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Assessing the Prevalence of Maxillary Midline Diastema in Dental College Students: A Cross-Sectional Study

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ABSTRACT

Objective: This study aimed to determine the prevalence, size distribution, and associated etiological factors of maxillary midline diastema (MMD) among dental college students in Bangladesh.

Methods: A multicentre, cross-sectional study was conducted from January 2021 to December 2023, involving 1,407 undergraduate dental students from three institutions. Participants were selected via multistage sampling. Data were collected through clinical examinations performed by calibrated examiners and a structured questionnaire. MMD was defined as a space ≥ 0.5 mm between the maxillary central incisors. Results: The overall prevalence of MMD was 22.2% (n=312). Among those with a diastema, the most common size was 1–2 mm (45.5%), followed by <1 mm (40.1%), and >2 mm (14.4%). No statistically significant associations were found between the presence of MMD and gender (p=0.71) or age (p=0.95). The most prevalent etiological factor was labial frenum abnormality (35.9%), followed by tongue thrusting (29.5%) and tooth size-jaw size discrepancies (24.0%). Other contributing factors included lip biting (20.2%) and thumb sucking (18.6%). Notably, 30.4% of affected students had no identifiable oral habit.

Conclusion: The study reveals a high prevalence of maxillary midline diastema in this young adult population, affirming its status as a common clinical finding. The etiology is predominantly multifactorial, with labial frenum abnormality being the most significant associated factor. The persistence of MMD into early adulthood, particularly among future dental professionals, underscores its relevance as a condition of aesthetic and functional concern. These findings highlight the need for a comprehensive diagnostic approach and effective management strategies in clinical practice and dental education.

Keywords: *Maxillary Midline Diastema, Prevalence, Dental Students, Labial Frenum, Etiology, Cross-Sectional Study*

1. INTRODUCTION

The maxillary midline diastema (MMD), defined as a space greater than 0.5 mm between the two maxillary central incisors, is a common clinical finding and a subject of significant aesthetic concern for many individuals [1]. While it can be a normal transient feature in the mixed dentition stage due to the eruption of the permanent canine teeth, its persistence into adulthood often prompts individuals to seek orthodontic or restorative treatment [2] The aesthetic impact of MMD is considerable, influencing self-perception, social interactions, and overall quality of life, making it a relevant focus in dental research and practice [3]. The etiology of MMD is multifactorial, involving a complex interplay of genetic, anatomical, and environmental factors [4]. Prominent among the identified causes are abnormalities of the labial frenum, particularly its low insertion and

hyperplastic nature, which can physically prevent the approximation of the central incisors [5]. Other significant etiological factors include discrepancies between tooth size and jaw size (bolton discrepancies), oral habits such as thumb sucking and tongue thrusting, and the presence of mesiodens or other pathological conditions [6]. Furthermore, a familial predisposition has been observed, suggesting a potential hereditary component in some cases [7]. The prevalence of MMD exhibits considerable variation across different populations, ethnic groups, and age cohorts. Studies have reported prevalence rates ranging from 1.6% to 25.4% in various populations [8]. For instance, a study among Turkish children reported a prevalence of 5.8% [9], while another in Iraqi adolescents found a rate of 16.7% [10]. This wide disparity underscores the importance of population-specific epidemiological data to inform clinical practice and public health planning. Dental college students represent a unique population for such studies. As future dental professionals, their own oral health status and perceptions can influence their clinical judgment and patient counseling. Furthermore, this group is readily accessible for detailed clinical examinations, providing reliable data on oral conditions [11]. Understanding the prevalence and associated factors of MMD among this demographic can shed light on its burden in young adults and highlight potential areas for educational focus within the dental curriculum. While numerous studies have investigated MMD in children and adolescents, there is a relative paucity of recent cross-sectional data focusing specifically on young adult populations, particularly those within professional dental education. Therefore, this study aims to assess the prevalence of maxillary midline diastema, characterize its size distribution, and identify the associated etiological factors and oral habits among students in a dental college. The findings will contribute to the existing epidemiological literature and provide insights relevant to both clinical dentistry and dental education.

