SEBHA UNIVERSITY JOURNAL OF MEDICAL SCIENCES VOL.19 NO. 1 2024
DOI: 10.51984/JOMS.V19I1.2609

مجلة جامعة سبها للعلوم الطبية
Sebha University Journal of Medical Sciences

Journal homepage: www.sebhau.edu.ly/journal/joms

Frequency and characteristics of tooth agenesis among Sirte orthodontic patients in Libya

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Keywords:
Dental agenesis.
Libyan
Congenital tooth missing
Orthopantomography

ABSTRACT

In dental practice, it is common to see patients who have one or more teeth that are developmentally absent. Significant functional, cosmetic, and psychosocial issues are linked to tooth agenesis. Dental agenesis is a crucial problem that has not received enough attention in Libyan research. Because the management calls for a multidisciplinary approach, it is significant from an academic and clinical standpoint to shed some light on this anomaly. There has been a recent emphasis on the need to identify research gaps in this sector and support the scientific community by conducting studies on the genetic origins of tooth agenesis and tumor development. The occurrence and characteristics involved in tooth agenesis in Sirte orthodontic patients are summarized in this article. Appropriate planning and management may be difficult, and patient care will probably necessitate multidisciplinary and interdisciplinary involvement. However, prompt diagnosis can help. Dental professionals must possess a thorough understanding of tooth agenesis's clinical features and available treatments. Non-syndromic tooth agenesis has been occasionally described in literature and data available for its prevalence is rare in Libya. This retrospective radiography study's objective was to gather information on the frequency and pattern of non-syndromic congenital teeth missing in orthodontic patients. The data for this study were chosen from 500 consecutive orthodontic patients who matched the inclusion criteria. The radiographic data had at least one orthopantomogram (OPG) of clear, sufficient quality, which was complemented with periapical radiographs as needed. From statistical analysis a prevalence of 3.8 percent hypodontia was seen in the sample. It was determined that the frequency of hypodontia in the Sirte orthodontic population of Libya is 3.8%, which is within the range globally. However, to precisely estimate the prevalence of hypodontia, more research needs be done on a larger non-orthodontic population. The current study's objective was to establish baseline data by determining the characteristics of congenital absence of the permanent teeth in Sirte, Libya.

الفقدان الخلقي للأسنان الدائمة عندمرضى التقويم الليبيين

افطيمة لامين درباش

قسم تقويم الأسنان وطب أسنان الأطفال وطب الأسنان الوقائي. كلية طب الأسنان. جامعة سرت. سرت. ليبيا

الكلمات المفتاحية:
الأسنان المفقودة الخلقية
عدم تكوّن الأسنان
ليبيا
صورة بانورامية للأسنان

الملخص

في ممارسة طب الأسنان، من الشائع أن نرى مرضى لديهم سن أو أكثر غائبة عن النمو. عدم تكوّن الأسنان يؤدي الى مشكلات وظيفية وتجميلية ونفسية اجتماعية كبيرة. يعد عدم تكوّن الأسنان مشكلة بالغة الأهمية لم تحظ باهتمام كافٍ في البحث الليبي. ولأن االعلاج يدعو إلى نهج متعدد التخصصات، فمن المهم من وجهة نظر أكاديمية وسريرية إلقاء بعض الضوء على هذه الشذوذ. كان هناك تأكيد مؤخرًا على الحاجة إلى تحديد فجوات البحث في هذا القطاع ودعم المجتمع العلمي من خلال إجراء دراسات حول الأصول الجينية لعدم تكوّن الأسنان وتطور الورم. تدرس هذه الدراسة حدوث وخصائص عدم تكوّن الأسنان لدى مرضى تقويم الأسنان في سرت. و الدراسات جول حالة عدم تكوّن الأسنان غير المتلازمية ، والبيانات المتاحة عن انتشارها في ليبيا نادرة . كان الهدف من هذه الدراسة الاستراجعية لصور اشعة المرضى هو جمع معلومات عن تواتر ونمط فقدان الأسنان الخلقية غير المتلازمية لدى مرضى تقويم الأسنان. تم اختيار بيانات هذه الدراسة من 500 مريض تقويم أسنان الذين انطبقت عليهم معايير الإدراج. البيانات الشعاعية تحتوي على صورة بانورامية واحد على الأقل واضح وبجودة

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Article History : Received 11 September 2024 - Received in revised form 23 December 2024 - Accepted 27 December 2024

