# Orofacial–Myofunctional therapy after lingual frenectomy in patient with tongue-tie: a systemic postural approach with mezieres method and postural bench

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## Abstract

**Aim** In this study we present the new postoperative oro-myofunctional protocol following frenectomy by atmospheric plasma associated with a systemic postural approach, which determines functional recovery through body symmetry restoration based on the concepts of the French "Mezieres Method" and postural bench.

**Study design** A total of 130 patients (76 female, 54 male) affected by ankyloglossia of class III/IV, according to Kotlow's Tongue Tie Classification have been treated with atmospheric plasma followed by oro-myofunctional therapy associated with a systemic postural approach. The overall change, improved/worsened speech, feeding, or sleep has been evaluated through the 10 points Parents Speech Satisfaction (PSS) Score after one week and two months.

**Results** In all patients, the lingual frenulum has been removed using atmospheric plasma, a thermal technique that creates a sublimation of the superficial tissues, without going in-depth, and used in many medical fields. No complications or adverse events were reported during the postoperative period. After oro-myofunctional therapy, all patients reported a significant ameliorating of overall change in PSS score ($p<0.0001$) after one week and two months. In addition, a significant increase in speech capability and feeding capability was detected after comparing the results at one week and at two months ($p<0.01$). Following this trend, the sleep satisfaction scores show a statistically significant increase between the PSS score at one week and at two months ($p=0.0029$).

**Conclusions** Based on the findings of the current investigation, myofunctional therapy in tongue-tie results in a consistent significant functional ameliorating of feeding capability, speech and sleeping of subject treated as reported with traditional oro-myofunctional therapy.

KEYWORDS Tongue-tie, ankyloglossia, atmospheric plasma, oro-myofunctional therapy, lingual frenulum, frenectomy

## Introduction

Ankyloglossia is anatomically characterised by an abnormally short, thick, or tight tongue frenulum and limited tongue movement, which may contribute to multiple dysfunctions including difficulties in breastfeeding, swallowing, and speech articulation [Webb et al., 2013]. The tongue is an important structure that determines breathing, nursing and nutrition, swallowing, chewing, speech, teeth position, and periodontal tissue health. The lingual frenulum is a normal anatomical structure, with 99.5% of healthy infants reported as having an observable and/or palpable lingual frenulum [Haham et al., 2014]. The lingual frenulum is a membranous fold of mucosal tissue, which connects the ventral surface of the tongue to the floor of the mouth on one side and the basal bone of mandible on the other side.

A frenulum is defined as pathological when it presents abnormalities of length, volume, consistency, and insertion.

Tongue-tie is one of the most common midline congenital developmental malformations. It has an incidence rate of 4.8% among the newborn population [Messner et al., 2000].

In rare cases the tongue fuses partially or totally to the floor of the mouth due to an excessive shortness of the frenulum with a reduced or absent lingual mobility, a condition known as ankyloglossia [Pompéia et al., 2017]. On the contrary, there may be mild forms, where tongue mobility is partially reduced: in these cases, consideration should be given to the patient's age. Indeed, with growth the tongue can stretch and resize; it is necessary to wait until the age of 6–7 years for the possibility of spontaneous regression due to the use of compensatory muscle activity that makes it look as if the frenulum stretches [Coelho, 2010]. Ankyloglossia has been defined as "the condition in which the tongue cannot make contact with the hard palate or cannot protrude more than 1–2 mm past the mandibular incisors", whilst the Academy of Breastfeeding Medicine defines it as a "sublingual frenulum which changes the appearance and/or function of the infant's tongue because of its decreased length, lack of elasticity or attachment too distal beneath the tongue or too close to or onto the gingival ridge" [Amir et al., 2006].

During tongue embryogenesis, the cells of the lingual frenulum undergo apoptosis and migrate distally to the medial region of the lingual dorsum. Ankyloglossia is due to incomplete migration or no migration of the lingual frenulum cells which results in a short lingual frenulum [Villa et al., 2020].