2. METHODOLOGY

Study Design and Setting

A multicentre, cross-sectional study was conducted at Mandy Dental College, Udayan Dental College & Hospital, Rajshahi, Saphena Women's Dental College, Delta Medical College, over a 12-month period from January 2021 to December 2023. The study was carried out at three major dental colleges in Bangladesh, selected to ensure geographical diversity and representative sampling of the dental student population.

Study Population and Sampling

The study included undergraduate dental students from all academic phases (1st to 4th phase) who were available during the data collection period.

Inclusion Criteria:

Undergraduate dental students (BDS program) from 1st to 4th phase

Students present on campus during data collection period

Students willing to participate in the study

Students with fully erupted maxillary central incisors

Exclusion Criteria:

Students undergoing active orthodontic treatment

History of trauma or surgery affecting maxillary anterior region

Presence of prosthetic crowns or extensive restorations affecting midline

Congenital anomalies affecting maxillary arch development

Students with missing maxillary central incisors

A multistage sampling technique was employed. The sample size was calculated using the single population proportion formula with the following parameters: prevalence (p) of 20%, 95% confidence level (Z = 1.96), and margin of error (d) of 2.5%. The minimum required sample size was 983, which was increased to 1407 to account for potential non-response and to enhance subgroup analysis power. The sample was proportionally allocated to each participating centre based on their student enrollment strength.

Data Collection Methods

Data collection was performed by four calibrated examiners (postgraduate residents in Orthodontics) using a structured data collection form. The form consisted of three sections:

Demographic information (age, gender, phase of study)

Clinical examination findings

Questionnaire on history and oral habits

Prior to data collection, examiner calibration was conducted with 30 students not included in the final sample, achieving an inter-examiner reliability Kappa score of 0.85.

Clinical Examination

Intraoral examination was performed under standard dental unit illumination using mouth mirror and graduated periodontal probe. Maxillary midline diastema (MMD) was defined as a space ≥ 0.5 mm between the mesial surfaces of maxillary central incisors. For students with MMD, the diastema size was measured to the nearest 0.1 mm. Labial frenum was assessed for abnormalities based on attachment morphology. Oral habits including tongue thrusting, lip biting, and thumb sucking were recorded based on patient history and clinical examination.

Data Analysis

Data from all centres were compiled and analyzed using IBM SPSS Statistics Version 26.0. Descriptive statistics (frequencies, percentages) were used to summarize demographic and clinical characteristics. Chi-square test was employed to assess associations between MMD and categorical variables like gender and age groups. A p-value < 0.05 was considered statistically significant.

Results

The findings of this cross-sectional study, based on a sample of 1407 dental college students, are presented in the following tables.

Table 1: Demographic Characteristics of the Study Population (N = 1407)

Variable	Category	N	(%)
Gender	Male	655	46.5
	Female	752	53.5
Age Group (years)	19–21	720	51.2
	22–24	687	48.8

The study population comprised 1407 students, with a slightly higher proportion of females (752, 53.5%) than males (655, 46.5%). The participants were almost evenly distributed between the two age groups, with 51.2% (720) aged 19-21 years and 48.8% (687) aged 22-24 years.

Table 2: Prevalence of Maxillary Midline Diastema (N = 1407)

Variable	Category	(N)	(%)
Presence of Midline Diastema	Yes	312	22.2
	No	1095	77.8

The overall prevalence of maxillary midline diastema (MMD) in the study population was 22.2% (312 students). The vast majority of students, 1095 (77.8%), did not present with a diastema.

Table 3: Distribution of Diastema Size among Students with Midline Diastema (n = 312)

Diastema Size (mm)	(N)	(%)
<1 mm	125	40.1
1–2 mm	142	45.5
>2 mm	45	14.4

Among the 312 students with a diastema, the most common diastema size was 1–2 mm, affecting almost half of this subgroup (142, 45.5%). This was closely followed by diastemas smaller than 1 mm (125, 40.1%). A diastema larger than 2 mm was less common, present in 45 students (14.4%).

