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The role of the maxillary labial frenectomy in closure of the midline diastema: A review and management recommendations

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Abstract

A maxillary midline diastema is often seen in childhood as part of physiological development, but those persisting after the establishment of the permanent dentition may be a functional and aesthetic concern for which patients seek treatment. The association between an enlarged maxillary labial frenum and a maxillary midline diastema is commonly reported in the literature. However, the aetiologic role of an enlarged frenum likely represents only a proportion of diastema cases, and many diastemas exist without the presence of an abnormal frenum. This paper provides an overview of the maxillary labial frenectomy and its' role in closure of the midline diastema, providing management recommendations for practitioners.

Clinical Relevance

There are conflicting views amongst dentists on the association between an enlarged maxillary labial frenum and a midline diastema. This paper reviews the topic and discusses whether the literature supports provision of a maxillary labial frenectomy to aid midline diastema closure.

Objectives Statement

To provide an overview of the role of the maxillary labial frenectomy in closure of the maxillary midline diastema, with provision of management recommendations for clinicians.

The authors declare that there is no conflict of interest.

Informed consent has been given for the use of the images included in this article.

The maxillary labial frenum

The maxillary labial frenum (MLF) is a dynamic structure, connecting the central portion of the upper lip to the mucosa of the maxillary alveolar process.¹ It is a normal, albeit variable, structure that provides stability for the upper lip.¹ Being larger in early childhood, the MLF generally diminishes in size and moves to a more coronal position following eruption of the permanent incisors and growth of the alveolar process.²

Labial frenal attachments can be classified clinically by their anatomical insertion level as detailed in Table 1,³ with clinical photographs demonstrating these attachments in Figure 1. Mucosal and gingival frenal attachments are the most commonly seen types,^{4,5} and are often considered 'normal' variations, with papillary and papillary penetrating types seen as enlarged or 'abnormal' variations and potentially pathological.⁶ There are no microscopic differences seen between an aberrant MLF and a frenum of more normal configuration and position.⁷

A pathological frenum has been described as one that is inordinately large and/or attaching close to the gingival margin, with residual fibers persisting between the maxillary central incisors into the interincisal suture.⁸ In view of this, the so called 'blanch test' has traditionally been used to determine whether a frenum is abnormal (and potentially requiring treatment).⁹ This involves applying tension over the frenum by pulling the upper lip upwards and outwards, to check for blanching of the palatal mucosa in the region of the incisive papilla,¹⁰ as shown in Figure 2.

Frenum attachments and their impact on oral function and development has long been a topic of interest amongst both dentists and other healthcare specialties,⁹ and there are many reported complications associated with enlarged frenum attachments in the literature.^{1, 11,12} A pathological frenum attachment has been reported to jeopardize gingival health by causing plaque retention and an interference with oral hygiene practices.^{5,13} It may also be subject to recurrent trauma with a toothbrush,¹⁰ and is a reported contributory factor in gingival recession cases due to the

increased muscle pull on the gingival margin.^{5, 13} Additionally, in adults, an abnormal frenum attachment can interfere with the successful fit and retention of dentures.¹⁴ In view of this, select cases presenting in the permanent dentition with an enlarged MLF and an associated periodontal or prosthodontic complication, may warrant a discussion of the potential benefits of a frenectomy procedure. It has also been stated that enlarged frenum attachments can cause feeding difficulties in newborns, and contribute to buccal caries in breastfeeding infants, however these associations are refuted, with no high-quality evidence to support them.^{1,12}

The maxillary midline diastema

A maxillary midline diastema (MMD) can be defined as a space of greater than 0.5mm between the proximal surfaces of two adjacent central incisors¹⁵ and it is often observed in children as part of normal development in the mixed dentition. Many MMD disappear spontaneously with the eruption of the lateral incisors and canines, though in some individuals they can persist after the establishment of the permanent dentition.^{16, 17} It has been reported that during normal physiological development, diastemas seen in 9-year-olds that are less than 2mm wide generally close spontaneously.¹⁸

