Original Article

Artigo Original

Aspects of stomatognathic system before and after adenotonsillectomy

Aspectos do sistema estomatognático pré e pós-adenotonsilectomia

Fernanda Bastos de Andrade-Balieiro[1]
Renata Azevedo[2]
Brasília Maria Chiari[2]

Keywords

Speech
Stomatognathic system
Voice
Palatine tonsil
Adenoids
Phonation

ABSTRACT

Purpose: To verify the speech therapy aspects of the stomatognathic system, including phonoarticulatory structures (lips, tongue, and soft palate) and swallowing, respiratory, speech, and phonation (vocal quality and resonance) functions, before and after undergoing adenotonsillectomy. **Methods:** The study included 22 children, 17 males and 5 females, aged between 5 and 10 years, suffering from hypertrophy of palatine and adenoid tonsils, with surgical indication for adenotonsillectomy and with no previous speech therapy. The speech-language pathology evaluation was performed before surgery and during the period between 1 and 6 months after adenotonsillectomy. It consisted of an evaluation of structures (lips, tongue, and soft palate) and of swallowing (liquid), respiration (mode), speech, and phonation (voice quality and resonance) functions. To evaluate vocal quality and resonance, 15 participants with the postoperative evaluation carried out in a period from 1 to 2 months were considered. **Results:** There were differences regarding nasal respiratory mode, lips closed at rest posture, changed tongue tonus, adequate mobility of the soft palate, changed tongue posture during liquid swallowing, and absence of interposition compensatory mechanism of lips in swallowing. Reduction in the frequency of distortion processes was also found. With regard to speech, little improvement in vocal quality and resonance was seen. **Conclusion:** Following adenotonsillectomy, some structures and functions can spontaneously readapt or improve. However, most children needed to be referred to speech therapy for readapting stomatognathic structures and the assessed functions.

Descritores

Fala
Sistema estomatognático
Voz
Tonsila palatina
Tonsila faríngea
Fonação

RESUMO

Objetivo: Verificar os aspectos fonoaudiológicos do sistema estomatognático, incluindo as estruturas fonoarticulatórias (lábios, língua e palato mole) e as funções de deglutição, respiração, fala e fonação (qualidade vocal e ressonância), pré e pós adenotonsilectomia. **Métodos:** Participaram 22 crianças, 17 do gênero masculino e cinco do gênero feminino, na faixa etária entre 5 e 10 anos. Todas apresentavam hipertrofia de tonsilas palatina e faríngea com indicação cirúrgica de adenotonsilectomia e nenhuma delas havia passado por fonoterapia prévia. A avaliação fonoaudiológica foi realizada no período pré-operatório e entre um e seis meses após a adenotonsilectomia e constou de avaliação das estruturas (lábios, língua e palato mole), das funções de deglutição (líquido), respiração (modo), fala e fonação (qualidade vocal e ressonância). Para avaliar a qualidade vocal e a ressonância, participaram 15 sujeitos com avaliação pós-operatória realizada no período de um a dois meses. **Resultados:** Houve diferença quanto ao modo respiratório nasal, postura de lábios ocluídos em repouso, tônus de língua alterado, mobilidade adequada de palato mole, postura de língua alterada na deglutição de líquido, e ausência do mecanismo compensatório de interposição de lábios na deglutição. Houve redução na frequência dos processos de distorção. Em relação à fonação, foi observada discreta melhora na qualidade vocal e ressonância. **Conclusão:** Após a adenotonsilectomia algumas estruturas e funções podem se readaptar ou apresentar melhora espontaneamente. No entanto, foi necessário encaminhar a maioria das crianças para o atendimento fonoaudiológico na busca da readaptação das estruturas estomatognáticas e funções avaliadas.

Correspondence address:
Fernanda Bastos de Andrade-Balieiro
R. Graúna, 180, Moema, São Paulo (SP), Brazil, Zip Code: 04514-000.
E-mail: andrade.fe@gmail.com

Received: 08/03/2011

Accepted: 11/30/2011

This study was carried out at the Post-graduation program in Human Communication Disorders: Speech Therapy Field, Departamento de Fonoaudiologia, Universidade Federal de São Paulo – UNIFESP – São Paulo (SP), Brazil.
(1) Post-graduation program in Human Communication Disorders: Speech Therapy Field, Departamento de Fonoaudiologia, Universidade Federal de São Paulo – UNIFESP – São Paulo (SP), Brazil.
(2) Departamento de Fonoaudiologia, Universidade Federal de São Paulo – UNIFESP – São Paulo (SP), Brazil.
Conflict of interest: nothing to declare.

