

Stability of Midline Diastema Closure by Frenectomy and Orthodontic Treatment: A Systematic Review

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ABSTRACT

Introduction: Midline diastema is one of the most common aesthetic complaints in mixed and sometimes in permanent dentition stage. High frenal attachment is the major aetiological factor causing midline spacing. Combined frenectomy and orthodontic treatment can be done to close the midline diastema which may also increase the stability and reduce relapse.

Aim: To assess the stability of midline diastema closure by using frenectomy and orthodontic treatment.

Materials and Methods: A systematic review was conducted on clinical trials showing the stability of midline diastema closure using frenectomy and orthodontic treatment, articles were searched from 1995 to 2022. A total of 521 articles were retrieved. Among these 433 articles were screened. The risk of bias was assessed for all the studies included in this review.

Results: A total of five studies were included in the systematic review which had clinical trials showing the stability of midline diastema closure in patients having midline diastema of at least 0.5 mm. Four studies using orthodontic treatment have shown some amount of relapse and one study using orthodontic treatment and frenectomy has shown prominent closure of median diastema.

Conclusion: Closure of maxillary median diastema is more prominent when performed using combined frenectomy and orthodontic treatment than orthodontic treatment alone and the risk of relapse is minimal. However, furthermore clinical studies are required to confirm the stability of midline diastema closure by using orthodontic treatment and frenectomy.

Keywords: High frenal attachment, Midline spacing, Mixed dentition, Thick frenum

INTRODUCTION

Ay space or gap existing in midline of the dental arch is termed as midline diastema. It can be defined as a space greater than 0.5 mm between proximal surfaces of adjacent central incisors. It is common in primary and mixed dentitions and is considered normal during this stage [1,2]; whereas in permanent dentition, the incidence of midline diastema is not normal and is present in approximately 38% of people [3].

The midline diastema eventually disappears after eruption of permanent maxillary canines [4,5]. This may not occur in some cases due to abnormal frenal attachment resulting in persistent maxillary midline diastema [5]. The common causes for midline diastema include transient malocclusion, abnormal frenal attachment, midline pathology, genetic predisposition, supernumerary teeth (mesiodens), missing teeth, odontogenic tumours or cysts, tooth material and arch length discrepancy, abnormal tooth position and habits like thumb sucking, lip or finger sucking [1,6].

The most common aetiologic factor of midline diastema is abnormal labial frenum attachment. The maxillary labial frenum is a fold of mucous membrane which develops as post-eruptive remnant of the tectolabial band during intrauterine life and connects the tubercle of upper lip to the palatine papilla. Transient midline diastema may be seen in the ugly duckling stage. After eruption of the permanent central and lateral incisors, the erupting permanent canines displace the roots of lateral incisors mesially resulting in transmission of force to the roots of central incisors which also get displaced mesially. This results in distal divergence of crowns of central incisors causing midline spacing. This phenomenon is called as Broadbent phenomenon or the ugly duckling stage [6,7].

Depending upon the site of attachment of fibre, frenum can be classified as mucosal, gingival, papillary and papillary penetrating [7,8]. High frenal attachment can cause midline spacing. Midline diastema can be diagnosed both clinically and radiographically.

This includes taking proper history and clinical examination and checking for presence of pernicious habit. Blanch test is a test used for indicating abnormal frenal attachment. It is performed by pulling the lips upward and outward to see for presence of blanching in the soft tissue palatal to or between the central incisors. Presence of blanch indicates high frenal attachment [5]. Measuring the mesiodistal width of teeth and comparing it with the arch length determines tooth material arch length discrepancies. Any discrepancy will also lead to thick frenal attachment. Radiographs like periapical, occlusal and panoramic radiograph helps in diagnosing midline pathology. The normal radiographic image of the suture is V shaped. Periapical radiographs showing notching in interdental bone is a diagnostic feature of thick and fleshy frenum [9].

Management of midline diastema due to abnormal frenal attachment can be done by removal of underlying cause, orthodontic management, and surgical management. Orthodontic management involves using fixed appliances incorporating springs or elastics and removal appliances like finger springs and labial bows. However, relapse of midline diastema occurs twice as much in abnormal frenum compared to normal frenal attachment [1,10]. Combined orthodontic and surgical management can be done for prevention of relapse.

