Correlation of Infant Labial Frenum Morphology and Maxillary Deciduous Tooth Eruption among Ningxia-region Population

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Research Article

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Abstract

**Background:** Infant labial frenum morphology will directly lead to the midline diastema between maxillary deciduous tooth which locates in the facial aesthetic area. Facial aesthetic area causes family members' medical demands.

**Objective:** To explore the correlation of infant labial frenum morphology and maxillary deciduous tooth eruption with the age of infants and provide theoretical support for clinical practice.

**Methods:** 1,268 infants (730 males and 538 females) of 5-36 months old who had routine physical examinations in the Children's Health Center of Maternal and Child Health Hospital of Ningxia Hui Autonomous Region in 2022 were selected. Multiple linear regression was used to assess the correlation of labial frenum morphology with age and the correlation of maxillary deciduous tooth eruption with age. The age discrimination equation between different genders was also established.

**Results:** There was a negative correlation between labial frenum morphology and age (male: r=-0.567, female: r=-0.571, P<0.001) and a close relation between maxillary deciduous tooth eruption and age (male: r=0.769, female: r=0.803, P<0.00).

**Conclusion:** The correlation of labial frenum morphology and maxillary deciduous tooth eruption with age can provide guidance to the aesthetic anxiety of infants' family members.

Introduction

Esthetic dentistry plays an important role in social interaction activities and psychological well-being as it influences how people think of themselves and how the society sizes them up. The diastema in the maxillary primary central incisor, especially the diastema in the deciduous dentition, is a common aesthetic appeal[^1]. In order to explore the cause behind, Zhao Xia et al.[^2] believe that thick maxillary labial frenum leads to diastema in the maxillary anterior teeth, which affects facial aesthetics. Labial frenum is also associated with aesthetic and language disorders and requires surgical excision[^3] sometimes.

This study aims to study the correlation of labial frenum morphology and maxillary deciduous tooth eruption with age so as to provide data support for clinical work.

Materials And Methods

1.1 Study subjects

With the approval of the Ethics Committee of Maternal and Child Health Hospital of Ningxia Hui Autonomous Region, 1,268 infants (730 males and 538 females) of 5-36 months old who had routine physical examinations in the Maternal and Child Health Hospital of Ningxia Hui Autonomous Region in
2022 were selected. Inclusion criteria: no systemic disease, no oral and maxillofacial syndrome, no history of trauma or operation on maxillary labial frenum and adjacent mucosa, no drug-induced gingivitis, and no cleft lip and palate during the examination period. Exclusion criteria: history of tooth extraction; history of maxillofacial trauma and facial deformities; gingivitis and Down syndrome.

1.2 Study methods

The infants’ family members were informed of the necessity of examination. An effective knee-to-knee examination was adopted with adequate light. Specifically, the family members and the examiner faced each other knee-to-knee. The family members helped the examiner pull the infant’s hands and controlled the infant’s legs to keep the infant’s head directed toward the examiner so that the examiner could well control the infant’s head movement. These behaviors could reduce the unnecessary movement of the infants, and the examiner could also complete the visual clinical examination with adequate light. The examiner lifted the upper lip of the infant with index finger and thumb of both hands for the observation of the labial frenum classification and maxillary deciduous tooth eruption.

According to the classification method of labial frenum morphology proposed by Mirko\cite{4} in 1974, the labial frenum attachment was divided into four types based on the different attachment positions (Fig. 1):

Type A. Mucosa attachment type, referring to that the upper labial frenum is embedded in the mucosa and is attached to the mucogingival junction;

Type B. Gingiva attachment type, referring to that the upper labial frenum is embedded in the mucosa and is attached to the attached gingiva;

Type C. Gingival papilla attachment type, referring to that the upper labial frenum is embedded in the gingival papilla;

Type D. Gingival papilla-through attachment type, referring to that the upper labial frenum bypasses the gingival papillae between maxillary central incisors and moves to the gingival papilla on the palatal side.

The maxillary deciduous tooth eruption was divided into six types: 0. no deciduous tooth eruption; 1. maxillary primary central incisor eruption; 2. maxillary primary lateral incisor eruption; 3. maxillary deciduous canine eruption; 4. first maxillary deciduous molar eruption; 5. second maxillary deciduous molar eruption.

1.3 Statistical analysis

All data were recorded in the Excel and statistical analysis was performed with SPSS 21.0 and multiple linear regression. The labial frenum morphology and maxillary deciduous tooth eruption were analyzed by Pearson correlation coefficient with r being the correlation coefficient. If P<0.05, it would be considered
statistically different. The correlation of labial frenum morphology and maxillary deciduous tooth eruption with age was studied.

