Application and effects of neuromuscular electrical stimulation in the rehabilitation of oropharyngeal dysphagia: a literature review

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ABSTRACT

Objective: To analyze the different methods of Neuromuscular Electrical Stimulation (NMES) in the intervention of oropharyngeal dysphagia. **Methods:** Review using the descriptors: "deglutition disorders" and "electrical stimulation" in PubMed, BVS, SciELO, and MedLine, from 1997 to 2015. Classified according to the CAPES Integrated System (SiCAPES), PEDro, and Jadad scales. **Results:** There were 165 articles found, from which 25 were selected according to the theme. Between 2009-2012 there were more publications (60%, n = 15). Case-control was the most reported type of study (28%, n = 7). Most individuals were investigated after a stroke (44%, n = 11). The most popular type of therapy considered NMES at rest and traditional therapy (TT) (28%, n = 8), NMES during swallowing and TT (28%, n = 7), and NMES at rest (24%, n = 3). Vital Stim® was the most cited electrical stimulation device (32%, n = 8). Transcutaneous electrical nerve stimulation was the most reported (76%, n = 19). As to location, electrodes placed on the neck (48%, n = 12) and submental (44%, n = 11) stood out. Electric current commonly used: FES (40%, n = 10) and TENS (24%, n = 6). Fluoroscopy was the prevailing evaluation method (52%, n = 13). For SiCAPES distribution, the greatest number of materials was classified as B2 (36%, n = 9) and A1 (16%, n = 4). On the PEDro scale, the studies mostly scored 11 (24%, n = 6) and 10 (16%, n = 4). Considering the Jadad scale, (24%, n = 6) the studies scored 3 points. **Conclusion:** A higher prevalence of therapeutic effect on hyolaryngeal complex elevation, an important airway defense mechanism during swallowing, and the use of FES current and electrodes placed on the submental region or neck. Further research is needed, with defined etiological groups, to prove the therapeutic effect in the medium and long term.

Keywords: Electric Stimulation Therapy, Deglutition Disorders, Rehabilitation

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INTRODUCTION

Swallowing is the transport of food from the mouth to the stomach. It is a complex function that depends on synchrony between muscles and nerves, which can be divided into three phases: oral, pharyngeal, and esophageal. However, some authors include the anticipatory and preparatory oral stages. Dysphagia is any change in one of these phases, with the main etiology of mechanical or neurogenic alterations, resulting from a disease or prior condition. The pharyngeal phase of swallowing, when altered, provides the greatest impact to the health of an individual, because at this stage events occur which are essential for the protection of the lower airways, which include the elevation and anterior displacement of the hyolaryngeal complex.[1]

In speech therapy for oropharyngeal dysphagia, strategies are used such as changes in the consistency of the diet, adjustments to posture, myofunctional exercises, and thermal, oral motor sensory, or neuromuscular stimulation. The lattermost, considered recent in the field of Speech Therapy, still needs more research to prove its effectiveness and efficiency.

Neuromuscular Electrical Stimulation (NMES) is the passage of electrical pulses that stimulate sensory nerve endings and muscle fibers. The current of functional electrical stimulation (FES) is applied to promote contraction and the Transcutaneous Neural Stimulation (TENS) is applied for pain relief and relaxation.[2,3] Dysphagia rehabilitation has combined functional exercises with electrodes deployed in the head and neck area especially to optimize and aid the laryngeal excursion.[4]

OBJECTIVE

The objective of this study was to review, describe, and critically analyze the different methods of NMES applied in the treatment of oropharyngeal dysphagia.

METHODS

This is a literature review using the descriptors "swallowing disorders," "neuromuscular electrostimulation" and their combinations in English. The Virtual Health Library - VHL/LILACS, the Scielo Digital Library, and the electronic PubMed/MedLine databases were consulted. The search was limited to the period from 1997 to 2015.

From analyzing the title and reading the abstract and full text, the research was included that suited the proposed objective. These studies describe the use of NMES as a tool in the rehabilitation of patients diagnosed with oropharyngeal dysphagia. The following variables were considered: the proposed therapy, the electrostimulation device, the type of electrical current used, and the arrangement of electrodes.

