Original Article

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Evaluation of the Relationship Between Maxillary Labial Frenulum Attachment Types, Periodontal Health, and Dental Caries in Preschool Children

Okul Öncesi Çocuklarda Maksiller Labial Frenulum Ataçman Tipleri ile Periodontal Sağlık ve Diş Çürükleri Arasındaki İlişkinin Değerlendirilmesi

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ABSTRACT

Objective: The purpose of the study was to investigate any possible relation between maxillary labial frenulum attachment type on periodontal status and dental caries in pre14school children.

Methods: This cross-sectional study was conducted for six months among the children who were admitted for treatment at a university clinic. The children aged between 3 to 6 years were enrolled in the study. The types of maxillary labial frenulum attachment were recorded as mucosal, gingival, papillary, and papillary penetrating types. Plaque index (PI), gingival index (GI), and dental status (dmft) of maxillary primary incisors were evaluated. Kruskal-Wallis and Pearson's chi-squared tests were used for statistical analysis.

Results: A total of 214 children (mean age was 4.4±0.9 years) were evaluated. The most common maxillary frenulum attachment type was the gingival type (45.8%), while the papillary penetrating type (13.1%) was the least common. The PI and GI scores in children with mucosal type frenulum were lower than in children with the gingival, papillary, and papillary penetrating types ($p<0.01$). The dmft scores were lower in children with mucosal type frenulum and higher in children with papillary type frenulum ($p<0.01$).

Conclusion: Papillary and papillary penetrating types of frenulum attachments were associated with a decline in periodontal health and higher caries incidence in maxillary primary incisors.

Keywords: Oral health, caries, maxillary frenulum, periodontal health

ÖZ

Amaç: Bu çalışmanın amacı, okul öncesi çocuklarda maksiller labial frenulum ataçman tipi ile periodontal sağlık ve diş çürükleri arasında olası bir ilişki olup olmadığını araştırmaktır.

Yöntemler: Kesitsel tipteki bu araştırma, bir üniversite kliniğine tedavi için başvuran çocuklarda 6 aylık bir süre boyunca yürütülmüştür. Çalışmaya 3 ila 6 yaş arasındaki çocuklar dahil edilmiştir. Maksiller labial frenulum ataçmanının tipi mukozal, gingival, papiller ve papillaya penetre olarak kaydedilmiştir. Maksiller süt kesici dişlerin plak indeksi (Pİ), gingival indeksi (Gİ) ve çürük durumu (dmft) değerlendirilmiştir. İstatistiksel analiz için Kruskal-Wallis ve Pearson ki-kare testleri kullanılmıştır.

Bulgular: Toplam 214 çocuk (ortalama yaş: 4,4±0,9) değerlendirilmiştir. En sık görülen maksiller frenulum ataçman tipi gingival tip (%45,8) iken, en az görülen ise papillaya penetre tip (%13,1) olmuştur. Mukozal tip frenuluma sahip çocuklarda Pİ ve Gİ skorları gingival, papiller ve papillaya penetre tipteki çocuklara göre daha düşüktür ($p<0,01$). Mukozal tip frenuluma sahip çocuklarda dmft skorları daha düşük iken, papiller tip frenulumlu çocuklarda ise daha yüksektir ($p<0.01$).

Sonuç: Papiller ve papillaya penetre tip frenulum ataçmanları, periodontal sağlığı olumsuz etkilemiş ve maksiller süt kesici dişlerde daha yüksek çürük insidansı görülmesine neden olmuştur.

Anahtar Sözcükler: Ağız sağlığı, diş çürüğü, maksiller frenulum, periodontal sağlık

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Introduction

The frenulum, one of the most interesting anatomic structures in the oral cavity, is a collagenous fibrous tissue fold of mucous membrane and connects the lip, cheeks, and tongue to the alveolar process. It originates embryologically from a residue of cells of the vestibular lamina at the midsagittal area, consisting mostly of connective tissue and epithelium, which rarely contain muscle fibers (1,2). There are seven types of frenulum described in the literature; most prominently the maxillary labial frenulum, the mandibular labial frenulum, the lingual frenulum, and four buccal frenula, generally present in the oral cavity (3). Although their primary function is providing stability in the maxilla and mandible, there is controversy about their contribution to mastication (4).

