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REVIEW ARTICLE

Treatment Effects for Dysphagia in Adults with Multiple Sclerosis: A Systematic Review

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Abstract Dysphagia or swallowing difficulties have been reported to be a concern in adults with multiple sclerosis (MS). This problem can result in several complications including aspiration pneumonia, reduced quality of life and an increase in mortality rate. No previous systematic reviews on treatment effects for dysphagia in MS have been published. The main objective of this study is to summarise and qualitatively analyse published studies on treatment effects for dysphagia in MS. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were applied to conduct a systematic search of seven databases, using relevant key words, and subsequent analysis of the identified studies. The studies were required to meet all three inclusion criteria of including a statement on intention to treat, or measure the effects of treatment for dysphagia in adults with MS and data on treatment outcomes for at least one adult diagnosed with MS. Retained studies were evaluated by two independent reviewers using a critical appraisal tool. This study has not been registered. A total of 563 studies were identified from the database searches. After screening and assessment of full articles for eligibility, five studies were included in the review. Three examined electrical stimulation and two examined the use of botulinum toxin. One study testing electrical stimulation was a randomised controlled trial, two were well-designed case series and two were case series lacking experimental control. All studies reported some positive effects on dysphagia; however, treatments that involved the use of electrical stimulation showed larger effect sizes. There is a paucity of evidence to guide treatment of dysphagia in MS, with only electrical stimulation and botulinum toxin treatment represented in the literature search conducted here. While both treatments show initial promise for reducing the swallowing impairment, they require further research using well-controlled experimental designs to determine their clinical applicability and long-term treatment effects for dysphagia across different types and severity of MS.

Keywords Dysphagia · Deglutition · Multiple sclerosis · Treatment · Systematic review

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Introduction

Swallowing, also known as deglutition, is a semi-automated motor action of the respiratory, oropharyngeal and gastrointestinal muscles that is responsible for transporting swallowed material such as liquids and food from the mouth to the stomach and protecting the airway during the transport [1]. It is generally divided into three phases: oral, pharyngeal and oesophageal, where the oral phase is voluntary and the pharyngo-oesophageal phase is reflexive [2]. Dysphagia refers to the disturbance that occurs in the sensorimotor functions of swallowing such as delay in initiating the swallow or reduced transport of the swallowed material [1]. It is frequently seen in individuals with multiple sclerosis (MS), which is a long-lasting, progressive disease that leads to damage in the sheaths of nerve cells in the brain and spinal cord [3]. There are four types

of MS: relapsing-remitting MS, secondary progressive MS, primary progressive MS and relapsing progressive MS [1, 4]. The most common type of MS, relapsing-remitting MS, begins with a single attack that is followed by relapses over time, which results in some residual disability [4]. Most patients enter secondary progressive form of MS after 10 years from the initial diagnosis, which presents with less inflammation and more neurodegeneration [4]. Primary progressive MS is the least frequent type of MS and is characterised by the lack of relapses and progressive worsening of neurological status [4].

Depending on different types of assessment, the incidence of dysphagia in MS has been estimated as 33–43 % [5–7]. It appears to be more frequent in more impaired MS patients and in those with cerebellar, brainstem and cognitive impairments. However, dysphagia is also seen in ~17 % of MS patients with milder impairments [1]. The different manifestations of dysphagia are possibly caused by a combination of numerous potential factors, for instance damage to the neurons of the brain stem, specifically to the corticobulbar tract, as well as damage to the lower cranial nerves' input [2]. Cognitive and affective impairments may also influence the type and severity of symptoms observed [2].

Symptoms of the dysphagia in MS may include impairment of the oral and pharyngeal phases of swallowing [5, 8]. Some of the most frequent symptoms reported by patients with MS include coughing and/or choking during or after eating or drinking, food sticking in the throat, needing to swallowing multiple times per mouthful, difficulty managing saliva, difficulty initiating a swallow, drooling and altered eating habits [7]. The main clinical measure in progression and severity of the symptoms is the Expanded Disability Status Scale (EDSS) [9].

