



TO DETERMINE THE PREVALENCE OF MAXILLARY LABIAL AND MANDIBULAR LINGUAL FRENUM AND IT'S RELATIONSHIP BETWEEN THE UPPER MIDLINE SPACE AND TO CLINICALLY ASSESS THE MAXILLARY LABIAL FRENUM MORPHOLOGY IN 3 TO 14 YEARS CHILDREN OF CHENNAI CITY

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ABSTRACT

BACKGROUND AND AIM: Frenum is a dynamic and changeable structure, subject to variations at different stages of development. Thus the aim of the study was to clinically assess the maxillary labial and mandibular lingual frenum and relationship between the midline diastema and maxillary labial frenum morphology in 3-14 years children of Chennai city.

METHODOLOGY: A total of 951 children were clinically examined. The findings were recorded and analyzed statistically.

RESULTS: The simple frenum (n=822) morphology and mucosal level (602) of frenum attachment was the most prevalent type of maxillary labial frenum, N-1 type (870) of frenum is the most prevalent lingual frenum. The level of gingival insertion moves apically with age. Persistence of papillary type of frenal attachment causes midline diastema. No association between frenum morphology and midline diastema, frenum attachment and morphology was noticed.

CONCLUSION: It can be concluded that the frenum attachment level in children shifts more apically with age. The persistence of the papillary type of attachment in permanent dentition is associated with diastema. Whereas no association between morphology and attachment, morphology and diastema. The dentist should give importance for the frenal attachment levels and midline diastema during oral examination.

KEYWORDS : Labial Frenum, Lingual frenum, Diastema

INTRODUCTION

A frenum is a fold of mucous membrane usually with enclosed muscle fibers that attaches the lips and cheeks to alveolar mucosa and / or gingiva and underlying periosteum both in the maxilla and in the mandible.¹ The Labial frenum provides stability for the upper lip, also called as frenulum labii superioris.² The lingual frenulum is a median fold of mucosa that joins the tongue's posterior-inferior surface and gingival tissue that covers the lingual surface of the anterior alveolar ridge³ connecting the tongue to the floor of the mouth, allowing free movement of the tongue. Frenum is a dynamic and changeable structure and is subjective to variations in shape, size and location at the different stages of growth and development.^{4,5} When alveolar growth exceeds the vertical and transverse growth of the frenum, it modifies its position buccally towards the alveolar crest.^{6,7,8} This change in position during child growth was believed to be caused by the frenum's static position while the surrounding structures grow.^{9,10}

In children, the maxillary labial frenum has been associated with several clinical problems one such is midline diastema. which can complicate orthodontic therapy and can contribute to post orthodontic relapse.¹¹ The maxillary labial frenum is also a local anatomic factor that affects the accumulation and retention of plaque and can interfere with effective tooth brushing.¹² Similarly the developmental anomaly of lingual frenum- ankyloglossia (tongue-tie), is an anomaly which is characterized by alteration in the tongue's frenulum resulting in restriction of tongue tip mobility,¹³ leading to speech and deglutition changes.³

When the lingual frenum is short it influences the swallowing pattern because of restricted upward movement resulting in maxillary protrusion and anterior open bite.^{14, 15} The midline diastema is a space or gap between the maxillary central incisors which is greater than 0.5mm.¹⁶ This space can be a normal growth characteristic during the primary and mixed dentition and generally is closed by the time when maxillary canines erupt.⁶ Various etiological factors were claimed responsible for midline diastema to persist even after the complete eruption of the permanent dentition. One among them is the frenum. The studies showed frenum as a positive and negative factor responsible for midline

diastema.^{4,17,18,19} It was thought that the labial frenum interfered with the closure of midline diastema.^{11,19,20,21,22,23} This belief resulted in a misdiagnosis and unnecessary surgical interventions of the frenum.¹⁹

There are no clear cut guidelines available in the literature about when to intervene with labial and lingual frenum abnormalities and no studies available to establish a relationship between the different types of frenum morphologies and the presence of midline diastema in children.

