Ref: Ro J Stomatol. 2025;71(3)
DOI: 10.37897/RJS.2025.3.8

Maxillary (upper) midline diastema: prevalence, etiology, and aesthetic perception in patients attending a dental teaching clinic in Basrah

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ABSTRACT

Background. Midline diastema, a gap between the maxillary central incisors, is common feature of anterior dentition during development but, if it persistent into adulthood, it is considered an anomaly with aesthetic implications.

Objective. This study aimed to determine the prevalence, gender differences, and etiological factors of maxillary midline diastema among patients attending the teaching clinic at the College of Dentistry, University of Basrah.

Methods. A cross-sectional study was conducted on 592 patients (246 males and 346 females) aged 10-35 years (mean age 22.08 ± 6.68 years). Clinical and radiographic examinations were performed. Patients with a history of orthodontic or prosthodontic treatment of the anterior teeth, or those with periodontal disease, were excluded.

Results. Midline diastema was diagnosed in 90 patients (15.2%). The prevalence was significantly higher in males (18.3%) than in females (13%), with a threshold ($p = 0.05$). The most frequent etiological factor was generalized spacing (24.4%), followed by hereditary predisposition (23.3%). High frenum insertion and peg-shaped or small lateral incisors each accounted for 15.6% of cases, while canine impaction or malposition accounted for 11.1%. Rotated, impacted, or missing central incisors represented 6.7% of cases, oral habits 3.3%, and mesiodens 1.1%. Regarding patient perception, 56.7% considered the diastema an aesthetic problem, while 43.3% were satisfied with their appearance ($p < 0.0001$). More than half (54.4%) expressed willingness to undergo treatment, compared with 45.6% who did not ($p < 0.0001$).

Conclusion. Midline diastema is a multifactorial condition requiring thorough clinical and radiographic assessment and, in some cases, involving a multidisciplinary approach. In this study, its prevalence was 15.2%, higher in males than in females. Generalized spacing and genetic factors were the most common etiologies, while mesiodens was rare. More than half of the affected patients perceived diastema as an aesthetic problem and expressed a desire for treatment.

Keywords: midline diastema, upper anterior teeth, aesthetic, prosthodontic restorations

INTRODUCTION

The term diastema originates in Greek and refers to a gap or space between two or more adjacent teeth. A common type is midline diastema, which typically occurs between the upper or lower central incisors and is more frequently observed in the upper jaw [1]. Midline diastema can be a normal developmental feature during the primary and mixed dentition stages. It often resolves naturally as maxillary canines erupt into the oral cavity [2]. In most children, the natural medial eruption path of the maxillary lateral incisors and canines leads to the spontaneous closure of this space. However, in some cases, diastema persists [3].

Numerous etiological factors contribute to midline diastema, including a mismatch between tooth

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Article History:
Received: 28 June 2025
Accepted: 10 September 2025

size and jaw length and abnormal attachment of the labial frenum between the central incisors [4,5]. Other contributing factors include congenitally missing or extracted incisors, peg-shaped lateral incisors, and canine impaction [6-8]. Racial differences also play a role. Studies have shown that white populations have a lower risk of developing midline diastema than black populations [7,9]. Lavelle et al. reported a higher prevalence of maxillary midline diastema in Africans (West Africa) than in Caucasians (British) or Mongoloid populations (Chinese from Hong Kong and Malaya) [9,10]. Additional causes include muscular imbalance, oral habits, abnormal maxillary arch structures, physical impediments, and other dental anomalies. Systemic conditions, such as Down syndrome, may also be associated with midline diastema [11].

Typically, the midline diastema is located between the upper anterior teeth and may persist until the permanent dentition is fully developed. Treatment is usually driven by aesthetic and psychological concerns rather than functional needs. Accurate diagnosis and comprehensive treatment planning are essential for selecting the most appropriate approach for each case [12–16].

Despite the global understanding of midline diastema, there is a noticeable lack of localized epidemiological data in many regions, including Basrah and Iraq, which limits the ability to draw region-specific conclusions about its prevalence, causative factors, and treatment outcomes. Local studies are essential to identify population-specific trends, such as genetic predispositions, cultural oral habits, and access to dental care, which may influence the occurrence and management of diastema. From a clinical perspective, understanding the underlying etiology is crucial in determining whether diastema is transient or requires intervention. Early diagnosis allows for timely management, especially in cases of abnormal frenum attachment, missing teeth, or systemic conditions. Treatment decisions should consider the patient's age, growth stage, aesthetic concerns, and psychological impact. A multidisciplinary approach, including orthodontics, pediatrics, and periodontics, may be required to ensure optimal outcomes tailored to individual patients.

