

# Etiology and treatment of midline diastema: A review of literature

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## Abstract

**Introduction:** Midline diastema can be physiological, dentoalveolar, due to a missing tooth, due to peg lateral, midline supernumerary teeth, proclination of the upper labial segment, prominent frenum or due to a self-inflicted pathology by tongue piercing. The treatment involves observation and follow up, active orthodontic tooth movement, combined orthodontic and surgical approach, restorative treatment and Mulligan's technique of overcorrection.

**Material and Methods:** Hand and electronic searching was done for 55 articles for this review of literature.

**Results:** Midline diastema is common dental anomaly having multiple causes and various orthodontic and surgical options for management.

**Conclusions:** Midline diastemas require proper diagnosis and timing for better care of patients.

**Keywords:** spacing; gap; diastema causes

## Introduction

A space between adjacent teeth is called a "diastema". Midline diastemata (or diastemas) occur in approximately 98% of 6 year olds, 49% of 11 year olds and 7% of 12-18 year olds.<sup>1</sup> In most children, the medial erupting path of the maxillary lateral incisors and maxillary canines, as described by Broadbent results in normal closure of this space.<sup>2</sup> In some individuals however, the diastema does not close spontaneously. The continuing presence of a diastema between the maxillary central incisors in adults often is considered an esthetic or malocclusion problem.<sup>3</sup> Midline diastema's can be physiological, dentoalveolar, due to a missing tooth, due to peg shaped lateral, midline supernumerary teeth, proclination of the upper labial segment, prominent frenum and due to a self-inflicted pathology by tongue piercing.<sup>4,5</sup> Angle and Sicher<sup>6</sup> stated that an abnormal frenum is a cause of midline diastema, while Tait<sup>7</sup> in his study reported that frenum is an effect and not a cause for the incidence of diastema.

The extent and the etiology of the diastema must be properly evaluated. In some cases interceptive therapy can produce positive results early in the mixed dentition. Proper case selection, appropriate treatment selection, adequate patient cooperation, and good oral hygiene all are important.<sup>8-10</sup> Eruption, migration and physiological readjustment of the teeth, labial and facial musculature, development into the beauty-conscious teenage group, the anterior component of the force of occlusion and the increase in the size of the jaws with accompanying increase in tonicity of the facial musculature all tend to influence closure of the midline dental space.<sup>11</sup> The mandibular diastema is not a normal growth characteristic. The spacing, though seen less frequently than maxillary diastema, often is more dramatic. No epidemiologic data have been published on its prevalence. The primary etiologic factor in mandibular diastema is tongue thrust in a low rest position.<sup>12</sup>

Many patients seek closure of a diastema for aesthetic reasons. In the case of normal physiological development, diastemas of less than 2mm in nine-year-old children generally

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close spontaneously.<sup>13</sup> If they do not do so, small diastemas (less than 2mm) can be closed with finger springs on a removable appliance or with a split Essix plate, as described by Sheridan.<sup>14</sup> In adults with wider diastemas, fixed appliances are required for correction so that crown and root angulations are controlled.<sup>15</sup>

The etiology, pathogenesis and diagnosis of maxillary median diastema have been somewhat controversial over the years. The purpose of this paper is to review the published information and controversies regarding the etiology and treatment of the midline diastema in order to give the practitioner an overview to direct effective diagnosis and treatment.

## Material and Methods

Computer databases, including PubMed, Science direct and Google advance search were searched. Internationally published research literature, review articles and relevant citations were included. After the electronic literature search, a hand search of key orthodontic journals was undertaken to identify recent articles. The review was restricted to articles dealing with the etiology and management of maxillary midline diastema. Exclusion criteria included articles that did not follow the objective of this review and articles in a language other than English.

## Results

A broad search of published articles (The Angle Orthodontist, American Journal of Orthodontics and Dentofacial Orthopedics, British Dental Journal, European Journal of Orthodontics, Journal of clinical pediatrics, Journal of Oral Pathology Pakistan oral and Dental Journal, Journal of dental association) was done using both the electronic database and hand searching. A total of 55 studies were retrieved initially. 45 studies were closely related to study objective were used to write the review of literature for the etiology and management of midline diastema.