The dysphagia, left untreated, may lead to reduced quality of life, increased risk of weight loss and dehydration, and aspiration pneumonia; therefore, dysphagia should be identified in patients with MS at an early stage [10, 11]. The first steps to diagnosing and managing dysphagia should be based on a detailed assessment of oral and pharyngeal function of swallowing acquired by clinical assessments including obtaining case history, bedside evaluation, questionnaires and Flexible Endoscopic Evaluation of Swallowing (FEES) [11]. Based on initial and detailed evaluation of the swallowing function, a diagnosis of mild, moderate or severe dysphagia can be assigned with an appropriate intervention plan. Intervention can involve modifying the consistency of the consumed diet, compensatory strategies to ensure safe swallowing, swallowing exercises to improve strength and coordination of the swallowing mechanism and airway protection, as well as instrumental or pharmacologic interventions such as injection of botulinum toxin or electrical stimulation [1, 11]. Intervention response is dependent upon numerous factors including patient heterogeneity; variability in disease course and progression; capabilities for individual patients to compensate and patient comorbidities [12]. These factors have demonstrated challenges for designing MS therapeutic trials and determining their clinical applicability and long-term treatment effects for dysphagia across different types and severity of MS [12].

Although the prevalence of dysphagia in adults with MS is relatively high, only few studies have reported how to provide treatment for dysphagia in this population, and no systematic reviews on the therapeutic effects of treatments have been published. The aim of this article is to complete a systematic review that evaluates the literature related to the effects of treatment for dysphagia in adults with MS.

Methodology

Systematic Search Strategy

The search strategy used follows PRISMA search guidelines [13]. The flow diagram of study selection is presented in Fig. 1.

Identification

A comprehensive literature search was carried out by two of the authors (DA and HB) independently to find articles that investigated the treatment effects for pharyngeal dysphagia in adults with MS, using seven databases related to

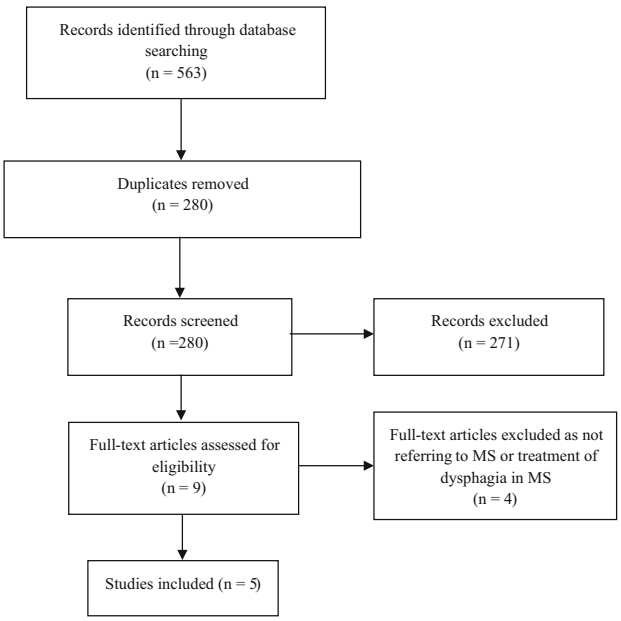

Fig. 1 Flow diagram of study selection

speech-language pathology as described in Table 1. These were CINAHL, Embase, Medline, PubMed, SCOPUS, SpeechBite and Web of Science. A free text search was applied using key search terms relevant to the main aim of the review, including the following: Multiple sclerosis, MS, dysphag*, deglutit*, swallow*, intervent*, treat*, rehabil* and manag*. Search terms were joined within groups using 'OR' Boolean operators, and with 'AND' Boolean operators between groups. This is to ensure that each study contained at least one of the search terms from each group. In some search terms, asterisks were included; this enabled part of words with different spelling to be detected or to include a search term and its plurals. The search terms were adapted based on each database in addition to the use of database-specific filters including restrictions to the following: English language, abstract available, adults and humans. There was no restriction on date.