Hence, the present study was undertaken to find the prevalence of frenum attachment levels and frenum morphology and their relation to diastema in school going children of 3-14 years age group from five various Schools of Chennai City, Tamil Nadu.

AIMS AND OBJECTIVES

Clinical assessment of maxillary labial and mandibular lingual frenum and relationship between the upper midline space and maxillary labial frenum in 3-14 years school going children of Chennai city.

MATERIALS AND METHODS

Following the approval from the ethical committee of the institution, 951 children of both the sexes from 3-14 year age were examined for the study with the following inclusion and exclusion criteria.

INCLUSION CRITERIA

1. children of both sexes from 3 to 14 years of age
2. Presence of healthy maxillary anterior teeth.
3. Healthy gingiva

EXCLUSION CRITERIA²⁴

1. Children with congenital/ developmental/ acquired orofacial anomalies
2. History of trauma in the anterior portion of the maxilla.
3. Children with interproximal caries or restoration on the upper central incisors and/or any alterations in the size and shape of the incisors.

4. Any oral habits and/or any type of previous orthodontic/periodontal treatments.
5. History of surgical intervention in maxillary labial/ and mandibular lingual region.
6. Patient's on medication which are known to affect gingiva

METHODS:

Clinical examination:

A single investigator examined all the children and a trained assistant did data entry. Clinical examination was done by direct visual method under natural light by gently lifting the upper lip with the index finger and thumb using both the hands.²⁵ allowed for the observation and classification of labial frenum for attachment level, morphology and midline diastema. The lingual frenum was assessed by visual examination. Children's were asked to open their mouth as wide as possible and then asked to touch the tip of the upper central incisors with the tip of their tongue. The shape and the length of the frenum were observed and in order of increasing severity,¹³ based solely on appearance. All the findings were recorded in the proforma and data was analyzed statistically.

Labial frenum: Attachment level

Classification of Frenal attachment: (PlacekM etalclassification 1974)⁸

Mucosal: frenum inserting upto and including the mucogingival junction with no evidence of crossing into the attached gingiva.

Gingival:frenum inserting into the attached gingiva and not extending coronal to the line demarcating the base of the midline papilla that was defined as the line connecting the gingival zeniths of the central incisors.

Papillary: frenum inserting coronal to the line demarcating the base of the midline papilla without any visible evidence of frenum extension to the palatal aspect or of blanching anywhere on the palatal aspect of the midline papilla or on the incisive papilla even when further tension was applied to the frenum.

Papillary penetrating: frenum inserting coronal to the line demarcating the base of the midline papilla combined with visible evidence of frenum extension to the palatal aspect or of blanching anywhere on the palatal aspect of the midline papilla or on the incisive papilla when further tension was applied to the frenum.

Labial frenum: Morphology

Classification of Morphology: (Modified Sewerin's typology 1971)¹⁶

- Simple frenum
- Simple frenum with appendix
- Simple frenum with nodule
- Persistent tectolabial
- Double
- Simple frenum with nichum
- Bifid frenum
- Two or more variations at the same time

Lingual frenum:

Classification of lingual frenum (Northcutt ME 2009)¹⁵

N-1: The frenum constrains the normal mobility of tongue limiting its ability to reach the incisal edges of the upper anterior teeth when the mouth is wide open.

N-2: Short lingual frenum, stronger than N-1 and usually thick. An N-2 frenum pulls on the tongue with sufficient force to form a sulcus

tip or on the underside of the tongue.

N-3: shorter and stronger than N-2, creates sufficient force to distort the whole tongue, forming a pronounced "U or V" shape at the tip.

N-4: frenum attached to the tip of the tongue and affects speech.