The reported prevalence of MMD in adults varies between 1.6% to 25.4%, depending on the population studied, with an even greater variety in the young population groups.¹⁷ There is no commonly used classification for diastema size, but some authors define diastemas less than 2mm as small and those wider than 2mm as large.¹⁸ The aetiology is thought to be multifactorial with numerous contributory factors, as shown in Table 2,^{19, 20, 21, 22} and radiographic examination is essential to assess for these factors alongside a thorough history and clinical examination.¹⁸

Whilst there are no notable complications associated with the presence of a diastema, it can be an aesthetic concern for patients for which they may seek treatment.¹⁷ In a 2012 study, 43% of

the sample of 200 patients thought the MMD to be unaesthetic, and all of them desired treatment to close it.²³ A study of 120 participants from the same year which looked at the perceptions of dentists, orthodontists and laypersons regarding smile aesthetics, found that all groups rated the diastema unattractive if wider than 1.5mm.²⁴

The enlarged maxillary labial frenum and its relationship to the diastema

There are many studies in the literature on the association between MLF presentations and MMDs, but despite this, no definitive relationship between the two has been established.^{1, 20} Many authors report that an enlarged frenum can cause a midline diastema,^{19, 20, 21, 25} and that abnormal periodontal ligament fibers lying in a heavy fibrous band between the central incisors could cause relapse of the diastema after orthodontic closure.¹⁸ However, some authors report that the enlarged frenum is an effect and not a cause for the incidence of a diastema.²⁶ We also know that enlarged frenum's do exist in the absence of a diastema, and many diastemas exist without the presence of an abnormal frenum.¹⁶

Management options for the maxillary midline diastema

The treatment options for closure of the MMD and the sequence of care will vary with patient age along with other factors such as orthodontic need and patient concerns. The optimal treatment can only be considered once the contributing factors have been determined.¹⁸ Dental anomalies such as supernumerary or ectopic teeth require appropriate management, often followed by a period of monitoring to allow the possibility of spontaneous space closure.¹⁸ It is also essential that any habits contributing to the diastema such as digit sucking are ceased.¹⁶

Diastema closure is not considered in the primary dentition and is only considered in the mixed dentition in select cases, such as when a large diastema is preventing the eruption of further permanent teeth.²⁷ The treatment options for diastema closure in the permanent dentition are often combined and are displayed in Table 3. Each option comes with its challenges, and an

important consideration particularly in children, is their ability to cooperate with the required treatment. This must be carefully balanced with the patient and parent's wish for space closure.

The maxillary labial frenectomy

The association between an enlarged MLF and MMD has led to the belief that removal or modification of the frenum is required to facilitate closure of the diastema.¹⁹ A frenectomy involves complete removal of the frenum including its attachment to the underlying bone, as opposed to a frenotomy which involves simple incision of the attachment.²⁸

A frenectomy can be performed using a scalpel, electrosurgery or soft-tissue lasers as shown in Figure 3. These methods differ in their anaesthetic requirements, cutting characteristics, haemostasis, healing time, post-operative pain and swelling, and costs involved.^{29,30} The surgical scalpel method is the most commonly used, though electrosurgery and laser techniques have gained popularity due to the reported reduction in post-operative pain and swelling.^{29,31} There is insufficient evidence to support claims that one technique is superior to another and patients have been shown to be satisfied with the surgical treatment regardless of method.^{1, 2, 32} In view of the reduced post-operative complications, it would be reasonable to choose a less invasive technique such as electrosurgery.

Risks following a frenectomy procedure, regardless of method, include post-operative bleeding, pain, swelling, risk of infection and scarring.²⁹ Performing the procedure in children is also complicated by difficulties in compliance, and many paediatric patients will require sedation or general anaesthesia for the procedure to be carried out.³³ A 2014 study looking at upper labial frenectomies in children under 11 years of age found that 71% of the patients required the procedure to be done under general anaesthesia,³³ and the additional risks associated with this need to be considered.

