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Original Article:

Creation of a 13-Item Bedside Dysphagia Screening Test

Petra Mandysova, Vice-Dean, Faculty of Health Studies, University of Pardubice, Pardubice, Czech Republic; Neurology Clinic, Pardubice Regional Hospital, Czech Republic,
Jana Škvrňáková, Vice-Dean, Faculty of Health Studies, University of Pardubice, Pardubice, Czech Republic; Otorhinolaryngology and Head and Neck Surgery Clinic, Pardubice Regional Hospital, Czech Republic,
Edvard Ehler, Chief of Staff, Neurology Clinic, Pardubice Regional Hospital, Czech Republic; Faculty of Health Studies, University of Pardubice, Pardubice, Czech Republic
Michal Černý, Otorhinolaryngology and Head and Neck Surgery Clinic, Pardubice Regional Hospital, Czech Republic; Faculty of Health Studies, University of Pardubice, Pardubice, Czech Republic.

Address For Correspondence:
Petra Mandysová,
Faculty of Health Studies,
University Pardubice,
Průmyslová 395,
532 10 Pardubice,
Czech Republic.
E-mail: Petra.Mandysova@upce.cz

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Abstract:
Dysphagia is a common problem that affects people with many health conditions and that can have serious complications. Various dysphagia screening tests exist; however, their creation was associated with certain weaknesses, e.g. none of them used "objective" instrumental tests (e.g., videofluoroscopy or flexible endoscopic examination of swallowing, FEES) in all patients to verify the results. In addition, most dysphagia screening tests were developed for stroke patients. The purpose of this study was to fill this gap. Our research included not only patients with stroke but also patients with other neurological and otorhinolaryngologic conditions. We tested 33 physical examination items in 44 patients and analyzed the results by comparing them to FEES results. Our study is the first one that performed this kind of comparison in all the patients enrolled in the study. Data mining was used to create a 13-item dysphagia screening test that has 88.2% sensitivity.
Key Words: Dysphagia; Dysphagia Screening; Flexible Endoscopic Examination of Swallowing; Physical Examination; Videofluoroscopy

Introduction:

Impaired swallowing is a relatively common health problem. The exact prevalence of dysphagia reported in the literature varies depending on the studied population and the study design. For example, the prevalence of dysphagia in the general non-treatment-seeking population ranges between 6 and 16%,(1-2) and in the "well" elderly, between 13.8% and 33%.(3-4) Specific patient populations have an even higher prevalence of dysphagia – it is estimated to occur in 29% to 78% of patients with stroke,(5-9) up to 34% of patients with multiple sclerosis, 81% of patients with Parkinson's disease,(5) 24% of patients with myasthenia gravis,(10-11) and 71.8% to 72.4% of patients with head and neck cancer.(12-13)

The most common complications of dysphagia include dehydration, nutritional deficiency, and weight loss.(12,14) Aspiration is a particularly serious complication as it can lead to aspiration pneumonia and even death.(9,12,15) Furthermore, patients with dysphagia frequently report distress and a negative impact on social activities such as eating out in restaurants or at friends' houses.(12-13)

Because dysphagia is such a common and potentially serious problem, it is very important to detect its presence as early as possible. The two most common instrumental methods used to detect dysphagia are videofluoroscopy and flexible endoscopic evaluation of swallowing (FEES).(16) However, it may not be realistic to use these methods on a large scale because instrumental testing requires access to sophisticated equipment and trained specialists. Simpler dysphagia assessment methods exist, mainly dysphagia screening tools, which consist in bedside physical examination of the patient. Such tools can have positive outcomes: for example, Hinchey et al. showed that health care institutions using dysphagia screening protocols had lower pneumonia rates compared to hospitals without such protocols.(17) However, the quality and difficulty of the published swallowing screening tools varies. One of the simplest tools, designed for nurses caring for stroke patients, consists solely of "a water swallow test" – the patient is offered three teaspoons and then half a glass (60 mL) of water and is observed for any swallowing difficulties such as coughing, choking, breathlessness, and a wet or gurgly voice after swallowing.(18) However, the authors (18) did not provide any information on the test's sensitivity and specificity. The Massey Bedside Swallowing Screen (MBSS), consisting of physical examination of the patient and a water swallow test, was reported to have a 100% sensitivity and specificity.(19) However, such high diagnostic performance of the test may be disputable, especially since the MBSS was developed on the basis of a study of only 25 stroke patients, of whom even fewer patients—four—underwent videofluoroscopy to verify the results obtained by screening.(19) The Toronto Bedside Swallowing Screening Test (TOR-BSST) was developed based on a much larger study – it had enrolled 311

