http://dx.doi.org/10.23925/2176-2724.2019v31i2p328-338

Oropharyngeal exercises morphophisiology: an integrative review

Morfofisiologia dos exercícios orofaríngeos: revisão integrativa

Morfofisiología de los ejercicios orofaríngeos: revisión integrativa

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Abstract

Introduction: Among the possible speech-language therapy approaches for the orofacial and oropharyngeal regions, the use of exercises constitutes a frequent proposal to bring about changes in the musculature involved and the functionality of these regions. However, little is sought in relation to the understanding of how the exercises work for this musculature and especially what the possible changes that can be observed from the exercise training program. **Objective:** To carry out an integrative review of the scientific literature referring to the morphophysiology of the exercises oropharyngeal used speech therapy. **Method:** the bibliographic survey was carried out in the electronic databases: Pubmed, MEDLINE and Scielo, using the Descriptors in Health Sciences (DeCs): "exercise"; "physiology"; "myofunctional therapy"; "dysphagia" and "Speech, Language and Hearing Sciences" in Portuguese and English. Inclusion and exclusion criteria were applied based on the title and the abstracts. **Results:** In total, 890 studies were found in the databases. Based on the inclusion and exclusion criteria, 12 articles were analyzed carefully. The selected articles presented which muscles are activated during exercise, which individual effectiveness of the proposed exercise and the cases in which these therapies are indicated. Although these studies have contributed to the current knowledge base, they have different methodological designs. **Conclusion:** There seems to be a small number of studies addressing the effects promoted by orofacial myofunctional therapy in muscles and oropharyngeal functions. Most of them are related to the studies of oropharyngeal dysphagia.

Keywords: Physiology; Exercise; Oropharynx; Myofunctional Therapy; Speech therapy.

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Authors' contributions: ASS: study design, data collection, article writing; RRRP: review of the manuscript and orientation of the research development; EMGB: method, critical review and orientation of research development.

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Received: 19/12/2018
Accepted: 20/05/2019

Resumo

Introdução: Dentre as possíveis abordagens terapêuticas fonoaudiológicas para as regiões orofacial e orofaríngea, a utilização de exercícios constitui-se em proposta frequente para trazer mudanças na musculatura envolvida e na funcionalidade dessas regiões. Entretanto, pouco se busca em relação à compreensão de como os exercícios funcionam para essa musculatura e principalmente quais as possíveis mudanças que podem ser observadas a partir de um programa de treinamento com exercícios. **Objetivo:** Realizar revisão integrativa da literatura científica referente à morfofisiologia dos exercícios orofaríngeos empregados na terapêutica fonoaudiológica. **Método:** Realizada busca nas bases de dados eletrônicas: Pubmed, Medline e Scielo, pela combinação dos seguintes Descritores em Ciências da Saúde (DeCs): "fisiologia", "exercício"; "terapia miofuncional"; "disfagia" e "Fonoaudiologia" nas línguas portuguesa e inglesa, por descritores associados (e/and). A seleção dos estudos foi realizada por meio da leitura do título, resumo, para aplicação dos critérios de inclusão e exclusão. **Resultados:** No total, foram encontrados 890 estudos nas bases de dados. A partir dos critérios de inclusão e exclusão foram selecionados 12 artigos, os quais foram analisados criteriosamente. Os artigos selecionados apresentaram quais músculos são ativados durante a prática dos exercícios, qual efetividade individual do exercício proposto e os casos em que essas terapêuticas são indicadas. Embora esses estudos tenham contribuído para a base de conhecimento atual, os mesmos possuem diferentes desenhos metodológicos. **Conclusão:** Parece existir reduzido número de estudos que abordem os efeitos promovidos pela terapia miofuncional orofacial nos músculos e funções orofaríngeas, sendo a maioria deles relacionados aos estudos da disfagia orofaríngea.

Palavras-chave: Fisiologia; Exercício; Orofaringe; Terapia Miofuncional; Fonoaudiologia.