Table 4 (Adjusted for Full Sample, N = 1407)

Variable	Category	(N)	(%)
Family History of Diastema	Yes	87	6.2
	No	1320	93.8
History of Orthodontic Treatment	Yes	58	4.1
	No	1349	95.9

Analysis of the full sample's history revealed that only a small proportion reported a family history of diastema (87, 6.2%) or a previous history of orthodontic treatment (58, 4.1%).

Table 5: Association of Midline Diastema with Gender and Age

Variable	Category	Midline Diastema Present (n, %)	Midline Diastema Absent (n, %)	Total (n)	χ^2	p-value
Gender	Male	142 (21.7)	513 (78.3)	655	0.14	0.71
	Female	170 (22.6)	582 (77.4)	752		
Age Group (years)	19–21	158 (21.9)	562 (78.1)	720	0.05	0.82
	22–24	154 (22.4)	533 (77.6)	687		
Total		312 (22.2)	1095 (77.8)	1407		

Statistical analysis using the chi-square test found no significant association between the presence of a midline diastema and gender ($\chi^2 = 0.14$, p-value = 0.71) or age group ($\chi^2 = 0.05$, p-value = 0.82). The prevalence was similar between males (21.7%) and females (22.6%), and consistently around 22% across both age cohorts.

Table 6: Distribution of Oral Habits and Etiological Factors among Students with Midline Diastema (n = 312)

Etiological Factor	(N)	(%)
Labial Frenum Abnormality	112	35.9
Tongue Thrusting	92	29.5
Spacing / Tooth Size-Jaw Size Discrepancy	75	24.0
Lip Biting	63	20.2
Thumb Sucking	58	18.6
Other / Unknown	12	3.8
No Identified Habit	95	30.4

***Percentage calculated from the total number of students with midline diastema (n=312). *

Note: The total percentage exceeds 100% as participants could report multiple etiological factors.

The most prevalent etiological factor identified among students with MMD was a labial frenum abnormality (112, 35.9%). Tongue thrusting (92, 29.5%) and spacing or tooth size-jaw size discrepancies (75, 24.0%) were also common. Other contributing habits included lip biting (63, 20.2%) and thumb sucking (58, 18.6%). Notably, 95 students (30.4%) with a diastema had no identifiable habit. The total percentage exceeds 100% as participants could report multiple factors.

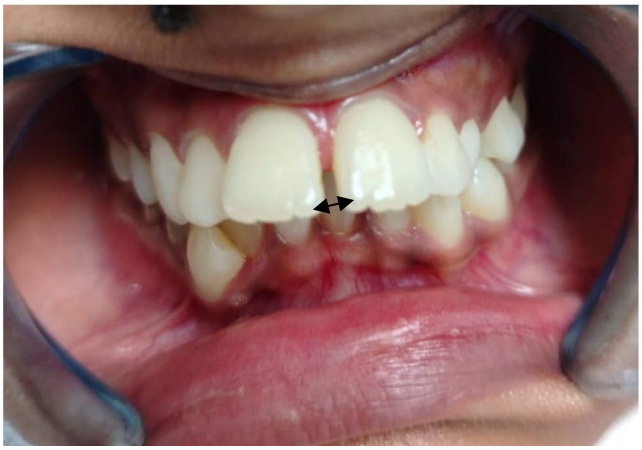

Fig. 1: Points of maxillary midline diastema measurements

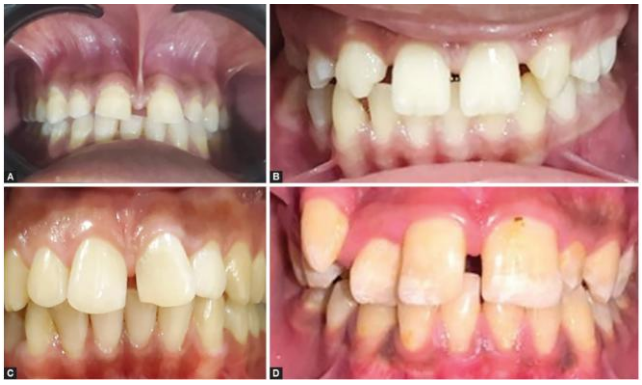

Fig 2: A to D: Clinical cases present with different etiologies of maxillary midline diastema. (A) Presence of a highly attached frenum; (B) Generalized spacing between teeth and congenitally missing lateral incisor; (C) Flared or rotated central incisors; (D) Malposed canine teeth

