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Evidence-based systematic review: Oropharyngeal dysphagia behavioral treatments. Part III—Impact of dysphagia treatments on populations with neurological disorders

John Ashford, PhD;[1] Daniel McCabe, DMA;[2] Karen Wheeler-Hegland, PhD;[3] Tobi Frymark, MA;[4*] Robert Mullen, MPH;[4] Nan Musson, MA;[3] Tracy Schooling, MA;[4] Carol Smith Hammond, PhD[5–6]
[1]Tennessee State University/Vanderbilt University, Nashville, TN; [2]Davenport and Taylor Memorial Hospital, Bath, NY; [3]Malcom Randall Department of Veterans Affairs Medical Center (VAMC), Gainesville, FL; [4]American Speech-Language-Hearing Association, Rockville, MD; [5]Durham VAMC, Durham, NC; [6]Duke University, Durham, NC

Abstract—This evidence-based systematic review (EBSR) is part of a series of reviews examining the state of the research regarding behavioral interventions for dysphagia. This EBSR focuses primarily on dysphagia secondary to neurological disorders (e.g., brain injury, stroke, Parkinson's disease, and dementia). The seven behavioral treatments investigated were three postural interventions (side lying, chin tuck, and head rotation) and four swallowing maneuvers (effortful swallow, Mendelsohn, supraglottic swallow, and super-supraglottic swallow). We systematically searched the dysphagia literature from March 2007 to April 2008 using 14 electronic databases. Seven studies met the inclusion and exclusion criteria and were evaluated for methodological quality and stage of research. Of the included studies, only two were judged to be efficacy research; the remaining five were considered exploratory. Methodological quality of studies ranged from one to seven out of eight possible quality markers. Five of seven treatment interventions were addressed by at least one study. No studies were found to address the effortful swallow or the super-supraglottic swallow. Currently, limited evidence from seven studies shows the potential effects of dysphagia behavioral interventions for select groups of individuals with neurologically induced dysphagia. Further research is needed to evaluate the effectiveness of these and the remaining interventions with various populations with neurological disorders.

Key words: chin-tuck posture, dysphagia, effortful swallow maneuver, evidence-based practice, evidence-based systematic review, head-rotation posture, Mendelsohn maneuver, rehabilitation, side-lying posture, super-supraglottic swallow maneuver, supraglottic swallow maneuver, treatment.

INTRODUCTION

Speech-language pathologists (SLPs) trained in dysphagia management have an integral role in evaluating and treating swallowing disorders for adults with neurologically induced dysphagia. Cerebrovascular accidents (CVAs), head injuries, and degenerative diseases are often associated with oropharyngeal dysphagia and can lead to serious and life-threatening consequences, such as aspiration pneumonia, malnutrition, and immunocompromised health. Data from the Agency of Health Care Policy and Research report an estimated 300,000 to 600,000 individuals each year exhibit some form of dysphagia because of

Abbreviations: ASHA = American Speech-Language-Hearing Association, CVA = cerebrovascular accident, EBSR = evidence-based systematic review, ES = effect size, LMS = Lateral Medullary Syndrome, N-CEP = National Center for Evidence-Based Practice in Communication Disorders, NOMS = National Outcomes Measurement System, PD = Parkinson disease, sEMG = surface electromyography, SLP = speech-language pathologist, VA = Department of Veterans Affairs.

[*]**Address all correspondence to Tobi Frymark, MA; National Center for Evidence-Based Practice in Communication Disorders, American Speech-Language-Hearing Association, 2200 Research Blvd, 245, Rockville, MD 20850; 301-296-8736; fax: 301-296-8588. Email: tfrymark@asha.org**
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neurological illnesses or injuries [1]. Moreover, findings from the American Speech-Language-Hearing Association's (ASHA's) National Outcomes Measurement System (NOMS) indicate swallowing as the most commonly treated disorder for individuals with neurogenic diagnoses [2]. NOMS data reveal that 47.6 percent of patients receiving SLP intervention in healthcare settings are being treated for dysphagia secondary to neurogenic diagnoses; the majority of whom (66.8%) improve swallow function after SLP services [2].

The primary aim of SLP intervention is to reduce the risk of aspiration and improve swallow function for safe and efficient oral intake [3]. To do this, clinicians employ a number of behavioral therapeutic approaches, including the use of compensatory swallowing postures and maneuvers. Pioneered by Larsen in the early 1970s, "neck-flexed postures" and "breath-holding maneuvers" were first introduced to reduce the risk of aspiration and improve deglutition [4]. Others expanded on this early work and further investigated specific compensatory postures of the head and neck as a means to protect the airway, while additional studies examined swallow maneuvers to alter specific aspects of swallow physiology [5–7]. To date, little is known about the effectiveness of these interventions for populations with neurogenic diagnosis.

