

Prevalence and Pattern of Labial Frenal Attachments in Adult Nigerians - a Pilot Study

Umezudike KA¹, Alade GO²,
Ogundana AC¹

Correspondence: Alade GO
Email: graceochos@yahoo.co.uk

¹Department of Preventive Dentistry, Faculty of Dental Sciences, College of Medicine, University of Lagos, Idi-araba, Lagos, Nigeria

²Department of Community Dentistry and Periodontology, Faculty of Dentistry, College of Health Sciences, University of Port Harcourt, Rivers State, Nigeria

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ABSTRACT

Introduction

The frenum is a band of mucous membrane which connects the lips and cheeks to the alveolar mucosa, underlying periosteum, or the gingiva with a primary function of stabilizing the lips and tongue. There are variations of frenal attachment and morphologies, some associated with health, others resulting to loss of periodontium. This study therefore aims to assess the various attachments and morphologies within our study population.

Materials and Methods

This was a descriptive cross-sectional study conducted at the Oral Diagnosis and Periodontology clinics of the Lagos University Teaching Hospital Idi-Araba among participants who reported to both clinics. Convenience sampling method was employed in participants' selection, and interviewer-administered questionnaires were used for data collection and documentation of socio-demographic variables, and findings of intra-oral examination. Ethical approval was obtained from the institutional Health Research Ethics

Committee and informed consent was obtained from each participant. Data was analyzed using the Statistical Product and Service Solutions (SPSS) version 27. P values < 0.05 were statistically significant.

Results

The study comprised 337 participants, 203 (60.2%) were females. Mean age was 34.6±15.2 years. The frenal attachment distribution in the maxilla was mucosal 204 (60.5%), gingival 105 (31.2%), papillary 23 (6.8%), and papillary penetrating 5 (1.5%); while in the mandible, 233 (69.1%), 92 (27.3%), 9 (2.7%) and 3 (0.9%) presented with mucosal, gingival, papillary, and papillary penetrating frenal attachment respectively. Simple frenum was the most prevalent frenum morphology in the maxilla [328 (97.3%)] and the mandible [321 (95.2%)], followed by trifid frenum in both maxilla [5 (1.5%)] and mandible [4 (1.2%)]. Diastema was present in 27.6% in maxilla and 11.0% in the mandible.

Conclusion

In this study, mucosal type was predominant among all age groups. Males presented more with gingival and mucosal type of frenal insertion, while females presented more with papillary type of frenal insertion. Papillary and/or papillary penetrating were significantly associated with the presence of diastema.

INTRODUCTION

The frenum is a band or fold of mucous membrane which connects the lips and cheeks to the alveolar mucosa, its underlying periosteum, or the gingiva. It is made up mainly of connective tissue, epithelium, and some muscular fibers enclosed within it.¹ It is a mucosal attachment of a loose part to a more rigid part, and several frena are usually present and located in different parts of the oral cavity.² The main function of the frenum is to give some stability to the upper and lower lips, and the tongue.^{3,4,5} The prominent ones

are the maxillary labial frenum (inside the upper lip), mandibular labial frenum (inside the lower lip), the lingual frenum (under the tongue), and the buccal frena (inside the cheek).³

The maxillary labial frenum (MLF) is a vital band of oral mucosa composed of stratified squamous epithelium, elastic, collagen fibers and nerve fibers.⁶ In the first few years of life, it appears as a thick, broad tissue that gradually decreases in size, becoming thinner with age. The labial frena attachments extend above the alveolar process in infants forming a raphe that reaches the palatal papilla. In adulthood, however, with teeth eruption and the growth of the alveolar process, the position of this attachment generally changes.²

A normal frenum typically inserts apical to the free gingival margin, usually at the mucogingival junction.⁷ The band of the attached gingiva may then serve as a protective mechanism for the free gingiva against the excessive pull or pressure of the frenum during lip movement.⁷ However, abnormalities can occur leading to variation in its level of attachment or position,⁵ resulting in a variety of shapes and sizes. Abnormal or aberrant frena can be visually detected by applying some tension over it resulting in blanching due to ischemia of the region.³

