Clinical parameters of speech therapy respiratory function from the use of inspiratory encourager

Parâmetros clínicos Fonoaudiólogicos da função respiratória a partir do uso de incentivador inspiratório

Los parámetros clínicos fonoaudiológicos de la función respiratoria a partir del uso de incentivador inspiratorio

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Abstract

Account of the effects of training with inspiratory incentive in healthy adults. **Method:** longitudinal observational Coorte study, with healthy adult volunteers in order to verify the quality and capacity of the respiratory dynamics and laryngeal efficiency from the use of inspiratory incentive airflow was conducted screening by questionnaire with open and closed questions, breath evaluation of the then (type, method and frequency / min.), maximum phonation time (MPT), spirometry and training inspiratory supporter of Respiron® make, model Classic Middle Level - NCS through 30 inspirations (three sets of 10 repetitions) twice a day. **Results:** Selected five volunteers with a mean age of 51.4 years, initially with average respiratory tract, nasal way, respiratory average frequency of 15.20 cycles / min; MPT of vowels in 17,10s of fricatives in 13,42s; average spirometry peak expiratory flow - PEF 282.13 l / min and volume expiratory flow - VEF 2:41 l. Post-training remained the type, manner and respiratory rate; there was an increase of the average members of TMF to 18,48s and fricatives to 16,65s ; PFE increased to 413.4 l / min or 24.8 l / s with significant trend ($p < 0.10$) and VEF to 2.89 l no statistical difference. **Conclusion:** The use of incentive provided an increase in capacity, improved quality and laryngeal efficiency.

Keywords: Respiratory Rate; Respiratory Mechanics; Spirometry; Respiration; Larynx;

Resumo

Relato dos efeitos do treino com incentivador inspiratório em adultos saudáveis. Método: Estudo observacional, de Coorte e longitudinal de voluntários adultos saudáveis, com o objetivo de verificar a qualidade e a capacidade da dinâmica respiratória e eficiência laríngea a partir do uso do incentivador inspiratório de fluxo de ar; foi realizada uma triagem através de questionário com perguntas abertas e fechadas, seguida da avaliação da respiração (tipo, modo e frequência/min.), tempos máximos de fonação (TMF), espirometria e treinamento com incentivador inspiratório da marca Respiron®, modelo

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Classic Nível Médio – NCS, através de 30 inspirações (três séries de 10 repetições), duas vezes ao dia. Resultados: Selecionados 5 voluntários com idade média de 51,4 anos, apresentando inicialmente tipo respiratório médio, modo nasal, frequência respiratória média de 15,20 ciclos/min; TMF de vogais em 17,10s, de fricativas em 13,42s; espirometria média de pico de fluxo expiratório - PFE 282,13 l/min e volume de fluxo expiratório - VEF 2.41 l. Pós-treinamento mantiveram-se o tipo, modo e frequência respiratória; houve aumento das médias dos TMF de vogais para 18,48s e fricativas para 16,65s; aumento dos PFE para 413,4 l/min ou 24,8 l/s com tendência significativa (p<0.10) e VEF para 2.89 l sem diferença estatística. Conclusão: O uso do incentivador proporcionou aumento na capacidade, melhora na qualidade e eficiência laríngea.

Palavras-chave: Taxa Respiratória; Mecânica Respiratória; Espirometria; Respiração; Laringe.

