Chapter 4

Endoscopic Criteria in Assessing Severity of Swallowing Disorders

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Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/60836

1. Introduction

The management of patients with swallowing disorders must involve a team of specialists whose work is aimed at preventing complications, ensuring a proper hydration and nutrition; as well as the the best quality of life to the patient [1]. This is an axiom that has guided our clinical activity for over 25 years. The goals of the team [2], in fact, can be summarized as follows:

- Diagnostic assessment (impairment)
- Define severity (development of complications)
- Treatment options
- Rapid and usable exchange of information
- Monitoring of results achieved (also considering complications, worsening)
- Improve the quality of life of the patient (disability and handicap):
- Collection of self-assessment questionnaires of the symptom and results.

The first three goals require an instrumental assessment. In other words the definition of the bio-mechanical events that are responsible of the deglutition disorder, have to be assessed with one or more instrumental tools, able to define the altered or mistimed movements, or muscular patterns, that compromise the passage of the bolus through the oral and pharyngeal cavities [3].

Simplifying such an approach, the evaluation of the clinical severity of a swallowing disorder remains a crucial aspect to determine, when managing patients with diseases or co-morbidities that may predispose them to respiratory or nutritional complications. The evaluation of the risk of complications, as just mentioned earlier, is a value that synthesizes data regarding the

patient in his/her totality, in relation to physical parameters (age, sex, race), the main pathology or other co-morbidities, the possibilities of an ecological management of the deglutition disorders (ie the possibility to effect behavioral strategies), also considering the wish of the patient and of the family [1].

The systematic method of the FEES (fiberoptic endoscopic evaluation of swallowing) evaluation is reported elsewhere in this book.

In this chapter the utility of endoscopy in the evaluation of dysphagic patients, new ways to conceive endoscopy and the correlations of endoscopy with a whole clinical context in the attempt to determine severity, will be discussed.

2. Instruments and settings

In daily practice, an instrumental procedure is indicated in the face of any suspected dysphagia or when a definition in differential diagnostic terms of the oro-pharyngeal situation is required. An instrumental procedure is also indicated for patients with pathologies that carry a high risk of complications even if they are apparently asymptomatic or when there is a discrepancy between the subjective signs and the outcome of a bedside evaluation. Even the clinical onset of dysphagia with complications makes an instrumental investigation of swallowing necessary [4-13].

So: which tool ?

The local availability of resources conditions the management of these patients but the possibility of a specialistic evaluation (carried out by a deglutologist) or the evaluation by trained carers has to be guaranteed in all the settings where elderly or dysphagic patients are recovered [1]. The tools, which are chosen, will be the available ones in our setting, aware that the "human factor" is the key to the success or failure of the clinical outcome. In our experience, the best way to manage dysphagic patients is represented by the evaluation of their swallowing abilities by means of a non instrumental clinical evaluation (clinical swallowing assessment, CSA) [14] and an instrumental endoscopic evaluation [15].

3. The endoscopic evaluation

Since 1988, when Susan Langmore first proposed the FEES protocol [16], the use of endoscopy in the evaluation of swallowing, has become an extraordinary tool in the hand of clinicians, offering a revolutionary way to observe the pharynx and the larynx during dynamic tasks (respiration, phonation and swallowing) and during the passage of the bolus. The possibility to test sensation is another extraordinary potentiality of the procedure. Subsequently, various standardized protocols for the dynamic study of swallowing have been proposed [17,18] but another advantage of endoscopy, in addition to those shown in Table 1, is exactly that of the possibility to adapt the evaluation to any kind of patient and in any kind of setting [19].

http://dx.doi.org/10.5772/60836

	ADVANTAGES	DISADVANTAGES
FEES	Less invasive Easy to perform Well tolerated Possible for a long time (fatigue viewing) Portable (acute and sub-acute patients) Routine Economic Therapeutic feed-back Decision making of oral feeding Natural foods Direct visualization of structures Motor and sensory activities Three-dimensional similar view Optimal pooling evaluation Pooling management viewing	Pharyngeal phase only White-out Indirect consideration about - Oral - Esophageal phase Fear and discomfort Poor vision in repeated swallowing acts Not possible if changes in upper airway
VFSS	Whole deglutition evaluation Time parameterization	Invasive (radiological exposure) Uncomfortable execution Environment and suitable personnel Expensive Bi-dimensional view (under estimation of pooling matter) Motor activity only (reaction to aspiration, if documented) Fatigue evaluation missing

Table 1. Advantages and disadvantages comparison between VFSS and FEES [19]

Firstly FEES has been compared and contrasted to VFSS (video-fluoroscopic study of swallowing) proposed by J. Logemann [20], an examination nowadays considered the instrumental gold standard for the study of swallowing. Compared to VFSS, FEES redeemed itself in terms of sensitivity, specificity and predictive values, if we consider its ability to identify aspiration as the main sensory-motor event linked to dysphagia and the leading cause of airway complications [21,19]. In a more recent period, the role of VFSS, as the instrumental gold standard, has been questioned [22].

