Oropharyngeal Dysphagia
Screening and Assessment

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KEYWORDS

• Oropharyngeal dysphagia • Screening • Assessment • Quality of life
• Diagnostic performance • Reliability • Methodology

KEY POINTS

- Bedside screening is an essential first step in the management of patients at risk for dysphagia. If patients fail the screening further assessment is required.
- Assessment may relate to different aspects of swallowing. Abnormalities in swallowing are not necessarily correlated and may show dissimilar changes after treatment. Therefore, including several evaluation techniques when studying swallowing problems may be useful.
- There are a great variety of screening and assessment tools for dysphagia available; use of a particular tool must be justified based on its reliability and validity and its discriminative and evaluative purpose.
- There is an urgent need for evidence-based clinical guidelines for screening and assessment of patients with oropharyngeal dysphagia.

INTRODUCTION

Because the human aerodigestive tract caters to the combined functions of breathing, vocalizing, and swallowing, the large supralaryngeal space created by the low larynx positioning in adults increases a risk of aspiration or choking. Any dysfunction in this system may lead to dysphagia.[1] Dysphagia is associated with high morbidity and mortality rates. It can lead to dehydration, malnutrition, or aspiration pneumonia and may have major effects on social and psychological well-being.[2] Early and reliable screening for symptoms of dysphagia in subject populations at risk is an effective

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Abbreviations	
FEES	Fiberoptic endoscopic evaluation of swallowing
FHS	Functional health status
HRQOL	Health-related quality of life
Se	Sensitivity
Sp	Specificity
VFS	Videofluoroscopy

and vital first step in appropriate dysphagia management.[3] Those patients that fail the initial screening need to be referred for further clinical assessment. Apart from videofluoroscopic (VFS) and fiberoptic endoscopic evaluation of swallowing (FEES), a variety of assessment tools and patient self-evaluation questionnaires are found in the literature. This article provides an overview of bedside screening and assessment tools for patients with oropharyngeal dysphagia with emphasis on diagnostic performance and methodology.

BEDSIDE SCREENING

An Overview

It is generally agreed that the first step in the management of patients at risk for oropharyngeal dysphagia is bedside screening.[4] Bedside screening aims at identifying patients at risk for aspiration or unsafe swallowing as a step before further clinical assessment. Screening tools need to meet several criteria: easy administration, few time-consuming procedures, noninvasive methods avoiding distress to patients, and well-defined noncomplex training of health allied practitioners. Above all, screening methods need to be valid and reliable. In 2009, Bours and colleagues[5] published a systematic review on the psychometric characteristics of bedside screening tests for detecting dysphagia in adult patients with neurologic disorders using either VFS or FEES as a reference test. Meanwhile, Kertscher and colleagues[6] have carried out an updated review of the literature including recent literature up to December 2012. In both reviews, criteria on validity, generalizability, and reliability were adapted from the Dutch Cochrane Center (**Table 1**) and used to assess the methodologic quality of the included studies on diagnostic tests. An overview of studies with an overall sufficient methodologic quality is presented in **Table 2**. Next, diagnostic performance was determined by calculating prevalence, sensitivity, specificity, positive and negative predictive value, and likelihood ratio of a negative or positive test. Sufficient diagnostic performance was defined as high sensitivity ($\geq$70%) and moderate specificity ($\geq$60%). Studies showing sufficient methodologic quality and describing bedside screening tests having sufficient diagnostic performance are summarized in **Table 3**. The list of different types of bedside screening includes trial swallow tests using different aliquots of water, various viscosities and/or volumes, or combining the results of pulse oximetry. Furthermore, data are available on the application of oxygen desaturation using a single water swallow, the screening for clinical features during an oropharyngeal examination, and the implementation of a standardized form on clinical identifiers to detect unsafe swallow. The feasibility of the screening tests in terms of complexity and time required to execute the screening proved to be sufficient for all 10 studies. Further details on the studies that were included in the review, especially on other psychometric characteristics, such as likelihood ratios of screening tools, can be found in the original articles and in the systematic reviews by Bours and colleagues[5] and Kertscher and colleagues.[6]

Table 1
Criteria for methodologic quality assessment of studies (according to the Dutch Cochrane Center)

Number	Quality Criteria[a]	Domain
1	Were the reference test and the index test interpreted independently (blinded)?	Validity
2	Was the reference test applied to all patients who received the index test?	
3	Was the index test applied independent of relevant information on clinical data of the patient regarding the target condition?	
4	Was the period between the reference test and the index test short enough to be reasonably sure that the target condition did not change between the two tests? (within 24 h in acute stroke, and within 7 d in order neurologic diseases)	
5	Was the selection of the study population valid?	
6	Are data presented in enough detail to calculate appropriate test characteristic?	
7	Was the study population appropriate to evaluate the proposed use of the index test?	Generalizability
8	Was the index test described in detail so it could be reproduced?	Reliability
9	Were satisfactory definitions used for normal/abnormal reference test results and normal/abnormal index test results?	

[a] Scoring of criteria: +, if item has been addressed; −, if item has been violated; ?, if no information is available.

Data from Methodological Quality Assessment in Diagnostic Studies. Available at: http://www.cochrane.nl.