Resumen

Relato de los efectos de lo entrenamiento con incentivador inspiratorio en adultos sanos. Método: Estudo observacional longitudinal y Coorte, de voluntarios adultos sanos con el objetivo de verificar la calidad y la capacidad de la dinámica respiratoria y eficiencia laringea con el uso de un incentivador inspiratorio de flujo de aire, se llevó a cabo el cribado mediante un cuestionario con preguntas abiertas y cerradas, evaluación de la respiración (tipo, método y frecuencia / min.), El tiempo máximo de fonación (TMF), espirometría y el entrenamiento inspiratorio con el uso del Respiron®, modelo Classic Nivel Medio - NCS, a través de 30 inspiraciones (tres series de 10 repeticiones) dos veces al día. Resultados: Seleccionados cinco voluntarios con una edad media de 51,4 años, inicialmente con tipo respiratorio promedio, modo nasal, frecuencia media respiratoria de 15,20 ciclos / min; TMF de las vocales en 17,10s de fricativas en 13,42s; pico promedio espirometría flujo espiratorio - PEF 282,13 l / min y el flujo espiratorio volumen - VEF 2:41 l. Post-entrenamiento se mantuvo el tipo, modo y la frecuencia respiratoria; hubo un aumento de los promedio de TMF a 18,48s de las vocales y fricativas a 16,65s; PFE aumentó a 413,4 l / min con tendencia significativa (p < 0.10) y VEF a 2,89 l sin diferencia estadística. Conclusión: El uso del incentivador logro un aumento de la capacidad, la mejora de la calidad y eficiencia de la laringe.

Palabras clave: Frecuencia Respiratoria; Mecánica Respiratoria; Espirometría; Respiración; Laringe.

Introdução

Breathing consists of one of the main vital functions in human beings by promoting gas exchange (pulmonary hematosis) and providing the necessary oxygen to the cells of the organism. To achieve this goal, the respiratory muscles and the rib cage produces a mechanical ventilating the lungs work, and thus, renewing the alveolar air.[1,2,3]

Morph-functional point of view, breathing occurs appropriately, when it is exclusively nasally, because there is airway protection by filtering, heating and humidification of air .[4]

As for the respiratory mode it is found three classifications, nasal when there is predominant use of the nasal cavity and some point of sealing of the oral cavity; oro-nasal when is held now by the nasal cavity and then by the mouth; and oral when there are predominantly use of oral cavity.[5,4]

The ideal breathing pattern can be replaced by a substitute oral breathing. This functional adaptation occurs due to organic or non-organic cause, leading to oro-nasal or oral respiratory mode. [4]

It is known that there are variations in respiratory types. These variations are described in the literature as diaphragmatic breathing (abdominal or lower) when there is a greater protrusion of the abdominal wall, chest or average with striking chest expansion and clavicular or upper with higher elevation of shoulders and cervical tension. There are also mixed when there is the use of two respiratory types interspersed; diaphragmatic-abdominal or costodiaphagmatic-abdominal, when, in addition to the protrusion of the abdominal wall, a striking lateral expansion of the chest. This last being the recommended for obtaining a better respiratory capacity.[5,6]

Vital capacity (VC) is the amount of air you can exhale the lungs followed by a maximal voluntary inspiration. It is evaluated through the record of the amount of pulmonary ventilation in maximum expiration by spirometry, performed from the

request to the subject that expires all the air in the appliance, with a maximum expiration.[3,7]

Forced expiratory volume is the measure of lung function, regarded as the most useful clinically and is the volume of air that can be exhaled, during the first second; in maneuver forced expiration from a maximum inspiration.[8] Expiratory flow peak (EFP) presents the maximum air flow during the maneuver forced vital capacity. [9]

The incentive spirometry can be used to promote deep breaths and provide greater respiratory capacity by improving oxygenation. In healthy adults, the incentive spirometry generates an increase in the volume of the chest wall, with a larger contribution, and lower abdominal muscle activity respiratory.[10] The respiratory capacity may influence on the results of clinical parameters that make up other systems of human organism.

The voice is with the production of sounds by the larynx (phonation) and air resonance in various spaces located between the glottis and the lips, associated with other functions, such as articulation.[11] On phonation aerodynamic, forces must be balanced with the mioelastics forces of the larynx. [7]

The phonatory control and expiratory phonation are provided by the characteristics of individual phonation dynamics, estimated by maximum phonation time (MPT) of vowels and the relationship between the emission of the fricatives /s/ and /z/, which has the purpose to evaluate the efficiency of the glottis.[12,13,14]

The normal MPT values expected for adult men are between 20 seconds to 35s, and for women, between 15s and 25s. The vowels /a/, /i/ and /u/ are commonly used, and the consonants /s/ and /z/.[13-16]