INTRODUCTION

Hypertrophy of palatine and adenoid tonsils is the main cause of mechanical obstruction of air passage through the upper airways, resulting in substitute mouth respiration[1]. The changed respiratory pattern may provide facial deformities, which are characterized by alterations in the maxilla, hard palate, malocclusion, tonicity, and posture of structures from the stomatognathic system in the pattern of swallowing[2,3] and speech[4]. Soft palate mobility can also be damaged and change vocal resonance peculiarities. When the quality of life is damaged, many times medical conduct is directed toward surgical procedures.

Reevaluation, from 1 to 6 months beginning at surgery[2,5,6], may evidence spontaneous improvement of the respiratory, vocal, and swallowing patterns and readjustment of stomatognathic system structures, which happens due to the increase of space in the oropharynx associated with clearance of the upper airways, enabling nasal respiration. As a consequence of a new stimulus, a redefinition of the articulators and of the vocal resonance is possible. However, the persistence of such alterations[3,7] may happen in many post-adenotonsillectomy cases. Therefore, speech therapy intervention is needed to acquire a new pattern.

The present study aims to verify the speech therapy aspects from the stomatognathic system — including phonoarticulatory structures (lips, tongue, and soft palate) and swallowing, respiration, speech, and phonation functions (vocal quality and resonance), before and after adenotonsillectomy.

METHODS

The study was approved by the Ethics Research Committee from Universidade Federal de São Paulo (Unifesp), under protocol number 1422/09. All people responsible for the participants signed the Free Informed Consent. Twenty-two children were included in the study, 17 males and 5 females, aged from 5 to 10 years (mean=7.01 years; SD=1.72), who underwent adenotonsillectomy and speech therapy evaluation before and after the surgical procedure.

Children with hypertrophy of palatine and adenoid tonsils and surgical indication of adenotonsillectomy, selected at Serviço de Otorrinolaringologia Pediátrica of Unifesp, without previous speech therapy and within the determined age range, were included in the investigation. Those diagnosed with craniofacial malformation and neurological syndromes or presenting difficulties in accomplishing the required tasks in the evaluation tests were not included.

The speech therapy evaluation was carried out by the same speech therapist, before and from 1 to 6 months after adenotonsillectomy surgery. An exam of the phonoarticulatory structures of the stomatognathic system — lips, tongue, and soft palate — and of the functions — respiration (respiratory mode), swallowing (liquid), speech, and phonation (vocal quality and resonance) were considered. These structures and functions were chosen because, according to literature review, they have more impact after adenotonsillectomy and because of the common occurrence of flaccidity and change of the habitual position of the orofacial structures due to their use[8,9].

Evaluation of the lips was done during rest by observing the profiles, which were classified into occluded, closed at rest position with no need of excessive muscular contraction; half-opened, separate and did not present contact between the upper and lower lips; and opened, lips were separate and the jaw was lowered[10] or need of muscular effort was seen for lip sealing, for tensioning the mentalis and lip or perioral musculatures.

Rest position of the tongue was evaluated during the speech assessment, and when the participant was silent, his/her lips were stood back by the evaluator. It was classified into normal, remaining inside the dental arches in the inspection, or changed, interposed between the lips in the direct and/or projected observation or between the upper and lower teeth in the inspection of the oral cavity posture.

In order to evaluate lip tonus, the realization of lip stretching and retraction movements was required, concomitantly to placement of opposed counter-resistance force, applied by the investigator with a spatula. Tonus was classified as normal, when it presented decreased or increased resistance by the evaluator's judgment, or changed, when it presented decreased or increased resistance. Upper and lower lips were evaluated following the same criteria. In order to assess the tongue tonus, children were requested to remain with their mouths opened and to project their tongues beyond their lips, without touching them or the teeth. At this time, the counter-resistance force was done using a spatula, which the investigator held on tightly[11]. Tongue tonus was considered normal, when it presented an appropriate resistance to the movement, or changed, when it presented a decreased or increased resistance. The soft palate was evaluated regarding mobility during emission of the vowels /a/ and /ã/, being divided into normal, when a wide mobility was seen, or changed, when a discrete movement was noticed.