Selection of Bedside Screening

Summarizing all studies, both cited literature reviews conclude that no statistical pooling proved possible because of the heterogeneity of the bedside screening tests, the differences in implementation of tests, and diversity in end points either in the reference or in the index test. Only a few tests met the criteria for sufficient methodologic quality and diagnostic performance. Still, when deciding which type of bedside screening to implement in a clinical setting several factors need to be considered. First of all, the criteria used to describe study quality may sometimes be open to discussion and different interpretation.[22,23] Furthermore, the psychometric characteristics of a diagnostic test need to be taken into account. In both literature reviews[5,6] sufficient diagnostic performance was defined as high sensitivity and moderate specificity: sensitivity greater than or equal to 70% and specificity greater than or equal to 60%. These fixed cutoff points, however, could be argued. Apart from the fact that cutoff points may be somewhat arbitrary, possibly excluding screening tests by only failing a few percentages, different bedside tests may aim at different goals in distinct clinical settings. For example, the 3-oz water swallow test by Suiter and Leder[19] did meet the original methodologic quality standards but failed the criteria on psychometric characteristics. Although the sensitivity was very high (97%) the specificity was only 49%, suggesting an optimal patient safety by missing hardly any patients at risk for aspiration, but meanwhile having many false-negatives. Failing the screening protocol indicates the need for further assessment, but not all work settings may be

Table 2
Studies with sufficient methodologic quality[a]: type of bedside screening plus diagnostic performance[b]

References (N = 16)	Type of Bedside Screening	Diagnostic Performance
Chong et al,[7] 2003	Trial swallow using water	+
	Trial swallow using water in combination with oxygen desaturation	+
	Trial swallow using different viscosities in combination with oxygen desaturation	+
	Oxygen desaturation	–
Clavé et al,[8] 2008	Trial swallow using different viscosities	+
	Trial swallow using different viscosities in combination with oxygen desaturation	+
Daniels et al,[9] 1997	Trial swallow using water	–
	Clinical features	+
Leder & Espinosa,[10] 2002	Standardized form with clinical features	–
Lim et al,[11] 2001	Trial swallow using water	+
	Trial swallow using different viscosities in combination with oxygen desaturation	+
	Oxygen desaturation	+
Logemann et al,[12] 1999	Trial swallow using various viscosities	–
	Clinical features	–
	Standardized form with clinical features	–
Mann,[13] 2002	Standardized form with clinical features	+
Mari et al,[14] 1997	Trial swallow using water	–
Martino et al,[15] 2009	Trial swallow using water	+
McCullough et al,[16] 2001	Trial swallow using different viscosities	+
	Clinical features	–
	History components	–
Smith et al,[17] 2000	Trial swallow using different viscosities	+
	Trial swallow using different viscosities in combination with oxygen desaturation	+
	Oxygen desaturation	–
Smithard et al,[18] 1998	Trial swallow using water	+
Suiter & Leder,[19] 2008	Trial swallow using water	–
Trapl et al,[20] 2007	Trial swallow using different viscosities	+
Wakasugi et al,[21] 2008	Cough elicitation	–

[a] Methodologic quality is considered to be sufficient if no more than one criteria (see Table 1) has been allocated a minus or a question mark.
[b] Diagnostic performance is considered to be sufficient (+) when minimum criteria of specificity ≥60% and sensitivity ≥70% are met; other studies are indicated by a minus (–).

Data from Refs.[7–21]; Bours GJ, Speyer R, Lemmens J, et al. Bedside screening methods for dysphagia in neurologic patients: a systematic review. J Adv Nurs 2009;65(3):487; and Kertscher B, Speyer R, Palmieri M, et al. Bedside screening to detect oropharyngeal dysphagia in patients with neurologic disorders: an updated systematic review. 2013 Sep 13. [Epub ahead of print].

able to deal with so many requests for follow-up. Another choice to be made is the type of boluses used in the screening test. Clavé and colleagues[8] introduce the volume-viscosity swallowing test, a trial swallow protocol including three different viscosities and volumes. The test results may provide direct indications for choices on

Table 3
Overview of studies with sufficient methodologic quality and bedside screening with sufficient diagnostic performance (specificity ≥60% and sensitivity ≥70%)

Type of Bedside Screening	References (N = 11)	Description Bedside Screening	End Point Bedside Screening	Psychometric Characteristics	
				Sensitivity	Specificity
Trial swallow using water	Chong et al,[7] 2003	5 × 10 mL of water	Coughing, choking, or voice change	79	63
	Lim et al,[11] 2001	5 × 10 mL of water	Coughing, choking, or voice change	85	75
	Martino et al,[15] 2009	Toronto Bedside Swallowing Screening Test *1st step*: screening for abnormalities (eg, breathiness, gurgles, hoarseness, whisper quality of voice, and tongue moments); *2nd step*: 10 × 1 tsp. of water	Failure at any item (of 1st or 2nd step)	91 (all patients) 96 (acute patients) 80 (rehabilitation patients)	67 (all patients) 64 (acute patients) 68 (rehabilitation patients)
	Smithard et al,[18] 1998	*1st step*: 3 × 5 mL of water; *2nd step*: 60 mL of water (in 2 min)	Coughing, choking, and/or wet voice: present in two out of three trials (1st step) or any swallow (2nd step) Assessment by physician	70	66