METHODS

Study design and setting

A cross-sectional study was conducted by examining 928 patients attending teaching clinics at the College of Dentistry, University of Basrah, over a period of 3 months. These were examined randomly to determine the presence and etiology of the midline diastema.

Inclusion and exclusion criteria

Participants were selected according to specific inclusion and exclusion criteria. The inclusion criteria comprised patients aged 10–35 years, to ensure complete permanent dentition and avoid the "ugly duckling" stage, with natural upper anterior teeth, a healthy periodontium, and no history of orthodontic treatment.

The exclusion criteria included patients with artificial or missing upper anterior teeth, periodontally compromised anterior teeth, or a history of orthodontic treatment.

Selection of patients

In this study, true randomization was done so that all eligible patients attending the clinic during a defined period had an equal and independent chance of being selected. Systematic random sampling, where every nth patient is selected, plus a computer-generated random listing of all eligible patients is listed, and a computer randomly selects a subset, was done.

Examiner calibration and reliability

Before data collection, two examiners (both licensed dental practitioners) underwent a calibration session to ensure consistency in the identification and measurement of upper midline diastema. The calibration involved examining 10 randomly selected patients not included in the final study sample. Diastema width was measured using a digital caliper with a precision of 0.01 mm, measured at the incisal edge between the maxillary central incisors. Inter-examiner reliability was assessed using the intraclass correlation coefficient (ICC) for continuous measurements, yielding a value of 0.92, indicating excellent agreement. Intra-examiner reliability was also evaluated by having each examiner repeat measurements on the same 10 patients after a 1-week interval, resulting in ICC values of 0.90 and 0.88, respectively. These results confirmed that the measurements were reproducible and reliable.

Clinical and radiographic examinations

After the exclusion criteria, 592 patients (346 females, 246 males) were informed about the aim of this study and examined clinically and radiographically, with their information recorded on a specially designed chart, including their names, ages, and the etiological factor of diastema if present.

The presence of a visible space between the maxillary central incisors was recorded as a diastema. The causative factors were identified by intraoral and radiographic examination of the labial frenum, interdental spacing, peg-shaped maxillary lateral incisors, missing, impacted, or malposed canine or

central incisor presence of supernumerary teeth, and genetic factors were also recorded by asking the patient about the presence of diastema in their family members and their opinions regarding the effect of midline diastema on the aesthetic appearance and the need for treatment in the future.

Statistical analysis

Statistical Packages for Social Sciences, version 27 (SPSS-27), was used to analyze the data. Simple frequencies and percentages were used for data presentation. The Chi-square test was used to determine the significance of distinct percentage differences. Statistical significance was achieved when the p-value was less than 0.05.

RESULTS

This study involved 592 patients, including 246 males and 346 females. The patients were aged between 10 and 35 years old, with a mean age of 22.08 ± 6.68 years. (Table 1)

TABLE 1. Gender distribution in this study

Variables	No.	%
Male	246	41.6
Female	346	58.4
Total	592	100.0

Of the 592 patients who met the selection criteria, 90 had a midline diastema (Table 2).

TABLE 2. Frequency of midline diastema

Midline diastema	No.	%
Absence	502	84.8
Presence	90	15.2
Total	592	100.0

Statistically, there was a significant difference ($p<0.05$) in the prevalence of midline diastema between males and females (18.3% males, 13% females) (Table 3).

TABLE 3. Prevalence of midline diastema according to gender.

Gender	Presence of diastema		Total No. (%)
	Absence No. (%)	Presence No. (%)	
Male	201 (81.7)	45 (18.3)	246 (100)
Female	301 (87)	45 (13)	346 (100)

P < 0.05

The results were statistically analyzed, and each diagnosed etiological factor for midline diastema was recorded as a ratio of the total number of patients recorded with diastema and expressed as a percentage.

Diverse intraoral anomalies are associated with the presence of a diastema. These included interdental spacing, high frenal attachment, history of oral habits, peg-shaped lateral incisors, and unerupted canines. All included patients with diastema had at least one of the previously mentioned causative factors.

