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Case reports

The use of photobiomodulation in swallowing difficulties in individuals who developed the severe form of COVID-19

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ABSTRACT

This study aimed to verify the use of photobiomodulation in swallowing difficulties in individuals who had a severe form of COVID-19. This case report was based on a quasi-experimental, quantitative study, with primary data collected from a non-probabilistic sample of 13 adults (aged ≥ 19 to < 60 years) of both sexes, who had the severe form of COVID-19. Swallowing was assessed with the Dysphagia Risk Assessment Protocol, and the intervention used photobiomodulation. Descriptive statistics were used. It was found that all research participants' risk for dysphagia in water and pudding swallowing tests improved from before to after the intervention. It can be concluded that photobiomodulation had positive results in speech-language-hearing practice to treat swallowing difficulties in adults who were affected by the severe form of COVID-19, intubated, tracheostomized, and needed an alternative feeding route, as the swallowing difficulties improved.

Keywords: COVID-19; Deglutition Disorders; Intubation, Intratracheal; Laser Therapy

A study conducted at the Universidade Cesumar, Maringá, Paraná, Brazil.

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INTRODUCTION

The coronavirus, which causes COVID-19 and is called SARS-CoV-2 by the World Health Organization (WHO), brought a new reality to the world and Brazil. The COVID-19 pandemic onset and the efforts to cope with the disease and its consequences brought many health-related uncertainties[1] and required redoubled healthcare. The complexity of the cases, the scarce scientific knowledge about the new coronavirus, its high infectivity, pathogenicity, and virulence in vulnerable individuals, generated the need for strategies to face the pandemic more appropriately[2,3].

Although the peak of the pandemic has passed, new strains of the virus still emerge. Moreover, it has not been possible yet to describe all the nuances involving the coronavirus pandemic and its long-term consequences[4]. The persistence of sequelae and symptoms after the virus infection is characterized by long-haulers[3,4].

Some types of manifestations in humans have been identified as neurocognitive post-COVID, autonomous post-COVID, gastrointestinal post-COVID, respiratory post-COVID, musculoskeletal post-COVID, psychological post-COVID, and other non-specific manifestations[4]. A study[3] in patients with a long hospital stay states that more than 50% of them had post-COVID symptoms up to 3 months after hospital discharge and that these are very common in patients who had the severe form of COVID-19.

Post-intensive care syndrome occurs in most post-COVID-19 cases due to complications secondary to invasive or non-invasive procedures, such as the use of sedatives, mechanical ventilation, neuromuscular blockade, and long periods of immobilization, which can compromise physical and respiratory fitness and cause sarcopenia and cognitive disorders[5]. Muscle weakness should be considered in patients after prolonged orotracheal intubation (OTI), especially those affected by COVID-19[6].

A study[7] that assessed swallowing in patients with severe acute respiratory syndrome undergoing prolonged OTI showed changes in the pharyngeal phase of swallowing related to muscle weakness. The presence of underlying comorbidities, which worsen COVID-19, often results in OTI, which, in turn, can lead to difficulty swallowing after 48 hours of intubation[8]. Difficulty swallowing can harm and negatively impact various aspects of life, such as dehydration, malnutrition, and significant impairment in food intake, especially regarding liquid and thin liquid consistencies[7]. These consistencies increase the risk of bronchoaspiration, which is the entry of foreign substances (food, saliva, or water) into the lower respiratory tract[9]. This can seriously compromise lung health, for instance with aspiration pneumonia or lung infections, possibly leading the individual to death[9].

Bronchoaspiration is caused by the incoordination between breathing and swallowing, which, in turn, is due to pulmonary impairment caused by COVID-19 infection. It impacts the dynamics of swallowing since these two functions are coordinated with each other and use the same anatomical structures[10]. Hence, the incoordination and malfunction of these structures increase the risk of bronchoaspiration[10,11]. Another factor found in studies[12] is neurological impairment due to the invasion of the virus into the central nervous system, which can also impact swallowing[13-15].

The relationship between COVID-19 and dysphagia is still a developing field, but there is already enough knowledge to establish connections between the two. Because the respiratory system is closely linked to the normal swallowing pattern, patients who experience significant respiratory complications are at risk of developing dysphagia, which can lead to bronchoaspiration[16].