Results

2.1 Labial frenum

Regarding the different morphologies of labial frenum, we found that average age varied in groups of different ages and different gender (Table 1). Through the analysis, we found that the most common labial frenum attachment in the deciduous dentition was type D. Infants of different gender with type D were the youngest. The sample average gradually increased from type D to type A. The sample average of females was greater than that of males under the same labial frenum morphology, except for type D.

2.2 Maxillary deciduous tooth eruption

The different labial frenum morphologies and maxillary deciduous tooth eruption were grouped (Table 2). Type D was most likely to cause aesthetic anxiety. With the increasing number of erupted maxillary deciduous teeth, the total sample size gradually decreased. The gradual eruption of maxillary deciduous teeth would relieve the aesthetic anxiety of infants’ family members.

2.3 Labial frenum and maxillary deciduous tooth eruption

The Pearson correlation analysis of the two variables between different gender (Table 3) showed that there was a correlation between labial frenum morphology and age (male: r=-0.567, female: r=-0.571, P<0.001), and a correlation also existed between maxillary deciduous tooth eruption and age (male: r=0.769, female: r=0.803, P<0.001). When assessing the applicability of the sample model in age changes (adjusted R²), the male labial frenum morphology could explain 32.1% of the variation, and the male maxillary deciduous tooth eruption could explain 59.1% of the variation; the female labial frenum morphology could explain 32.5% of the variation, and the female maxillary deciduous tooth eruption could explain 64.4% of the variation. The regression analysis, with age being the dependent variable and different labial frenum morphologies and maxillary deciduous tooth eruption being the independent variables, showed that different labial frenum morphologies and maxillary deciduous tooth eruption could be used for age estimation (P<0.001). The regression equation was as follows:

Female: Age=10.282-1.38×labial frenum+3.96×maxillary deciduous tooth eruption

Male: Age=10.788-1.263×labial frenum+1.173×maxillary deciduous tooth eruption

Discussion

The labial frenum, a tissue rugae of gingiva, is usually triangular muscle fibers attached to the mucosa, gingiva or periosteum which extend from the maxillary median line area of gingiva to the vestibulum and the central part of the upper lip[5,6]. The maxillary labial frenum begins to develop in the tenth week of
embryo development. It forms a continuous tissue nodular band from the marginal structure inside the lip during the third month of embryo development, bypasses the alveolar process marginal ridge and moves to the incisive papilla, which is morphologically similar to the postnatal developmental abnormalities of labial frenum. Before the birth of the fetus, parts on both sides of the alveolar crest merge to form a continuous tissue band, which is attached to the alveolar bone and divides both sides into the labial side (labial frenum) and the palatal side (incisive papilla)\textsuperscript{[7]}. Dasgupta et al.\textsuperscript{[8]} confirm that the labial frenum may have different morphologies and suggest that this is simply normal anatomic variation.

Based on the acceptable difference (about 2-3 mm) between the dental median line and the facial median line, the largest correlation between incisive papilla and facial midline was observed without a clear reference point in the maxillary median line\textsuperscript{[9]}. The maxillary labial frenum, being a bridge between the facial median line and the dentition, plays a very important role in determining more accurately the relationship between the two\textsuperscript{[10]}. Farahani et al.\textsuperscript{[10]} confirm that the labial frenum deviates less from the median line than the incisive papilla does. Meanwhile, Eskelsen et al.\textsuperscript{[13]} suggest the maxillary labial frenum be a study marker for the facial median line. Studies show 23.2% prevalence rate of diastema in the upper and lower anterior teeth, 97% prevalence rate of maxillary diastema, 1.3% prevalence rate of mandibular diastema, and 1.7% prevalence rate of concurrent maxillary and mandibular diastema\textsuperscript{[12]}. To study the causes of diastema, Hasan et al.\textsuperscript{[13]} studied 1,021 orthodontic patients of 13 to 35 years old and found that the main causes of diastema in females were thumb sucking and lateral incisor loss (14.1% and 12.5%, respectively), and for males, the causes were high labial frenum and supernumerary teeth (39.4% and 30.3%, respectively). Infants’ sucking becomes more difficult when their short maxillary labial frenum limits their upper lip movement. The correct sucking area for breastfeeding is not just the nipples, but also the areolae. Only when the nipples and the areola fully enter an infant’s mouth can enough milk be sucked into the infant’s mouth\textsuperscript{[14]}.