Screening

All references were exported to EndNote software. Duplicates were removed both electronically and manually. Title, abstract and key words of the remaining references were screened independently by two of the authors, and articles were excluded if they did not meet the inclusion criteria as described in Table 2. Specifically, articles were required to include (a) a statement on intention to treat, or measure the effects of treatment for, dysphagia resulting from MS in adults, and (b) data on treatment outcomes for at least one adult diagnosed with MS.

Eligibility

Full-text articles that were retained after screening were assessed against the inclusion criteria in Table 2 before being reviewed. Any articles excluded at this point were not further analysed.

Data Analysis

Only studies on the treatment of dysphagia in adults with MS were included. All study designs were included in the review. Data extraction was carried out independently by two of the authors (DA and HB) and included analysing each study for the following variables: stated purpose, sample size and characteristics, confirmation of diagnosis, use of control group, experimental design and class of evidence [American Academy of Neurology (AAN), 2011], type of intervention applied, treatment dosage, dependent measures used to quantify treatment effect, method of analysis to determine treatment effect and effect size, and whether longer-term retention of treatment effect was measured. The AAN system defines four classes of evidence: Class I trials are randomised controlled clinical trials; Class II are retrospective cohort studies or case–control studies that otherwise meet the criteria for Class I, or randomised controlled trials lacking one to two criteria for a Class I rating; Class III are controlled studies including within-participant designs that use masked, objective or independent outcome assessors, these studies present evidence of internal validity (i.e. some degree of experimental control allowing confidence that the reported

Table 1 Free text database search

Database	Search string
CINAHL	(Multiple sclerosis or MS) AND (dysphag* OR deglutit* OR swallow*) AND (intervent* OR treat* OR rehabil* OR manag*) Limiters—English Language; Abstract Available
Embase	(Multiple AND sclerosis) AND (dysphag* OR deglutit* OR swallow*) AND (intervent* OR treat* OR rehabil* OR manag*) Limit to English and adults
Medline	(Multiple Sclerosis or MS) and (dysphag* or deglutit* or swallow*) and (intervent* or treat* or rehabil* or manag*) Limit to English and humans
PubMed	(Multiple Sclerosis or MS) and (dysphag* or deglutit* or swallow*) and (intervent* or treat* or rehabil* or manag*) Limit to English and humans
Scopus	(Multiple Sclerosis or MS) and (dysphag* or deglutit* or swallow*) and (intervent* or treat* or rehabil* or manag*) Limit to English and Doc Type: Article
SpeechBite	Multiple Sclerosis
Web of Science	(Multiple sclerosis or MS) AND (dysphag* or deglutit* or swallow*) AND (intervent* or treat* or rehabil* or manag*) Refined by: LANGUAGES: (ENGLISH)

Table 2 Inclusion and exclusion criteria

Inclusion criteria (based on PICO): Population: Multiple Sclerosis (MS) patients Intervention: Dysphagia interventions Comparator: All stated interventions compared with each other Outcomes: Any positive clinical outcome measure (objective & subjective) Study design: All		
Screening & selection tool		
Patient population	**Include** □ Adults with MS	**Exclude** □ Adults with other neurological disorders □ Children □ Animals
Interventions	**Include** □ Any dysphagia related intervention that directly influence the swallowing function	**Exclude** □ Non dysphagia related interventions □ Intervention that does not directly influence the swallowing function (i.e. PEG or NGT)No intervention
Study design	**Include** □ RCT □ Cohort Study □ Case series	**Exclude** □ Case reports □ Systematic review/ meta-analysis □ Expert opinion articles

Note. PEG= percutaneous endoscopic gastrostomy; NGT= nasogastric tube; RCT= randomised controlled trial

effects are due to the experimental treatment); and Class IV are uncontrolled studies, studies with no clear diagnostic criteria for participant inclusion, or studies with inadequately defined outcome measures. The reviewers were blinded to each other's ratings and any differences were subsequently resolved.

