

Mandibular Second Premolar Agenesis: A Retrospective Cross-sectional Study from Palestine

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INTRODUCTION

Developmental abnormalities may result in discrepancies in teeth that may range from the absence of teeth (hypodontia)^[1] to having more teeth than the normal number (hyperdontia).^[2] Tooth agenesis, which can be either full or partial anodontia, is one of the most common dental anomalies in permanent dentition.^[1,3]

The total absence of tooth development in the primary, permanent, or both dentitions is known as anodontia. Partial anodontia is the lack of development and absence of one or more teeth. Partial hypodontia may be subdivided into oligodontia, the congenital absence of six or more teeth (third molars are not included), and hypodontia, the congenital absence of fewer than six teeth (third molars are not included).^[4,5] Hypodontia is the most common form of tooth agenesis.^[6,7] The prevalence of hypodontia varies between different ethnic groups, from 2.8% to 11.3%, depending on the population studied.^[7] The maxillary arch is more frequently affected than the mandibular arch, and unilateral rather than bilateral agenesis is more frequently seen in permanent dentition than in deciduous dentition.^[8] Tooth agenesis occurs as an isolated disease or related to syndromes.^[7,9] Factors contributing to tooth agenesis can

ABSTRACT **Objectives:** This retrospective study aimed to determine the prevalence of congenitally missing mandibular second premolars. **Materials and Methods:** A total of 1,843 radiographs were collected from five different cities in Palestine. Two experienced dentists independently examined the panoramic radiographs and demographic data (age and gender). **Results:** Among the 1,843 radiographs, 1,039 were for females (57.37%) and 804 were for males (43.63%); 13 cases had at least one congenitally missing mandibular second premolar. The prevalence of congenitally missing mandibular second premolars in the study population was 0.7%. There was no significant association between gender and mandibular second premolar agenesis. Unilateral agenesis was more common than bilateral, and the left side had more cases of congenitally missing mandibular second premolars than the right side. **Conclusions:** The prevalence of congenitally missing mandibular second premolars in this study population was 0.7%, within the range reported in other populations.

KEYWORDS: Agenesis, hypodontia, mandibular premolar, prevalence

be either congenital, such as metabolic, inheritance, and gene mutations, or environmental, factors which include biological, chemical, and physical factors. In addition, a combination of genetic and environmental factors can cause some of these anomalies.^[10,11]

Except for third molars, the most frequently observed missing teeth are mandibular second premolars and maxillary lateral incisors, which vary among ethnicities. The maxillary lateral incisor was reported to be the most common in Yemeni,^[12] Jordanian,^[13] Malaysian,^[14] Turkish,^[15,16] Romanian,^[17] Mexican,^[18] Pakistani,^[19] and American^[20] populations, while the mandibular second premolars were the most common in Iranian,^[21] Portuguese,^[22] Indian,^[23] Japanese,^[24] Korean,^[25] and European^[8] populations.

Congenitally missing mandibular second premolars can negatively affect dental occlusion, function, and esthetics. Oral rehabilitation of patients with

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congenitally missing mandibular premolars often requires a multi-disciplinary approach and usually results in prolonged treatment and a more significant burden of care.^[26,27] Many studies have evaluated the prevalence of hypodontia among various populations and reported various results regarding congenitally missing second premolars. This study aimed to investigate the frequency of congenitally missing mandibular premolars among the general population in five different cities in Palestine.

MATERIALS AND METHODS

For this cross-sectional investigation, a total of 1,843 digital panoramic radiographs were randomly selected and drawn from the archives of a private dental radiology center in five different cities in Palestine from 2019 to 2023. The radiographs were investigated for congenitally missing mandibular second premolars. Tooth agenesis was diagnosed when there were no signs of crown calcification on the radiograph and no evidence or history of loss attributable to orthodontic treatment, caries, periodontal problems. The inclusion criteria were: age between nine or older as all the permanent teeth would have erupted by this time, with no history of extraction, trauma, or previous orthodontic treatment. Exclusion criteria were: poor-quality radiographs, incomplete records (x-rays, clinical notes), syndromic and craniofacial disorders (e.g., cleft lip/palate), or a history of previous orthodontic treatment.

Ethical approval for the study was obtained from the IRB committee at the Arab American University-Palestine (2023/A/45/N). Statistical analysis was performed using IBM SPSS Statistics V. 22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp.). Descriptive statistics were tabulated. The Chi-square test was used to determine if there were any differences in the distribution of mandibular second premolar agenesis based on gender, location (left or right), and whether it was unilateral or bilateral. A P value of <0.5 was considered statistically significant.