The notable maxillary labial frenulum has been associated with several clinical problems in infants or children. The most prominent complication is midline diastema, occurring as a result of preventing contact between maxillary incisors, whereas it is a physiologic condition during the early developmental stage (5). The midline diastema is a major esthetic problem for children and parents; it may also complicate orthodontic treatment and can be possibly responsible for the progression of dental caries in breastfeeding children. Breastfeeding or bottle-feeding difficulties occurring as a result of inhibition of sealing on the maternal breast or feeding bottle could be associated with a restrictive maxillary labial frenulum in newborns (6). As also a local anatomic factor, the maxillary labial frenulum may cause dental plaque accumulation. The limited toothbrushing ability of children can be affected and removing the plaque can be more difficult (5).

The free or gingival insertion level of hyperplastic maxillary frenulum attachment may complicate cleaning the maxillary incisors by preventing the movement of the upper lip. It potentially leads to dental caries, especially in facial-cervical regions (7). Dental caries is a common disease that affects most of the populations around the world. In children, early childhood caries (ECC) is defined as the presence of one or more decayed, missing (due to caries), or filled tooth surfaces in any primary tooth in a child younger than 6 years. One of the main etiologic factors of ECC is inadequate oral hygiene. The removal of plaque on the teeth surfaces is predisposing to the formation of dental caries. Facial-cervical caries lesions are frequently observed in the maxillary anterior region in children (8).

The clinical morphological classification of the maxillary labial frenulum was described by Placek et al. (9). The classification depends on the anatomical insertion level of attachment and aims to help clinicians for identifying functional problems. The maxillary labial frenulum İs classified according to whether the attachment İs located at the mucogingival junction, the attached gingiva, the interdental papilla, and through the interdental papilla to the palate (7). The position of insertion, shape, or structure of the maxillary labial frenulum can change during the growth and development period due to its dynamic nature (10). Although the prevalence of different types of maxillary labial frenulum has been studied in adults, there are only a few studies investigating this classification in children (5,11).

Although anecdotal theories sustain, there is no evidence supporting these clinical results to date. Considering this limited information, the purpose of this cross-sectional study was to investigate any possible relation between maxillary labial frenulum attachment type on periodontal problems and dental caries in children. In addition, the prevalence of maxillary labial frenulum attachment type was described in a Turkish population.

Methods

Statement of Ethics

Ethical approval was obtained from the Research Ethics Committee of Bezmialem Vakıf University in full accordance with the ethical principles of the Helsinki Declaration (protocol no. 04.11.2020- 12/24). Written informed consent from the parents and verbal assent from the children were also obtained.

Study Design and Participants

This cross-sectional study was performed at the Bezmialem Vakıf University Pediatric Dentistry Clinic between November 2020 and May 2021. The physically healthy children aged between 3 to 6 years were enrolled in the study. Children who were admitted to the clinic for a routine dental examination, fulfilled inclusion criteria, and were willing to participate were included in the study. The children with congenital or developmental anomalies, history of trauma or surgical operation on the maxillary anterior region, and under any medication affecting the gingiva were excluded from the study. Demographical data such as age and gender were recorded.

Clinical Examination

The clinical examinations were performed in the dental unit under adequate lighting with experienced two pediatric dentists. Children were examined to record the type of maxillary frenulum. In addition, oral hygiene of children and dmft, plaque index (PI), and gingival index (GI) score of maxillary primary incisors were assessed. An adjusted scoring chart was used when scoring the clinical outcomes (Table 1).

