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STUDY PROTOCOL

Action of blowing exercise with an occluded straw in the oral cavity and oropharyngeal space in healthy participants: Study protocol

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ABSTRACT:

Background: The choice of an exercise in clinical speech therapy practice must consider the clinical objectives to be achieved, therefore, it is important to identify and analyze the physiology of the muscles involved in the proposed action. Swallowing videofluoroscopy is a non-invasive radiological examination, which allows dynamic visualization of the swallowing phases, assists in defining therapeutic approaches and contributes to scientific research. **Objective:** to study the mechanical phenomena that occur in the oral cavity, oropharynx and laryngopharyngeal region under the action of blowing through an occluded straw and measure the spaces resulting from the exercise. **Methods:** This is a cross-sectional study, involving healthy individuals accordind according to the inclusion and exclusion criteria. The study will follow the recommendations of The Strengthening the Reporting of Observational studies in Epidemiology (STROBE). Anamnesis, clinical evaluation of the oral cavity and image capture will be carried out through videofluoroscopy of swallowing. Measurements will be carried out with the subjects at rest position, during the preparation and execution of the blowing exercise with an occluded straw and comparison of the measurements obtained to verify possible gains in amplitude in the intraoral, oropharyngeal and laryngopharyngeal space. **Discussion:** The blowing exercise with an occluded straw, used in the clinical practice of speech therapy, has shown positive results in terms of gaining muscle strength and improving the clinical condition of patients. However, this technique does not present scientific evidence that proves its application as a therapeutic resource favorable to gaining mobility and strength of the velopharyngeal, lingual and suprahyoid muscles.

Keywords: Myofunctional therapy; speech therapy; velopharyngeal sphincter; fluoroscopy.

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BACKGROUND

Choosing an exercise in speech therapy clinical practice involves aspects that go beyond knowing how to describe and guide the proposed action. It is necessary to consider the professional's expertise, as well as their physiological anatomical knowledge, and ability to associate this knowledge in a meaningful way with each case[1, 2].

Exercises that involve the orofacial, laryngeal, and respiratory muscles are intensely present in speech therapy. However, its choice generally occurs based on empirical knowledge, obtained in everyday clinical practice, and muscle physiology is not always taken into account, especially that of the muscles involved in the requested action. There is still no robust quantity of publications in the literature that present exercises practiced

in speech therapy with a detailed description of their physiological action and the structures involved[1, 2].

To achieve a better therapeutic response, it is essential to consider the intensity, frequency, and duration of each proposed exercise. Exercise physiology directs us to specific objectives for target muscles, such as toning, mobilizing, and relaxing. The choice of the type of contraction to be applied at the time of therapy must be by the goal to be achieved according to the case in question[1, 2].

Good scientific knowledge of the morphophysiology of skeletal muscles, on the part of the professional, contributes to a specific, personalized, and humanized therapeutic planning, favoring the definition of conducts, which involves in their strategies, the careful selection of exercises to avoid harm to the therapeutic evolution or discomforts, such as possible muscle fatigue or contracture[1-3].

Muscle fatigue can occur when a muscle reduces and or stop the intensity of its contractions, no longer responding to a certain stimulus, due to the high stimulus load given by vigorous and/or prolonged contractions. This phenomenon alters muscle contraction effectiveness and may occur due to changes in metabolic processes that continue to supply energy to muscle cells, or due to factors related to the central nervous system[4, 5].

Skeletal muscle contracture can be understood as a muscle contraction that is maintained without a stimulus, due to the high frequency of stimuli that generate a high expenditure of adenosine triphosphate (ATP), in addition to which this can supply energy to muscle cells, leading to a prolonged state of muscle contraction[5].

The exercise of blowing into an occluded straw involves the suprahyoid muscles, velopharyngeal sphincter, and respiratory dynamics. In the literature, we find studies that describe exercises used in speech therapy clinics that use semi-occluded commercial straws[6-8] and blows[9-11], which record a possible action of the soft palate, tongue dorsum, and suprahyoid muscles. However, no scientific records were found on blowing exercises with an occluded straw.