Recently, ASHA's National Center for Evidence-Based Practice in Communication Disorders (N-CEP) partnered with the Department of Veterans Affairs (VA) to conduct a series of evidence-based systematic reviews (EBSRs) examining the current state of the evidence on compensatory swallowing postures and maneuvers. EBSRs employ specific and transparent procedures to evaluate the scientific research [8], providing an invaluable resource to SLPs seeking evidence. This current review is part of a series of EBSRs targeting the impact of behavioral swallowing treatments, including head and neck postures and swallowing maneuvers for individuals with neurologically induced dysphagia. Other reviews in this series focus on behavioral swallowing treatments of populations with no disorders (Wheeler-Hegland et al., this issue, Part II, p. 185) and populations with structural disorders (McCabe et al., this issue, Part IV, p. 205).

Clinical questions were identified targeting seven behavioral swallowing treatments (postures and maneuvers) for individuals with neurologically induced dysphagia. Operationally defined in Part I (Frymark et al., this issue, p. 175), the goal of postural treatments is to alter the flow of the bolus by repositioning the body, head, and/or neck before the onset of the pharyngeal phase of the swallow, with the position maintained until the swallow is completed. Postures included side lying, chin tuck, and head rotation. Maneuvers were defined as volitional movements of the oral, pharyngeal, or laryngeal structures before or during the pharyngeal phase of the swallow that are intended to increase swallow force or alter airway protection mechanisms. Maneuvers studied included the effortful swallow, Mendelsohn, supraglottic, and super-supraglottic. In constructing the clinical questions, we also considered various outcomes. Outcomes were classified as those effects on swallow physiology (e.g., timing, efficiency, pressure, and elimination of aspiration), functional swallow ability (e.g., oral feeding, weight gain, and quality of life), and pulmonary health (e.g., aspiration pneumonia). Three clinical questions under review were as follows:

1. What is the effectiveness of dysphagia behavioral interventions (i.e., side-lying, chin-tuck, or head-rotation postures; effortful swallow, Mendelsohn, supraglottic swallow, or super-supraglottic swallow maneuvers) on *swallowing physiology* for individuals with neurologically induced dysphagia?
2. What is the effectiveness of dysphagia behavioral interventions (i.e., side-lying, chin-tuck, or head-rotation postures; effortful swallow, Mendelsohn, supraglottic swallow, or super-supraglottic swallow maneuvers) on *functional swallowing outcome*s for individuals with neurologically induced dysphagia?
3. What is the effectiveness of dysphagia behavioral interventions (i.e., side-lying, chin-tuck, or head-rotation postures; effortful swallow, Mendelsohn, supraglottic swallow, or super-supraglottic swallow maneuvers) on *pulmonary health* for individuals with neurologically induced dysphagia?

METHODS

A detailed account of the methods used in this review is described elsewhere in this series. Part I (Frymark et al., this issue, p. 175) outlines the development of the clinical questions, inclusion/exclusion criteria, and search parameters, as well as the scheme used by ASHA and the VA to appraise the evidence. Briefly, we conducted a systematic search of the literature from March 2007 to April 2008, investigating the impact of seven behavioral interventions on individuals with dysphagia secondary to neurological etiology. Studies

were included in this review if they had been published in a peer-reviewed journal from 1985 to 2008, had been written in English, and contained original data pertaining to one or more of the three clinical questions just listed. Studies were limited to those that included individuals aged ≥18 years with the diagnosis of neurologically induced dysphagia. Studies were excluded if they reported data on mixed populations; mixed swallowing treatments; or surgical, medical, or pharmacological interventions along with swallowing treatment.

We identified 219 studies through the systematic search of the literature, which included populations with disorders and nondisorders. Two of the coauthors independently reviewed each citation, with 18 studies meeting preliminary inclusion criteria for this review. Upon review of the full text, 11 studies were further rejected as not meeting inclusion criteria, resulting in a total of 7 studies in the final analysis. Percent agreement between authors for study inclusion was 90 percent.