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Table 3
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Type of Bedside Screening	References (N = 11)	Description Bedside Screening	End Point Bedside Screening	Psychometric Characteristics	
				Sensitivity	Specificity
Trial swallow using different viscosities	McCullough et al,[16] 2001	*4 sections*: history, oral motor (speech and praxis), voice, and trial swallows *Protocol trial swallows* Thin liquid (2 × 5 mL); Thick liquid (2 × 5 mL); Puree (2 × 5 mL); Solid (2 × 0.25 of a cookie)	Subjective overall judgment of likelihood of aspiration	78 (trial swallows)	63 (trial swallows)
	Smith et al,[17] 2000	Variety of quantities and consistencies	Subjective assessment of aspiration	80	68
	Trapl et al,[20] 2007	Gugging Swallowing Screen *1st step*: Indirect swallowing test (saliva test); *2nd step*: Direct swallowing test; Semisolid (one-third to one-half tsp., 5 × 0.50 tsp. of thickened water); Thin liquid (3, 5 10, 20, 50 mL of water); Solid (5 × small piece of dry bread)	Risk of aspiration on Gugging Swallowing Screen	100	63
	Clavé et al,[8] 2008	*Volume-Viscosity Swallowing Test* Nectar (5, 10, and 20 mL); Water (5, 10, and 20 mL); Pudding (5, 10, and 20 mL)	Penetration Piecemeal deglutition (multiple swallows per bolus)	84 88	65 87

Trial swallow using water in combination with oxygen desaturation	Chong et al,[7] 2003	*Water test* 5 × 10 mL of water *Pulse oximetry* (during fiberoptic endoscopic evaluation of swallowing) 3 to 5 spoons of 8 mL honey, nectar, thin and paste consistency	Coughing, choking, or voice change or ≥2% desaturation	94	63
Trial swallow using different viscosities in combination with oxygen desaturation	Chong et al,[7] 2003	*Water test* 5 × 10 mL of water *Pulse oximetry* (during fiberoptic endoscopic evaluation of swallowing) 3 to 5 spoons of 8 mL honey, nectar, thin and paste consistency	Coughing, choking, or voice change or ≥2% desaturation	94	63
	Clavé et al,[8] 2008	*Volume-Viscosity Swallowing Test* Nectar (5, 10, and 20 mL); Water (5, 10, and 20 mL); Pudding (5, 10, and 20 mL) *Finger pulse oximetry* (during Volume-Viscosity Swallowing Test)	Impaired safety (eg, voice change including wet voice, cough, or decrease in oxygen saturation ≥3%)	88	65
	Lim et al,[11] 2001	*Water test* 5 × 10 mL of water *Pulse oximetry* 10 mL of water	Coughing, choking, or voice change or ≥2% desaturation	98	70

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Table 3
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Type of Bedside Screening	References (N = 11)	Description Bedside Screening	End Point Bedside Screening	Psychometric Characteristics	
				Sensitivity	Specificity
	Smith et al,[17] 2000	*Swallow test* Various quantities and viscosities *Pulse oximetry* (during videofluoroscopy) 3, 5, 10, and 20 mL thick liquid; Same quantities dilute liquid; 5 mL yoghurt; 5 ml solid (bread)	Subjective assessment of aspiration and ≥2% desaturation	73	76
Oxygen desaturation	Lim et al,[11] 2001	Oxygen desaturation test (10 mL of water)	≥2% desaturation	77	83
Clinical features	Daniels et al,[9] 1997	Oropharyngeal examination including examination of gag reflex, volitional cough, speech, and voice	Feature/end point: dysphonia (present/absent)	73	72
Standardized form with clinical features	Mann,[13] 2002	Clinical assessment including oral-motor-sensory examination (voice, speech, and language function)	Feature/end point: dysphagia (definite/probable/possible)	73	89
		Swallow test: 5 and 20 mL of water, thickened fluid	Feature/end point: aspiration (definite/probable/possible)	93	63

Data from Refs.[7–9,11,13,15–18,20]; Bours GJ, Speyer R, Lemmens J, et al. Bedside screening methods for dysphagia in neurologic patients: a systematic review. J Adv Nurs 2009;65(3):483–7; and Kertscher B, Speyer R, Palmieri M, et al. Bedside screening to detect oropharyngeal dysphagia in patients with neurologic disorders: an updated systematic review. 2013 Sep 13. [Epub ahead of print].

oral intake after screening with regard to advised viscosities and volumes unlike, for example, the 3-oz water swallow test by Suiter and Leder[19] or the Toronto Bedside Swallowing Screening Test by Martino.[15] These two screening tools focus on identifying aspiration or dysphagia after which, in case of failing the screening protocol, further assessment is required. The concept of screening may differ from study to study and the distinction between what is considered to be screening and what is considered to be assessment may become an underlying issue.

Differences between screening protocols may not always have major implications for patients' well-being, but the consequences for health care professionals within their work settings may be substantial. In general, it is accepted that a screening tool needs to be valid, reliable, and feasible. Other requirements resulting from the implementation of a chosen screening protocol may affect the number of health care professionals involved, changes in workload and time pressure, or need for training of staff in screening procedures to improve outcome reliability. Furthermore, the availability of follow-up assessments, such as FEES or VFS, must be addressed and the need for trained personnel in performing these gold standard assessments. Future cost-effectiveness studies are required to measure the effects of bedside screening for oropharyngeal dysphagia in relation to increased health care costs because of the complications as a result of aspiration.

ASSESSMENT

Gold Standards

After screening for oropharyngeal dysphagia and failing the test protocol, further assessment is usually required. In the literature, VFS and FEES are taken as the gold standards for further assessment. Either one is used to assess the swallow physiology and functioning and to define the success or failure of swallowing therapy, frequently along with a variety of clinical evaluations, such as dysphagia severity ratings or dietary status.[24] As in bedside screening, protocols may differ in chosen cut-off points for aspiration or penetration, number of trial swallows, or bolus consistencies and volumes offered to the patient during assessment. No guidelines or consensus exist on protocols in either of the gold standards. Different types of variables may be measured using visuoperceptual ratings, although there are little data available on intrasubject or intersubject variability, or using one of many software applications to derive complementary objective measurements,[25,26] including spatial or temporal variables (**Table 4**).