Results

General Results

A total of 563 studies were identified from database searches, with 280 remaining after removal of duplicates. Titles

and abstracts were then screened for eligibility of the remaining articles. This resulted in exclusion of 271 articles either because they were not referring to MS or were not referring to treatment of dysphagia in patients with MS, leaving nine to be assessed for eligibility against inclusion criteria. After assessing full articles for eligibility, only five studies met the inclusion criteria (See Table 3). Of the five studies, three examined electrical stimulation [14–16] and two examined the use of botulinum toxin [17, 18].

The five studies included a total of 64 MS participants (37 females, 27 males; age: $M = 43.7$ years, range 29–59 years), who presented with swallowing problems including incomplete relaxation and defective opening of the upper oesophageal sphincter, aspiration, pharyngeal residue and delayed swallowing initiation. The median sample size of the studies was 8.5 (range 2–25). The studies used various dependent measures to examine the effectiveness of the treatments such as Dysphagia Severity Score (DSS), EDSS, FEES focusing on the pooling of saliva in the valleculae and pyriform sinuses, the 50 mL water swallowing speed test, the penetration/aspiration scale (PAS) and electromyographic (EMG) measures of suprahyoid/submental muscles. The median number of total treatment sessions was 1 (range 1–6), and these were delivered over a median of 1 day (range 1–6). All studies reported some degree of swallowing improvement resulting from the application of treatment. None of the studies was deemed adequately homogeneous in terms of outcomes and number of sessions and hence a meta-analysis was not possible. Below, we discuss the studies grouped by treatment approach. As the studies varied widely in terms of purpose and method, they are discussed individually below and summarised in Table 3.

Electrical Stimulation

Three studies examined the effects of electrical stimulation on the swallowing function of adults with MS [12–14]. The purpose of these studies was to determine whether electrical stimulation has positive effects on both motor and sensory function for swallowing. Each study used a different method of stimulation: neuromuscular electrostimulation (NMES) aimed to use electrical impulses to activate pharyngeal and laryngeal musculature through intact peripheral nerves to improve the strength and speed of swallowing in patients with pharyngeal dysphagia [11], pharyngeal stimulation applied slightly above the patients upper oesophageal sphincter via electrodes to promote improvement in swallowing physiology and induce reduction of aspiration [12], or stimulation of the vagal nerve through implant to improve cerebellar tremor and dysphagia [13].

Bogaardt et al. [16] conducted a Class IV trial with a relatively large sample of 25 patients with MS (Age: $M = 53.1$ years, range 29.9–72.7 years; time since the onset of MS: $M = 16.5$ years, range 3.6–48.3 years). For all patients, the main swallowing problem observed was pooling of liquid in the pyriform sinuses during consumption of thin and thick fluids, as determined by either FEES, self-report, or nurse-report of frequent coughing during mealtimes. The primary focus of the study was to examine the effects of neuromuscular electrostimulation (NMES) on pooling of saliva or liquid in the valleculae and pyriform sinuses. Patients were stimulated with a 200-μs phase duration at 30-Hz frequency for 20 min two times a week for 3 weeks. After stimulation, the scores of ten patients improved in the DSS from median severity of two

Table 3 Studies that fulfilled the inclusion criteria

First author, references	Design	Primary focus	Dependent measures	Number of MS subjects	No. of treatment sessions	AAN
Alfonsi et al. [17]	Case series	Effects of BTX injection into the CP muscle in treating dysphagia	DSS	2	1	IV
Bogaardt et al. [16]	Case series	Effects of neuromuscular electrostimulation on the swallowing function	FEES, DSS	25	6	IV
Marrosu et al. [15]	Case series	Effects of vagal nerve stimulation on dysphagia	50 mL water swallowing speed test	3	Not specified	IV
Restivo et al. [14]	Randomised controlled trial	Effects of intraluminal electrical pharyngeal stimulation on dysphagia	PAS, EMG	20	5	I
Restivo et al. [18]	Case series	Effects of botulinum neurotoxin type A for severe oropharyngeal dysphagia	PAS	14	1	IV