It is important to intercept a short frenulum in newborn babies. In these patients, the tongue-tie release improves breastfeeding, latching, sleep disorders and changes the trajectory of growth and development of the jaws [Villa et al., 2020; Yoon et al., 2017].

Messner and Lalakea [2002] showed that 71% of young children with ankyloglossia had speech abnormalities related to restricted tongue mobility. It is believed that ankyloglossia can affect pronunciation by limiting the mobility of the tongue in all planes of space [Ito et al., 2015].

Several studies compared the incidence of articulation dysfunction among participants with and without ankyloglossia, that have shown language difficulties in patients with tongue-tie

[García Pola et al., 2002; Walls et al., 2014; Salt et al., 2020].

A short and fibrotic lingual frenum is also associated with delayed development or deterioration of speech. The pronunciation of consonants like 't', 'd', 'n', and 'l' in the development of frontal and lateral lisps are commonly observed in toddlers with tongue-tie[Queiroz Marchesan, 2004] .

Swallowing and chewing are also altered in individuals with tongue-tie along with discoordination of jaw muscles during speech, resulting in the development of parafuncions or compensatory positions negative habits such as aerophagia, mouth breathing, and forward tongue positioning [Klockars, 2007; Tuli and Singh, 2010]. The risk of developing Class III malocclusions along with reduced maxillary growth and mandibular prognathism is increased in children with ankyloglossia [Queiroz Marchesan, 2004; Defabianis, 2000; Yang et al., 2009; Campan et al., 1996].

Frenotomy is the primary surgical treatment option, which can be further classified into simple release (frenotomy, frenulotomy, or frenectomy) and surgery (frenuloplasty) [Khan et al., 2020] .

Articulation disorders in children with ankyloglossia were improved by tongue-tie release (frenuloplasty/frenulotomy). Substitution and omission of speech sounds improved relatively early after surgery and progressed to distortion of speech sounds, which is a less-impaired form of articulation disorder. Postoperative tongue exercises and speech training by a speech pathologist are necessary for older patients to correct defective speaking habits [Ito et al., 2015].

Saccomanno et al. [2019] demonstrates that lingual frenectomies and postoperative rehabilitation exercises can affect functions and the entire orofacial muscle balance. The same study shows an improvement of the electromyographic potential, suggesting a clinical improvement of muscular functions after treatment.

Postoperative speech therapy helps develop new muscle movements, and this therapy is required for at least 4 weeks after surgery to correct well-established compensatory movements, and the tongue must be mobilised to prevent scar formation [Tripodi et al., 2021].

Togue-tie is associated with orofacial dysfunctions with repercussions on posture [Boyd et al., 2021a]. There is an association between swallowing and posture [Cayley et al., 2000]with the expectation that anterior open bite (AOB. Different researches have demonstrated that tongue thrust plays an important role in the etiology of malocclusion and posture [Gelb et al., 2021, 2; Botzer et al., 2021, 3; Saccomanno et al., 2014]. The aim of oro-myofunctional therapy is to train the patient to lift the body of the tongue in order to learn a normal resting position of the tongue and physiological swallowing pattern [Takahashi et al., 1995; Boyd et al., 2021b].

The object of a myofunctional program is to establish a new neuromuscular pattern and to correct abnormal functional and resting postures. Many techniques have been proposed for treatment of lingual frenulum; the authors used the atmospheric plasma, which is a thermal technique that creates a sublimation of the superficial tissues, without going in-depth, and is used in many medical fields [Scarano et al., 2023, 2020c, 2020b, 2020a, 2020a] different surgical approaches have been proposed. Atmospheric plasma is a thermal technique of vaporization or sublimation of the superficial tissues, without going deep, and the resulting fine carbonized layer avoids bleeding. The aim of the present investigation was to evaluate the effectiveness of atmospheric plasma (voltaic arc dermabrasion).

