

Morphological variations in Maxillary labial frenum: A cross-sectional study

Dr. Savvy Pokhrel,¹ Dr. Srishti Poudel,² Dr. Bhageshwar Dhama,³ Dr. Deepa Aryal,⁴ Dr. Sagun Regmi⁵

^{1,2} PG Resident, ³Professor, ^{4,5}Lecturer
Department of Periodontics,
Kantipur Dental College Teaching
Hospital and Research Centre,
Kathmandu, Nepal

Corresponding Author

Dr. Savvy Pokhrel
Email: pokharelsavvy@gmail.com

Citation

Pokhrel S, Poudel S, Dhama B, Aryal D, Regmi S. Morphological variations in Maxillary labial frenum: A cross-sectional study. J Kantipur Dent Coll. 2022;3(2): 25-30.

ABSTRACT

Introduction: Maxillary labial frenum is a dynamic structure that is subjected to variations during different stages of human growth and development. It can pose a significant problem if tension from lip movement pulls the gingival margin away from the tooth or if the tissue restrains the closure of a diastema during orthodontic treatment.

Objective: To assess the types of maxillary labial frenal attachments and the morphological variations among them.

Materials and Method: A cross-sectional observational study was conducted among 157 subjects within the age group of 19-29 years at Kantipur Dental College from June 2022 to July 2022. Non-probability convenience sampling method was utilized. Types of maxillary frenal attachments and the morphological variations were recorded according to Mirko and Sewerin classifications respectively. Data were compared and analyzed using SPSS 20.

Result: The mucosal type of frenal attachment was found in 51.6% of subjects followed by gingival in 25.5%, papillary in 19.1% and papilla penetrating in 3.8%. 66.2% presented with normal frenum, 22.9% with nodule, 10.2% with appendix and 0.6% with bifid frenum.

Conclusion: There are variations in the maxillary frenal attachments which can pose significant problems.

Keywords: Aberrant frena; maxillary labial frenum; frenal attachment; morphological variations.

INTRODUCTION

A frenum is a fold of mucous membrane composed of highly vascularized connective tissue covered with epithelium¹ with variable amount of dense collagen and elastic fibers, but no muscle fibers.²

Maxillary labial and mandibular labial and lingual frena are the most notable frena in the oral cavity.³ Maxillary labial frenum extends from vestibular mucosa of the upper lip to the alveolar or gingival mucosa in the midline of maxillary arc. It is a dynamic structure that is subjected to variations during different stages of human growth and development.^{3,4} Its primary function is to provide stability to the upper lip.³

It originates as a posteruptive remnant of the tectolabial bands, which are embryonic structures appearing about three months in utero as a continuous band of tissue and connect tubercle of upper lip and palatine papilla.² The frenum, also referred to as tectolabial frenum, at this stage, interestingly mimics the frenum that is considered abnormal in the postnatal life.⁵ However, with time, the growth of alveolar process relocates the frenum in a more apical position. The failure of the attachment to

migrate results in a persistent band of tissue between the maxillary central incisors thereby resulting in several undesirable consequences.² However, one should always consider the fact that, like any other structure in the human body, the maxillary labial frenum also has a range of normality. It varies in bulk as well as in the height of attachment.⁵ Therefore, it is important to distinguish normal from abnormal frenal attachments. Thus, this study aims to determine the prevalence of different types of frenal attachments and also the morphological variations encountered among Nepalese population.

Over time, several studies have been conducted and classifications have been proposed relating to the maxillary labial frenum. Sewerin I, in 1969, had reported eight morphological variations present in the upper labial frenum.⁶ Later on in 1974, Mirko *et al.* suggested a classification on the basis of the site of frenal attachment.⁷ Classification by Mirko *et al.* (1974)

- Mucosal: When the frenal fibers are attached up to mucogingival junction
- Gingival: When fibers are inserted within attached gingiva

- Papillary: When fibers are extending into interdental papilla
- Papilla penetrating: When the frenal fibers cross the alveolar process and extend up to palatine papilla

Classification by Sewerin I (1969)

- Normal frenum
- Normal frenum with nodule
- Normal frenum with appendix
- Normal frenum with nichum
- Bifid labial frenum
- Persistent tectolabial frenum
- Double frenum
- Wider frenum

MATERIALS AND METHOD

This was a cross-sectional observational study conducted in the Department of Periodontology and Oral Implantology, Kantipur Dental College Teaching Hospital and Research Centre, Basundhara, Kathmandu, Nepal from June to July, 2022. Ethical approval was taken from the Institutional Review Committee (KDC-IRC ref. no. 23/022).

