Prevalence, Aetiology, Management and Retention of Midline Diastema in Orthodontic Patients in Ghana

Newman-Narney M¹, Sackeyfio J², Hewlett S³, Amoah G¹, Narney S⁴, Otu-Narney N⁵

Abstract

Background: In African cultures, the midline diastema is regarded as a sign of beauty but, on the contrary, in western societies, it is considered unattractive.

Aim: To review the presentation, management, retention and associated aetiological factors of midline diastema in orthodontic patients at the University of Ghana School of Medicine and Dentistry orthodontic clinic and a private orthodontic clinic over a ten-year period.

Method: This retrospective study was designed with data from patient records in combination with telephone follow-up (TFU). It included collection of data on demographics, chief patient concerns, diastema characteristics, status of midline diastema and bonded retainers at TFU. The level of statistical significance was prespecified at 0.05. SPSS Version 22 was used for statistical analysis.

Results: Midline diastema was seen in 92 out of 661 patients resulting in a prevalence rate of 13.9%. The most common aetiological factor for the midline diastema was proclination of maxillary incisors (n=32, 34.8%) and the most influencing factor for orthodontic treatment was protruding upper teeth (n=26, 28.3%). The greatest mean diastema widths of 4.3 mm were observed in patients whose chief concern was the presence of the diastema. Midline diastema was closed using fixed labial brackets in all patients. In majority (n=89, 96.7%) of patients, the midline diastema was completely closed. Evaluation of retention by TFU showed that (n=80, 88.9%) patients still had bonded retainers in place.

Conclusion: Patients tended to be more concerned about the proclination of incisors than the diastema.

Keywords: Midline diastema, orthodontic patients, Ghana

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Introduction

Spacing between the upper and lower teeth develops during the deciduous dentition, persists through the mixed dentition stage but tends to close spontaneously when all the permanent teeth erupt and are aligned in their normal position in the arch. However, sometimes the space between adjacent teeth persists and is termed a diastema.¹,² Another definition of a midline diastema is an interproximal space between two central incisor teeth which measures more than 0.5 mm in the upper or lower arch. The incidence of the midline diastema varies according to age, gender and ethnicity.³,⁴,⁵,⁶ Studies by Taylor,⁷ Gardiner⁸ and Weyman⁹ showed that the incidence of maxillary midline diastema in children ranged between 44.4% to 97% and 10% to 48.7% in 6-year-olds and 10-year-olds respectively.

Some studies¹⁰ have reported that the midline diastema occurs more frequently in females than in males but others⁹,¹⁰ dispute this claim. Ethnic variations observed by different studies indicate that the midline diastema is more common in African than
Caucasian populations.11,12,13

The aetiology of the midline diastema is multifactorial. It may be due to genetic inheritance,14 or to local oral conditions such as hypertrophic labial frenum, oral habits, presence of mesiodens and missing or anomalous shaped teeth creating additional spacing in the arch.15,16 Additionally, there may be incisal tooth shape/arch size discrepancy or increased angulation of incisors which creates a labial proclination of the teeth with subsequent increased arch perimeter causing ensuing spacing.13,15,16

The perception of diastema varies amongst different ethnic groups. In most African societies, the diastema is regarded as a sign of beauty and therefore desirable,13,14 whilst in the Western cultures it tends to be considered unesthetic and undesirable.15,20

The objective of this study was to determine the prevalence, aetiology, management and retention methods of midline diastema among orthodontic patients attending the Orthodontic clinic of the School of Medicine and Dentistry, University of Ghana and a private orthodontic clinic in Accra, Ghana.

Materials and Methods

This cross sectional retrospective study was carried out on 661 successive orthodontic patients who were treated by the principal author at the Orthodontic clinic of the School of Medicine and Dentistry, University of Ghana and the Orthodontic Centre, Ghana, from June 2007 to December 2017.

The minimum age for inclusion was set at 12 years to exclude diastema of the ‘ugly duckling stage’ of dental development. Patients were excluded if they had previous orthodontic treatment.

Serial records of patients with midline diastema (orthodontic casts, panoramic radiographs, occlusal radiographs, Lateral cephalograms, and patient records were retrieved and reviewed.

Information collected included sociodemographic features, chief complaint, method of management of the midline diastema and its retention.

All patients were treated with fixed orthodontic appliance of either one or both jaws.

At deband, patients were fitted with palatal/lingual bonded permanent retainers and or removable thermoplastic/hawley retainers.

