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LINGUAL FRENULUM: QUANTITATIVE EVALUATION PROPOSAL

Irene Queiroz Marchesan, Ph.D.

ABSTRACT: The purpose of this study was to establish a quantitative method to classify lingual frenulum as normal and altered. **Methods:** 98 people were included in this study. All measurements were made with maximum opening of the mouth. A digital caliper was used to measure the length of the frenulum under three conditions: a) with the tongue tip on the incisal papilla; b) with the tongue sucked up and maintained against the hard palate; and c) with tongue stretching over a spatula. **Results:** observations indicated that the most useful and statistically significant way of measuring frenulum length was achieved with maximum mouth opening and the tongue tip on the incisal papilla. **Conclusion:** this quantitative method was demonstrated to be effective for identifying and distinguishing normal and altered frenular length.

KEYWORDS: Lingual frenulum; Tongue/physiology; Tongue diseases; Speech disorders; Quantitative evaluation

INTRODUCTION

Speech therapists find many patients with various complaints leading to the hypothesis that some alteration in the anatomy of the lingual frenulum (or frenum) is the cause for the problems, or at least, may aggravate them. The most common symptoms that may raise such hypotheses would be: imprecision of speech; soft /r/ phoneme with change for other phonemes or with distortion; small opening of the mouth during speech; imprecision or inefficacy of tongue movements in isolated movements; the tongue, when protruded, forming a heart in its apex, with little protrusion capability, or with protrusion bending its apex downward; a tongue rest posture on the floor of the mouth; difficulties of performing movements with the tip of the tongue, such as licking ice cream cone; history of difficulty to suckling during breast-feeding; inefficient mastication and deglutition with alteration for difficulty of coupling the tongue in the hard palate.

The most frequent problem mentioned in the literature related to an altered lingual frenulum is speech production (Garcia-Pola et al, 2002; Lee et al, 1989; Mukai et al, 1993; Velanovich, 1994; Wright, 1995; Kotlow, 1999; Sanchez-Ruiz et al, 1999; Messner et al, 2000 and 2002; Elias-Podesta et al, 2001 & Lalakea et al, 2003). Issues related to feeding, mainly during the

breast-feeding phase, are the next most frequently cited problem related to an altered frenulum (Velanovich, 1994; Kotlow, 1999; Messner et al 2000; Elias-Podesta et al, 2001; Berg, 1990; Marmet et al, 1990 & Ballard et al 2002). These are followed by problems with range of motion of the tongue (Garcia-Pola et al, 2002; Wright, 1995; Messner et al, 2000, 2002; Lalakea et al, 2003 & Defabianis, 2000); and deglutition alterations (Wright, 1995; Kotlow, 1999 & Sanches-Ruiz et al, 1999).

Various terms for and classifications of lingual frenulum alterations are found in the literature: tongue-tie, ankyloglossia, hypertropic frenulum, thick frenulum, muscular frenulum, fibrotic frenulum, and frenulum with anterior insertion, short frenulum and short frenulum with anterior insertion (Kotlow, 1999; Singh & Kent, 2000; Houaiss, 2001; Moore & Dalley, 2001 & Marchesan, 2004). While many of classifications address the form of the frenulum, other characteristics are also important. Singh and Kent (2000) describe the lingual frenulum as a mucous membrane fold that extends from the underside of the tongue to the floor of the mouth. A large median fold of mucous membrane cover arises from the gingival on the lingual surface of the tongue (Moore & Dalley,

2001). The foreshortened, small or absent lingual frenulum characterizes ankyloglossia. This can occur with full fusion or partial fusion of the tongue with the floor of the mouth.

Ankyloglossia is also characterized as the tongue's movement limited by a short or absent lingual frenulum (Singh & Kent, 2000). Partial ankyloglossia, or tongue-tie, is a congenital condition, - the membrane under the tongue is very short or its insertion is very close to the tip of the tongue, hindering the tongue's protrusion (Berg, 1990). Ankyloglossia continues to be defined as being a developmental anomaly, characterized by short and thick lingual frenulum resulting in limitations of tongue movements (Garcia-Pola et al., 2002).

Some researchers have attempted to differentiate and classify the frenulum. In one study the lingual frenulum is differentiated and classified according to: short mucous membrane; mandibular insert and hypertropic long mucous membrane inserted into the crest of the alveolar edge (Elias-Podesta et al., 2001). In another study, the frenulum is classified as: short; anterior insertion; and short with anterior insertion (Marhesan, 2004). This classification is similar to the aforementioned definition, where the tongue-tie or ankyloglossia is defined as a short membrane, or inserted very close of the tip of the tongue (Berg, 1990). These classifications depend on the qualitative criteria used, which is often fundamentally based on the evaluator's experience.