stroke patients, 20% of whom had been randomly allocated to videofluoroscopic assessment of swallowing in order to confirm the findings obtained by screening.(7) The final version of the TOR-BSST contains 4 items and its sensitivity is 91.3% and negative predictive value is 93.3% and 89.5% in acute and rehabilitation settings, respectively.(7) However, implementation of the TOR-BSST may not be easy as it requires training by a speech language therapist, who first needs to obtain certification by attending a workshop organized by the authors of the tool. The Gugging Swallowing Screen (GUSS), developed by Trapl et al., is interesting due to the fact that the authors replaced the above mentioned water swallow test by a thickened fluid swallow test, which they considered safer.(8) The test was developed based on a study of 50 stroke patients, 49 of whom underwent not only physical examination of the swallowing function but also FEES to verify the results obtained by screening.(8) This comparison enabled to determine the test's sensitivity (100%), specificity (50-69%), and negative predictive value (100%).(8)

A critical analysis and comparison of the mentioned dysphagia screening tools leads to the following summary: a) most dysphagia screening tools include the use of unthickened water even though the use of thickened water may be safer; b) none of the mentioned screening tools have been evaluated by comparing them to "objective" tests (videofluoroscopy, FEES) in *all* patients, c) the published dysphagia screening tools focus on stroke patients, and d) implementation of the published dysphagia screening tools may not always be easy.

The current study aimed to fill the identified gaps in existing research and to develop a screening tool that could be used to conduct dysphagia screening not only in stroke patients but also in patients with other diseases. It was planned that the tool would be developed based on a comparison of physical examination of the swallowing function and FEES results; FEES was to be performed in *all* the enrolled patients, which would mean that our study would be supported by "objective" data to a higher degree than all the other mentioned research studies, where fewer than 100% of the patients underwent FEES or videofluoroscopy.

Methods:

The study was initiated on January 1, 2009. Patients admitted to a regional hospital in the Czech Republic and meeting a set of criteria (prone to dysphagia based on the main diagnosis, medically stable, sufficiently alert, able to collaborate, able to maintain a sitting position) were enrolled in the study. Most patients had a neurological or otorhinolaryngologic disease (cerebrovascular accident, myasthenia gravis, multiple sclerosis, amyotrophic lateral sclerosis, or cancer of the head or neck).

A trained clinician (an advanced-degree nurse) performed a detailed bedside physical examination that focused on swallowing and a fluid swallow test using thickened and unthickened fluids. In total, this examination consisted of 33 items that had been selected based on the MBSS (19) and discussions with dysphagia experts (physicians, speech therapists, nurses). Based on Trapl et al.'s GUSS,(8) the swallow test consisted in using thickened fluids in the 1st step (Fig. 1) and unthickened fluids in the 2nd step. Thickened fluids of pudding consistency were used; this consistency was obtained by mixing 60 mL of plain tea with 2 measuring scoops of a commercial thickener (starch-based thickening powder) sold in pharmacies. Not all 33 items were always tested – sometimes, patients did not collaborate (e.g., they did not understand all the clinician's instructions). Other times, a specific test item (e.g., drinking unthickened tea from a cup) was not deemed to be safe based on the patient's performance on the other items and was therefore omitted.