Accepted studies were evaluated for methodological rigor with the use of the levels-of-evidence scheme developed by ASHA [9]. Authors blinded to one another's results independently appraised each study on a maximum of eight quality indicators (study design, blinding, sampling/allocation, group/participant comparability, outcomes, significance, precision, and intention to treat when applicable) and determined a final quality score. Part I (Table 1 in Frymark et al., this issue, p. 175) highlights the quality markers and corresponding quality indicators in which each study was appraised with quality-marker ratings ordered from highest to lowest quality level for each area evaluated. Studies were awarded 1 point for those indicators rated at the highest quality. Studies pertaining to controlled trials could obtain a maximum quality score of 8, while all other studies, where "intention-to-treat" analysis was not applicable, could obtain a maximum score of 7. Discrepancies in ratings between authors were resolved through consensus by all authors and documented as such. Interrater reliability of study quality between blinded reviewers is reported in Part I (this issue, p. 175).

Studies were then placed into one of four stages of research, including exploratory, efficacy, effectiveness, or cost-benefit/public policy research, with use of the decision tree depicted in Part I (Figure 2 in Frymark et al., this issue, p. 175). Data were extracted on participant and intervention variables for each study, and effect sizes (ESs) were reported or calculated for outcome measures when possible [10–11]. A final synthesis of the body of scientific literature is reported based on the study quality-marker scores and corresponding stage of research.

RESULTS

After reviewing and selecting the studies pertaining to neurological impairments, we examined only five of the seven postural techniques or maneuvers: chin-tuck, side-lying, and head-rotation postures and Mendelsohn and supraglottic swallow maneuvers. Studies of dysphagia treatment using the effort swallow and the super-supraglottic maneuvers were not included because no studies examining these interventions met the selection criteria for this review. Of the seven studies that met the inclusion criteria, four evaluated the impact of behavioral treatments on swallowing physiology (clinical question 1) [12–15], two addressed functional swallowing outcomes (clinical question 2) [16–17], and only one addressed pulmonary health outcomes (clinical question 3) [18]. The remaining 212 studies were rejected as (1) not addressing swallowing outcome specifically, (2) not addressing dysphagia intervention with populations with neurological impairments, (3) not using compensatory and/or swallowing intervention maneuvers, or (4) using more than one intervention approach simultaneously with another.

Study Characteristics and Quality

We evaluated accepted studies for methodological rigor using the quality evaluative scheme developed by ASHA [9], as just described. Quality-marker scores for included studies are presented in **Table 1**. Five studies were exploratory and scored ≤4 out of 7 possible quality markers [13–17], and two studies were efficacy trials [12,18]. These two studies scored highest on the ASHA quality assessment regimen [9], with a score of 7 of 8 possible markers, including intent-to-treat analysis. One point was deducted for lack of assessor blinding.

Participant and Intervention Characteristics

A cumulative total of 820 participants were reported in the seven studies. Totals include use of overlapping participants in two studies [12,18]. Each participant was medically diagnosed with one or more primary neurological disorders, including Parkinson disease (PD) with and without dementia (47%), dementia (43%), CVA (6%), cerebellar ataxia (3%), head injury (1%), and other neurological diagnoses such as motor neuron disease, multiple sclerosis,

Table 1.
Methodological quality, stage of research, and quality-marker scores for seven studies reviewed.

Study	Design	Assessor Blinding	Random Sampling Described	Subjects Comparable/ Described	Valid Outcome Measure	Significance	Precision	Intention to Treat	Quality-Marker Score	Research Stage
Crary et al., 2004 [1]	Case series	No	No	Yes	Yes	Yes	Yes	NA	4 of 7	Exploratory
Drake et al., 1997 [2]	Case study	No	No	Yes	No	No	No	NA	1 of 7	Exploratory
Logemann et al., 2008 [3]	Controlled trial	No	Yes	Yes	Yes	Yes	Yes	Yes	7 of 8	Efficacy
Logemann et al., 1989 [4]	Case series	No	No	No	No	Yes	Yes	NA	2 of 7	Exploratory
Nagaya et al., 2004 [5]	Case series	Yes	No	Yes	Yes	No	No	NA	3 of 7	Exploratory
Robbins et al., 2008 [6]	Controlled trial	No	Yes	Yes	Yes	Yes	Yes	Yes	7 of 8	Efficacy
Shanahan et al., 1993 [7]	Case control	No	No	No	No	Yes	No	NA	2 of 7	Exploratory