MS multiple sclerosis, *AAN* American Academy of Neurology (2011), *BTX* botulinum toxin, *CP* cricopharyngeal, *DSS* dysphagia severity score, *FEES* flexible endoscopic evaluation of swallowing, *PAS* penetration/aspiration scale, *EMG* electromyographic

to one [16]. However, the scores of seven patients' remained the same. The patients also showed an improvement on the penetration-aspiration scale (PAS) for drinking water and swallowing yogurt as determined by the FEES. For water intake, ten patients had an improved PAS score. This improvement was found to be significant ($p < 0.01$). For yogurt intake, a small improvement was observed in four patients. Six of the 25 patients had significant reduction in pooling of saliva in the pyriform sinuses ($p < 0.01$), and 23 participants reported through a questionnaire that their swallowing had improved.

Restivo et al. [14] executed a Class I randomised controlled trial examining the effects of intraluminal electrical pharyngeal stimulation on dysphagia in MS. The study included 20 dysphagic patients with MS (14 with relapsing-remitting MS, and 6 with secondary progressive MS; 13 females, 7 males; age: $M = 39.7$ years, disease duration: $M = 9.8$ years, dysphagia duration: $M = 22.0$ months) who were randomised to receive real or "sham" pharyngeal stimulation. Ten patients received 5 Hz "real" pharyngeal stimulation for 10 min and the others received "sham" pharyngeal stimulation for 10 min for five consecutive days. Patients were evaluated through videofluoroscopy and EMG examinations and by the PAS prior to the treatment, and immediately after the last session of treatment. They were also followed-up 2 and 4 weeks post-pharyngeal stimulation. After "real" pharyngeal electrical stimulation, considerable improvements in all the primary (Penetration/Aspiration Scale) and secondary outcome measures (variation in EMG) were observed. Therapeutic effects were greatest immediately after treatment and 2 weeks post-treatment, but effects were still retained above baseline level at 4 weeks post-treatment.

In the case series study by Marrosu et al. [15], three men (age: $M = 32$) with relapsing-remitting MS with an average of 8 years history of postural cerebellar tremor and dysphagia for liquids and solids were recruited. A vagus nerve stimulator was implanted in each participant and, 45 days after the implantation, 1.25 mA current was delivered by telemetry at 10 Hz. Following stimulation, there was an average 65 % improvement in score for the 50 mL swallowing speed test from pre-treatment to 2- to 3-month post-treatment; however, contrary to the experimenters' prediction, ability to swallow solids failed to improve.

Botulinum Toxin

The two studies (Alfonsi et al.; Restivo et al.,) that examined the effectiveness of botulinum toxin to treat dysphagia are listed in Table 3. The purpose of the botulinum toxin treatment in both studies was to improve the relaxation of the cricopharyngeal muscle. Alfonsi et al. [17] conducted a Class IV trial with 32 participants, of whom two were MS patients with mild to moderate dysphagia. These two cases (sex: female; age: $M = 49$ years; time since onset: $M = 75.5$ months) presented with clinical dysphagia characterised by insufficient relaxation and defective opening of the upper oesophageal sphincter, as confirmed by EMG evaluation. Participants received a single injection with 15 units of botulinum toxin into one side of the cricopharyngeal muscle. EMG measures were taken during the procedure to ensure accurate placement of the neurotoxin. An A–B design was used where participants were tested once pre-injection and once at 2-month post-injection. Of the two MS participants, only one had a positive swallowing response and improved from one to zero (out of two) in dysphagia severity score [17].

