hypodontia through the analysis of panoramic radiographs of 1438 patients of the Faculty of Dentistry of the University of Oporto (714 boys and 724 girls between the ages of 6 and 15). The findings of the study reveal that the 2.92% of the study population had at least one missing permanent maxillary lateral incisor. A study in Turkey investigated the panoramic

radiographs of 2722 patients retrospectively to determine the prevalence and distribution of the hypodontia, oligodontia, and hyperdontia. The study reported that the prevalence of missing maxillary lateral incisors was 2.27% ([Karadas et al., 2014](#)). [Albashaireh and Khader \(2006\)](#) who conducted a retrospective investigation on 1045 panoramic x-rays of patients who had attended for treatment at the faculty of Dentistry at Jordan University of Science and Technology. Furthermore, [Hashim and Al-Said \(2016\)](#) retrospectively investigated congenitally missing permanent lateral incisors in the records of 1000 Qatari patients attending a dental center at Rumaila hospital in Qatar. They found that 2.6% of the study population had at least one missing lateral incisor. A study in Greece ([Delli et al., 2013](#)) assessed the panoramic radiographs of 1745 military male students (mean age:  $18.6 \pm 0.52$  years) who attended the Center for Aviation Medicine of the Armed Forces of Greece during the period 1997–2011 for maxillary lateral incisors agenesis. The study reported the incidence of 1.3% in the investigated population. In Australia, [Stamatiou and Symons \(1991\)](#) studied the agenesis of the permanent lateral incisors among 5127 patients. They reported that the frequency of absent lateral incisors in the maxilla was 2%. [Kabbani et al. \(2017\)](#) examined 8000 Syrian school children (age range 12–15 years) to identify those affected by bilateral or unilateral congenital absence of maxillary lateral incisors. They reported that the prevalence of isolated maxillary lateral incisors agenesis was 1.15%. a meta-analysis of ten studies, including 48,274 subjects found that the prevalence of missing maxillary lateral incisors is 1.55–1.78 (95% CI) ([Polder et al., 2004](#)).

The distribution of missing permanent maxillary lateral incisors in the percentage of all missing teeth has been also reported as part of studies investigating the prevalence of hypodontia among various populations (Table 6).

The different results from all the previous studies may arise from racial differences and differences in the methodology of the study including sample selection and the age of the subject involved in the study.

Prevalence of missing maxillary lateral incisors among females was 2.1% and 1.7% among males. There was no significant association between gender and lateral incisor agenesis ( $P < 0.05$ ) which is in agreement with other studies. [Batool and Ahmed \(2016\)](#), [Mani et al. \(2014\)](#). Yet, [Pinho et al. \(2005\)](#) reported that females were more frequently affected ([Pinho et al., 2005](#)). The present study shows that 66.6% of the cases that were with at least one missing lateral incisor were unilateral while 33.3% of cases were bilateral. Unilateral agenesis was significantly higher than bilateral cases which is consistent with results obtained by other studies reporting that the majority of maxillary lateral incisor agenesis occur unilaterally ([Delli et al., 2013](#); [Pinho et al., 2005](#)). Nevertheless, other studies reported that bilateral agenesis is more common than unilateral ([Coelho et al., 2012](#); [Mani et al., 2014](#); [Stamatiou and Symons, 1991](#)) and sometimes equal in distribution ([Batool and Ahmed, 2016](#); [Hashim and Al-Said, 2016](#)). Seven cases had missing lateral incisors on the right side of the maxillary arch, whereas 27 cases were on the left side. A significant difference ( $P < .05$ ) was indicated in the prevalence of right or left agenesis. These findings were consistent with studies done on Pakistani and Qatari populations ([Batool and Ahmed, 2016](#); [Hashim and Al-Said, 2016](#)). However, right side agenesis was reported [Pinho et al.](#) to be more common than left side

**Table 6** Distribution of missing lateral incisors in % of the total missing teeth.

Study	Country	Sample size	Affected people	Total missing teeth	Missing laterals (% of the total missing teeth)
Cantekin (Cantekin et al., 2012)	Turkey	1291	80	135	21 (15.5)
Affan (Abu Affan and Serour, 2014)	Sudan	2401	64	100	19 (19)
Bernadette (Bernadette et al., 2013)	Romania	947		136	60 (44.1)
Ajami (Ajami et al., 2010)	India	600	54	94	25 (26.6)
Nordgarden (Nordgarden et al., 2002)	Norway	9532	430	774	154 (19.9)
Rolling (Rølling and Poulsen, 2009)	Denmark	8138	601	1070	212 (19.8)
Aktan (Aktan et al., 2010)	Turkey	100,577	1471	3147	1202 (38.2)
Behr (Behr et al., 2011)	Germany	1353	171	693	103 (14.9)
Al-Moherat (Al-Moherat et al., 2009)	Jordan	1726	123	197	88 (44.5)

agenesis (Pinho et al., 2005). The different results may again be attributed to the racial differences and differences in the methodology of the study.