Studies that have compared VFSS and FEES show that both procedures are comparable and have equivalent values of sensitivity, specificity and predictive abilities [23-30]. A more proper approach is to consider these two examinations as complementary [21]. The availability of both, allows the clinician to choose the method most appropriate to each case, relating to the required information. FEES also shows a considerable versatility in the management of the patients, of the multidisciplinary team and of the therapeutic process. The fact that it can be performed at the bedside, in any clinical condition and repeated over time, according to changing clinical needs, makes it an optimal method in the follow-up of any patient (Table 1).

4. The procedure

As previously said, the systematic method of FEES evaluation is reported elsewhere in this book. In the following paragraph, there is only a reference to the main steps of the evaluation that are summarized in Table 2. The most important step, in the endoscopic procedure, is the evaluation of the correlations existing between the morphological and functional findings; a few considerations follow. What must be remembered is that the anatomy influences the function, and the function influences the behavior of the structure to the passage of the bolus. In other words the safe functioning of the effectors of swallowing can be inferred evaluating the anatomical shaping of the effectors and the ability of the structure to support the passage of the bolus through the pharynx subsequently inferred by their functional abilities.

EVALUATION		SITE
Morphological	- Tumor - Ulcer - Erythema - Morphological defects - Hypertrophy - Hypotrophy - Atrophy - Asymmetry - Pathological events at rest	Epi-pharynx (soft palate) Meso-pharynx (tongue base) Hypo-pharynx (larynx)
Functional	- Symmetry - Reduced speed of movement - Reduced range of movement - Altered coordination	
Motor activities	- Velo-pharyngeal closure - Base of tongue retraction - Pharyngeal movements - True vocal cords movements - Sphincterial activity	
Pooling - dry swallows	- Color - Viscosity - Awareness - Patient reaction - Dry swallow frequency	
Sensation	- Reaction to the endoscope - Reaction to light touch of structures	

Table 2. Main parameters of anatomical and functional assessment.

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Sensation is a crucial factor, strongly influencing the safe passage of the bolus through the cavities. A copy of the peripheral sensation is sent in parallel to the cortex and to the brainstem, to coordinate the neuro-motor activity of the muscular effectors of the oral cavity, pharynx and supra-hyoid muscles. Table 3 and Fig.1 represent the central and peripheral interaction between sensation and motor activities.