كافية ودعمها بصور اشعة جول الذروة حسب الحاجة . من التحليل الإحصائي، لوحظ انتشار نقص الأسنان بنسبة 3.8 في المائة في العينة. وقد تم تحديد أن معدل نقص الأسنان في حالات النقويم في سرت هو 3.8٪، وهو ضمن النطاق العالمي. ومع ذلك، لتقدير معدل انتشار نقص الأسنان بدقة، هناك حاجة إلى إجراء المزيد من الأبحاث على عدد أكبر من السكان (عير حالات التغويم)

1. Introduction:

One of the most typical diseases influencing human tooth development is teeth agenesis **(Arai K, 2019)**, often known as congenital absence of teeth (Hypodontia). Depending on race, the evidence indicates that hypodontia is more prevalent in some people than others. from 2.63% to 11.2%. **(Polder *et al.*, 2004, Altug-Atac *et al*.,2007, O'Dowling and McNamara 1990, Chung *et al.*, 2008 and Schonberger *et al.*, 2022).** Any circumstance in which one or more teeth are absent because they never developed is known as dental agenesis. Agenesis of wisdom teeth are most frequent **(Sanchez *et al.*, 2009).** A congenitally absent tooth is one that has not emerged into the mouth cavity and is not discernible on a radiograph **(Nuvvula *et al*., 2010).**

Insufficient attention has been paid to dental agenesis, a critical issue in Libyan research. It is important from an academic and clinical perspective because management necessitates a multidisciplinary approach. It is not uncommon for dentists to see people who are missing one or more teeth from their development, and early adolescent diagnosis allows for more efficient management of congenitally missing tooth issues. Dentists should be aware of these specific incisor/premolar phenomena, regardless of biological gender **(Tunis *et al.*, 2021).**

Tooth agenesis has significant functional, cosmetic, and emotional implications **(Gökkaya *et al.*, 2015),** a young person who has congenital tooth loss may experience severe physical and mental effects, especially if the absent tooth is unluckily located near the front of the mouth **(Sisman, 2007).** In terms of presentation and treatment planning, young people with hypodontia seem to experience negative psychosocial effects **(Johal *et al.*, 2021).** According to a recent meta-analysis, 6.4% of people worldwide have hypodontia **(Khalaf *et al.*, 2014),** it is unclear exactly what causes hypodontia. It is widely acknowledged that a complex etiology involving genetic, epigenetic, and environmental variables is at play, even though several explanations have been put out **(Meade *et al.*, 2023 and Brook, 2009).**

A medical syndrome or a condition may cause tooth agenesis, which can also happen on its own or as a sign of another. Across affected family members, there are substantial differences in the number, symmetry, and positioning of the affected teeth **(Li S *et al*., 2008).** Individuals with dental agenesis typically have a delay in the development and growth of their teeth, according to some analyzed research. The magnitude of the developmental delay depends on how severe this congenital dental missing tooth is **(Ruiz- Mealin *et al.*, 2012).** For the early diagnosis of congenitally absent teeth, clinical examination is advised between the ages of 3 and 4 years during the primary dentition stage and 12 to 14 years during the permanent dentition **(Forestier *et al*., 2008).** It is advised to exclude children 12 years of age or below because this issue almost completely goes away after that age **(Rakhshan & Rakhshan., 2016).** A disorder known as tooth agenesis describes the absence of teeth because of a developmental issue. Depending on the degree, this aberration can be categorized as either hypodontia, oligodontia, or anodontia. Hypodontia is defined as the developmental absence of one to five teeth, whereas oligodontia is the agenesis of six or more teeth **(Gill & Barker, 2015),** while Anodontia occurs when all teeth fail to develop **(Al-Ani *et al.*, 2017).** The most frequent dental anomaly, occurring 20–30% of the time, is tooth agenesis. While some teeth are congenitally missing more commonly than others, not all teeth are equally impacted **(Dali *et al*., 2012).**

Unilateral congenital missing is more common than bilateral, and females have a 1.37-times higher incidence of dental agenesis than males do **(Polder *et al.*, 2004).** The most common missing teeth (apart from third molars) are permanent mandibular second premolars, followed by maxillary lateral incisors and second premolars **(Qutub *et al.*, 2021).** The most common tooth kinds that go missing vary depending on the community investigated, and females are 3:2 more likely than males to experience dental agenesis than vice versa **(Polder *et al.*, 2004).** In around 80% of affected patients, the etiology of non-syndromic tooth agenesis (NSTA) is related to mutation of genes involved in craniofacial and dental development **(Hennekam, 2010).** Certain genetic, epigenetic, and/or environmental elements play a role in the creation of the complete dentition, which frequently results in distinct tooth agenesis phenotypes when this process is interrupted **(Gkantidis *et al.*, 2017).** Byahatti and Ingafou (2012) estimated that 5% of third molars in Libyan students were congenitally missing. All four third molars were present in 93.5 percent of the persons in the study sample with dental agenesis, three third molars were present in 2.5 percent, two third molars were present in 1 percent, and one third molar was present in 0.5 percent of the participants. However, 2.5% of people were missing all four of their third molars. In third molar agenesis, three percent more females than males showed a predilection for the maxilla (2.1 per cent) **(Byahatti & Inghafou, 2012).** While third molar agenesis was studies by Byahatti and Ingafou (2012), other common dental agenesis was not studied according to the author's knowledge hence this study was conducted to:

This study's objectives:

1- To look at the frequency of tooth agenesis in the Libyan orthodontic patients other than third molar.
2- Investigate gender differences in dental development in the studied groups.
3- To assessing the characteristics of permanent dentition hypodontia in Libya to establish baseline data.

No clinical practice recommendations or standards of care exist for the management of non-syndromic tooth agenesis (NSTA). For cases of congenitally missing teeth, treatment options include maintaining primary teeth, closing, and maintaining orthodontic spaces, restoring with composite or fixed bridge, tooth transplantation, dental implants, or redistributing orthodontic spaces to make the prosthetic treatment more convenient. **(Hobson *et al*, 2003)**

To determine the frequency of hypodontia in Libya, no investigation has yet been done according to author knowledge.

2. Materials and Methods:

Study design: Cross-sectional retrospective study.

A retrospective analysis of all available orthopantomograms (OPGs) was done, Libyan orthodontic patients aged 14 to 20 years (Mean age 17 years) with no other associated medical problems were selected, and cases with cleft palate or cleft lip were not included, those having unclear OPGs, poor-quality images, or no appropriate documentation of their date of birth were not included. Images, which are accessible in the digital format, are seen on a computer monitor, older OPGs, which were available as X-ray films, were examined on a negatoscope in a dark room. All teeth, excluding third molars, were inspected on the X-rays to see if they were present in each quadrant. If there was proof of crypt development with or without calcification of the crown, the teeth were considered, and vice versa. Teeth lost because of dental caries or orthodontic treatment were compared to clinic dental records and deemed to be "not missing." In situations where there was doubt, the author looked at the OPG to determine which tooth was most likely missing.

Inclusion criteria include:

- Orthodontic patients aged 14 to 20 years.
- Medically free patients.

Exclusion criteria include:

- Cases with cleft palate or cleft lip and associated other medical conditions.
- Unclear OPGs, poor quality images.

In this study, hypodontia was clinically defined as the lack of one to five teeth throughout development, excluding third molars

(Hennekam *et al.*, 2010). The OPGs of the selected patients were collected and analyzed between July 2022 and October 2022, and the required information was recorded in a database including patient name, age, sex, presence of systemic disease. The records of 500 consecutive patients who satisfied the inclusion requirements were chosen from the private dental clinics. The radiographic data had at least one orthopantomogram (OPG) of clear, sufficient quality, which was complemented with periapical radiographs as needed. A tooth was regarded as being absent when it was not possible to identify in the x- ray. SPSS was used to do statistical analysis (SPSS, Chicaco, IL). The chi square test was used to compare group differences after descriptive data were calculated.

3. Results:

The prevalence of agenesis in the permanent dentition among the population under study was 3.8%, third molars excluded (Figure 1). Out of the 19 cases of agenesis, 68% of cases had missing maxillary lateral incisors only, and 32% had missing mandibular second premolar. Of the 13 cases of missing lateral incisors, 46% had unilateral congenital missing lateral incisors and 54% bilateral missing. While for the missing second premolars, had an equal unilateral and bilateral distribution (Figure 2).

The maxillary lateral incisors' bilateral agenesis was more common than their unilateral counterpart. There were no differences in second premolar agenesis. A majority (77%) of missing upper lateral incisors was found in female, and 23% in male cases. For second premolar agenesis, 83% of cases were female, and 17% were male (Figures 3-5).

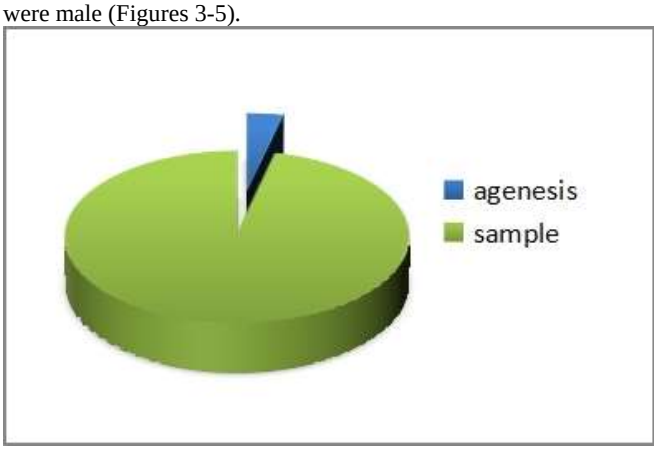

Fig.1. Prevalence (3.8%) of teeth agenesis among the study population.