The study population included the dental students enrolled in the college, and the patients visiting the Department of Periodontics, in the age range of 19 to 29 years. Subjects who had undergone surgery in the region of upper labial frenum, any trauma or injury to the mucosa at the site, any congenital or developmental abnormality in the upper frenum or premaxilla, missing one or both maxillary central incisors, past or ongoing orthodontic treatment and subjects taking any medication known to affect the gingiva, were excluded from the study.

Non-probability convenience sampling method was used and the sample size was calculated using the formula: $n = z^2pq/e^2$; where n = required sample size, $z = 1.96$ at 95% confidence interval, $p = 0.776$, $q = 1-p (0.224)$, $e = 0.07$ (7% maximum permissible error). Hence, $n = 136$. Therefore, a total of 136 subjects were included in the study.

The examination of frenum was done in the clinical setting. The types of frenal attachment and the morphological variations among them were assessed on the basis of Mirko et al.⁷ and Sewerin⁶ classifications respectively.

RESULT

In the study, there were 109 females and 48 males as the study subjects. Out of the total of 157 subjects, when frenal attachments were studied on the basis of the classification given by Mirko et al.⁷, the most common type of frenal attachment was found to be the mucosal type which was present in 51.6% of subjects. This was followed by the gingival type constituting 25.5% of the subjects, then by the papillary type which was found in 19.1% and lastly by

the papilla penetrating type present in 3.8%. (Table 1) On the basis of the Sewerin classification⁶, 66.2% of subjects presented with normal frenum, 22.9% with nodule, 10.2% with appendix and 0.6% with bifid frenum. (Table 2)

Table 1 Prevalence of different types of attachment of maxillary labial frenum

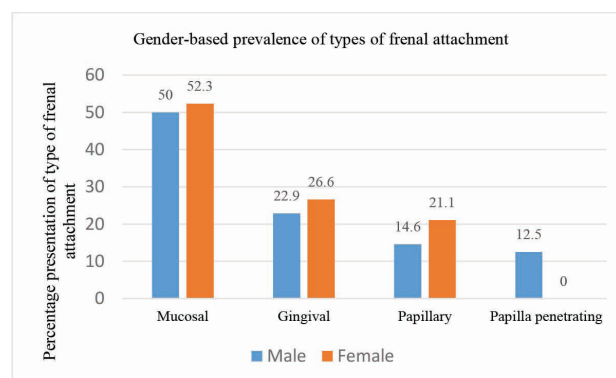
Type of frenal attachment	Frequency	Percentage
Mucosal	81	51.6
Gingival	40	25.5
Papillary	30	19.1
Papilla penetrating	6	3.8
Total	157	100

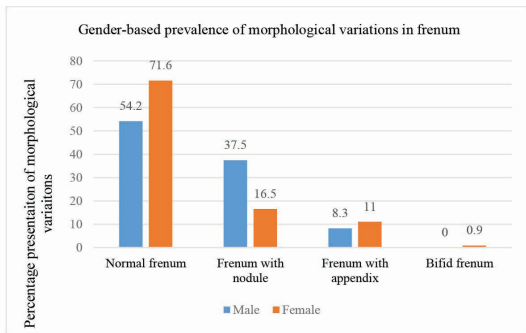
Table 2 Prevalence of morphological variations in maxillary labial frenum

Morphological variations	Frequency	Percentage
Normal frenum	104	66.2
Normal frenum with nodule	36	22.9
Normal frenum with appendix	16	10.2
Bifid frenum	1	0.6
Total	157	100