1. Crary MA, Carnably Mann GD, Groher, ME, Helseth E. Functional benefits of dysphagia therapy using adjunctive sEMG biofeedback. Dysphagia. 2004;19(3): 160–64. [PMID: 15383945] DOI:10.1016/0003-9993(93)90035-9
2. Drake W, O'Donoghue S, Bartram C, Lindsay J, Greenwood R. Eating in side-lying facilitates rehabilitation in neurogenic dysphagia. Brain Inj. 1997;11(2):137–42. [PMID: 9012947] DOI:10.1080/026990597123737
3. Logemann JA, Gensler G, Robbins J, Lindblad AS, Brandt D, Hind JA, Kosek S, Dikeman K, Kazandjian M, Gramigna GD, Lundy D, McGarvey-Toler S, Miller Gardner PJ. A randomized study of three interventions for aspiration of thin liquids in patients with dementia or Parkinson's disease. J Speech Lang Hear Res. 2008;51(1):173–83. [PMID: 18230864] DOI:10.1044/1092-4388(2008/013)
4. Logemann JA, Kahrilas PJ, Kobara, M, Vakil NB. The benefit of head rotation on pharyngoesophageal dysphagia. Arch Phys Med Rehabil. 1989;70(10):767–71. [PMID: 2802957]
5. Nagaya M, Kachi T, Yamada, T, Sumi Y. Videofluorographic observations on swallowing in patients with dysphagia due to neurodegenerative diseases. Nagoya J Med Sci. 2004;67(1–2):17–23. [PMID: 15279064]
6. Robbins J, Gensler G, Hind J, Logemann JA, Lindblad AS, Brandt D, Baum H, Lilienfeld D, Kosek S, Lundy D, Dikeman K, Kazandjian M, Gramigna GD, McGarvey-Toler S, Miller Gardner PJ. Comparison of 2 interventions for liquid aspiration on pneumonia incidence: A randomized trial. Ann Intern Med. 2008; 148(7):509–18. [PMID: 18378947] Erratum in: Ann Intern Med. 2008;148(9):715.
7. Shanahan TK, Logemann JA, Rademaker AW, Pauloski BR, Kahrilas PJ. Chin-down posture effect on aspiration in dysphagic patients. Arch Phys Med Rehabil. 1993;4(7):736–39. [PMID: 8328896] DOI:10.1016/0003-9993(93)90035-9

NA = not applicable.

and depression (1%). As can be seen in **Table 2**, which presents the medical diagnoses of all participants by study, diagnostic category representations were skewed toward PD and dementia because of the high number of participants with these diagnoses reported in the Logemann et al. study (711 participants; 87% of the total number of subjects) [12]. The ages of the participants ranged from 23 [13] to 95 years [12]. All studies explicitly stated that all participants met the inclusion criteria of demonstrated dysphagia, and two studies explicitly stated an additional inclusion criterion of demonstrated aspiration [12,18]. Dysphagia and aspiration were confirmed in all participants by using the videofluoroscopic swallow study. Aspiration was verified in participants in four studies by using videofluoroscopy [12,14–15,18]. Bedside assessments for dysphagia were reported in only one study as the referral basis for further instrumental study and subsequent inclusion of the participants in the study [12]. The remaining studies did not report screening or preinstrumental assessment as part of the study methodology.

Clinical Question 1

Of the 219 studies reviewed, four [12–15] were applicable to clinical question 1 (p. 196) in addressing physiological outcomes used in behavioral dysphagia treatments (**Table 2**). Three studies examined the physiological effects of the chin-tuck posture [12,14–15], all of which reported its impact on decreasing aspiration. Shanahan et al. also examined the effects of chin tuck on increasing swallowing onset [15].

Use of the chin tuck was reported to have eliminated aspiration in 15/30 (50%) participants included in a mixed sample of participants neurologically involved [15] and in 1/13 (8%) of participants with PD and 4/7

Table 2.
Participant and intervention characteristics by clinical question.