Given this scenario, this study proposes an understanding of the physiology of the blowing exercise with a occluded straw in the oral cavity and oropharyngeal space in healthy participants. We also seek to understand the behavior of the tongue and soft palate, considering whether the exercise, when activated, promotes a gain in amplitude in the intraoral space and oropharynx in healthy participants.

During this exercise, the object of this study, it is expected that a positive pressure will occur in the oral cavity since there is no possibility of air escaping through the occluded straw. This pressure, in turn, increases the intraoral and oropharyngeal space, causing an elevation and support of the soft palate against the pharyngeal walls and a slight depression of the posterior region of the tongue. It is worth highlighting that there is an intrinsic relationship between the suprahyoid and lingual muscles, which leads to consider the possible impact of this exercise on specific muscle group[12].

The morphophysiological understanding of the exercise of blowing into an occluded straw is essential to determine its therapeutic applicability, in which clinical conditions it is favorable, and to what extent it can be indicated. Therefore, it is important to have a physiological anatomical theoretical basis for the oral cavity and the

velopharyngeal sphincter, as well as an understanding of the technique of videofluoroscopy of swallowing, chosen for this study.

OBJECTIVES

Main objective

To quantify by videofluoroscopic recording the action of the blowing exercise with a commercial straw occluded in the oral cavity and oropharynx of healthy participants.

Specific objectives

• Describe the immediate effect of blowing exercise with an occluded commercial straw on the oral cavity and oropharynx of healthy participants.

• Measure the amplitude in the intraoral and oropharyngeal space when performing the blowing exercise with an occluded straw in healthy participants.

• Measure the contraction time of the muscles of the oral cavity and soft palate during the performance of the blowing exercise with an occluded straw with healthy participants.

METHODS

Study design

This is a cross-sectional clinical study to be carried out in a single center, involving healthy individuals as specified in the inclusion and exclusion criteria. The study will follow the recommendations of The Strengthening the Reporting of Observational studies in Epidemiology (STROBE)[13], as shown in Figure 1.