Likewise, when evaluating the prevalence of type of frenal attachment in each gender, out of 48 males, 50.0% had mucosal, 22.9% had gingival, 14.6% had papillary and 12.5% had papilla penetrating types of attachment. While, out of 109 females, 52.3% had mucosal, 26.6% had gingival and 21.1% had papillary types of frenal attachment. Similarly, evaluation of morphological variations revealed normal frenum in 54.2%, frenum with nodule in 37.5% and frenum with appendix in 8.3%, in males. Likewise, in females, 71.6% had normal frenum, 16.5% had frenum with nodule, 11% had frenum with appendix and 0.9% had bifid frenum. (Figure 1)

Figure 1: Gender-based prevalence of types of attachment and morphological variations of maxillary labial frenum





Comparing the presentation of frenal attachment between males and females, 29.6% of mucosal type was presented by males and 70.4% by females, 50% of gingival type by both males and females, 23.3% of papillary type by males and 76.7% by females, while 100% of the papilla penetrating type was seen in males. (Table 3) (Figure 2)

Likewise, 25% of normal frenum was presented by males and 75% by females, 50% of frenum with nodule was presented by both males and females, 25% of frenum with appendix by males and 75% by females, and bifid frenum by 100% females. (Table 4) (Figure 2)

Table 3 Comparison of types of frenal attachment between genders

Mirko classification		Gender		Total
		Male	Female	
1	Count	24	57	81
	% within Mirko classification	29.6%	70.4%	100%
	% within gender	50.0%	52.3%	51.6%
	% of total	15.3%	36.3%	51.6%
2	Count	11	29	40
	% within Mirko classification	27.5%	72.5%	100%
	% within gender	22.9%	26.6%	25.5%
	% of total	7.0%	18.5%	25.5%
3	Count	7	23	30
	% within Mirko classification	23.3%	76.7%	100%
	% within gender	14.6%	21.1%	19.1%
	% of total	4.5%	14.6%	19.1%
4	Count	6	0	6
	% within Mirko classification	100%	0%	100%
	% within gender	12.5%	0%	3.8%
	% of total	3.8%	0%	3.8%
Total		48 (30.6%)	109 (69.4%)	157 (100%)

Table 4 Comparison of variations in maxillary labial frenum between genders

Mirko classification		Gender		Total
		Male	Female	
1	Count	26	78	104
	% within Sewerin classification	25.0%	75.0%	100%
	% within gender	54.2%	71.6%	66.2%
	% of total	16.6%	49.7%	66.2%
2	Count	18	18	36
	% within Sewerin classification	50.0%	50.0%	100%
	% within gender	37.5%	16.5%	22.9%
	% of total	11.5%	11.5%	22.9%
3	Count	4	12	16
	% within Sewerin classification	25.0%	75.0%	100%
	% within gender	8.3%	11.0%	10.2%
	% of total	2.5%	7.6%	10.2%
4	Count	0	1	1
	% within Sewerin classification	0%	100%	100%
	% within gender	0%	0.9%	0.6%
	% of total	0%	0.6%	0.6%
Total		48 (30.6%)	109 (69.4%)	157 (100%)

Figure 2: Comparison of percentage presentation of types of frenal attachment and morphological variations of maxillary labial frenum