As to functions, liquid swallowing was analyzed through the direct observation of the oral and face cavities, with the purpose of detecting the presence or not of compensatory movements at the act of swallowing. A 10 mL water glass was offered[12], and the children were oriented to put all the liquid in the oral cavity and to perform an ordinary swallowing. Visually, it was verified how the normal swallowing was done. It was classified as changed when there was at least one of the compensatory movements, named as tongue interposition between the arches, lip pressure, and lip interposition during the act of liquid swallowing. The swallowing was considered normal when there was not an excessive contraction of the perioral musculature, perfect lip sealing, tongue confinement inside the dental arches, and efficiency of liquid swallowing[13].

Respiratory mode was classified into nasal, when there was predominant use of nasal cavity and some sealing point of oral cavity; oronasal, when there was performance from both the nasal cavity and the oral one; and oral, predominant use of oral cavity, complemented by children's inability to maintain the water sip in the mouth for 3 minutes[13].

Speech evaluation was carried out by naming 86 pictures, which included all phonemes of the Brazilian-Portuguese language in its varied positions. At production, identification of the changes from the investigator's perceptive-auditory analysis and visual inspection of the tongue movement were done. Designations of pictures were phonetically transcribed for future analysis. For the present study, only the distortion process[14] was considered as speech alteration, because this is a phonetic deviation that may suffer more influence of the stomatognathic system. Thus, speech was classified into normal, when it was performed without any articulation disorder, or changed, when there was the production of /s/ and /z/ phonemes with tongue projection in the anterior or lateral regions of the dental arcade, associated or not with the tongue interposition of the phonemes /t/, /d/, /n/, and /l/.

In the vocal evaluation, the number of children involved was changed, because in this phase it was opted to assess only those that took the postoperative speech therapy evaluation between one to two incomplete months, in order to avoid that an extended period to perform postsurgical evaluation could compromise the result. Therefore, 15 children were included.

Children were oriented to pronounce the sustained vowel /a/ to assess the general grade of vocal quality deviation. Whenever needed, the evaluator would do a hand movement so that the child could keep the emission until ceasing the movement. For the resonance evaluation, they were oriented to say an automatic sequence — number counting (from 1 to 10). Whenever necessary, the investigator would say in low intensity the number that the child should pronounce.

Recordings were done in a silent room by a voice expert professional who used the ITAUTEC® N8310 computer for recording and storing vocal sample and a professional microphone with a condenser of SAMSON CSUS® brand, which was positioned between 5 and 8 cm from the child's mouth. All recordings were registered in the Sound Forge program.

Three voice speech therapists, with more than 3 years working in vocal clinic, participated as investigators, in an independent judgment through perceptive-auditory analysis. Thirty-three voices were analyzed. From these, 10% were randomly repeated for intra-evaluator reliability.

Vocal samples were randomly gathered. Each child assembled two recordings, before and after adenotonsillectomy, which were made of a sustained vowel /a/ for evaluating the general grade of change of vocal quality and automatic sequence for resonance assessment. The samples were edited and the beginning of the emission was forsaken due to the typical instability of the vocal attack. Finally, the material was recorded in a CD and delivered to each judge in charge of the perceptive-auditory analysis.

In vocal quality analysis, the investigators were recommended to analyze only the general grade if the voices had or did not have alterations, without the need of classifying them as to their type. To do this, they used the visual analogical scale (VAS)[15]; values from 0 to 35.5 mm represent normality; from 35.6 to 50.5 mm, a vocal deviation of mild grade; from 50.6 to 90.5 mm, a moderate grade deviation; and above 90.6 mm, an intense deviation. Values were correlated as follows: grade 1 corresponded to normal variability of the vocal quality (values up to 35.5 mm in the VAS); grade 2 represented a narrow region for mild deviations (35.6–50.5 mm); grade 3 corresponded to a wide range of moderate deviations (50.6–90.5 mm); and grade 4 represented a small range for intense deviations (above 90.6 mm).