The diastemata were measured with a digital Boley gauge on the pre- and post-treatment dental casts. Measurement of the space between the central incisor teeth was made by placing calipers at a right angle to the teeth at a point 1 mm from the incisal edge.

Telephone interviews (TFU) were conducted with patients to enquire about the status of their fixed bonded retainers and relapse of their diastemas during the retention phase, in lieu of clinical evaluation.

The data were compiled into Microsoft Excel spreadsheet and then imported into Statistical Package for Social Sciences version 22.0 (SPSS Inc., Chicago IL United States (SPSS) version 22 for statistical analysis. Descriptive statistics and a qualitative analysis were used to evaluate prevalence, aetiology, management and retention and the level of statistical significance for all the tests was prespecified at 0.05

Results

Table 1: Distribution of Midline Diastema according to Sex (n=92)

<table>
<thead>
<tr>
<th>Status/gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diastema present</td>
<td>42 (15.2%)</td>
<td>50 (13.0%)</td>
<td>92 (13.9%)</td>
</tr>
<tr>
<td>Diastema absent</td>
<td>235 (84.8%)</td>
<td>334 (87.0%)</td>
<td>569 (86.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>277 (41.9%)</td>
<td>384 (58.1%)</td>
<td>661 (100%)</td>
</tr>
</tbody>
</table>

There was no statistical significant difference in the prevalence of midline diastema between males and females (p=0.4333)

The sample size was 661 comprising 384 (58.1%) females and 277 (41.9%) males. 92 patients (13.9%) presented with midline diastema of which 50 (13.0%) were females and 42 (15.2%) were males (Table 1). There was no significant difference in the prevalence of midline diastema between males and females (p>0.05).

The ages of the patients with diastema ranged from 12 to 58 years with a mean age of 18.8 years. The majority of the patients (n=64, 69.6%) were of the 12 to 19-year age range (Table 2).

Table 2: Age Distribution among the sexes (n=92)

<table>
<thead>
<tr>
<th>Age(years)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 – 19</td>
<td>28</td>
<td>36</td>
<td>64 (69.6%)</td>
</tr>
<tr>
<td>20 – 29</td>
<td>10</td>
<td>8</td>
<td>18 (19.6%)</td>
</tr>
<tr>
<td>30 – 39</td>
<td>1</td>
<td>2</td>
<td>3 (3.2%)</td>
</tr>
<tr>
<td>40 – 50</td>
<td>3</td>
<td>4</td>
<td>7 (7.6%)</td>
</tr>
</tbody>
</table>
Protruding maxillary incisal teeth was the chief concern of the majority of patients (n=26, 28.3%) and closure of midline diastema ranked forth (n=12, 13.0%) (Figure 1).

Figure 1: Frequency of Chief Complaints of Orthodontic Patients with Midline Diastema (n=92)

Table 3 shows the distribution of the site of diastema in this study. Majority of patients (n=86, 93.5%) presented with midline diastema in the maxilla only, followed by (n=4, 4.3%) patients presenting with mandibular diastema. Only (n=2, 2.2%) patients presented with both maxillary and mandibular diastema. There was no statistically significant difference between males and females in the distribution of midline diastema in the jaws (p>0.05).

Table 3: Distribution of Midline Diastema by Site (n=92)

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary jaw</td>
<td>39(92.9%)</td>
<td>47(94.0%)</td>
<td>86(93.5%)</td>
</tr>
<tr>
<td>Mandibular jaw</td>
<td>2(4.7%)</td>
<td>2(4.0%)</td>
<td>4(4.3%)</td>
</tr>
<tr>
<td>Both Max/Mand</td>
<td>1(2.4%)</td>
<td>1(2.0%)</td>
<td>2(2.2%)</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>50</td>
<td>92</td>
</tr>
</tbody>
</table>

There was no statistically significant difference between males and females in the distribution of midline diastema in the jaws (p=0.976)

The size of the maxillary midline diastema ranged from 1.00 to 10.48mm with a mean of 3.09mm. The mandibular midline diastema measurements ranged from 4.00 to 5.37mm with a mean of 4.6mm. The relationship between the chief complaint and the size of the diastema is as shown in Table 4.

