Proposal for a myofunctional therapy protocol in case of altered lingual frenulum. A pilot study

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Abstract

In this article, the authors propose a specific Myofunctional Therapy Protocol for patients with altered lingual frenulum. In such cases tongue muscles are hypofunctioning and their range of motion is reduced. To compensate for this limitation, dysfunctional lingual motor patterns are established, such as the use of some muscles at the expense of others; this negatively affects the development and functions of the stomatognathic system. The Myofunctional Therapy Protocol presented in this pilot study was developed with the aim of making the muscles of the tongue, the floor of the mouth and the soft palate more coordinated, and increasing muscle contraction strength, in order to produce improvements on the muscle tone, on orofacial and nasal functions and a better wound healing and functional recovery in the case of surgical therapy (frenulotomy).

KEYWORD Altered lingual frenulum, Deviate swallowing, Myofunctional therapy, Short lingual frenulum, Tongue-tie.

Introduction

The lingual frenulum is a fibromucosal tissue extending from the floor of the mouth to the midline of the ventral surface of the tongue. The primary function of the frenulum is to keep a balance between the growing bones, the tongue and the lip muscles during fetal development, and to limit the movement of the muscular tissues like lips, tongue and cheeks [Srinivasan and Chitharanjan, 2013]. The alteration of the lingual frenulum is a congenital anomaly that limits tongue mobility and has a series of implications for the stomatognathic system, resulting in a critical impact on the oral functions and therefore on the growth and development of the orofacial complex. The onset of this congenital anomaly shows a greater impact in males rather than females, with a ratio of 3:1 and with a 5% incidence reported at birth [Huang et al., 2015]. The main impairments concern breastfeeding [Bhattad et al., 2013; Pompéiaa et al., 2017; Yoon et al., 2017a], craniofacial growth [Pompéiaa et al., 2017; Srinivasan et al., 2013; Yoon et al., 2017b], dental occlusion [Bhattad et al., 2013; Vaz and Bai, 2015; Yoon et al., 2017a], breathing [Bhattad et al., 2013; Pompéiaa et al., 2017; Yoon et al., 2017a], swallowing [Bhattad et al., 2013; Pompéiaa et al., 2017; Yoon et al., 2017a], verbal articulation [Pompéiaa et al., 2017; Suzart and de Carvalho, 2016], social and relational aspects [Bhattad et al., 2013]; it is also related to the syndrome of obstructive sleep apnea [Guilleminault et al., 2016; Huang et al., 2015]. Myofunctional rehabilitation aims to increase awareness of correct postures, optimisation of amplitude, accuracy, coordination of tongue movements, strengthening muscular and functional capacities and optimal participation of the tongue in all other lingual functions such as swallowing, chewing, and non-verbal functions. Above all, it is important to make these processes automatic through repetition, for the principle of neuroplasticity and cortical reorganisation during the motor rehabilitation process. It is this automatism that is the most difficult target to achieve, so it is important to provide a maintenance protocol to keep stability over time. In this article it is presented a Myofunctional Therapy Protocol, simple to perform for patients and which is useful for enhancing orofacial and nasal functions in cases of altered lingual frenulum.

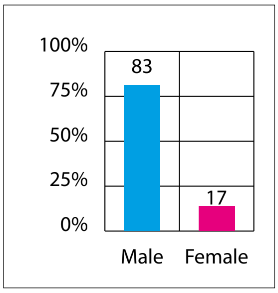


FIG. 1 Male prevalence of the sample.

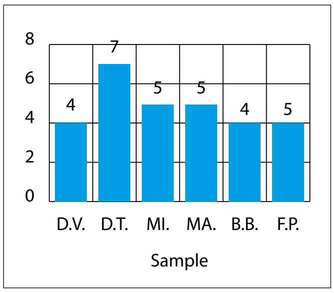


FIG. 2 Respiratory type.

