Lingual frenectomy and alveolar tap production: 
An acoustic and perceptual study

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Abstract
In this phonetic study, productions of the consonant in the stressed syllable position of the word arara as produced by 13 subjects with short and/or anterior lingual frenulum were compared before and after lingual frenectomy. The results from the measurement of the stressed consonant duration and from the identification of the consonant manners of articulation based on the inspection of spectral characteristics are discussed and related to the answers to a perceptual identification test. After surgery, the number of tap productions did not increase, but alveolar productions did. These clinically relevant findings show frenectomy improved tongue mobility, but, as temporal controls were not totally re-established after surgery and 6-month speech therapy sessions, the production of the alveolar tap remained largely unchanged.

Key words: Alveolar tap, articulation disorders, auditory perception, Brazilian Portuguese, Latin America, lingual frenulum, phonetics, speech, speech acoustics, speech production measurement

Introduction
This paper reports the findings of an acoustic, articulatory, and perceptual investigation on the phonetic characteristics of the alveolar tap as produced by a group of subjects, native speakers of Portuguese, before and after lingual frenectomy.

Portuguese has two rhotic phonemes. They occur in syllable onset position. In coda position their opposition is neutralized. Their allophones include velar, uvular, and glottal fricatives, alveolar approximants, alveolar trills, and alveolar and retroflex flaps.

The alveolar tap, the object of this study, is a highly frequent consonant sound in Brazilian Portuguese (1). It occurs in two phonetic contexts: between vowels and in consonant clusters (2). Producing this sound involves fine motor co-ordination since it is produced with a fast movement of the tip of the tongue towards the alveolar region. Following the brief contact between the articulators there is the release.

The average of the total duration of the tap in Brazilian Portuguese is 37 ms (3). In terms of language development, it is considered the last sound to be acquired, at age 6 or 7 years (4,5).

The alveolar tap is also of interest from a clinical standpoint, since several kinds of speech disorders tend to be manifested when motor and temporal tap production requirements are not met. Those speech disorder manifestations, in infants as well as in adults (6–8), show on perceptual evaluation and are commonly referred to as omissions, substitutions, or sound distortions. Difficulties in producing the alveolar tap may affect speech intelligibility. Such difficulties make people search for clinical counseling.

The production of the alveolar tap may be difficult for people who suffer from ankyloglossia. Tongue-tie, or ankyloglossia, is a well-recognized but poorly defined condition, as a congenital oral anomaly characterized by the presence of a hypertrophic lingual frenulum. It involves a short, thick, fibroed, or fixed...
lingual frenulum. It has been reported to cause feeding difficulties, speaking, social, or mechanical problems (9–11). This alteration occurs when a common minor embryologic tissue remnant persists in the midline sublingual tissue, which usually undergoes apoptosis during the embryonic development (12).

The ankyloglossia affects tongue mobility, making both feeding and speech more difficult (9–11). Although it is a rather common condition, diagnostic criteria for ankyloglossia are needed so that intervention and prognosis can be better defined. The abnormal lingual frenulum can be classified as:

1. Anterior: this category of frenulum has an anterior attachment near the tip of the tongue in the inferior surface of the tongue. Its position affects tongue mobility as well as the production of some sounds such as the alveolar tap.
2. Short: its extension is short, and has greater impact on the tongue posture since the tongue remains on the floor of the mouth. In these cases, speech may be commonly produced with less extensive amplitude of movement of the articulators.
3. Short and anterior: this type is less commonly found in the population. It yields greater impact on speech, since the tongue remains on the floor of the mouth and the movement of the anterior part of the tongue is restricted (6,8).

As much as ankyloglossia is still surrounded by controversy, surgical interventions have been proposed since ancient Greek medicine. A possible corrective intervention is known as frenectomy, a quite safe and efficient procedure used to release the tongue and improve its lingual functions (12,13). The most common indications of frenectomy are for speech/articulation problems (64%), restricted movement (18%), and lactation/nourishing problems (8%) (14). Recent ultrasound studies reveal that frenectomy normalizes the sucking action in babies with ankyloglossia. Randomized controlled trials show that 95% of breast-feeding problems disappear (15,16). As for the surgery results, some improvement in tongue mobility and speech articulation has been reported (11,17–19). However in South America, including Brazil, frenectomy is not a common pediatric surgical procedure, and surgery is not performed unless articulation problems and/or other related alterations relating to tongue mobility occur in older children.