Figure 1: Thickened tea of pudding consistency

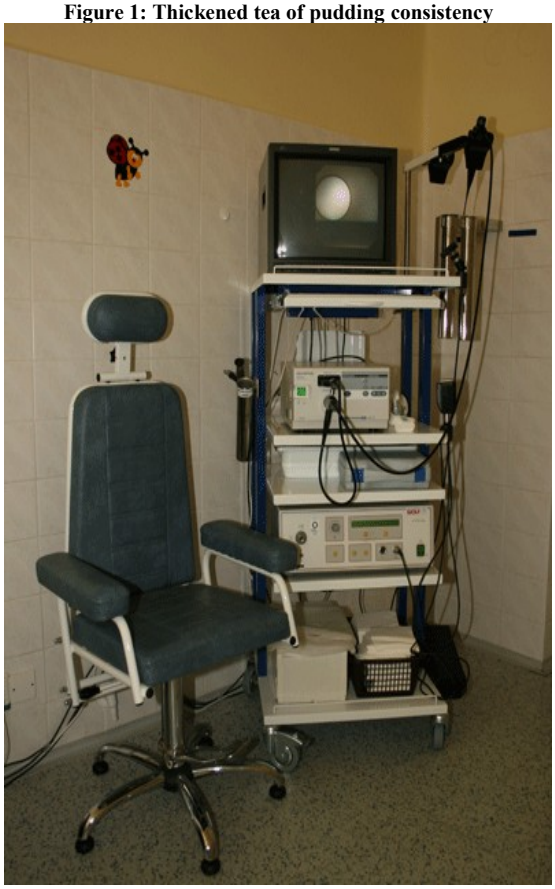


Figure 2: FEES

A specially trained physician performed FEES (Fig. 2) on the above patients and scored them using Rosenbeck's Penetration Aspiration Scale (PAS) (Table 1).(16) The results of the bedside physical examination and the patient's PAS score were compared, with the aim to identify those items of physical examination that were abnormal and that correlated with abnormal FEES results. These items would form the basis of a dysphagia screening test.

The study was approved by the hospital ethics committee. The patients were to sign an informed consent to participate in the study. Patients who agreed to undergo physical examination but refused FEES were excluded from data analysis.

Statistics

Data were entered into a Microsoft Excel spreadsheet, setting out the FEES results and physical examination items as columns (1 = normal result, 2 = abnormal result) and allocating one row for each patient. Next, rows (patients) and columns (FEES and physical examination items) with zero variability were identified. A patient having the same result across the whole row (i.e., having number 1 in all the columns) was a "healthy" patient, and such patients were deleted from further analysis. Similarly, those test items that displayed zero variability were removed from further analysis. The aim of these two steps was to eliminate rows (patients) and columns (physical examination items) that would not contribute to the explanation of variation that was observed and to prepare a data matrix for further analysis using data mining. In addition, FEES results (PAS scores) were converted to binary data (PAS score 1 = 1, i.e. normal, and PAS scores 2-8 = 2, i.e. abnormal). The relationship between explanatory variables (physical examination items entered in columns) and the response variable (FEES results, i.e. PAS scores) was examined and those explanatory variables that were abnormal (their value was 2) while the FEES was abnormal (had a value of 2) were identified.

Table 1: Rosenbeck's Penetration Aspiration Scale (16)

Score	Description of Event
1.	Material does not enter airway
2.	Material enters the airway, remains above the vocal folds, and is ejected from the airway.
3.	Material enters the airway, remains above the vocal folds, and is not ejected from the airway.
4.	Material enters the airway, contacts the vocal folds, and is ejected from the airway.
5.	Material enters the airway, contacts the vocal folds, and is not ejected from the airway.
6.	Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway.
7.	Material enters the airway, passes below the vocal folds, and is not ejected from the trachea despite effort.
8.	Material enters the airway, passes below the vocal folds, and no effort is made to eject.

Results:

There were 44 patients who entered the study. Of these, 3 patients were found to be "healthy", i.e. their physical examination and FEES were normal. Of the remaining 41 patients, 17 had an abnormal FEES result and 24 patients had a normal FEES result (Table 2). Among the 17 patients with abnormal FEES results, 11 patients had a very high PAS score (PAS score 6 or 7). At the same time, one patient with an abnormal FEES result had normal physical examination – this patient was included in the analysis. Next, 9 columns (physical examination items) with zero variability were identified and were deleted from further analysis, meaning that the final number of physical examination items used for analysis was 24.