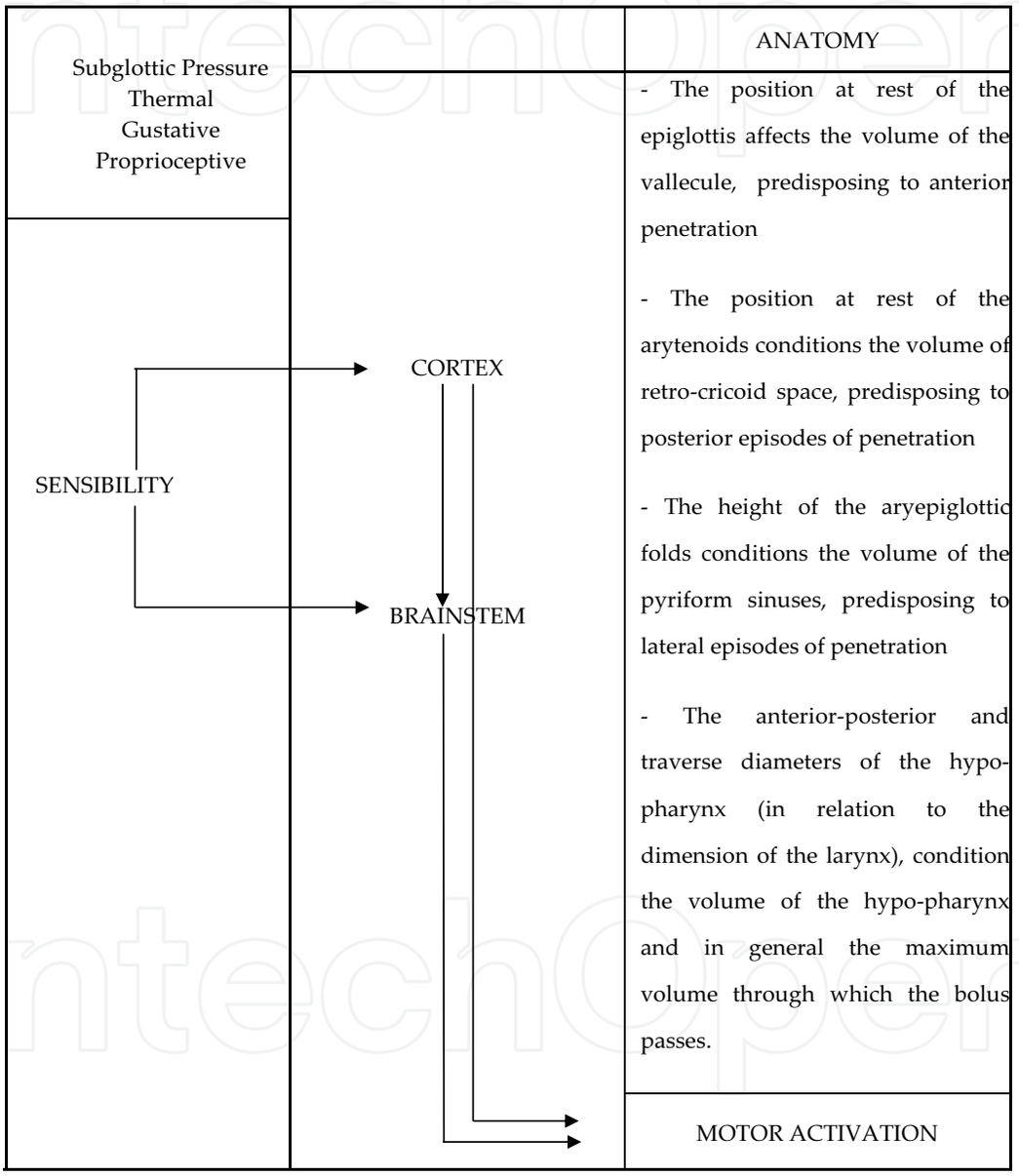

Table 3. Central and peripheral interaction between sensation and motor activities.

The stimulation of sub-glottic receptors may possibly act as a signal for the central nervous system that the larynx is "ready" (that is protected) for the bolus passage into the pharynx and this signal may, at the same time, influence the low motoneurons of the brainstem innervating

Figure 1
Interaction of subglottic pressure among respiration, deglutition and phonation.

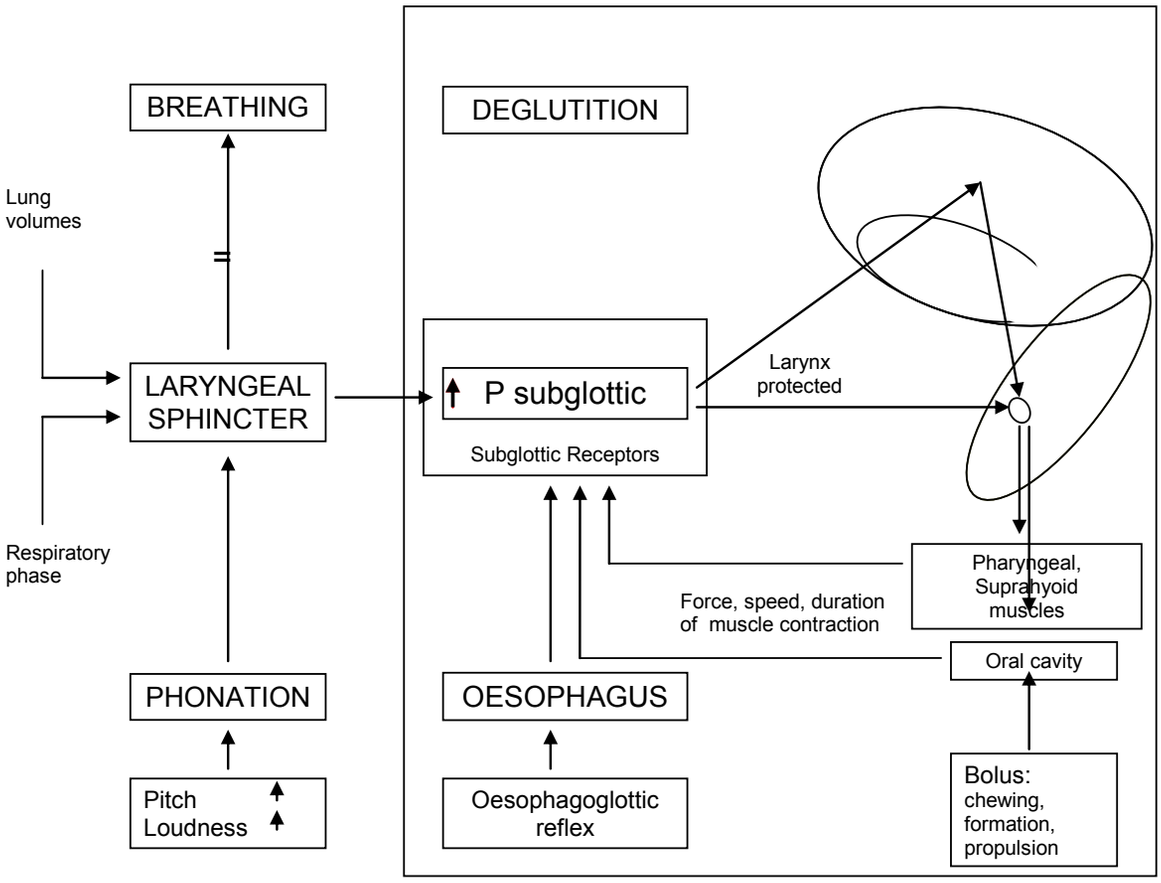

Figure 1. Interaction of subglottic pressure among respiration, deglutition and phonation.