With the purpose of analyzing resonance characteristics, the investigators were oriented to identify by the sound if there was any difference between the emissions presented. If one was identified, they were guided to describe the most relevant aspect(s) seen. Emissions were presented in pairs, that is, every child had the pre- and post-emission, which were edited and presented to judges randomly.

In order to make the analysis easier, the resonant characteristics were assessed regarding positive aspects—when the judges highlighted an improvement of resonance, classifying them as projected, balanced, or with reduction of hypo- and hypernasality—and negative aspects, when there was worsening of resonant impression, both due to reduction as to increase of nasality. Evaluators were able to hear the emission every time they wished to and, posteriorly, they marked in the 100-mm-line drawing the vocal change grade and in another sheet the resonant impression that the emission showed.

Results were tabulated and submitted to statistical analysis by data comparison before and after adenotonsillectomy. Wilcoxon's test was used for the analysis associated with structures and functions of the stomatognathic system. McNemar's test was used to analyze the respiratory mode. In the speech evaluation, descriptive statistics, mean, standard deviation, and frequency distribution were applied.

In the vocal evaluation, the statistic method used to measure the reliability grade between both variables was Cronbach's test, which evidenced statistically high values ($p<0.005$). This could infer that such data present internal consistence, that is, with a non-biased sample ($p<0.001$). A 5% significance level for the statistical analysis ($p<0.05$) was adopted.

RESULTS

Data were grouped in respiratory mode; evaluation of stomatognathic system structures; swallowing function; speech and voice evaluation.

In the respiratory mode analysis, there was a difference between both moments of evaluation ($p<0.001$), with the nasal respiratory mode after surgery being predominant (Table 1).

Table 1. Comparison of the respiratory mode before and after adenotonsillectomy

Respiratory	Oral		Nasal		Oronasal		p-value
mode	n	%	n	%	n	%	
Before	15	68	1	5	6	27	0.001*
After	2	9	15	68	5	23	

*Significant values ($p<0.05$ – McNemar's Test.

In the evaluation of structures and functions of the stomatognathic system, the comparison of lip posture pointed a difference (p<0.000) between the moments before and after adenotonsillectomy, with half-opened lip posture happening more before and occluded one after surgery (Table 2).

Table 2. Comparison of the lip posture at rest before and after adenotonsillectomy

Lip posture	Occluded		Half-opened		Opened		p-value
	n	%	n	%	n	%	
Before	2	9	14	64	6	27	<0.000*
After	14	64	3	18	5	22	

*Significant values (p<0.05) – Wilcoxon's test.

Speech therapy evaluation of resting tongue posture showed an improvement between moments before (predominance of changed posture) and after adenotonsillectomy (predominance of appropriate tongue posture) (Table 3). The difference found in tongue tonus analysis shows that reduced tonus prevailed in both moments (Table 3).

Upper lip tonus was changed in most cases assessed before undergoing adenotonsillectomy and normalized in 55% of the evaluated cases after surgery (p=0.637). The lower lip tonus was assessed as altered (reduced) in all children before adenotonsillectomy and normalized in most of them after the surgical procedure (p=0.479) (Table 3).

The soft palate mobility analysis presented a difference between the evaluation before and after adenotonsillectomy (p<0.000) (Table 3). In the swallowing evaluation before and after adenotonsillectomy, there was a difference in the following evaluated aspects: tongue posture and compensatory mechanism of lip interposition (Table 3).

Swallowing had an alteration in all the samples before surgical procedure and was kept changed in most of it after adenotonsillectomy (p=0.108). The compensatory mechanism of lip pressure seemed to be altered in some part of the sample in the evaluations before and after adenotonsillectomy (p=0.361) (Table 3).

In the speech evaluation analysis, reduction of the distortion process was seen in the postoperative evaluation (Table 4).

In the evaluation concerning the vocal quality alteration grade, a predominance of grade 1 both before and after adenotonsillectomy (p=0.48) was verified Grade 1 is within the normality variation (Table 5).

The resonance evaluation has showed a difference (p<0.001) between emissions before and after adenotonsillectomy. There was predominance of negative aspects before adenotonsillectomy and of negative ones after such process (Table 5).