Clinical Assessment

Another step after screening is clinical examination or assessment by a dysphagia therapist. Although in many countries swallowing assessment and treatment are provided by speech and language pathologists, there are exceptions. Other disciplines, such as occupational therapists, dieticians, nurses, or physiotherapists, also can be involved, or can even be the main health caretaker in a patient's dysphagia treatment. Many different definitions and descriptions of clinical assessments can be found in the literature. Miller,[33] for example, distinguishes in the process of clinical examination for dysphagia, the subjective description of the swallowing problem or patients' complaints, the medical history taking, the expert's clinical observations during interview and examination process, including the evaluation of a patient's mental status, and finally the physical examination. The clinical examination may fulfill multiple purposes: to identify possible causes of dysphagia and to assess swallowing safety or risk of aspiration; to decide on oral versus alternative feeding routes; to clarify the need for

Table 4
Screening and assessment of oropharyngeal dysphagia

Method	Description	Main Purposes	Health Caretakers
Bedside screening	Types: Trial swallow using water Trial swallow using different viscosities Trial swallow using water in combination with oxygen desaturation Trial swallow using different viscosities in combination with oxygen desaturation Oxygen desaturation Clinical features Standardized form with clinical features	To detect patients at risk for oropharyngeal dysphagia First step of decision-making process in patients at risk for oropharyngeal dysphagia Failure indicates need for further assessment	Usually, nurses or other health caretakers (eg, speech pathologist)
Gold standard	Videofluoroscopy of swallowing act (VFS) Visuoperceptual evaluation by experts Quantatitive evaluation using software applications[25,26] Variables[27] Visuoperceptual variables: Penetration Aspiration Scale,[28] piecemeal deglutition Spatial variables: Quantification of changes in spatial dimensions (eg, hyoid movement) Temporal variables: timing and duration of changes in anatomic configuration (eg, duration of velopharyngeal junction) Fiberoptic Endoscopic Evaluation of Swallowing (FEES) Variables Mainly visuoperceptual variables	To detect and quantify abnormalities in swallowing function/physiology and/or anatomic structures Is considered to be the gold standard in diagnosing presence of (silent) aspiration, thus in determining safety of swallowing Although considered to be the gold standard, no consensus/guidelines about protocols for either FEES nor VFS	Usually, physician (eg, radiologist, neurologist, gastroenterologist, laryngologist) plus dysphagia therapist

Clinical assessment	Including, eg, Medical/patient history (eg, pneumonia, weight loss) Assessment of cognition and communication Evaluation of the oral, laryngeal, and pharyngeal anatomy, physiology, and function (including cranial nerve examination) Oral intake/nutritional status (eg, Functional Oral Intake Scale,[29] Mini Nutritional Assessment[30]) Mealtime observations Intervention trial (bolus modification, postural adjustments and/or swallow maneuvers)[1]	To detect and quantify abnormalities in swallowing function/physiology and/or anatomic structures To clarify the need for further assessment (eg, gold standard, supplementary methods) Assessment outcome may provide direct information for intervention/treatment by dysphagia therapist	Dysphagia therapist, usually a speech pathologist
Patient self-evaluation	Functional health status questionnaires (eg, 10-item Eating Assessment Tool,[39] Sydney Swallow Questionnaire[40]) Health-related quality of life questionnaires (see **Table 5**)	To describe the functional health status as experienced by the patient To describe the impact of oropharyngeal dysphagia on quality of life as experienced by the patient	Patient Patient
Supplementary methods	Examples: 1. Cough reflex testing 2. Cervical suscultation 3. Oxygen desaturation 4. FEESST[31] 5. Esophagography 6. Video manometry 7. EMG and sEMG 8. Esophageal Ph monitoring 9. Gastroesophageal/laryngopharyngeal reflux questionnaires	Corresponding main purposes: 1. To determine presence/absence of cough reflex 2. To detect (audible) residue in airways 3. To quantify reduced oxygen saturation of arterial blood 4. To quantify motor and sensory deficiencies during FEES 5. To visualize/detect abnormalities in esophageal function and/or anatomy	Depending on supplementary method: physician, dysphagia therapist, and/or researcher

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Table 4
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Method	Description	Main Purposes	Health Caretakers
	10. Scintigraphy 11. Endoscopic ultrasound 12. Other imaging techniques: eg, computed tomography, magnetic resonance imaging, functional magnetic resonance imaging, positron emission tomography 13. Oral motor pressure measurements 14. Respiratory indicators (eg, sustained fever, rhonchi, sputum Gram stain, or sputum culture)	6. To assess oropharyngeal/esophageal motility, pressures and coordination during swallow (optional: combined with FEES/VFS) 7. To detect electrical potential activity within muscles (EMG) or muscle strength using surface electrodes (sEMG; eg, submental muscle placement) 8. To diagnose and quantify gastroesophageal reflux disease by measuring esophageal pH 9. To describe the functional health status and impact of gastroesophageal/laryngopharyngeal reflux as experienced by the patient 10. To visualize and track (radionuclide) bolus movement and residue/aspiration by use of a gamma camera 11. To study the oral aspects of bolus preparation and transfer (soft tissue visualization) 12. To visualize abnormalities in swallowing function/physiology and/or anatomic structures (different pros and cons per technique) 13. To quantify oral motor muscle pressure/strength[32] 14. To identify indicators associated with pneumonia[32]	

Abbreviations: EMG, electromyography; FEES, fiberoptic endoscopic evaluation of swallowing; FEESST, fiberoptic endoscopic evaluation of swallowing with sensory testing; VFS, videofluoroscopy.

further assessment (eg, FEES or VFS); and to establish baseline or pretreatment clinical data to be compared with follow-up assessment after intervention or during the course of progressive diseases. Other authors provide similar overviews on swallowing examination, but with different focus on issues relevant to specific subject populations. For example, in dysphagic patients with head and neck oncology the effects of irradiation and chemotherapy may be highly relevant in the diagnostic and prognostic management of the swallowing disorder, whereas in patients suffering from progressive neurologic diseases palliative care ethical questions, such as the maintaining of artificial feeding, may need to be addressed. Furthermore, clinical assessment may refer to a huge variety of assessment questionnaires and tools describing different aspects of oropharyngeal dysphagia. In the absence of systematic literature reviews it is hard to provide a complete overview.