There were 7 physical examination items that were *always* normal in normal-FEES patients and that were abnormal in more than 10% of abnormal-FEES patients (Table 2). These items are described in terms of their abnormal response: 1) "inability to clench teeth", 2) "soft palate movement is not symmetrical, uvula deviation occurs", 3) "inability to swallow thickened fluids without choking", 4) "voice hoarseness after swallowing thickened fluids", 5) "thickened fluids dripping from the mouth", 6) "voice hoarseness after swallowing unthickened fluids given by a teaspoon", and 7) "unthickened fluids dripping from the mouth after drinking from a cup and swallowing". Of these 7 items, "voice hoarseness after swallowing thickened fluids" was abnormal the most frequently (in 17.6% of abnormal-FEES patients); the other 6 items were abnormal in only 11.8% of abnormal-FEES patients.

Furthermore, the original PAS scores were examined in relation to these 7 physical examination items. It was found that all but one abnormal physical examination item result were associated with very high PAS scores, i.e. PAS = 6 or 7. If the 7 physical examination items were used to create a dysphagia screening test (where only one abnormal item would mean that the entire screening test was abnormal or positive), the sensitivity, specificity and efficiency of such a test in our sample would be 52.9%, 100% and 80.5%, respectively (Table 3). Sensitivity is the probability that a patient with dysphagia is positive on the screening test (i.e., the patient's physical examination is abnormal for at least one of the tested items), specificity is the probability that a patient with no dysphagia is negative on the screening test (i.e., the patient's physical examination is normal for all the tested items), and efficiency is the overall percentage of patients correctly identified.(20)

Table 2: Results of FEES testing and physical examination items {See End of Article)

In contrast with the above-mentioned 7 physical examination items, other physical examination items were abnormal in abnormal-FEES patients much more frequently; in fact, 3 items were abnormal in more than half of the abnormal-FEES patients. These 3 items are "voice change", "facial weakness or asymmetry" and "dysarthria" and they were abnormal in 88.2%, 76.5% and 58.8% of the abnormal-FEES cases, respectively (Table 2). In addition, 3 other items that were abnormal quite frequently could be included in the dysphagia screening test because they did not increase the test's difficulty as the patient would be swallowing thickened and unthickened fluids to test some of the previously mentioned items anyway. These 3 items are: "coughs after swallowing thickened fluids" (abnormal in 35.3% of the abnormal-FEES patients), "coughs after swallowing teaspoons of unthickened fluids" (abnormal in 17.6% of the abnormal-FEES patients) and "coughs after drinking and swallowing unthickened fluids" (abnormal in 11.8% of the abnormal-FEES patients) (Table 2). Whether or not the patient starts coughing during a fluid swallow test is not dependent upon the clinician's instructions or commands; instead, cough develops if the fluid enters the patient's respiratory pathways.

The inclusion of the above six items in the dysphagia screening test aimed to improve the screening test's sensitivity without increasing its difficulty too much. In our sample, these six items in combination with the above mentioned 7-item physical examination test had 88.2% sensitivity (Table 3).

Table 3: Sensitivity, specificity and efficiency of the 13-item and 7-item dysphagia screening tests