Few studies have been designed to quantify the frenulum through direct measurements. This may be due to the difficulty and imprecision in measuring the soft tissues involved. Only three studies have been identified that used quantitative criteria to measure and classify the lingual frenulum. In the first study (Lee, Kim, & Lim, 1989) the lingual frenulum was measured with a ruler created for this purpose. The length of the lingual frenulum was classified in the following manner: average length of frenulum with less than 10 mm - a mild ankyloglossia; between 10 and 15 mm - moderate; more than 15 mm (type-1) severe ankyloglossia; and, a frenulum clinically

considered as representing severe ankyloglossia even though frenulum length was less than 15-mm length (2 subjects were classified as type-2 severe ankyloglossia). The authors of this study noted that the longer the frenulum, the more anterior it would be inserted and the less the mobility and autonomy of the tongue (Lee et al., 1989)

In the second study (Kotlow, 1990), the individual was requested to protrude the tongue out of the mouth as far as possible while the length of the tongue was measured using a ruler. The frenulum was designated as clinically acceptable when longer than 16 mm; Class I as medium ankyloglossia of 12 to 16mm; Class II as moderate ankyloglossia of 8 to 11 mm; Class III as severe ankyloglossia of 3 to 7 mm; and Class IV or as full ankyloglossia if smaller than 3 mm (Kotlow, 1990). In the last study the authors used the Hazelbaker (1993) scale for assessing the frenulum. Criteria were developed with this scale to observe the appearance and movements of the tongue, as well as the elasticity and insertion point of the frenulum. The length of tongue's frenulum was measured with the tongue in an elevated position, with the following measurements recorded: big, small or equal to 1 cm (Ballard et al., 2002). For this study, a normal frenulum insertion was considered as approximately 1-cm from the apex.

A review of the literature indicates that disagreement persists among some health professionals regarding how to classify the frenulum as normal or altered. Differences in clinical judgment also exist regarding the indications for/against surgery. Due to the variety of professional opinions regarding surgical treatment of an altered lingual frenulum, patients are often insecure or confused about their options regarding intervention. While a lingual frenulum may be characterized as normal or altered depending on the evaluation criteria used by the evaluator, those classified as altered may or may not be indicated for surgery. If a uniform method of classification and evaluation quantification and qualification were developed, it should result in higher examiner reliability and accuracy in distinguishing between a normal and altered

frenulum and more consistency in recommendations for surgery. Accordingly the purpose of this study was to develop a method of differentiating between a normal frenulum and an altered frenulum using qualitative evaluation and numeric quantification. This study aims, therefore, to determine and report a quantitative method to classify a lingual frenulum as either normal or altered.

METHODS

98 subjects were enrolled in this research. They were accompanied by a parent or relative. They were patients of the Clinic - School CEFAC's. Authorization for the subjects' participation in the study was obtained after they had been informed in writing about the procedures and the purpose of the research. The subjects included in this study were 18 years of age or older, were not receiving speech therapy, did not have any temporomandibular joint problems, had not previously had a lingual frenectomy, had their central upper and lower incisors, and did not have anterior open bite.

Two speech therapists evaluated the frenulum and characterized it as normal or altered using the qualitative protocol proposed by Marchesan (2004) according to the following criteria: a) short or smaller than most frenulum, although inserted correctly (Moore & Dalley, 2001) at the halfway back area on the undersurface of the tongue and extending to the floor of the mouth (Singh & Kent, 2000) (Figure 1); b) with anterior insertion, demonstrating normal size while being inserted at any point forward from the halfway area along the underside of the tongue; it may be inserted close to the apex (Figure 2); c) short with anterior insertion, this being a mix of the previous two (Figure 3).

In addition to a qualitative evaluation, each subject was requested to perform various movements of the tongue to assess lingual range of movement. The requested movements were: protrude the tongue outside the mouth; tongue moved laterally to each labial commissure; and upward and downward vertical movements of the

tongue. Any difficulty with the requested movements resulted in the frenulum being classified as altered.