Most clinical handbooks on dysphagia seem to agree on the relevance of the following elements in the assessment of dysphagia: the medical and patient history taking; the assessment of cognition and communication abilities; the evaluation of the oral, laryngeal, and pharyngeal physiology, anatomy, and functioning with special focus on the cranial nerve examination; and the oral intake assessment.[34–37] Medical and patient history may refer to medical chart reviewing to retrieve information on such factors as diseases associated with dysphagia; respiratory impairment or use of medication; the occurrence of (possibly recurrent) pneumonia; or sudden weight loss. The dietary level and the nutritional status can be reviewed by such instruments as the Functional Oral Intake Scale by Crary and colleagues[29] or the Mini Nutritional Assessment by Guigoz,[30] in addition to mealtime observations and trial swallows providing patients with liquid and food boluses of different consistencies and volumes possibly in combination with postural adjustments and swallow maneuvers.[1] **Table 4** presents examples of commonly used assessment procedures for dysphagia in clinical practice. However, little information has been published on the validity and reliability of this process of clinical assessment for dysphagia.

Patient Self-Evaluation

Patient self-evaluation (see **Table 4**) is covered by self-administered questionnaires. Two different concepts need to be distinguished: functional health status (FHS) versus health-related quality of life (HRQOL). FHS refers to the influence of a given disease, oropharyngeal dysphagia, on particular functional aspects, whereas HRQOL is the unique personal perception of someone's health, taking into account social, functional, and psychological issues.[38] Even though FHS and HRQOL are considered two distinct concepts, many inventories combine them, making it hard to distinguish between disease-related functioning and disease-related quality-of-life as experienced by the patient.

In general, self-administered FHS inventories aim at quantifying the symptomatic severity of oropharyngeal dysphagia as experienced by the patient. Several examples are found in the literature, such as the Eating Assessment Tool (EAT-10)[39] or the Sydney Swallow Questionnaire (SSQ).[40] The first questionnaire, the EAT-10, is a clinical instrument for documenting the initial dysphagia severity and monitoring a patient's treatment response. Ten symptom-specific items using five-point scales (0–4: no problem to severe problem) result in a total score ranging between zero and 40. Based on normative data, an EAT-10 score of three or higher is considered to be abnormal, thus distinguishing between normal and abnormal swallow behavior.[39] The SSQ contains 17 items recorded as visual analogue scales. Wallace and colleagues[40] ascribe strong face, content, and construct validity and test-retest reliability to the SSQ. Although many FHS questionnaires can be found in the literature, restricted data are available on the measurement properties of these health status questionnaires.

Table 5
Questionnaires on HRQoL in oropharyngeal dysphagia

References (N = 5)	HRQoL Questionnaire	Abbreviation	Domains (N_{items})	Total Number of Items[a]	Single Items (N_{items})	Rating Scale	Range of Total Score[b]
Chen et al,[42] 2001	MD Anderson Dysphagia Inventory	MDADI	Physical (8) Functional (5) Emotional (6)	20 (including one single item)	Global assessment (1)	5-point scale	20–100
Ekberg et al,[43] 2002	European Dysphagia Group Questionnaire[c]	EDGQ	Background data (3) Eating habits (5) Personal feelings and importance (8) Seeking help (8) Medical status (4)	28	NA	Mostly dichotomous scale (plus "Don't know" option)	NA
McHorney et al,[2] 2002 McHorney et al,[44,45] 2000	SWAL-QOL	SWAL-QOL	Burden (2) Eating duration (2) Eating desire (3) Symptom frequency (14) Food selection (2) Communication (2) Fear (4) Mental health (5) Social functioning (5) Fatigue (3) Sleep (2)	44	Food and liquid intake (3) Global health (1)	5-point scale	0–100
Silbergleit et al,[46] 2012	Dysphagia Handicap Index	DHI	Physical (9) Functional (9) Emotional (7)	25	Severity (1)	3-point scale	0–100
Woisard et al,[47] 2006	Deglutition Handicap Index	DHI	Physical (10) Functional (10) Emotional (10)	30	NA	5-point scale	0–120

[a] Total scores based on total number of items excluding single items, except for the MDADI (one single item included in the total score).
[b] In case of MDADI and SWAL-QOL low scores indicate low functioning and high scores high functioning, whereas in case of the Deglutition Handicap Index and the Dysphagia Handicap Index low scores indicate high functioning and high scores low functioning.
[c] Interview (in contrast to all other self-administered questionnaires).

Adapted from Timmerman AA, Speyer R, Heijnen BJ, et al. Psychometric characteristics of health-related quality of life questionnaires in oropharyngeal dysphagia. In press; with permission.