Studies were excluded where the complete text was not accessible. In addition, those that were not suitable to the theme proposed were also excluded if they involved other health areas, applied the transcutaneous neural stimulation for vocal rehabilitation, applied it on animals, or presented therapy performed by the caregiver.

The articles pertinent to the theme were evaluated for methodological quality and classified according to the PEDro and Jadad scales, and by the CAPES Integrated System (SiCAPES). The area of interdisciplinary assessment was analyzed in their categories A1, A2, B1, B2, B3, B4, B5 and C, in accordance with SiCAPES, which lists and describes the vehicles used to publish intellectual production.

RESULTS

The search in databases resulted in 165 articles being found; 25 were selected, 1 of which was written in Portuguese and 24 in English. Based on the analysis of the title, abstract, and full text, 140 studies (84.81%) were excluded: 82 (49.69%) were not suitable to the theme proposed; 46 (27.87%) whose complete text was not accessible; 8 (4.84%) involved other areas of health; 1 (0.6%) applied neural stimulation for vocal rehabilitation, another 2 (1.21%) dealt with animals; and 1 (0.6%) presented the therapy performed by the caregiver.

The articles included were classified according to the scientific method they applied, the degree of scientific evidence presented, and the period of publication as described in tables 1, 2, and 3. The studies classified as non-systematic review of the literature had their references consulted and analyzed so that new work could be included.

As a tool for evaluating the quality of methodological articles and classification of vehicles for scientific publication, the Integrated System Capes - SiCAPES, Jadad, and PEDro scales were applied to all articles included (Table 3).

Heterogeneous etiological groups characterize the studies analyzed. Table 4 presents the etiologies found with greater frequency.

Scale of quality of life, swallowing, and the examination of the videofluoroscopy of swallowing (VFS), considered the gold standard for diagnosing oropharyngeal dysphagia, constitute the primary method of evaluation used by researchers to analyze the results or effects of NMES. The prominent scales were the Functional Oral Intake Scale (FOIS), the American Speech-Language Hearing Association scale (ASHA), the National Outcome Measurement System (NOMS), the M. D. Anderson Dysphagia Inventory (MDADI), and the Dysphagia-Specific Quality of Life (SWAL-QOL) (Table 5).

Because of the different arrangements of the applicability of NMES in the rehabilitation process of swallowing disorders, Table 6 presents the distribution of the settings used when considering the type of therapeutic proposal, model of electrostimulation device, type of electrical current used, and arrangement of electrodes.

DISCUSSION

The NMES used in the rehabilitation process of oropharyngeal dysphagia has shown varying results in swallowing dynamics, and it currently appears that these findings depend directly on their application methods. From the analysis of the studies, construction methodology, the time of application of NMES, configuration, and type of electrostimulator employed, it was possible to verify that NMES can lead to therapeutic effects and interfere in different ways in the swallowing dynamics and on excursion of the hyolaryngeal complex, an important airway defense mechanism during swallowing.[6]

The methodological construction refers to the positioning of the electrodes, an important factor in determining the group of muscle fibers to be stimulated. Beom et al.[7] sought to verify the effectiveness of the stimulation of the suprahyoid muscles compared the infrahyoid muscles in individuals with dysphagia resulting from brain injury. The study included 132 individuals whose etiology of dysphagia ranged between stroke, TBI, and brain tumor. The participants were divided into two groups

Table 1. Classification of scientific evidence according to the types of studies

Type of study	N (%)	Level of evidence
Randomized clinical trials	7 (28)	7 (8)
Case-control Studies	7 (28)	7 (6)
Not Specified	6 (24)	-
Non-systematic literature reviews	3 (12)	7 (1)
Case Report Studies	2 (8)	7 (4)

Table 2. Distribution of the studied articles according to the publication period

Year of publication	N (%)
2013 (2015)	3 (12)
2009 (2012)	15 (60)
2005 (2008)	4 (16)
2001 (2004)	2 (8)
1997 (2000)	1 (4)