Besides pre-existing lung diseases, other reasons may explain the occurrence of dysphagia in patients with COVID-19. Around 80% of patients report symptoms of anosmia and ageusia associated with COVID-19. These symptoms can affect the sensation and perception of food, impairing adequate swallowing, and increasing the risk of dysphagia. These additional factors should be considered when evaluating patients with COVID-19 for dysphagia[17].

Many patients develop dysphagia after prolonged intubation and extubation, at rates ranging from 3% to 62%[18]. The prevalence of swallowing disorders increases as the duration of intubation is prolonged[18]. Dysphagia is associated with longer hospitalizations and an unfavorable prognosis due to the high risk of complications such as aspiration pneumonia, malnutrition, and dehydration[18].

Post-intubation dysphagia is multifactorial, firstly because of the endotracheal tube, which can damage the pharynx or larynx, resulting in edema, mucosal abrasions, hematomas, and ulcerations[19]. Intubation can also lead to displacement and subluxation of the arytenoid cartilage, while the cuff of the endotracheal tube can exert pressure on the branch of the recurrent laryngeal nerve[19]. Secondly, intubation can lead to muscle atrophy due to lack of use, which is aggravated by prolonged administration of sedatives and the use of neuromuscular blockers[20]. These factors combined help develop post-intubation dysphagia, increasing the risk of complications and negatively impacting the patient's eating and swallowing process[19,20].

Ten days (7-12 days) is the average OTI time in COVID-19 patients[21]. A study[22] reports that tracheostomy (TT) is performed after 15 days of prolonged OTI when these patients' extubation is not expected. There are some criteria for indicating the TT procedure. However, it can put COVID-19 patients at risk if the procedure is performed early, due to the uncertain prognosis of the disease. Moreover, it poses a risk regarding team contamination and post-operative management[23]. Hence, the recommendation is to keep the cuff inflated after performing the TT until obtaining a negative result for SARS-CoV-2[22].

One of the resources currently used in speech-language-hearing therapy is to irradiate a light source[24]. Known as photobiomodulation or low-level light therapy, it applies red and/or infrared light, capable of inducing photochemical processes, mainly in the mitochondria, and thus stimulating the production of adenosine triphosphate (ATP) [25]. This light energy is absorbed by cells and converted into chemical energy, which can stimulate the production of ATP and improve cellular metabolism. ATP is an important molecule that is involved in many biochemical processes in the body, including the production of new cells, the repair of damaged tissues, and the regulation of inflammation. Photobiomodulation is a non-invasive painless treatment that has been shown to be safe and effective in a variety of clinical settings[26].

Photobiomodulation emerges as a promising treatment approach. This method uses light-emitting diodes or low-level lasers to irradiate tissues, activating cellular photoreceptors. This irradiation is absorbed by internal photoacceptors, such as porphyrins, cytochrome C oxidase, and light-sensitive ion channels. Cytochrome C oxidase, unit IV in the mitochondrial respiratory chain, absorbs red and near-infrared wavelengths. This process increases electron transport, mitochondrial membrane potential, and ATP production. The absorption of photons by light-sensitive ion channels increases the intracellular concentration of calcium ions (Ca2+). This increase in Ca2+ activates various signaling pathways involving reactive oxygen species (ROS), cyclic adenosine monophosphate (cAMP), nitric oxide (NO), and Ca2+. These signaling pathways play a crucial role in regulating cellular processes such as cell proliferation, differentiation, and survival[27].

The biochemical reactions promoted by photobiomodulation significantly benefit the muscular area, enhancing myofunctional therapy[28]. This increases muscle strength gain and reduces fatigue levels, improving muscle performance during activities with different functions[28]. Thus, low-level light therapy is an effective resource to be used in this area as this therapeutic resource can stimulate muscle trophism more quickly[28]. This helps to tone or relax the muscles, providing more efficient results compared to the exclusive use of myofunctional exercises[28]. Speech-language-hearing pathologists must be trained in this therapeutic approach and have a comprehensive understanding of the patient's general condition, including the underlying pathology[28].

Photobiomodulation can decrease oxidative stress and the production of reactive oxygen species, improve mitochondrial function, and stimulate the mitochondrial respiratory chain, ATP synthesis, and microcirculation[29]. This technique can significantly benefit muscle repair and recovery, helping improve muscle performance and function[29]. Thus, using photobiomodulation has particularly had various benefits in areas related to orofacial motricity, dysphagia, snoring, facial paralysis, in the potential increase of myofunctional training, and aesthetics[30].