RESULTS

A total of 1,843 radiographs were examined, 1,039 were for females (57.37%), and 804 were for males (43.63%). Thirteen radiographs had at least one congenitally missing mandibular second premolar; six (46.2%) were for females, and seven (53.8%) were for males. The Chi-square test revealed no significant association between gender and mandibular second premolar agenesis ($P = 0.608$). The prevalence of congenitally missing mandibular second premolars in the study sample was 0.7%. Only one case of bilateral agenesis was detected. Around 83% of the

12 cases with unilateral agenesis were on the left side of the mandibular arch. Non-parametric Chi-square test reveals that unilateral agenesis is significantly higher compared to bilateral agenesis ($P < 0.05$), and the left side had significantly more cases of agenesis than the right side ($P < 0.05$). Table 1 provides the distribution of congenitally missing mandibular second premolars among the study population.

DISCUSSION

Although there are many studies on the prevalence of hypodontia among different study populations, the number of publications reporting premolar agenesis is limited. The prevalence of congenitally missing mandibular second premolars was not always directly stated in the literature but was presented in tables and had to be calculated and concluded. Table 2 shows the percentage of missing mandibular second premolars among all missing teeth reported in studies.

The prevalence of congenitally missing mandibular second premolars in our study was 0.7%, which is within the range of 0.66%–3.62% described by prior studies. In a Dravidian population, the frequency of congenitally missing mandibular second premolars was examined by Lakshmanan and Gurunathan.^[28] They investigated 4,600 patients and found a frequency of 1.37%. Mani *et al.*^[14] assessed the prevalence and patterns of tooth agenesis from panoramic x-rays of 834 healthy Malay children aged 12–16 years who had attended the Universiti Sains Malaysia dental clinics. They reported the prevalence of mandibular second premolar agenesis to be 1.5%. Al-Abdallah^[13] investigated the panoramic radiographs of 8,225 Jordanian dental patients for congenitally missing mandibular second premolars and reported that 1.22% were found to have at least one missing lower second premolar. Another study in Portugal^[22] examined the panoramic radiographs of 1,438 patients who were receiving treatment in the outpatient clinic at the Faculty of Dentistry of the University of Oporto (714 boys and 724 girls between the ages of 6 and 15). The study showed that 3.62% of the population had one or more congenitally missing mandibular second premolars. A study in Turkey retrospectively investigated the panoramic radiographs of 2,722 patients for tooth agenesis. The prevalence of congenitally missing mandibular second premolars was reported to be 0.88%.^[16] Albashaireh and Khader^[29] carried out a retrospective analysis of 1,005 panoramic x-rays taken of patients who had received care at the Faculty of Dentistry at the Jordan University of Science and Technology. The mandibular second premolars were the most frequently missing teeth, accounting for 3.4% of the study population. Additionally, Hashim and Al-Said^[30] examined the records of 1,000 Qatari patients who visited a

dental clinic at Rumaila Hospital in Qatar for congenitally missing mandibular second premolars. They found that 2.7% of radiographs showed at least one missing mandibular second premolar. To evaluate the prevalence of tooth agenesis, a study conducted in Turkey^[31] examined the data from a total of 100,577 individuals who were collected from six different regions. The study reported that the incidence of congenitally missing mandibular second premolars was 0.66%. In Iran, Sheikhi *et al.*^[21] assessed the prevalence of congenitally missing permanent teeth among 3,000 patients. They reported that the prevalence of congenitally missing mandibular second premolars was 2.6%. Musaed *et al.*^[12] examined 5,100 archival records of patients attending local dental centers and colleges of dentistry in Yemen to identify those affected by congenital absence of mandibular second premolars. They reported that the prevalence of mandibular second premolar agenesis was 1.18%. A meta-analysis of 10 studies, including 48,274 subjects, found that the prevalence of congenitally missing mandibular second premolars is 2.91%–3.22%.^[8] The different results from all the previous studies may arise from racial differences and differences in the study's methodology, including sample selection, size, and the age of the subjects involved in the study.

In line with prior studies, there was no significant association between gender and mandibular second premolar agenesis.^[14,29,30,33,34] Other studies, however, indicated that females were more frequently affected.^[12,28,31] According to the current study, 92.3% of the cases with at least one congenitally missing mandibular second premolar were unilateral and 6.7% were bilateral. This is similar to what was found in earlier studies, which showed that most cases of mandibular second premolar agenesis were unilateral.^[12,16,21,30] According to other studies, bilateral agenesis is more prevalent than unilateral agenesis^[12,28,30] and sometimes has an equal distribution.^[22] Ten of the 12 unilateral occurrences (two on the left side of the mandibular arch) occurred there. These results agreed with the Turkish^[16,31] and Jordanian^[13] populations. The different results may again be attributed to racial differences and differences in the study's methodology. The left and right sides were similar.^[12,29,30]

The examined subjects' demographic characteristics often influence the prevalence rates of investigated anomalies. The current study investigated the prevalence of mandibular second premolar agenesis in non-orthodontic patients. The prevalence shown in this study is lower than in prior studies on tooth agenesis in orthodontic populations.^[35,36] The latter has been found to have higher prevalence rates, as people with hypodontia are frequently more motivated to get orthodontic treatment to improve their facial and dental esthetics.^[37-39]