Table 3. Methodological classification of the articles

SiCAPES	N (%)	PEDro scale	N (%)	Jadad Scale	N (%)
A1	4 (16)	11 points	6 (24)	3 points	6 (24)
A2	4 (16)	10 points	4 (16)	2 points	2 (8)
B1	3 (12)	9 points	2 (8)	0 points	17 (68)
B2	9 (36)	7 points	3 (12)		
C	1 (4)	4 points	3 (12)		
		3 points	1 (4)		
Not Found	4 (16)	2 pontos	2 (8)		
		1 ponto	1 (4)		

Table 4. Etiologies present in the studies analyzed

Etiology	N (%)
Encephalitis	1 (4)
Cerebral atrophy	1 (4)
Traumatic brain injury and Surgery	2 (8)
Multiple Sclerosis	2 (8)
Parkinson's Disease	3 (12)
Asymptomatic patients	7 (28)
Cerebral vascular accident (CVA)	11 (44)
Surgical and radiotherapy of the HNC	15 (56)

Legend: HNC - Head and Neck Cancer

Table 5. Methods for the analysis of results applied to selected articles

Method of Assessment	N (%)
Rating scales of Swallowing	13 (52)
Videofluoroscopy of Swallowing	13 (52)
Scales of Quality of Life	10 (40)
Electromyography	6 (24)
FOIS	4 (16)
Others	7 (28)

with 66 individuals each. In both groups the NMES was associated with TT according to the Vital Stim Therapy Training Manual treatment protocol and the characterization of the TT specific to each case and differing groups regarding the positioning of the electrodes and electrostimulator used, namely: the first group received stimulation of the suprahyoid muscles through an electrostimulator from Stimplus; in the second, the supra and infrahyoid muscle groups were stimulated using the Vital Stim® device. One 30-minute session was held each day over a period of 2-3 weeks and each individual was submitted to 10-15 sessions in total. The study by Boem evaluated swallowing before and after the VFD treatment and concluded that both therapies had similar effects on the improvement in swallowing of patients with cerebral lesions as far as decreasing the occurrence of laryngeal penetration and laryngotracheal aspiration.[7]

However, in a more judicious analysis one could verify that the lack of description of methodology in conducting the VFD, the heterogeneity of the etiologies, and the variability of therapeutic methods are factors that indicate possible interference in the results found.

In 2006, a study with 29 healthy volunteers tested 10 placements of electrodes positioned on the surface of the submental and larynx region, with arrangements in the vertical and horizontal. In the first test, two pairs of bipolar electrodes were used and, later, a single pair. It was observed that NMES on the larynx caused it as well as the hyoid bone to lower, in addition to reducing the peak elevation of the hyolaryngeal complex during swallowing in healthy adults.[8]

In this case, the therapeutic effect obtained with the application of NMES does not meet one of the main concepts of defense of the lower airways during swallowing. The movement of the hyolaryngeal complex, with regard to its elevation and anterior displacement, is considered to simultaneously favor the opening of the pharyngoesophageal transition (PET), protecting the lower airways, and ensuring safe transport of the bolus into the esophagus. From the concept of targeted pressure, it appears that the increased subglottic pressure resulting from the glottic coaptation with the elevation and anterior displacement of the hyolaryngeal complex, simultaneous to the opening of the PET and reduction of esophageal pressure, makes the esophagus receptive to the bolus at the end of the pharyngeal phase of swallowing. The

Table 6. Settings applied in therapeutic approaches with NMES

Type of Therapy N (%)	Type of Device N (%)	Type of Current N (%)	Position of the Electrode N (%)	Location of the Electrode N (%)
NMES at rest and TT 8 (28)	Not Specified 8 (32)	FES 10 (40)	Transcutaneous 19 (76)	Submental Region 11 (44)
NMES at rest 3 (24)	Vital Stim® 8 (32)	TENS 6 (24)	Soft palate 2 (8)	Neck 12 (48)
NMES during swallowing/TT and TT 7 (28)	Others 9 (36)	FES/TENS 2 (8)	Pharyngeal lumen 2 (8)	Submental region and Neck 2 (8)
Not Specified 7 (28)		Not Specified 7 (28)	Intramuscular 2 (8)	