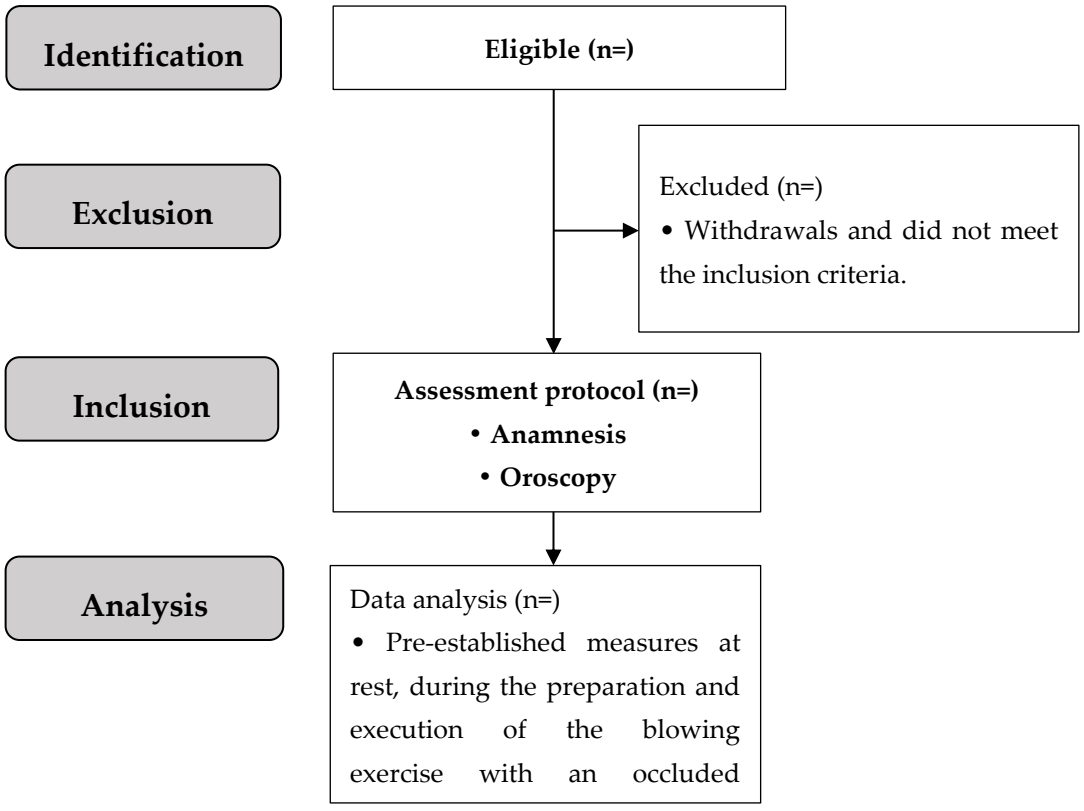

Figure 1. Study flowchart according to the STROBE statementEthical Considerations

Data collection will be carried out at the Hemodynamics Service of Hospital do Coração de Goiás, in the city of Goiânia (GO), Brazil, with surgical arch equipment from GE Medical Systems, reference OEC 9900 MD C-arm. Duly trained speech therapists will perform clinical assessments and videofluoroscopy exams on individuals involved in the study.

The study will follow the Guidelines and Regulatory Standards for Research Involving Human Beings of the National Health Council of the Brazilian Ministry of Health (December 2012). This research protocol was approved by the Human Research Ethics Committee of the Evangelical University of Goias – UniEVANGÉLICA under process no. 5,836,897/2023. All participants involved in the study will sign the Free and Informed Consent Form (TCLE) in writing.

Selection of Participants

The recruitment of participants will take place in the months of November and December 2023, using a simple approach, explaining the objective of the study and the role of each participant, among academics from the speech therapy course and the researcher's social environment, in accordance with the eligibility criteria proposed in the study.

Inclusion and Exclusion Criteria

The sample will consist of a single group of healthy participants, with no complaints of respiratory diseases, both genders, adults, aged between 20 and 30 years old and with intact phonoarticulatory organs. Exclusion criteria will be considered participants who present mouth breathing, snoring, documented obstructive sleep apnea, comorbidities that compromise respiratory function and who are unable to perform the blowing exercise adequately.

Outcomes

Primary Outcome

Changes in air space amplitude in the oropharynx and oral cavity obtained through videofluoroscopic images.

Secondary Outcome

Duration of maintenance of contraction of the suprahyoid muscles and soft palate obtained through videofluoroscopic images.

Assessment Protocol

Anamnesis

After the participant's inclusion in the study, an initial interview will be carried out with specific questions to collect clinical and anthropometric data, such as gender, age, peripheral blood pressure, respiratory and heart rate, aiming to obtain answers that confirm or not the participant's participation. Same, considering the inclusion and exclusion criteria. It is worth mentioning that it is at the time of the anamnesis that the patient is inserted into the clinical universe, therefore, we understand that at the time of this initial interview the participant actually becomes an active element of the research[14].

Oroscopy

After completing the anamnesis, an oroscopy will be performed, defined by an assessment of the oral cavity carried out in all life cycles, which allows the visualization of all the structures that make it up[15]. This exam is based on an excerpt from the speech-language visual assessment protocol for Orofacial Myofunctional Assessment[16]. Morphological aspects of the oral cavity will be visualized and analyzed, such as lips, tongue, cheeks, hard palate, soft palateand, teeth.

Image Capture

The capture of images in profile (sagittal plane), by videofluoroscopy, will take place through two views with the participant at rest and during the blowing exercise on an occluded straw. For a reliable analysis, some precautions will be observed. During the capture of images, the participant must be in a sitting position at 90º on a chair, with their arms resting on their thighs and their feet hip-width apart, with the chair positioned in the center of the surgical arch.

To acquire the image at rest, the tip of the tongue must remain in contact with the inferior alveolar crest, the lips sealed without tension and basal breathing in a nasal manner. The second image will be captured during preparation for the exercise, with the straw occluded in the mouth and the third image while performing the blowing exercise into an occluded straw.