In Brazil speech problems related to restricted tip tongue movements caused by lingual frenulum disorder are quite common (48.9%) (20), especially affecting the production of alveolar tap (48.8%) (21). There are no research works on the effects of surgeries performed at late age or on the effects of the pre- or postoperative speech therapy. Besides, there is no valid frenulum evaluation protocol being used by all health professionals. Therefore, several existing means of assessing tongue-tie have been put forth. In the speech therapy context, Marchesan (6–8) described speech problems related to some alterations of the lingual frenulum and proposed protocols to be used to evaluate its structure.

The clinical experience (following patients from the preoperative to the postoperative stages) at the CEFAC Institute, a therapy clinical center, has shown that individuals who have short lingual frenulum usually present disordered speech. The most affected Brazilian sounds are the alveolar tap and the alveolar fricatives. Adaptations and compensations of the jaw movements (lateralizations and excessive fronting) and increased salivation are also commonly found in this population. Another clinical finding is that the surgical release of the frenulum increases the tongue movement range, providing significant improvement in speech articulation. It also improves functions such as chewing and swallowing in the immediate postoperative period as well as speech production in adult patients. In a few cases, there are no noticeable speech changes, but the articulation range is always found to be more extensive.

This is the first study in Brazilian Portuguese to investigate experimentally the speech productions of subjects who had undergone frenectomy. The choice of taps as the object of this study was determined by clinical reports at CEFAC showing that it is the most difficult sound to be produced by the patients before and after frenectomy.

Three related questions are addressed in this paper: What kinds of sounds are produced when patients whose lingual frenulum is short and/or anterior try to produce the alveolar tap? After lingual frenectomy and weekly speech therapy sessions over a 6-month period, does the production of taps turn out to be better? What kinds of changes occur?

The search for acoustic and perceptual descriptions of the impaired speech related to tongue movement restrictions in cases of short/anterior lingual frenulum is thought to be useful to help planning the speech therapy process and interdisciplinary interventions. In this paper, an acoustic and perceptual study of the alveolar tap in cases of short and/or lingual frenulum is developed. It has a high functional load, and it is among the three most frequent consonant sounds in Brazilian Portuguese.

**Material and methods**

The research was approved by the CEFAC’s ethics committee (171/06).
Research subject selection

The selection of the subjects was made at the CEFAC Institute, and, for that purpose, the subjects were clinically assessed by means of the lingual frenulum protocol, proposed by Marchesan (22), which assesses the tongue and frenulum aspects by taking into account its shape, size, and the tongue mobility, as well as possible interferences in speech functions, breathing, chewing, and swallowing.

The speech assessment test at the CEFAC Institute consists of semi-spontaneous speech (reporting a tour), automatic speech (counting from 1 to 20, saying the days of the week and the months of the year), and picture naming (25 pictures to elicit all the Brazilian Portuguese sounds and 25 to elicit the most affected sounds by the frenulum alteration, the alveolar sounds \[t, \ d, \ n, \ s, \ z, \ \theta, \ l\]). The speech task and the tongue mobility test are filmed for post-analysis.

For the purpose of the present study, the tap was chosen among the alveolar consonant sounds since its productions require precise fast movements of the tip of the tongue and it is often pointed out by the ankyloglossia clinical population as one of the most difficult sounds to be produced.

Research subjects

In this study, 13 Brazilian Portuguese-speaking subjects’ productions were analyzed. All the subjects had been diagnosed as having short and/or anterior frenulum (Figure 1a and b). The photos were taken in the Orofacial Motricity Department of the CEFAC Institute, where they were subjected to evaluation and/or speech therapy. The subjects had no language/hearing difficulties.

This group’s age range was between 7;3 and 47;7 years, the average age being 19;8. The lowest age limit in the studied group was established by the age in which Brazilian Portuguese speech sounds are reported to be acquired (4,5). Information about the speakers of the studied group is shown in Table I.