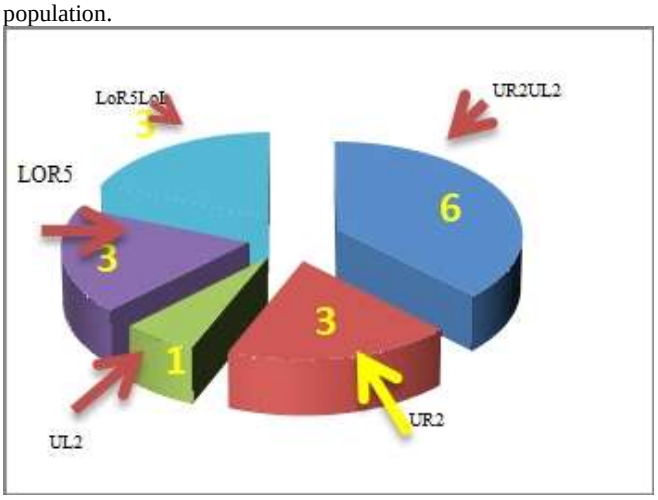

Fig.2. Distribution of missing teeth in female, bilateral upper lateral incisor (UR2UL2), upper right lateral incisors (UR2), upper left lateral incisors (UL2), bilateral lower second premolar (LOR5LOL5), lower right second premolar (LOR5).

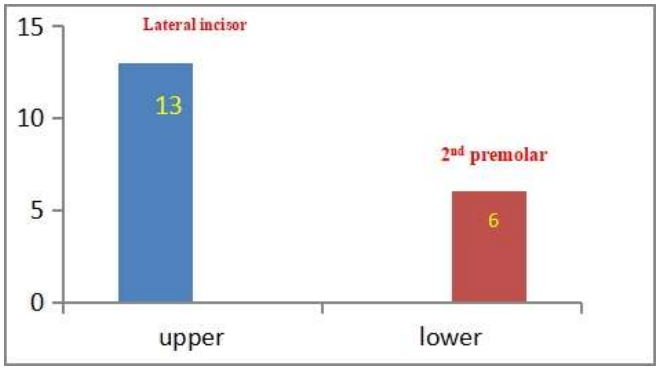

Fig.3. Representation of missing lateral incisors and missing second premolar in the sample.

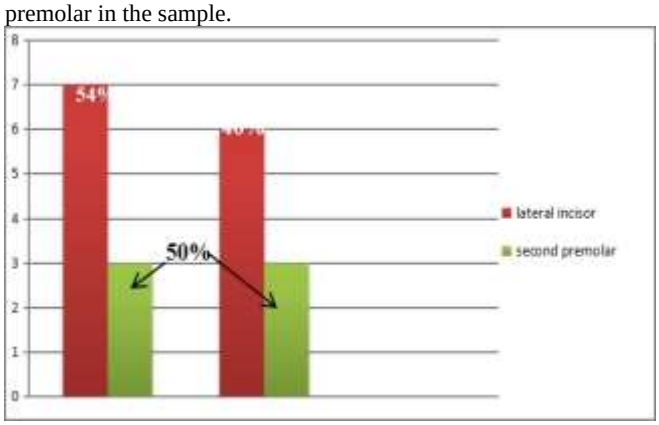

Fig. 4. Unilateral and Bilateral distribution of the missing teeth.

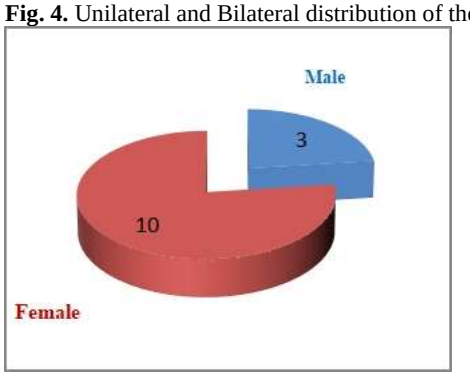

Fig.5. Distribution of missing lateral incisors among gender.