DISCUSSION

The etiology of the upper airways is multi-factorial, and if its cause is organic, it is frequently related to the hypertrophy of tonsils[7]. In the presence of agents that difficult air passage through upper airways, it is common the mouth substitute respiration[2,7,16]. Phonoarticulatory structures of the stomatognathic system (lips, tongue, and soft palate) and some functions (respiration, swallowing, speech, and phonation) can be susceptible to changes in participants diagnosed with hypertrophy of palatine and adenoid tonsils.

In the respiratory mode evaluation before adenotonsillectomy, findings evidenced high occurrence of the oral respiratory mode, with improvement of the pattern at post-adenotonsillectomy, presenting a higher incidence in the nasal mode. Change of the respiratory mode can be understood as a possible consequence of hypertrophy of tonsils, with predominance of the oral respiration[4,7]. After surgical intervention, it is possible to observe changes in the previous adopted respiratory mode, becoming, in most cases, the nasal mode, which is physiologically expected[2,17].

Inappropriate respiratory pattern may provide several retinues of postural adjustments and alterations of functions from the stomatognathic system. Due to the reduction on the oropharyngeal space, the tongue adopts an anteriorized posture[4,16,18], as it was verified in this study before surgical intervention. Data regarding the post-adenotonsillectomy evaluation indicated appropriate tongue rest posture, that is, inside the oral cavity, in most of the sample. The new tongue positioning is a consequence of the respiratory mode adaptation from the larger oropharyngeal space due to tonsil exeresis[2,6,17].

Table 3. Comparison of the evaluation of structures from the stomatognathic system and swallowing function before and after adenotonsillectomy

Structures of the stomatognathic system and swallowing functions	Before				After				p-value
	Normal		Changed		Normal		Changed		
	n	%	n	%	n	%	n	%	
Tongue posture at rest	7	32	15	68	13	59	9	41	0.806
Tongue tonus	0	0	22	100	6	28	16	72	0.000*
Upper lip tonus	7	32	15	68	13	59	9	41	0.637
Lower lip tonus	0	0	22	100	20	91	2	9	0.479
Soft palate mobility	2	9	20	91	22	100	0	0	0.000*
Tongue posture at the act of swallowing	6	23	16	73	11	50	11	50	0.043*
Swallowing pattern	0	0	22	100	3	23	19	87	0.108
Lip interposition	5	23	17	77	12	55	10	45	0.038*
Lip pressure	2	10	20	91	4	18	18	82	0.361

*Significant values (p<0.05)—Wilcoxon's test.

Table 4. Comparison between before and after adenotonsillectomy regarding the occurrence of speech distortions

Speech	Distortion	
	Mean	SD
Before	1.9	2.02
After	1.31	1.64
p-value	0.10	

*Significant values (p≤0.05) – Wilcoxon's test
Legend: SD=standard deviation.

Table 5. Comparison between before and after adenotonsillectomy concerning the general grade of vocal quality change and the resonant impression evidenced at emission

VAS	Before		After		p-value
	n	%	n	%	
Grade					
1	11	65	12	71	0.48
2	3	17	2	12	
3	1	6	3	17	
4	2	12	0	0	
Resonance					
Positive aspects	6	35	11	65	<0.001*
Negative aspects	11	65	6	35	

*Significant values (p<0.05) – McNemar's test.
Legend: VAS=visual analogical scale.

Other morphological alterations that are commonly present in oral breathers are half-opened and opened lips and facial hypotonia, especially from the lips and tongue[2,6,7]. As a result from the posture evaluation of tongue at rest, a higher incidence of half-opened lips, followed by opened ones, was verified before adenotonsillectomy. After adenotonsillectomy, a postural change prevailing the position of occluded lips, was observed.

Maintenance of inappropriate posture of lips happens many times due to the obstruction of airways from the hypertrophy of tonsils[19,20]. Improvement of posture of lips arises upon the possibility of adopting a respiratory pattern that is physiologically more appropriate after exeresis of the tonsils, making the reorganization of some phonoarticulatory organs possible, mainly with regard to the posture of the articulators, provided that, because of nasal respiration, the lip sealing is possible[2,17].