There is no significant correlation between labial frenum morphology and gender, and labial frenum morphologies are evenly distributed for both gender. This conclusion has already been confirmed by Biradar et al.\textsuperscript{[15-17]}. However, this study reached a different conclusion that the sample average of females was greater than that of males under the same labial frenum morphology, except for type D. This may be related to the ethnicity and age of the subjects, which needs further research.

The attachment positions of labial frenum are different. In this study, among the prevalence rate of four types, the prevalence rate of type D was the highest (35%), followed by that of type B (23.97%). But some scholars have found that type B (50.7%) is most common in children, followed by type C (32%)\textsuperscript{[15]}. Boutsi\textsuperscript{[18]} also confirm that type B (42%) is most common in children while type A (10.2%) is least common. Jonathan et al.\textsuperscript{[1]} studied children between 3 and 5 years old, finding that type A (42%) is most common in children (47.5%), which is followed by type B (38.1%), and type D (14.2%) is least common. Rajani et al.\textsuperscript{[19]} studied the labial frenum morphology of different osseous types in children between 13 and 30 years old, finding that type A (42%) is most common, followed by type B (34%), type C (20%) and
type D (4%). Chaulagain [20] finds that type A is most common. According to the above analysis, the attachment position of labial frenum gradually changed to type A from type D as age increased.

It is worth mentioning that the data about oral soft tissues and perioral tissues are important for individual identification in some special cases of criminal investigations [21]. The labial frenum can be used as an important parameter. Dasgupta [8] et al. studied 1,200 children between 3 and 12 years old, finding that the presence of abnormal labial frenum may be the reason for the emergence of continuous maxillary diastema, but big maxillary diastema tends to stay till the eruption of maxillary canine teeth. Sumita Upadhyay et al. [22] studied 198 children between 1 and 14 years old, finding the attachment position of maxillary labial frenum changes with age, and there is no significant statistical difference between males and females. For children in the stage of deciduous teeth and mixed dentition, the attachment position of maxillary labial frenum moves toward the tooth root as occlusion progresses [23].

The subjects of this study were infants. With the increase of maxillary deciduous tooth eruption, the attachment position of maxillary labial frenum gradually moved to the direction of mucogingival junction, that is, the direction of the tooth root, and the diastema between maxillary primary central incisors became smaller. These results can be used as a scientific basis for clinical practice to effectively size up the growth of infants. In conclusion, there was a correlation between labial frenum morphology and maxillary deciduous tooth eruption, which can provide guidance for the aesthetic appeal of infants’ family members to adopt temporary observation and treatment by clinicians.

**Declarations**

**Ethics approval and consent to participate**

The study was approved by the ethics review board of Maternal and Child Health Hospital of Ningxia Hui Autonomous Region. We have obtained written informed consent from all participants of their parent or guardian before beginning of the study. All methods were performed in accordance with the Declaration of Helsinki and relevant policies in China.

**Consent for publication**

Not applicable.

**Availability of data and materials**

All data generated or analysed during this study are included in this published article.

**Competing interests**

The authors declare that they have no competing interests with regards to authorship and/or publication of this paper.

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Authors' contributions

YYC has contributed to conception, design, survey, data reduction, analyses and drafted the manuscript; JW has contributed to survey and data reduction; SHG and TF have contributed to conception, design, survey, interpretation of results and critically revise the manuscript. All authors contributed to multiple revisions and approved the final manuscript.

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Authors' information (optional)

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#Co first author

References


Tables

Table 1 Grouping of labial frenum morphologies by gender

<table>
<thead>
<tr>
<th>Labial frenum morphology</th>
<th>Gender</th>
<th>N</th>
<th>Minimum (age / month)</th>
<th>Maximum (age / month)</th>
<th>95% confidence interval</th>
<th>Mean (age / month)</th>
<th>SD</th>
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<td>86</td>
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<td>36</td>
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<td>17.508</td>
<td>6.1289</td>
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<tr>
<td>D</td>
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<td>5</td>
<td>44</td>
<td>11.231-12.784</td>
<td>12.007</td>
<td>6.4830</td>
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<td></td>
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<td>6.2074</td>
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Table 2 Grouping of labial frenum morphologies and maxillary deciduous tooth eruption
<table>
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**Table 3 Linear regression analysis for correlation of labial frenum and maxillary deciduous tooth eruption with age (n=1268)**

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<th>Maxillary deciduous tooth eruption</th>
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<tr>
<td>Pearson(r)</td>
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</table>

**Figures**
Figure 1

Classification of labial frenum morphology