As it is a non-invasive therapeutic resource, without toxicity and with promising results, photobiomodulation has raised the interest of speech-language-heating pathologists – although only a few professionals use it[31]. Those who work in muscular rehabilitation have been studying the topic for its effects on the muscular system. This resource is used by applying monochromatic light to the tissue, influencing cellular activity, stimulating or inhibiting chemical or physiological functions[32], reducing muscle fatigue [25], increasing strength gain[33], and relaxing the musculature more quickly[34]. Thus, this study aimed to verify the use of photobiomodulation to address swallowing difficulties in individuals who had a severe form of COVID-19.

CASE PRESENTATION

This case report was based on a quasi-experimental, quantitative study, with primary data collection and a non-probabilistic sample. The research was approved by the Human Research Ethics Committee of the Universidade Cesumar (UniCesumar), Brazil, under evaluation report number 5.476.392, CAAE: 59367422.0.0000.5539.

Participants

Research participants were selected from the 133 individuals recruited for the project entitled, "Effects of a multidisciplinary intervention model on biopsychosocial parameters of people with obesity after COVID-19".

They were recruited for this project via referral from a hospital, after medical discharge, between August and December 2021. As inclusion criteria, individuals had to be 19 to 65 years old; diagnosed with COVID-19 via qualitative molecular test (RT-PCR); having contracted COVID-19 between January 3, 2021, and July 1, 2021; and having received the first dose of the COVID-19 vaccine. All project participants underwent clinical assessment and answered a standardized questionnaire with 90 open- and closed-ended questions, including data on medical history, pre-existing diseases, the need for hospitalization, time and type of hospitalization, symptoms during and/or after COVID-19, and the duration of symptoms after hospital discharge.

The inclusion criteria for this research were as follows: adults (aged ≥ 19 to < 60 years) selected from the aforementioned project; of both sexes; who developed the severe form of COVID-19, that is, who developed more severe symptoms of the disease, were intubated or tracheostomized, used oxygen or non-invasive mechanical ventilation, and/or required a feeding tube; and/or who had odynophagia, choking or difficulty swallowing as a consequence of COVID-19; and who were interested and willing to participate in the intervention once a week with photobiomodulation. Individuals who did not have a severe form of COVID-19 and who attended fewer than 75% of the photobiomodulation sessions were excluded.

Based on the sample of 133 individuals who had been recruited, 55 developed the severe form of COVID-19, having been intubated, tracheostomized, and having used oxygen, NIV, and a feeding tube. However, after contact with the participants, only 17 complained of any type of swallowing difficulty and were interested in participating in the photobiomodulation intervention. Of the 17 individuals recruited for this research, four did not attend at least 75% of the photobiomodulation sessions.

Procedures

Data were collected in three stages over 3 months. After selecting the participants, the first stage was via phone call by the lead researcher, from March to April 2022. In this first contact, they were informed clearly about the assessments and procedures that would be carried out during the photobiomodulation intervention.

The intervention was scheduled directly with the research participants and/or family members, establishing the day, time, and place for photobiomodulation, performed at the originating institution's laboratory and/or speech-language-hearing teaching clinic.

Their speech-language-hearing history was surveyed to obtain data on clinical conditions presented during hospitalization and after hospital discharge. These collected data included the length of stay, use of oxygen, use of non-invasive ventilation, need for intubation, use of tracheostomy, use of a feeding tube, difficulty swallowing, pain when swallowing, choking when swallowing, and delay in feeding.

Swallowing was assessed individually at the speech-language-hearing teaching clinic, using the Dysphagia Risk Assessment Protocol (PARD, in Portuguese). The same researcher carried out both the swallowing assessment and photobiomodulation intervention.

Data were collected by the lead researcher (a speech-language-hearing pathologist) and members of the Physical Education, Physical Therapy, Sports, Nutrition, and Performance Study Group (GEFFEND, in Portuguese) – a multiprofessional study group focused on overweight treatment.