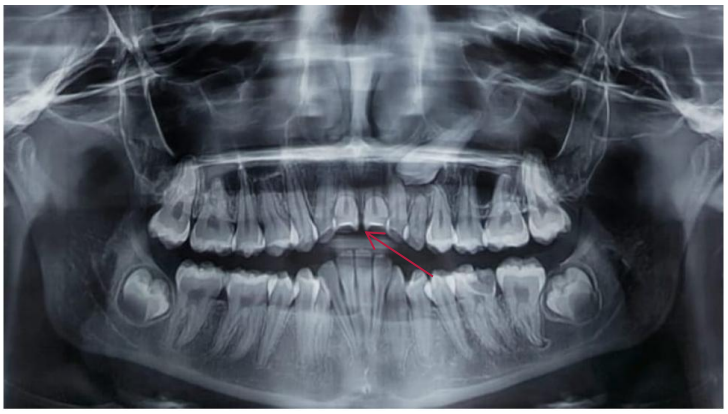

Fig 3: Radiographic cases show causes of maxillary midline diastema. Impacted canine teeth.

3. DISCUSSION

This cross-sectional study aimed to assess the prevalence, characteristics, and associated factors of maxillary midline diastema (MMD) among dental college students in Bangladesh. The findings reveal an overall MMD prevalence of 22.2%, with the most common diastema size falling within the 1-2 mm range. No significant associations were found between MMD and gender or age. The most frequently identified etiological factor was an abnormal labial frenum, followed by tongue

thrusting and tooth size-jaw size discrepancies. The prevalence rate of 22.2% observed in this study falls within the wide range (1.6% to 25.4%) reported in previous literature across different populations [12]. This rate is higher than the 5.8% reported among Turkish children (Tamay, Z. et al., 2014) [13], but lower than the 25.4% found in a study of Iraqi adolescents (Altemimi et al., 2019). This disparity underscores the influence of ethnic and genetic factors on the presentation of MMD, as supported by the known variations in craniofacial morphology and tooth dimensions among different racial groups [14]. The relatively high prevalence in our sample of young adults is noteworthy, as MMD often diminishes with the eruption of permanent canines during adolescence. Its persistence into early adulthood in this cohort highlights it as a relevant clinical condition for this age group, often necessitating aesthetic or orthodontic intervention [15].

Our findings indicate that gender and age were not significant predictors for MMD, with similar prevalence rates observed across males (21.7%) and females (22.6%) and all age groups. This aligns with several other studies that found no sexual dimorphism in the occurrence of MMD [16]. This suggests that the etiological factors governing MMD operate independently of gender and remain stable throughout young adulthood, reinforcing the concept that its presence is largely established during the developmental period and persists if not treated. Regarding the characteristics of the diastema, the majority (85.6%) were 2 mm or smaller, with the 1-2 mm category being the most prevalent (45.5%). This distribution is clinically significant, as smaller diastemas (<1 mm) may sometimes be managed with restorative procedures like composite bonding, while larger diastemas, particularly those over 2 mm, often require comprehensive orthodontic treatment or even a combination of orthodontics and frenectomy [17]. The fact that 14.4% of students had a diastema larger than 2 mm indicates a substantial subset for whom simple intervention may be insufficient. Consistent with established literature, an abnormal labial frenum was the most commonly associated etiological factor, identified in 35.9% of students with MMD [18]. A thick, fleshy, and low-inserting frenum can create a physical barrier preventing the natural approximation of the central incisors, a finding that underscores the importance of a thorough frenal examination in patients presenting with MMD [19]. The second most common factor was tongue thrusting (29.5%), a parafunctional habit that exerts anterior force on the teeth, potentially preventing space closure and maintaining the diastema [20]. Similarly, tooth size-jaw size discrepancies (Bolton discrepancies) were implicated in 24.0% of cases, where generalized spacing due to tooth material deficiency relative to the arch length manifests prominently in the midline [21].