Frenectomy used in correction of midline diastema usually involves complete removal of maxillary midline frenum [6]. Various surgical techniques include V-shaped incision, Z-plasty incision and lateral pedicle gingival flap (Miller technique). Frenectomy can also be done using CO₂ laser or radiofrequency ablation [4,11,12]. The stability of midline diastema closure can be increased by performing frenectomy and orthodontic therapy simultaneously [9]. Since literature is sparse on the stability of midline diastema after frenectomy and orthodontic treatment, the aim of this study is to determine the stability of midline diastema closure by frenectomy and orthodontic treatment.

MATERIALS AND METHODS

This systematic review was conducted in SRM dental college, Ramapuram campus, Chennai, India, in the year 2022, with the registration number (SRMU/M&HS/SRMDC/2022/S/017). For the current review, the PICO question was formulated (mentioned below), and the keywords were deduced. The articles collected from the data base was further scrutinised and included based on the inclusion and exclusion criteria.

The PICO of the review is as follows:

Population (P) includes patients with midline diastema;

Intervention (I) being frenectomy and orthodontic treatment;

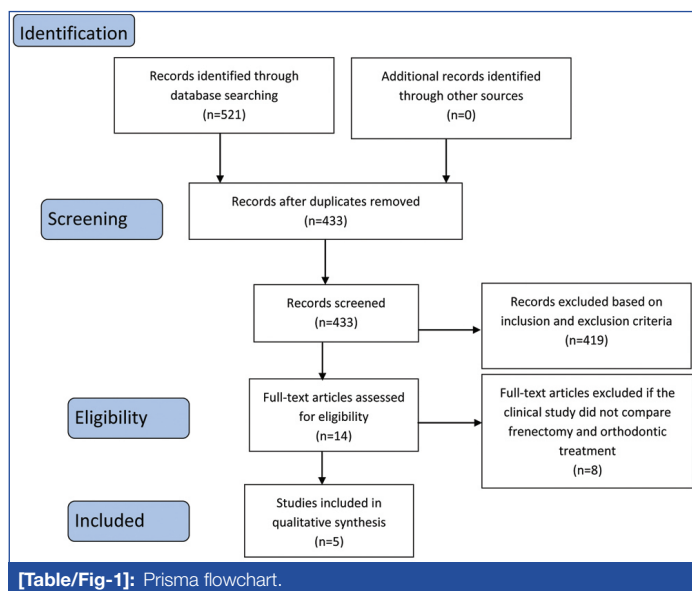
Comparison (C) between orthodontic treatment or combined orthodontic treatment and frenectomy;

Outcome (O) includes stability of closure of midline diastema.

Inclusion criteria: Publications of studies in English with full text articles, articles based on orthodontic treatment or frenectomy as one of the treatment modalities, clinical trial studies of patients with maxillary diastema greater than or equal to 0.5 mm and half crown of permanent canines erupted and publications from all years were included in the study.

Exclusion criteria: Articles published in languages other than English, articles for which only abstracts available, case reports, case series, other systematic reviews, meta-analysis which did not compare between frenectomy and orthodontic treatment were excluded from the study.

Search strategy: Published literature on stability of midline diastema closure by frenectomy during or after orthodontic treatment which includes databases such as PubMed, Scopus, Cochrane and Google Scholar, from the year 1995 to 2022 were taken to study review. A literature search to collect relevant data was performed using the main keywords (Midline Diastema AND Frenectomy AND orthodontic treatment AND Stability). [Table/Fig-1] shows the flow diagram of the reports that were identified, screened, assessed for eligibility, excluded and included in the review.



The tool used to assess risk of bias of all the studies was done according to a study by Cozza P et al., which categorised the quality of the study as high, medium, and low accordingly [13].

RESULTS

The search yielded 521 articles and 433 were screened and assessed independently. A total of 419 articles were excluded which were irrelevant. Out of the remaining 14 full text articles, five articles were included and studied for this systematic review [1-3,7,8].

[Table/Fig-2] shows data collection and quality analysis of the included studies. All the five trials were performed in individuals presenting with midline diastema of at least 0.5 mm. In all the five studies orthodontic treatment were used except one study which uses both orthodontic and frenectomy for midline diastema closure. [Table/Fig-3] shows the risk of bias in all the studies based on the outcome.

