

Association of Median Diastema with Maxillary Labial Frenal Attachment in School-Going Children

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ABSTRACT

Objective: To determine the frequency of the type of maxillary labial frenal attachment and its association with median diastema in school-going children of Raiwind, Lahore.

Methodology: After taking ethical approval from Sharif Medical & Dental College, this cross-sectional study was carried out in 8 different schools of Raiwind, Lahore, during a period of 3 months, from January to March 2020. A total of 815 school-going children of both genders, aged 10 to 16 years, were included in this study, after prior permission from the school principals and written informed consent from the parents of these children. Intraoral examination was performed on these children to check the type of maxillary labial frenal attachment (mucosal, gingival, papillary, papillary penetrating), median diastema (presence or absence), and type of dentition (mixed or permanent).

Results: A total of 815 children participated in this study with a mean age of 12.5 ± 1.1 years, out of which 56.2% were males and 43.8% were females. Gingival type of maxillary labial frenum was most common while the papillary penetrating was the least common. Median diastema was present in about 32.8% of the children with no statistically significant difference in genders. Diastema was present in 100% of the students having the papillary penetrating type of labial frenal attachment. It was least common in mucosal type (22.8%) of frenal attachment. Regarding the type of dentition, 57.9% had mixed dentition and 42.1% had permanent dentition. An association between median diastema and type of frenal attachment was determined using the Chi-square test and the results were significant ($p \leq 0.05$). There was a statistically significant difference of frenal attachment types among gender and dentition as well.

Conclusion: This study found maxillary labial frenal attachment types in children in the following descending order: gingival, mucosal, papillary, and papillary penetrating. The percentage of median diastema was highest in papillary penetrating type and lowest in mucosal type of labial frenum. The association between median diastema and the type of labial frenal attachment was statistically significant.

Keywords: Maxillary labial frenal attachment. Median diastema. Frenectomy.

INTRODUCTION

The frenal attachment is one of the most interesting yet misunderstood anatomic structures in the oral cavity and is subject to variation in size, location, and morphology throughout its development.¹ A vertical band of muscle fibers of orbicularis oris and oral mucosa, comprise the labial frenum, which limits the movement of the lips by attaching them to the alveolar mucosa and periosteum of maxillary and mandibular arches.² The labial frenum primarily functions for the provision of stability to the lips, both at rest and during oral functions such as mastication, smiling, speech, and swallowing.³

The labial frenum arises as a part of the oral cavity within the first few weeks of fetal life, along with the developing lips and cheeks. A prominence starts to appear in the middle part of the inner zone of the upper lip which changes into a tuberculum as growth and development progresses. As soon as the tuberculum is developed, one more prominence appears on the anterior part of the palate which develops into palatine

papilla. The prominences of the tuberculum and the palatine papilla are connected by a continuous fold of tissue called the tectolabial frenum. It simulates an abnormal frenum of post-natal life. It extends as a continuous band of tissue from the inner aspect of the upper lip, over and across the alveolar ridge, to be inserted in the palatine papilla. The labial and palatal portions are divided by the growing alveolar process that causes a severance of the continuous fold of the tissue in any normal individual. The palatine papilla is developed from the palatal part whereas the superior labial frenum develops from the labial tissue that extends from the upper lip to the crest of the alveolar ridge.³

At various stages of growth and development, the levels of the frenal attachment are different.¹ The different types of frenal attachments were classified by Placek et al., depending on the anatomical location of the frenum in mucogingival junction, attached gingiva, interdental papilla, and papilla extending to the palate.⁴ The papillary and papillary penetrating types are likely to be pathological if they persist beyond the mixed dentition phase.⁵

The spaces between two or more consecutive teeth can occur anywhere in the mandibular and maxillary arches and are called diastema.⁶ The etiological factors of the median diastema or a gap between maxillary central incisors are the presence of supernumerary teeth (mesiodens), a disproportion between the size of the