More recently, quality-of-life questionnaires too have become part of the assessment protocol for swallowing disorders, taking a patient's well-being into consideration when judging the effects of a therapy.[24] **Table 5** provides an overview of questionnaires describing mainly HRQOL in oropharyngeal dysphagia as retrieved by systematic literature search.[41] One of the earliest published questionnaires, the SWAL-QOL by McHorney and colleagues,[2,44,45] is still considered the gold standard and exhibits good internal-consistency reliability and short-term reproducibility. However, because of the rather large number of 11 subscales and 44 items, this questionnaire is not always considered to be the best choice for daily clinical practice with a lot of time pressure. In that light other questionnaires have been developed. Before being able to choose which instruments should be used, measurement properties of these questionnaires need to be determined and compared with quality criteria, such as those defined by Terwee and colleagues.[48] **Table 6** provides an overview of definitions of measurement properties of health status questionnaires based on a classification according to Terwee and colleagues.[48]

Supplementary Methods

Apart from the previously mentioned methods, several other evaluation techniques are available for assessment of dysphagia (see **Table 4**). Although some of these methods are well-known and commonly used, other techniques are less frequently applied and

Table 6
Definitions of measurement properties of health status questionnaire

Measurement Property[a]/Domain	Definition
Content validity	The extent to which the measurement incorporates the construct or domain of the phenomenon under study.
Internal consistency	The extent to which items in a (sub)scale are intercorrelated, thus measuring the same construct.
Criterion validity	The extent to which the measurement correlates with an external criterion (gold standard) of the phenomenon under study.
Construct validity	The extent to which a measurement corresponds to theoretical concepts (constructs) concerning the phenomenon under study.
Reproducibility	Synonym: repeatability. The degree to which repeated measurements in stable persons (test-retest) provide similar answers.
Agreement	The extent to which the scores on repeated measures are close to each other (absolute measurement error).
Reliability	The extent to which patients can be distinguished from each other, despite measurement errors (relative measurement error).
Responsiveness	The ability of a questionnaire to detect clinically important changes over time in the construct to be measured.
Floor or ceiling effect	The number of respondents who achieved the lowest or highest possible score.
Interpretability	The degree to which qualitative meaning, clinical or commonly understood connotations, can be assigned to an instrument's quantitative scores or change in scores.

[a] Classification according to Terwee and colleagues.
Adapted from Refs.[48–52]

restricted only to experimental settings. **Table 4** presents a quick glance at the variety in supplementary methods; it is beyond the scope of this article to describe the advantages and disadvantages of each method in more detail. Furthermore, the list of supplementary methods in **Table 4** is not complete because improved methods have replaced older techniques (eg, the present use of VFS recordings instead of a single radiograph image of the swallow act) and newly developed methods continue to be presented. The latter include the introduction of dual-axis swallowing accelerometry as a tool for noninvasive analysis of swallowing function[53] and the use of acoustic analysis or airflow measurement of voluntary cough to help in detecting dysphagia.[54,55] Choices of supplementary methods may be influenced by factors related to workplace setting, research, clinician's preference and expertise, and criteria on reliability and validity.

SUMMARY

Because patients do not necessarily show abnormalities or changes after treatment intervention in all aspects of swallowing, it may be useful to include several evaluation techniques when studying swallowing problems. For example, objectified findings on VFS or endoscopic recordings of swallowing may not be consistent with a patient's own judgment of therapy outcome.[24] It is clear from the literature that many different screening and clinical assessment or instrumental examination tools are being used in daily practice. Pettigrew and O'Toole[56] described an international concern for clinician disagreement in the profession of speech and language therapy regarding the variability in conducting clinical examinations and clinical decision-making in dysphagia. Clinicians not only use a wide range of assessment tools; they also make different choices about outcome parameters, rating procedures, or protocols. Even for the gold standards, FEES and VFS, no agreement exists on the number of swallow trials, the bolus consistencies, or volumes to be used.[1]

Apart from the great diversity in screening and assessment of dysphagia, methodologic problems in research and clinical practice are common and need to be considered. These problems include inadequate randomization during patient allocation to different intervention groups; lack of blinding assessors to moment of measurement (eg, pretreatment vs posttreatment); and failure to apply the intention-to-treat principle to all participating patients. In addition, the frequent use of unvalidated or unreliable instruments or questionnaires may generate data that cannot be interpreted adequately and, therefore, result in data that actually do not contribute to formal patient examination.[24] In light of these methodologic problems and the heterogeneity of study designs reported in the literature, statistical pooling of outcome data usually remains a hazardous challenge.[1] To improve the quality of clinical measurements, the reliability and validity of health questionnaires need to be determined and compared with criteria on measurement properties (eg, Terwee and colleagues[48]). Furthermore, information on interrater and intrarater reliability should be provided when describing visuoperceptual evaluation of videorecordings (eg, FEES or VFS) or perceptual assessment of voice samples. Despite great variety in screening and assessment tools for dysphagia, the use of an instrument can only be justified by its sufficient reliability and validity and the discriminative and evaluative purposes of the assessment.[57]

The lack of consensus, protocols, and guidelines for screening and assessment of oropharyngeal dysphagia is striking, both in the literature and in daily clinical practice. There is an urgent need for standardization in terminology, specified protocols for different examination tools, and well-defined clinical pathways for distinct patient populations with oropharyngeal dysphagia. Recent international initiatives seem promising, such as the foundation of the International Dysphagia Diet Standardisation

Initiative, a clinical expert group that aims at the development of global standardized terminology and definitions for texture modified foods and thickened liquids. Furthermore, a growing number of associations of clinical professionals are involved in evidence-based guideline development including aspects of screening and assessment (eg, the European Society for Swallowing Disorders; the European Society for Clinical Nutrition and Metabolism). Despite international increased awareness of oropharyngeal dysphagia and its impact on a patient's well-being or need for early screening and assessment, future implementation of newly developed guidelines in clinical practice and in the education of professionals will prove essential when evaluating the final outcome of initiatives on standardization and guideline development in the field of oropharyngeal dysphagia.