Oral FEES (O-FEES) and the esophageal FEES (E-FEES) have been introduced. The E-FEES is possible by means of the introduction of a 70 cm endoscope into the esophageal cavity

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(endoscope in deep position) (Table 4). In this stage the procedure, with the same morphological and functional goals of FEES for the pharynx, has been known since 1994 (trans-nasal pharyngo-esophago-gastroduodenoscopy: T-EGD) [33]. Later Hermann first performed the test with bolus [34]. With shorter instruments, and where the study of the stomach or duodenum is not required, a trans-nasal examination of the esophagus is possible (trans-nasal esophagoscopy – TNE). TNE as a procedure also used for many years in the instrumental evaluation of patients with ENT complaints [35]. In a short time it became an office practice, performed on outpatients without anesthesia. Several protocols have been proposed [36-38] for patients with bolus or other complaints of gastroesophageal reflux diseases. The application of the procedure in patients with voice problems or other signs of laryngopharyngeal reflux (LPR) and swallowing disorders is limited [39]. The procedure allows for a perfect viewing of the esophageal wall and its movements, up to the cardias and of the functioning of the esophageal sphincters. With the tip of the endoscope in a retrograde position, retracting the instrument close to the upper part, a direct back viewing of the upper esophageal sphincter and its dynamics during different tasks (swallowing, belching, Valsalva) is possible. TNE also permits the evaluation of the role of saliva, bile and gas during swallowing and digestion, aside from testing the effects of reflux on the upper digestive and respiratory tracts. Finally, it allows for the proper placement of catheters before functional pharyngeal or esophageal assessment [22, 34].

The term E-FEES could be used in similarity to the new term of O-FEES, proposed for the endoscopic evaluation of the oral stage of swallowing.

O-FEES is performed using an endoscope with a reversible tip of 180°, starting from a position intermediate between the high and low (in relation to the anatomy of the patient). In this position it is possible to intercept the soft palate and introduce the tip of the instrument into the oral cavity (*anterior position or retrograde position*) (Fig. 2). From this position, it is possible to see an inverted image of the oral cavity and its content, up to the teeth and lips, if kept open. With the tip retroflexed and by retracting the endoscope by a few centimeters (*anterior posterior position*) (Fig. 3), the coana with the instrument emerging from the nasal cavity, can be seen. The glosso-palatal port is, thus, visible in a dorsal viewing. Even from the tip in these positions, it is possible to obtain static (anatomical) and dynamic (phono-articulatory) information and test sensation. More information is collected during the bolus tests: bolus preparation (Fig. 4) and propulsion (Fig. 5) can be checked directly, as well as bolus entering into the pharyngeal cavity. Any kind of consistency can be tested, checking oral preparation and propulsion. The passage of the bolus through the fauces is not visible, because of the presence of the white-out, as happens during pharyngeal transit as viewed with the tip in the high position. After the tests with bolus and with the tip in the anterior position, the presence and location of residue (on the hard palate, gums, alveoli, tongue) can be verified (Fig. 6) [22].

With O-FEES and E-FEES variations, the functional assessment of the effectors of swallowing is complete. A trace of the functional assessment is reported in Table 4.

	Static evaluation	Dynamic evaluation	Sensation
Endoscope position			
NASAL-RHINOPHARYNGEAL (naso-rhino-pharynx)	*Morphology of:* - Nasal cavities - Rhinopharynx - Pathological muscular activities *Pooling site:* . Nasal cavities . Rhynopharynx . Tubal ostium	*Speech* Velo-pharyngeal sphincter : - Velum deviation - Gap of closure - /s/ forced *Deglutition* - Nasal regurgitation	*General of the area:* - Reaction to the endoscope - Reaction to light touch of structures *Pooling* - Perception - Cleaning efforts - Cleaning effectiveness
HIGH (meso-pharynx)	*Morphology of:* - Base of tongue - Pharyngeal wall - Pathological muscular activities *Pooling site:* . Valleculae . Pyriform synus . Post-pharyngeal wall . Retro-cricoidal space	*Speech* - Base of tongue: retraction . /l/ ball . /k/ cocco - Pharyngeal wall deviation: . /e/ strained . /e/ repeated *Deglutition (dry swallowing)* - Base of tongue movements - Pharyngeal movements	*General of the area:* - Reaction to the endoscope - Reaction to light touch of structures - Gag reflex (base of tongue) *Pooling* - Perception - Cleaning efforts - Cleaning effectiveness
ANTERIOR (retrograde) (oral cavity)	*Morphology of:* - Tip, medium and base of tongue - Hard palate and gums/teeth - Lips *Pooling site:* . Hard palate . Tongue: tip, medium, base	*Speech* - Tongue movements: . /ka/ repeated - Lips movements : . /pa/ repeated *Deglutition (dry swallowing)* - Medium, base of tongue movements	*General of the area:* - Reaction to the endoscope - Reaction to light touch of structures - Gag reflex (tongue) *Pooling* - Perception - Cleaning efforts - Cleaning effectiveness
ANTERIOR POSTERIOR (oral cavity)	*Morphology of:* - Base of tongue - Soft palate (superior face) - Glosso-palatal seal - Coana *Pooling site:* . Hard palate . Tongue: body, base	*Speech* - Tongue movements: . ka/ repeated - Palate movements . /ma/ repeated *Deglutition (dry swallowing)* - Tongue movements - Palate movements - Pharyngeal movements	*General of the area:* - Reaction to the endoscope - Reaction to light touch of structures - Gag reflex (tongue) *Pooling* - Perception - Cleaning efforts - Cleaning effectiveness
LOW (hypo-pharynx)	*Morphology of* - Hypo-pharynx - Larynx during respiration - Pathological muscular activities *Pooling site:* . Sopra-glottic . Glottic . Sub-glottic . Cervical trachea	*Speech* - Glottic closure: . /a/ strained . /a/ repeated - Posterior commissure deviation . /a/ strained . /a/ repeated - Glottic opening: . Sniff - Vocal quality *Sphincterial activities* - True vocal cords closure: /a/ strained (time) - False vocal cord closure: . /a/ forced . Glide up /ee/ . Valsalva . Cough - Epiglottis inversion: . Dry swallows	*General of the area:* - Reaction to the endoscope - Reaction to light touch of: . Aryepiglottic folds . Arytenoids . True vocal folds . False vocal cords *Pooling* - Perception - Cleaning efforts - Cleaning effectiveness
DEEP (esophagus)	*Morphology of* - UES - Body - LES	*Sphincterial activities* - UES . Valsalva . Cough . Belching . Dry swallows - LES *Muscular activity* - Body	*General of the area:* - Reaction to the endoscope