In this study we present the new postoperative oro-myofunctional therapy protocol following frenectomy with atmospheric plasma associated with a systemic postural approach, which determines functional recovery through body symmetry restoration based on the concepts of the French "Mezieres Method" [Lena et al., 2022] and postural bench.

## Materials and Methods

This retrospective study was conducted from October 2015 to November 2019. This investigation was conducted in accordance with the ethical principles of the European Union rules on good clinical practice, according to the declaration of Helsinki and the additional requirements of Italian law. The authors treated 130 children (76 female and 54 male) with ages spanning from 4 to 11 years (with an average age of 5.8 years) presenting ankyloglossia classified as class III or IV, according to Kotlow's classification, with the atmospheric plasma technique. All children received a complete oral and lingual examination at the initial visit and standardised photographs were taken following the Kotlow's classification. Postoperative visits were at one week and two months. At each visit, careful attention was paid to lingual movement, mouth opening and lingual scarring. The lingual frenulum was removed using atmospheric plasma also known as voltaic arc dermabrasion (VAD, Europe Medical s.r.l. Montesilvano, PE, Italy). It is generally accepted practice to use local administration of an anaesthetic spray (lidocaine spray, Ogna S.p.A. Milan, Italy) or infiltration of Articaine (Pierrel S.p.A, Milan, Italy)-for this treatment.The frenulum was evaporated by plasma device. During the same session, the frenulum was also treated once with a series of spots using a 50 kHz high voltage alternating current power supply (3 kV, 2 mA) with 2W. No suture was applied. Photographs taken before and after the treatment were used by a joint examiner to evaluate the outcome of the study. All the procedures were performed by the same operator for all the patients at the Oral Surgery Unit of University of Chieti-Pescara (Italy). During the procedure the tongue was gently pulled and lifted towards the palate in order to prevent deformation and misshaping. After the atmospheric plasma procedure instructions were given, such as avoiding spicy food, salt and vinegar. No anti-inflammatory nor antibiotic therapy was required, but rinses with chlorhexidine mouthwash (3/4 a day) for a week, were prescribed. Immediately after the procedure the patients were referred to the speech therapist specialist for oro-myofunctional therapy through functional exercises and returned to their normal routine [Ferrés-Amat et al., 2016]. At one week and at two months, the satisfaction about speech, feeding, and quality of sleep were reported by the parents through a 10-point scale Parents Speech Satisfaction (PSS) Score. A scale questionnaire about overall change, improved/worsened speech, feeding, or sleep was compiled by the parents. Parents of all 130 children enrolled completed the 1-week and two-month follow-up questionnaire.

*Statistical methods* The visual analogic scale of overall change, improved/worsened speech, feeding, or reported sleep, were measured after one week and after two months from the end of treatment through a dedicated case report form. The study data points were evaluated through the statistical software package GraphPad 8 (Prism, San Diego, CA, USA). The non-parametric variables comparison was evaluated applying the Wilcoxson rank test considering a level of significance for $p<0.05$.

*Oro-myofunctional protocol* All patients presented at least one of these orofacial myofunctional symptoms: observable and reported mouth breathing, observable dysfunctional swallow pattern, reported snoring, clenching, and/or myofascial pain or tension.

All patients before and after lingual frenectomy received a few sessions of Orofacial-Myofunctional Therapy (OMT). The number of sessions is 10 and the total duration of the OMT is 6 months, which varied according to individual cases and in accordance with

improved lingual movement. The average duration of time from treatment date to follow-up was 6.3 ± 3 months, ranging from 4 to 9 months. A 10-point Parents Speech Satisfaction (PSS Score) was applied to all patients:

- Point 0-4: No results to unsatisfactory result.
- Point 5: No differences compared to the baseline time-point
- Point 6-10: Satisfactory to very satisfactory result.

The scale was applied to evaluate the following parameters: overall change, speech improvement, feeding, chewing, swallowing and reported sleep quality, OMF pain.