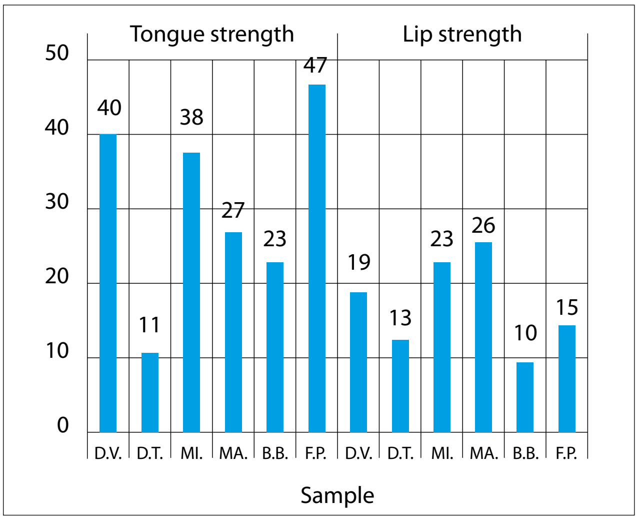


FIG. 3 IOPI – Measure of strength in kPA.

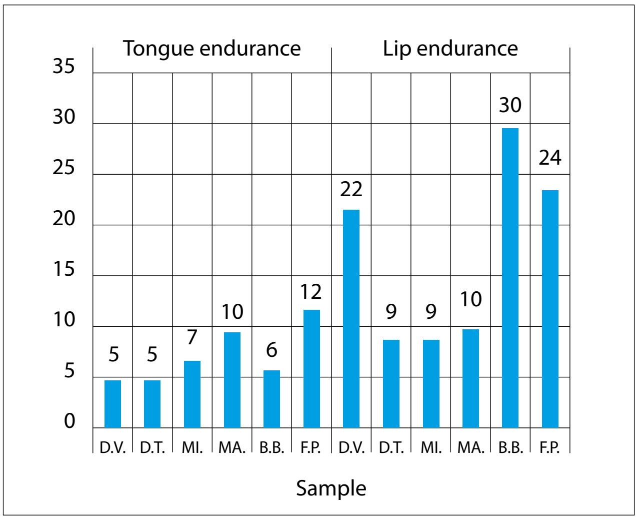


FIG. 4 IOPI – Measure of endurance in seconds.

Materials and methods

The sample comprised 6 children (5 males and 1 female), aged between 4.5 and 11.7 years (mean age of 7.7 years). The inclusion criterion was the presence of an altered lingual frenulum; the exclusion criteria were: the presence of genetic syndromes, malformations, auditory, cognitive and motor abnormalities. The sample underwent a dental and orthodontic examination and no cavities were found in any subject. Parents were asked to fill out a questionnaire on eating habits, oral hygiene habits, fluoride prophylaxis and family history of caries [Paglia et al., 2016]. To estimate the risk of malocclusion, the ROMA index (Risk Of Malocclusion Assessment) [Grippaudo et al., 2008] was applied in 5 patients in mixed dentition and the Baby-ROMA index [Grippaudo et al., 2014] for the patient in primary dentition. The 5 patients in mixed dentition obtained Grade 3 of the ROMA index and were classified as "moderate risk", due to the presence of moderate changes in dental and/or skeletal relationships, but tending to persist and worsen over time. The patient in primary dentition was classified as having Grade 1 of the Baby-ROMA index for which the risk of malocclusion is considered mild and routine checks are recommended to monitor the occlusion. Early treatment of orthodontic problems can be useful in preventing the worsening of the condition in permanent dentition [Grippaudo et al., 2013a].

The sample was submitted to myofunctional evaluation at the Orthodontics department of the Gemelli University Hospital in Rome. All evaluations were conducted by the same speech therapist, to minimise variability. This one-on-one 60 min individual assessment was carried out in a single session. The assessment method included a functional analysis through standardised and non-standardised tools, such as:

- The Lingual Frenulum Protocol [Marchesan, 2012];
- Iowa Oral Performance Instrument (IOPI Pro), evaluation of the tongue and lips strength and endurance [Adams et al., 2013; Clark et al., 2009];
- Assessment of the airway and expiratory permeability test with the adapted oronasal plaque, from the Protocol for the Phonoaudiological Assessment of Breathing with Scores (ProPABS) [Susanibar and Dacillo, 2015];
- Clinical examination of the swallowing of saliva, water and biscuit (Kinder Cards, Ferrero);
- Video and photographic documentation.