Congenitally missing mandibular second premolars should be diagnosed as early as possible. Early tooth diagnosis can impact treatment success, patient options, and the quality of the results.^[40,41] Several studies have reported that lower second premolars have the most variations in differentiation and calcification stages after third molars.^[42,43] Usually, the second premolars calcify at about 2–2.5 years, while the crown is completely formed at 6–8 years. Mandibular second premolars have been reported to demonstrate delayed calcification beginning at 5–6 years of age.^[44-46] The diagnosis of dental agenesis of a mandibular second premolar before seven is probably inconclusive and is commonly confirmed at 8–9 years of age.^[8,43]

The treatment of congenitally missing mandibular second premolars can be challenging. It varies depending on the patient's age, dental health, and esthetic concerns. Preserving a primary mandibular second molar may be a viable part of the treatment plan.^[47] Whenever a retained primary second molar is part of the treatment plan, it is essential to consider its status. This includes the condition of its crown, root, and bone; its condition regarding root resorption, its vertical condition relative to the occlusion; and the dento-skeletal relationships.^[48,49] Other treatment options that may be part of the treatment plan may include orthodontic treatment (e.g., closing the space or opening the space for implant replacement), prosthetic replacement (e.g., bridge or dental implant), or no treatment if the condition does not cause functional or esthetic concerns.^[48] Another approach for treatment is autotransplantation of other teeth if such transplants are available.^[50] Compared to mature teeth in adults with closed foramen, tooth transplants in children have a better prognosis when root development is still incomplete and the apical foramen is still open.

Dental professionals need to be aware of the prevalence of dental abnormalities across the population they treat. Planning a course of treatment requires understanding the pattern and prevalence of tooth agenesis. If done properly and on time, interdisciplinary therapy could protect the patient from esthetic and functional discrepancies that might interfere with optimal development and growth and result in functional, occlusal, and esthetic disharmony.

This study provides data regarding congenitally missing mandibular second premolars. It helps dental professionals better understand the occurrence of mandibular second premolar agenesis. It highlights the significance of early diagnosis and referral to reduce or avoid problems that may compromise function and appearance. However, this study has certain limitations due to its retrospective nature and limited sample size.

Table 1: Distribution of the sample population.

Gender	Total number of patients investigated (%)	Patients with normal dentition	Patients with missing premolars	Unilateral cases		Bilateral cases
				Right	Left	
Male	804 (43.63)	797	7	1	6	0
Female	1,039 (57.37)	1,033	6	1	4	1
Total	1,843 (100)	1,830	13 (0.7%)	2 (16.7%)	10 (83.3%)	1
				12 (92.3%)		1 (7.7%)

P value left vs. right = $P < 0.5$. P value unilateral vs. bilateral = $P < 0.5$

Table 2: Distribution of missing mandibular second premolar in % of the total missing teeth according to studies investigating hypodontia

Study	Country	Sample size	Affected ppl	Total missing teeth	Number of the total missing mandibular second premolars	% of the total missing teeth
Mani <i>et al.</i> ^[14]	Malaysia	834	227	508	21	4.13
Al-Abdallah ^[13]	Jordan	8,225	302	584	155	26.54
Coelho <i>et al.</i> ^[22]	Portugal	1,438	115	266	76	28.6
Karadas <i>et al.</i> ^[16]	N. Turkey	2,722	108	157	32	20.38
Albashaireh and Khader ^[29]	Jordan	1,005	55	93	34	36.6
Aktan <i>et al.</i> ^[31]	Turkey	100,577	1,471	3,147	1,020	32.4
Musaed <i>et al.</i> ^[12]	Yemen	5100	165	293	112	38.22
Nordgarden <i>et al.</i> ^[32]	Norway	9,532	430	774	364	47
Sheikhi <i>et al.</i> ^[21]	Iran	3,000	262	454	106	23.4
Bernadette <i>et al.</i> ^[17]	Romania	947	-	136	42	30.88
Abu Affan and Serour ^[33]	Sudan	2,401	64	100	18	18
Hashim and Al-Said ^[30]	Qatar	1,000	78	113	37	32.7

A larger study sample might aid in producing more representative results. Future research is required to determine the causes of tooth agenesis and hypodontia in Palestine.

CONCLUSION

The prevalence of congenitally missing mandibular second premolars was 0.7%, and there was no significant difference in the prevalence among males and females. Mandibular second premolar agenesis occurred more unilaterally than bilaterally.

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Ethical approval

Ethical approval for the study was obtained from the IRB committee at the Arab American University-Palestine (2023/A/45/N).

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Conflicts of interest

There are no conflicts of interest.

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