Following the classification of the frenulum as normal or altered, four measurements were obtained using the digital Starret slide caliper. All measurements were taken by a single speech therapist. The recorded measurements included: a) maximum mouth opening (with no tongue interference) as measured at the incisal edges of the left upper and lower central incisors. This measurement served as a reference support point for the slide caliper (Figure 4), and was taken as an absolute value reference for subsequent comparison with other measurements; b) for the second measurement each subject was requested to put the apex of his/her tongue on the palatine (incisal) papilla, maintaining this posture with the mouth open maximally and with the support points for the slide caliper maintained at the left central incisors (Figure 5); c) the third measurement was obtained while the subject created a negative pressure by sucking the tongue against the hard palate area, maintaining this position with the mouth open (Figure 6); d) the last measurement was taken while each subject protruded the tongue and stretched it maximally over a wooden spatula held by the examiner at the lower incisors (Figure 7). A mark made with a black pencil was recorded on the spatula at the place of the longest measurement of the tongue. Using the slide caliper, this measurement, from the tip of the spatula to the place where the tongue had reached in extension was measured (Figure 8). All measurements were logged onto a previously designed table consisting of the following data: initials of subject's name and age, collection date, classification of frenulum as normal or altered, the measurements taken at full mouth opening, tongue on the papilla, tongue sucked against the hard palate, and tongue on the spatula. The rule of three was applied, comparing the wide-open mouth reference value with each of the other three measurements. The data were collected between the months - August 2002 to December 2003.

Figure 1. Short Frenulum

Figure 2. Frenulum with Anterior Insertion

Figure 3. Frenulum with Anterior Insertion and Short

Figure 4. Full Mouth Opening

Figure 5. Tongue on the Papilla

Figure 6. Tongue Suctioned on the Hard Palate

Figure 7. Tongue on the Spatula

Figure 8. Measuring the Spatula

The Mann-Whitney U test was adopted as the statistical instrument to evaluate differences among the normal and altered groups. 5% (0.050) significance level was adopted for statistical tests. This research was approved by the Committee of Ethics in Research under N°. 100/03. It was considered without risk, but informed written consent was necessary.

RESULTS

Table 1 displays the comparison data for the 98 subjects. For the open mouth task there was no significant difference among the medians of the frenulum ($p > 0.05$). For the normal frenulum, the median of the tongue on the papilla (33.2), the median of the tongue sucked against the hard palate (27.1), and tongue on the spatula (29.9) was

larger than for the altered group, 27.7; 25.1 and 26.2 respectively. These findings were statistically significant ($p < 0.05$).
Insert Table 1

Table 2 displays the distribution of differences among the tongue measurements on the incisal papilla and wide-open mouth with relation to the normal versus altered frenulum in the 98 adults subjects. The differences in the measurements were significantly larger among the altered frenulum group. The median of the difference between wide-open mouth and mouth open with the tongue on the papilla was 12.2 for normal frenulum and 21 for altered frenulum. Also, the median of the difference between wide-open mouth and tongue on the papilla was 13.4 (6.1) and for altered frenulum 19.4 (7.7).
Insert Table 2

Table 1.. Distribution of 98 cases above 18 years old in relation with the normal frenulum versus altered frenulum

Measures	Open mouth	Tongue on papilla	Sucked tongue	Tongue on spatula
Normal frenulum				
N	82	82	76	76
Min-max	34,6 – 56,2	20,5 – 44,0	15,2 – 36,5	19,8 – 40,8
Median	46,0	33,2	27,1	29,9
Average (dp)	46,6 (5,1)	33,1 (5,0)	27,0 (4,4)	30,0 (4,9)
Altered frenulum				
N	16	15	13	13
Min-max	38 – 60.2	19.7 – 37.9	15.7 – 34.8	20.6 – 35.3
Median	47.2	27.7	25.1	26.2
Average (dp)	47.9 (6.9)	28.1 (4.7)	24.2 (4.8)	26.8 (4.1)
p-value	0.6071	0.0007*	0.0350*	0.0277*

* = $p < 0.05$ was considered statistically significant

N = Number of subjects

Measures in millimeters

Table 2. - Distribution of the differences among the tongue measurements on the papilla and open mouth with relation to the normal frenulum versus altered frenulum of all the 98 adults older than 18 years.

Measures	Open mouth	Tongue on papilla	Difference between open mouth and papilla
Normal frenulum			
N	82	82	82
Min-max	34.6 – 56.2	20.5 – 44.0	3.9 – 29.0
Median	46.0	33.2	12.2
Average (dp)	46.6 (5.1)	33.1 (5.0)	13.4 (6.1)
Altered frenulum			
N	16	15	15
Min-max	38 – 60.2	19.7 – 37.9	7.9 – 29.2
Median	47.2	27.7	21
Average (dp)	47.9 (6.9)	28.1 (4.7)	19.4 (7.7)
p-value	0.9547	0.0005*	0.0056*

* = $p < 0.05$ was considered statistically significant

N = Number of subjects

Measures in millimeters

DISCUSSION

After the measurement phase of the study was completed, from the examiner's point of view, the more-easily obtained measurement was with the tongue on the incisal papilla. It was possible to obtain this measurement with any type of frenulum alteration. The measurement obtained with the tongue sucked onto the hard palate by negative pressure is difficult to obtain, since few subjects were able to maintain this posture while the measurement was taken. The posture of the tongue required for this measurement was particularly difficult to maintain in subjects with a short frenulum, especially for subjects with short frenulum who also had an anterior attachment.