DISCUSSION

Midline diastema is a common aesthetic complaint in the mixed and sometimes in permanent dentition stage. It is normal to have a diastema in the early and late mixed dentition stages, but it eventually closes during further development. Midline diastema could be transient or it can occur due to midline pathology, genetic predisposition, supernumerary teeth (mesiodens), missing teeth, odontogenic tumours or cysts, tooth material and arch length discrepancy and oral habits. The high frenal attachment was the major aetiological factor causing midline spacing. Treatment of diastema varies and it requires correct diagnosis of its aetiology and early intervention relevant to the specific aetiology. If the diastema is due to transient malocclusion, no treatment is usually initiated as it spontaneously closes after the eruption of permanent maxillary canines [9].

Management of midline diastema due to abnormal frenal attachment involves orthodontic treatment and surgical management that is frenectomy. Orthodontic treatment alone may not provide stability if the underlying cause is due to abnormal frenum, therefore it can be combined with frenectomy to prevent relapse of midline diastema closure. This research yielded several studies which includes management of midline diastema by using either orthodontic treatment or frenectomy or both [1,2].

In this systematic review the stability of midline diastema closure by using either orthodontic treatment or frenectomy or both has been reported. Shashua D and Artun J has discussed relapse after orthodontic correction of maxillary median diastema on 96 individuals having 0.5-5.62 mm diastema with mean age of 10.9-53.5 years and concluded that about 50% orthodontic patients having median diastema larger than 0.5 mm experience relapse and that abnormal labial frenum is associated with initial width of diastema and is not a risk factor for relapse [1].

Morais JF et al., has discussed the post-retention stability after orthodontic closure of maxillary interincisor diastemas in 30 patients (17 females, 13 males) out of which 18 were Class-I and 12 were Class-II, according to Angle's classification of malocclusion [2]. He concluded that midline diastema relapse was statistically significant and occurred in 60% of the sample. Only initial diastema width and overjet relapse showed association with relapse of midline diastema.

S. No.	Author	Year of publication	Design of the study	Experimental and control samples	Orthodontic treatment or frenectomy	Methods used to assess the stability	Treatment duration	Success rate	Conclusion by authors
1	Shashua D and Artun J [1]	1999	Retrospective	96 individuals having 0.5-5.62 mm diastema with mean age of 10.9-53.5 years	Orthodontic treatment	Study models, radiographs, photographs, clinical examination and questionnaire	4-9 years	Incidence of diastema relapse is 49% i.e., 47 out of 96 patients	About 50% out of 10% orthodontic patients having median diastema larger than 0.5 mm experience relapse. Abnormal labial frenum is not a risk factor for relapse

2	Morais JF et al., [2]	2014	Retrospective	30 patients (7 female, 13 male) out of which 18- are Class-I and 12 are Class-II	Orthodontic treatment	Dental cast, panoramic and periapical radiographs	Mean treatment time 2.38 years	Relapse occur in 18 patients (60%) with mean increase in diastema upto 0.78 mm	Statistically significant relapse which occur in 60% of sample. Relapse is associated with initial diastema width and overjet relapse
3	Carruitero MJ et al., [3]	2020	Retrospective	24 patients (15 female, 9 male) with 8 Class-I and 16 Class-II	Orthodontic treatment	Dental cast, panoramic and periapical radiographs	2-5.81 years	Relapse of maxillary interincisor diastema occur in 27.78%, specifically 8.33% for midline diastema	Stability for maxillary interincisor diastema closure was 72.22%, specifically 91.67% for midline diastema closure
4	Suter VG et al., [7]	2014	Retrospective	59 patients, Group-A -11 patients with diastema <2 mm Group-B -41 patients with diastema 2-4 mm Group-C -7 patients with diastema >4 mm	31 patients (52.5%)- frenectomy and active orthodontic treatment, 27 patients (45.8%)- frenectomy. For one patient information consent regarding the orthodontic treatment was not available	Medical charts with written documentation and intraoral photographs	-	Diastema closure after each follow-up- 2-12 weeks- 0 (frenectomy alone), 4 (frenectomy+ orthodontic therapy) -3-19 months-3 (frenectomy alone), 20 (frenectomy+ orthodontic therapy) -21-121 months-4 patients have persisting diastema	Closure of maxillary midline diastema with prominent frenum is more predictable with frenectomy and orthodontic treatment than with frenectomy alone
5	Sullivan TC et al., [8]	1996	Retrospective	35 patients aged 9.1-15.4 years with diastema 0.9-3 mm	Orthodontic treatment	Impression putty and stainless steel calipers	1.2-4.4 years	12 patients (34%)- measurable relapse, 6 patients (17%)- 0.1-0.3 mm relapse, 3 patients (9%)- 1-1.6 mm, 2 patients (6%)-3 mm relapse	Abnormal frenum and intermaxillary clefts are not risk factor for relapse. Proclination of maxillary incisors was the only post-treatment change associated with relapse

