

Variations in the Attachment and Morphology of Maxillary Labial Frenum in Diverse Population of Gujarat: An Observational Study

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ABSTRACT

Background: The primary objective of this study was to evaluate the prevalence of frenal variations in a diverse ethnic population of Gujarat.

Materials and Methods: This study was conducted on 1000 participants within age group of 18 – 30 years (527 males, 473 females). Intraoral examination was done to evaluate the variations in maxillary frenum and photographs were taken.

Results: In this study, according to type of frenal attachment most commonly found frenal attachment is mucosal type and least common is papillary penetrating type. According to morphologic variations, Frenulum Normale was most commonly found, followed by Frenulum Normale Cum Nodulo while Frenulum Tectolabiale Persistens was found to be least common. However, no statistically significant difference was found between males and females ($P > 0.05$) with respect to all types of frenal attachments. Midline diastema was found in papillary, papilla penetrating type and frenulum tectolabiale persistens. Furthermore, other structural variations was not found in morphology of frenum in the diverse population of Gujarat.

Conclusion: Maxillary labial frenum is a small anatomical landmark in the oral cavity which have diverse morphology and attachment. The dentist should give due importance to frenum assessment during the intra-oral examination.

Keywords: Maxillary Labial Frenum, Frenal Attachment, Frenal Morphology.

INTRODUCTION

A frenum is a soft tissue band or fold of mucosal membrane by which lips and cheeks attaches to the alveolar process of jaws to limit their movements. It is defined as a “fibrous band of tissue attached to the bone of the mandible and maxillae, and is present superficial to muscle attachments.”¹ Frenums are generally present in the vestibular mucosa of maxillary and mandibular central incisors or premolar region of both maxilla and mandible. A diverse variation of frenums can be

observed in the oral cavity namely: maxillary and mandibular labial and buccal frenum; mandibular lingual frenum.² Maxillary labial frenum is more dynamic structure among all types of frenum and is subjected to variations during different stages of human growth and development.³ Stability to the upper lip is maintained by the it.² Histologically enormous loose fibrous connective tissue, elastic fibers along with many striated muscle fibers are present in the frenal section.^{4,5} Variations in the

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maxillary labial frenum depend on the attachment of fibers and its structure.⁶

An encroached frenum pulls the gingival margin away from the tooth and promote plaque accumulation that increases the probability for occurrence of gingival recession². Several classifications have been proposed to classify the variations in frenum, but the classifications given by **Placek** in 1974⁷ and **Sewerin** in 1969⁸ are widely accepted till date.

Depending upon the attachment of fibers, frenum have been classified as (**Placek 1974**):⁷

1. Type 1 [Mucosal attachment] – Frenal fibers are attached up to mucogingival junction
2. Type 2 [Gingival attachment] – Fibers are inserted within attached gingiva
3. Type 3 [Papillary attachment] –Fibers are extending into interdental papilla
4. Type 4 [Papilla penetrating attachment] – Frenal fibers cross the alveolar process and extend up to palatine papilla.

Sewerin 1969⁸ has also classified the variations in the morphology of frenum as:

- A. Variations of the upper labial frenum
 1. Frenulum normale
 2. Frenulum normale cum appendice
 3. Frenulum normale cum nodulo
- B. Anomalies of the upper labial frenum
 1. Frenulum bifidum
 2. Frenulum cum recessu
 3. Frenulum tectolabiale persistens
 4. Duplicatio frenuli
 5. Coincidence of two or more frenulum variations or anomalies.

However, longitudinal studies categorizing related to the types of the maxillary labial frenum and their role in health and disease are scarce. Therefore the present study was aimed to evaluate the relationship between periodontal health and the various types of maxillary labial frenum in a diverse population in Gujarat.

MATERIALS AND METHODS

1000 participants between the age group of 18 – 30 years including (527 males, 473 females) who visited the out-patient department of Narsinhbhai Patel Dental College and hospital, Visnagar, Gujarat were enrolled for the study. The study was approved by the Institutional Research Review Committee. All the participants were explained about the study, and a written informed consent was taken from all the participants. Participants having history of any past surgeries in maxillary labial frenum; trauma/injury to the maxillary anterior mucosal region, any congenital/developmental abnormality in maxillary frenum or premaxilla, and one or both maxillary central incisors missing were excluded from the study. The examination of maxillary labial frenum was done by upward distention of the upper lip following which photographs were taken. The collected data were subjected to statistical analysis.

Statistical analysis

Chi-Square test [using IBM SPSS Statistics v. 20.0] was used for the statistical analysis of the recorded data to find the level of significance.