A clinical speech-language-hearing assessment of swallowing was carried out in the second stage, following the methods described in PARD, which assesses the risk of bronchoaspiration. It was performed by the lead researcher (speech-language-hearing pathologist), who underwent specific training to apply PARD. Participants were seated, with their backs resting on the chair and their feet flat on the floor to prevent inadequate posture from interfering with the research results.

PARD is a Brazilian protocol[35] indicated for assessing the risk of dysphagia at the bedside, though it can also be used in speech-language-hearing clinics. Its application requires controlled volumes of water and pudding. The protocol is divided into three stages – water swallowing test, pudding swallowing test, and classification of the degree of dysphagia and procedures. As determined by the authors of PARD, participants are assessed while swallowing volumes of water measured in a syringe and offered in a cup and pudding offered in a spoon. The water was offered in volumes of 1, 2, 3, 4, and 5 ml, and the paste was offered in volumes of 3, 5, and 10 ml, repeated three times to confirm the results. Moreover, water in 50 ml servings was freely supplied.

The assessment procedures have 11 items for the water swallow test. Oral myofunctional behavior variables must be observed so that clinical judgment is the most effective and safe for the patient. When evaluating oral leakage, it is observed whether the patient manages the bolus adequately or with difficulty. The oral transit time is adequate when the bolus is swallowed in around 4 seconds and abnormal when the patient is unable to swallow it or takes longer than 4 seconds. In the nasal reflux item, it is considered appropriate for water not to escape through the nose and abnormal if it does. The number of swallows is those needed to clear the digestive tract after introducing the bolus into the oral cavity; it is appropriate to need a single swallow, and abnormal when it takes more than one. The laryngeal elevation is evaluated with the index and middle fingers positioned over the hyoid and thyroid cartilage, being appropriate when the larynx elevates two of the examiner's fingers and abnormal when it elevates fewer than two of the examiner's fingers. In cervical auscultation, a stethoscope is used on the side of the neck. It is adequate when three sounds characteristic of swallowing are heard and abnormal when there are either bubbly or no sounds. Oxygen saturation is measured using pulse oximetry, recorded before, during, and after the swallowing assessment; it is appropriate when saturation drops no more than 4 points and abnormal when it drops more than 4 points. In vocal quality, it is observed whether the patient has a wet voice immediately after the first minute of swallowing; if the voice remains clean, it is adequate; if wet, it is abnormal. The presence of coughing (whether or not voluntary, and whether or not followed by clearing of the throat) in the first minute after swallowing is a sign of change; if there is no cough after the first minute of swallowing, it is considered adequate. In the choking item, if it is not present, it is appropriate; if they choke during or after swallowing, it is abnormal. Clinical signs such as heart and respiratory rates must be also verified. No significant changes are present if the heart rate is between 60 and 100 beats per minute and the respiratory rate is between 12 and 20 breaths per minute; it is considered abnormal when there is cyanosis, bronchospasm, or significant vital sign changes[35].

Pudding swallowing is assessed by 12 items in the protocol. The same 11 items used in the water swallowing test are reassessed, but it is also necessary to analyze the occurrence of food residue in the oral cavity. Hence, the volumes offered are adjusted according to variations in the food consistency. The oral transit time increases from 4 seconds with water to 17.5 seconds with pudding – it is abnormal when they take longer than 17.5 seconds or cannot swallow. Food residue in the oral cavity is the accumulation of food in the oral cavity after swallowing. It is appropriate when there is no food residue in the oral cavity after swallowing and abnormal when there is food residue in the oral cavity[27]. The degree of dysphagia is classified into seven levels, with three types of procedures according to the severity of the swallowing disorder, guiding the speech-language-hearing pathologist to decide which one to use.

- Level I Normal swallowing – Normal with both consistencies in all items assessed.
- Level II Functional swallowing – It may be abnormal or changed but does not result in aspiration or reduced swallowing efficiency, making it possible to maintain adequate oral nutrition and hydration.
- Level III Mild oropharyngeal dysphagia – There is a swallowing disorder, requiring specific swallowing guidance by the speech-language-hearing pathologist and minor diet changes. There is spontaneous and effective coughing and/or clearing of the throat and slight oral changes with adequate compensation.
- Level IV Mild to moderate oropharyngeal dysphagia – There is a risk of aspiration, though minimized by maneuvers and therapeutic techniques.
- Level V Moderate oropharyngeal dysphagia – There is a significant risk of aspiration.
- Level VI Moderate to severe oropharyngeal dysphagia – Only one consistency is tolerated, requiring maximum assistance and strategies. There are signs of aspiration, and the person must be often requested to clear the throat. There is aspiration of two or more consistencies, absence of reflex cough, and weak and ineffective voluntary cough.
- Level VII Severe oropharyngeal dysphagia – Food cannot be received orally[35].