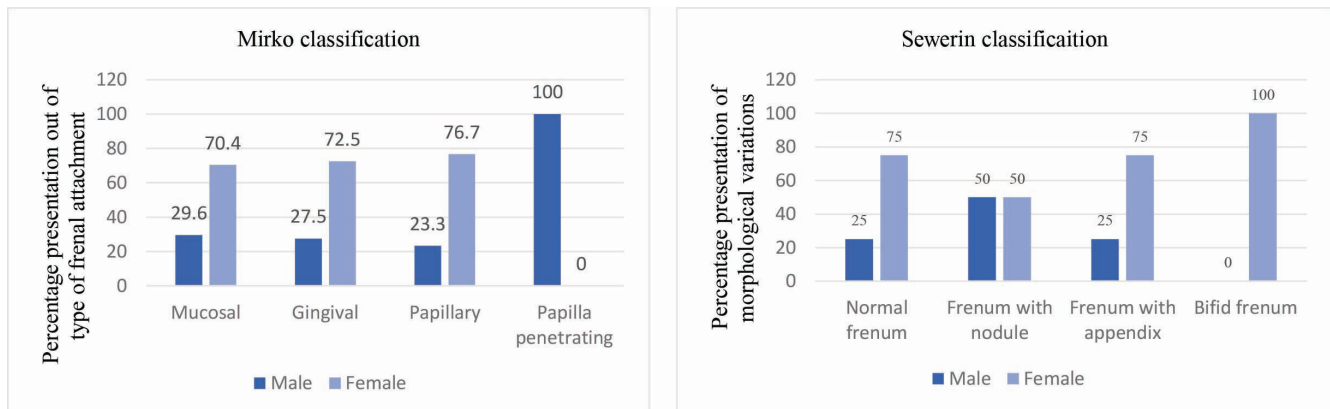


Figure 3: Clinical pictures of types of maxillary frenal attachment

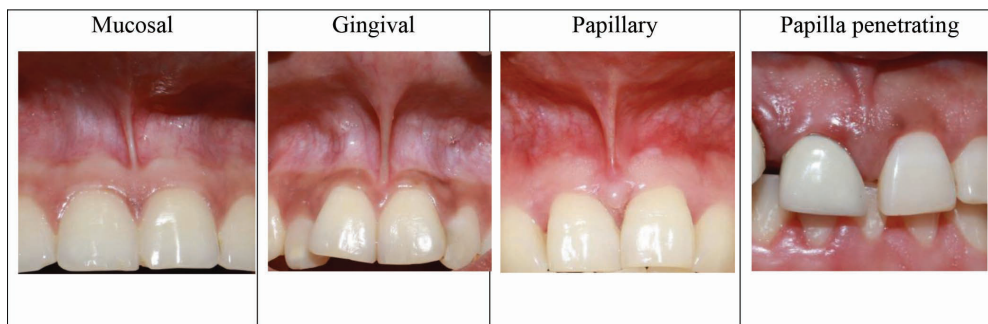
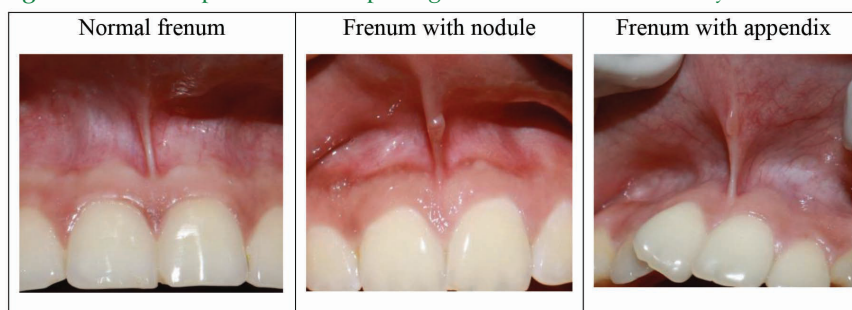


Figure 4: Clinical pictures of morphological variations in maxillary labial frenum



DISCUSSION

Depending upon the extension of attachment of fibres, frena have been classified into mucosal, gingival, papillary and papilla penetrating types along with other anatomical variations. Papillary and papilla penetrating types are considered as pathological⁸ and are associated with enhanced plaque accumulation, loss of papilla, recession, malalignment of teeth, diastema, relapse of diastema after orthodontic treatment, compromised denture fit or retention⁹ and have also been linked as a feature of various syndromes.³

Back in the time, some studies described frenum to be abnormal simply because they were hypertrophied, while some suggested frena to be abnormal only in case they predisposed to midline diastema. Some suggested that hypertrophied frena usually diminished in size with

increase in age and eruption of permanent teeth and also that a frenum should not to be described as aberrant simply because of the incidental presence of the space for which it might not be responsible. Therefore, frenum should always be considered as an associated structure rather than an isolated entity.⁵