Table I. Data related to subject’s gender, type of lingual frenulum, and age at the time of frenectomy.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Gender</th>
<th>Type of lingual frenulum</th>
<th>Age at the time of frenectomy (years;months)</th>
<th>Postoperative recordings: months after frenectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>Short</td>
<td>8;0</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>Short and anterior</td>
<td>16;10</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>Short and anterior</td>
<td>7;3</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>Short</td>
<td>36;7</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>Short and anterior</td>
<td>16;1</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>Short</td>
<td>23;3</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>Anterior</td>
<td>24;9</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>Short</td>
<td>7;8</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>Short and anterior</td>
<td>14;10</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>Short and anterior</td>
<td>47;7</td>
<td>9</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>Short and anterior</td>
<td>36;5</td>
<td>13</td>
</tr>
<tr>
<td>12</td>
<td>M</td>
<td>Short and anterior</td>
<td>8;5</td>
<td>17</td>
</tr>
<tr>
<td>13</td>
<td>M</td>
<td>Anterior</td>
<td>10;3</td>
<td>6</td>
</tr>
</tbody>
</table>

M=male; F=female.
The speech production experiment

Corpus. Among the recordings of the carrier sentences, which make up the clinical database at the CEFAC Institute, the sentence Diga arara baixinho (“Say arara in a soft way”) was chosen. The word arara, which refers to a Brazilian bird, was chosen because it is a CV-structured word, a common and productive word form (trisyllabic and paroxytone) in Brazilian Portuguese.

This database was generated from the clinical routine of the speech data collection made at the CEFAC Institute as mentioned in the previous item in this article. The database recordings were made in an acoustically treated room. The sentences, written in 72-pt Times New Roman, were randomly presented, one by one, on flash cards. The subjects received instructions as to the reading task to be performed at normal speech rate.

In this study, 26 productions of the consonant sound in the stressed syllable of the word arara were analyzed. Each of the 13 patients included in this study had two productions analyzed: one in the preoperative stage (Figure 1a and b) and one in the postoperative stage (after 6 months of speech therapy) (Figure 1c and d). For the perceptual test 12 distractors were introduced, yielding 38 tokens.

Articulatory and acoustic data

The acoustic inspection (23) of the speech samples was based on the waveform and the wide-band spectrogram characteristics in order to describe the productions of the stressed consonant in the word arara. The stressed syllable consonant sound was segmented and inspected by means of the software PRAAT version 5144 (24). The investigated acoustic characteristics relate to the presence/absence of continuous and/or transient noise, presence/absence of vowel formant patterns, and consonant formant structuring. The segmentation of the stressed consonant in the word arara followed the criteria postulated by Ladefoged (25). No spectral measures were made. Acoustic characteristics were used to classify the manner of articulation of the stressed consonant productions in the word arara, based on spectral characteristics (silence, bursts, noise, and formants).

The duration (in ms) of the stressed consonant in the productions of the word arara were measured in the waveform, using the wide-band spectrogram as reference.

The absolute duration values were normalized by z-score transformation. Furthermore, the absolute and normalized duration measures were statistically analyzed by means of T test (software SPSS), significant value at \( P < 0.05 \), for global (the three types of frenulum disorders as a group) and intra-type comparisons in the pre- and the postoperative stages test for dependent samples.

For the intra-groups comparison, only two of the groups were considered: the short and short/anterior. The anterior lingual frenulum group was not included since it comprised only two subjects and one of these subjects did not produce the consonant sound under study in the preoperative stage.

The results from the inspection of spectral characteristics (silence, bursts, noise, and formants) and from the measurement of the stressed consonant duration were discussed and related to the answers to a perceptual identification test.

The speech perception experiment

To build the speech perception experiment, the productions of the word arara were segmented in a way as to eliminate the final syllable. This procedure aimed at avoiding the word to be recognized by its phonotactic structure, prompting the identification of the alveolar tap. With the VCV segmentation, the listeners’ imposition of linguistic structure tends to be avoided, since several words may be formed (ata, ara, ala, aba, acha, aja, ada, asa, assa, aia). As stimuli for the perception test, besides ara samples, the distractors apa, acha, aja, and ata were added. For the forced choice task, all Brazilian Portuguese consonant sounds which can occur between the two central vowels have been included.