Table 4: Distribution of Width of Midline Diastema Against Chief Complaint. N=92

<table>
<thead>
<tr>
<th>Chief complaint/ measurement</th>
<th>Width of midline diastema (mm)</th>
<th>Mean/mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closure of diastema /space</td>
<td>1.19 - 10.48</td>
<td>4.3</td>
</tr>
<tr>
<td>Correction of protruding maxillary teeth</td>
<td>1.00 - 6.36</td>
<td>2.7</td>
</tr>
<tr>
<td>Incorrect alignment of teeth</td>
<td>1.10 - 2.47</td>
<td>1.8</td>
</tr>
<tr>
<td>Correction of crossbite</td>
<td>1.50 - 1.99</td>
<td>1.7</td>
</tr>
<tr>
<td>Routine dental examination</td>
<td>0.56 - 2.64</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Figure 2 demonstrates that the most common aetiological risk factor was the proclination of teeth (n=32, 34.8%). The least common aetiological factor was congenitally missing lateral incisors (n=2, 2.2%) preceded by habit and alveolar intraosseous cleft, each (n=3, 3.3%) There was no patient with an aetiological risk factor of a supernumerary tooth or mesiodens (Figure 2)

Figure 2: Frequency of Primary Etiological Risk Factors of Clients with Midline Diastema (n=92).

The treatment procedures included fixed bonded
orthodontic appliances to close the diastemas completely or partially. Additional procedures included restorative composite build-up of peg-shaped laterals, fixed or removable prostheses to replace missing lateral incisors and frenectomies.

Midline diastema were completely closed in (n=89, 96.7%) patients. Partial closure was attained in (n=3, 3.3%) patients.

The period that the patients had been in retention after the active treatment at the telephone interviews (TFU) ranged from 1 to 8 years, with a mean period of 6 years.

At TFU contact, (n=80, 86.9%) of the patients still had the diastema closed while (n=2, 2.2%) had relapse of the diastema. (Table 5)

<table>
<thead>
<tr>
<th>Post treatment status</th>
<th>Complete closure</th>
<th>Partial closure</th>
<th>Relapsed</th>
<th>Lost to follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post treatment</td>
<td>89 (96.7%)</td>
<td>3 (3.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post follow up</td>
<td>80 (86.9%)</td>
<td>3 (3.3%)</td>
<td>2 (2.2%)</td>
<td>7 (7.6%)</td>
</tr>
</tbody>
</table>

Table 5: Status of Midline diastema at immediate post treatment and post follow up periods

Contact with the patients who had retainers bonded (n=81), revealed that (n=72, 88.9%) patients still had their retainers in place and (n=2, 2.5%) patients had lost their bonded retainers. Seven (8.6%) patients were lost to follow up (Figure 3).

Figure 3: Pie Chart showing Patient with Retainers (n=81)

Discussion

The prevalence of midline diastema varies among different racial groups. Previous studies reported lower incidence in Caucasians compared to the African population. Studies from Sudan, Nigeria and Kenya reported midline diastema prevalences of 7.3%, 28% and 36% respectively. The prevalence of 13.9% recorded in the present study was higher than the reports from Sudan but lower than those of Nigeria and Kenya this could be due to the fact that the study sample was from orthodontic patients as opposed to the samples from the general population in the other African studies.

In our study the greatest number of patients with midline diastema (n=64, 69.6%) was recorded in the youngest age group of 12-19 years and the lowest number (n=3, 3.2%) recorded in the 30-39-year age group. This finding supports reports of previous studies which documented higher incidences of the midline diastema in the younger age groups when compared with the older population. The midline diastema is regarded as a developmental phenomenon which develops during the eruption of the permanent incisors and closes after the eruption of all the incisors. It is therefore observed commonly during the second decade of life.

Several previous studies reported a higher prevalence of the midline diastema in females than in males, however Richardson et al. and Liu et al. recorded a higher prevalence in males after the ages of 12 and 14 years respectively. They attributed the higher prevalence in males in this age group to the late eruption of the incisors in males when compared with females. The majority of patients in the current study presented between the ages 12 to 19 years, a period that the midline diastema occurs more in males than in females, however, there was no statistical difference observed between the prevalence of midline diastema in males and females. This finding may be due to the study’s small and specialized orthodontic population.

This sample of orthodontic patients was more concerned about protrusion of the incisor teeth, generalized spacing and mal-alignment of their teeth and jaws than the presence of a midline diastema only. Closure of the midline diastema was the major concern of patients who had the widest midline diastema ranging from 1.19 to 10.43 mm with a mean of 4.3 mm. These findings may be because in African societies, the midline diastema tends to be considered a sign of beauty especially in women and therefore most desirable.

The maxillary midline diastema was the more
common type of diastema recorded in this study which agrees with previous reports. Huang and Create suggested that the maxillary midline diastema is a normal growth characteristic and follows a specific developmental pattern unlike the mandibular midline diastema. In addition, the mandibular midline diastema is less conspicuous than the maxillary diastema and thus is expected to be of less concern to a sample of orthodontic patients.