In the enrolled sample a positive correlation between the predominance of short lingual frenulum [Huang et al., 2015] in males is reported (Fig. 1). From the myofunctional evaluation of the sample, data can be traced back to a prominent hypofunction of the tongue muscles and of the orbicularis oris (Fig. 3, 4). The tongue range of motion ratio (TRMR) is a ratio of mouth opening with tongue tip to maxillary Incisive papillae at roof of mouth (MIOTTIP) to maximal interincisal mouth opening (MIO) and it identifies functional ankyloglossia [Yoon et al., 2017a], reporting a degree 3 of tongue mobility, which is significantly below average, in 5 out of 6 cases (Fig. 5). The analysis of the respiratory type shows that with a score of 4/13, 2 children have a nasal breathing, while 4 children with a score between 5-7/13, have slight oro-nasal breathing (Fig. 2).

Following the baseline evaluation, the study sample was trained by the same speech therapist to correctly execute the exercises of the Myofunctional Therapy Protocol. Later, the sample was randomly divided into 3 groups.

The first group included 2 patients studied as a control, to whom no therapy was prescribed.

The second group included 2 patients who were prescribed the home exercises according to the Myofunctional Therapy Protocol, to be performed daily without the supervision of the speech therapist.

The third group included 2 patients treated by the same speech therapist for 3 weeks, with a frequency of 3 office visits per week, which was associated with the assignment of home exercises of the proposed Protocol.

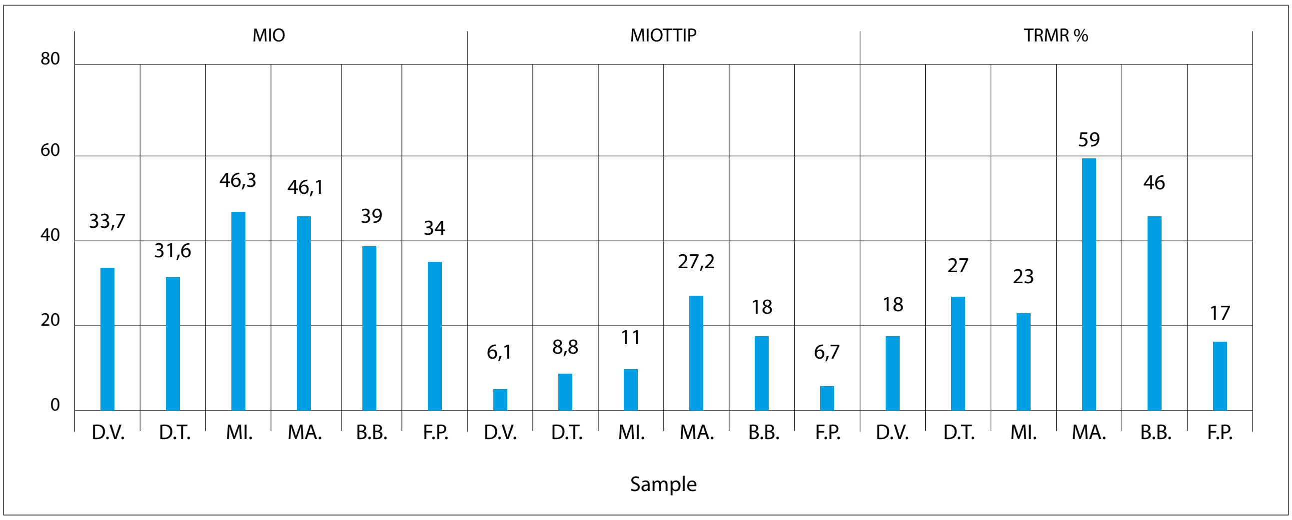


FIG. 5 Restriction of tongue mobility in mm and percentage report.