Table 4. The main steps of the anatomo-functional evaluation

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Also the tests with bolus can be modified and enriched by O-FEES and E-FEES, as synthesized in Table 5. (UEP: upper esophageal sphincter; LES: lower esophageal sphincter)

PHASE	SENSORY-MOTOR EVENT
Bolus tests: different volumes and consistencies	
ORAL Endoscope in anterior position Endoscope in anterior-posterior position Endoscope in high position	**WHITE OUT**
Linguo-palatal sphincter competence Tongue movements Tongue propulsion Oral transport Total time	Spillage (premature bolus falling) Bolus preparation Bolus propulsion Bolus flow Site of pharyngeal reflex onset Pre-swallow penetration Pre-swallow aspiration
PHARYNGEAL Endoscope in high and low position	**WHITE OUT**
Velo-pharyngeal closure Vocal cords closure Laryngeal elevation Epiglottic inversion	Bolus flow Site of pharyngeal reflex onset Pre/intra-swallow penetration Pre/intra-swallow aspiration
Laryngeal returns low Epiglottis returns to rest	Pooling evaluation (site, amount, management): Post-swallow penetration Post-swallow aspiration Awareness Dry swallows Clearing Gurgling Cough with/without emission residues Effective management (larynx/trachea cleaned)
ESOPHAGEAL Endoscope in deep position Endoscope in deep retrograde position	**WHITE OUT**
Peristaltic activity Sphincters activity	Bolus flow Bolus delivery Bolus pooling

Table 5. Main sensory-motor events of swallowing investigated by the Bolus 2.2 modified.

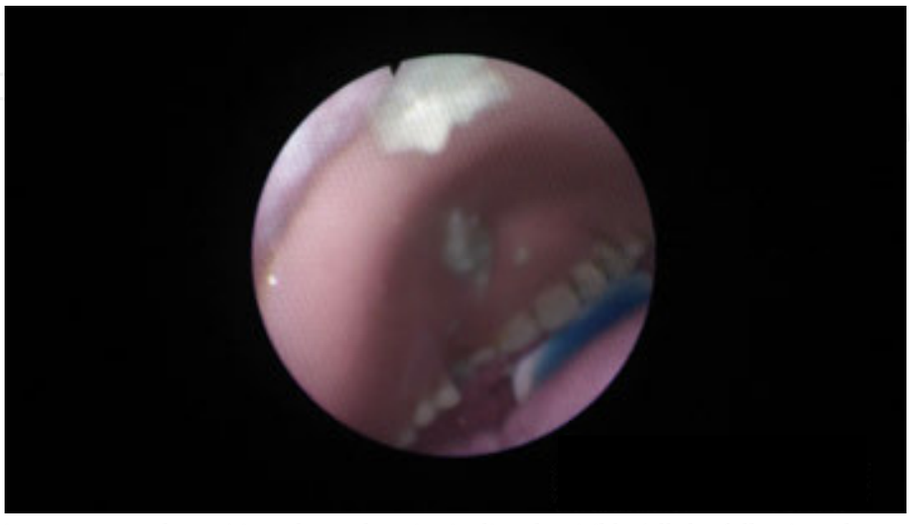

Figure 2. Anterior or retrograde position: the oral cavity is directly visible (all the following photographs have been rotated 180° to obtain viewing equal to the real one and make the images more easily interpretable).

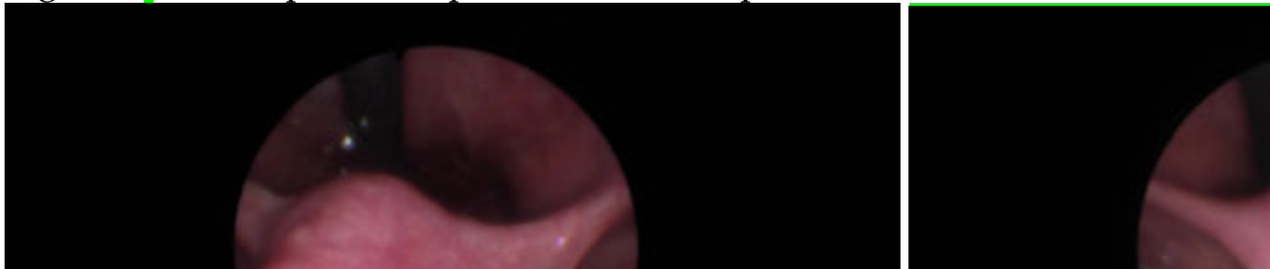

Figure 3. Antero-posterior position: the soft palate is lifted from the base of the tongue or lowered.