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teeth and arch perimeter, abnormal labial frenum, hypodontia, and periodontal disease.⁶ It is a common aesthetic problem in mixed and early permanent dentition with a reported frequency of 1.6-25.4%.⁷ Among the various causes of median diastema, the role of the frenum is of vital interest. The pull of the inordinately large and wide frenal attachment is much greater than usual in some individuals. This variation may require orthodontic treatment for reasons beyond mere cosmetics. It produces a constant force on the attached gingiva with the ultimate consequence of periodontal pocket and localized gingival recession.⁶ This study was aimed to determine the distribution of the type of maxillary labial frenal attachment and its association with median diastema in school-going children of Raiwind Lahore. During orthodontic treatment, understanding the association of frenal attachment and median diastema is of immense importance as the frenal tissue can inhibit the closure of a diastema. A seemingly perfect orthodontic correction of diastema may be unstable leading to post-orthodontic relapse. In cases of high frenal attachment, the adjunctive surgical removal of the labial frenum becomes quite necessary by employing Miller's technique, V-Y plasty, Z plasty, conventional frenectomy, or electrocautery.⁸ This study will contribute to the local database and will highlight the importance of this association in orthodontic diagnosis and treatment planning. It will also support the grounds for spreading public awareness regarding median diastema, its etiology, effect on the rest of the dentition, role in aesthetics, and diverse treatment options available for treating this problem.

METHODOLOGY

This cross-sectional study involved 815 children studying in 8 different schools of Raiwind, Lahore. Firstly, ethical approval (Letter No.SMDC/SMRC /106-19, 07-11-2019) for the study was obtained from Sharif Medical & Dental College, Lahore and the study duration was from January to March 2020. Thereafter, permission was taken from the schools' principals for intraoral examination of the children fulfilling the selection criteria. Informed consent was also taken from their parents prior to the examination date. The inclusion criteria were children of both genders aged 10 to 16 years, having fully erupted both maxillary central incisors. The exclusion criteria were children having foreign ethnicity, children with hypodontia, microdontia, macrodontia, supernumerary tooth, periodontitis, cleft lip and/or palate, or any other orofacial deformity. Children undergoing orthodontic treatment or with a previous history of orthodontic treatment, dental trauma, restored anterior teeth, dental prosthesis, or any dental extraction were also excluded.

Data was collected by the primary researcher. To avoid visual fatigue, the number of children examined per day was kept to a maximum of 30, which corresponded to the number of children in one class. All intraoral examinations were performed by the direct visual method. Each child was examined while seated in an upright position under natural daylight using disposable wooden blades to retract the upper lip and examine median diastema and frenal attachment. The child's head was then extended to view the palatine papilla on the palatal surface to check for any palatal attachment of the frenal fibers. Type of maxillary labial frenal attachment, presence or absence of median diastema, type of dentition, whether mixed or permanent, were recorded in a pre-designed proforma along with the demographic data.

The type of frenal attachment was based on classification by Placek et al. (Figure 1).

- Mucosal: when the frenal fibers are attached up to the mucogingival junction.
- Gingival: when the frenal fibers are inserted within the attached gingiva.
- Papillary: when the frenal fibers are extending into interdental papilla.
- Papilla penetrating: when the frenal fibers cross the alveolar process and extend up to palatine papilla.⁴

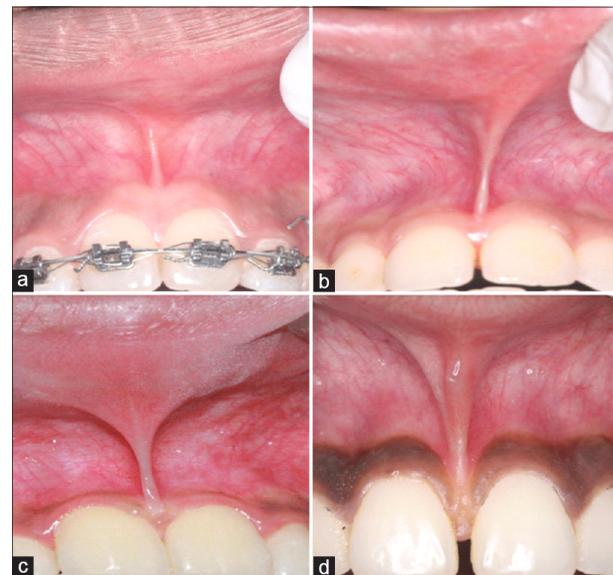


Figure 1: Types of Maxillary Labial Frenal Attachment

- (a) Mucosal type (b) Gingival type
 (c) Papillary type (d) Papillary penetrating
 Median diastema is seen in b & d

STATISTICAL ANALYSIS

Data was analyzed by Statistical Package for the Social Sciences (SPSS) version 25. Quantitative variables

like age were represented as mean and standard deviation. Categorical variables like gender, labial frenal attachment type, and median diastema (presence or absence) were represented as frequency or percentage. The Chi-square test was used to determine the association between median diastema and labial frenal attachment. A p-value of ≤ 0.05 was considered significant.