The maxillary labial frenectomy and diastema closure

Provision of a frenectomy in early childhood

Whilst some studies suggest that an initial improvement in diastema width in children can be obtained through a frenectomy, control subjects improved equally with age, and this is likely related to eruption of the permanent canines.^{1, 20, 34} It has also been postulated that the scarring which results from carrying out MLF release in childhood, could make a diastema more likely in the permanent dentition.³⁵ Both the American Academy of Otolaryngology-Head and Neck Surgery and the Australian Collaboration for Infant Oral research agree that that MLF release is not indicated in children for prevention of a diastema in the permanent dentition.¹ Whilst there is no current consensus from a similar body in the U.K, the authors are in agreement with this.

Provision of a frenectomy in the permanent dentition without orthodontic treatment

Whilst some case studies have reported spontaneous space closure after a maxillary frenectomy without orthodontic intervention,³⁶ there is little evidence in the literature to support this. The few papers that compare the outcome of space closure following a labial frenectomy without orthodontic treatment are of poor quality and provide a low quality of evidence.^{8, 34, 37, 38,}
³⁹ In the absence of high-quality research that supports this treatment, the authors cannot recommend the use of a maxillary labial frenectomy alone in closure of the upper midline diastema.

Provision of a frenectomy in the permanent dentition in conjunction with orthodontic treatment

A maxillary labial frenectomy is often considered as part of an orthodontic treatment plan and may be performed before or after the orthodontic space closure.^{18, 33} There is much debate between dentists from different specialties on the additional benefits and ideal timing of the frenectomy procedure.

Some clinicians believe that performing a frenectomy prior to orthodontic treatment makes surgical access easier.⁷ It is thought that access to the deep fibers is more limited following full

closure of the space, and the residual fibers may later cause relapse.⁷ In certain cases, a prominent MLF can also prevent complete apposition of the maxillary central incisor teeth.^{7, 40} Other clinicians think that the scar tissue formed by performing the frenectomy early may cause difficulties in subsequent diastema closure with orthodontic treatment.^{7, 10, 40} By performing the frenectomy towards the end of orthodontic space closure, before the appliances are removed, it is also believed that the scar tissue formed may help to stabilise the closure.^{38, 40}

Whilst a survey of dental professionals found no agreement amongst oral and maxillofacial surgeons of when the diastema should be closed, it found that paediatric dentists and orthodontists generally agreed that the procedure should follow orthodontic closure of the space.⁴¹ The literature also contains more support for this sequence than against, and other than in select cases where the frenum size or attachment position inhibits space closure, the authors agree that this is usually the most appropriate order of treatment. It is also important that all diastema cases being considered for frenectomy to aid space closure should be planned in conjunction with an orthodontist.

With regards to stability of the diastema after orthodontic closure, some authors report that an enlarged frenum increases the already high risk of relapse.^{18,42} However, others found no association between relapse and an abnormal frenum.^{43, 44} We do know that an essential measure in preventing relapse following closure of a diastema, regardless of the presence of an enlarged frenum, is long term orthodontic retention.^{27, 45} There is no firm evidence to support maxillary frenectomies as a way of reducing the risk of relapse, and we should not necessarily routinely prescribe this procedure.

Management recommendations when considering a frenectomy to aid closure of the maxillary midline diastema

- The presence of either an abnormal MLF or a MMD are not indications themselves for performing a frenectomy.

- A frenectomy procedure alone, without orthodontic treatment, cannot be recommended for closure of the MMD.
- If a frenectomy is being considered to aid space closure in the permanent dentition, this should be discussed with an orthodontist and planned in conjunction with the patient's orthodontic treatment.
- In the majority of cases, performing the frenectomy towards the end of orthodontic treatment is preferred.
- Long term orthodontic retention after diastema closure, regardless of whether a frenectomy is performed, is always recommended.