To perform the exercise, the participant will remain in the same position, with the tip of the tongue on the inferior alveolar crest. The plastic straw will remain with one end stabilized between the lips, and the other end occluded by two folds and held firmly by the person performing the exercise, to prevent air from escaping. The participant will be asked to inhale nasally, blow into the straw with contracted cheeks, maintaining the intensity of the blow for three seconds and then release the air. For this experiment, a polypropylene plastic straw with 5mm in diameter and 21cm in length will be used. After the two folds at one end, the straw will be 18 cm long.

Measurements of the oral cavity and oropharyngeal space

After capturing the images at rest and during the action of blowing into an occluded straw, the space of the oral cavity will be measured in the direction of the lingual-posterior dorsum towards the beginning of the soft palate and the oropharyngeal space that started from the base of the tongue towards the uvular muscle of the soft palate. The measurements of the oral cavity and oropharyngeal space will be quantified by the RadiAntViewer DICOM software (64-bit) according to Figure 2. Based on these measurements, a comparative analysis will be made between the image at rest, preparation and, under the action of exercise, verifying increased intraoral and oropharyngeal space.

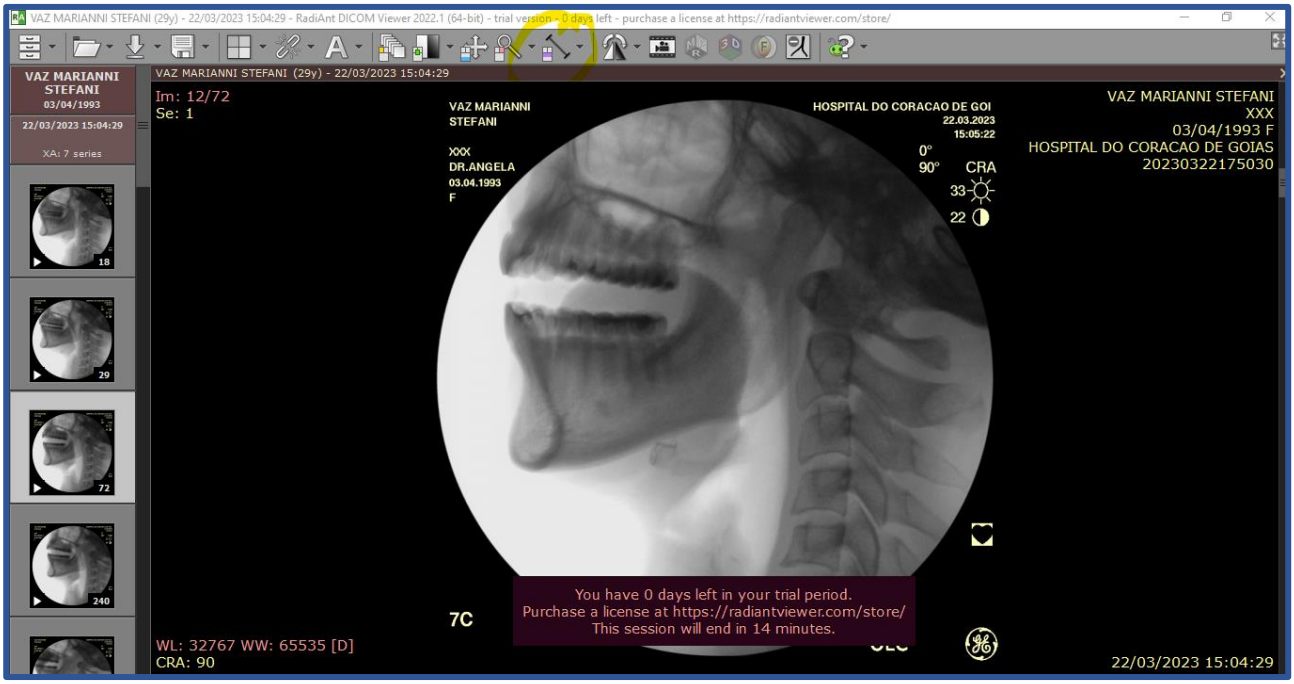

Figure 2. Images analyzed using RadiAntViewer DICOM Software (64-bit).