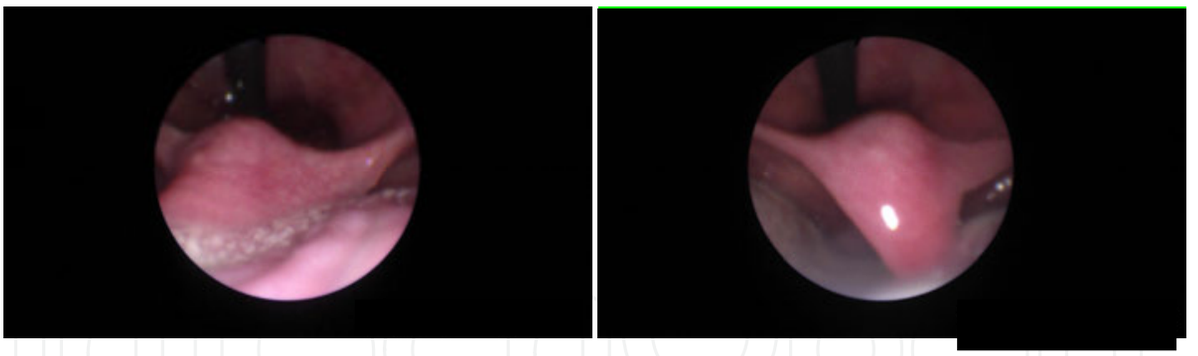

Figure 3. Antero-posterior position: the soft palate is lifted from the base of the tongue or lowered.

Figure 5 Anterior position: bolus propulsion.

Figure 4. Anterograde retrograde position: bolus preparation.

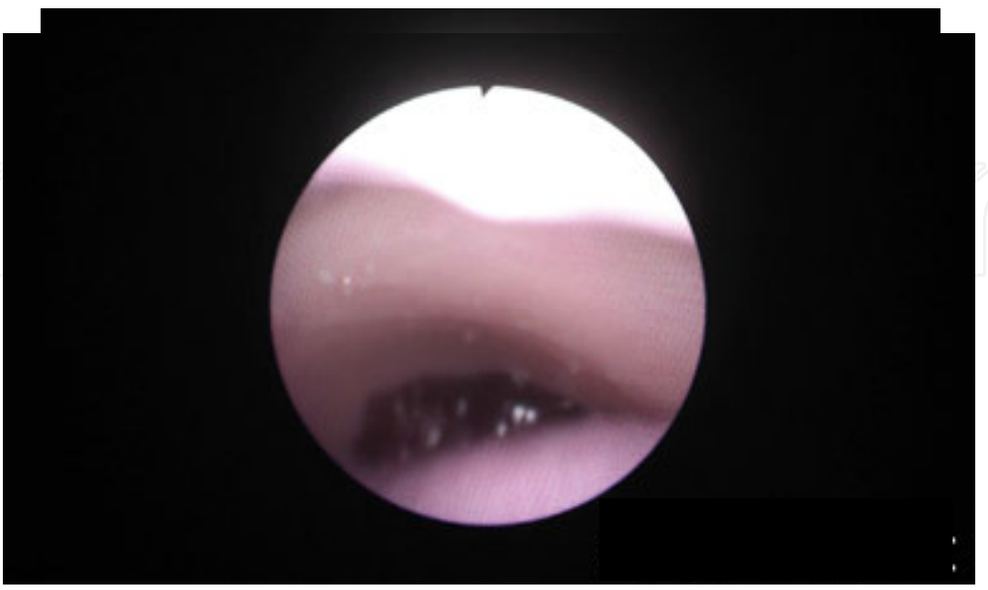

Figure 5. Anterior position: bolus propulsion.

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Figure 6 Anterior position: tongue clearing of material coating the oral cavity.

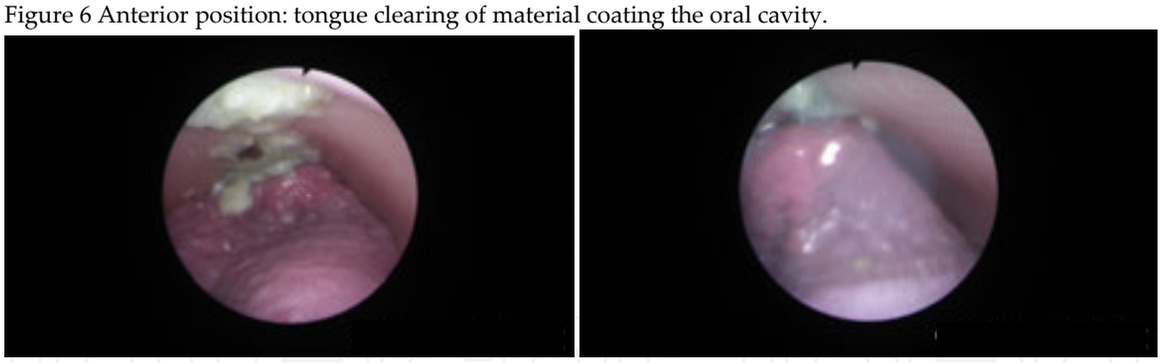

Figure 6. Anterior position: tongue clearing of material coating the oral cavity.