Lip tonus evaluation evidenced a reduction of the upper and lower lips tonus before adenotonsillectomy, with the maintenance of reduced tonus in the lower lip and adjustment of the upper lip tonus after surgery. On the other hand, the tongue tonus was kept changed in most children before and after adenotonsillectomy. However, there was a discrete improvement after surgery.

In literature[17], a possible spontaneous myofunctional improvement was seen in the first months after adenotonsillectomy. It was hypothesized that a new oropharyngeal condition should enable a spontaneous improvement concerning posture, because the main maintenance factor of inappropriate pattern of tongue posture and respiration was eliminated.

The muscular physiology describes that several stimuli act on the skeletal muscle, promoting physiological and molecular alterations, which collaborate for modifying the muscle contractile activity from the reorganization of cellular events. These changes are directly involved in the mechanical function of the muscular fiber, converging for an improvement of contraction and for generating strength. Therefore, it is possible that the skeleton musculature fibers get adapted to the stimulus, which is a phenomenon called muscular plasticity[21]. This effect refers to the assumption that improvement found in the upper lip and tongue tonus may have happened due to muscular plasticity, because muscles are normally kept in a state of partial contraction and the action of an extensive external stimulus (herein the nasal respiration, the occluded lips, and the appropriate tongue posture) above the threshold results in a reaction of the muscle[22].

The soft palate mobility can be compromised, in other words, reduced due to the increase of mass in the oropharyngeal area. However, after performing adenotonsillectomy, it is expected that mobility be reestablished, evidencing improvement of speech and voice[3,4,16].

Normal swallowing is the absence of facial expression and tongue muscles in the oral cavity. Any change seen before or during swallowing indicates a change in such function. Compensatory mechanisms like lip pressure, mentalis action, and tongue interposition may be present in the swallowing classified as changed[8,9]. In an attempt to correct such alterations, compensatory mechanisms of lip interposition and pressure may be present, acting more actively in the search for lip sealing to appropriate respiration[7–9].

Literature[6,17] mentions a swallowing normalization from 1 to 6 months after surgical procedure and without speech therapy intervention. Nevertheless, our study showed that changed swallowing persisted in most parts of the sample.

Probable changes in the phonoarticulatory structures may compromise speech unintelligibility, concerning both articulation or voice, because the appropriate participation of mobile and fixed articulators of the stomatognathic system to perform the speech is not useful. Therefore, this study included speech research and some voice characteristics relevant to the approached theme (presence or absence of change in the vocal quality and resonance).

The presence of deviations in the articulation due to a changed form or function of stomatognathic structures constitutes a type of articulatory disorder[23]. The distortion in the production of phonemes /s/, /z/, /t/, /d/, /n/, and /l/ with tongue interposition[14] may be present in cases associated with oral respiration[4,7,24], change of articulators[24] mainly from the tongue, and alteration of swallowing[4,7].

It is found in literature a description of a variation regarding age range for the process of phonemic acquisition. For the present study, the age range included 3- to 5-years-old participants[25], because the recent process of literacy starts at kindergarten with 5-year-old participants. Therefore, both school and parents search for speech therapy support upon cases of articulatory imprecision. Thus, the present study was initiated in such age range and adopted 5 years as the limit for phonemic acquisition.

The oral respirator syndrome may also cause damage to the voice, especially regarding vocal quality and resonance, once the pharynx, tongue, palate, oral cavity, and nose act as resonance cavities and are, in some way, responsible for vocal quality[26]. The global analysis of vocal quality based on VAS showed that the voice from most children was classified as grade 1, within the normality pattern, both before and after adenotonsillectomy.

In order to check the impression that resonance may cause before and after adenotonsillectomy, those analyzed by the judges were named according to positive (clear and balanced emission) and negative (any event that could interfere in the projection of emission) aspects. The results of such analyses showed a higher incidence of negative aspects before undergoing adenotonsillectomy and higher occurrence of positive aspects after surgery. The negative aspect that was more stated by the judges was the presence of hyponasality, followed by hypernasality, in lower proportions. The positive aspect that was more mentioned by the judges was projected and balanced emission.