*Before Frenectomy* Before lingual frenectomy all the patients received 3–4 sessions of preparatory intervention for oral surgery (if the child is small, more sessions are needed to enter a relationship of trust with the patient) in which the therapist works on orofacial function awareness, on easing existing tensions and on nasal and diaphragmatic breathing. Exercises proposed are active and passive lingual exercises in decompensated postures based on the concepts of the French "Mezieres Method" [Coelho, 2010] using a postural bench. When the frenulum allows it, the patients are asked to repeat the exercises at home according to a precise schedule customized for the age of the patient.

*After Frenectomy* The first therapy session is carried out immediately after the surgery. One weekly session (2 if the patient is young) for 5 weeks, 2 fortnightly sessions for the following month, 1 monthly control session in the following 3 months. Consultation with the surgeon is essential to decide the beginning and the end of the treatment.

The patient was placed in the supine position and aligned on the postural bench, based on his vertical line (occipital bone, scapula 7$^{th}$ dorsal vertebra, and sacrum), to recreate the correct curves according to the lordosis of the spine subsequently then place the upper limbs abducted to 120° then the patient was placed in the supine position, with the lower extremities elevated at more than 90° of flexion of the hips and the knees extended or flexed. The method aims to affect the muscle, fascia and connective tissue chains and facilitates the release of the diaphragm through specific breathing techniques. The postural bench aids the exercise described by Mezieres. In the first session, diaphragmatic breathing exercises are proposed, associated with active movements of the on postural bench in decompensated postures. In subsequent sessions, passive exercises are introduced to initiate new movement patterns or "to force" some lingual movements and postures and lingual stretching following active exercise. At home, muscle training should be repeated 2–3 times a day for the first week, 2 times a day for 3 subsequent weeks, 1 time a day until the end of the treatment (Figs. 1–8). Details of the exercises can be found in Addendum A.

## Results

The outcomes of present investigation suggest that speech, solid feeding, and sleep can be affected by a tongue-tie, and that releasing a tongue-tie properly combined with orofacial-myofunctional exercises can provide better quality of life and functional improvement. Benefits reported by the patients included improvement to tongue mobility, 81% at one week and 96% at two months. At one week, 58% of patients reported enhanced speech, 58% noticed improved feeding, and 61% observed a profound sleep in their children. At two months, 72% of patients reported enhanced speech, 75% noticed improved feeding and 74% observed a profound sleep in their children.

*PSS Score findings* The clinical findings reported a significant overall change with a PSS score mean of 8.0±1.3 and 8.5±0.81 respectively after one week and two months ($p<0.0001$) (Table 1; Fig. 8). In addition, a significant increase of the speech capability was detected after one week and two months ($p<0.0001$) with 8.1±1.2 and 8.6±1.4 ($p<0.0001$). A consistent improvement of the feeding capability was detected at one week with a mean of 7.9±1.4 with a significant increase at two months 8.5±0.8 ($p=0.0078$). Moreover, the sleep satisfaction reported an increase from 8.0±1.2 at one week to 8.4±0.89 ($p=0.0029$) (Table.1; Fig. 8).

## Discussion

The 10-point Parents Speech Satisfaction (PSS Score) identified an immediate effect on sleeping, feeding, speech and overall changes after one week from the surgery. In addition, these advantages appear to be consolidated at two months by passive/active lingual exercise, reporting a significant increase of PSS variables score ($p<0.01$).