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Figures

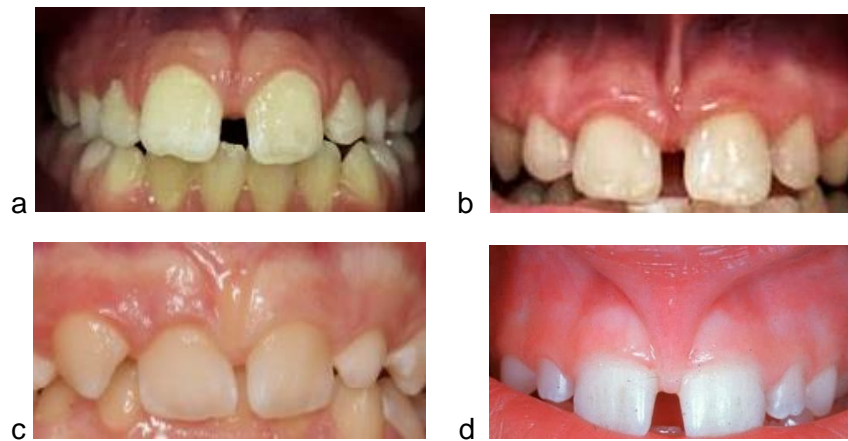


Figure 1. a) A mucosal frenum attachment b) A gingival frenum attachment c) A papillary frenum attachment d) A papilla penetrating frenum attachment



Figure 2. Blanch test being performed, resulting in slight blanching of the frenum and incisive papilla



Figure 3. a) Start of frenectomy procedure using electrocautery b) Start of frenectomy procedure using soft tissue laser c) Start of frenectomy procedure with frenum clipped ready for scalpel blade

Tables

Frenum type		Features
I	Mucosal	The frenal fibers are attached up to the mucogingival junction
II	Gingival	The frenal fibers are inserted within the attached gingiva
III	Papillary	The frenal fibers extend into the interdental papilla
IV	Papilla penetrating	The frenal fibers cross the alveolar process and extend up to the palatine papilla

Table 1. Frenum types as classified by Placek Mirko et al.

Dental factors	Periodontal factors	Muscular or neuromuscular factors	Habits
Hypodontia Microdontia Proclination of upper labial segment Dentoalveolar disproportion Midline pathology such as supernumerary teeth or a cyst Ectopic canines Familial characteristic	Enlarged frenum attachment Periodontal disease	Large tongue Improper tongue position during rest or function	Digit sucking Tongue thrusting Mouth breathing Tongue piercing

Table 2. Factors contributing to an upper midline diastema

Treatment option	Suitable cases	Important points
Accept	<p>Patient happy with diastema appearance</p> <p>Patient unable to cease contributory habit</p> <p>Patient unable to cooperate with treatment for diastema closure</p> <p>Diastema closure not possible such as cases with extensive generalised spacing, severe hypodontia or large diastema width</p>	<p>Diastema closure can still be considered in the future</p>
Restorative space closure with composite or porcelain restorations	<p>Good oral hygiene and caries-free dentition</p> <p>Orthodontic treatment has been completed or is not required in the future</p> <p>Spacing appropriately distributed and teeth sufficiently aligned for aesthetic outcome</p> <p>Patient able to cooperate with treatment</p>	<p>Patient understands ongoing maintenance required</p> <p>Composite preferred to porcelain to avoid tooth preparation</p> <p>More difficult in cases with high smile line</p> <p>May require orthodontic treatment first to idealise spaces</p>
Orthodontic space closure	<p>Good oral hygiene and caries-free dentition</p> <p>Patient able to cooperate with treatment</p> <p>Orthodontic plan favors diastema closure such as redistribution of spacing</p> <p>Orthodontic space closure deemed possible by an orthodontist</p>	<p>Long term retention required</p> <p>May involve long treatment time</p> <p>Long-term maintenance may be preferable to restorative options</p> <p>May require further space closure restoratively</p>
Orthodontic space closure + frenectomy	<p>Good oral hygiene and caries-free dentition</p> <p>Patient able to cooperate with treatment</p> <p>Frenum size or attachment position prevents full closure of diastema or causes relapse</p> <p>Procedure is recommended as part of overall orthodontic plan</p>	<p>Long term retention required</p> <p>Frenectomy procedure may necessitate use of sedation or general anaesthetic</p> <p>Timing of frenectomy procedure needs to be considered</p>

Table 3. Treatment options for diastema closure