The relationship between the productions of consonants s/z allows you to check the efficiency of the glottis which can be classified as normal, with the occurrence of hypercontraction muscle or lack of cooptation of the vocal folds. The expected values for adults without complaints from vocal changes are of 0, 8 and 1,2s. Low values are indicative of hyperaduction of the vocal folds that need greater muscle activity (hypercontraction) to the phonation; values above 1,2s indicate lack of glottal contact; once /s/ evaluates the respiratory control, the /z/ adds the phonatory component in the issuance. [15,16]

The incentive spirometer air flow consists of an instrument used for inspiratory muscle training that aims at obtaining deep inspirations and supported with visual feedback, which enables inflation of the lungs, restoring the pulmonary volumes and capacities.[17,18] Its use for training helps to increase the strength of this musculature, the fatigue resistance, reduced dyspnea during daily activities and exercise. In addition, its use is of low economic cost. [19]

For the purpose of providing sustained maximum inspirations, prevent and treat pulmonary complications such as atelectasis and pneumonia stemming from depression of normal breathing pattern, caused by the reduction or absence of sighs in the postoperative period of upper abdominal and thoracic surgeries and, for the disorders and respiratory diseases, whose pattern is usually changed, using the incentive apparatus of breath helps in the treatment and has been an alternative for maintenance and prevention of alveolar collapse. [20,21]

Therefore, this study is to verify the quality, the capacity of respiratory dynamics and laryngeal efficiency from the use of the incentive spirometry.

Methods

Observational study, Cohort, longitudinal, of type case report, which was attended by different researchers in different stages of the research. This was approved by the EC of the University under the number 503.290.

Participated in this study five individuals, adults, healthy, volunteers who agreed to participate in the study by signing the informed consent – IC. The criteria for inclusion in the study were: being an adult and not having complaints of respiratory problems and be part of the University community. The exclusion criteria were: be smokers; submit sequels or chronic respiratory diseases, neurological disorders, orthopedic, heart and/or adenotonsillar surgery.

The researcher 1 – R1 has hosted the volunteers, reported on the research goals and requested the signing of IC and performed the screening and assessment. The screening process of the participants consisted of identifying information, socio-demographic and questions regarding breathing (opened and closed). Initially, participants were evaluated on the type, mode and respiratory rate; MPT; spirometry assessment, through the Microlife brand ® pickflow PF100 model in a sitting position, with nasal occlusion and result set through the average of three measurements.

The researcher 2 – R2 instructed about the Respiron ® appliance, as for the positioning and

use, i.e., in a sitting position with both feet on the ground and with the spine aligned; and to perform the inspiration deeply through the nipple of the equipment.

For four weeks, the participants held the respiratory training with the Respiron®, Classic model medium average level-NCS. This unit is constructed in high strength plastic and consists of three balls of different colors, to measure the inspiratory capacity. It can be used for obtaining deep inspirations and sustained, inflation of the lungs, reestablishing the lung volumes and its capacities and thereby strengthening the respiratory muscles. It uses the visible effect of the elevation of balls contained in the appliance, with levels of difficulty and maintaining these height briefly (Figure 1).

Figure 1. Respiron®
NCS Indústria e Comércio Ltda. In: http://www.ncsdobrasil.com/respiron-classic.html .

The participants held the respiratory training with the Respiron ®, through 30 inspirations (three sets of 10 repetitions), twice a day. Each week, they were monitored as to their performance by R2 and, if they had reached the goal, i.e. "lift" the three spheres of the appliance during the 30 inspirations, passed to the second and third level of the resistance unit, consecutively.

The R2 explained how to realize the inspirations in the appliance, the amount of repetitions, the pause time between each series and how it should be performed at home. Each volunteer was instructed to stipulate a fixed schedule, according to his activities, for with a routine during the week there would be no failures in the conduct of the exercises. The volunteer was asked to go back to the lab every week to perform the monitoring to verify how he was after the week of training and analyze whether it was possible to increase the level of difficulty.

In each session, the R2 used the timer of the brand Syncbrotimer ® X-3000 to check in seconds the expiratory time of each participant, whereas it was satisfactory when the voluntary inspiration lifted the three spheres of the appliance.