RESULTS

A total of 815 children participated in this study with a mean age of 12.5 ± 1.1 years, out of which 56.2% were males and 43.8% were females. Among the types of frenal attachment, the gingival type (61.3%) was the most common while papillary penetrating (4.3%), the least common (Figure 2).

Median diastema was present in about 32.8% of children, out of which 153 (57.3%) were males and 114 (42.7%) were females. There was no significant difference in diastema among both genders (p-

value=0.707). An association between median diastema and the type of frenal attachment was determined using the Chi-square test. Figure 3 shows percentage of median diastema in various frenal attachment types. A p-value of 0.001 showed a statistically significant association between the two variables.

Among the gingival type of frenal attachment (which is most common), 58.8% were males and 41.2% were females. The distribution of various types of frenal attachment according to gender is displayed in Table 1. There was an insignificant difference in frenal attachment types among genders (p-value=0.001).

Regarding the type of dentition, 57.9% had mixed dentition and 42.1% had permanent dentition. In mixed dentition, median diastema was present in 51.7% of children, and in permanent dentition, it was found in 48.3% of children. An association between median diastema and dentition was determined using the Chi-square test and a p-value of 0.007 was significant.

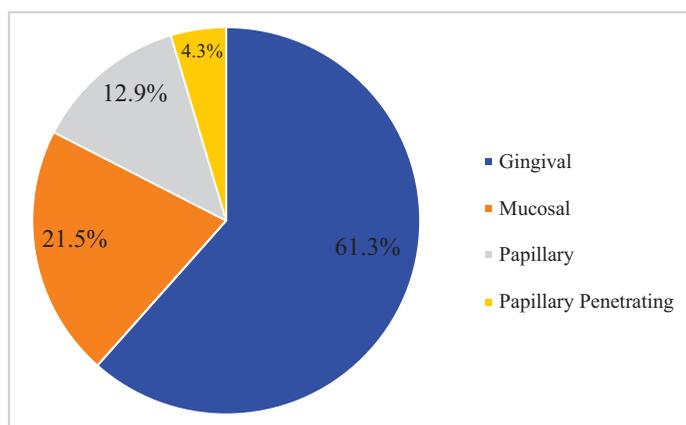


Figure 2: Percentage of Maxillary Labial Frenum Attachment Type

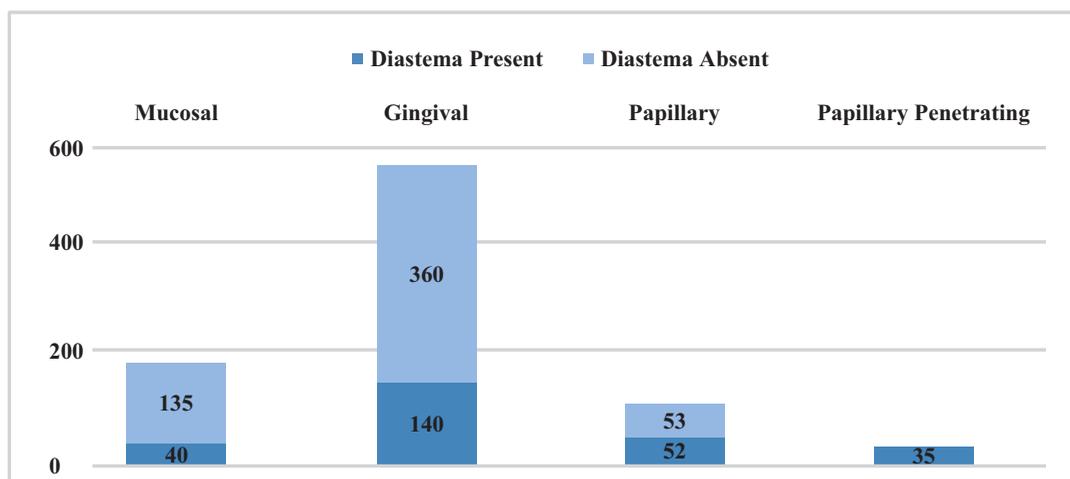


Figure 3: Percentage of Median Diastema in Various Frenal Attachment Types

Table 1: Gender Distribution of Maxillary Labial Frenal Attachment Type

Type of Frenal Attachment	Male	Female	Total	p-value
	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	
Mucosal	104(59.4%)	71(40.6%)	175(100%)	0.001*
Gingival	294(58.8%)	206(41.2%)	500(100%)	
Papillary	40(38.1%)	65(61.9%)	105(100%)	
Papillary Penetrating	20(57.1%)	15(42.9%)	35(100%)	
Total	458(56.2%)	357(43.8%)	815(100%)	

*Significant p-value