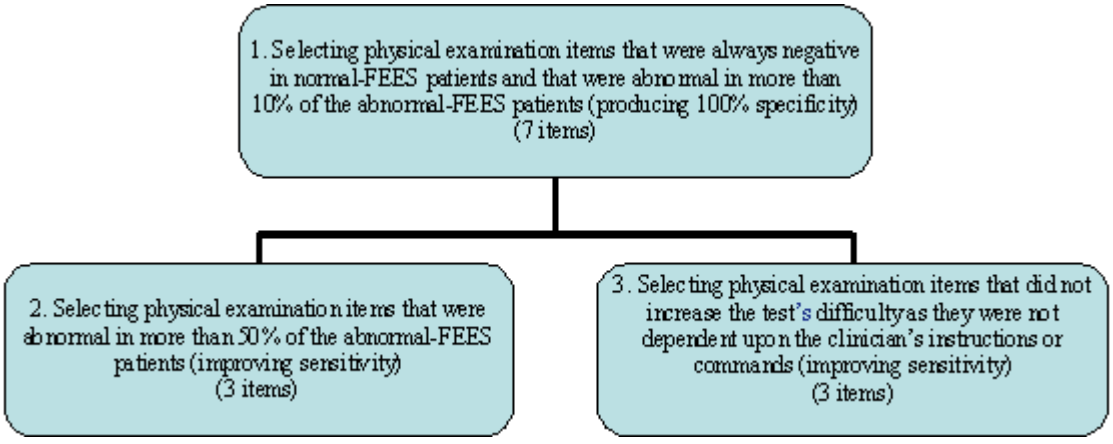
Dysphagia based on "objective" testing (FEES)				
		Abnormal FEES (PAS = 2-8)	Normal FEES (PAS = 1)	Screening test (total)
Results of 13-item physical examination screening test	Abnormal (positive)	a = 15 (true positive)	b = 20 (false positive)	a + b = 35
	Normal (negative)	c = 2 (false negative)	d = 4 (true negative)	c + d = 6
True dysphagia status (total)		a + c = 17 (dysphagia present)	b + d = 24 (dysphagia absent)	
Sensitivity = a / (a + c) = 15/17 = 88.2%				
Specificity = d / (b + d) = 4/24 = 16.7%				
Efficiency = (a + d) / (a + b + c + d) = 19/41 = 46.3%				
Results of 7-item physical examination screening test	Abnormal (positive)	a = 9 (true positive)	b = 0 (false positive)	a + b = 9
	Normal (negative)	c = 8 (false negative)	d = 24 (true negative)	c + d = 32
True dysphagia status (total)		a + c = 17 (dysphagia present)	b + d = 24 (dysphagia absent)	
Sensitivity = a / (a + c) = 9/17 = 52.9%				
Specificity = d / (b + d) = 24/24 = 100%				
Efficiency = (a + d) / (a + b + c + d) = 33/41 = 80.5%				

The downside is that the added 6 items were abnormal in normal-FEES patient as well. As Table 2 demonstrates, these 6 items were abnormal in normal-FEES patients with the following frequencies: “voice change” in 75%, “facial weakness or asymmetry in 45.8%”, “dysarthria” in 29.2%, “coughs after swallowing thickened fluids” in 16.7%, “coughs after swallowing teaspoons of unthickened fluids” in 20.8% and “coughs after drinking and swallowing unthickened fluids” in 25% of the cases. As a result, the inclusion of these six items in the dysphagia screening test increased the number of “false positive” cases from 0 to 20 and consequently, it lowered the screening test’s specificity to 16.7% (Table 3).

Discussion:

The results show that it was possible to identify 7 physical examination items whose abnormal results were in association with abnormal FEES results while not producing any abnormal results in normal-FEES patients. However, the frequency of such abnormal results in the abnormal-FEES patients is quite low (11.8-17.6%). In addition, in all but one case, these seven items were abnormal in patients whose PAS scores were 6 or 7. In other patients with abnormal FEES results (PAS scores 2-4), the results of these 7 physical examination items were normal. In other words, the 7 physical examination items may not be able to detect problems in abnormal-FEES patients if their PAS scores are not too high.

At this point, the question of screening tool sensitivity and specificity emerges. While screening tests that employ stringent criteria have high specificity and low false positive rates, more people who are at risk will be missed by such screening tests (low sensitivity, high false negative rates).(20) This could be acceptable in situations where limited resources exist to follow up all patients who screen positive. However, given the fact that undetected dysphagia can lead to pneumonia and even death, (9,12,15) it may better to establish dysphagia screening that uses lenient—and not strict—criteria and that is as sensitive as possible. In addition, lenient criteria, and many positive outcomes, are suitable when the probability of a condition (in this case, dysphagia) is high, even if only some of the cases are true positives and the rest are false positives.(21) As was mentioned above, the frequency of dysphagia in selected disorders, mainly neurological and otorhinolaryngologic diseases, is high. In our sample, 17 out of 44 patients (38.6%) had dysphagia (i.e. had an abnormal PAS score) according to the FEES results, which supports the findings mentioned in the literature. If we consider that dysphagia is a frequent problem and that undetected dysphagia can have serious consequences, our 7-item physical examination (dysphagia screening) test is not lenient enough. It has 52.9% sensitivity, meaning that only slightly more than half of the patients who had dysphagia (had an abnormal PAS score on FEES) were identified using this screening test. Achieving higher sensitivity and detecting more patients with dysphagia is preferable. Therefore, we decided to extend the 7-item screening test by including three physical examination items that were abnormal very frequently (each item was abnormal in more than half of the abnormal-FEES patients): “voice change”, “facial weakness or asymmetry” and “dysarthria” and another three physical assessment items (“coughs after thickened fluids/after teaspoons of unthickened fluids/after drinking unthickened fluids”) that were abnormal less frequently but that did not increase the difficulty of the test. Graph 1 illustrates the process of physical item selection for the final dysphagia screening test (Table 2).