Quality control

To ensure the quality of the data, the speech therapist researchers involved in this study will guide the health professionals present at the time of obtaining the images, on how they should proceed for the adequate development of research activities.

Sample calculation

Due to the fact that we did not find a previously published study, the convenience sampling criterion was adopted in accordance with the "Intention to treat" principle.

Statistical analysis

Numerical values will be presented as mean and standard deviation. The Shapiro Wilk test will be used to verify the normality of the distribution of the variables studied. For intergroup comparisons of variables that present non-parametric distribution, the Friedman test will be used and for the comparison of parametric variables, the repeated measures ANOVA test will be used. The level of statistical significance determined will be 5% for all tests ($p<0.05$). Statistical analysis will be performed using the software – Statistical Package for Social Sciences SPSS 21.0® (Chicago, IL, USA).

FINAL CONSIDERATIONS

This study aims to observe the action of blowing with an occluded straw in the oral cavity and oropharyngeal space in healthy participants, as well as the mobility of the structures involved and how much amplitude is gained with the positive pressure generated by blowing into the occluded straw.

During the execution of the blowing exercise with an occluded straw, it is expected that there will be a gain in amplitude in the space between the tongue and soft palate, as well as greater elevation and support of the soft palate in relation to the depression of the tongue dorsum. This fact could be explained by the mechanical relationship between the tongue and the soft palate established by the palatoglossus muscle[17].

According to Lubker, 1968, the greatest elevation and stretching of the soft palate occurs with the tongue in the highest position. Even so, it is possible to visualize a dorsolingual depression favored by the positive pressure generated in the oral cavity by the return of air that cannot be expelled through the occluded straw[18].

In the speech therapy clinic, the practice of semi-occluded vocal tract exercises are frequently used, especially in cases involving rehabilitation and voice improvement. These are exercises whose technique involves some type of occlusion in the vocal tract, associated with other exercises such as vibrating lips and tongue, phonation in tubes, fricative sounds, prolonged /b/, humming, glottal firmness, lip constriction[19]. During the performance of SOVTE there is a direct relationship between the source and filter, vocal folds and vocal tract respectively, which when subjected to the action of the exercise, the phenomenon of biofeedback occurs, enhancing the relationship between both, where a passive system receives and responds to a energy stimulus given[20].

Considering the principle of impedance, it can be assumed that the intense flow of air from the lungs, the breath, sustained for 3 seconds, will cause a positive pressure in the oral cavity and oropharynx, generating a response of gain in amplitude in these regions, a since there is no possibility of air escaping due to the occlusion of the straw[20]. The capacity of the lingual, soft palate and pharyngeal muscles to respond to the given stimulus is configured by remaining in a state of contraction[5]. Therefore, we hope to verify the effect of exercising with an occluded straw in the clinical practice of speech therapy.

Authors' contribution: Conceptualization, A.S.G.S., S.V.M**.,** and L.V.F.O.; Methodology, A.S.G.S., S.V.M. and, L.V.F.O.; Project administration A.S.G.S. and, L.V.F.O Investigation, A.S.G.S., S.V.M**.,** and L.V.F.O; Data curation, W.R.F.J., M.C.O., J.P.R.A., and, L.V.F.O,; Formal analysis, S.K.A.S., B.M.R.S., B.O.M., C.C.B.M., and .V.F.O.; Supervision, W.R.F.J. and, L.V.F.O.; Writing-original draft, A.S.G.S., S.V.M**.,** and L.V.F.O.; Writing-review and edit , A.S.G.S., S.V.M**., C.C.B.M., W.R.F.J.,** and L.V.F.O, All authors have read and approved the final version of the manuscript

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Data Availability Statement: The data presented in this study will be provided without restrictions upon communication with the corresponding author.

Conflict of interest: The authors declare no conflict of interest.

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