Variations in the position of the maxillary labial frenum has, sometimes, led to confusion about what should be accepted as normal, particularly a high frenal attachment. This underscores the importance of classifying the types of labial frenum based on their position and relationship with other structures in the oral cavity. Different researchers have proposed different classifications for the frenum, the most widely accepted being by Sewerin in 1971⁸ and later by Mirko et al, in 1974.⁷ According to Sewerin,⁸ the morphology of the frenum is classified as: Normal frenum, Normal frenum with a nodule, Normal frenum with appendix, Normal frenum with nichum, Bifid labial frenum, Persistent tectolabial frenum, Double frenum, and Wider frenum.⁹ This was followed by a more simplified classification depending on the extension of attachment of the fibers by Mirko et al,⁷ into 4 groups. Mucosal: insertion of the frenal fibers into the mucosa, which may extend to the mucogingival

junction (MGJ) but does not cross the MGJ; Gingival: insertion of the frenal fibers beyond the MGJ into the attached gingiva; Papillary: extension of the frenal fibers into the interdental papilla without crossing palatally; and Papilla penetrating: attachment of the frenal fibers into the midline papilla across the alveolar process with extension to the palatal mucosa.

The pattern of presentation of different types of frenal attachment and its relationship to the maxillary central incisors and the gingival margin is yet to be reported in the adult Nigerian population. This is also because the rationale for the surgical intervention for the frenum, considered high, is often based on information from studies among the White and Asian populations. It is possible that racial or ethnic differences may affect the pattern of presentation of the frenum among Nigerians. To the best of our knowledge, this has not been reported among the adult Nigerian population. The aim of the present study, therefore, is to characterize the morphological patterns of the labial frenum, and its relationship with the central incisors and gingiva in an adult Nigerian population.

MATERIALS AND METHODS

The study was carried out at the Oral Diagnosis and Periodontology clinics of the Lagos University Teaching Hospital Idi-Araba. It was a descriptive cross-sectional study by design, among routine patients attending the Oral Diagnosis and Periodontology clinics for dental consultation, routine check-up and treatment. The study was conducted for a period of six months; from March 2022 to September 2022. A non-probability sampling method (convenience sampling) was used to select the participants. A minimum sample size of 330 participants was calculated using the formulae suitable for prevalence studies. Interviewer-administered questionnaires were used for data collection; information on socio-demographic variables of subjects such as age, gender, educational level, ethnicity, and oral hygiene practices were documented. Intraoral examination was performed using dental mirrors, dental explorers, and Williams periodontal probes on selected index teeth in the mouth to assess the teeth present, missing teeth, carious teeth, teeth with gingival recession, and tooth mobility.

Oral hygiene status was determined by the primary investigator using the oral hygiene index simplified by Greene and Vermillion 1964. This was done by identifying 6 index teeth (16, 11, 26, 31, 36 and 46), buccal surfaces of all index teeth and lingual surfaces of 36 and 46 were examined for debris and calculus accumulation. The debris and calculus scores were added up individually then, divided by the number of teeth examined to get the Simplified oral hygiene index score

The frenum was assessed by the primary investigator using two widely accepted classification systems by Sewerin in 1971⁸ and Mirko et al, in 1974⁷ to determine the morphology and insertion of the frenum respectively. The attachment location of the frenum and its morphology was assessed under direct visual method by upward and downward distension of the upper and lower lips respectively: Morphology of frenum (Normal frenum, Normal frenum with a nodule, Normal frenum with appendix, Normal frenum with nichum, Bifid labial frenum, Persistent tectolabial frenum, Double frenum and wider frenum). Insertion of the frenum (Mucosal: insertion of the frenal fibers into the mucosa and may be up to the mucogingival junction (MGJ) but does not cross the MGJ; Gingival: insertion of the frenal fibers beyond the MGJ into the attached gingival; Papillary: extension of the frenal fibers into the interdental papilla without crossing palatally; and Papilla penetrating: attachment of the frenal fibers into the midline papilla across the alveolar process with extension to the palatal mucosa.) Where there was more than one millimeter space between the maxillary and mandibular central incisors, midline diastema was noted.

Inclusion criteria included subjects ≥ 18 years of age, and presence of upper and lower anterior incisors, while exclusion criteria included subjects with history of trauma to the premaxillary and anterior mandibular regions, missing upper and lower incisor teeth, frenal surgeries, periapical infection, non-indigenes of Nigeria, and those who refused to give consent to participate in the study.