At the end of 4 weeks of training was carried out a reassessment of the parameters collected initially at R1, whose data have been computed in the worksheet Excel ®. Up to 5 weeks, according to the availability of the participant, after this re-evaluation, a new collection was carried out in order to verify the maintenance or not of clinical parameters.

To describe the profile of the sample according to the variables under study were made frequency tables with absolute frequency values (n) and relative (%) of categorical variables (sex, marital status, current job, profession, respiratory complaint type and respiratory mode), and descriptive statistics of numeric variables (age, education, MPT, respiratory frequency/min and spirometry), with average values, standard deviation, minimum and maximum values, median and quartiles.

For comparison of categorical variables between the 2 reviews (pre and post training with research unit) was used the McNemar test for related samples (for 2 categories) and the test of symmetry of Bowker for related samples (for 3 categories). To compare the numeric values between the 2 reviews (pre and post training with research unit) was used Wilcoxon test for related samples, due to the small size of the sample. The significance level adopted for statistical tests was 5% ($P < 0.05$).

Results

This study included the participation of 5 adults, 60% being male and 40% female. The average age was 51.4 years, the minimum age being 41 years and maximum of 60 years, all professionally active until the time of the end of the study.

Initially the participants presented respiratory type medium, nasal mode (100%), respiratory frequency average of 15.20 cycles/min; MPT of vowels in 17.10s, of fricatives in 13.42s; Spirometry, expiratory flow peak average – EFP 282.13 l/min or 16.93 l/s and expiratory flow volume – EFV1 2.41 l.

The averages for the male participants for EFP were 333.10 l/min or 19.98 l/s and EFV1 were 2.81l, for the female participants the average of PEF was 205.66 l/min or 12.34 l/s and FEV1 of 1 1.79 l.

Post-training remained the type, mode and respiratory rate; There was an increase of the averages of the MPT of vowels to 18.48s and fricatives for 16.65s; increase of the EFP to 413.4 l/min or 24.80 l/s, with significant trend ($p < 0.10$) and EFV1 for 2.89 l without statistical difference. This data is exposed in Figure 2 and 3.

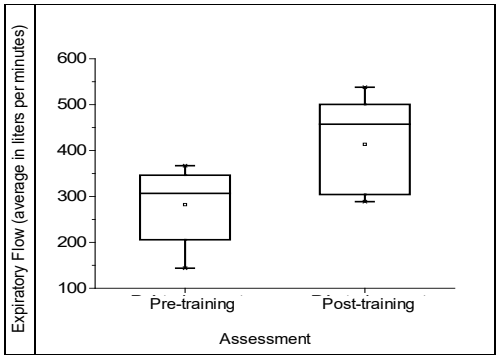

Figure 2. Expiratory flow

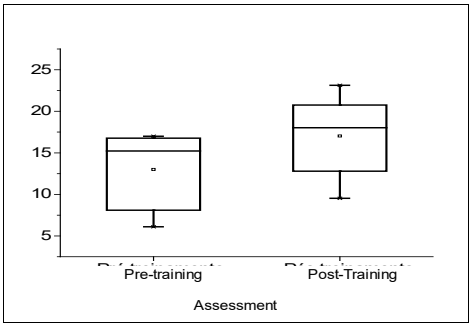

Figure 3. Maximum time of phonation the fricative/s/

The male participants presented values of EFP larger than female participants, the average values were EFP 486.11 l/min or 29.16 l/s and EFV1 of 3.27 l for male volunteers and 304.33 l/min or 18.26 l/s and EFV1 of 2.30 l for female volunteers. The initial average performances of each participant are set out in table 1.

Table 1. Individual Medium Initial Clinical Parameters of Participants

Volunteers	Average MPT*					Espirometria	
	/a/	/e/	/u/	/s/	/z/	EVF1**	EFP***
V1	22,15	22,59	22,52	17	22,38	1,81	19,54
V2	18,31	18,51	20,16	16,54	16,16	1,82	8,62
V3	11,52	17,26	15,25	10,10	7,04	2,92	18,40
V4	13,08	12,10	14,35	15,23	17,59	3,71	22,02
V5	17,02	16,37	9,34	6,10	6,09	1,77	16,05

MPT* maximum phonation time in seconds, ** in liters, ***in liters per second

The categorical variables and numeric comparisons between pre and post-training assessments with the incentive respiratory unit are in table 2.