The stimuli \( (n = 26) \) were randomly presented to 19 expert judges. The judges listened to the stimuli and indicated the consonant they heard in a forced-choice answer sheet. The data were analyzed and organized in a confusion matrix presenting absolute and relative results from the perceptual evaluation of the consonant stimuli. The confidence intervals related to the results of the consonant perceptual identification test results have also been calculated.

Results

Three kinds of results are presented: acoustic, articulatory, and perceptual findings.

Acoustic data analysis: duration measures

The absolute and normalized \((z\text{-score})\) duration values of the consonants in the stressed syllable of the word arara produced by the 13 subjects in the pre-and postoperative stages are presented in Tables II and III.

The measured duration values were found to be greater than the reported 37 ms mean duration for...
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the alveolar tap in Brazilian Portuguese (3). The consonant mean duration and the standard deviation values decreased in the postoperative stage. However, no statistical differences were found between them.

Similar duration values were found in the preoperative and postoperative stages for the consonants produced by the short and short/anterior lingual frenulum groups. The measured duration values of the consonants produced by the group of subjects who had anterior lingual frenulum were found to be shorter than the other two groups but longer than the average duration values described for Brazilian Portuguese.

The measured absolute duration values arranged according to the types of lingual frenulum are presented in Figure 2. The anterior lingual frenulum group was not included since it had only two members and one of them, in the preoperative stage, had produced a vowel instead of the consonant under study.

The articulatory data analysis: manners of articulation

The data concerning the articulatory phonetic classification (2) and the acoustic cues of the consonant sounds (25) in the pre- and postoperative stages are presented in Table IV. These data were obtained by means of the inspections of the acoustic characteristics (presence of silence, bursts, noise, and formant structure).

The acoustic phonetic characteristics of the pre- and postoperative productions of the consonant under study were found to differ. To illustrate these findings, Figures 3 and 4 present the waveforms and the wide-band spectrograms for the word arara contrasting the pre- and postoperative productions by subjects 13 (Figure 3) and 9 (Figure 4).

Subject 13 did not produce a consonant in the preoperative stage but in the postoperative stage produced an alveolar nasal sound. Subject 9 produced an approximant at the preoperative stage and a tap at the postoperative stage.

During the acoustic inspection procedure, voice quality settings, especially breathy and harsh voice, were observed by the researchers.

Perceptual data analysis: findings

The results of the perceptual tests before and after lingual frenectomy are displayed in Tables V–VIII.

The main differences between the preoperative and postoperative stages are: a greater number of nasal alveolar sounds and a smaller number of plosives were identified in the postoperative data. There were no changes in relation to the number of consonants identified as alveolar laterals.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Preoperative (n = 4)</th>
<th>Postoperative (n = 4)</th>
<th>Preoperative (n = 7)</th>
<th>Postoperative (n = 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of lingual frenulum disorder</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absolute mean (ms)</td>
<td>52.19</td>
<td>48.30</td>
<td>61.73</td>
<td>48.27</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>34.61</td>
<td>22.57</td>
<td>85.80</td>
<td>35.96</td>
</tr>
<tr>
<td>Standard error</td>
<td>17.30</td>
<td>11.28</td>
<td>35.03</td>
<td>14.68</td>
</tr>
<tr>
<td>P value (significance P &lt; 0.05)</td>
<td>P = 0.77</td>
<td>P = 0.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T value</td>
<td>T = 0.31</td>
<td>T = 0.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normalized mean (z-score)</td>
<td>-0.572</td>
<td>0.115</td>
<td>0.091</td>
<td>0.113</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.539</td>
<td>0.781</td>
<td>1.338</td>
<td>1.244</td>
</tr>
<tr>
<td>Standard error</td>
<td>0.269</td>
<td>0.390</td>
<td>0.546</td>
<td>0.508</td>
</tr>
<tr>
<td>P value (significance P &lt; 0.05)</td>
<td>P = 0.58</td>
<td>P = 0.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T value</td>
<td>T = -0.61</td>
<td>T = -0.11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table III. Absolute and normalized (z-score) mean values of duration, standard deviation, and standard error mean of the consonant productions at the onset of the stressed syllable of the word arara as related to the type of lingual frenulum disorder in the pre- and postoperative stages.
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The acoustic characteristics identified by means of the inspection of the wide-band spectrograms are congruent with the results of the perceptual test.