Resumen

Introducción: Entre los posibles abordajes terapéuticos fonoaudiológicos para regiones orofacial y orofaríngea, la utilización de ejercicios se constituye en propuesta frecuente para traer cambios en la musculatura involucrada y en la funcionalidad de esas regiones. Poco se busca en relación con la comprensión de cómo los ejercicios funcionan para esa musculatura y principalmente cuáles son los posibles cambios que pueden ser observados a partir de un programa de entrenamiento con ejercicios. **Objetivo:** Realizar revisión integrativa de la literatura científica referente a la morfofisiología de los ejercicios orofaríngeos empleados en la terapia del habla. **Método:** el levantamiento bibliográfico fue realizado en las bases de datos electrónicos: Pubmed, MEDLINE y Scielo, mediante la combinación de los siguientes Descriptores en Ciencias de la Salud (DeCs): "fisiología", "ejercicio"; "terapia miofuncional"; "disfagia" y "fonoaudiología", en los idiomas portugués y inglés. **Resultados:** En total, se encontraron 890 estudios en las bases de datos. Criterios de inclusión y exclusión se aplicaron en el título y en los resúmenes, siendo seleccionados 12 artículos, los cuales fueron analizados. Los artículos seleccionados presentaron qué músculos se activan durante la práctica de los ejercicios, cuál es la efectividad individual del ejercicio propuesto y los casos en que esas terapias son indicadas. Aunque estos estudios han contribuido a la base de conocimiento actual, poseen diferentes diseños metodológicos. **Conclusión:** Parece existir un número reducido de estudios que abordan los efectos promovidos por la TMO en los músculos y funciones orofaríngeas, siendo la mayoría de ellos relacionados con los estudios de la disfagia orofaríngea.

Palabras claves: Fisiología; Ejercicio; Orofaringe; Terapia Miofuncional; Fonoaudiología

Introduction

Among the possible speech-language therapy approaches for the orofacial and oropharyngeal regions, the use of exercises constitutes a frequent proposal to bring about changes in both the musculature involved and the functionality of these regions. The organization or functional improvement of breathing, sucking, chewing, speech articulation from exercises aims to promote results in the oropharyngeal musculature that are protective of the airways, especially of swallowing. Exercises involving the oropharyngeal musculature – and consequently swallowing – have been used to seek the modification of muscular behavior also during sleep, in order to reduce the risks of obstructive sleep apnea[1].

However, little is done to understand how the performance of exercises acts in the modification of the musculature and, more importantly, what changes can be observed from a training program with exercises. Thus, as a starting point it seems decisive to understand the morphology and physiology of muscle movement, as well as specific oropharyngeal exercises[2,3], such as those present in the literature regarding dysphagia[4].

The striated skeletal muscle presents high plasticity, which enables this tissue to alter its morphological, metabolic and functional characteristics in response to specific stimuli. The characteristics of muscle fibers and their bioenergetic capacity for the production of adenosine triphosphate (ATP), which provides energy to supply the contraction, determine strength and muscular capacity[5, 6].

The exercise principles relevant to speech therapy are intensity, specificity and transference. Intensity covers the amount of load, volume and stimulus duration of the exercise. Specificity refers to how close the exercise task corresponds to the target outcome. Transfer is based on the logic of using cross-training and non-specific strength training to improve function. Exercises that do not force the neuromuscular system beyond the level of habitual activity will not cause adaptations – adaptations only occur when challenging the system beyond typical use[7].

Rehabilitation specialists must know the specific objectives achieved with the exercise. Findings in the literature on exercise science and physical rehabilitation suggest that the method and manner of training should differ significantly if the goal is to increase strength, speed, endurance, or some combination of them. The understanding of how training can be structured to facilitate and maximize neuromuscular plasticity is an integral component in the development of successful treatments[4].

Although several authors present speech therapy intervention programs in different ways, little is understood about the morphophysiology of the exercises. That is to say, despite the literature demonstrating the efficacy of orofacial myofunctional therapy (OMT), the mechanisms by which these improvements occur are poorly elucidated[2, 3, 8-13].

Considering the need to understand the mechanisms by which the therapy used is effective, the present study seeks to analyze the scientific literature regarding the morphophysiology of oropharyngeal exercises used in speech therapy.

Methods

It is an integrative review following six stages of elaboration: identification of the theme and elaboration of the hypothesis or guiding question; search in the literature; data collection; critical analysis of included studies; discussion; interpretation of the results; and presentation of the integrative review[14, 15].