The maxillary labial frenulum attachment was categorized as mucosal, gingival, papillary, and papilla penetrating according to the classification of Placek et al. (9). If the frenal fibers are attached up to the mucogingival junction, it is classified as mucosal; if the frenal fibers are inserted within the attached gingiva, it is classified as gingival; if the frenal fibers are extending into the interdental papilla, it is classified as papillary and if the frenal fibers cross the alveolar process and extend up to the palatine papilla, it is classified as papilla penetrating (Figure 1).

Periodontal health was assessed using the PI and GI. The means of four surfaces (mesial, distal, buccal, lingual) were used as the PI and GI scores. Microbial dental plaque accumulation of the maxillary incisors was assessed with the PI, according to Silness and Loe (12). Gingival health was assessed using the GI, according to Loe and Silness (13).

Dental status was reported using the World Health Organization criteria for deciduous teeth (14). The dmft index of maxillary

primary incisors was recorded by examiners using a dental mirror and explorer under dental unit lighting. To determine the dmft index, summation of decayed, missed, and filled maxillary primary incisors was calculated. The dmft scores were categorized as <1 and ≥1 to analyze the data.

Statistical Analysis

Statistical analyses were performed using SPSS software for Windows (Ver. 12.0, IBM Corp., Chicago, Ill., USA) at a significance level of α=0.05. Intra- and interobserver reliability were assessed with the intraclass correlation coefficient. Descriptive statistics were presented as the mean ± standard deviation. All data were tested for normal distribution with the Shapiro-Wilk test. Pearson's chi-square and Kruskal-Wallis tests with Bonferroni correction were used for comparisons.

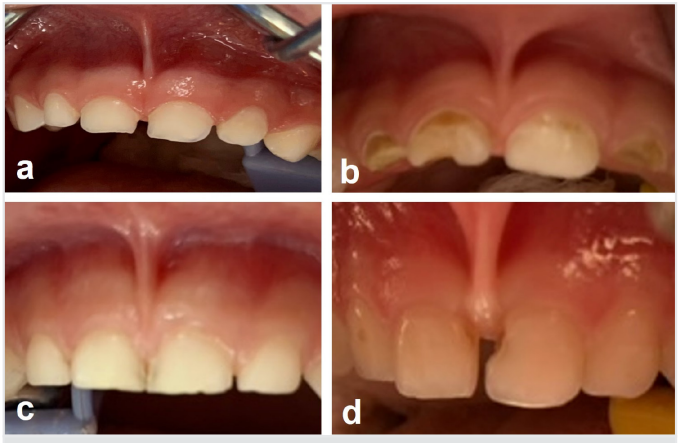

Figure 1. Examples of maxillary labial frenulum attachment types. **(a)** Mucosal, **(b)** gingival, **(c)** papillary, **(d)** papillary penetrating

Table 1. Clinical assessment criteria

Type of maxillary frenulum attachment[9]	0: mucosal 1: gingival 2: papillary 3: papilla penetrating
dmft	0: <1 1: ≥1
Plaque index[12]	0: no plaque 1: film at the gingival margin and adjacent tooth 2: moderate accumulation 3: abundance on a plaque
Gingival index[13]	0: normal gingiva 1: mild inflammation 2: moderate inflammation 3: severe inflammation

Results

A total of 214 children were included in the present study. The children included 96 boys and 118 girls whose ages ranged from 3 to 6 years (mean age was 4.4± 0.9 years). The intra- and interobserver kappa values were above 0.8 and 0.6 for the PI and GI measurements, respectively.

The prevalence of maxillary frenulum attachments is shown in Figure 2. The most common attachment type was the gingival type (45.8%), whereas papillary type (23.8%) and mucosal type (17.3%) attachments were less common, and the least common attachment type was the papillary penetrating type (13.1%).

The PI and GI scores of maxillary primary incisors were significantly different among the maxillary frenulum attachment types (Table 2). Post-hoc analysis revealed that the PI and GI scores of maxillary primary incisors in children with mucosal type frenulum were lower than in children with gingival type, papillary type, and papillary penetrating type frenulum ($p< 0.01$). The PI and GI scores of maxillary primary incisors in children with gingival type frenulum were lower than in children with papillary type and papillary penetrating type frenulum ($p<0.01$).