[Table/Fig-2]: Data collection and quality analysis [1-3,7,8].

S. No.	Author	Year	Article/sample size	Sample size calculation	Withdrawal	Method error analysis	Blinding of assessment	Statistics adequate	Quality of study
1	Shashua D and Artun J [1]	1999	Yes	No	Yes	Yes	No	Yes	Medium
2	Morais JF et al., [2]	2014	Yes	No	No	Yes	No	Yes	Medium
3	Carruitero MJ et al., [3]	2020	Yes	Yes	No	Yes	No	Yes	Medium
4	Suter VG et al., [7]	2014	Yes	No	No	No	No	Yes	Medium
5	Sullivan TC et al., [8]	1996	Yes	No	No	Yes	No	Yes	Medium

[Table/Fig-3]: Risk of bias [1-3,7,8].

Carruitero MJ et al., discussed the stability of maxillary interincisor diastema closure after extraction orthodontic treatment involving 24 patients (15 females, 9 males), out of which eight were Class-I and 16 were Class-II, according to Angle's classification of malocclusion and concluded that maxillary interincisor diastema closure showed no statistically significant relapse after orthodontic treatment with premolar extractions [3]. Clinically, significant stability for maxillary interincisor diastema closure was 72.22% and, specifically, for interincisor midline diastema closure, it was 91.67%.

Suter VG et al., discussed whether the maxillary midline diastema close after frenectomy in 59 patients [7]. He has divided the patients into Group-A: 11 patients with diastema <2 mm, Group-B: 41 patients with diastema 2-4 mm and Group-C: 7 patients with diastema >4 mm among which 31 (52.5%) patients had underwent frenectomy and active orthodontic treatment, 27 (45.8%) patients underwent frenectomy. For one patient information consent regarding the orthodontic treatment was not available. He concluded that closure of maxillary midline diastema with prominent frenum is more predictable with frenectomy and orthodontic treatment than with frenectomy alone.

Sullivan TC et al., has discussed a post-retention study of patients presenting with a maxillary median diastema which involves 35 patients aged 9.1-15.4 years with diastema 0.9-3 mm [8]. He concluded that abnormal frenum and intermaxillary clefts are not

risk factor for relapse. Proclination of maxillary incisors was the only post-treatment change associated with relapse.

Limitation(s)

No Randomised Controlled Trials (RCTs) were conducted and lesser studies regarding the comparison of two procedures used in this review. However, further clinical studies with proper randomisation must be conducted to assess the midline diastema closure and its stability using different methods.

CONCLUSION(S)

Closure of maxillary median diastema is more prominent when it is performed by using combined frenectomy and orthodontic treatment than orthodontic treatment alone. Also, abnormal frenum is not a risk factor for relapse. The stability improves when frenectomy is done as a combination with orthodontic treatment. However, furthermore clinical studies are required to confirm the stability of midline diastema closure by using orthodontic treatment and frenectomy.

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PLAGIARISM CHECKING METHODS: [Jan H et al.]

- Plagiarism X-checker: Sep 29, 2022
- Manual Googling: Jan 11, 2023
- iThenticate Software: Mar 13, 2023 (20%)

ETYMOLOGY: Author Origin**AUTHOR DECLARATION:**

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Sep 20, 2022**Date of Peer Review: **Nov 24, 2022**Date of Acceptance: **Mar 14, 2023**Date of Publishing: **May 01, 2023**