Table 2. Comparative Analysis between Pre and Post-Training Evaluations of Participants

Variable	Average /SD	*P*-value*
Frequency Cycles1	15.20 /±3	*P*=1.000
Frequency Cycles2	15.20 /±4.71	
DIF. Frequency Cycles	0.00 /±2.55	
VocalA1	16.42/±4.24	*P*=0.813
VocalA2	15.94/±3.34	
DIF. Vocal A	-0.48/±2.41	
Vocal E1	17.37/±3.79	*P*=0.625
Vocal E2	18.21/±2.67	
DIF. Vocal E	0.84/±3.92	
VocalU1	16.32/±5.17	*P*=0.188
VocalU2	21.30/±5.14	
DIF. Vocal U	4.98/±5.40	
Fricative S1	12.99/±4.73	*P*=0.125
Fricative S2	17.03/±4.93	
DIF. Fricative S	4.03/±3.20	
Fricative Z1	13.85/±7.05	*P*=0.313
Fricative Z2	16.27/±3.06	
DIF. Fricative Z	2.42/±4.11	
Ratio S/Z1	1.02/±0.26	*P*=1.000
Ratio S/Z2	1.04/±0.24	
DIF. Ratio S/Z	0.02/±0.26	

* P-value for the Wilcoxon test

The results after 5 weeks training period were maintenance of inspiratory and respiratory mode type, with respiratory cycles on average of 15.60 cycles/min. Data show significant change compared to initial values. It was found that the MPT were 19.26s for vowels and 17.20s for fricatives. The values of the ratio s/z found the standard of normality described between 0.8 and 1.2s; Spirometry average were EFP of 410.66 l/min or 24.64 l/s and EFV1 of 2.8 l. The average found in the EFP for male participants was 486.22 l/min or 29.17 l/s and EFV1 of 3.24 l and for females was EFP of 297.33 l/min or 17.84 l/s and EFV1 of 2.14 l. Maintenance results values are given in table 3.

Table 3. Average of the Values Found in the Maintenance

Medium	Reassessment	Maintenance
Vocals* (/a/, /e/ e /u/)	18,48	19,26
Fricatives* (/s/ e /z/)	16,65	17,20
EFP**	24,8	24,61
EFV***	2,89	2,8

MPT* maximum phonation time in seconds, ** in liters/second *** in liters

Discussion

The use of incentive respiratory appliance is common in physical therapy clinical practice in aid of cardiothoracic and abdomen post-surgery patient's recovery.[20] Studies show the usage in clinical research related to diseases and respiratory disorders, as in chronic obstructive pulmonary disease (COPD), asthma and sleep apnea. [22,23]

Study associating the use of incentive respiratory units to swallowing disorders is found in the literature and front of these disorders the use of the appliance aims to increase the total lung capacity, in order to maintain the subglottic pressure in their maximum values. The pressure is one of the defense mechanisms of the larynx, and the use of incentive respiratory appliances help to increase respiratory capacity of air storage, once that generates greater activation of the diaphragm with the practice of exercises. [24]

However, there are reports of the use of the incentive respiratory appliance, in research, whereas the clinical parameters in healthy individuals, it was formalized the hypothesis that the better the inspiratory expansion, the best results in quality and respiratory capacity, as well as laryngeal efficiency.

With laryngeal efficiency, the laryngeal function triggered by the pressure of air from the lungs converts the aerodynamics in acoustic energy and reflects on the whole health.

The respiratory capacity is an important predictor for the production and vocal health, because the aerodynamic data can be used in the aid of differential diagnosis, in speech therapy practice, between laryngeal changes, breathing control and/or lung conditions. [17]

A healthy adult inspires, on average, between 12 to 18 cycles/min at rest, and usually the movements of inspiration and expiration occur with the same amplitude, interspersed by slight pauses. When there is a change in any of these characteristics or respiratory frequency cycles, abnormal rhythms appear.[1,16,17] The media of respiratory rate found among the participants of this study are in the media expected for adult individuals. The results show that the media remained with a small change without significant differences.