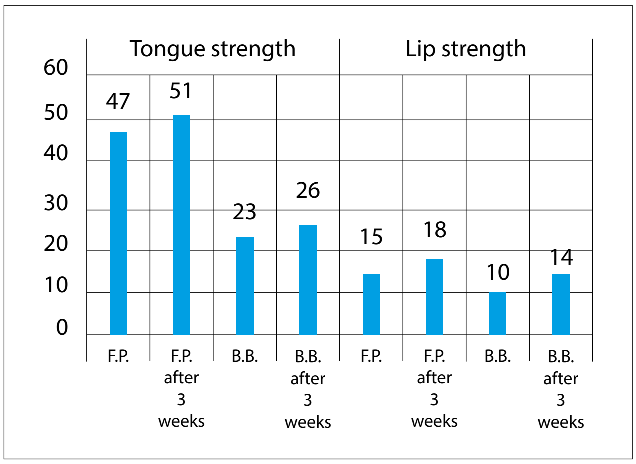


FIG. 6 IOPI – Measure of strength in kPA, pre- and post-TMF.

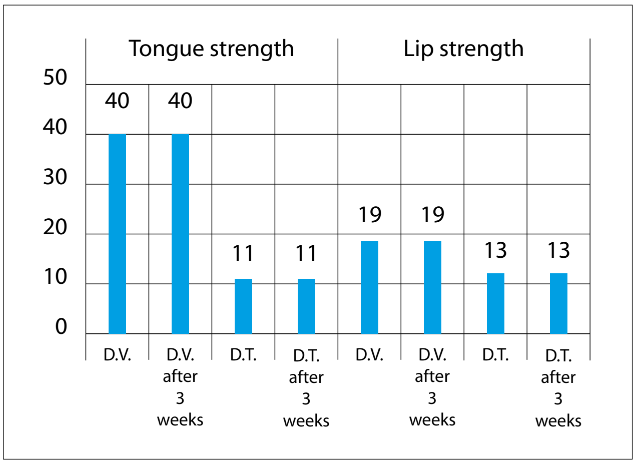


FIG. 7 IOPI – Measure of strength in kPA, Control group.

The treatment practice developed for this pilot study included the Myofunctional Therapy Protocol, which was complemented by the Therapy Diary for conducting home exercises. The Protocol consisted of 8 exercises, divided according to the functional goals to be pursued. Each goal included 2 exercises, for each of which there were 15 repetitions. To make therapy more motivating and increase the compliance of patients in the developmental age, the exercises have been proposed in a playful formulation. In the same way, the Therapy Diary was created, containing a personal data sheet, practical and explanatory advices for the exercises, schedules for the planning of the therapy program. Furthermore, the diary was a useful aid to the speech therapist to monitor the regularity with which the exercises were performed at home. Patients who were prescribed this Protocol at home, had to repeat the exercises following the directions of the Therapy Diary. Each exercise had to be repeated 15 times, for 3 sessions a day in front of the mirror, since visual feedback reduces variability in performance; in this way, every day the children performed at least 30 minutes of myofunctional home therapy.

First goal

Establish tongue rest posture and increase oral proprioception to help the patient become aware of the morphology of the oral cavity and in particular of the tongue and the palate, as a prerequisite to restore functional neuromuscular patterns.

Proposed exercises

1. Raise the tip of the tongue on the maxillary incisive papillae and then exercise a light suction. Hold this position for 10 seconds.
2. Place the tip of the tongue on the maxillary incisive papillae, then slide the tongue backwards over the palate in the direction of the uvula, then forward again, repositioning it on the papillae.

Second goal

Increase mouth opening and optimise the elevation of the tongue; stimulate the coordination of the orbicularis oris and optimise lip competence.

Proposed exercises

3. Slowly open the mouth, touch the maxillary incisive papillae with the tip of the tongue, then open the mouth to the maximum.
4. Place the tip of the tongue on the maxillary incisive papillae; keeping this position, open and close the mouth, without pushing the tongue against the teeth.

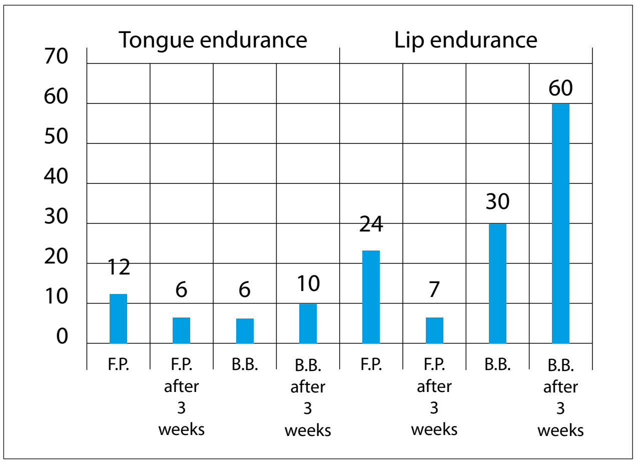


FIG. 8 IOPI – Measure of endurance in seconds, pre- and post-TMF.