Discussion

In this acoustic, articulatory, and perceptual study, productions of the consonant sound in the stressed syllable position of the word arara as produced by 13 subjects with short and/or anterior lingual frenulum were compared before and after lingual frenectomy.

The acoustic inspection of the data made it possible to classify the manners of articulation of the consonants produced by the subjects and infer speech production characteristics (silence, bursts, noise, and formants) to be related to the results of the perceptual test. These kinds of data were found to be congruent. The perceptual judgment results for plosive and fricative sounds were compatible, respectively, with the transient and continuous noise findings. The perceptual judgments results for laterals and semivowels were compatible with the formant structure findings based on the inspection of the acoustic characteristics using wide-band spectrograms and waveforms.

The percentages of consonant sounds identified as alveolars in the pre- (75%) and postoperative (77%) stages reveal a tendency towards reaching the articulatory target of the tap before and after lingual frenectomy. Yet the 59% of the alveolar taps

![Figure 2. Distribution of absolute duration values for the subgroups of subjects related to the type of the lingual frenulum in pre- and postoperative stages.](image)

Table IV. Data related to the phonetic classification of the consonant sounds in the pre- and postoperative stages.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Type of lingual frenulum</th>
<th>Phonetic classification preoperative</th>
<th>Phonetic classification postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Short</td>
<td>Resonant, vowel</td>
<td>Resonant, trill</td>
</tr>
<tr>
<td>2</td>
<td>Short and anterior</td>
<td>Resonant, approximant</td>
<td>Resonant, nasal</td>
</tr>
<tr>
<td>3</td>
<td>Short and anterior</td>
<td>Resonant, lateral</td>
<td>Resonant, approximant</td>
</tr>
<tr>
<td>4</td>
<td>Short</td>
<td>Resonant, approximant</td>
<td>Resonant, approximant</td>
</tr>
<tr>
<td>5</td>
<td>Short and anterior</td>
<td>Resonant, tap</td>
<td>Resonant, tap</td>
</tr>
<tr>
<td>6</td>
<td>Short</td>
<td>Resonant, approximant</td>
<td>Resonant, tap</td>
</tr>
<tr>
<td>7</td>
<td>Anterior</td>
<td>Resonant, tap</td>
<td>Obstruent, click</td>
</tr>
<tr>
<td>8</td>
<td>Short</td>
<td>Obstruent, aspirated plosive</td>
<td>Obstruent, click</td>
</tr>
<tr>
<td>9</td>
<td>Short and anterior</td>
<td>Resonant, tap</td>
<td>Resonant, tap</td>
</tr>
<tr>
<td>10</td>
<td>Short and anterior</td>
<td>Resonant, tap</td>
<td>Resonant, tap</td>
</tr>
<tr>
<td>11</td>
<td>Short and anterior</td>
<td>Resonant, tap</td>
<td>Resonant, tap</td>
</tr>
<tr>
<td>12</td>
<td>Short and anterior</td>
<td>Obstruent, plosive</td>
<td>Resonant, approximant</td>
</tr>
<tr>
<td>13</td>
<td>Anterior</td>
<td>Resonant, vowel</td>
<td>Resonant, nasal</td>
</tr>
</tbody>
</table>

![Figure 3. The waveforms and the wide-band spectrograms of the productions of the word arara in the preoperative (I) and postoperative (II) stages in a case of lingual frenectomy—Subject 13.](image)
Lingual frenectomy: perceptual-acoustic findings

Identified in the postoperative stage against the 62% in the preoperative stage indicate that the timing gesture to produce the tap has not been fully implemented. This is compatible with the findings of the consonant duration measurements. The comparison between the duration values of the consonant in the pre- and postoperative stages indicated few differences (Tables II and III, Figure 2).

The tap involves a very rapid movement and short contact between the articulators. On the contrary, the contact between the articulators is longer in the productions of stops, nasals, and laterals. In the case of fricatives the constriction period is also longer.