6. Endoscopy with a whole clinical context and severity

Returning to our topic, it can be assumed that those parameters that express inefficient or unsafe swallowing are markers of severity: respectively residue and false routes (airway invasion). An efficient and safe swallowing expresses the perfect balance between events that occur in the domain of time and space, domains in which vector forces guarantee that defensive strategies are put in place to protect the airways, or cleanse the containment cavities from the bolus passing through them [40]. The anatomo-functional evaluation and the tests with bolus, resumed earlier, offer several points for reflection. Residue or material pooling into cavities (before or after the tests with bolus) are powerful indicators of disturbed swallowing, predisposing the patient to airway invasion [41]. Material pooling and residue were used to develop scores, variously used in clinical practice. There are several scores in the literature, with severity criteria divided into 4 or 5 levels and this division does not seem to interfere with the inter-intra rater reliability of those scores [42, 43]. In 2008 the P-score was introduced [44]. In the development of this score, pooling is considered in a broader sense, as any material that is present in the containment cavities of the hypo-pharynx and larynx, before and after the act of swallowing. The severity criterion proposed by the score (Table 6) takes into account anatomical parameters: site, identified by anatomical landmarks; amount: determined in a semi-quantitative way by the amount of pooling materials (coating, more or less than 50% of cavity containment capacity); management, as well as the efficiency of secretion management, considering the number of dry swallowings performed by the patient, either spontaneously or upon request of the clinician involved in the assessment. The effectiveness of gargling, throat clearing or coughing is considered in the same way.

In clinical practice, the P-score may be integrated with other parameters of the clinical swallowing evaluation (CSE), that are more easily determined: age, sensation of the pharynx, patient collaboration. These parameters are considered in the P-SCA score (pooling-sensation, collaboration and age score) as those able to mitigate the severity criteria expressed by the endoscopic evaluation alone (see earlier and [44]). The inter-rater and intra-rater reliability of the P-score has recently been determined [40]. Four judges with long-standing experience in the use of endoscopy, and after a training session, evaluated 30 films (the pharyngeal transit of boluses with different consistency) of 23 subjects with swallowing disorders. The films,

randomly recorded on two different CDs, were viewed three times: a first time, after 24 hours and after 7 days. Inter and intra-rater reliability was calculated through the intra-class correlation coefficient ICC(3,k) individually for site, amount, management and the total score. As for the items site, amount, management and total P-score, the ICC(3,k) was 0.999, 0.997, 1.00, and 0.999, respectively. The analysis of variance showed no statistically significant dependency determined by the consistency in the differences detected.

As regards the domains previously mentioned, we have that in the time domain, the score may identify events that occur before or after swallowing; indeed, part of the material pooling that has not been swallowed during the previous swallow, becomes a bolus for the next swallow, with a different volume. The P-score considers the sequence of swallowing in the "management", evaluating the fate of a bolus that persists in the pharynx after five empty swallows. In the space domain, where forces are in action, the P-score identifies the pathway and the flow of the bolus: the pathway is identified by the direction along the digestive or respiratory tracts, as well as false route (penetration or aspiration); the flow is indicated by the amount of bolus that does not cross the pharynx while swallowing.

The events that occur in these domains together with vectorial forces, may be integrated in different ways, generating a very wide range of possibilities. For instance, the dynamic vectors and volumetric aspects, considered by the score, allow for information to be obtained on the reaction of the patient to airway invasion (management): the occurrence, or absence, of dry swallowing, cough or throat clearing, in response to the transit of the bolus in the larynx or in the cervical trachea before, during or after swallowing is considered.

Pooling	**Endoscopic landmarks**		**Bedside parameters**		
			Sensation	**Collaboration**	**Age (years)**
Site	Valleculae	1	Presence = - 1 Absence = +1	Presence = - 1 Absence = +1	+1 (<65) +2 (65-75) +3 (>75)
	Marginal zone	1			
	Pyriform sinus	2			
	Vestibule/vocal cords	3			
	Lower vocal cords	4			
Amount	Coating	1			
	Minimum	2			
	Maximum	3			
Management	< 2	2			
	2 >< 5	3			
	> 5	4			
Score	P 4-11		P-SCA 3-16		

Table 6. P-score and P-SCA score

The P-score expresses, as a numerical value, a continuum of severity that in clinical practice may be used in different ways, with correlations that still have to be verified (Table 6).

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Therefore, a minimum score (P-score 4_5) may indicate the absence of endoscopic signs of dysphagia. A low score (P-score 6_7) may identify mild dysphagia, a medium score (P-score 8_9) moderate dysphagia, and a high score (P-score 10_11), severe dysphagia. The score refers to a specific type of consistency and volume, and may change according to these. A similar subdivision can be made for the P-SCA score (for more details see [44]). In this way, it is possible to give clear indications with reference to treatment, or make comparisons before and after treatment.

Anatomical landmarks and bedside parameters with relative values.