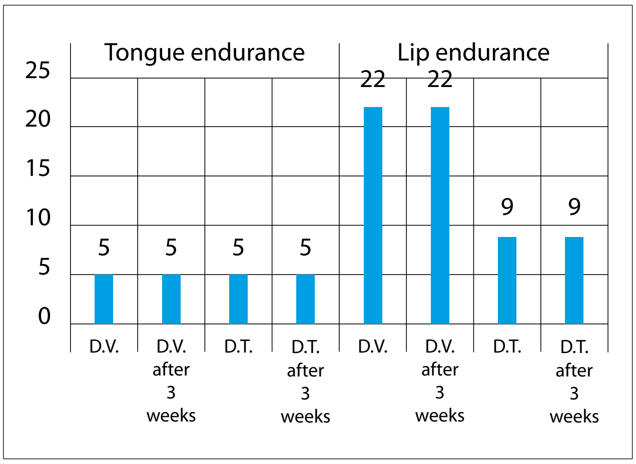


FIG. 9 IOPI – Measure of endurance in seconds, Control group.

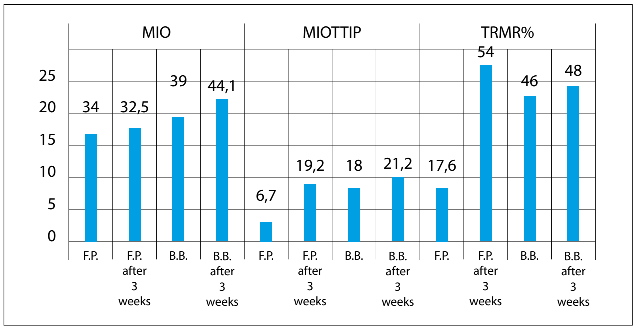


FIG. 10 Restriction of lingual mobility in mm, pre- and post-TMF.

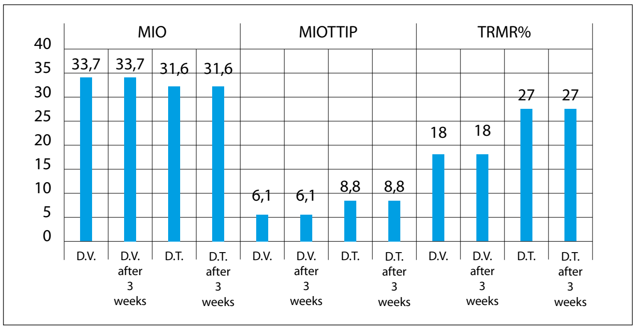


FIG. 11 Restriction of lingual mobility in mm, Control group.

Third goal

To tone up the muscles of the tongue and the floor of the mouth, to increase muscle contraction strength and endurance and to enhance the pharyngeal phase of swallowing.

Proposed exercises

5. Protrude the tongue, first making it look wide-shaped, then making it pointed-shaped.
6. Lift the tip of the tongue just behind the retroincisal papilla. Attach the posterior part of the tongue to the palate. Breathe in air between the tongue and the palate to create a vacuum. Slowly open the mouth. Hold this position for 5 seconds, then detach the tongue from the palate, producing an explosive sound similar to a "CHUCK" ['tʃ ak].

Fourth goal

To improve tongue and soft palate mobility, strengthening their muscles and in particular the genioglossus and the palatoglossus muscles, to enhance nasal breathing [Paskay, 2016].

Proposed exercises

7. Make circular movements with the tongue on the outer surface of the teeth.
8. Move the tip of the tongue upwards, as close as possible to the nose, then downwards towards the chin; then sideways towards the labial commissures.