As search criterion, the following descriptors in Health was used, in both English and Portuguese: "physiology" (*fisiologia*), "exercise" (*exercício*), "myofunctional therapy" (*terapia miofuncional*), "dysphagia" (*disfagia*), and "speech therapy" (*fonoaudiologia,* Language and Hearing Sciences), by associated descriptors (and/e).

For the bibliographical survey, searching of scientific articles was performed in the following electronic databases: "Medical Literature Analysis and Retrieval System Online" (MEDLINE), "US National Library of Medicine at the National Institutes of Health" (PubMed), Scientific Electronic Library Online (SCIELO), with no restriction regarding the time of publication, resulting in 890 articles from the three databases. From that number, the publication period was restricted to the last five years, from January 2013 to November 2018 and titles repeated in more than one of the databases were excluded as well.

The inclusion criteria for the selection of articles were articles in full, electronically available at the time of data collection published in Portuguese

or English languages, which addressed the active musculature during the practice of oropharyngeal exercises and their respective individual effectiveness, as well as the mechanisms by which this therapy is effective. The selected studies should necessarily report morphophysiological data of the oropharyngeal exercises used.

The selection of studies began with the verification of titles and abstracts related to the proposed theme, application of the inclusion and exclusion criteria, complete reading of the articles and analysis of the material composing the proposed survey. Data was presented in a descriptive way.

For the data collection and critical analysis of the studies, two instruments were used with information on identification, type of publication, methodological characteristics of the study, and results, in addition to exercise/therapy, active musculature during therapy, and individual therapeutic effectiveness.

Results

Eight hundred and ninety studies were found from the method used. PubMed was the one database that most published studies related to the subject, followed by MEDLINE and SCIELO. Among the descriptors, the combinations "physiology," "exercise," and "dysphagia"; and "physiology", "exercise," and "speech therapy" were the ones that resulted in more studies. The combination of the descriptors "physiology", "exercise," and "myofunctional therapy" was the one that provided the lowest number of results, as shown in Table 1. These data show that the descriptor "myofunctional therapy" is still little used in scientific literature, as studies with the descriptors "speech therapy" and "dysphagia" presented myofunctional therapy data.

From the 890 studies found, 393 were excluded due to the restriction on the publication period; 241 were excluded due to duplicity. So, starting from the 256 articles initially obtained, only 12 met the inclusion criteria for the present study, as shown in the studies selection diagram found in Figure 1.

The selected articles were read in full, evaluated according to the data collection instruments, and submitted to critical analysis. Among the articles, ten are original articles, one is a case report and one is a review.

The data of the studies is presented in Chart 1. The exercises referenced in the articles analyzed are presented in Chart 2. The synthesis of data extracted from the literature review article is shown in Chart 3.

Table 1. Studies found in the databases with the descriptors listed.

Descriptors	PubMed	MEDLINE	SciELO
Fisiologia + exercício (physiology + exercise) + Terapia Miofuncional (myofunctional therapy)	33	0	0
Fisiologia + exercício (physiology + exercise) + disfagia (dysphagia)	339	139	0
Fisiologia + exercício (physiology + exercise) + Fonoaudiologia (Speech therapy, Language and Hearing Sciences).	275	114	1
Total	647	253	1

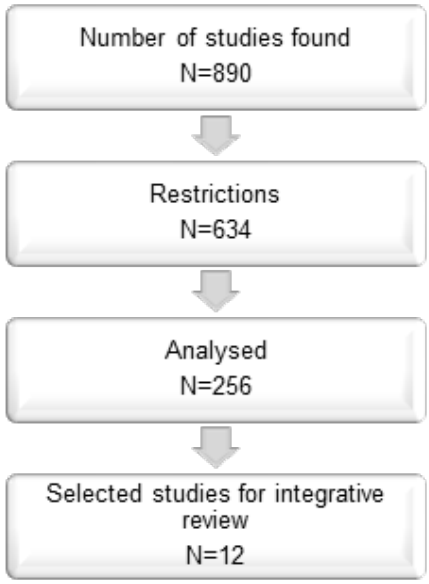

Figure 1. Stages of literature review process

Chart 1. Characteristics of the analyzed studies.