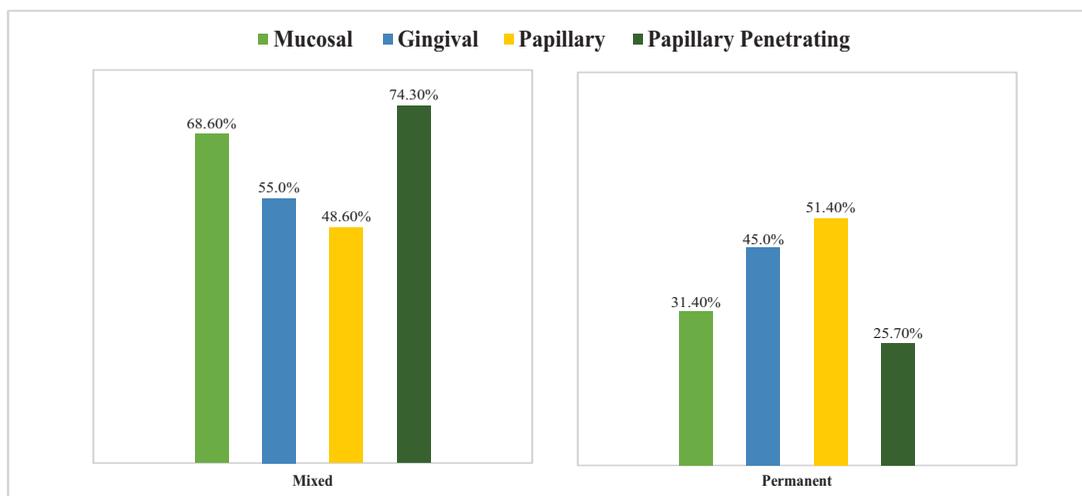


Figure 4: Distribution of Maxillary Labial Frenal Attachment Types among Mixed and Permanent Dentition

Figure 4 shows the distribution of frenal attachment types among both the dentitions and there was a statistically significant association between them (p-value=0.001).

DISCUSSION

The characterization of maxillary labial frenum and interdental spaces of maxillary central incisors is important because they may impose some modifications in dental treatment procedures.⁹ The current cross-sectional study conducted on 815 school-going children of Raiwind Lahore, Pakistan, found that the most frequent type of maxillary labial frenum was gingival (61.3%). Similar results were found in other studies.^{10,11} However, according to Jindal et al., and Nadar, mucosal type was the most common.^{3,12}

The present study showed papillary (12.9%) and papillary penetrating (4.3%) are the least common types of frenal attachment, comparable to the studies

conducted in Iraq and Jordan.^{1,13} However, Thahir et al. found papillary penetrating in 16.1% of subjects and papillary type in 3.1% of subjects from Prague.⁴ Similarly, Jindal et al. found papillary penetrating in 3.2% of the sample population and papillary type in 2.4% of the sample population in India.³ The difference in these results from the current study are probably representative of the population diversity.

The gender-based analysis in this study showed a statistically significant difference regarding the types of labial frenum (p=0.001), whereas, in other studies no significant gender difference was found.^{5,10}

The present study found median diastema in 32.8% of school-going children, whereas a study conducted by Deepa in Chennai reported 75.5% children with diastema.¹⁴ According to Jonathan et al., 41.75% of the population of Sri Ganganagar city had median diastema.² In this study, it was considerably higher in males (57.3%) than females (42.7%), similar to the

studies conducted in Jammu Kashmir and India.^{15,16} The higher prevalence in males can probably be attributed to their late dental development than females.