Numerous studies evaluated the prevalence of hypodontia in orthodontic patients (Altug-Atac and Erdem, 2007; Behr et al., 2011; Endo et al., 2006; Gomes et al., 2010). The present study analyzed the prevalence of lateral incisor agenesis in a large sample of non-orthodontic subjects. The nature of the examined subjects usually influences prevalence rates of the examined anomalies. The prevalence reported by this study falls short of the published data from studies on tooth agenesis in orthodontic populations. Higher prevalence rates have been reported in the latter because patients with hypodontia are usually more motivated to seek orthodontic treatment to restore their dental and/or facial aesthetics (Al-Moherat et al., 2009; Altug-Atac and Erdem, 2007; Behr et al., 2011; Durrani et al., 2010; Endo et al., 2006; Gomes et al., 2010).

The definitive treatment may include either the orthodontic closing of spaces of missing teeth followed by reshaping the canine (canine substitution) or opening these spaces and preparing adjacent teeth for fixed or removable prosthesis. However, dental implants might be a more appropriate treatment option after opening the space of missing teeth by orthodontics because they do not require preparing the adjacent teeth for fixed or removable prosthesis. However, the decision to open lateral incisor spaces for prosthetics or close spaces by mesial movement of the canines requires a careful diagnosis and comprehensive multidisciplinary treatment planning. The successful management of impacted maxillary canines requires close cooperation of an orthodontist, an oral surgeon, a radiologist a periodontist and a prosthodontist (Pinho, 2011).

Patients with congenitally missing maxillary lateral incisors have a significant tendency to develop skeletal Class III. Chung et al. (2008) studied a sample of 1622 Korean subjects and found that, compared with Classes I or II, hypodontia was more predominant in Class III subjects. Bassiouny et al. (2016). found that subjects with missing lateral incisors show a significantly higher prevalence of skeletal Class III than controls as shown in the cephalometric readings related to the sagittal relationship of the maxilla and mandible due to maxillary deficiency (Bassiouny et al., 2016). Nonetheless, most patients with severe skeletal Class III malocclusion are candidates for orthognathic surgery in adulthood. In partnership with a maxillofacial surgeon, three treatment options can be proposed to the Class III subjects with missing lateral incisors (Cozzani et al., 2011). The first would involve closing the

spaces left by the congenitally missing teeth before bimaxillary surgery. This choice would also require restoration of the maxillary canines to resemble lateral incisors and the first premolars to simulate canines Another option involves orthodontic treatment of the maxillary and mandibular arches, reopening of the maxillary lateral incisor space, and surgical treatment to correct the vertical and sagittal skeletal discrepancies. This option would also include replacing the missing maxillary lateral incisors with two dental implants. Although this solution would produce Class I molar and canine relationships on both sides, the gingival contour and margin levels would be critical and difficult to control in the long term. The third choice is nonsurgical orthodontic treatment. This option would involve extraction of the mandibular first premolars and replacement of the missing maxillary lateral incisors with 2 dental implants. The premolar extractions and opening of the lateral incisor spaces would permit resolution of the anterior crossbite and achieve an occlusal compromise. However, neither facial esthetics, skeletal asymmetry, nor the transverse discrepancy would be improved. This treatment option is usually considered for adult patients where no growth is expected.

The general dental practitioner should have an idea of the prevalence of dental anomalies among the population he or she is dealing with in dental offices. A knowledge of the pattern and prevalence of tooth agenesis is important for treatment planning. If properly and timely done, an interdisciplinary treatment might prevent the patient from esthetic and functional discrepancies that may interfere with adequate development and growth that may cause functional, occlusal and esthetic disharmony.

This study provides useful information and statistics regarding lateral incisor agenesis and helps dental professionals learn more about the prevalence of maxillary lateral incisor agenesis and emphasizes the importance of early diagnosis and referral to reduce or prevent a number of complications that may affect function and aesthetics.

Still, this study has limitations as it is a retrospective study, and the sample size was small and only representative of the patient pool at one dental imaging center. Wider population groups should be studied in Palestine in order to draw more representative results.

## 5. Conclusion

The prevalence of congenitally missing lateral incisors was 1.91% and there was no significant difference the prevalence

among male and females. Agenesis occurred more unilaterally than bilaterally. Unfortunately, the etiology of maxillary lateral incisor agenesis has never been investigated in the Palestinian population. Future studies are needed to evaluate the etiology of hypodontia and tooth agenesis in Palestine.

### Conflict of interest

The authors declared that there is no conflict of interest.

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