A thick wide maxillary frenum attached close to the gingival margin is considered as a factor contributing to midline diastema. A thick maxillary frenum is considered normal during early developmental stage but eventually with the enlargement of alveolar process and eruption of maxillary anterior teeth, the frenal attachment thins out and relocates to a more apical position. Therefore, the papillary and papilla penetrating types of frenal attachment are considered pathogenic if it exists beyond the mixed dentition period.¹⁰ High frenal attachment if not

intervened leads to recurrence of midline diastema even after successful orthodontic treatment.⁸

An adequate zone of attached gingiva is essential for maintaining the gingival health.^{11,12} Hence, a frenum which is unusually large and wide with no apparent zone of attached gingiva in the permanent dentition and or when the interdental papilla shifts when the frenum is extended, is said to be pathogenic.¹⁰

A thick wide frenum is also considered to be a compromising factor for denture resistance and retention. To add to this, large notches that are required to accommodate such large frena are thought to be responsible for fracture of dentures. Therefore, early recognition and surgical removal of such frena is important for favourable treatment outcome with dentures.¹³

Moreover, frenal abnormalities reflect various underlying syndromes such as such as Turner syndrome, Ellis-van Creveld syndrome, Oral-facial-digital syndrome, Ehlers Danlos syndrome, Infantile hypertrophic pyloric stenosis, Holoprosencephaly etc. Various reports addressing these problems have been discussed.^{8,14-17} Thus, the dentist needs to give due importance for frenum assessment during oral examination and prepare to correct any abnormalities whenever indicated.

There are very few studies that have been published pertaining to the different types of upper labial frena and their prevalence.

Jindal *et al.* in 2016 conducted a study on 500 subjects where 66% of patients presented with mucosal type of attachment followed by gingival type in 28.4%, papilla penetrating type in 3.2% and the least common being the papillary type found in only 2.4%. Moreover, normal frenum was the most common (77.6%) followed by frenum with nodule (12.4%) while frenum with appendix was found to be the least common (9%).³ In a study by Rajani *et al.* in 2018 regarding the type of frenal attachment, mucosal type (42%) was found to be the most prevalent followed by gingival (34%), papillary (20%), and papillary penetrating type (4%).¹⁰

Similar studies have been conducted in the context of Nepal. In 2018, a study was conducted on 356 Nepalese individuals by Rajkarnikar *et al.*¹⁸ in which frequency of mucosal type of frenal attachment (70.5%) was seen to be the most common followed by gingival type (28.4%), then papillary type (0.8%) and the least common being the papilla penetrating type (0.3%).

Later on, Joshi *et al.* in 2021 conducted a similar study among 340 Newari children. They concluded that the mucosal type of attachment was observed in 60% of the

participants followed by gingival type seen in 29.7%. Regarding the morphological variations, more than 80% of the participants had simple frenum; frenum with nodule was present in 7.3% and frenum with appendix in 6.5% of study participants. Frenum with appendix was mostly present in males 10.1% than in females 2.5%.¹⁹ The findings of all these studies are similar to the present study.

A study done back in 2012 by Upadhyay and Ghimire, who evaluated the frenal attachment among 198 children ranging from 1 to 14 years and concluded the gingival attachment as the most common type seen in 61.1%, as opposed to the finding of the present study, and papilla penetrating as the least common type of frenal attachment observed in only 8.1%, with no significant gender based difference.²⁰

The present study reflects the prevalence of types of frenal attachment and also the frequency with which the morphological variations exists in the maxillary labial frenum within the study subjects. However, this study does not compare the findings among the different age groups and whether the tests to determine if the frenum is aberrant coincide with the types of attachments that are indeed considered to be the most pathogenic.

CONCLUSION

Maxillary labial frenum is a dynamic structure and has variations that can indeed have a variety of consequences. Correction of aberrant frenum is important. Therefore, it should never be overlooked and should always be considered as one of critical aspects of oral examination.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to Dr. Sujita Shrestha and Dr. Sunita Khanal for the continuous support in statistical analysis and the overall study.