It was found on literature[25] normal values for healthy adults of EVF1 at 3.77 l (SD ± 0.67) for men and 2.56 l (SD ± 0.57) for women; the EFP in 11.1 l/s (SD ± 1.75) for men and 7.14 l/s (SD ± 1.28) for females.[25] The values found in the present study show an increase of the values of EFP for all participants, of both sexes, with values set as normal for healthy adults. However, for the EVF1 it was observed larger values in pre and post-training and without reaching the values stipulated as "normal" for healthy adults.

According to the literature the EVF[1] evaluates basically obstructive airway disorders, as occurs in diseases such as COPD, which will interfere directly in the air stream and air storage capacity .[1,25-27]

It turns out that the city of Porto Alegre in the South of the country is bordered by a lake and features high air humidity and a considerable temperature range in different seasons of the year. With this climate, characteristic of this town, residents end up getting obstructive disorders varied during the year, being respiratory diseases the most frequent in hospitalization in South Brasil[28], which is believed to be the justification for the normality of EVF[1] having not been achieved. At the same time, there was no verbalization of the participants regarding the improvement in fatigue resistance during everyday activities.

When compliance with the aerodynamic flow changes and, consequently, laryngeal efficiency has been as necessary an aerodynamic forces control respiration, phonation and contraction of muscles of the larynx that relate to their mioelastics forces. [1,25,26,27]

The VC is indirectly related to the vocal production when it comes to sustain production [17, 26,] i.e. the MPT of the vowels. Studies suggest proportionality between the VC and the MPT. [26] Individually, this study found that the same proportionality, since the volunteers showed increased VC (EFP) and MPT. Considering the media of MPT, the vowel /a/ was the only one who had their times diminished. The vowel /a/ is classified as oral, open and central, which introduces minimal changes in the mioelastics balance of the larynx.[26]

Verification of the MPT of fricatives, whose assumption is in speech dynamics using efficiently pulmonary substitution, by producing the fricative voiceless (/s/), to evaluate the air support and the ability to control, and the sound production (/z/), resulting from the vocal behavior, with the establishment of the relationship between s/z to evaluate speech dynamics and the competence of the glottis. [15,16,29] The values found pre-training indicate that the volunteer 1 (V1) presented values below 0.8, indicative of laryngeal hyper constriction; the

volunteer 3 (V3) values above 1.2, indicative of lack of glottal contact; and the others were within the normal expected standards, according to the literature. [13-17, 27]

Respiratory physiology is vocal physiology--related, associated to airflow by pneumophonic measures, i.e., from the aerodynamic forces control of respiration and phonation and mioelastics forces related to laryngeal contraction.[17,26,27] This can be evidenced in the maintenance of aerodynamic control, keeping the MPT expanded and mioelastics forces of the larynx by average values obtained at the fricatives after 3 to 5 weeks without exercise with the appliance.

The values obtained in the spirometry also remained, even after the end of the training, showing an increase in respiratory capacity of volunteers which indicates the benefits of using supporter, in the clinical practice of respiratory in speech-language therapy; this can be a resource for the treatment and improvement of patients' quality of life.

It was noted that after training with the Respiron ® appliance there was an improvement in MPT in the final production averages of vowels and fricatives, which suggests that the use of breath enhancers can provide an increase in storage capacity, since this appliance provides an increased activity of the diaphragm muscle, in which a greater aerodynamic flow provides bigger vocal control and ability to production.

Conclusion

The reduced sample did not allow a relevant value of statistical significance. It is suggested, therefore, to carry out further research to expand the scientific evidence obtained from a larger sample.

Training with the incentive inspiratory appliance increase the capacity of storage of air, and this interferes in quality and respiratory dynamics positively and in the balance of the laryngeal efficiency. The use of the appliance kept the new parameters achieved after 5 weeks of training.

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