The dental status of the children, as measured by the dmft, was significantly different among the maxillary frenulum attachment types (Table 3). Post-hoc analysis revealed that the absence of decay missed, or filled primary maxillary incisors was significantly higher in children with mucosal type frenulum ($p<0.01$). However, the presence of decay, and missed or filled primary maxillary incisors was significantly higher in children with papillary type frenulum ($p<0.01$).

Discussion

The present study indicated that there was a significant association between maxillary labial frenulum attachment types and oral health (periodontal status and dental caries) in pre-school children. There are only a few studies investigating the association between maxillary labial frenulum attachment types and oral health status, including periodontal health and dental caries, among preschool children (15).

The classification method of maxillary labial frenulum attachment may vary in different studies. There are different classifications regarding the categorization of the maxillary labial frenulum (9,16). Sewerin classified the maxillary labial frenulum attachment into 8 types according to anatomical variations and anomalies (16). Placek et al. (9) classified based on the relationship between the maxillary labial frenulum and the periodontium of maxillary incisors. This more practical classification method has gained wide acceptance and has been commonly used. We also used the classification of Placek et al. (9) that was used in many previous studies including children.

There are many studies investigating the incidence of maxillary frenulum attachment types in children (5,9,17-19). Similar to our results, Boutsi and Tatakis (5) reported that gingival type was the most common maxillary labial frenulum attachment type in their study using the same classification method as our study. In

children, the earliest epidemiologic study about maxillary labial frenulum attachment was published by Bergese (20). Although Bergese (20) used a different classification method, the most prevalent maxillary labial frenulum attachment type was reported as "inserting the attached gingiva", which was consistent with the results of the present study. In previous studies involving older children, it was reported that the mucosal type was the most common maxillary labial frenulum attachment type (9,21).

The frenulum inserted into the gingiva is considered abnormal as it facilitates the development of midline diastema and limits lip movement (22,23). Abnormal frenulum attachments

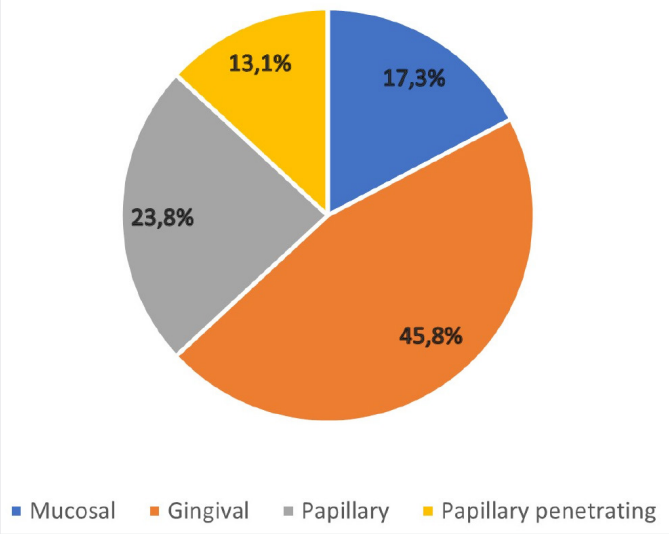

Figure 2. Distribution of maxillary labial frenulum attachment types

Table 2. The association between maxillary labial frenulum attachment types, plaque index, and gingival index scores

	Maxillary labial frenulum attachment types	Median (interquartile range)	P-value*
PI	Mucosal[A]	0.13 (0.00-0.50)	0.01
	Gingival[B]	0.75 (0.25-1.00)	
	Papillary[C]	1.38 (1.00-1.88)	
	Papillary penetrating[C]	2.00 (1.50-2.09)	
GI	Mucosal[A]	0.00 (0.00-0.25)	0.01
	Gingival[B]	0.75 (0.13-1.00)	
	Papillary[C]	1.00 (0.75-1.38)	
	Papillary penetrating[C]	1.50 (1.00-1.75)	