Ethical approval was obtained from the Health Research Ethics Committee of the Lagos University Teaching Hospital before commencement of the study. Written

informed consent was also obtained from the participants prior to data collection.

Minimum sample size and Data Analysis

This was determined by applying the formulae suitable for prevalence studies¹⁰ resulting in a minimum sample size of 330. Data were analyzed using the Statistical Product and Service Solutions (SPSS) version 27. Continuous variables were expressed as means and standard deviation. Categorical variables were presented as frequencies and percentages. Differences between age groups were compared using the chi-square test for categorical variables, and independent t test for continuous variables for 2 groups or ANOVA for more than 2 groups. P values < 0.05 were statistically significant.

RESULTS

Socio-demographic characteristics of participants

We enrolled three hundred and thirty-seven participants into the study, two hundred and three (60.2%) of whom were females, while the remaining one hundred and thirty-four (39.8%) were males. The mean age of the participants was 34.6±15.2 years. Majority (78.3%) had tertiary education and 60.8% were singles. (Table 1)

Table 1: Socio-demographic characteristics of participants

Variable	Frequency (n=337)	Percentage (%)
Age group (Years)		
≤20	28	8.3
21-30	162	48.1
31-40	56	16.6
41-50	30	8.9
51-60	32	9.9
>60	29	8.6
Mean±SD	34.6 ±15.2	
Gender		
Male	134	39.8
Female	203	60.2
Educational level		
Primary	12	3.6
Secondary	61	18.1
Tertiary	264	78.3
Religion		
Christianity	288	85.5
Islam	47	13.9
Others	2	0.6
Marital status		
Single	205	60.8
Married	124	36.8
Widowed	8	2.4

Oral hygiene practices of participants

Majority of participants, 66.8% (n=225), brushed their teeth once daily, 65.6% used medium textured toothbrushes, 43.3% brushed with vertical method of brushing, while 39.2% brushed in all directions. A small percentage of the participants (4.5%) claimed they had difficulty with brushing. Most participants (71.5%) claimed they spent 2-5 minutes brushing their teeth, 75.4% used medium force during brushing, while 8.3% used heavy force. Most participants claimed they used interdental cleaning aids. (Table 2)

Table 2: Oral hygiene practices of participants

Variable	Frequency (n=337)	Percentage (%)
Difficulty brushing		
Yes	15	4.5
No	322	95.5
Direction of brushing		
Any direction	130	38.6
Circular	10	3.0
Scrub	49	14.5
Roll	148	43.9
Frequency of daily brushing		
Once	219	65.0
Twice	112	33.2
Not specified	6	1.8
Texture of toothbrush		
Hard	52	15.4
Medium	221	65.6
Soft	64	19.0
Duration of bushing (Minutes)		
<2	62	18.4
2-5	241	71.5
>5	34	10.1
Self-perceived force applied while brushing		
Heavy	28	8.3
Medium	254	75.4
Light	55	16.3
Use of chewing stick		
Yes	33	9.8
No	304	90.2
Interdental cleaning aids		
Nothing	37	11.0
Dental floss	94	27.9
Toothpick	199	59.1
Interdental brush	2	0.6
Others (ginger, fingernails, rubber band)	5	1.4

Oral hygiene (OH) status of the participants

One hundred and thirty-four (39.8%) of the participants had good OH, 165 (49%) had fair OH, while only 38 (11.3%) had poor OH. This is

as shown in Figure 1

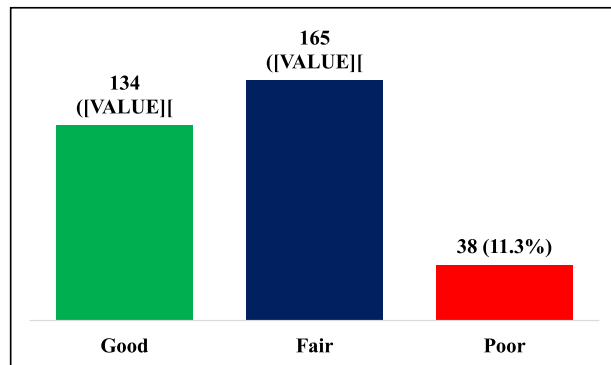


Figure 1: Oral hygiene Status of participants

Prevalence of diastema in the maxilla and mandible of participants

Less than a third of the participants (27.3%) had diastema present between the maxillary teeth while only 11% of the participants had diastema between the mandibular teeth. (Figure 2)