The terms "tongue tie" and "ankyloglossia" are used synonymously to represent a condition where movement of the tongue is assessed as being limited. This limitation is usually attributed to the lingual frenulum "tethering" the tongue, with the frenulum itself often being called a "tongue tie." However, it is generally agreed that ankyloglossia is not a purely anatomical or appearance-based diagnosis, and that limitation of tongue movement is crucial to the diagnosis and in the decision to proceed to frenotomy [Suter and Bornstein, 2009; Puapornpong et al., 2014; Chinnadurai et al., 2015; Francis et al., 2015; Walsh and Tunkel, 2017]. As of yet, no clear anatomical variables have been identified that have direct correlation with limitation of specific tongue movements, or improvement in any objective outcome measures following frenotomy. Consequently, major controversy still exists around when and how the frenulum is determined to be limiting movement, and when that limitation is sufficient enough to warrant surgical intervention. According to the literature, historically, speech/myofunctional therapy was introduced to improve mandibular growth, nasal breathing, and facial appearance as an adjunct to orthodontic treatment [Rogers, 1918].

The harmonious development of the dentition and facial skeleton is influenced by force distribution between oral and perioral structures. Any alterations in the equilibrium of craniofacial muscle activities may influence the developing craniofacial skeleton structures [Koletsi et al., 2018]. The relationship between function and form and the functional matrices theory described by Moss [1968] dates back to 1968. The tongue position and breathing are the problems most commonly associated with myoskeletal and myofunctional defects that may influence the muscular activity of a growing facial skeleton and dentition. The aim of therapeutic approaches for treating myoskeletal problems and orofacial dysfunction is to provide an environmental and functional equilibrium for the oral and perioral structures to develop. The best results can only be achieved with very early intervention. Treatment in infancy is excellent in cases of difficulties with breastfeeding, swallowing, chewing, speech or sleep [Villa et al., 2020; Yoon et al., 2017]. Tongue size and mobility, affected in true macroglossia or ankyloglossia, have been associated with discrepancy between oral cavity and tongue functionality or volume [Ingervall and Schmoker, 1990]. Speech disorders have also been associated with children who exhibit myoskeletal and myofunctional problems, in fact myofunctional therapy has been advocated as a means to treat myoskeletal and myofunctional problems. Orofacial-myofunctional therapy (OMT), consists of targeted active and passive exercises to correct muscle patterns, dysfunctions or parafunctions in patients, and bring them to a healthy function, with the aim of not just having the muscles in harmony, but in balance as well which helps with breathing, chewing, swallowing, speaking, sleep due to an optimal resting posture of the tongue,

FIG 1 The tongue tip goes on the roof of the mouth (mouth open)


FIG 2 A-The tongue is pushed forward for between 5 and 10 seconds. B- Lateralization of the tongue protruded to the right. C- Lateralization of the tongue protruded to the left


FIG 3 A-Palate brushstroke with closed and open mouth (various degrees of opening). B- Upper wiper- the tongue moved to right. C- Upper wiper- the tongue moved to left



FIG 4 The tip of the tongue is moved against the hard palate on the roof of the mouth, just behind the maxillary papilla and moved back and forth keeping it always adherent to the palate

FIG 5 The tongue is moved against the hard palate on the roof of the mouth, just behind the maxillary papilla and the mouth is opened without detaching the tongue from the palate

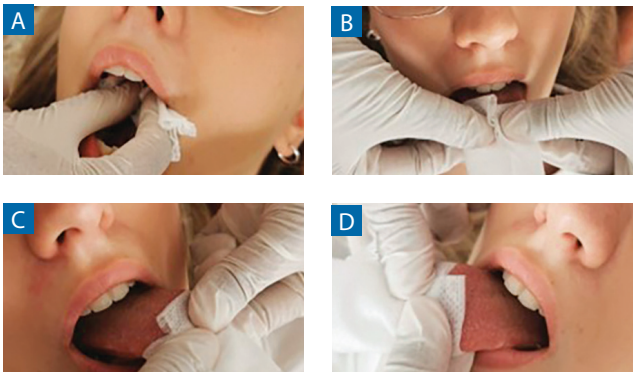


FIG 6 A. The tongue is taken with gauze and the tongue is brought towards the palate; B. tongue pulled forward; C. to the left, and; D. to the right while the patient focuses on breathing


FIG 7 A. Massage of the scar with a circular motion for a few seconds. B. Massage of the scar by gently pulling the tissue upwards