## Discussion

The midline diastema is a space (or gap) greater than 0.5mm between the mesial surfaces of maxillary central incisors. The space can be a normal growth characteristic during the primary and mixed dentition and generally is closed by the time the maxillary canines erupt. For most children, with the eruption of canine normal closure of this space occurs. For some individuals, however, the diastema does not close spontaneously.<sup>16</sup> Midline diastema's can be genetical, physiological, dentoalveolar, due to a missing tooth, due to peg shaped lateral, midline supernumerary teeth, proclination of the upper labial segment, prominent frenum and due to a self-inflicted pathology by tongue piercing.<sup>17,18</sup>

Midline spacing has a racial and familial background.<sup>19</sup> Although no specific genes have been investigated for its genetic etiology but there are many syndromes and congenital anomalies which contained midline diastema one of their component e.g. Ellis-van Creveld syndrome,<sup>20</sup> Pai Syndrome,<sup>21</sup> lateral incisor agenesis<sup>22</sup> and cleft palate,<sup>23</sup> median cyst.<sup>24</sup>

Midline diastema may be considered normal for many children during the eruption of the permanent maxillary central incisors. When the incisors first erupt, they may be separated by bone and the crowns incline distally because of crowding of the roots. With the eruption of lateral incisors and permanent canines, midline diastema reduces or even closes (ugly duckling stage).<sup>25</sup>

A maxillary midline diastema may be caused by the insertion of the labial frenum into the notch in the alveolar bone, so that a band of heavy fibrous tissue lies between the central incisors.<sup>26</sup> The two central incisors may erupt widely separated from one another and the rim of bone surrounding each tooth may not extend to the median suture. In such cases, no bone is deposited inferior to the frenum. A V-shaped bony cleft develops between two

central incisors, and an "abnormal" frenum attachment usually results.<sup>27</sup> Transseptal fibers fail to proliferate across the midline cleft, and the space may never close.<sup>28</sup> Angle and Sicher stated that an abnormal frenum is a cause of midline diastema,<sup>29,30</sup> while Tait in his study reported that frenum is an effect and not a cause for the incidence of diastema.<sup>31</sup>

V-shaped midline bony clefts may interrupt the formation of transseptal fibers and have been suggested as a cause of diastemas. Higley<sup>32</sup> suggested that a slight cleft of intercrestal bone can hold the teeth apart. Orthodontic relapse has been correlated with severity of maxillary bony notching.<sup>33</sup>

Patients with supernumerary teeth had delayed or failed eruption of permanent teeth, whereas inverted supernumeraries were more likely to be associated with bodily displacement of the permanent incisors, median diastema and torsion.<sup>11</sup>

Conditions associated with tooth size-arch length discrepancy such as anodontia, oligodontia, microdontia, peg shaped laterals, macrognathia may cause midline diastema. If the lateral incisors are small or absent, the extra space can allow the incisor teeth to move apart and create a diastema.<sup>34</sup>

Prolonged pernicious habits can change the equilibrium of forces among the lips, cheeks, and tongue and cause unwanted dentofacial changes tooth movement.<sup>35</sup> The outward pressure from prolonged oral habits (light continuous force over 6 hr) with inadequate lips seal can cause the maxillary incisors to flare out, which leads to the midline diastema. Examples include: lower lip biting and digit sucking.<sup>36</sup>

Conditions such as macroglossia, tongue thrust, improper tongue rest position, and/or flaccid lip muscles can cause midline diastema.<sup>37</sup>

Rapid maxillary expansion can cause midline diastema due to opening of the intermaxillary

suture but it is temporary and closes by itself in most cases.<sup>38</sup>

An open midpalatal suture or skeletal cleft may prevent normal space closure and present as midline diastema.<sup>3</sup>

An object can deflect the eruption pattern of the maxillary central incisors or physically move

the incisors laterally to create midline spacing. Examples include:

Retained primary tooth, midline pathology (cysts, fibromas), Foreign body and associated periodontal inflammation

Moyers stated that imperfect fusion at the midline of premaxilla is the most common cause of maxillary midline diastema. The normal radiographic image of the suture is a V-shaped

Structure.<sup>11</sup>

Because of the potential for multiple etiologies, the diagnosis of a diastema must be based on a thorough medical/dental history, clinical examination, and radiographic survey. Diagnostic study models also may be necessary for analysis and measurement when the diastema may be due to malocclusion, or tooth and/ arch size discrepancy. The medical/dental history should investigate any pertinent medical conditions (such as hormonal imbalances), oral habits, previous dental treatment and/or surgeries, and family history of diastemas or other related dental problems. The clinical exam should include evaluation of possible pernicious oral habits, soft tissue imbalances (e.g., macroglossia), improper dental alignment (rotated teeth, excessive overbite/overjet), missing teeth, or other dental anomalies. The "blanching test" may be used to evaluate the frenal attachments.