Data collected were categorized as 3-6 years, 7-12 years and 13-14 years and statistically analyzed using Statistical Package for Social Sciences (Version 11). The maxillary labial frenum was evaluated for its attachment levels and morphology by using Chi square test. The lingual frenum was evaluated using Chi square test. Mean age of labial and lingual frenum was evaluated by one-way ANOVA followed by Post-Hoc Tukey HSD test. Association of attachment levels, morphology and midline diastema was evaluated by Chi square association test.

RESULTS

Table 1 shows the distribution of sample according to gender in all three age groups. There was no statistical (P=0.455) difference between the distribution of males and females.

Table 1: The Distribution Of Sample According To Gender

AGE GROUPS	MALES	FEMALES	TOTAL
	n (%)	n (%)	n (%)
3-6 years	126 (13.25)	103 (10.83)	229 (24.08)
7-12 years	267 (28.08)	265 (27.87)	532 (55.95)
13-14 years	96 (10.09)	94 (9.88)	190 (19.97)
TOTAL	489 (51.42)	462 (48.58)	951 (100)
P VALUE	0.455 (NS)		

Table 2 shows children's age by labial frenum insertion levels in which 602 children had mucosal attachment with the mean age 10.29±2.595 years, 255 had gingival attachment with mean age as 8.42±3.483 years, 69 had papillary type with mean age of 8.10±3.177 years and 25 had papillary penetrating type with mean age of 5.68±1.930 years. Age differs significantly (P=0.000) among children with different attachment levels, except gingival and papillary types not being significantly different (P=0.151).

Table 2: shows Children's Age By Labial Frenum Insertion Levels

ATTACHMENT LEVELS	n (%)	MEAN AGE (IN YEARS) ± S.D
MUCOSAL	602 (63.30)	10.29 ±2.595 ^{AB}
GINGIVAL	255 (26.81)	8.42±3.483 ^A
PAPILLARY	69 (7.26)	8.10±3.177 ^A
PAPILLAR PENETRATING	25 (2.63)	5.68±1.930 ^B
P VALUE	0.000***	

Table 3 shows the prevalence of maxillary labial frenum morphology according to age and gender. In 3-6 years age group, simple type (n=196) of frenum was the most prevalent followed by nodule (n=21), appendix (n=8) and tectolabial (n=4) in a descending order. In 7-12 years, simple frenum (n=459) was the most prevalent type followed by appendix (n=37), nodule (n=18), tectolabial (n=16) and the least being double frenum (n=2). In 13-14 years, simple frenum was the most prevalent (n=167) followed by appendix (n=15), nodule (n=5) and the least being tectolabial (n=3). Other frenum types (simple with nichum, bifid and two or more variations at the same time) were not present in the study sample. No statistically significant difference between males and females in relation to distribution of morphological types in all the three Age groups (3-6 years P =0.965, 7-12 years P = 0.134, 13-14 years P=0.773) (Chi square test)

Table 3 :prevalence Of Maxillary Labial Frenum Morphology According To Age And Gender.

AGE GROUP	GENDER	MORPHOLOGICAL TYPE								TOTAL	P VALUE
		Simple frenum	Simple with Appendix	Simple with Nodule	Persistent Tectolabial	Double frenum	Simple with nichum	Bifid	Two or more variations		
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
3-6 years	MALES	107(54.6)	5 (62.5)	12 (57.1)	2 (50)	-	-	-	-	126 (55)	0.965 (NS)
	FEMALES	89 (45.4)	3 (37.5)	9 (42.9)	2 (50)	-	-	-	-	103 (45)	