There are case reports that mention the presence of hypernasality after surgical intervention[2], which was not evidenced in this study. Improvement of resonant characteristics can be justified by an increase in energy amplitude due to reduction of surface area of the tissue and increase of nasal passage after surgery[27], decreasing the acoustic weakening[28], both associated with appropriate mobility of the palate[4,5,16].

The study on the aspects of speech therapy before and after adenotonsillectomy allows to infer that hypertrophy of palatine and adenoid tonsils causes changes in degrees and varied impacts, in the tonicity and posture of lips and tongue and in the soft palate mobility, interfering in the act of swallowing, speaking, and phonating.

When the causal factor of upper airways obstruction is suppressed, it is possible to observe, in some cases, a spontaneous improvement in some aspects. However, in this study, this improvement was not enough to appropriate the conditions of all involved aspects, being necessary to refer 19 of 22 children to speech therapy.

Furthermore, one should pay closer attention to the clinical evaluation of structures and functions of stomatognathic system, which is commonly done subjectively and may vary based on the investigator's clinical experience. The presence of a Control Group could be also important in reducing the subjectivity.

Therefore, it is necessary to perform a speech therapy evaluation after the surgical intervention, in order to reevaluate the structures and functions of the stomatognathic system. At postoperative period, in the event of maintenance of the changed aspects, a child must be referred to speech therapy to correct such inadequacies.

CONCLUSION

Based on our findings, it was concluded that after adenotonsillectomy, some structures and functions can be readjusted or can present a spontaneous improvement. However, many children need to be referred to speech therapy to readjust the stomatognathic structures and assessed functions. Thus, it is necessary to consider speech therapy evaluation after adenotonsillectomy for analyzing the condition of structures and functions of the stomatognathic system.

**FBAB was in charge of data collection, tabulation, and analysis; scientific review and manuscript writing; RA was responsible for data analysis, method and statistic verification, and scientific and final reviews; BMC was in charge of the scientific review, method verification, final review, and proofreading.*

REFERENCES

1. Carvalhal ML, Castagno LA. Hipertrofia da amígdala faríngea: clínica e cirúrgica. Rev Bras Otorrinolaringol. 1986;52(2):16-9.
2. Junqueira P, Vaz ACN, López CP, Pignatari SN, Weckx LLM. Técnica de correção de hipernasalidade causada por adenoidectomia. Ver Bras Otorrinolaringol. 2002;68(4):593-6.
3. Salami A, Jankowska B, Dellepiane M, Crippa B, Mora R. The impact of tonsillectomy with or without adenoidectomy on speech and voice. Int J Pediatr Otorhinolaryngol. 2008;72(9):1377-84.
4. Mora R, Jankowaska B, Mora F, Crippa B, Dellepine M, Salami A. Effects of tonsillectomy on speech and voice. J Voice. 2009Sep;23(5):614-8.
5. Bertino G, Matti E, Migliazzi S, Pagella F, Tinelli C, Benazzo M. Acoustic changes in voice after surgery for snoring: preliminary results. Acta Otorhinolaryngol Ital. 2006;26(2):110-4.
6. Lundeborg I, McAllister A, Graf J, Ericsson E, Hultcrantz E. Oral motor dysfunction in children with adenotonsillar hypertrophy-effects of surgery. Logoped Phoniatr Vocol. 2009;34(3):111-6.
7. Valera FC, Travitzki LV, Mattar SE, Matsumoto MA, Elias AM, Anselmo-lima WT. Muscular, functional and orthodontic changes in pre school children with enlarged adenoids and tonsils. Int J Pediatr Otorhinolaryngol. 2003;67(7):761-70.
8. Bianchini AP, Guedes ZCF, Vieira MM. Estudo da relação entre a respiração oral e o tipo facial. Rev Bras Otorrinolaringol. 2007; 73(4):500-5.
9. Lemos CM, Wilhelmsen NSW, Mion OG, Mello Júnior JF. Alterações funcionais do sistema estomatognático em pacientes com rinite alérgica. Rev Bras Otorrinolaringol. 2009;75(2):268-74.
10. Cattoni DM, Fernandes FDM, Di Francesco RC, Latorre MRDO. Características do sistema estomatognático de crianças respiradoras orais: enfoque antroposcópico. Pro Fono. 2007;19(4):347-51.
11. Daniels L, Worthigham C. Provas de função muscular: técnicas de exame manual. 6a ed. Rio de Janeiro: Guanabara Koogan; 1996.
12. Falda V, Guimarães A, Bérzin F. Eletromiografia dos músculos masseteres e temporais durante deglutição e mastigação. Rev Assoc Paul Cir Dent. 1998;52(2):151-7.
13. Junqueira P. Avaliação miofuncional. In: Marchesan IQ. Fundamentos em fonoaudiologia: aspectos clínicos da motricidade oral. Rio de Janeiro: Guanabara- Koogan; 1998. p. 13-21.
14. Yavas MS, Hernandorena CLM, Lamprecht RR. Avaliação fonológica da criança: reeducação e terapia. Porto Alegre: Artes Médicas; 1992.
15. Yamasaki R, Leão S, Madazio G, Padovani M, Azevedo R, Behlau M. Correspondência entre escala analógico-visual e a escala numérica na avaliação perceptivo-auditiva de vozes. In: 16º Congresso Brasileiro de Fonoaudiologia; 2008. Set 24-27. Campos do Jordão. Anais Sociedade Brasileira de Fonoaudiologia; Campos do Jordão, São Paulo; 2008. p. 1080
16. Mora R, Jankowaska B, Mora F, Crippa B, Dellepine M, Salami A. Effects of adenotonsillectomy on speech spectrum in children. Int J Pediatric Otorhinolaryngol. 2007;71(8):1299-304.
17. Valera FC, Travitzki LV, Anselmo-lima WT. Myofunctional evaluation after surgery for tonsils hypertrophy and its correlation to breathing