Panoramic and periapical radiographs are necessary to evaluate the patient's dental age and any physical impediments, abnormal suture morphology, missing teeth, dental anomalies, improper dental alignment, or abnormal eruption paths. In some instances,

complete orthodontic records and a Bolton's analysis<sup>39</sup> may be necessary to rule out skeletal/dental malocclusions as well as possible jaw size and/or dental size discrepancies.

Persisting midline diastemas are often seen by dentists in people seeking esthetic improvement. A study by Kerosuo<sup>40</sup> reports that people with significant anterior crowding or midline diastema were very frequently considered less intelligent, beautiful and sexually attractive and were perceived to be of a lower social status in comparison to the same individuals when they had excellent occlusion. Rosenstiel and Rashid<sup>41</sup> in an Internet study concerning the opinion of lay people about anterior teeth esthetics, showed that conditions such as diastema and midline deviation received the worst ratings. Detailed analysis and understanding of malocclusion is needed by the orthodontist, so that he/she may successfully treat midline diastema for the patient's esthetic and functional benefit.

Before the practitioner can determine the optimal treatment, he or she must consider the contributing factors. These include normal growth and development, toothsize discrepancies, excessive incisor vertical overlap of different causes, mesiodistal and labiolingual incisor angulation, generalized spacing and pathological conditions.<sup>42</sup> A carefully developed differential diagnosis allows the practitioner to choose the most effective orthodontic and/or restorative treatment. Diastemas based on tooth-size discrepancy are most amenable to restorative and prosthetic solutions.<sup>43</sup> The most appropriate treatment often requires orthodontically closing the midline diastema. The following treatment options are in practice.

In some cases, orthodontic closure of the diastemas is limited to the central incisors. In patients with good posterior occlusion or who have economic considerations, the diastema can be closed simply with removable

orthodontic appliances. A removable Hawley appliance with finger springs is commonly used. Simple fixed appliances often have been used.<sup>44,45</sup> These devices involve a U- or V-shaped sectional wire and some double-helical closing loops and are bonded directly to the incisors or attached to lingually bonded tubes. Micromagnetic devices have been described.<sup>46</sup> These fixed appliances also can serve as post-treatment retainers. Diastema closure in these cases should be deferred until the canines erupt.

In certain instances closing a diastema requires bodily approximation of the incisors. Full banded/bracketed orthodontic arch appliances can move incisors bodily to close the space. However, if time or cost factors prohibit this type of treatment, or if the diastema is the only malocclusion needing treatment, sectional arch wire techniques are a useful alternative.<sup>47</sup> This technique involves bonding brackets directly on the four maxillary incisors and using a 0.018- in. sectional wire. An elastomeric chain or elastic thread should be placed from the mesial wing of one lateral incisor bracket through the brackets of the centrals to the mesial wing of the other lateral. Overstretching the elastomeric chain can cause unwanted mesial rotation of the lateral incisors if the elastomeric chain is connected from the distal wing of one bracket to the distal wing of the other. Treatment with a "2x4 appliance" or utility arch can provide better control of incisors during closure of the midline spaces and also can retract any minor incisor flaring. Although treatment is best delayed until canine eruption, it can be initiated after the lateral incisors have erupted.

Many cases of protruded maxillary incisors demonstrate overeruption of the incisors in both arches. Decreasing the overjet by simply moving the incisors lingually can cause a significant occlusal contact. Removable appliances often will cause this unwanted overbite and should be used carefully and

only in patients with minimal overbite and when the maxillary incisors are not in contact with mandibular incisors. Hawley-type retainers with a labial bow and clasps are useful for this limited therapy. In most cases of increased overjet, treatment requires the use of a full-arch fixed appliance technique to intrude the incisors while closing the diastema. Both arches may require treatment. In some of these cases headgear may be needed for appropriate anchorage.