*P-value less than 0.05 is considered significant using the Kruskal-Wallis test and post-hoc Bonferroni test.
There was significant difference between values with different superscript letters.

can affect suckling and feeding in infants, as well as they can contribute to the occurrence of dental caries. Kotlow (17) stated that although breastfeeding alone did not cause dental caries, breastfeeding in combination with abnormal maxillary frenulum attachment might be a contributing factor to the development of dental caries in a breastfed infant. Papillary type and papillary penetrating type frenulum in a nursing infant have the potential to cause dental caries, as they abnormally restrict the upper lip and make it difficult to remove residual milk after breastfeeding is complete. In our study, the reason for the higher oral hygiene, PI, and GI scores in children with papillary type and papillary penetrating type frenulum attachment may be the limitation of the normal functions and mobility of the upper lip. Accordingly, the incidence of caries in maxillary incisors increased in children with papillary type and with papillary penetrating type frenulum.

Frenal attachments have been considered as contributing to periodontal disease. Glickman (24) suggested that the frenulum, attached to the gingival margin, pulled the tissue margin away from the tooth and facilitated plaque accumulation. It is thought that plaque scores and the prevalence of gingivitis should increase in children in whom the labial frenulum attachment adheres to the gingival margin (25). This situation may explain our higher PI and GI scores in children with papillary type and with papillary penetrating type frenulum.

In the primary dentition, the physiological diastema between the maxillary incisors facilitates the cleaning of interproximal areas (26). However, abnormal maxillary frenulum attachment may be a contributing factor to decalcification and development of caries in the mesial areas of the maxillary central incisors by making it difficult to clean the interproximal areas. In our study, caries incidence was significantly lower in children with mucosal type frenulum, while it was significantly higher in children with papillary type frenulum. This result may be due to the change in the cleaning functions of the upper lip according to the frenulum type. In this case, it becomes even more important to remove the plaque that accumulates on the teeth by brushing. However, high frenal attachments such as papillary type or papillary penetrating

Table 3. The association between maxillary labial frenulum attachment types and dental status (dmft) of primary incisors

Maxillary labial frenulum attachment types	dmft		P-value*
	<1	≥1	
Mucosal	21[A]	16[B]	0.01
Gingival	36[A]	62[A]	
Papillary	4[A]	47[B]	
Papillary penetrating	6[A]	22[A]	

*P-value less than 0.05 is considered significant using chi-squared test and post-hoc Bonferroni test.
There was significant difference between values with different superscript letters.

type may complicate the patient's ability to remove plaque. Plaque control should be carefully monitored especially in young children with limited toothbrushing ability.

Study Limitations

The growth of the alveolar process in the coronal direction causes the apical migration of the frenulum attachment. As age progresses, the frenulum attachment may move from a more coronal position to a more apical position (27). Determining the age ranges more limited may provide a clearer determination of the placement of frenulum attachments in further studies. In addition, the possible relationship between maxillary labial frenulum attachment types and oral health will be clearly understood with further studies in which more children will be included.

Conclusion

In conclusion, this study's results showed that the most common maxillary frenulum attachment type in preschool children was the gingival type, while the papillary penetrating type was the least common. Papillary type and papillary penetrating type frenulum attachments were associated with a decline in periodontal health and higher caries incidence in maxillary primary incisors. In clinical examination, the type of maxillary labial frenulum attachment should be evaluated in terms of possible oral health problems.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Research Ethics Committee of Bezmialem Vakıf University in full accordance with the ethical principles of the Helsinki Declaration (protocol no: 04.11.2020-12/24).

Informed Consent: Written informed consent from the parents and verbal assent from the children were also obtained.

Peer-review: Externally peer reviewed.

Authorship Contributions

Surgical and Medical Practices: P.K.T., B.A., H.Y., Concept: D.K.T., Design: D.K.T., Ş.Ö., Data Collection or Processing: B.A., H.Y.A., Analysis or Interpretation: D.K.T., Ş.Ö., Literature Search: D.K.T., Ş.Ö., Writing: D.K.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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