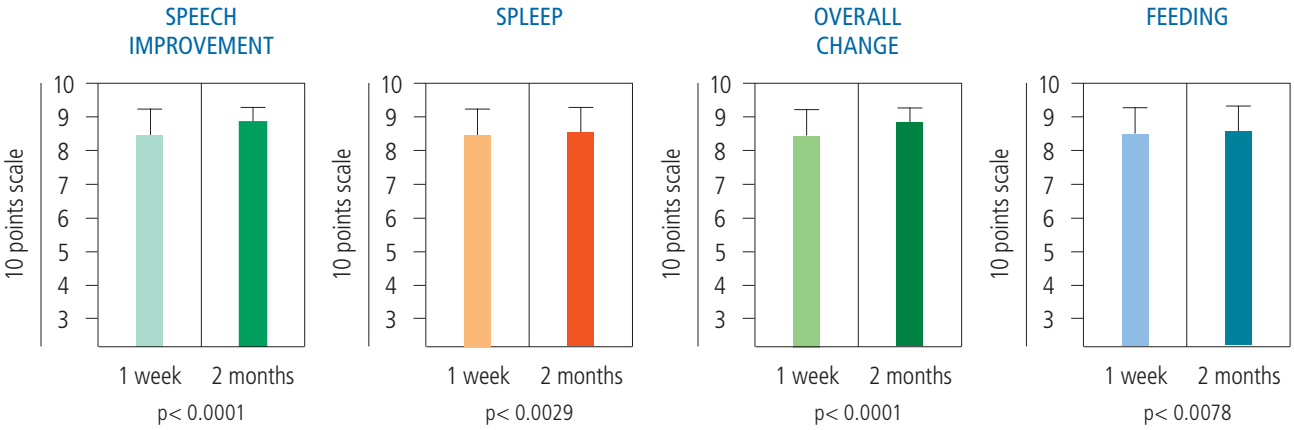


FIG 8 Graphs of the 10-point parents' satisfaction 10-point Parents Speech Satisfaction (PSS) Score of overall change, improved/worsened speech, feeding, or sleep, measured after one week and two months [Mann-Whitney test]