In general, fixed-type appliances can provide better control in crown/root angulation, overbite, and overjet. Bracketed/banded appliances can close diastemas due to improper tooth inclination, deleterious occlusal patterns, posterior bite collapse, deep bite with insufficient torque, or skeletal and/or dental class II division 1 malocclusion.<sup>48</sup> Some patients may need to wear a headgear or Class II elastics to distalize the posterior teeth. Class I relationships should be achieved before the diastema is closed. Removable orthodontic appliances can be used cautiously in diastema cases with Class I dental and/or skeletal relationship and mild or acceptable overbite. Management of maxillary midline diastema with missing lateral incisor in early mixed dentition by 2×4 appliance<sup>49</sup> included closure of space between maxillary central incisors, space created between permanent central incisor and deciduous canine to be closed by prosthetic replacement. Maxillary permanent canines to be guided in the place of lateral incisor and achievement of appropriate canine and molar relationship. Alternative treatment based upon the proclination of anterior teeth and molar occlusion, either canine could be retained in lateral incisor position and molar relationship finished in class II, or canine moved into its place and molar relationship finished in class I with replacement of missing lateral incisors.

There has been a controversy even among orthodontists concerning the need at all, and

the timing for a frenectomy. Some orthodontists support a viewpoint that there is a need for an early removal of the frenum, so as to prevent any obstacles to complete diastema closure. Other orthodontists propose to close the diastema first, and then carry out frenectomy in the hope that the resultant scar tissue will hold together the teeth in close apposition. A third body of clinicians rarely, if ever, considers surgical removal of the frenum. They prefer to combat the undeniably increased relapse potential when a diastema is closed, by using bonded retainers on the two central incisors.<sup>50</sup>

The indications for surgical removal of the maxillary midline frenum are usually the following; prevention of median diastema formation, prevention of post-orthodontic relapse of a median diastema, facilitation of oral hygiene, prevention of gingival recession.<sup>51</sup>

Various surgical techniques have been proposed by clinicians. The simplest method is performed with two parallel incisions on each side the frenum joined in the vestibule by a scissor cut. The wound edges are closed with a single suture.<sup>51</sup> this technique, known as a V-shaped incision., is reported to leave a scar contracture that can lead to periodontal problems, as well as loss of the interdental papilla between the maxillary central incisors.<sup>52</sup> other techniques are Z-plasty, Vestibular sulcus extension and Morselli'procedure. Last three techniques associated with less scar formation but surgically demanding.

It is important to mention that there are restorative solutions (veneers, crowning and composite buildup) to these cases without orthodontic intervention. However, restorative measures are more likely to be appropriate in adults and are also subject to on-going maintenance issues. Care must be taken that the emergence profile of any restoration is not over-contoured creating hygiene problems. Care must also be taken

with the crown width/length ratio. Maxillary midline spacing can also be reduced or temporarily closed with composite resin directly on the proximal surfaces of teeth adjacent to the space without bonding agent prior to orthodontics. It may then be removed as tooth movement proceeds. When combined orthodontic-restorative treatment is planned, collaboration between the orthodontist and the restoring dentist should begin at the diagnostic phase.<sup>53</sup>

A bonded palatal fixed retainer (on two central incisors or canine to canine) is advisable in the majority of cases to stabilise the post treatment result. In wider diastemas this retention should be permanent. As with all bonded retainers patients should be instructed in good oral hygiene, including the use of floss threaders. The authors generally provide patients who have bonded retainers with a removable Hawley-type retainer to be worn at night for the first few years. Mulligan<sup>48</sup> in a recent report presents a novel method of reducing retention requirements in these cases. He moves the apices of the incisors distally in finishing the treatment. In this way, he postulates, larger functional moments are produced when the incisor roots are divergent which help to keep the diastema closed. To test the stability he removed the archwires for a six-weeks period near the end of treatment. The disto-incisal edges of the tipped teeth are modified with the use of disks for enhanced aesthetics. This interesting approach holds promise.

## Conclusions

- Etiology of midline diastema is multifactorial.
- Proper diagnosis and timing is the important part of management.
- Management options are observation and follow up, orthodontic treatment, frenectomy and space closure and restorative treatment.
- Permanent retention is the most important part of treatment.

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