Frenal morphology in the Maxilla and Mandible

Majority of the participants had simple frenal morphology in the maxilla 328(97.3%) and mandible 321(95.2%), 5(1.5%) and 4(1.2%) participants had Trifid frenum in the maxilla and mandible respectively. Double frenum was present in 3(0.9%) and 2(0.6%) in the maxilla and mandible respectively. None of the participants had Bifid frenal morphology. (Table 3)

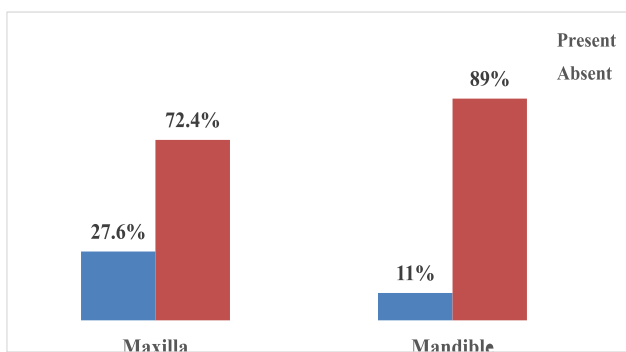


Figure 2: Prevalence of diastema among the participants

Table 3: Prevalence of Frenum morphology in maxilla and mandible

Variable	Frequency (n=337)	Percentage (%)
Maxillary morphology		
Simple frenum	328	97.3
Bifid frenum	0	0.0
Trifid frenum	5	1.5
Double frenum	3	0.9
Wider frenum	1	0.3
Mandibular morphology		
Simple frenum	321	95.2
With nodule	3	0.9
With appendix	2	0.6
With nichum	2	0.6
Double frenum	2	0.6
With appendix	1	0.3
Trifid frenum	4	1.2
With nodule	1	0.3
Wider frenum	1	0.3
Tied frenum with nodule	0	0.0

Type of frenal insertion in the maxilla and mandible

Most of the participants had mucosal frenal insertion in both the maxilla 204 (60.5%) and mandible 233(69.1%), while 105(31.2%) of the participants had the gingival type in the maxilla and 92(27.3%) in the mandible. (Table 4)

Table 4: Prevalence of Frenum insertion type in maxilla and mandible

Variable	Frequency (n=337)	Percentage (%)
Maxillary insertion of frenum		
Mucosal	204	60.5
Gingival	105	31.2
Papillary	23	6.8
Papillary penetrating	5	1.5
Mandibular insertion of frenum		
Mucosal	233	69.1
Gingival	92	27.3
Papillary	9	2.7
Papillary penetrating	3	0.9

Association between maxillary frenum and selected parameters

The mucosal type of frenal insertion was predominant among all age groups, and this finding was not statistically significant (P=0.265). Mucosal type of frenal insertion was present among 121(59.6%) females and 83(61.9%) males; 44(32.8%) males and 61(30.6%) females had gingival type of frenal insertion, while 7(5.2%) males and 21(10.3%) females had papillary type of frenal insertion, These findings however,

were not statistically significant (P=0.244). In the maxilla, the presence of diastema was significantly associated with papillary/papillary penetrating frenal insertion 17 (18.3%) than in those without diastema 11 (4.5%), while mucosal frenal insertion was significantly associated with the absence of diastema 160 (65.3%) than the presence of diastema 44 (47.8%). These findings were statistically significant (P<0.001). Mucosal frenal insertion was well distributed among participants with good 84 (62.7%), fair 96 (58.2%), and poor 24 (63.2%) oral hygiene status. Papillary/papillary penetrating frenal insertion was mostly observed among those with poor oral hygiene status. However, these associations were not significant (P=0.226). This is shown in Table 5.