Author, Year, Country	Study	Objectives	Sample	Result measurements	Results
Watts CR, 2013 [21] USA	Clinical Prospective	Investigate the effects of chin tuck against resistance exercise compared to head lifting exercise.	Healthy young women (mean age: 22.5 years)	Surface Electromyography (Surface EMG)	The activity of the laryngeal muscles responsible for elevating the larynx and moving it forward during swallowing is greater when performing the chin tuck against resistance exercise.
Yoon WL et al, 2014 [22] USA	Clinical Prospective	To compare the maximum and average activity of the surface EMG of the suprahyoid muscles during the chin tuck against resistance exercise and the Shaker exercise	40 healthy adults (age between 21 and 39 years)	Surface Electromyography (Surface EMG)	The chin tuck against resistance exercise has an impact equivalent to or greater than that of the Shaker exercise
Fujiu-Kurachi M et al, 2014 [27] Japan	Clinical Prospective	To investigate intraoral pressure during Masako maneuver in relation to the different degrees of tongue protrusion	18 healthy young people (mean age: 26.9 years)	Swallow tactile system Swallow Scan (Nitta, Osaka, Japan) – five points on the hard palate	The Masako maneuver serves as a resistance exercise that places different amounts of load on the tongue muscles, altering the extent of tongue protrusion.
Shaker R et al, 2016 [25] USA	Descriptive exploratory	To verify if the application of resistance against the antero-superior movement of the hyolaryngeal complex will overload the pharyngeal muscles	30 healthy volunteers (age between 42 and 56 years)	Video Fluoroscopy Swallowing Exam	Repeated swallows against resistive load induced by the restriction of the antero-superior excursion of the larynx induce safety in the fatigue of the pharyngeal peristalsis and, therefore, have the potential to strengthen the contractile function of the pharynx.

Sze WP et al, 2016 [23] USA	Clinical Prospective	To investigate the effectiveness of the chin tuck against resistance exercise and the Shaker exercise, based on the principles of muscle specificity and training intensity	39 healthy adults (mean age: 29 years)	Surface Electromyography (Surface EMG)	The chin tuck against resistance exercise causes greater impact on the suprahyoid muscles, and lower on non-target muscles compared to the Shaker exercise.
Park JS et al, 2016 [19] Koreia	Randomized clinical trial	To investigate the effects of expiratory muscle strength training on the activity of the suprahyoid, aspiration and dietary muscles in patients with stroke and dysphagia.	33 patients with dysphagia (mean age: 64.3 years)	Surface Electromyography (Surface EMG) Video Fluoroscopy Swallowing Exam.	The expiratory muscle strength training is effective in stimulating activity in the suprahyoid muscle group of patients with dysphagia after a stroke.
Kraaijenga SAC et al, 2016 [18] Amsterdam	Clinical Prospective	To investigate the efficacy of an intensive strength training protocol in patients with head and neck cancer and dysphagia after radiotherapy treatment	17 patients with head and neck cancer and dysphagia, (mean age: 65 years)	Video Fluoroscopy Swallowing Exam.	Objective and subjective effects of progressive loading on muscle strength and swallowing function have been demonstrated, indicating that swallowing muscles are still trainable in the long-term.
Namasivayam-MacDonald AM et al, 2017 [26] Canada	Case studies	To determine the efficacy of tongue pressure training in the elderly with mild to severe cognitive impairment in the long--term care setting	Elderly people with mild to severe cognitive impairment (mean age: 91 years)	Iowa Oral Performance Instrument (IOPI)	There was a clear difference between initial and final tongue pressures. However, despite improvements in tongue pressures, no improvement was associated with the function of swallowing.
Hutcheson KA et al, 2017 [24] USA	Technical report	Detect patterns related to swallowing and activity of palatine, laryngeal and pharyngeal muscles during expiratory training	2 healthy women (23 e 24 years of age)	High resolution pharyngeal manometry Surface and intramuscular electromyography.	The mechanisms by which expiratory muscle strength training can improve airway protection related to swallowing probably involve muscles beyond the suprahyoid and laryngeal region.
Eom MJ et al, 2017 [20] Koreia	Randomized clinical trial	To investigate the effect of expiratory muscle strength training on the function of swallowing in patients with stroke and oropharyngeal dysphagia.	42 patients with stroke and dysphagia (mean age: 69.2)	Video Fluoroscopy Swallowing Exam.	Expiratory muscle strength training may improve the effects of dysphagia in elderly patients following stroke on the basis of swallowing function.
Park JS et al, 2017 [17] Coreia	Non-randomized clinical trial	To investigate the effect of head lifting exercise in the laryngeal and aspiration complex in patients with stroke and dysphagia	27 patients with dysphagic stroke (mean age: 59.26)	Video Fluoroscopy Swallowing Exam.	The head lifting exercise is effective to improve the movement of the hyoid and decrease aspiration in dysphagic patients affected by stroke.