Restivo et al. [18] also conducted a Class IV trial, recruiting 25 participants with MS and severe dysphagia for both liquids and solids. Among the 25, only 14 participants (6 men, 8 women; age: $M = 37.1 \pm 5.3$ years; duration of disease: $M = 9.7 \pm 2.6$ years; duration of dysphagia: $M = 4.7 \pm 1.0$ years; 5 with relapsing-remitting MS, 6 with primary progressive MS, and 3 with secondary progressive form MS) were eligible for botulinum neurotoxin type A (BoNT/A) treatment as they had clear signs of upper oesophageal sphincter hyperactivity as determined by videofluoroscopy and/or by CP electromyography. All the other participants were excluded as they reportedly had dysphagia due to other causes and, therefore, BoNT/A injection to the CP muscle was contraindicated. The 14 participants were injected with 10 units BoNT/A in each side of the CP muscle under EMG control. An A–B design was used whereby participants were examined by videofluoroscopic and electromyographic assessments and with the penetration/aspiration scale (PAS) at pre-injection, and at 1-, 4-, 12-, 16-, 18- and 24-week post-injection. After the injection, 10 patients had normal swallowing, (PAS = 1) and the other four had remarkably improved swallowing function (PAS = 2 in three patients; PAS = 3 in one patient). Mean PAS score significantly improved in comparison to the pre-treatment score (score before BoNT/A = 6.8 ± 0.5; score at week 1 = 1.4 ± 0.6; $p < 0.0002$) benefits were evident in all 14 patients at week 1, continued unchanged until week 12, and reduced but stayed significant at week 16 and 18 ($p < 0.001$) in all the swallowing outcome measures.

Discussion

Main Findings

The aim of this systematic review was to analyse the literature concerning dysphagia treatments in adults with MS,

since no systematic review in this field has been published previously. The five identified studies involved instrumental interventions. No behavioural intervention studies (e.g. muscle strengthening exercises or training in compensatory strategies for safer swallowing) were found. Only one study qualified as a Class I trial (AAN, 2011), with the remaining four being Class IV trials lacking experimental controls to confidently argue that effects were solely due to the application of the treatment. However, effects such as botulinum toxin injection and electrical stimulation have been shown clearly to affect muscle movement in other body systems when accurately applied [19].

Some positive results were found in few studies; however, sufficient evidence stating significant therapy effects could not be found due to a paucity of well-designed Class I-III studies. The heterogeneity of treatment techniques, dosages and outcome measures made it difficult to directly compare the results of the studies included in this review. Additionally, the heterogeneity of the MS sample in most of the studies made it difficult to make generalisations about the effects of treatments on all MS population. It also may have contributed to incorrect and inconsistent results of the studies.

Among the five studies, two studies using electrostimulation showed the most positive therapeutic effects with greater effect sizes and demonstrated stronger evidence to support their use with MS patients with dysphagia. In Bogaardt's et al. study (2009), no control group or randomisation was used, so any conclusions about the effects of NMES on swallowing in MS must be considered preliminary and require confirmation with higher level experimental evidence. Additionally, no adequate follow-up measures were used; therefore, further examination is required to determine the effects of NMES on pharyngeal dysphagia over time. Furthermore, the NMES was combined with practice using a highly effortful swallow so it is possible that any treatment effect was due, at least in part, to the behavioural component of the intervention. The report of reductions in long-standing problems with saliva pooling and aspiration in the group of patients, from flexible endoscopy and patient self-evaluation, suggest further investigation is justified.

Similar findings were found in Restivo's et al. study [14] which was a convincing, well-randomised controlled trial that evaluated intraluminal pharyngeal electrical stimulation in patients with dysphagia and MS with some important improvements in all the primary and secondary outcome measures. The number of participants was small, and the patients were only followed-up 4 weeks after the treatment. The report of a statistically significant and large effect with this small sample, however, suggests a robust effect worth further investigation in larger samples. Also, since the follow-up time was fairly short; the question remains how long the effect of the electrical stimulation will remain. Therefore, in the future, randomised controlled studies evaluating pharyngeal electrical stimulation should focus on a including larger number of participants and longer follow-up time.