Table 5: Association between Maxilla frenum and selected parameters

	Mucosal (n=204) (%)	Gingival (n=105) (%)	Papillary/Papillary penetrating (n=28) (%)	p-value
Age group (Years)				
≤20	16(57.1)	10(35.7)	2(7.1)	0.265
21-30	96(59.3)	53(32.7)	13(8.0)	
31-40	34(60.7)	21(37.5)	1(1.8)	
41-50	17(56.7)	8(26.7)	5(16.7)	
51-60	19(59.4)	9(25.0)	5(15.6)	
>60	22(75.9)	5(17.2)	2(6.9)	
Gender				
Male	83(61.9)	44(32.8)	7(5.2)	0.244
Female	121(59.6)	61(30.0)	21(10.3)	
Diastema				
Yes	44(47.8)	31(33.7)	17(18.5)	<0.001*
No	160(65.3)	74(30.2)	11(4.5)	
OH status				
Good	84(62.7)	39(29.1)	11(8.2)	0.226
Fair	96(58.2)	58(35.2)	11(6.7)	
Poor	24(63.2)	8(21.1)	6(15.8)	

Association between mandibular frenum and selected parameters

Only 51(31.5%) of the participants in 21-30 year-old age group and 12(42.9%) of those in <20 year-old age group had gingival type of frenal insertion. Close to a quarter 41(73.2%) of the participants in 31-40-year-old age group and 23(76.7%) of those in 41-50-year-old age group had mucosal type of frenal insertion, while 3(9.4%) of the participants in 51-60-year-old age group and 2(6.9%) of those in >60 year-old age group had papillary type of frenal insertion. This finding was statistically significant (P=0.040).

Concerning gender, 93(69.4%) males and 140(69.0%) females had mucosal type of frenal insertion, while 37(27.6%) males and 55(27.1%) females had gingival type of frenal insertion. This finding was not statistically

significant ($P=0.897$). In the mandibular region, the presence of diastema was significantly associated with papillary/papillary penetrating frenal insertion 4(10.8%) than in those without diastema 8(2.7%), while mucosal frenal insertion was significantly associated with the absence of diastema 210(70.0%) than the presence of diastema 23(62.2%). These findings were statistically significant ($P=0.040$). Concerning the OH status, participants with mucosal type of frenal insertion, had good OH status 101(70.0%), fair OH 104(67.1%) and poor OH 28(73.1%), while gingival frenal insertion was found among 37(25.7%) of participants with good OH, 46(29.7%) of those with fair OH and 9(23.7%) of those with poor OH. This finding was not statistically significant ($P=0.885$). This is shown in Table 6.

Table 6: Association between mandibular frenal attachment and selected parameters

	Gingival (n=92)	Mucosa (n=233)	Papillary/ Papillary penetrating (n=12)	p-value
Age group (Years)				
≤20	12(42.9)	16(57.1)	0(0.0)	0.040*
21-30	51(31.5)	106(65.4)	5(5.1)	
31-40	15(26.8)	41(73.2)	0(0.0)	
41-50	5(16.7)	23(76.7)	2(6.7)	
51-60	6(18.8)	23(71.9)	3(9.4)	
>60	3(10.3)	24(82.8)	2(6.9)	
Gender				
Male	37(27.6)	93(69.4)	4(3.0)	0.897
Female	55(27.1)	140(69.0)	8(3.9)	
Diastema				
Yes	10(27.0)	23(62.2)	4(10.8)	0.040*
No	82(27.3)	210(70.0)	8(2.7)	
OH status				
Good	37(25.7)	101(70.1)	6(4.2)	0.885
Fair	46(29.7)	104(67.1)	5(3.2)	
Poor	9(23.7)	28(73.7)	1(2.6)	

The various patterns of frenal attachments encountered in this study are presented in figures II-VIII.

DISCUSSION

Dentofacial aesthetics is a key factor that affects the psychological and social well-being of an individual. The frenum is an important oral tissue that can affect the dental health and facial appearance, and its primary role is to provide stability to the lips and maintain a balance between the growing bones. An abnormal or high labial frenum has been frequently implicated and linked with persistent midline diastema, loss of papilla, recession, poor retention and stability of dentures, difficulties in speech, frequent trauma to the frenum, and interference with effective tooth brushing, leading to poor plaque control and