Generalized spacing was the most frequent etiological factor (24.4%), followed by the presence of diastema due to a hereditary factor (23.3%). There is a strong connection between generalized spacing and genetic factors. In 15.6 % of patients, the reasons behind diastema were high frenum insertion, and in 15.6% it was associated with peg or small lateral incisors.

On the other hand, canine impaction or malposition was recorded in about 11.1% of diastema cases. (6.7%) had rotated, impacted, or missing central incisors. 3.3% associated with oral habits. Only one case, 1.1% from the collected sample, had a midline diastema caused by mesiodense (Figure 1).

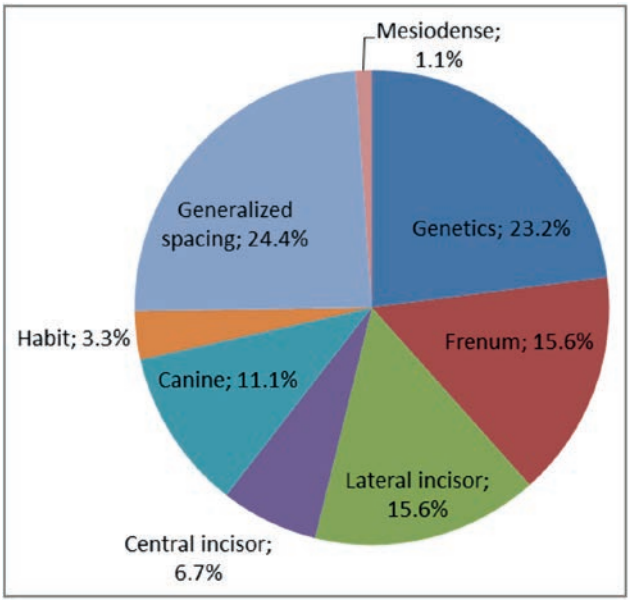

FIGURE 1. Distribution of etiological factors associated with midline diastema

About 51 (56.7%) of affected patients considered diastema as a problem affecting their aesthetic appearance, while the remaining 39 (43.3%) patients were satisfied with their appearance, with a high statistical difference (P < 0.0001) (Table 4).

TABLE 4. Effect of midline diastema on aesthetic

Aesthetic appearance	Not affect the appearance	Affect the appearance	Total
No. (%)	39 (43.3)	51 (56.7)	90 (100)

P < 0.0001

On the other hand, 49 (54.4%) of midline diastema patients looked to treat this condition, and the remaining 41 (45.6%) were not willing to close it, with a high statistical difference (P < 0.0001) (Table 5).

TABLE 5. Percentage according to the desire to treat midline diastema.

Treatment	Not want treatment	Want treatment	Total
No. (%)	41 (45.6)	49 (54.4)	90 (100)
P<0.0001			

DISCUSSION

The prevalence of midline diastema in our study was 15.2%, which is close to that reported by Adel et al. [17] (17.3%), and it is higher than that reported by Elfadel II et al. [18] (7.3%) and Ozair et al. [19] (5.8%), and was lower than that reported by J Logeswari et al. [20] and Sahar et al. [21], where the prevalence was 21.8% and 22%, respectively. This difference could be attributed to differences in inclusion criteria, sampling techniques, or genetic predisposition [22].

Regarding gender, the prevalence of midline diastema in males is higher than in females, which agrees with a study by Luqman et al. [23], where males were 25% while females 15% and a study by Ghimire et al. [24] also reported a significant difference (16.6% males, 10% females). Our results disagree with a study by Hasan et al. [25] (males 20.3%, females 26.4%) and another study by Drawn et al. [26] (males 31.5%, females 68.5%), where females had a higher prevalence. Regarding etiological factors responsible for midline diastema development, there is no agreement that a single factor could be the precise etiological factor [27].

Regarding this study, the most common etiology affecting was generalized spacing; this finding was similar to that found by Luqman et al. [23] (39%) and Abdullah et al.[28] (42%), where spacing was the most common cause, while in another study by Israa I. Elfadel et al. [19], it was the second most common cause after high frenum attachment by percentage of 48.8%.

The second most common cause was the genetic factor, which agreed with studies by Luqman et al.[23] (9%) and Abdullah et al.[28] (39%), where it was the second most common cause of generalized spacing. Meanwhile, it was the first etiological factor contributing to diastema in studies by Darwn et al. [26] (40%) and Biljana et al. [29] (49%).