The other major treatment for dysphagia in MS patients that was included in this systematic review was botulinum toxin injections. Alfonsi et al. [17] only included a small number of patients for each neurological disease in his study, with only two patients having MS with clinical dysphagia, and incomplete relaxation and defective opening of the upper oesophageal sphincter as confirmed by EMG evaluation. Only one of those two MS patients showed a positive response to the treatment. The study showed that botulinum toxin treatment was only able to improve swallowing function in patients who only suffer from absence of relaxation of CP muscle with no other abnormalities of oropharyngeal swallowing and patients with mild to moderate dysphagia, but not in those with severe dysphagia. Therefore, it would be difficult to determine the efficacy of this treatment in the MS population.

Botulinum neurotoxin type A was also evaluated by Restivo et al. [18], and it has been reported to be effective for all patients in all the swallowing outcome measures. However, only 14 patients out of 25 who presented with clear signs of upper oesophageal sphincter hyperactivity were eligible to undergo treatment. The remaining patients did not receive any treatment despite showing signs of severe dysphagia. This indicates that the botulinum neurotoxin type A treatment is only effective for patients with hyperactivation of CP, compared to patients with dysphagia associated with other electrophysiological patterns. Another thing that should be considered is that botox is an invasive procedure that has potential risks including laryngeal muscle weakness/paralysis or worsening of dysphagia [18]. For this reason, the treatment must be implemented by a qualified physician and under electromyographic guidance, in order to rule out those possible risks. Overall, 15 of the 16 patients studied across the two studies showed the predicted positive response to botox. This is consistent with studies of Botox treatment in other overactive or spastic (contracting) muscle systems, where its effects have been well studied and are well understood [18].

The remaining study (Marrosu [15]) included a sample of participants with symptoms that were considerably homogeneous, which could have been helpful in determining the effectiveness of the treatment with specific MS populations. However, it was a low-quality study that was written as a short report. It involved a surgical procedure that was not described thoroughly and clearly in the

methodology, and therefore, it would be difficult to replicate it and provide further evidence to warrant the effectiveness of the treatment.

Overall, this systematic review shows numerous flaws of the reviewed papers; therefore, larger-scale randomised controlled trials and non-randomised controlled are critically required to compare treatments with larger-sample sizes to potentially inform a greater number of clients with MS. Such efforts will serve to generate conclusive evidence through well-controlled experimental designs, including the need for researchers to ensure a degree of participant equality at the start of the trials, need for a reasonable control or alternate treatment group, blinding of judges who evaluate the treatment efficacy, use of follow-up measures and adequate randomization.

Limitations

The current systematic review has few limitations in regard to the search strategy, quality and data analysis. The search resulted in limited number of studies. This may be because the number of searched databases was too small or the search strategy was too specific. As a result, eligible studies may have been missed in spite of the extended search. Furthermore, the quality assessment of each study was done using critical appraisal criteria adapted from other tools such as the single-case -experimental design scale. Therefore, this tool is not a validated one and does not have evidence that supports its usage to qualitatively analyse therapy effect studies. The use of another validated quality assessment tool may have created different results.

Conclusion

Dysphagia is commonly seen in adults with MS, affecting more than 30 % of the population and resulting in complications such as dehydration and aspiration pneumonia. Nevertheless, there is limited number of reports that describe treatment of dysphagia in MS, and no systematic reviews on the therapeutic effects of these treatments were published. Therefore, this systematic review was conducted to appraise the literature related to the effects of treatment of dysphagia in adults with MS. Five studies were included in this systematic review and amongst them were two that involved the use of electrical stimulation and showed some positive therapeutic effects on dysphagia in adults with MS. However, more research is needed due to the low-evidence quality and poor generalisation of these studies.

This systematic review reveals that limited evidence is available for treatment of dysphagia in MS and much work needs to be done to develop its management. Therefore, further research is required to fill in the existing significant gaps in our knowledge on treatment of oropharyngeal dysphagia in those individuals. This would include well-designed Class III within-participant experimental studies, progressing to larger-scale Class II case–control studies and Class I randomised controlled trials to compare relative benefits of different approaches for different dysphagia conditions and patient profiles in adults with MS.

Compliance with Ethical Standards

Conflict of interest No conflicts of interest to declare.

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