After 3 weeks, the same speech therapist re-performed the myofunctional assessment, in the same way, to the group of cases treated by the therapist and the control group. The quantitative data emerged from the evaluations are shown in Figures 7-11.

Results

From the analysis of the results, we observe the differences between the 3 groups studied.

In the first group, studied as a control, to which no therapy was prescribed, no results were observed.

In the second group, which has been prescribed the home exercises of the proposed Protocol without the supervision of the speech therapist, no results have been highlighted.

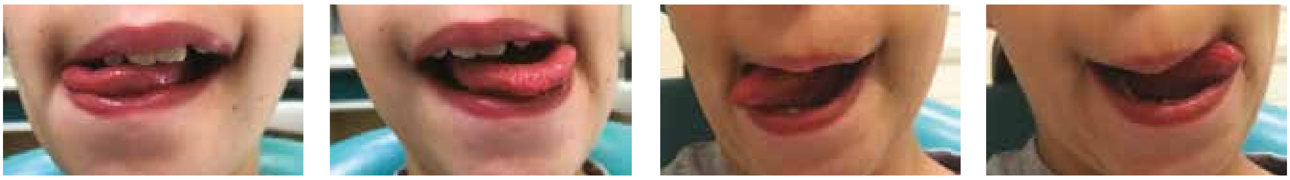
In the third group, treated with the Myofunctional Therapy with the control of the same speech therapist and with the prescription of the home exercises, positive results were obtained that confirm the achievement of the 4 goals set.

First goal

Both treated patients of the third group showed that they acquired the rest position of the tongue by visual assessment, and had a better awareness of their oral cavity.

Second goal

In both patients there was a significant increase in the maximum interincisal opening (MIO) and the maximum interincisal opening with the tip of the tongue in contact with the maxillary incisive papillae (MIOTTIP). As a result, an increase



A B C D

FIG. 12 Touching the labial commissures with the tip of the tongue. A-B Baseline evaluation. C-D Post-TMF.

A B C D

FIG. 13 Protrusion of the tongue. A-B Baseline evaluation. C-D Post-TMF.

in the TRMR was obtained, that is the ratio between MIO and MIOTTIP, which determines a change in the restrictions of tongue mobility [Yoon et al., 2017a] (Fig. 10). The other general tests of the Lingual Frenulum Protocol [Marchesan, 2012] which describe the morphological characteristics of the lingual frenulum were unchanged, due to the histological structure typical of the lingual frenulum [Martinelli et al., 2014]. The reinforcement of lip competence has been objectively detected through the IOPI. In both treated groups there was an increase in the orbicularis oris strength (Fig. 6), measured in kiloPascal [Adams et al., 2013; Clark et al., 2009]. The lip endurance was increased only in one of the two cases (Fig. 8).

Third goal

The IOPI documented an objective increase in the tongue strength (Fig. 6), measured in kilopascal. The tongue endurance was increased only in one of the two cases (Fig. 8). On clinical examination, swallowing was more functional, as there was minimal effort of the orofacial muscles, better mandibular stabilisation and the absence of recruitment of the head and shoulder muscles.

Fourth goal

The breathing function presented qualitative improvements. According to the breathing protocol (ProPABS) [Susanibar and Dacillo, 2015] in the semi-subjective examination of the respiratory type, an increase in the patency of the nasal cavities was visible (Fig. 15), while the markings of the nasal condensation remained minimally asymmetric and the scores of the functional breathing evaluation remained unchanged. This result was due to the muscular strengthening of the tongue and soft palate, in particular of the genioglossus and the palatoglossus muscles, which had important repercussions on the breathing function, and on the maintenance of the patency of the upper airways [Paskay, 2016]. The functional tests of the Lingual Frenulum Protocol [Marchesan, 2012], showed qualitative improvements of tongue mobility, observable in the lateralisation movements of the tongue in the direction of the labial commissures (Fig. 12), protrusion of the tongue (Fig. 13A-B), elevation of the tongue on the upper lip (Fig. 14) and a better adherence and pressure exerted in the palate suction test.