pattern: a 2-year-follow up. Int J Pediatric Otorhinolaryngol. 2006;70(2):221-5.
18. Kawashima S, Peltomaki T, Sakata H, Mori K, Happonen RP, Ronning O. Craniofacial morphology in preschool children with sleep-related breathing disorder and hypertrophy of tonsils. Acta Paediatr. 2002;91(1):71-7.
19. Menezes VA, Leal RB, Pessoa RS, Pontes RMES. Prevalência e fatores associados à respiração oral em escolares participantes do projeto Santo Amaro - Recife, 2005. Rev Bras Otorrinolaringol. 2006;72(3):394-9.
20. Schimit R. Caracterização da postura, tônus e mobilidade de lábios e língua em crianças respiradoras orais. [Dissertação] São Paulo: Universidade Católica de São Paulo - PUC/SP;2010: 59p.
21. Boff SR. A fibra muscular e fatores que interferem no seu fenótipo. Acta Fisiátrica. 2008;15(2):111-6.
22. Lopes CL. Qualidade Vocal Consultoria: tipos de ação muscular (cap. III) Paraná; 2008. [Internet]. [atualizado 2008 Abr 18]. Disponível em: http://qualidadevocal-fonoaudiologo.blogspot.com.br/2008/04/tipos-de-ao-muscular-cap-iii.html
23. Tomé MC, Farias SR, Araújo SM, Schimit BE. Ceceio interdental e alterações oclusais em crianças de 03 a 06 anos. Pro Fono. 2004;16(1):19-30.
24. Farias SR, Ávila CRB, Vieira MM. Relação entre fala, tônus e praxia não verbal do sistema estomatognático em pré-escolares. Pro Fono. 2006;18(3):267-76.
25. Andrade CRF. Prevalência das desordens idiopáticas da fala e da linguagem em crianças de um a onze anos de idade. Rev Saúde Pública. 1997;31(5):495-501.
26. Sataloff TS. Anatomia funcional e fisiologia da voz. In: Sataloff TS, Gould WJ, Spiegel JR. Manual prático de oncocirurgia. Rio de Janeiro: Revinter; 2002. p. 63-176.
27. Chuma AV, Cacae AT, Rosen R, Feustel P, Koltaii PJ. Effects of tonsillectomy and/ or adenoidectomy on vocal function: laryngeal, supralaryngeal and perceptual characteristics. Int J Pediatr Otorhinolaryngol. 1999;(47):1-9.
28. Behrman A, Shikowitz MJ, Dailey S. The effect of upper airway surgery on voice. Otolaryngol Head Neck Surg. 2002;127(1):36-42.