| ADDENDUM A |
|---|
| Sample active lingual exercises |
| The following exercises are provided as a general overview for myofunctional therapy exercises to be performed under the supervision of a speech therapist. When we pronounce the letter "n," the tongue tip goes on the top of mouth between the palatine wrinkles that is also called "the spot". |
| The spot is an important point in more exercise. |
| Exercise 1: tongue tip goes on the roof of mouth (mouth open) - place the tip of the tongue against the hard palate on the roof of the mouth, just behind the maxillary papilla for 10 seconds. This is repeated 5 times. |
| Exercise 2: tongue tip goes on the roof of mouth (mouth open and closed) - place the tip of the tongue against the hard palate on the roof of the mouth, just behind the maxillary papilla, and open and close the mouth. This is repeated 5 times. |
| Exercise 3: Protrusion of the tongue - the tongue is pushed forward between 5 and 10 seconds, then relax. This is repeated several times in a series of 5. |
| Exercise 4: Lateralisation of the tongue protruded to the right and left - the tongue is pushed to the right and pushed to the left. This is repeated 5 times. |
| Exercise 5: Palate brushstroke with closed and open mouth (various degrees of opening) - the tip of the tongue is moved against the hard palate on the roof of the mouth, just behind the maxillary papilla and moved back and forth keeping it always adherent to the palate. This is repeated 5 times. |
| Exercise 6: Upper wiper - the tongue moved to right and left, touching the last upper right molar and then the last upper left molar. This is repeated 5 times. |
| Exercise 7: Inner upper walk - the tip of the tongue is moved from the last right molar to the last left one, touching the inner face of all the teeth of the upper arch. This is repeated 5 times. |
| Exercise 8: Lower wiper - the tongue moved to right and left, touching the last lower right molar and then the last lower left molar. This is repeated 5 times. |
| Exercise 9: Lower internal walk- the tip of the tongue is moved touching the last lower right molar and then the last lower left molar touching all the teeth of lingual side of lower arch. This is repeated 5 times. |
| Exercise 10: Upper Outer walk- the tongue is pulled forward from the last right molar to the last left one, touching the inner face of all the teeth of the lower arch. This is repeated 5 times. |
| Exercise 11: Maximum lingual retrusion - the tongue is moved against the hard palate on the roof of the mouth, just behind the maxillary papilla and moved backwards (as far back as possible) for 5 seconds. This is repeated 5 times. |
| Exercise 12: Lingual snaps - the tongue is moved against the hard palate on the roof of the mouth, just behind the maxillary papilla and opening the mouth and click the tongue. This is repeated 5 times. |
| Exercise 13: Lion (Sucker Tongue) - the tongue is moved against the hard palate on the roof of the mouth, just behind the maxillary papilla and the mouth is opened without detaching the tongue from the palate. This position is held for 5 seconds. This is repeated 5 times. |
| Sample passive lingual exercises |
| Exercise 1: Guided by the gloved finger of therapist to brushstroke the palate - as active exercise 5 |
| Exercise 2: Guided upper wiper walk- as active exercise 7 |
| Exercise 3: Guided Lion - as active exercise 13 |
| These three exercises are proposed (while the patient is focused on diaphragmatic breathing) with the manual help of the speech therapist to force the movement and/or prevent the excessive production of connective tissue with scar formation. |
| Exercise 4: Lingual stretching - the tongue is held with a gauze and pulled (gently and gradually) while the patient focuses on breathing. |
| Exercise 5: Scar massage |
| Place the thumb and index fingers on the sides of the scar and massage with circular motion for a few seconds. Repeat 5 times. |
| Place the thumb and index fingers on the sides of the scar with a slight pressure and gently pull the tissue upwards. Repeat 5 times. |
| Place the thumb and index fingers on the sides of the scar and apply a constant pressure for a few seconds. Repeat 5 times. |
| These exercises are some of the possible examples. The order, number and duration of repetitions should be calibrated on the patient by the speech therapist. |

TABLE 1 Summary of the descriptive statistics of the 10-point parents' satisfaction Parents Speech Satisfaction (PSS) Score of overall change, improved/worsened speech, feeding, or sleep, measured after one week and two months [Mann-Whitney test]

lips and jaw. Therefore, the exercise selection included in this study focuses on increasing tongue mobility in all planes of space to promote normal function [Saccomanno et al., 2019].

The results observed in the present investigation should encourage speech therapists, oral surgeons and professionals treating children suffering from nursing, swallowing, chewing, speech, and sleep trouble to evaluate children for tongue restrictions, and consider treatment if these commonly associated symptoms are present, regardless of the degree of evident restriction.

The present study has a strict tentative character and wants to stimulate further research in the field of togue-tie. The limits were that the present study was done retrospectively, with no control group and the patient surveys were not validated.

Further research is recommended by means of larger, blindly performed and long-term follow-up studies, to confirm our results, to clarify the success of OMT based on the concepts of the French "Mezieres Method" on the postural bench.

**Conclusions**

The findings of this study showed that myofunctional therapy before and after tongue-tie releases with atmospheric plasma can yield significant functional improvements chewing and swallowing, speech and sleep of children, as reported by the parents. Also, clinical movement of the tongue improves, meaning that optimal motility of the tongue can be created.

*Conflict of interest*

The authors declare that they have no conflicts of interest.

*Author Contributions*

Conceptualization, AS, RDG. methodology, AS. RDG; software, FL, AS.; validation, AS, CB, GT; formal analysis, AS; investigation AS, RDG; data curation, RDG, AS, FL; writing—original draft preparation, AS, RDG; writing—review and editing, AS, FL. All authors have read and agreed to the published version of the manuscript."

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