In the postoperative stage, 19 productions of the consonant under study were identified as alveolar nasals. Acoustic data also provided evidence for nasal consonant productions. The fact that nasal consonants had not been produced in the preoperative stage reveals that rising of the tongue towards the alveolar ridge co-occurred with the lowering of the velum. This may be related to speakers’ strategies to overcome limitations imposed by tongue structure and function. The differences in voice qualities identified perceptually and by means of an acoustically based inspection by the researchers in this study may also be related to articulatory co-ordination gestures and should be further investigated.
No correlation was found between the type of lingual frenulum and the consonant duration values, either in absolute or normalized measures. The absence of statistically significant differences among the samples also adds to the issue.

Although no correlation between the three types of lingual frenulum and the acoustic characteristics of the tap has been found in this study, further research works including a wider population are needed since there is clinical evidence that limited tongue mobility may be differentiated depending on the type of lingual frenulum. There has been little research involving acoustic analysis of tap productions following frenectomy (6,8). Acoustic analysis can also be a very useful complementary tool to perceptual analysis in the clinical setting (6,8,26,27).

The findings support the idea that lingual frenectomy improves tongue mobility, making it possible to re-establish the oral function which had been compromised (10,12,14,16,18,19). Nevertheless, since the sensorimotor and temporal controls are not re-established naturally after surgery, speech production remains largely unchanged. Sounds such as the alveolar tap, which require refined movements, are especially difficult to produce under such circumstances (2,3).

The findings on the production of alveolar taps by the three groups of lingual frenulum suggest that when lingual frenectomy is not done at young age, speech production is affected. Speech therapy can be a relevant and complementary practice after surgery interventions in such cases, since it can introduce immediate treatment (6).

Due to the fact that the treatment of an abnormal lingual frenulum still holds a lot of controversy among professionals (11), the incorporation of protocols for evaluating and treating the various types of lingual frenulum is thought to be commendatory, mainly in contexts where frenectomy is not a common procedure at early ages (28).

The results of the perceptual test matched the findings of the acoustic characteristics inspection. The consonant duration values did not vary significantly among subjects both in the preoperative and postoperative stages, but all consonant values were found to be longer than the predicted for Brazilian Portuguese. In spite of the subjects having not succeeded in fulfilling the temporal requirements to produce the alveolar tap, the great number of consonants identified as alveolars in the preoperative and postoperative stages point to successful attempts by the subjects to reach the articulatory place of articulation of the tap. The analysis of the articulatory and acoustic characteristics corroborates these perceptual findings.
In this paper we addressed three research questions: What kinds of sounds are produced when patients whose lingual frenulum is short and/or anterior try to produce the alveolar tap? After lingual frenectomy and weekly speech therapy sessions over a 6-month period, does the production of taps turn out to be better? What kinds of changes occur?

The answer to the first question is that several kinds of sounds were produced: vowels, approximants, laterals, taps, trills, plosives, nasals, and clicks. The answers to the second and third questions are that findings in our study show frenectomy improved tongue mobility (a greater number of alveolar sounds were identified after surgery), but, as temporal controls were not totally re-established after surgery and weekly speech therapy sessions over a 6-month period, the productions of the alveolar tap remain largely unchanged. The surgery did not increase tap production.

Since lingual frenectomy improved tongue mobility and weekly speech therapy sessions over a 6-month period was not sufficient to improve speech sound productions, additional speech therapy might be needed to improve patients’ speech production. Factors such as type of frenulum disorder, age, and the surgical procedure are thought to interfere with the results of therapy and the length of treatment. These factors are found to be relevant and need to be addressed in future researches with a larger number of subjects and repetitions of the target sound.

Conclusion

The results of the perceptual test matched the findings of the acoustic characteristics inspection. The consonant duration values did not vary significantly among subjects both in the preoperative and postoperative stages, but all consonant values were found to be longer than the predicted for Brazilian Portuguese. In spite of the subjects having received weekly speech therapy sessions for a 6-month period after frenectomy, they did not succeed in fulfilling the temporal requirements to produce the alveolar tap. However, the greater number of consonants identified as alveolars in the postoperative stage points to successful attempts by the subjects to reach the articulatory place of articulation of the tap and to the fact that tongue mobility became better. These patients are thought to benefit from additional speech therapy.

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References