RESULTS

The present study demonstrates the variations in the frenal type based on two different classification systems described by **Placek**⁷ and **Sewerin**⁸. 56.9% the participants presented with mucosal type of frenal attachment while in 23.7% of the participants; gingival type of frenal attachment was seen. Papillary type was found only in 11.9% of participants, and Least common type of attachment was papilla penetrating type which was found only in 7.5% of participants as seen in Table I; Fig. 1. The gender-based variations were found to be more prevalent in females in relation to mucosal, papillary type and papilla penetrating type (57.08%, 12.47% and 7.6%) as compared to males (56.73%, 11.38%, and 7.4%) respectively. Only gingival type of frenal attachment was more prevalent in males (24.47%) as compared to females (22.83%) as seen in Table I. However, no significant difference was found between males and females ($P>0.05$) in relation to all types of frenal attachments. The prevalence of midline diastema was found to be more in the papilla penetrating

type of frenal attachment (81.33%) as compared to papillary type of frenal attachment (21.84%) as seen in Table I.

Table I: Prevalence of Variations in Frenal Attachment

VARIATION S	MALE N (%)	FEMALE N (%)	P	BOTH SEXES N (%)	MIDLINE DIASTEMA N (%)
Type I (Mucosal)	299 (56.73%)	270 (57.08%)	0.9127706	569 (56.9%)	-
Type II (Gingival)	129 (24.47%)	108 (22.83%)	0.5413754	237 (23.7%)	-
Type III (Papillary)	60 (11.38%)	59 (12.47%)	0.5953933	119 (11.9%)	26 (21.84%)
Type IV (Papilla Penetrating)	39 (7.4%)	36 (7.6%)	0.8993431	75 (7.5%)	61 (81.33%)



Fig 1: Types of frenal attachments (a) Mucosal type, (b) Gingival type, (c) Papillary type, (d) Papilla penetrating type.

According to the classification by **Sewerin**⁸ in this study, 84.3% of participants had frenulum normale while in 8.3% of participants, frenulum normale cum nodulo was present. In 3.5% of participants, there was frenulum normale cum appendice and in 3.7% of participants duplicatio frenuli found. While frenulum tectolabiale persistens was found in 0.2% of the participants along with midline diastema. Whereas other morphological variations were not found in the present study [Table II; Fig. 2].

Table II: Prevalence of Variations in Frenal morphology

VARIATIONS	MALE N (%)	FEMALE N (%)	P	BOTH SEXES N (%)
Frenulum Normale	436 (82.73%)	407 (86.04%)	0.1503200	843 (84.3%)
Frenulum Normale Cum Appendice	19 (3.6%)	16 (3.38%)	0.8474650	35 (3.5%)
Frenulum Normale Cum Nodulo	46 (8.72%)	37 (7.82%)	0.6040033	83 (8.3%)
Frenulum Bifidum	-	-	-	-
Frenulum Cum Recessu	-	-	-	-
Frenulum Tectolabiale Persistens	2 (0.37%)	-	-	2 (0.2%)
Duplicatio Frenuli	24 (4.55%)	13 (2.74%)	0.1309674	37 (3.7%)
Coincidence Of Two Or More Frenulum Variations Or Anomalies	-	-	-	-



Fig 2: Types of frenal morphology (a) Frenulum Normale, (b) Frenulum Normale Cum Appendice, (c) Frenulum Normale Cum Nodulo, (d) Frenulum Tectolabiale Persistens, (e) Duplicatio Frenuli.

The gender-based variations were found to be more prevalent in females in relation to frenulum normale (86.04%) as compared to males (82.73%), respectively. This high frequency in females is statistically insignificant ($P > 0.05$). frenulum normale cum nodulo, frenulum normale cum appendice and duplicatio frenuli were found to be more prevalent in males (8.72%, 3.6% and 4.55%) as compared to females (7.82%, 3.38% and 2.74%) respectively. Whereas frenulum tectolabiale persistens was found only in males (0.37%). This high frequency in males is statistically insignificant ($P > 0.05$), as seen in Table II.

DISCUSSION

Maxillary labial frenum is a complex structure though sometimes it is considered as a simple structure. The characterization of the maxillary labial frenum and the interdental spaces of maxillary central incisors are important because they may impose some modifications in dental treatments.⁹

The clinical implications related to frenal anomalies such as difficulties in speech, mastication, esthetics and maintenance of oral hygiene causing a periodontal problem have been well documented in the literature.^{10,11} If labial frenal attachment is inserted at or near the gingival margin, it interferes in tooth brushing and provide area for plaque accumulation by pulling the gingival margin which is responsible for initiation and progression of the periodontal diseases.²

There are several variations found in maxillary labial frenum. It has been considered that papillary type and papilla penetrating type of frenum attachments are pathologic.^{12,13} In a study done by **Placek**⁷, it was proposed that different type of frenal attachment affects the periodontal condition with papillary type, and papilla penetrating types of maxillary frenal attachments showing lower resistance against periodontal diseases in persons with pathologic changes as compared to healthy persons with similar types of frenal attachment.