Chart 2. Data from the exercises presented in the selected studies

Author, Year, Country	Exercise	Active muscle during exercise	Individual program effectiveness
Watts CR, 2013 [21] USA	Semi-rigid, adjustable device. Chin tuck against resistance exercise Head lifting exercise	Suprahyoid muscles	Improve hyolaryngeal excursion and UES opening
Yoon WL et al, 2014 [22] USA	Chin tuck against resistance exercise and Shaker exercise	Suprahyoid muscles	Promote anterior and superior movement of the larynx and hyoid bone, resulting in UES opening.
Fujiu-Kurachi M et al, 2014 [27] Japan	Masako maneuver	Base of tongue and pharyngeal wall	Facilitate pharyngeal constriction during the pharyngeal stage of deglutition.
Shaker R et al, 2016 [25] USA	Handmade device that affects laryngeal excursion induced by swallowing and UES opening	Suprahyoid muscles and pharyngeal constrictors	Resistance against antero-superior movement of the laryngeal complex during swallowing overloads the pharyngeal muscles and, through repetitive swallowing, results in neuromuscular fatigue.
Sze WP et al, 2016 [23] USA	Chin tuck against resistance exercise Shaker exercise"	Suprahyoid, infrahyoid muscles, anterior scalene and sternocleidomastoid muscles	Maintain the patency of the airway and the position of the hyoid. Increase the anteroposterior diameter of the UES opening and the maximum anterior laryngeal excursion after exercise.
Park JS et al, 2016 [19] Koreia	Expiratory muscle strength training	Digastric, milo-hyoid and genius-hyoid muscles.	Improve the ventilatory system by strengthening the respiratory muscles through strong oral expiratory action.
Kraaijenga SAC et al, 2016 [18] Amsterdam	Device "Chin tuck against resistance exercise" "jaw opening against resistance exercise" "effortful swallowing"	Suprahyoid and pharyngeal muscles	Improve hyolaryngeal elevation and UES opening. Increase the retraction of the base of the tongue and decrease the amount of pharyngeal residue
Namasivayam-MacDonald AM et al, 2017 [26] Canada	Lingual strength training	Anterior and posterior regions of tongue	Improve lingual strength
Hutcheson KA et al, 2017 [24] USA	Expiratory muscle strength training	Suprahyoid, velopharyngeal and laryngeal muscles	Establish vertical pharyngeal shortening as the laryngeal structure rises during the expiratory task and/or active reduction of the pharyngeal cross-sectional area as the airway compresses during expiratory tasks
Eom MJ et al, 2017 [20] Koreia	Expiratory muscle strength training	Suprahyoid muscles	To promote superior and anterior movement of the hyoid bone and larynx, establishing direct effects on aspiration, UES opening and pharyngeal residue. Stimulate the center of swallowing in the brainstem.
Park JS et al, 2017 [17] Koreia	Head lifting exercise	Digastric, milo-hyoid and genius-hyoid muscles.	Provide UES opening, assisting in the prevention of aspiration while the food bolus passes to the pharynx

Chart 3: Summary of the presentation of the literature review article (Hegland & Murry, 2013[16])

Author, Year, Country						
Hegland e Murry, 2013 [16], EUA						
Exercises	Supraglottic swallowing	Effortful swallowing	Mendelsohn maneuver	Lingual strength training	Shaker	Expiratory muscle strength training
Active muscle during exercise	Vocal folds	Base of tongue and pharyngeal muscles	Larynx (lifting)	Anterior and posterior region of tongue	Genius-hyoid, thyrohyoid, digastric muscles	Expiratory, suprahyoid and laryngeal muscles
Individual program effectiveness	Clean laryngeal vestibule waste	Push the food bolus into the oropharynx Reduction of or elimination of pharyngeal residue.	Keep larynx elevated longer by prolonging UES opening	Decrease the duration of oral and increase swallowing pressures	Strengthen the genius-hyoid, thyrohyoid and digastric muscles. Decrease hypopharyngeal food bolus pressure when entering UES.	Increase expiratory muscle strength Increase anterior suprahyoid activation Increase laryngeal movement