Study	*N*	Age (yr)	Sex		Etiology	Intervention	Outcome	Effect Size (95% CI)	Clinical Question*
			Male	Female					
Logemann et al., 2008 [1]	711	50–95	498	213	PD: 228 Dementia: 351 PD + dementia: 132	Chin tuck	Aspiration	RRR = –0.22 (–0.18 to –0.27); chin tuck vs honey-thick liquids RRR = –0.07 (–0.11 to –0.001); chin tuck vs nectar-thick liquids	1
Logemann et al., 1989 [2]	5	23–70	NR	NR	CVA with lateral medullary infarct	Head rotation	Oral phase timing UES opening UES diameter % Bolus into esophagus Laryngeal elevation distance	*d* = 0.42 (–0.87 to 1.63) *d* = 0.48 (–0.82 to 1.68) *d* = 0.67 (1.67 to 1.87) NR NR	1
Nagaya et al., 2004 [3]	25 23	M = 57 M = 70	12 9	13 14	PD Cerebral ataxia	Chin tuck; supraglottic swallow	Aspiration	NR NR	1
Shanahan et al., 1993 [4]	30	M = 74.3	15	15	CVA: 16 Motor neuron: 4 CHI: 4 MS: 2 Dementia: 2 Depression: 2	Chin tuck	Aspiration eliminated; pyriform retention	NR	1
Crary et al., 2004 [5]	25	M = 69	16	9	CVA	Mendelsohn maneuver	Oral intake	RR = 2.2 (1.4 to 3.5)	2
Drake et al., 1997 [6]	1	26	1	0	Head injury	Side lying	Oral intake	NR	2
Robbins et al., 2008 [7]	259	M = 81	178	81	Dementia: 131 PD: 83 PD + Dementia: 45	Chin tuck	Aspiration pneumonia	RRR = 0.02 (–0.04 to 0.07)	3

1. Logemann JA, Gensler G, Robbins J, Lindblad AS, Brandt D, Hind JA, Kosek S, Dikeman K, Kazandjian M, Gramigna GD, Lundy D, McGarvey-Toler S, Miller Gardner PJ. A randomized study of three interventions for aspiration of thin liquids in patients with dementia or Parkinson's disease. J Speech Lang Hear Res. 2008;51(1):173–83. [PMID: 18230864] DOI:10.1044/1092-4388(2008/013)
2. Logemann JA, Kahrilas PJ, Kobara, M, Vakil NB. The benefit of head rotation on pharyngoesophageal dysphagia. Arch Phys Med Rehabil. 1989;70(10):767–71. [PMID: 2802957]
3. Nagaya M, Kachi T, Yamada, T, Sumi Y. Videofluorographic observations on swallowing in patients with dysphagia due to neurodegenerative diseases. Nagoya J Med Sci. 2004;67(1–2):17–23. [PMID: 15279064]
4. Shanahan TK, Logemann JA, Rademaker AW, Pauloski BR, Kahrilas PJ. Chin-down posture effect on aspiration in dysphagic patients. Arch Phys Med Rehabil. 1993;74(7):736–39. [PMID: 8328896] DOI:10.1016/0003-9993(93)90035-9
5. Crary MA, Carnably Mann GD, Groher, ME, Helseth E. Functional benefits of dysphagia therapy using adjunctive sEMG biofeedback. Dysphagia. 2004;19(3): 160–64. [PMID: 15383945] DOI:10.1016/0003-9993(93)90035-9
6. Drake W, O'Donoghue S, Bartram C, Lindsay J, Greenwood R. Eating in side-lying facilitates rehabilitation in neurogenic dysphagia. Brain Inj. 1997;11(2):137–42. [PMID: 9012947] DOI:10.1080/026990597123737
7. Robbins J, Gensler G, Hind JA, Logemann JA, Lindblad AS, Brandt D, Baum H, Lilienfeld D, Kosek S, Lundy D, Dikeman K, Kazandjian M, Gramigna GD, McGarvey-Toler S, Miller Gardner PJ. Comparison of 2 interventions for liquid aspiration on pneumonia incidence: A randomized trial. Ann Intern Med. 2008; 148(7):509–18. [PMID: 18378947] Erratum in: Ann Intern Med. 2008;148(9):715.

*See p. 196 of main text for clinical questions.

CHI = closed head injury, CI = confidence interval, CVA = cerebrovascular accident, *d* = Cohen's *d* effect size, M = mean, MS = multiple sclerosis, NR = not reported, PD = Parkinson's disease, RR = relative risk, RRR = relative risk reduction, UES = upper esophageal sphincter.

(57%) participants with cerebellar ataxia [14]. Similarly, in a large-scale randomized-controlled trial that compared the use of chin tuck and thin liquids versus thickened liquids alone (no chin tuck), chin tuck was reported to eliminate aspiration in 92/228 (33%) participants with PD and in 90/351 (26%) participants with dementia [12].

Nagaya et al. examined these same effects with the supraglottic swallow maneuver [14]. Results from this study revealed that only 1 out of 12 participants with PD (8%) successfully executed the maneuver and subsequently eliminated aspiration [14]. Only one study examined the impact on physiological variables other than aspiration [13].