Legend: TT - Traditional Therapy (Direct and Indirect Swallowing Therapy)

effect of this concept is to direct the bolus from an environment of higher pressure to one of lower pressure. However, the non-elevation of the hyolaryngeal complex could result in a decrease in the subglottic pressure, leaving the lower airways open to the entry of food. In summary, the descent of the hyoid bone could interfere with the swallowing process making the feeding unsafe, consequently increasing the risk of aspiration.[9] On the other hand, perhaps this NMES method is suitable for TT as an exercise model of counter-resistance for muscle strengthening.

Another study, which included 23 individuals with cerebral atrophy, stroke, and post-radiation therapy who presented moderate to severe dysphagia, supported the hypothesis that synchronic NMES contraction of the thyrohyoid muscle, where the electrodes were placed, during swallowing improves the dysphagia resulting from the reduced elevation of the larynx.[10] Recently, some studies on the effectiveness of the Shaker exercise in the rehabilitation of dysphagia have said that the shortening of the thyrohyoid muscle associated with strengthening of the suprahyoid muscles favors the opening of the PET. The Shaker exercise, being isometric and isotonic, is one of the main exercises listed in the specialized literature for the rehabilitation of dysphagia. This exercise promotes the strengthening of the muscles involved in swallowing, especially the laryngeal suprahyoid muscles, improving the elevation, anteriorization, and stabilization of the hyolaryngeal complex, influencing the opening of the PET and reducing stasis in the piriform sinuses.[11]

In 2009, a study with 11 dysphagic patients, who had change in the opening mechanism of PET, and were randomized into two groups: the first group was submitted to TT and second only to the Skaker exercise. The VFD measured changes in the shortening of the thyrohyoid muscle before and after six weeks of treatment. The maximum shortening of the thyrohyoid occurred during the maximum excursion of the hyoid during its displacement of elevation and anterior displacement. In the first evaluation, no significant difference was observed as to the percentage of change in distance between the thyroid cartilage and hyoid bone, from the beginning of swallowing to the point of greatest hyoid excursion in both groups. However, after six weeks, the Shaker exercise group presented a higher percentage of variation of the thyrohyoid distance compared to the TT group.[12]

In 2012, Heck et al.[13] investigated the immediate and delayed effects of the use of NMES applied to 20 healthy volunteers paired by gender. Two pairs of electrodes were positioned on the centerline of the submental muscle group (ventral anterior of the digastric, mylohyoid, and geniohyoid muscles), spaced at 5mm. This placing was proposed in order to restrict the scope to the suprahyoid muscles.

Pulses at a frequency of 80Hz were applied with stimulus duration of 4 seconds and the intensity was gradually increased in 2mA according to threshold of tolerance of each participant. We used conventional manometry to measure the pressure of the oropharynx, hypopharynx and PET during swallowing of saliva with and without effort. The compared measurements were obtained before, during, and at 5, 30, and 60 minutes after the stimulation. However, there were no immediate changes in the pressure of the PET during swallowing, because the more important physiological event is associated with the horizontal excursion of the larynx. In theory, this result is due to the fact that these were healthy individuals who, having biomechanical integrity of the larynx, would not present significant changes when compared to the group with structural impairments.[13]

It is well known that the placement of electrodes on the anterior surface of the head and neck region is related to the muscle group targeted to stimulate the expected contraction and the vertical displacement of larynx. The areas of the suprahyoid, infrahyoid, and lower constrictor muscles of the pharynx at the level of the PET, are those with the highest prevalence for the application of NMES.[6]