Several aetiological factors have been identified in the development of midline diastema. In this study, proclination of maxillary incisor teeth which resulted in an increase of arch perimeter was the most frequent aetiological factor recorded. Similar observations were made by Jan et al. Generalized spacing between the teeth was the next frequent aetiological factor recorded in this study. This was reported in previous studies as the most frequent cause of the midline diastema and attributed this finding to tooth size/arc size discrepancy. Other potential risk factors observed in this study included, impacted canines, high frenal attachment, open bites associated with habits, alveolar intra-osseous cleft, rotated incisor teeth, peg shaped and congenitally missing lateral incisor teeth.

In an extensive review of the aetiology of the midline diastema, Huang and Create suggested that multiple factors may contribute to its development. In another review by Abu-Hussein and Watted, it was concluded that due to the multifactorial aetiology of the midline diastema, it was deemed important to understand the underlying cause of each midline diastema before embarking on orthodontic treatment.

The aetiological factor of a mesiodens was however not observed in this study.

In this study, all the patients were treated with fixed maxillary and or mandibular labial orthodontic appliance after detailed clinical assessment and diagnoses of the underlying etiological factor. Removable appliances, lingual appliances and aligners were not used for these patients.

Management of the individual cases was based on the presence or absence of the associated risk factors for the midline diastema. Restorative and periodontal consultations were made when necessary. Additional restorative procedures included restorative composite build-up of peg-shaped laterals, fixed or removable prostheses to replace missing lateral incisors and frenectomies for diastemas associated with low frenal attachments.

The treatment procedures included fixed bonded orthodontic appliances to close the diastemas completely or partially.

The fixed bonded arch treatment enabled the principal author to achieve axial alignment of the roots of the central incisors which is essential for long term stability of the closed midline diastema. Complete closure of the midline diastema was achieved in (n=89, 96.7%) patients. A few patients (n=3, 3.3%) requested for partial closure of the midline diastema.

Complete midline closure uncertainty was managed by a controlled reopening option assurance. To allow for unlimited time appraisal of diastema closure, complete closure was attained, fixed palatal retainers bonded and removable retainers delivered, hence the high percentage of complete diastema closure. Desired reopening was subsequently achieved by intentional fixed retainer detachment followed by collaborative, measured removable retainer adjustment.

Frenectomy was performed in patients with high frenulal attachment after closure of the midline diastema had been achieved as opposed to prior to closure. This procedure was suggested by Abu-Hussein and Watted to allow the postsurgical scar to stabilize the central incisors in the treated positions. Previous studies have recommended bonding of permanent maxillary/mandibular retainers to stabilize the achieved results. In our study, retention involved the bonding of fixed maxillary and or mandibular permanent retainers in (n=81, 88.0%) out of 92 patients, in addition to removable retainers. Whereas (n=11, 12.0%) were fitted with removable retainers only. Patients who were fitted with removable retainers only, desired the reduction of dental protrusion primarily and accepted the decrease of width of the midline diastema secondary to this reduction. They did not wish for the complete closure of their midline diastema.

Review of the patients revealed that 72 (88.9%) out of 81 orthodontic patients who received bonded palatal retainers still had their fixed retainers in place at TFU and two admitted to having lost their retainers. This result was unexpectedly high considering the unrefined and course nature of the typical West African diet.

A corresponding high number of patients (n = 80, 89.9%) stated that their diastemas were still closed and had not relapsed after several years of treatment. Our study supports the concept of bonding fixed palatal/lingual retainers to achieve long-term stability of the completely or partially closed midline diastema.

**Limitations**

The reliance on telephone interviews to determine
the post treatment status of the diastema and retention might limit the generalizability of the results.

Conclusion
The prevalence of midline diastema was 13.9% with no significant sex predilection. In a culture where midline diastema is considered attractive and desirable, patients tended to be more concerned with the associated proclination of their teeth than the midline diastema.

Retention was achieved with both fixed bonded palatal retainers and removable retainers. Frequently, patients and their guardians were undecided as to the attainment of complete diastema closure during treatment. In these cases, complete closure was attained. Desired reopening was facilitated with the debonding of fixed retainer and reopening magnitude controlled by the measured adjustment of the removable retainer.

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Authors’ Contributions
All authors have contributed adequately to be included as authors. MN, JS, SH and NO were responsible for study design. Data acquisition was by JS, SN and NO. Data analysis was by MN, JS, SH, GA and NO. All authors drafted the manuscript and approved its final version.

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