TOTAL	196 (100)	8 (100)	21 (100)	4 (100)	-	-	-	-	229 (100)	
7-12 years	MALES	223(48.6)	21 (56.8)	9 (50)	12 (75)	2 (100)	-	-	267 (50.2)	0.134 (NS)
	FEMALES	236(51.4)	16 (43.2)	9 (50)	4 (25)	-	-	-	265 (49.8)	
TOTAL	459 (100)	37 (100)	18 (100)	16 (100)	2 (100)	-	-	-	532 (100)	
13-14 years	MALES	83 (49.7)	9 (60)	3 (60)	1 (33.3)	-	-	-	96 (50.5)	0.773 (NS)
	FEMALES	84 (50.3)	6 (40)	2 (40)	2 (66.7)	-	-	-	94 (49.5)	
TOTAL	167 (100)	15 (100)	5 (100)	3 (100)	-	-	-	-	190 (100)	

Table 4 shows children's age by lingual frenum types in which 870 subjects had N-1 frenum with mean age of 9.34±3.219 years, 70 had N-2 frenum with mean age of 7.99±3.255 years, 10 had N-3 frenum with mean age of 6.20±0.632 years and 1 had N-4 with mean age of 6±0.000 years. With the increase in the mean age, the most prevalent lingual frenum attachment level was N-1 type which was statistically significant (P=0.000***) (one-way ANOVA).

Table 4: Shows Children's Age By Lingual Frenum Types

LINGUAL FRENUM TYPES	n (%)	MEAN AGE (IN YEARS) ±S.D
N-1	870 (91.48)	9.34±3.219 ^{AB}
N-2	70 (7.36)	7.99±3.255 ^B
N-3	10 (1.06)	6.20±0.632 ^A
N-4	1 (0.10)	6±0.0 ^A
P VALUE		0.000***

(A,B groups connected by same letter are not significant to each other, Tukey HSD test) (P=0.153).

Table 5 shows the evaluation of association between labial frenum attachment and midline diastema. In 3-6 years age group, out of 50 individuals with mucosal type, only 14 had midline diastema, out of 133 of the gingival attachment, 42 had midline diastema, out of 29 of papillary type, 8 had midline diastema and out of 17 of papillary penetrating type, 8 had midline diastema. In 7-12 years of age group, out of 392 individuals with mucosal type, 104 had midline diastema, out of 94 with the gingival attachment, 15 had midline diastema, out of 38 of papillary type, 6 had midline diastema and out of 8 of papillary penetrating type, 2 had midline diastema. In 13-14 years of age group, out of 160 with mucosal type, 9 had midline diastema, out of 28 with the gingival attachment, 9 had midline diastema and out of 2 with papillary type, 1 had midline diastema. No statistical association exists between the attachment levels and midline diastema in 3-6 years age group (P=0.494) and 7-12 years age group (P=0.105), whereas there was anstrong association between attachment levels and midline diastema in 13-14 years age group (P=0.000***) (Chi square association test) with regard to papillary type of attachment.

Table 5: shows The Evaluation Of Association Between Labial Frenum Attachment And Midline Diastema.

AGE GROUPS	ATTACHMENTS	MIDLINE DIASTEMA		TOTAL n (%)	P VALUE
		Yes n (%)	No n (%)		
3-6 years	Mucosal	14 (28)	36 (72)	50 (100)	0.494 (NS)
	Gingival	42 (31.6)	91 (68.4)	133 (100)	
	Papillary	8 (27.6)	21 (72.4)	29 (100)	
	Papillary penetrating	8 (47.1)	9 (52.9)	17 (100)	

Table 7: Shows Evaluation Of Association Between Labial Frenum Morphology And Attachment Levels.

AGE GROUPS	MORPHOLOGY	ATTACHMENT LEVELS				TOTAL n (%)	P VALUE
		Mucosal n (%)	Gingival n (%)	Papillary n (%)	Papillary penetrating n (%)		
3-14 years	Simple	520 (63.3)	221 (27)	61 (7.4)	20 (2.4)	822 (100)	0.222 (NS)
	Appendix	38 (63.3)	16 (26.7)	4 (6.7)	2 (3.3)	60 (100)	
	Nodule	21 (47.7)	17 (38.6)	4 (9.1)	2 (4.5)	44 (100)	
	Tectolabial	21 (91.3)	1 (4.3)	-	1 (4.3)	23 (100)	
	Double frenum	2 (100)	-	-	-	2 (100)	
TOTAL		602 (63.3)	255 (26.8)	69 (7.3)	25 (2.6)	951 (100)	