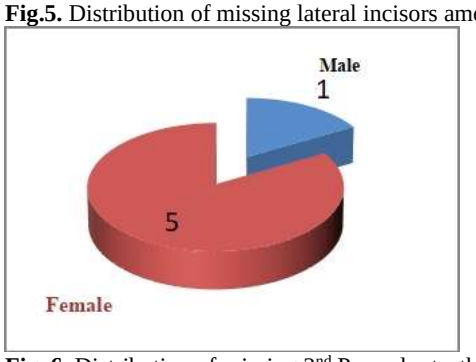

Fig. 6. Distribution of missing 2nd Premolar teeth among gender.

Table (1) showed that there is no statistically significant association between missing upper lateral incisors and missing lower second premolar data (Gender and location): since chi – square had P- value (0.75, 0.87) respectively greater than 0.05.

Table1. Statistical analysis of missing teeth according to side and gender.

	Gender		$\chi^2 - test\ (P - value)$
	Male	**Female**	
Missing Upper lateral incisors	23%	77%	**0.10 (0.75)**
Missing Lower second premolar	17%	83%	
	Side		

	Unilateral	Bilateral	$\chi^2 - test\ (P - value)$
Missing Upper lateral incisors	46%	54%	**0.02 (0.87)**
Missing Lower second premolar	50%	50%	

Discussion:

This study is an epidemiological analysis of hypodontia reported in consecutively treated participants at a private orthodontic clinic. As a result, the prevalence rate of the anomaly identified here does not necessarily directly represent that of the whole population. Independent records examination of the study's participants found 3.8% frequency of congenitally missing teeth. Clinically, this has been found to have a greater female occurrence. The study found that maxillary lateral incisors (68%), followed by mandibular second premolars (32%), are the most often missing teeth. of them 46% had unilateral congenital missing lateral incisors and 54% bilateral missing. While for the missing second premolars, 50% of cases had unilateral side missing and 50% had bilateral missing. Missing upper lateral incisors is more frequent than lower second premolars, this is in line with study done by Chung et al conducted in Korean community **[Chung et al., 2008]** and the study by Hassan et al conducted in Sudanese population **[Hassan et al., 2014**]. It is interesting to note that previous studies on the prevalence of missing permanent teeth revealed different outcomes dependent on ethnic origin. Asians are more likely to have missing mandibular second premolars and incisors, while Caucasians are more likely to have missing maxillary lateral incisors **[Endo et al., 2006) (Goya et al., 2008) (Zhang et al., 2015).** In Jordan's Druze community, genetic isolation due to endogamy and consanguineous marriages have resulted in missing teeth, particularly maxillary lateral incisors, and canines **(Alsoleihat, F.; Khraisat, A, 2014).**

Our study found a substantial difference between missing teeth in the maxilla and mandible, with the maxilla having a greater frequency (68%) compared to the mandible (32%). The increased occurrence of missing teeth and dental abnormalities in the maxilla could be due to variations in jaw ontogenesis since the maxilla grows and develops differentially than the mandible **(Tunis *et al.*, 2021)**. This study revealed that bilateral agenesis of maxillary lateral incisors was significantly more common than unilateral agenesis of the maxillary lateral incisors. This is consistent with studies done by Garib et al. **(Garib *et al.*, 2010),** and Abu-Hussein et al. **(Abu-Hussein *et al.*, 2015),** in cases with second premolar agenesis there was no difference, 77% of missing maxillary lateral incisors was found in female, and 23% in male cases. Previous studies have found that hypodontia is more common in female than in male, which is consistent with our findings **(Celikoglu et al., 2010).** Our results showed that second premolar agenesis, 83% of cases were female, and 17% were male, despite this high female ratio in the sample, the statistical analysis shows no significant differences according to gender, similar to finding of Shu et al. and Cavare et al research which found no significant variation in the number of missing teeth between sexes or between the right and left sides **(Shu *et al.*, 2024) (Cavare *et al.*, 2024)**. In this Libyan population sample, high female frequency could be attributed to sample selection, or it may be related to the fact that women in general are concerned more about esthetics and seek orthodontic treatment especially if the missing tooth is in anterior region.

Limitation: This study has limitations since it was a retrospective, and the study population were orthodontic patients from one Libyan city. Therefore, the results cannot be generalized to the whole Libyan population. However, the study results are important baseline data for other future studies in the Libyan population

Conclusion

Within the limits of this study, our findings demonstrate and confirm previous international studies that the most common congenitally missing tooth is the upper lateral incisors (68%), followed by the lower second premolar (32%) and females were more affected than males. We assume that the technique designs and sampling approaches (e.g., using available radiographs of dental patients) may be responsible for the observed increase. It is also proposed to be related to advancements in dental awareness and imaging methods.

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