The present study showed a significant association between the type of frenal attachment and median diastema ($p=0.001$). Diastema was present in 100% of children having the papillary penetrating type of labial frenum.

Deepa reported that there was an increased presence of median diastema in children with the gingival type and the papillary type of frenum attachment.¹⁴ Another study reported median diastema to be associated with the papillary (33.3%) and the papillary penetrating type (62.5%) similar to the present study.³ A study including Caucasian subjects in Poland also showed similar results.¹⁷

In this study, an association between the types of maxillary labial frenum and dentition was also studied. The most frequent type of frenal attachment in mixed dentition was papillary penetrating (74.3%) whereas, in permanent dentition it was papillary (51.4%). This is in contrast to another study in which the most frequently occurring frenal attachment type in mixed dentition was gingival (52.2%), in permanent dentition was mucosal (85.7%) and in primary dentition was also mucosal (41.1%).⁵

In the current study an association of dentition with median diastema was also determined and it was found to be significant ($p=0.007$). The percentage of median diastema was higher in mixed dentition children (51.7%) than in permanent dentition (48.3%). This result could be attributed to the fact that mesial drifting of permanent teeth during growth and development can reduce or close the median diastema.¹⁸ This could explain the reduced frequency of median diastema in older children with permanent dentition.

Median diastema in mixed dentition can be transitional which requires no orthodontic treatment. However, regular follow-up is essential in these children. Median diastema can be genetic, physiological, or due to dental factors like hypodontia, macroglossia, ankylosed central incisors, dentoalveolar discrepancy, and delayed or ectopic canine eruption. Midline alveolar bone cleft could also be considered as a contributory factor of median diastema.¹⁹ The difficulty for an orthodontist lies in decision making, whether to close, open, or redistribute the space in the arch. Orthodontic space closure by reciprocal anchorage, reducing incisor proclination, or composite build-ups may eliminate the need for prosthetic rehabilitation of median diastema but there can be an esthetic and/or functional problem in case of missing maxillary lateral incisors.²⁰ Treatment of median diastema depends on many factors such as the age of the patient, dentofacial profile, amount of overjet, lip support, tooth morphology, and root angulation. If all or most of these

factors are unfavorable, space opening and prosthetic replacement are probably the top choice.¹⁹

Papillary and papillary penetrating types of labial frenal attachment, which persist even after vertical alveolar growth during the transition from mixed to permanent dentition, require surgical treatment, with simultaneous fixed orthodontic treatment to close the median diastema.¹⁴ Even after treatment, timely and appropriate counseling about maintaining proper oral hygiene is certainly recommended. A great amount of emphasis should be placed on the proper examination of the maxillary labial frenum during routine dental check-ups, as it is relevant to smile aesthetics and also one of the leading causes of median diastema. This further makes it important to properly classify the frenum and its morphological variations before commencing orthodontic treatment so that a successful outcome in the long-term is achieved through proper diagnosis and treatment planning.²¹

CONCLUSION

The current study found maxillary labial frenal attachment types in children in the following descending order: gingival, mucosal, papillary, and papillary penetrating. Median diastema was present in all children with the papillary penetrating type of attachment. Furthermore, the frequency of median diastema decreased from papillary to mucosal type. The association between median diastema and the type of labial frenal attachment was statistically significant. The occurrence of median diastema was more common in males and mixed dentition, however, the association was significant for the type of dentition, but not gender.

LIMITATIONS & RECOMMENDATIONS

The limitation of this study is a small sample size from only one Tehsil of Lahore, Pakistan. Similar studies should be conducted in other districts of the country as well, covering a broader region for more purified results pertaining to the frenal type and its association with median diastema. The influence of other etiological factors on median diastema was not determined, as only labial frenal attachment type was assessed. Future studies may determine the exact single etiological factor of median diastema with a more refined sampling method. Furthermore, dental extractions, tooth size discrepancy, periodontal problems, and size variation of pre-maxilla should also be taken into consideration as a probable reason for diastema.

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