In this study, diastema occurs due to high frenum attachment, although it was the first common cause contributing to diastema in the study by Hasan et al. [25] (39.4%). A higher percentage than our study was also reported in studies by J Logeswari et al.[20] and Luqman et al.[23] (18.3%, 30%% respectively), while a lower percentage was reported by Biljana et al. [29] by only 3%.

In the present study, lateral incisors that could be congenitally missing, peg-shaped, or unerupted, which is equal to the prevalence of high frenum attachment in our study. This result is close to that of Hasan et al. [25] (16.4%), whereas a higher percentage was reported by Abdullah et al.[28] (24%) and Adel et al.[17] (43%).

Central incisors could be rotated, small, or proclined, while other studies by Israa I. Elfadel et al. [18] and Adel et al. [17] reported higher results (17.5%, 43% respectively).

Regarding canine abnormalities that could be unerupted, impacted, or malposed, a study by Abdullah et al. [28] reported more than double the percentage (26%).

The unhealthy habits; only three patients had diastema due to habits, which could be thumb sucking, tongue thrusting, or lip biting. These disagreed with a study by Darwin et al.[26] (40%), where it was the most frequent etiology in Diastema patients. A higher percentage was also reported by Luqman et al. [23] (9%).

The lowest percentage of the etiological variables for the diastema was the presence of mesiodens in the collected samples. This agrees with the study by Adel et al.[17], where it was also the least common cause of diastema in patients, by only four patients (6.2%). Another study by Biljana et al.[29] Also reported, only three patients (3%) had a diastema due to mesiodens.

In our study, more than half of patients who showed diastema considered it as an aesthetic problem, which disagrees with another study by Elfadel II et al. [18], who reported 43.8% of diastema patients considered it as an aesthetic problem, while 56.2%.

A highly significant difference was found between those who wanted to treat the diastema as an aesthetic demand; hence, this could be due to age difference, gender, and aesthetic demand. Several works discussed midline diastema prevalence, etiologies, and aesthetic perceptions in patients, which reflected the importance of this in orthodontics [30-34].

Study limitations

This review is primarily based on previously published international studies, many of which vary in their definitions, diagnostic criteria, and age range for midline diastema. The absence of comprehensive, localized epidemiological data makes it difficult to generalize these findings to specific populations. Moreover, many studies have focused solely on ei-

ther aesthetic or clinical aspects, rather than integrating both. The lack of longitudinal data also limits our understanding of the natural progression and long-term outcomes of untreated diastema. Reliance on patient self-report for genetic factors is a limitation.

Biases

Several sources of bias may have affected the available midline diastema data. These include selection, reporting, and racial and ethnic bias.

Future directions

Future research should focus on collecting region-specific prevalence data using standardized diagnostic criteria. Large-scale population-based studies are required to assess the influence of genetics, oral habits, and environmental factors in different communities. Longitudinal research can clarify the natural history of midline diastema and evaluate the effectiveness of various treatment modalities. Finally, incorporating patient-centered outcomes, such as psychological and social impacts, can help tailor holistic treatment approaches.

CONCLUSION

The prevalence of midline diastema in our study was 15.2%. The prevalence of midline diastema was higher in males than in females. The most common etiological factor for maxillary midline diastema in this study was generalized spacing in both sexes, and the second most common cause in our study was genetic factors. The least common etiological variable for diastema was the presence of mesiodens. More than half of the patients who showed maxillary midline diastema considered it an aesthetic problem, while others were accepting of midline diastema. Generalized spacing of the dentition is a condition that can arise from multiple etiological factors, including developmental, environmental, and genetic influences. Among these, genetic factors have been suggested to play a contributory role.

Recommendations

In brief, these include raised localized research, standardization of diagnostic criteria, a multidisciplinary approach, longitudinal studies on treatment outcomes, case-centered care, awareness and prevention, and expanding research on genetic and environmental factors.

Ethical approval

The Medical Ethical Committee of the Department of Orthodontics, College of Dentistry, University of Basrah, approved this study (no. 4.018-22-9 on 12/2/2024).

Conflicts of interest

The authors declare no conflict of interest regarding this article.

Financial support

The authors declare no external funding.

Use of AI

The authors declared the use of AI for proofreading purposes, and checked thoroughly the accuracy of the data we provided, and we are responsible for the provided data.

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