REFERENCES

1. Speyer R. Behavioural treatment of oropharyngeal dysphagia: bolus modification and management, sensory and motor behavioural techniques, postural adjustments, and swallow manoeuvres. In: Ekberg O, editor. Dysphagia: diagnosis and treatment. Berlin: Springer-Verlag; 2012. p. 477–91.
2. McHorney CA, Robbins J, Lomax K, et al. The SWAL-QOL and SWAL-CARE outcomes tool for oropharyngeal dysphagia in adults: III. Documentation of reliability and validity. Dysphagia 2002;17:97–114.
3. Perry L, Love CP. Screening for dysphagia and aspiration in acute stroke: a systematic review. Dysphagia 2001;16:7–18.
4. Takizawa C, Altman KW, Derex L, et al. Clinical pathway of stroke patients - Opinion paper on dysphagia treatment pathway (under review).
5. Bours GJ, Speyer R, Lemmens J, et al. Bedside screening methods for dysphagia in neurologic patients: a systematic review. J Adv Nurs 2009;65(3):477–93.
6. Kertscher B, Speyer R, Palmieri M, et al. Bedside screening to detect oropharyngeal dysphagia in patients with neurological disorders: an updated systematic review. In press.
7. Chong MS, Lieu PK, Sitoh YY, et al. Bedside clinical methods useful as screening test for aspiration in elderly patients with recent and previous strokes. Ann Acad Med Singap 2003;32(6):790–4.
8. Clavé P, Arreola V, Romea M, et al. Accuracy of the volume-viscosity swallow test for clinical screening of oropharyngeal dysphagia and aspiration. Clin Nutr 2008; 27:806–15.
9. Daniels SK, McAdam CP, Brailey K. Clinical assessment of swallowing and prediction of dysphagia severity. Am J Speech Lang Pathol 1997;6(4):17–24.
10. Leder SB, Espinosa JF. Aspiration risk after acute stroke: comparison of clinical examination and fiberoptic endoscopic evaluation of swallowing. Dysphagia 2002;17(3):214–8.
11. Lim SH, Lieu PK, Phua SY, et al. Accuracy of bedside clinical methods compared with fiberoptic endoscopic examination of swallowing (FEES) in determining the risk of aspiration in acute stroke patients. Dysphagia 2001;16(1):1–6.
12. Logemann JA, Veis S, Colangelo L. A screening procedure for oropharyngeal dysphagia. Dysphagia 1999;14(1):44–51.
13. Mann GD. MASA: the Mann assessment of swallowing ability. Dysphagia series. New York: Singular Thomson Learning; 2002.
14. Mari F, Matei M, Ceravolo MG, et al. Predictive value of clinical indices in detecting aspiration in patients with neurological disorders. J Neurol Neurosurg Psychiatry 1997;63(4):456–60.

15. Martino R, Silver F, Teasell R, et al. The Toronto Bedside Swallowing Screening Test (TOR-BSST) development and validation of a dysphagia screening tool for patients with stroke. Stroke 2009;40:555–61.
16. McCullough GH, Wertz RT, Rosenbek JC. Sensitivity and specificity of clinical/bedside examination signs for detecting aspiration in adults subsequent to stroke. J Commun Disord 2001;34:55–72.
17. Smith HA, Lee SH, O'Neill PA, et al. The combination of bedside swallowing assessment and oxygen saturation monitoring of swallowing in acute stroke: a safe and humane screening tool. Age Ageing 2000;29(6):495–9.
18. Smithard DG, O'Neill PA, Park C, et al. Can bedside assessment reliably exclude aspiration following acute stroke? Age Ageing 1998;27(2):99–106.
19. Suiter DM, Leder SB. Clinical utility of the 3-ounce water swallowing test. Dysphagia 2008;23:244–50.
20. Trapl M, Enderle P, Nowotny M, et al. Dysphagia bedside screening for acute stroke patients. The Gugging swallowing screen. Stroke 2007;38:2948–52.
21. Wakasugi Y, Tohara H, Hattori F, et al. Screening test for silent aspiration at the bedside. Dysphagia 2008;23:364–70.
22. Steele C, Cichero JA. Screening for aspiration risk [letters to the editor]. J Trauma Acute Care Surg 2012;73(1):292–3.
23. Leder SB, Suiter DM, Warner HL, et al. Re: screening for aspiration risk [letters to the editor]. J Trauma Acute Care Surg 2012;73(1):293.
24. Speyer R, Baijens L, Heijnen M, et al. Effects of therapy in oropharyngeal dysphagia by speech and language therapists: a systematic review. Dysphagia 2010;25:40–65.
25. Clavé P, De Kraa M, Arreola V, et al. The effect of bolus viscosity on swallowing function in neurogenic dysphagia. Aliment Pharmacol Ther 2006;24:1385–94.
26. Rofes L, Arreola V, Cabré M, et al. Diagnosis and management of oropharyngeal dysphagia and its nutritional and respiratory complications in the elderly. Gastroenterol Res Pract 2011;13. http://dx.doi.org/10.1155/2011/818979.
27. Baijens LW, Speyer R, Lima Passos V, et al. Swallowing in Parkinson patients versus healthy controls: reliability of measurements in videofluoroscopy. Gastroenterol Res Pract 2011;9. http://dx.doi.org/10.1155/2011/380682.
28. Rosenbek JC, Robbins JA, Roecker EB, et al. A penetration-aspiration scale. Dysphagia 1996;11:93–8.
29. Crary MA, Carnaby Mann GD, Groher ME. Initial psychometric assessment of a functional oral intake scale for dysphagia in stroke patients. Arch Phys Med Rehabil 2005;86:1516–20.
30. Guigoz G. The mini nutritional assessment (MNA) review of the literature – what does it tell us? J Nutr Health Aging 2006;10(6):466–87.
31. Aviv JE, Kim T, Sacco RL, et al. FEESST: a new bedside endoscopic test of the motor and sensory components of swallowing. Ann Otol Rhinol Laryngol 1998;107:378–87.
32. Robbins J, Kays SA, Gangnon RE, et al. The effects of lingual exercise in stroke patients with dysphagia. Arch Phys Med Rehabil 2007;88(2):150–8.
33. Miller RM. Clinical examination for dysphagia. In: Groher ME, editor. Dysphagia: diagnosis and management. Newton (MA): Butterworth-Heinemann; 1997. p. 169–89.
34. Daniels SK, Huckabee ML. Dysphagia following stroke. San Diego (CA): Plural Publishing; 2008.
35. Goodrich SJ, Walker AI. Clinical swallow evaluation. In: Leonard R, Kendall K, editors. Dysphagia assessment and treatment planning: a team approach. San Diego (CA): Plural Publishing; 2008. p. 103–36.