periodontal diseases.^{1,2,11} Abnormal frena may be a feature in syndromes such as Ehler-Danlos syndromes (absent MLF)¹² and Oral Facial Digital type 1 syndrome (multiple MLF)¹³ or in non-syndromic patients.¹⁴ The current study set out to characterize the patterns of the maxillary and mandibular labial frenum in the adult population in Nigeria. Regarding the morphology of the frenum in the maxilla and the mandible, most of the participants in the present study presented with the normal frenum pattern in both the maxilla and the mandible. This finding aligns with previous studies.^{6,15} Regarding the prevalence of the frenal attachment, the mucosal was the commonest, which is consistent with the pattern reported in an Indian study,¹⁶ but contrasts with other studies^{10,17} that observed gingival frenal attachment as the most common. Although, papillary and papilla penetrating frena were the least prevalent in the current study, as reported by Joshi et al,¹⁸ the lower incidence may be ascribed to the shift in attachment level from coronal to apical as alveolar processes expand in a coronal direction with age.¹⁷

The papillary and papilla penetrating frena are considered pathological if they extend beyond the mixed dentition,¹⁶ are unusually wide, lack an attached gingiva along the midline or if there is a shift in the interdental papilla following an extension of the frenum.¹⁹ They have been linked with loss of the papilla, recession, diastema, difficulty in brushing, alignment of teeth and psychological disturbances to an individual.²⁰⁻²²

In the current study, the predominantly high frenal attachment observed among participants in the 21–30-year-old age group is in tandem with previous studies.^{18,23-26} Comparing the age of the participants and the type of frenal insertion, participants within the age group 21-40 years, which made up majority of the population, had more of the mucosal type of frenal insertion. This finding contrasts with the study by Surekha et al,²⁷ conducted among an Indian population with a similar age group (20-40 years) in which most of the participants had the gingival type of frenal insertion. This probably reflects the variations that accompany the human population ethnicities and diversities.

Regarding gender-based variations, females presented more with the papillary type of insertion in both maxilla and mandible, while males presented more with the gingival and mucosal type. These findings contrast with a previous study⁹ among slightly younger participants aged 16-40 years, where the females presented more with gingival and mucosal type of insertion. This is also, in contrast to the study conducted by Joshi et al,¹⁸ among children, aged 6-16 years, in which the male and female participants showed close resemblance and order. The finding in the present study is not surprising as the papillary type of insertion has been associated with diastema formation and a previous Nigerian study has documented a higher prevalence of diastema in females than males.²⁸ Therefore, it was not surprising to observe in the current study, the relatively higher proportion of diastema in participants with papilla/papillary penetrating frena compared with mucosa or gingival insertion especially in the maxilla. This is consistent with previous studies.²⁹

It is important to highlight that diastema is an important aesthetic concern for teenagers and young adults, especially when it occurs in the anterior region of the maxillary and/or mandibular arches. High frenal attachment occurring in the maxilla and the mandible is one of the aetiological factors for diastema. Only a few participants in the present study presented with diastema, both in the maxilla and the mandible. However, the prevalence of maxillary midline diastema in this study was higher than that in the mandibular. This finding is in tandem with a previous study, where 21.8% of the participants had diastema in the maxilla while 9% presented with diastema in the mandible.³⁰ Diastema was found to be associated with patients with the papillary and papillary penetrating types of frenum.²⁹ High frenal attachment has also been associated with poor oral hygiene maintenance.³¹ Comparing the oral hygiene status with the types of frenal insertion, poor oral hygiene has been associated with the papillary and papillary penetrating type of frenal insertion.¹⁷ This may be because the frenal attachment encroaching on the marginal gingiva distends the gingival sulcus, encouraging plaque accumulation. However, in this study, the participants with mucosal type of frenal

insertion, presented more with good, fair and poor oral hygiene status, compared with other types of frenal insertion. This difference could be because of racial variations, or some participants may not be practicing appropriate oral hygiene measures. The study had some limitations which included its cross-sectional design and clinical setting rather than being community-based, which may affect its generalizability. Hence, we advocate larger community-based samples to further elucidate the findings and applicability.



Figure III: Gingival frenal attachment



Figure IV: Papillary frenal attachment



Figure V: Papillary penetrating frenum with nodule



Figure VIII: Broad frenal attachment with shallow vestibule



Figure VI: Bilateral frenal attachment



Figure IX: Double frenum



Figure VII: Multiple frenal attachment

Conflict of Interest and funding statement:
We certify that this research is original, not presently under consideration for publication elsewhere, free of conflict of interest. This study was funded by the authors.

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Figure VIII: Double frenum
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