The effectiveness of NMES based on the placement of electrodes on this muscle group is justified through the theory about the pressure valves that compose this system during the pharyngeal phase of dynamic swallowing.[8] In addition to the elevation of the hyolaryngeal complex for protection of the lower airways, the anteriorization of this complex is important in view of promoting shortening of the thyrohyoid muscle favoring the diameter of the dilation of the PET, which occurs in milliseconds and corresponds to one of the final events of swallowing.[11] However, if such events do not occur simultaneously and synchronously, there is a possibility of pharyngeal stasis and/or diversion of the boluses to the laryngotracheal region, increasing the risk of aspiration and possible infections.[9]

As for the time of intervention, type of device, and width of the pulse, during a review of the literature, it was observed that the time with the use of NMES was determined in accordance with the proposal of the research developed, and also from the type of device electrostimulation employed. Of the 25 articles included, 8 mentioned the Vital Stim® electrostimulator which transmits electrical signals in the period of 1 hour and whose specifications are: a variable pulse width of 700μs, frequency of 80 Hz, with maximum intensity of 25mA. According to the company, Vital Stim® provides neuromuscular electrical stimulation controlled to strengthen the muscles involved in swallowing dynamics and is the only approved by the Food and Drug Administration (FDA) for use in swallowing disorders.[14]

In 2011, a survey was conducted with 20 individuals, with carcinoma of the nasopharynx and dysphagia; where the volunteers were divided equally into two groups. The first was submitted to 15 sessions of NMES with Vital Stim®, whose electrodes were positioned between the hyoid bone and thyroid cartilage to stimulate the suprahyoid muscles. The duration of each intervention was 60 minutes with a frequency of one to three times per week. The other group performed TT with a program of strengthening exercises done twice a day with ten repetitions for each item proposed by the authors. The analysis of the

effect obtained after the treatment was performed through the VFD, where each patient had ingested 5 ml of barium sulfate in liquid and paste form. The preparation of the liquid consisted in adding 65 ml water to 340g of barium sulfate. The paste was prepared by adding 12 ml of barium sulfate to 15 ml of liquid solution prepared in advance. No significant difference in the improvement in swallowing dynamics was found between the groups. However, only the group that received electrical stimulation showed an increase in the speed of elevation and anteriorization of the hyoid bone.[15]

Another study had 28 people, dysphagic after a stroke, who were randomized into two groups. The control group received tactile-thermal stimulation, and the experimental group received the tactile stimulation and simultaneous thermal NMES with Vital Stim®. The electrodes were positioned in the submental region between the anterior belly of the digastric muscle and the hyoid bone, and the hyoid bone and thyroid cartilage. The therapeutic proposal was developed for four weeks, with 1-hour duration for each session, five times per week. The evaluation of swallowing made before and after four weeks of treatment showed that the experimental group got better scores on the Rosenbek scale of penetration and aspiration and change in pharyngeal traffic according to videofluoroscopic images. The VFD examination was performed from the ingestion of 10 ml of barium in semi-liquid and liquid consistencies. These results suggested the combination of the TT with NMES as a better treatment for swallowing disorders after stroke, as compared to TT applied separately in this study.[16]

The tactile-thermal stimulation, proposed by Lazzara, aims to stimulate the sensory oropharyngeal region in order to provide the individual with bettor perception of the boluses.[17] More recently, studies have mentioned the importance of the aggregation of sensory stimuli simultaneous with the application of this technique, aiming at an increased input, as well as pointing out the need to give continuity to the research related to the topic.[18] Upon videofluoroscopic assessment, methodological plurality was seen employed in the execution of such examination in order to verify the therapeutic efficacy. However, some studies report that the simple modification of the volume and the consistency of the boluses can have a direct effect on the excursion of the hyoid bone in dysphagic individuals, generating varying results. Therefore, the analysis of different methodological designs of studies becomes important for the comparison of therapeutic strategies, as well as the observation of the videofluoroscopic parameters used, considering possible interference in the results.[19]