	TOTAL	72	157	229	
7-12 years	Mucosal	104(26.5)	288(73.5)	392 (100)	0.105 (NS)
	Gingival	15(16)	79(84)	94 (100)	
	Papillary	6(15.8)	32(84.2)	38 (100)	
	Papillary penetrating	2(25)	6(75)	8 (100)	
	TOTAL	127	405	532	
13-14 years	Mucosal	9(5.6)	151(94.4)	160 (100)	0.000***
	Gingival	9(32.1)	19(67.9)	28 (100)	
	Papillary	1(50)	1(50)	2 (100)	
	Papillary penetrating	-	-	-	
	TOTAL	19	171	190	

Table 6 shows evaluation of association between frenum morphology and midline diastema. Out of 822 children with simple frenum morphology, only 188 had midline diastema. Out of 60 children with appendix type, 11 had midline diastema, out of 44 children with nodular type, 9 had midline diastema, out of 23 children with tectolabial type, 9 had midline diastema, out of 2 of double frenum type one had diastema. No statistical association exists between the morphological types and midline diastema (P=0.275) (Chi-square association test).

Table 6: Shows Evaluation Of Association Between Frenum morphology And Midline Diastema.

AGE GROUPS	MORPHOLOGY	MIDLINE DIASTEMA		TOTAL n (%)
		YES n (%)	NO n (%)	
3-14 YEARS	SIMPLE	188 (22.9)	634 (77.1)	822 (100)
	APPENDIX	11 (18.3)	49 (81.7)	60 (100)
	NODULE	9 (20.5)	35 (79.5)	44 (100)
	TECTOLABIAL	9 (39.1)	14 (60.9)	23 (100)
	DOUBLE FRENUM	1 (50)	1 (50)	2 (100)
TOTAL		218 (22.9)	733 (77.1)	951 (100)
P VALUE		0.275 (NS)		

Table 7 shows evaluation of association between labial frenum morphology and attachment levels. Out of 822 children with simple frenum 520 had mucosal type, followed by 221 with gingival, 61 with papillary and least being papillary penetrating in 20 individuals. Out of 60 children with appendix type, 38 had mucosal, 16 had gingival, 4 had papillary and 2 had papillary penetrating. Out of 44 children with nodular type, 21 had mucosal, 17 had gingival, 4 had papillary and 2 had papillary penetrating. Out of 23 children with tectolabial, 21 had mucosal, one had gingival and one had papillary penetrating. Out of 2 children with double frenum, both had mucosal type of attachment. There was no statistical association between the morphological types and the attachment levels (P=0.222).(Chi-square association test).

DISCUSSION

The anterior frenum is a combination of epithelium and connective tissue.^{22, 30, 31} The frenum may attach at variable locations in the attached gingival tissue and the anterior papillae inserting into the palate. In some instances the frenum may be completely absent.²¹ In the newborn, a tight maxillary frenum alone or in conjunction with ankyloglossia may interfere with proper latching of an infant to a mother's breast.^{41, 42} the maxillary frenum may interfere with lip flanging and prevent nursing.³¹

As the infant grows, this tissue may reposition itself away from the alveolar ridge or May cause diastema to develop between maxillary central incisors.²⁷ An existence of a diastema between the maxillary incisors may be a normal growth stage. Completion of mixed dentition stage of tooth eruption often reveals that this gap closes spontaneously as the remaining anterior teeth erupt. Diagnosis and treatment of the frenum as it relates to the diastema must include such things as elimination of contributing factors such as digit habits, tongue thrusting, pacifiers or presence of supernumerary teeth. An abnormally placed frenum may influence the growth and development of the anterior portion of the maxillary arch. When the frenum is wide and thick and causes blanching of the anterior papilla and when diastema is greater than 2 mm active intervention by frenectomy may be indicated.³⁴

An abnormal frenal attachment may also contribute to the failure of traumatic injuries to the area to heal, interfere with adequate oral hygiene, contribute to facial caries, restrict movement of the lip, contribute to speech abnormalities and create undesirable esthetics in the anterior teeth.³¹ When an oral examination concludes that the frenum is the contributing cause of oral problems, early revision may prevent more serious problems from occurring at a later age.