Discussion

The literature verified in the present study specifically analyzed the applicability and results of OMT in healthy adults and the elderly; in stroke patients; in patients with head and neck cancer and in those with cognitive impairment. The review of selected literature[16] presents the types of non-surgical treatments for swallowing rehabilitation. It seems important to note that studies that point to morphophysiology data from oropharyngeal exercises are those that focus on dysphagia[16-24].

Eligible therapies in the reviewed studies were: Shaker exercise or head lift exercise; chin tuck against resistance; effortful swallowing; jaw opening against resistance exercise; expiratory muscle strength training; tongue-strengthening exercises; swallow resistance. In addition to these exercises, the review of selected literature[16] presented two additional exercises: supraglottic swallowing and Mendelsohn maneuver, which were not found in the original articles included in this study.

The publication year of the selected literature review[16] is 2013. Thus, one can suppose that, according to the inclusion criteria of this study, little research has been done on the supraglottic swallowing and Mendelsohn maneuver in recent years.

Among the exercises investigated in the reviewed studies, there was a predominance of chin tuck against resistance, Shaker, and expiratory muscle strength training exercises in the description and proposal of the intervention.

It is noteworthy that Hegland and Murry[16], in their review of the literature, presented the head lifting exercise, also described as Shaker, as the exercise that promotes the engagement of genius-hyoid, thyrohyoid and digastric muscles. The strengthening of this muscular group favors the hyolaryngeal excursion and the opening of the Upper Esophageal Sphincter (UES)[16].

Park JS et al[17], by investigating the effect of the head lifting exercise (Shaker) on the laryngeal and aspiration complex of patients with dysphagic stroke, suggested that this exercise is characterized as an indirect, safe and effective intervention to improve anterior and superior movement of the hyoid bone, contributing to UES opening the hyoid bone contributing aiding in the prevention of aspiration.

In another study[18] with a sample of head and neck cancer patients, the exercises were applied: chin tuck against resistance, jaw opening against resistance exercise and effortful swallowing. According to the authors, the jaw opening against resistance exercise and effortful swallowing help increase the shrinkage of the base of the tongue and decreases the amount of pharyngeal residue, while the jaw opening against resistance exercise has the same purpose of the Shaker exercise, that is, the improvement of the hyolaryngeal elevation and the UES opening, as previously described[16, 17].

Three different studies[21-23] used healthy subjects and the same instrument of evaluation: surface electromyography (surface EMG), with the objective of comparing the effects of the Shaker exercise and jaw opening against resistance exercise as a proposed intervention for dysphagia.

The results obtained by Watts[21] showed that the activity of the muscles responsible for elevating the larynx and moving it forward during swallowing is greater when performing the jaw opening against resistance exercise in comparison to the Shaker exercise.

Similarly, Yoon et al[22] proposed that jaw opening against resistance exercise resulted in significantly greater activation during the isokinetic and isometric task on the suprahyoid muscles, concluding that the jaw opening against resistance exercise chin.

When referring to these therapies, Sze WP et al[23] reported that the jaw opening against resistance exercise, besides causing significantly greater impact on suprahyoid muscles, has a higher accuracy in focusing suprahyoid muscles, since the activation of non-target muscles is a consequence of the Shaker exercise dynamics.

These findings suggest two possibilities of exercises to promote the hyolaryngeal excursion and the UES opening, presenting the jaw opening against resistance exercise as the most promising. Studies[21-23] were published in 2013, 2014 and 2016 suggesting that this theory has remained in recent years.

Studies have also reported on the effectiveness of expiratory muscle strength training. According to the authors[16], the expiratory muscle strength training provides the engagement of the expiratory, suprahyoid and laryngeal musculature.

The results obtained in a randomized clinical trial[19] (RCT) showed that the expiratory muscle strength training enables activity in the suprahyoid muscle group and contributes to the decrease of aspiration in stroke and dysphagia patients. Another study[20] established the same methodology, and the results corroborated the previous study[19] in that the sharp contraction of suprahyoid muscles directly affects the anterior and anterior movement of the hyoid bone and the larynx. They also add that during expiratory muscle strength training, the sensory receptors of the tongue and oropharynx increase in several afferent stimuli, triggering the activation of the swallowing center located in the medulla oblongata in the brainstem.