Logemann et al. reported the effects of head rotation in five patients with Lateral Medullary Syndrome (LMS) [13]. The estimated amount of bolus swallowed improved from an average 33 percent with the head in the neutral position to 65 percent with the head rotated to the weak side. Oropharyngeal efficiency and cricopharyngeal anteroposterior opening diameter increased slightly ($p > 0.05$) in participants with the head rotated to the weak side. ESs were 0.42 for oropharyngeal efficiency and 0.67 for cricopharyngeal anteroposterior opening diameter.

Study designs included case series [13–14], case control design [15], and randomized-control trial design [12]. Statistical treatment of data was variable. Two studies used *t*-tests to determine probability of significance [13,15], and Logemann et al. used unadjusted pairwise comparisons [12]. Nagaya et al. provided data tables but no probability analyses [14]. Data describing the time between disease onset or dysphagia onset and intervention were highly variable [12,14–15] or not stated [13].

Clinical Question 2

The review of 219 citations revealed only two studies that apply to clinical question 2 (p. 196) in addressing functional outcomes using behavioral management (**Table 2**) [16–17]. These studies examined the Mendelsohn maneuver [16] and side-lying posture [17].

The Mendelsohn maneuver was studied in a case series, quasi-experimental study of participants with CVA [16]. The effect of this maneuver was monitored over an average 12 of 32 sessions with surface electromyography (sEMG) employed as a mechanism to monitor performance of the maneuver. Before treatment onset, 20 of 25 participants (80%) initially depended on nonoral feeding. Following treatment, 11of 20 participants (55%) progressed to total oral feeding. When compared with a similar group of participants with head and neck cancer, the group with stroke was more likely to improve to normal or functional food intake after this treatment regimen.

Drake et al. presented a case study of one 26-year-old participant using the side-lying posture to safely take oral feeding [17]. The participant was a patient with a closed head injury. Videofluoroscopic swallow study procedures, with patient in both the upright position and in a side-lying posture of 45°, documented how postural changes improved functionality over a 12-month recovery period. Swallow studies revealed oral and pharyngeal difficulties, including aspiration. The study had a number of methodological weaknesses. Functional outcome measures were based on findings from multiple videofluoroscopic swallow studies. Additionally, the findings could not statistically be treated because of the limitations of a case study design.

Clinical Question 3

Of the 219 studies reviewed based on clinical question 3 (p. 196), only 1 study was found that specifically addressed the issues of dysphagia, its treatment, and the incidence of pneumonia from aspiration (**Table 2**) [18]. All other studies reviewed were excluded because they did not directly address the issue of pulmonary health.

The Robbins et al. study [18], a randomized-controlled three-group parallel design, enrolled 515 participants between the ages of 50 and 95 years with physician-identified diagnoses of PD or dementia. Eligibility required observed aspiration on a videofluoroscopic swallow study with use of thin liquid. Participants were randomized to one of three intervention conditions for study for 3 months: chin-tuck posture with the use of thin liquid, nectar-thick liquid, and honey-thick liquid.

The Robbins et al. study limits treatment to the chin-tuck posture using thin liquid or thicker liquid consistencies [18]. No other dysphagia interventions were used during the 3-month treatment period. Assessed outcomes were presence of definite pneumonia and definite pneumonia and death, which relate directly to clinical question 3. Robbins et al. analyzed data using cumulative incidence rates for the outcomes of pneumonia and pneumonia or death using Kaplan-Meier life table calculations, intervention effects using a Cox model approach, and Fisher exact tests for comparisons [19–20].

DISCUSSION

This systematic review is part of an EBSR series that systematically examined the peer-reviewed literature evaluating the effects of behavioral-based intervention maneuvers or postural changes on the physiology, functionality, and pulmonary health of persons with oropharyngeal dysphagia. The preceding review in this series (Wheeler-Hegland et al., this issue, Part II, p. 185) concentrated on measurement of swallow physiology changes in nondisabled participants who were nondysphagic and included the greatest number of studies (17). This review examines the effects of these same dysphagia behavioral interventions in individuals with neurologically induced

dysphagia; while the final EBSR article in the series (McCabe et al., Part IV, p. 205) examined their effectiveness in individuals with structurally induced dysphagia (i.e., histories of head and neck cancer). Two additional articles in this series provided the specific methodology used to conduct the systematic reviews (Frymark et al., this issue, Part I, p. 175) as well as highlights the application of the EBSR findings to clinicians and researchers (Wheeler-Hegland et al., Part V, p. 215).