Graph 1: The process of item selection for the final 13-item dysphagia screening test

Including these 6 criteria enabled us to create a much more lenient dysphagia screening test with significantly improved sensitivity (88.2%). On the other hand, the inclusion of these criteria produced more (20) false positives and decreased the test's specificity (from 100% in the 7-item dysphagia screening test to 16.7%) and efficiency from 80% to 46.3% (Table 3).

It is interesting to compare individual items contained in our 13-item dysphagia screening test to other tests published in the literature. Some of our items overlap with items present in the mentioned GUSS ("voice change", "cough", "drooling" and "voice change after swallowing");(8) however, other items contained in the GUSS ("voluntary cough" and "ability to swallow saliva") were not included in our screening test because they had not been abnormal in too many of our patients.

In our study, one abnormal physical examination item was sufficient to label a patient as "positive" (i.e. possibly having dysphagia) and to warrant further investigation. This approach supports the idea of lenient criteria, as discussed above. While the GUSS method (8) uses the same approach, other dysphagia screening tools do not always label patients as "positive" despite the presence of several abnormal results. For example, the mentioned MBSS contains a decision tree according to which the patient's physical examination should be stopped if the patient does not have a "gag reflex", "voluntary cough" and "swallow reflex" and is not able to "swallow secretions";(19) however, no further instructions are available and it is not clear whether the patient should be labeled as "positive" and more detailed investigation should be recommended. In our view, the dysphagia screening process should be clearly defined and it should be based on lenient criteria so that maximum sensitivity could be achieved.