Procedures were followed according to the dysphagia classification and included the indication of

(a) an alternative feeding route, (b) speech-language-hearing therapy, and (c) assisted oral feeding.

The following recommendations were considered in this research to decide whether to use photobiomodulation after classifying dysphagia: (a) photobiomodulation intervention, (b) speech-language-hearing guidance, and (c) no need for photobiomodulation. Photobiomodulation intervention was carried out in individuals who had difficulty swallowing both liquids and solids according to PARD, with cough after swallowing, changes in vocal quality, and cervical auscultation perceived as abnormal. Speech-language-hearing guidance was indicated for individuals who did not have difficulty swallowing in PARD but had adapted their swallowing. No need for photobiomodulation was indicated for individuals who did not have difficulty swallowing in PARD.

Photobiomodulation intervention was carried out in the third stage, using the Therapy EC device manufactured by DMC, registered in the National Health Surveillance Agency (ANVISA) under number 80030810156, with a power of 100 mW, whose two laser diodes emit red (660 nm) and infrared (808 nm) wavelength light. It had a 0.06 cm beam diameter, 0.028 cm^2 beam area, 20-second application time per spot, and 4 J of energy in continuous emission. Red and infrared light were used in combination throughout the intervention. Photobiomodulation with these wavelengths aims to stimulate biological processes in cells through the absorption of energy by the mitochondria, oxygenate extrinsic laryngeal muscles to promote hyoid bone elevation and promote penetration of light deeper into tissues. The simultaneous use of red and infrared light is believed to provide comprehensive therapeutic benefits, as both wavelengths have complementary effects – red light acts more superficially, while infrared light reaches deeper layers[36,37]. Thus, both superficial and deeper tissues are reached for a more encompassing treatment. The irradiation of 4 J of red and infrared wavelengths combined lasts 20 s[37].

The use of infrared wavelength with point contact and mild compression provides greater penetration into tissues, allowing deep irradiation into the muscles, not limited to just the superficial portion[37]. This enhances the therapeutic action of the low-level laser on these tissues. Furthermore, red and infrared wavelengths have a greater affinity for cellular mitochondria, which are the organelles responsible for cellular respiration[37]. This increased affinity results in greater interaction of photons with mitochondria, stimulating mitochondrial function, and promoting beneficial effects on cellular energy production[37].

Thus, the combination of infrared wavelengths with point contact and light compression allows for deeper irradiation into muscle tissues and greater therapeutic efficacy, while red and infrared wavelengths direct their effects to mitochondria, enhancing the therapeutic benefits of low-level laser[37].

The intervention took place in the anterior region of the neck (five points on the right side, five points on the left side, and five points in the center), irradiating the base of the tongue and the suprahyoid, infrahyoid, and cricoid regions. Ten 15-minute sessions were held once a week.

In the fourth and final stage, all participants were reassessed with the PARD protocol immediately after the photobiomodulation intervention to compare swallowing difficulties before and after the intervention.

Data Analysis

Data were analyzed in SPSS 25.0 software, using a descriptive statistical approach. Absolute and percentage frequencies were used as descriptive measures for categorical variables.

RESULTS

Characterization of the Participants

The research sample included 13 individuals of both sexes (eight women and five men) who had the severe form of COVID-19, aged 24 to 59 years, with a mean age of 49.38 years (standard deviation ± 4.82). These data were obtained from the sociodemographic questionnaire answered in the first stage of the research.

Speech-Language-Hearing History Survey

The extracted data demonstrated that most patients (69.2%) who had the severe form of COVID-19 were hospitalized for more than 15 days, used oxygen and a feeding tube during hospital stay, and reported difficulties, chokes, and pain in swallowing after hospital discharge.

PARD

Table 1 shows that all research participants improved in the risk for dysphagia in the water swallowing test from before to after the intervention.