Questions posed by this review searched for specific evidence to support the use of select postural changes or physical maneuvers to effect positive change in the oropharyngeal swallowing functions in persons with neurological disorders. Specifically, do these postural changes and/or maneuvers significantly alter the neuromuscular physiology of swallowing, improve the functional outcomes for persons with dysphagia, and/or affect the pulmonary health of persons with dysphagia? The results of this clinical research review reveal a lack of sufficient homogeneity among studies, their study populations, research design rigor, and statistical treatments to answer these questions definitively. To date, a sufficient number and quality of reports have not provided clinicians with a clear understanding of the effectiveness and limitations of behavioral posture and maneuver interventions with persons with neurologically induced dysphagia.

Numerous studies have been published on oropharyngeal dysphagia and its treatments, but for most, their designs, use of mixed treatments, populations studied, numbers of subjects, methods of analyses, and results have been conducted more for preexperimental exploration rather than for substance, direction, and advancement of science. For example, of the seven studies that meet the criteria for inclusion in this review, four used quasi-experimental research designs [13–16] and one was nonexperimental [17]. Exceptions were the randomized-controlled trials reported by Logemann et al. [12] and Robbins et al. [18]. The two studies earned quality-marker scores of 7 out of a possible 8 points based on ASHA's levels-of-evidence scheme [9]. Methodological weaknesses were found among all the studies reviewed, including descriptive data reporting and lack of blinding and randomization. Four of the seven studies provided data adequate for ES calculations [12–13,16,18].

Kuhlemeier et al. report that dysphagia is a frequent complication of CVAs [21]. An incidence rate of 37 to 78 percent has been reported for this population [22]. However, studies meeting the inclusion criteria for this review included few participants with stroke. Of the seven studies reviewed, only 46 of 820 participants (6%) were reported to have suffered strokes. To the contrary, nearly equal numbers of participants with dementia and/or PD made up the majority of subjects in all studies reviewed. In addition, the majority of participants were reported in only two studies by Logemann et al. [12] and Robbins et al. [18], as can be seen in **Table 2**. Thus, findings of maneuver or posture effectiveness cannot be generalized to all persons who are neurologically impaired based on this EBSR and specifically cannot be applied to the population with stroke and dysphagia.

Clinical question 1 of this review asks how effective swallowing treatments are for altering swallowing physiology. Four studies reported the effects of physiological alterations on the swallowing mechanism using two postural changes (chin tuck and head rotation) and one physical maneuver (supraglottic swallow) [12–15]. Contrary to the clinical popularity of the chin-tuck posture, the findings from this review suggest it provides only limited physiological protection against aspiration in patients with neurological disorders. Logemann et al. reported the chin-tuck posture provided protection from aspiration in only 41 percent of patients with PD [12]. Similarly, Shanahan et al. reported elimination of aspiration in 50 percent of participants in a mixed sample of persons who are neurologically involved [15], and Nagaya et al. reported only 8 percent of participants with PD and 57 percent of participants with cerebellar ataxia used the chin-tuck posture effectively [14]. These data suggest the chin-tuck posture may be effective in reducing or eliminating aspiration in only up to one-half of patients with neurologically involved dysphagia. Even more telling of the limited usefulness of the chin-tuck posture are the findings in the Logemann et al. study indicating that using the posture with thin liquids was the least effective in preventing aspiration compared with using thickened liquids alone [12]. This finding is surprising given the wide acceptance of the chin tuck in clinical practice.

Although the chin tuck is a simple physiological postural adjustment and one that most patients can easily accomplish, Nagaya and colleagues reported that 40 percent of their participants with PD could not perform this posture [14]. These data suggest that the chin-tuck posture for some patients, particularly with end-stage degenerative disease, is not a task that is simply performed but may require more

physical strength, neuromotor control, and cognitive skill than has been routinely appreciated by clinicians.

Head rotation was the second postural change reviewed among the physiological treatment effects on dysphagia. This postural adjustment of head position to alter bolus flow through the pharynx has been examined in only one study of patients following LMS [13]. No other studies were found reporting the use of the head rotation with any other populations who are neurologically impaired. While Logemann and colleagues provide preliminary and exploratory clinical evidence supporting the effectiveness of this posture change with LMS patients [13], the study's limited sample size of five warrants caution in the generalization of their results to other patients with stroke. Thus, the evidence base supporting the use of the head-rotation posture with patients who are neurologically involved is severely limited.