REFERENCES

1. Popovich F, Thompson GW, Main PA. The maxillary interincisal diastema and its relationship to the superior labial frenum and intermaxillary suture. *Angle Orthod.* 1977 Oct;47(4):265–71.
2. Henry SW, Levin MP, Tsaknis PJ. Histologic features of the superior labial frenum. *J Periodontol.* 1976 Jan;47(1):25–8.
3. Jindal V, Kaur R, Goel A, Mahajan A, Mahajan N, Mahajan A. Variations in the frenal morphology in the diverse population: A clinical study. *J Indian Soc Periodontol.* 2016 Jun;20(3):320–3.
4. Dewel BF. The normal and the abnormal labial frenum; clinical differentiation. *J Am Dent Assoc.* 1946 Mar;33:318–29.
5. Ceremello PJ. The superior labial frenum and the midline diastema and their relation to growth and development of the oral structures. *American Journal of Orthodontics.* 1953 Feb 1;39(2):120–39.
6. Sewerin I. Prevalence of variations and anomalies of the upper labial frenum. *Acta Odontol Scand.* 1971 Oct;29(4):487–96.
7. Mirko P, Miroslav S, Lubor M. Significance of the labial frenum attachment in periodontal disease in man. Part I. Classification and epidemiology of the labial frenum attachment. *J Periodontol.* 1974 Dec;45(12):891–4.
8. Priyanka M, Sruthi R, Ramakrishnan T, Emmadi P, Ambalavanan N. An overview of frenal attachments. *J Indian Soc Periodontol.* 2013 Jan;17(1):12–5.
9. Chaubey KK, Arora VK, Thakur R, Narula IS. Perio-esthetic surgery: Using LPF with frenectomy for prevention of scar. *J Indian Soc Periodontol.* 2011 Jul;15(3):265–9.
10. Rajani ER, Biswas PP, Emmatty R. Prevalence of variations in morphology and attachment of maxillary labial frenum in various skeletal patterns - A cross-sectional study. *J Indian Soc Periodontol.* 2018;22(3):257–62.
11. Lang NP, Løe H. The relationship between the width of keratinized gingiva and gingival health. *J Periodontol.* 1972 Oct;43(10):623–7.
12. Miyasato M, Crigger M, Egelberg J. Gingival condition in areas of minimal and appreciable width of keratinized gingiva. *J Clin Periodontol.* 1977 Aug;4(3):200–9.
13. Al Jabbari YS. Frenectomy for improvement of a problematic conventional maxillary complete denture in an elderly patient: a case report. *J Adv Prosthodont.* 2011 Dec;3(4):236–9.
14. Kusiak A, Sadlak-Nowicka J, Limon J, Kochańska B. The frequency of occurrence of abnormal frenal attachment of lips and enamel defects in Turner syndrome. *Oral Dis.* 2008 Mar;14(2):158–62.
15. Hattab FN, Yassin OM, Sasa IS. Oral manifestations of Ellis-van Creveld syndrome: report of two siblings with unusual dental anomalies. *J Clin Pediatr Dent.* 1998;22(2):159–65.
16. King NM, Sanares AME. Oral-facial-digital syndrome, Type I: a case report. *J Clin Pediatr Dent.* 2002;26(2):211–5.
17. De Felice C, Toti P, Di Maggio G, Parrini S, Bagnoli F. Absence of the inferior labial and lingual frenula in Ehlers-Danlos syndrome. *Lancet.* 2001 May 12;357(9267):1500–2.
18. Rajkarnikar J, Khanal, Acharya J. Prevalence and Variations of the Maxillary Labial Frenum in Children , Adolescents and Adults. In 2018 [cited 2023 Aug 16]. Available from: <https://www.semanticscholar.org/paper/Prevalence-and-Variations-of-the-Maxillary-Labial-%2C-Rajkarnikar-Khanal/8921622676162d21f8d8247e80d690e040e66cb0>
19. Joshi DU, Pradhan DM, Lawaju DN, Khadka DN, Chaulagain DR. Variations in Maxillary Frenal Morphology in a Sample of Newari Children of Bhaktapur. *Journal of Nepalese Society of Periodontology and Oral Implantology.* 2021 Jul 3;5(1):34–8.
20. Upadhyay S, Ghimire N. Attachment of Maxillary Labial Frenum in Nepalese Children. *Orthodontic Journal of Nepal.* 2012 Jun 30;2(1):38–31.