The measurement of the tongue on the spatula in subjects whose frenulum had severe anterior insertion was much lower when compared with the wide-open mouth.

However, in the subjects with a short frenulum that attached posteriorly on the undersurface of the tongue, which allowed freedom in the anterior portion of the tongue, little measurement differences were found when compared with the wide-open mouth measurement. For subjects with a short frenulum or with slight anterior insertion, no significant differences were identified, while in normal subjects there were relevant differences. While measurements for tongue protrusion are easily collected, this measurement condition is not considered to be critical in the comparison and differentiation between a normal and altered frenulum. In contrast, it seems important to point out that the significant difference between the measurement of the tongue on the incisal papilla and the measurement for the open mouth has the most potential for differentiating between a normal and altered frenulum, with a 33.2 median for a normal

frenulum and of 27.7. for an altered frenulum.

The findings submitted in Table 1 indicate that there is no statistical difference ($p = 0.6071$) among subjects with either a normal frenulum (46.0) for the open mouth measurements or an altered frenulum (47.2 median). Accordingly, this measurement can be considered as absolute value and can serve as a reference for other measures of the frenulum.

The quantitative classifications found in the three unique studies mentioned in the literature (Lee et al, 1989; Kotlow, 1999 & Ballard et al, 2002) used frenulum measuring forms that differ from those used in this study. For this reason, it is not possible to compare the data with these studies.

To facilitate the physician's analysis of the frenulum, the percentages of all sampled subjects were calculated by dividing the measurement of the tongue on the incisal papilla by the measurement obtained with the wide-open mouth. It was determined that for the subjects whose frenulum had been classified as normal, a percentage above approximately 60% was found, while, for subjects whose frenulum had been classified as altered, a percentage around 50% or less was obtained.

There is obviously no measurement (percentile) that can be strictly adopted that clearly designates a frenulum as normal or altered, because some normal subjects, although few, also showed a value below 50%, while some subjects with altered frenulum showed values above 50%. This variation may have occurred due to a lack of differentiation of the data for the group with an altered frenulum when compared with the data for the group with normal frenulum.

All subjects with an altered frenulum were grouped together for statistical purposes, and treated as a single group. It was noted that for the subjects with altered frenulum with anterior insertion, the percentage with mouth fully open, compared with mouth open with tongue on the papilla was above 50%. Even though this occurred with few subjects it should be considered. A trend

was identified that subjects with an altered frenulum had low percentile values, while normal subjects, tended to have higher percentile values when comparing relationships between the wide-open mouth measurements with those of the tongue on the incisal papilla.

Based on the results of this study, it can be inferred that the smaller the relationship between the measurement of the tongue on the incisal papilla and the measurement of mouth opening, the larger the chance that the frenulum is altered. There is no value in making a recommendation for surgery based only on a calculated figure. An appropriate suggestion based on the data in this study is that quantitative data should be analyzed together with the qualitative data in evaluating the normal or altered state of a lingual frenulum. For this purpose, use one of the frenulum classifications proposed in the literature (Garcia-Pola et al, 2002; Elias-Podesta et al, 2001; Berg, 1990; Singh & Kent, 2000; Marchesan, 2004 & Halzebaker, 1993).

Additional research should be conducted to increase the precision criteria for measuring the lingual frenulum. As a limiting factor, it should be noted that such measurements are of soft tissue structures which can possess a great degree of variation. Depending on the place of contact for tongue support with maximal opening of the mouth, and while attempting to sustain a specific posture of the tongue during the measurement, subject performances may show differing numerical values in repeated measures.

The data obtained with the classification of a frenulum, when using qualitative or quantitative classifications, or both, should always be analyzed together with the clinical history and with the data found in the clinical examination.

It is hoped that this study may aid other health professionals in evaluating whether a lingual frenulum is normal or altered. Additional research is needed to fully identify all the pertinent factors and variations that may be found when assessing a lingual frenum.

CONCLUSION

The comparison of the values obtained with the measurement of the mouth maximally open with the values found when the mouth is open with the tongue tip touching the incisal papilla, seems to be a viable clinical tool for determining whether a lingual frenulum is normal or altered.

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