36. Groher ME. Clinical evaluation of adults. In: Groher ME, Crary MA, editors. Dysphagia: clinical management in adults and children. Maryland Heights (MI): Mosby Elsevier; 2010. p. 162–90.
37. Murry T, Carrau RL. Evaluation of dysphagia. In: Clinical management of swallowing disorders: Evaluation of dysphagia. San Diego (CA): Plural Publishing; 2006. p. 97–136.
38. Ferrans CE, Zerwic JJ, Wilbur JE, et al. Conceptual model of health-related quality of life. J Nurs Scholarsh 2005;4:336–42.
39. Belafsky PC, Mouadeb DA, Rees CJ, et al. Validity and reliability of the Eating Assessment Tool (EAT-10). Ann Otol Rhinol Laryngol 2008;117(12):919–24.
40. Wallace KL, Middleton S, Cook IJ. Development and validation of a self-report symptom inventory to assess the severity of oral-pharyngeal dysphagia. Gastroenterology 2000;118(4):678–87.
41. Timmerman AA, Speyer R, Heijnen BJ, et al. Psychometric characteristics of health-related quality of life questionnaires in oropharyngeal dysphagia (under review).
42. Chen AY, Frankowski R, Bishop-Leone J, et al. The development and validation of a dysphagia-specific quality-of-life questionnaire for patients with head and neck cancer: the MD Anderson Dysphagia Inventory. Arch Otolaryngol Head Neck Surg 2001;127:870–6.
43. Ekberg O, Hamdy S, Woisard V, et al. Social and psychological burden of dysphagia: its impact on diagnosis and treatment. Dysphagia 2002;17:139–46.
44. McHorney CA, Bricker DE, Kramer AE, et al. The SWAL-QOL outcomes tool for oropharyngeal dysphagia in adults: I. Conceptual foundation and item development. Dysphagia 2000;15:115–21.
45. Mchorney CA, Bricker DE, Robbins JA, et al. The SWAL-QOL outcomes tool for oropharyngeal dysphagia in adults: II. Item reduction and preliminary scaling. Dysphagia 2000;15:122–33.
46. Silbergleit AK, Schultz L, Jacobson BH, et al. The dysphagia handicap index: development and validation. Dysphagia 2012;27:46–52.
47. Woisard V, Andrieux MP, Puech M. Validation of a self assessment questionnaire for swallowing disorders (Deglutition Handicap Index). Rev Laryngol Otol Rhinol (Bord) 2006;127(5):315–25.
48. Terwee CB, Bot SD, de Boer MR, et al. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol 2007;60:34–42.
49. Last JM, editor. A dictionary of epidemiology. Oxford (United Kingdom): Oxford University Press; 2001.
50. Mokkink LB, Terwee CB, Patrick DL, et al. COSMIN checklist manual. 2012. Available at: www.cosmin.nl. Accessed March 5, 2013.
51. Everitt BS. Medical statistics from A to Z: a guide for clinicians and medical students. Cambridge (United Kingdom): Cambridge University Press; 2006.
52. McHorney CA, Tarlov AR. Individual-patient monitoring in clinical practice: are available health status surveys adequate? Qual Life Res 1995;4(4):293–307.
53. Lee J, Sejdić E, Steele CM, et al. Effects of liquid stimuli on dual-axis swallowing accelerometry signals in a healthy population. Biomed Eng Online 2010;9:7. Available at: http://www.biomedical-engineering-online.com/content/9/1/7.
54. Smith Hammond CA, Goldstein LB, Horner RD, et al. Predicting aspiration in patients with ischemic stroke: comparison of clinical signs and aerodynamic measures of voluntary cough. Chest 2009;135(3):769–77.
55. Pitts T, Troche M, Mann G, et al. Using voluntary cough to detect penetration and aspiration during oropharyngeal swallowing in patients with Parkinson disease. Chest 2010;138(6):1426–31.

56. Pettigrew CM, O'Toole C. Dysphagia evaluation practices of speech and language therapist in Ireland: clinical assessment and instrumental examination decision-making. Dysphagia 2007;22:235–44.
57. Speyer R, Pilz W, Kruis van der J, et al. Reliability and validity of student peer assessment in medical education: a systematic review. Med Teach 2011;33: e572–85.