Other oral habits such as lip biting (20.2%) and thumb sucking (18.6%) were also notable contributors. These habits can alter the equilibrium between the lingual and labial muscular forces, leading to proclination of incisors and the development or persistence of a diastema [22]. It is critical to note that 30.4% of affected students had no identifiable habit or clear local factor. This suggests the potential role of other underlying causes not assessed in this study, such as the inherent growth pattern of the maxilla, the presence of unerupted mesiodens, or stronger genetic predispositions than what was captured by our family history variable [23]. The low reported rate of family history (6.2% of the total sample) may be due to underreporting or a polygenic, multifactorial inheritance pattern that is not easily recalled by participants. This study has several implications. For dental educators, the high prevalence of MMD among future dentists underscores the need for robust training in diagnosing its multifactorial etiology and managing patient concerns, particularly regarding aesthetics. For clinicians, the findings reinforce the necessity of a comprehensive diagnostic approach that includes assessment of the labial frenum, evaluation of oral habits, and analysis of tooth-size-arch-length relationships before formulating a treatment plan.

A key limitation of this study is its cross-sectional design, which can identify associations but not establish causality. The reliance on self-reported data for habits and family history is subject to recall bias. Furthermore, the study was confined to dental students, who may not be fully representative of the general young adult population in Bangladesh. Future longitudinal studies are recommended to trace the natural history of MMD and the outcomes of various intervention strategies.

4. LIMITATIONS

Despite the robust sample size and multicentre design, this study has several limitations that should be considered when interpreting the results. Firstly, the cross-sectional nature of the study allows for the identification of associations but cannot establish causal relationships between the identified factors and the diastema. Secondly, data on oral habits and family history were self-reported, which is susceptible to recall and social desirability bias. The assessment of habits like tongue thrusting could have been enhanced with more objective diagnostic aids. Thirdly, the study population, consisting exclusively of dental students, may not be fully representative of the general Bangladeshi young adult population, potentially limiting the generalizability of the findings. Lastly, radiographic examination was not incorporated into the protocol, which means the possible influence of underlying supernumerary teeth (e.g., mesiodens) or root angulations might have been undetected in some cases.

5. CONCLUSION

This cross-sectional study conducted among dental college students in Bangladesh found a considerable prevalence (22.2%) of maxillary midline diastema (MMD), affirming its status as a common clinical entity in this young adult demographic. The most frequently observed diastema size was 1–2 mm. The study identified no statistically significant association between the presence of MMD and the variables of gender or age, suggesting that these factors are not primary determinants in this population. The etiology was predominantly multifactorial, with labial frenum abnormality emerging as the most significant

associated factor, followed by oral habits such as tongue thrusting and underlying tooth size-jaw size discrepancies. A notable proportion of cases presented with no identifiable habit, indicating the potential role of other genetic or developmental influences. The persistence of MMD into early adulthood, particularly among future dental professionals, underscores its relevance as a condition of aesthetic and functional concern that warrants informed clinical attention.

6. RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

Clinical Practice: Dentists and orthodontists should adopt a comprehensive diagnostic approach for patients presenting with MMD. This must include a thorough assessment of the labial frenum, evaluation of periororal muscle function and oral habits, and a detailed space analysis to identify tooth size-arch length discrepancies before formulating a treatment plan.

Patient Education: There is a need for increased patient education regarding the etiological role of oral habits like thumb sucking and tongue thrusting in the development and persistence of MMD. Early intervention and habit-breaking appliances should be considered in managing pediatric and adolescent patients.

Dental Curriculum: Dental educational institutions should emphasize the multifactorial etiology of MMD in their curricula. Training should focus on differential diagnosis and the range of available treatment modalities, from minimally invasive restorative techniques to orthodontics and surgery, to equip future dentists with the skills to manage this condition effectively.

Future Research: Future studies should employ a longitudinal design to better understand the natural progression of MMD and the long-term stability of various treatment outcomes. Research involving the general population and incorporating radiographic assessment would provide a more comprehensive understanding of the condition's prevalence and etiology.

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