Laryngeal Valsalva maneuver, or the supraglottic swallow, was investigated in one study [14]. Results from Nagaya et al. indicate that this maneuver is difficult for some patients to learn and manage [14]. Only 1 out of 13 participants with PD (8%) successfully executed the maneuver and subsequently eliminated aspiration. Four of seven participants (57%) with cerebellar ataxia successfully executed the maneuver and were able to eliminate aspiration, but as noted with patients with PD, some of the participants with cerebellar ataxia (43%) could not perform this maneuver effectively or could not eliminate aspiration using this maneuver. The review process did not identify any other studies reporting the physiological effects of the supraglottic swallow maneuver with persons who are neurologically impaired, particular those following strokes. From these limited findings, the supraglottic swallow maneuver may be an effective treatment for a limited number of patients who are neurologically impaired, but it may prove too difficult to perform for some with reduced cognitive and motor skills.

Clinical question 2 of this systematic review asks if postural changes or maneuvers effectively improve functional outcomes. Functional outcome studies related to posture changes or maneuvers have been reported in two studies [16–17]. Crary et al. examined the use of the Mendelsohn maneuver in 25 participants with CVA using sEMG to monitor performance of maneuver [16]. The paired combination of the Mendelsohn maneuver with biofeedback sEMG is a promising treatment method for some patients with neurological problems. The improvement in functional oral intake in roughly half the stroke patients studied suggests that maneuver-based treatment approaches may be facilitated with the concurrent use of biofeedback, which provides patients with visible, physiological targets to execute treatment properly. This pairing also affords clinicians and researchers the ability to consistently monitor patient or subject task performance, either with daily training logs completed by the patient or subject or during each therapy session. As such, quantifiable short-term treatment goals can be monitored and adjusted within and between sessions in a manner in which progress is clear and meaningful for both the patient and clinician.

Drake and colleagues reported a single case study of a male patient with a head injury who used the side-lying posture to improve oral intake [17]. The participant eventually reestablished self-feeding in an upright posture. The side-lying posture is the only behavioral treatment included in this review that bears no support from studies with nondisordered swallowers (Wheeler-Hegland et al., this issue, Part II, p. 185). As such, the specific physiological mechanisms that underlie the functional improvements noted for this single subject study are not clear [17]. With the paucity of physiological evidence and the lack of experimental control in this single subject report, elucidating whether the functional improvement noted was due to a treatment effect or natural recovery over time is difficult. To date, insufficient literature shows that an evidence base exists for using the side-lying posture as a treatment for neurogenic dysphagia.

Clinical question 3 of this systematic review asks if the use of postural changes and maneuvers in behavioral treatment of dysphagia affects pulmonary health. The direct relationship between impaired pulmonary health (i.e., pneumonia from aspiration) and laryngotracheal aspiration has not been firmly established, but bacteria from the oropharynx are suspected to be the leading cause of pneumonia from aspiration [23]. Aspiration pneumonia is a major cause of morbidity and mortality among older persons who are hospitalized or in nursing homes [24]. A study by Robbins et al. was the only study located during the literature search that examined the incidence of pneumonia among a cohort of 259 participants with PD or dementia [18]. The conclusion from this study was that the chin-tuck posture when used with thin liquids does not effectively reduce the incidence of pneumonia among populations with PD and dementia [18]. These findings raise important questions about the use of behavioral treatments with certain populations and whether behavioral

intervention, indeed, reduces potential development of pneumonia. Furthermore, these results do not directly address the use of the chin-tuck posture in preventing pneumonia with the population with CVA or other subpopulations of persons with neurologically induced dysphagia. These studies are still needed.

CONCLUSIONS

Future research should continue to test postural alterations and maneuvers in well-designed and -controlled studies using quantifiable, relevant outcome measures in specific populations. The results of this systematic review indicate that the research supporting behavioral interventions of postures or maneuvers is young and sparse and use of these interventions should be considered and weighed with other important aspects of clinical decisions, which include the expertise of the treating clinician and patient preferences. By understanding all aspects of evidence-based decisions, the clinician is an invaluable team member who is instrumental in facilitating change to promote the best possible outcome for the patient.

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Author Contributions:
Study concept and design: T. Frymark, T. Schooling, R. Mullen, K. Wheeler-Hegland, J. Ashford, D. McCabe, N. Musson, C. Smith Hammond.
Analysis and interpretation of data: T. Frymark, T. Schooling, R. Mullen, K. Wheeler-Hegland, J. Ashford, D. McCabe, N. Musson, C. Smith Hammond.
Drafting of manuscript: T. Frymark, D. McCabe, J. Ashford.
Critical revision of manuscript for important intellectual content: J. Ashford, T. Frymark.
Statistical analysis: R. Mullen.
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