Studies investigating the maxillary labial frenum types and their role in periodontal disease progression are scarce. Present study was conducted to evaluate the variations of maxillary frenum in 1000 participants attending the out-

patient department of Narsinhbhai Patel Dental College and hospital, Visnagar, Gujarat.

According to the **Placek**⁷ classification, in this study, 56.9% participants presented with mucosal type of frenal attachment while in 23.7% of the participants, gingival type was seen. Papillary type found only in 11.9% of participants and Least common type of attachment was papilla penetrating was found only in 7.5% of participants as seen Table 1. In the similar study done by **Placek**⁷ the prevalence was found to be as mucosal (46.6%), gingival (34.3%), papillary (3.1%), and papilla penetrating (16.1%). The difference in results in this study as compared to **Placek**⁷ could be due to the diversity of population.

Another study by **Jindal V et al**¹⁴ in 2016 showed that 66.0% of the participants presented with mucosal type of frenal attachment while in 28.4% of the participants, gingival type was seen. Least common type of attachment was papillary type found only in 2.4% of participants, and papilla penetrating type in 3.2% of participants. **Rajani et al**¹⁵ in 2018 found that out of 150 study participants, mucosal type (42%) was most prevalent followed by gingival (34%), papillary (20%), and papilla penetrating type (4%). Frenulum normale (45.33%) was the most prevalent in all three groups, followed by frenulum bifidum (19.33%).

Another aspect of this study was to evaluate the association of abnormal frenal types with midline diastema. Midline diastema is often considered unaesthetic and it is one of the main reasons why participants seek orthodontic treatment. It may be caused by the insertion of the labial frenum into the notch in the alveolar bone so that a band of heavy fibrous tissue lies between the central incisors.¹⁶ In this study The prevalence of midline diastema was found to be more in the papilla penetrating type of frenal attachment (81.33%) as compared to papillary attachment (21.84%) as seen in Table I. According to morphologic variations midline diastema was found in frenulum tectolabiale persistens (0.2 %) as seen in table 2. **Sękowska A and Chalas R**¹⁷ in 2017 found statistically significant differences between study group and control group in maxillary labial frenulum attachment ($p < 0.05$). Normal frenulum attachment (mucosal or gingival type) was typical for group

without diastema, but enlarged frenulum (papillary or papilla penetrating type) was characteristic for diastema group. Type of frenulum had significant ($p < 0.05$) impact to the width of diastema. Small diastema (≤ 2 mm) more often coexisted with normal frenulum. Oversized frenulum was observed in the wide diastema (> 2 mm).

Various studies have found difference in the morphologic variations of the frenum. In 1969, a study done by **Sewerin**⁸ found that frenulum normale variation was more prevalent (60.2%) as compared to frenulum normale cum appendice (19.9%) and frenulum normale cum nodulo (9.1%). Whereas, frenulum bifidum (3%); frenulum recessu (2.8%); frenulum tectolabiale persistens (2.6%) and duplicatio frenuli (0.4%) was prevalent in less than 5% of all the designated participants. In the present study according to **Sewerin**⁸ classification, 84.3% of participants had frenulum normale while in 8.3% of participants frenulum normale cum nodulo. In 3.5% of participants had frenulum normale cum appendice; 3.7% of participants had duplicatio frenuli and in 0.2% of the participants had frenulum tectolabiale persistens. While all other forms were absent in this study as seen in Table II. Another study done by **Sagar et al**¹⁸ in 2016, found that the frenulum normale cum nodulo was more prevalent (28.33%). Whereas frenulum tectolabiale persistens (20%); coincidence of two or more frenulum variations or anomalies (20%); frenulum normale cum appendice (16.67%) and frenulum bifidum (13.33%) were less prevalent.

Townsend et al.⁶ in 2013 found that, frenum normale was the most common frenum types, followed by frenum with nodule and frenum with appendix among the 284 examined participants. In 2018, **Jonathan PT et al**¹⁹ found that simple type maxillary labial frenum morphology was more prevalent, which increased significantly with age followed by persistent tectolabial frenum, which decreased significantly with age ($P < 0.001$). The commonest location of frenum attachment was alveolar mucosa followed by gingiva and papillary penetrating incisive papilla. 42.2% of the total study participants were having midline diastema and it was more prevalent in the 6–9 years' age group. Statistically significant relationship was found between midline diastema and persistent tectolabial frenum and a significant inverse

relationship was found between the level of gingival insertion and midline diastema ($P < 0.001$).

Hence, proper identification of various frenal morphologies and subsequent modification of treatment procedures are vital for a successful treatment outcome.

CONCLUSION

To conclude, high frenal attachment causing difficulties in speech, mastication, and aesthetics and it is also responsible for initiation and progression of periodontal diseases. In summary, it is apparent that proper identification of various frenal variations are important and need to be addressed. The dentist thus needs to give importance to frenum assessment during intra-oral examination.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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