In 2011, Barikroo and Ami[20] reported the case of a patient with dysphagia after encephalitis that showed improvement in capacity in clinical and functional aspects of swallowing, as well as the elevation of the larynx after weekly treatments of 1 hour per session for three months. Two pairs of electrodes were used, one placed in the submental region and the other on the skin of the thyroid cartilage. This study highlighted that the TT provided satisfactory results in the rehabilitation of the dysphagia. However, functional NMES therapy, in combining electrical stimulation simultaneous with the TT, resulted in significantly better positive effects. NMES can promote muscle reeducation on the affected active structure, as well as reorganization of the cortical area responsible for motor control of the affected muscle.[20]

In addition to Vital Stim®, other researchers have used various electrostimulators with differing configurations and achieved similar results. Hans et al.[14] proposed NMES associated with swallowing with effort in 25 patients with multiple sclerosis, for 3 weeks with 2 sessions per week. In this study, we used the device ELECTROSTIMULATION Myomed 134® (Enraf-Nonius, Rotterdan, the Netherlands). As a result, there was a decrease in salivary stasis in the piriform sinuses and aspiration of thin fluid during swallowing.[14] It is known that the contraction of the muscles given by electrical stimulation may contribute to an improved hyolaryngeal excursion in its elevation and anteriorization movements, and the consequent opening of the PET.[21]

In relation to the current applied in NMES for rehabilitation of dysphagia, it was observed that other electrostimulators also achieved satisfactory performance in spite of the restricted configuration of the Vital Stim® device.[20,21,22] The selected articles presented distinct therapeutic programs as to intensity, frequency, and relevance of the proposed therapy, and results were obtained both in favor of NMES as strengthening, and opposed to its use.

In the study conducted by Terré and Meari,[22] the effectiveness of NMES was evaluated in the rehabilitation process of oropharyngeal dysphagia secondary to acquired brain injury. The study included 20 patients, 14 of whom had post-stroke lesions and 6 with severe Traumatic Brain Injury (TBI). It was a randomized, prospective study, whose subjects were divided into 2 groups with 10 participants each. The first group received real NMES associated with TT, and the second, a modified (placebo) NMES associated with TT. In the real application of NMES the vital Stim® device was used with two pairs of electrodes: the first pair was positioned horizontally in the submental area on the mylohyoid muscle above the hyoid bone. The second pair was placed lower, laterally on the mid-line of the thyrohyoid cartilage in the region of the thyrohyoid muscle. The real NMES carried the following specifications: frequency of 80 hz, pulse duration of 300µs, and initial intensity of 2.5 mA magnitude, progressively increased up to 25 mA, considering the subject's tolerance. In the second group, doing the modified NMES associated with TT the same stimulator was used and two pairs of electrodes were used: an upper pair on the chin and jaw region, and another pair lower laterally on the mid-line of the thyrohyoid cartilage over the region of the thyrohyoid muscle. However, stimulation was only applied to the upper portion at intensity of 2.5 mA with the intent to merely promote sensory stimuli, without promoting muscle contraction.

Both groups completed the program of 20 sessions for 1 month and were re-evaluated 3 months after the end of the program through the VFD and esophageal manometry. The VFD examination was performed with the patient seated in profile with side view. The patients were instructed to ingest portions of 3, 5, 10, and 15 ml of barium in pudding, nectar, and liquid consistencies at a certain time. In addition, the FOIS was applied to determine whether there was any evolution of consistency ingested orally from the therapeutics established. Immediately after the treatment, both groups showed evolution in the FOIS. However, the group receiving real NMES associated with TT showed more evolution and a higher score when compared to the group who underwent modified NMES associated with TT.

In the re-evaluation after the end of the program, the groups presented similar evolutions on the FOIS, with the real NMES group still having the better score. Six patients in each group also still had aspiration. However, only the real NMES group showed significant improvement in relation to the viscosity of the boluses, which showed identified signs of aspiration, in addition to an increase being described in the peak amplitude of contraction of the pharynx of this group. The study concluded that NMES could accelerate the process of rehabilitation of oropharyngeal dysphagia secondary to acquired brain injury.[22]

In contrast to the previous study, Langmore et al.[23] sought to verify, through a randomized clinical study, the efficacy of the NMES and