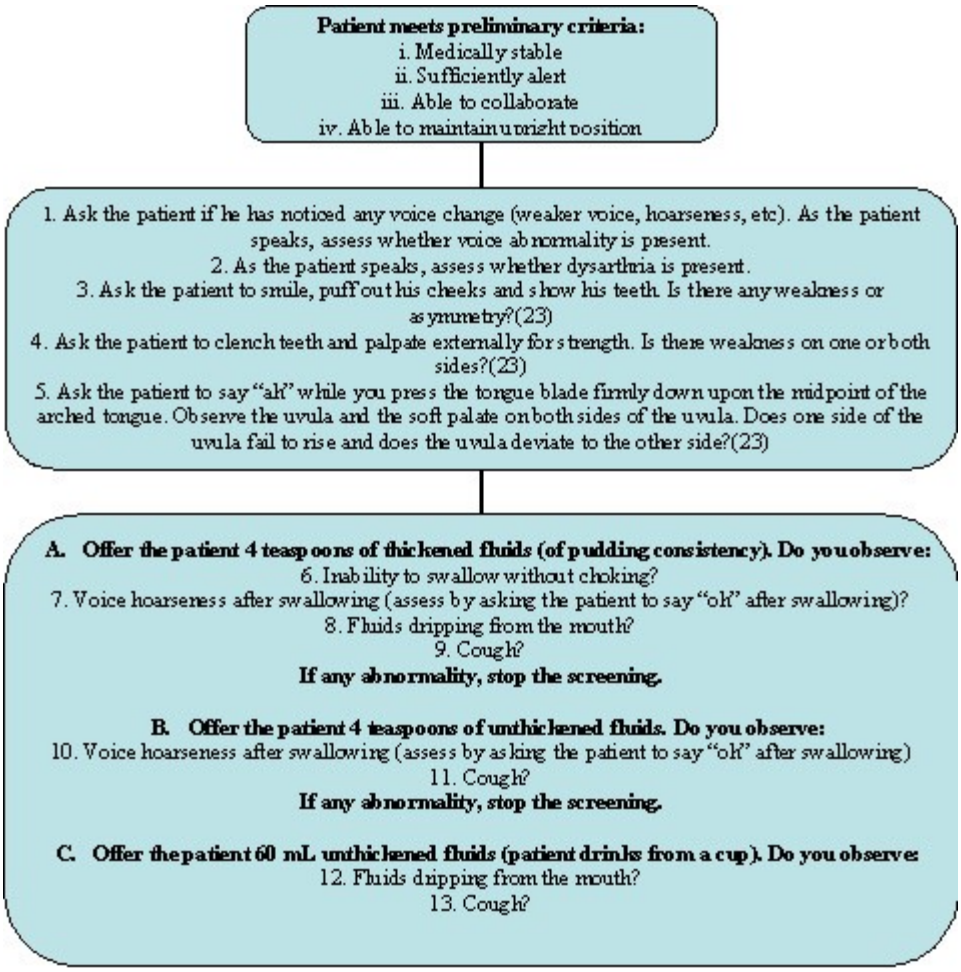
A very interesting observation can be made if we focus on the difference between items tested after swallowing thickened and unthickened fluids. We tested four items after the patient was given thickened fluids ("inability to swallowing without choking", "voice hoarseness after swallowing", "cough after swallowing" and "fluids dripping from the mouth") and abnormal results were obtained in 11.8-35.3% of the abnormal-FEES patients (the most frequent abnormality was "cough after swallowing") (Table 1). In normal-FEES patients, three of these items always produced normal results and for only one item —"cough after swallowing"—, abnormal results were obtained in 16.7% of the cases (Table 1). On the other hand, we tested four items after the patient was given unthickened fluids (two items —"cough after swallowing" and "voice hoarseness after swallowing"—were tested after teaspoons of unthickened fluids and two items —"cough after swallowing" and "fluids dripping from the mouth" after drinking unthickened fluids from a cup). In abnormal-FEES patients, the frequency of abnormal results upon testing the items ranged from 11.8-17.6% of the cases. In normal-FEES patients, two items produced only normal results, and the third and fourth item produced abnormal results in 20.8% and 25% of the cases, respectively. In other words, unthickened fluids produced abnormal results in normal-FEES patients more frequently than in abnormal-FEES patients. Given this result, it appears than testing with thickened fluids is more accurate than testing with unthickened fluids although we admit that many of the abnormal-FEES patients did not complete unthickened fluid testing, which did not enable us to conduct a complete analysis of this aspect of testing.

The fact that some physical examination items were abnormal yet the FEES result was normal can be explained by the fact that FEES cannot detect problems in the oral phase of swallowing.(22) For example, the patient may have facial weakness; however, this problem will not be detected by the endoscope. In addition, FEES is not able to visualize the period of "white out" that occurs in the beginning of the pharyngeal phase of swallowing.(22) This is one of the study's limitations, as discussed below. Experts developing screening tools through comparisons with videofluoroscopy may claim that videofluoroscopy can assess not only the pharyngeal but also the oral phase of swallowing and so it would be interesting to compare our results to studies using videofluoroscopy rather than FEES to confirm physical examination findings. However, even in large studies, such as the mentioned Martino et al.'s study leading to the development of TOR-BSST,(7) videofluoroscopy was performed in only a low percentage of the examined patients, which did not enable detailed and accurate comparisons to physical examination items.

To conclude, health care institutions wishing to adopt a dysphagia screening tool that is based on bedside physical examination should realize that each screening tool has its limitations and should implement protocols that maximize positive outcomes. Our study identified 7 physical examination items that had excellent specificity; however, since the aim of screening is to alert the team caring for the patient (the physician, speech language therapist, etc.) that the patient may be experiencing swallowing problems and will need further assessment, we recommend the 13-item dysphagia screening test, which has very good sensitivity. As Graph 2 shows, some of the test's items can be tested together; e.g., the patient is given thickened fluids and is observed for the occurrence of four items simultaneously: "inability to swallow without choking", "voice hoarseness after swallowing", "fluids dripping from the mouth after swallowing" and "cough after swallowing". This means that although the test contains 13 items, the clinician does not have to perform 13 separate examinations but only 8. Before the procedure is initiated, the patient should meet preliminary criteria that were mentioned in the methods section. We believe that even some patients who are not medically stable could undergo screening (in our study, patients who were not stable were excluded mainly due to the fact that they needed to undergo FEES in addition to bedside physical examination, which we considered somewhat demanding).