The present study sample included the subjects of primary, mixed and permanent dentition of 3-14 years age range with a mean age of 9.20 years. The study sample selection was in accordance with the studies done by Boutsi EA et al,²⁹ Kaimenyi²⁶ and differed from other studies in which only children with primary dentition,^{6,25} children or adolescents with mixed and permanent dentition^{37,38} and adult samples^{2,8,16} were analyzed. Even though this was not a longitudinal study, the sample allowed for the observation of the characteristics (morphology and insertion) presented by the labial frenum, lingual frenum and the presence of midline diastema at the age range of 3-14 years.

The frenum dynamically changes^{4,5} as the age advances and observed that the gingival insertion level increases in length with the age advancement.²⁹ it shows that mucosal type of attachment was prominent in 63.30% of children and the least common is the papillary penetrating type (2.63%) and there is a shift in the percentage of distribution of attachment level from papillary penetrating to mucosal as the mean age increases (P=0.000***). The study results were comparable to the findings of Maria Diaz et al,²⁵ Bergese et al³⁹ (primary dentition) and Popovich et al²⁴ done on the mixed dentition and Sapan H Patel,² Placek M et al,¹⁰ Lindsey D et al,²³ Kaimenyi et al,²⁶ Boutsi EA et al,²⁹ Addy et al³⁵ and Janczuk and Banach³⁶ on permanent dentition. The simple frenal morphology (3-6 years n=196, 7-12 years n=459, 13-14 years n=167) being the most common morphological type and the least common is double frenum (7-12 years n=2) while simple frenum with nichum, bifid and two or more variations at the same time were not found. These results were similar to the findings of Sapan H Patel² and Maria E Diaz et al,²⁵ except for the presence of other frenal types in their study.

In the present study N-1 frenum (91.48%) was the most prevalent lingual frenum and N-4 (0.10%) was the least prevalent. There was a shift in the distribution of lingual frenal attachment level from N-4 type to N-1 as the mean age increases (p=0.000***). This is in accordance with the study done by Northcutt ME.¹⁷ The present study findings suggest that both labial and lingual frenum migrated from coronal to apical with increase in age. The data obtained with

the qualitative or quantitative (or both) classifications of lingual frenum, should always be analyzed together with the clinical history and with the data found in the clinical examination.²⁸

On evaluation of association between the labial frenal attachment levels and midline diastema, in permanent dentition there is a significant association seen which is inversely related (P=0.000***). These results confirms that the persistence of the more coronal attachment level (papillary, papillary penetrating) was associated with diastema as were seen in other studies like Lindsey D²³ who reported a strong association between spacing and blanching both in children and adults and Maria E Diaz et al.²⁵

The results of the present study shows no association between frenal morphology and diastema (Table 6) (P=0.275 NS) and frenal morphology and attachment levels (Table 7) (P=0.222 NS). We could not come across any comparative studies in the literature about the association between morphology, diastema and attachment levels to compare with our results.

The study shows, simple frenum is the most prevalent type of morphology and mucosal level of gingival insertion was the most commonly seen. As age increases, there was a shift in the frenum insertion level from papillary to mucosal type. No association between level of attachment and frenal morphology, frenal morphology and diastema was found in primary and mixed dentition age groups where as in permanent dentition, an inverse relation was obtained between level of insertion and midline diastema.

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