TT combination in patients with oropharyngeal dysphagia secondary to radiation therapy for the treatment of HNC. There were 170 individuals with HNC who were divided into two groups: The first group received the real NMES associated with TT and the second, the modified NMES (placebo) associated with TT. Each group was submitted to the respective therapeutic program for 3 months, doing 2 sessions per day, 6 days a week, being re-evaluated every 3 weeks. In performing the real and modified NMES, two pairs of electrodes were positioned in the submental region over the suprahyoid muscles. They used the e-stim device from BMR Neurotech 2000, applying the frequency of 70 Hz, pulse of 300μs and amplitude of 0-99 mA to the real NMES and 0-25 mA to the modified NMES, while respecting the subject's tolerance. The subjects were instructed to swallow only during the electrical input, alternating between regular swallowing with the maneuvers that have been taught: Mendelsohn, super-supraglottic area, and using effort. After the end of the program the VFD was done, the assessment of diet and quality of life of individuals. The VFD was performed by having the subject ingest barium modified with different specifications, namely: thin liquid, thickened liquid, pudding, banana, and cookie. It was observed that the group undergoing real NMES had a worsening on the Penetration-Aspiration Score, compared to the group that received the modified NMES. However, all individuals reported improvement in the ingestion of food and quality of life. This study concluded that the NMES does not add benefits to the TT, however the TT alone also does not present greater efficacy. According to the authors, the behavioral therapies today have limitations in the rehabilitation process of the oropharyngeal dysphagia secondary to radiation therapy.[23]

Even being flagged as a therapeutic tool and in cases of instruments with FDA approval for their applicability, authors consider them premature and question the indiscriminate use of this instrument in the rehabilitation process. Currently, the need has been emphasized for evidence that includes high quality methodology whose studies are less influenced by variables, that has greater scientific significance with well defined treatment proposals and randomized clinical trials with appropriate control and experimental groups. Tables 1 and 3, respectively, are the types of studies analyzed and the tools for assessing their methodological and scientific quality.

Studies with homogeneous etiology and use of objective methods for the assessment of the mechanics of swallowing, such as the VFD, are needed in order to ensure that more reliable results and evaluations.[24-27] However, according to Table 4, heterogeneous groups constitute the studies analyzed, possibly because of the large occurrence of similar clinical manifestations, although from distinct etiologies.

An instrumental examination is a tool of great value for the diagnosis and follow-up of the dysphagic patient. However, when analyzing the methods applied to evaluate the results of the NMES (Table 5), one notices that the scales for the evaluation of deglutition, being of a qualitative nature, are used as much as the objective methods. It is understood that this scenario is established by virtue of the difficult access for conducting such examinations and the practicality in applying instruments such as scales.

The temporal distribution of the studied articles, presented in Table 2, shows a higher number of publications in the period between 2009 and 2015, with 18 of the 25 studies included in this review. It can be inferred that this fact is related to changes in therapeutic paradigms, resulting from the increase of technological resources in clinical practice of swallowing disorders. In addition, more specifically in Brazil, the recognition of dysphagia as a field of knowledge has influenced the advancement of studies. The use and application of objective examinations and scales for the evaluation of therapeutic outcomes were also evident in the results found in the review.

CONCLUSION

Through a literature review it is clear that the NMES triggers different results depending on its application. Despite the need for proof of its immediate and long-term effects in the rehabilitation of patients with oropharyngeal dysphagia, a higher prevalence of therapeutic effect was seen in the elevation and anterior displacement of the hyolaryngeal complex, an important defense mechanism of the airway during the swallowing function. The main location, in use of the current FES, was with electrodes positioned centrally in the submental or neck region.

However, considered recent in the field of Speech Therapy, it still requires studies with well-defined etiological groups, because there is a higher frequency of publication with post stroke and radiotherapy patients. It is also reported that it was possible to identify major methodological variability both in the process of therapeutic application of NMES as in the evaluation process, by means of instrumental methods, of the results obtained by NMES. All of these aspects deserve special mention regarding the verification of the effectiveness and efficiency of this procedure in future research.

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