Although it was not a therapeutic target, qualitative improvements were noted for speech and articulation. In particular, a reduction of articulatory distortions is appreciated, above all for phonemes / t /, / d /, / l /, / n /, / s / and for the consonant groups. Lip involvement and mandibular lateralisation during the verbal articulation were reduced, compared to the early assessment.

The sample enrolled for this study had a positive correlation with the predominantly male onset of the short lingual frenulum [Huang et al., 2015].

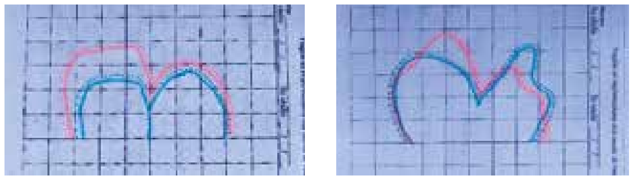
Although the sample was very small, the results obtained by applying the Myofunctional Therapy Protocol as proposed were encouraging and many aspects emerged to guide future therapy sessions. No results were found in the functional performance of the patients who performed the home therapy without the control of the speech therapist, mostly due to the discontinuity in therapy, as the exercises were not performed daily because the patients experienced difficulties in performing the protocol systematically. The supervision of the speech therapist is essential in determining the success of the therapy, within the time allotted for the therapy cycle, as patients need modeling, correcting, providing instructions and supervising the implementation of the home assignments.

Discussion

This pilot study is particularly important if we consider the paucity of references concerning the application of myofunctional therapy in patients with altered lingual frenulum. Even in this small sample, the Myofunctional Therapy Protocol has produced multiple results, improving orofacial and nasal functions. Improvement of the muscle tone and of the contraction strength of the tongue and the lips and the increase of tongue mobility obtained have brought about subsequent improvements on the stomatognatic functions. This Protocol can be associated with surgical frenulum release, to ensure the achievement of better results and a more rapid and effective functional recovery, in

A B

FIG. 14 Touch the upper lip with the tip of the tongue. A Baseline evaluation, B Post-TMF.



C D

FIG. 15 Nasal condensation marking. A Baseline evaluation, B Post-TMF.

order to avoid the risk of formation of postoperative scars that would limit tongue mobility, requiring surgical revision. The application of this Myofunctional Therapy Protocol ensures the success of the treatment, as it helps to optimise the suprahyoid muscles, recover the compromised oral functions and prevent the tissues from re-connecting after surgery, causing relapse [Moeller, 2012]. After the surgical release of the lingual frenulum [Junqueira et al., 2014], it is necessary to respect the times and phases of the wound healing process. In the first three post-operative days, during the phases of haemostasis, inflammation and proliferation, the patient must abstain from myofunctional therapy exercises. The patient is encouraged to speak, to gently move the tongue and to rinse the wound with saline. After the third post-operative day, the speech therapist observes the patient to determine the state of wound inflammation, ensuring that there is no excessive pain, bleeding, heat or drainage from the wound. It is necessary to schedule a follow-up appointment with the speech therapist for the following week, during the maturation and remodeling of the wound: during this phase the Myofunctional Therapy Protocol will be administered for an effective and stable post-surgical treatment over time.

Conclusions

Myofunctional therapy is an essential support for the development of the cranio-mandibular-occlusal complex, as the posture of the tongue, its mobility and its orofacial functions play a significant role in facial skeletal development [Saccomanno et al., 2014]. In the scientific literature there are very few studies that document myofunctional therapy protocols for cases of altered lingual frenulum. The protocol presented in this pilot study produces objectively quantifiable results, suggesting to be effective in reinforcing the intrinsic and extrinsic tongue muscles, the orbicularis oris, the floor of the mouth and the soft palate, improving oral proprioception and qualitatively enhancing oral functions in cases of altered lingual frenulum. It is proposed to apply the Myofunctional Therapy Protocol to a larger study sample to standardise it and make it usable for functional improvement of borderline cases, pre-surgery preparation and for rehabilitation post frenectomy-frenotomy. In case of alteration of the lingual frenulum, the early diagnosis, the multidisciplinary management and the adoption of a systematic Myofunctional Therapy Protocol are the key to success for an effective and decisive procedure, in order to prevent the occurrence of structural and functional alterations and guarantee an improvement in the quality of life of these patients.

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