Table 1. Distribution of participants according to the dysphagia risk assessment in the water swallowing test before and after the intervention

VARIABLES	Pre-test (n = 13)	Post-test (n = 13)
	f (%)	*f* (%)
Oral escape	-	-
Present	3 (23.1)	0 (0.0)
Absent	10 (76.9)	13 (100.0)
Oral transit time	-	-
Adequate	10 (76.9)	13 (100.0)
Slow	3 (23.1)	0 (0.0)
Nasal reflux	-	-
Present	0 (0.0)	0 (0.0)
Absent	13 (100.0)	13 (100.0)
Number of swallowings	-	-
Single swallowing	4 (30.8)	13 (100.0)
Multiple swallowings	9 (69.2)	0 (0.0)
Laryngeal elevation	-	-
Adequate	4 (30.8)	13 (100.0)
Reduced	9 (69.2)	0 (0.0)
Cervical auscultation	-	-
Adequate	13 (100.0)	13 (100.0)
Abnormal	0 (0.0)	0 (0.0)
Voice quality	-	-
Adequate	7 (53.8)	13 (100.0)
Abnormal	6 (46.2)	0 (0.0)
Cough	-	-
Absent	6 (46.2)	13 (100.0)
Present	7 (53.8)	0 (0.0)
Choke	-	-
Absent	6 (46.2)	13 (100.0)
Present	7 (53.8)	0 (0.0)

Caption: n = number of participants; f = absolute frequency; % = relative frequency

The assessment of the risk for dysphagia in the pudding swallowing test before and after the intervention (Table 2) showed that all participants had satisfactory results in post-intervention assessment.

Table 2. Distribution of participants according to the dysphagia risk assessment in the pudding swallowing test before and after the intervention

VARIABLES	Pre-test (n = 13)	Post-test (n = 13)
	f (%)	*f* (%)
Oral escape	-	-
Absent	4 (30.8)	13 (100.0)
Present	9 (69.2)	0 (0.0)
Oral transit time	-	-
Adequate	6 (46.2)	13 (100.0)
Slow	7 (53.8)	0 (0.0)
Nasal reflux	-	-
Present	0 (0.0)	0 (0.0)
Absent	13 (100.0)	13 (0.0)
Oral cavity residue	-	-
Absent	4 (30.8)	13 (100.0)
Present	9 (69.2)	0 (0.0)
Number of swallowings	-	-
Single swallowing	0 (0.0)	13 (100.0)
Multiple swallowings	13 (100.0)	0 (0.0)
Laryngeal elevation	-	-
Adequate	5 (38.5)	13 (100.0)
Reduced	8 (61.5)	0 (0.0)
Cervical auscultation	-	-
Adequate	5 (38.5)	13 (100.0)
Abnormal	8 (61.5)	0 (0.0)
Voice quality	-	-
Adequate	6 (46.2)	13 (100.0)
Abnormal	7 (53.8)	0 (0.0)
Cough	-	-
Absent	6 (46.2)	13 (100.0)
Present	7 (53.8)	0 (0.0)
Choke	-	-
Absent	0 (0.0)	13 (100.0)
Present	13 (100.0)	0 (0.0)
Oxygen saturation	-	-
Normal	13 (100.0)	13 (100.0)
Abnormal	0 (0.0)	0 (0.0)
Level of dysphagia	-	-
Normal swallowing	0 (0.0)	13 (100.0)
Functional swallowing	4 (30.8)	0 (0.0)
Mild oropharyngeal dysphagia	9 (69.2)	0 (0.0)
Procedure	-	-
SLH therapy	13 (100.0)	0 (0.0)
SLH guidance	0 (0.0)	0 (0.0)
No therapy needed	0 (0.0)	13 (100.0)

Caption: n = number of participants; f = absolute frequency; % = relative frequency; SLH = speech-language-hearing

DISCUSSION

The study aimed to verify the effectiveness of photobiomodulation in swallowing difficulties in individuals who had a severe form of COVID-19. It found that all research participants' risk for dysphagia assessed with PARD improved from the beginning to the end of the intervention.

Photobiomodulation[38] has primary effects on the matter, including the biochemical effect (which triggers the release of neurotransmitters and modifies enzymatic reactions by accelerating or slowing them down), the bioelectric effects (which involve an increase in ATP production, resulting in greater efficiency in the sodium-potassium pump), and the bioenergetic effect (which normalizes the energy demand with the person's physical needs).