A non-randomized study[24] with a methodological design different from the previous ones[19, 20] stated that during the expiratory tasks the activity of the pharyngeal musculature may reflect vertical pharyngeal shortening as the laryngeal structure rises or the pharyngeal transversal area is reduced, as the via compressed during expiratory tasks. The authors[24] also observed that the suprahyoid muscles and thyroarytenoid muscle appear to be more active before expiratory task, i.e., in the preparation to the act of performing the expiratory task than during the task itself. In conclusion, the mechanisms by which the expiratory muscle strength training improves the protection of the airways during swallowing involves muscles beyond the suprahyoid and laryngeal region.

There were findings on supraglottic swallowing and Mendelsohn maneuver only in one literature review[16]. This review pointed out that the Mendelsohn maneuver causes the laryngeal elevation leading to the UES opening, and that supraglottic swallowing closes the vocal folds during swallowing, favoring the cleaning of residues in the laryngeal vestibule. According to the included studies, we did not find original articles to confirm such descriptions.

With the hypothesis of promoting resistance to swallowing by means of a handmade device that affects the laryngeal excursion, Shaker et al[25] showed that repeated swallows against a resistive load result in neuromuscular fatigue. This result suggests future studies to directly evaluate the potential improvement in pharyngeal muscle strength and increase in pharyngeal pressure.

Namasivayam-MacDonald et al[26], analyzing the effectiveness of tongue-pressure training in elderly patients with mild to severe cognitive impairment, showed a clear difference between the initial and final tongue pressures using the Iowa Oral Performance Instrument (IOPI). However, despite these improvements in the tongue pressure, no improvements associated with the swallowing function were identified.

Fujiu-Kurachi et al[27], investigating the intraoral pressure during Masako maneuver in relation to different degrees of tongue protrusion, concluded that it serves as a resistance exercise that places different amounts of load on the tongue muscles by changing the length of the tongue protrusion. The authors

reported that the maximum extent of tongue protrusion of an individual should be taken into account, as this feature may restrict tongue movement.

The selected articles presented which muscles are activated during the exercises, the individual effectiveness of the proposed exercise and the cases in which these therapies are indicated. Although these studies have contributed to the current knowledge base, they have different methodological designs. Among the articles selected, only two[19, 20] are characterized as RCTs and only seven studies [16, 18, 21-23, 25, 27] have discussed the principles of exercise.

The main limitations of these studies[16-27] are related to their reduced sample size; to the effects of natural recovery by neuroplasticity; non-presentation of brain imaging tests since neural adaptation related to swallowing could not be firmly confirmed; and finally, there was no follow-up after the end of the intervention and the durability of the effects could not be determined.

No studies by Brazilian researchers were found describing the morphology of oropharyngeal exercise. Most studies have described the efficacy of therapeutic programs considering only their effects without specifying whether the exercises used in the program are efficient individually and the way of accomplishment that would guarantee the achievement of the proposed objectives.

In the majority of the studies reviewed[17-23, 25], the authors used Surface Electromyography (Surface EMG) and Video Fluoroscopy Swallowing Exam as results measurement. Three studies[24, 26, 27] used different instruments, such as the Iowa Oral Performance Instrument (IOPI); the swallow tactile system Swallow Scan; pharyngeal manometry and Intramuscular Electromyography. All reported data relate to the effect of therapy immediately upon completion of OMT, and reports on myofunctional assessment can be understood as limited.

Most of the reviewed authors[16-25] presented the adequacy of the suprahyoid muscles as a result of OMT, but some of the methods used may reflect the behavior of musculature proximal to or associated with the suprahyoid muscles, being therefore difficult to conclude.

Conclusion

There appears to be a small number of studies addressing effects promoted by OMT on oropharyngeal muscles and functions, most of them being related to oropharyngeal dysphagia studies. Aspects referring to morphophysiology are addressed especially regarding specific exercises directed towards the suprahyoid and laryngeal musculature. It is little debated whether the effects of OMT are, in fact, related to the improvement of muscular and orofacial functions.

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