The study's limitation is the fact that some physical examination / fluid swallow items were not tested. This situation occurred especially if the patient had problems with swallowing thickened fluids – at this point, the test was stopped as it was deemed unsafe to continue and to offer the patient unthickened fluids. If we had continued with testing, more patients would have abnormal findings upon swallowing unthickened fluids as well. We believe that further research in this area is necessary; it would be beneficial to determine whether indeed, screening tests using thickened fluids are more beneficial than screening tests using unthickened fluids.

Furthermore, universality of the FEES method that consists in scoring patients according to the PAS is limited given the fact that this method evaluates only penetration and aspiration of food and not other aspects of dysphagia (prolonged mastication, escape of fluid through the nose, etc.). In this respect, the proposed dysphagia screening test is a test focusing on the risk of penetration and aspiration as well. Future research should focus on easy and quick identification of those patients who have swallowing problems that do not necessarily cause aspiration (swallowing problems mainly in the oral phase of swallowing) but that affect the patient's food intake and associated emotional and social functioning. Such research may require the use of "objective" tests other than FEES or videofluoroscopy to verify the findings. Finally, dysphagia research should focus on patients with a variety of diseases and conditions and on non-treatment-seeking people living in the community, mainly the elderly.



Graph 2: The procedure: 13-item dysphagia screening test

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	FEES (PAS score)	Spasms of neck and face	Dys arthria	Whisper	Aphasia	Inability to clench teeth	Face weakness/ asymmetry	Abnormal status of the oral cavity	Tongue weakness / asymmetry	Abnormal tongue sensation	Abnormal soft palate sensation	Soft palate movement is not symmetri-cal, uvula deviation occurs	Gag reflex is absent
Patients with abnormal FEES results (17 patients)													
Frequency of abnormal result (absolute)	17	3	10	1	1	2	13	2	7	4	1	2	6
Frequency of abnormal result (%)	100	17.6	58.8	5.9	5.9	11.8	76.5	11.8	41.2	23.5	5.9	11.8	35.3
Patients with normal FEES results (24 patients)													
Frequency of abnormal result (absolute)	0	3	7	0	2	0	11	1	6	3	3	0	4
Frequency of abnormal result (%)	0.0	12.5	29.2	0.0	8.3	0.0	45.8	4.2	25.0	12.5	12.5	0.0	16.7
PE items that are normal in normal-FEES patients and that are abnormal in > 10% of the abnormal-FEES patients (see text)						x						x	
PE items that are abnormal in more than 50% of the abnormal-FEES patients (see text)			x				x						
PE items that do not increase the test's difficulty (see text)													
Final dysphagia screening test items (see text)			x			x	x					x	

	Voluntary cough is absent	Inability to swallow saliva	Voice change	Inability to shrug shoulders / shoulder weakness	Thickened fluids: unable to swallow without choking	Thickened fluids: voice hoarse after swallowing	Thickened fluids: cough after swallowing	Thickened fluids: dripping from mouth	Teaspoons of un-thickened fluids: voice hoarse after swallowing	Teaspoons of un-thickened fluids: cough after swallowing	Drinking un-thickened fluids: cough after swallowing	Drinking un-thickened fluids: dripping from mouth
Patients with abnormal FEES results (17 patients)												
Frequency of abnormal result (absolute)	1	4	15	8	2	3	6	2	2	3	2	2
Frequency of abnormal result (%)	5.9	23.5	88.2	47.1	11.8	17.6	35.3	11.8	11.8	17.6	11.8	11.8
Patients with normal FEES results (24 patients)												
Frequency of abnormal result (absolute)	0	2	18	5	0	0	4	0	0	5	6	0
Frequency of abnormal result (%)	0.0	8.3	75.0	20.8	0.0	0.0	16.7	0.0	0.0	20.8	25.0	0.0
PE items that are normal in normal-FEES patients and that are abnormal in > 10% of the abnormal-FEES patients (see text)					x	x		x	x			x
PE items that are abnormal in more than 50% of the abnormal-FEES patients (see text)			x									
PE items that do not increase the test's difficulty (see text)							x			x	x	
Final dysphagia screening test items (see text)												