With no potential harmful effects on either tissues or the biological system, photobiomodulation has positive effects on living beings[39]. After an injury, living biological tissues must regenerate through a complex set of vascular, cellular, and biochemical events to replace dead or imperfect cells with healthy ones[31].

Possible risks of dysphagia have been reported[15] in individuals with TT, senescence, preexisting diseases, and pulmonary problems. These same factors reinforce the possibility of risk for dysphagia in cases of COVID-19. In the present study, most participants were hospitalized for more than 15 days, used oxygen and a feeding tube during their hospital stay, and reported difficulties, choking, and pain when swallowing after hospital discharge.

One-third of the patients[7] who had been intubated due to the severe form of COVID-19 had dysphagia after hospital discharge. Many of these occurrences were due to prolonged OTI, which, in turn, is due to the delay in performing TT. It produces aerosols and may contaminate health professionals – hence, TT was often performed only after 30 days of intubation[40,41]. This corroborates the findings of this study, which demonstrates that 69.2% of individuals had difficulty swallowing and used an alternative feeding route (nasogastric tube), 53.8% had a TT, and 69.2% had odynophagia and choking when swallowing.

A study conducted in Macapá, Brazil[42] identified a prevalence of females, with a lower mean age than in the present study – which also had a prevalence of females, but with a mean age of 49.38 years. Another study, carried out in Rio Grande do Sul, Brazil[3] found a prevalence of males, with a higher mean age, and of patients admitted to intensive care units.

Water[27] and pudding are processed differently when swallowed. Hence, standardized assessments must use both consistencies. A study[43] aimed to investigate the presence of laryngeal aspiration and penetration with a videofluoroscopic swallowing study and verified that liquid aspiration occurred in 3.4% and pudding aspiration, in 1.3% of individuals. Another experimental study[44] with the same objective as the previous one found a risk of laryngeal penetration/aspiration, depending on the consistency of the food, with greater prevalence for liquids. The authors concluded that the mixture of consistencies in dysphagia should be used with caution. It is worth highlighting that the present research used PARD because it measures the amount of liquid, pudding, and solid food per swallow, corroborating previous studies that concluded that mixing consistencies may cause difficulties.

Laryngeal movement during liquid ingestion has been analyzed[45] with sensors and surface electromyography of the suprahyoid muscles, showing that liquid ingestion takes 4 seconds. A similar study was carried out in 2009[46], finding that the duration of muscular activity recruited for swallowing increased according to food consistency. This shows the importance of evaluating swallowing with different consistencies, mainly liquid (water) and pudding.

The comparison of water and pudding swallowing results before and after photobiomodulation intervention showed that most research participants had swallowing difficulties with both consistencies. However, as swallowing is highly adaptable, they did not report such difficulty in swallowing in the speech-language-hearing history survey. Individuals with swallowing disorders make several adaptations to eat safely and effectively[39]. Post-intubation dysphagia can often be underdiagnosed because adaptations mask swallowing difficulties[47-50].

Photobiomodulation effectively reduced swallowing difficulties after the intervention. The post-intervention swallowing reassessment showed that 100% of research participants had improved swallowing of both consistencies. Some participants reported a burning sensation and pain when swallowing during the intervention and relieved symptoms by the fifth session.

The research demonstrated that using photobiomodulation in speech-language-hearing clinical practice provides highly relevant and successful therapy. Given that the intervention on research participants was satisfactory, individual limitations must be considered to preserve their quality of life.

The results must be interpreted with caution due to limitations, such as the lack of a control group to compare the results and the absence of inferential statistics because of the small sample size.

In short, the participants' condition notably improved – although such improvement may be related more to the time elapsed after extubation than directly to the action of the laser. An issue to be raised is the absence of a control group in this research, which prevents the authors from conclusively ascribing the effects observed to the use of laser.

CONCLUSION

The results indicated benefits of using photobiomodulation in speech-language-hearing practice to treat swallowing difficulties in adults affected by the severe form of COVID-19, who were intubated and needed to use an alternative feeding route, providing improvement in the research participants.

The results are expected to help and deepen knowledge about the use of photobiomodulation in the clinical assessment of swallowing, especially for individuals who underwent such a severe form of COVID-19.

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