P: pooling P-SCA: pooling _ sensation, collaboration, age

P score:

45 = minimum score, corresponding to no dysphagia

6_7 = low score, corresponding to a mild dysphagia

8_9 = middle score, corresponding to a moderate dysphagia

10_11 = high score, corresponding to a severe dysphagia

P-SCA score:

3_4 = minimum score, corresponding to no dysphagia

5_8 = low score, corresponding to a mild dysphagia

9_12 = middle score, corresponding to a moderate dysphagia

13_16 = high score, corresponding to a severe dysphagia.

7. The integrated clinical evaluation

The instrumental criterion of severity (endoscopic or radiological) needs to be contextualised according to a more general clinical criterion of severity, of the patient and of the swallowing disorder, considering that the non-instrumental assessment tends to underestimate the risk of aspiration, whereas the instrumental assessment tends to overestimate it [45].

It is therefore a relative criterion, which is identified through its parametrization. In clinical practice, aspiration is the most significant event that marks a swallowing disorder, yet it is not the only one. It is worth considering that during an instrumental assessment, we check the outcome of a very low number of swallowing acts, compared to the number of swallowings that are performed, for instance, during a meal or a whole day. It should be considered that many variables affect the successful outcome of pharyngeal transit of a bolus (Table 3). Swallowing patterns may be modified in real time in response to the functional status of swallowing effectors, in their turn related to sensation, volume, consistency and position of the bolus in the mouth when the pharyngeal reflex is elicited.

In 2008 [46], in a perspective study, the P-score and the P-SCA score (Table 6) were applied to a sample of 556 consecutive patients (inpatients and outpatients, 318M/238F, mean age 65.56±10.36 years), seen at our Swallowing Centre.

The correlation between the two tests was determined by the Spearman correlation coefficient. The agreement between the two scores has been calculated (Cohen's Kappa) considering the categories of risk corresponding to the totalized scores (no dysphagia, mild, moderate, severe). The categories of risk individualized with the two scores have been studied with the aim to underline possible systematic divergences in the attribution of the severity to the cases. Subsequently, the P-score and the P-SCA score were dichotomized, dividing the patients without risk from those with middle and high risk of aspiration. By the comparison of the dichotomic scores with the result of the FEES evaluation (considered as gold standard), the values of sensitivity and specificity have been obtained.

The results of this study documented a close correlation between the P-score and P-SCA score (rho=0.88) (Table7): The correlation is significant (p<0,001).

The agreement among the scores as regards the categories of risk attributed results discrete (Cohen's Kappa=0,46 p <0,001).

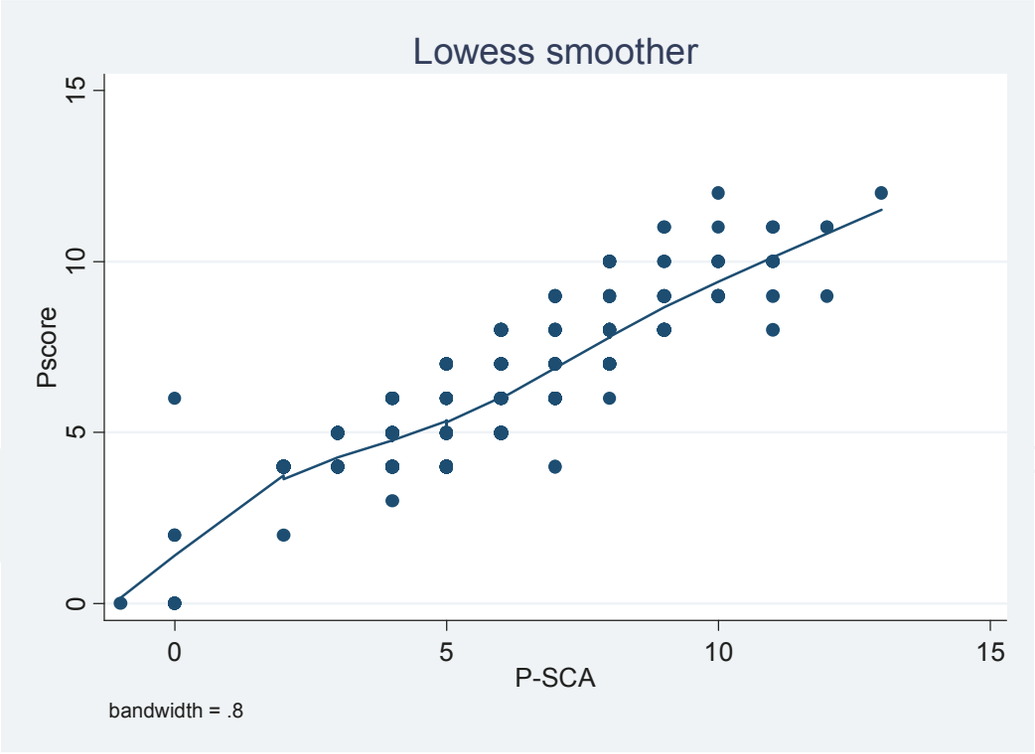

Table 7. Correlation between P-score and P-SCA score

The double Table 8 shows how the two scores have classified the patients in the different categories of risk.

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	P-SCA score				
P-score	**No**	**Mild**	**Moderate**	**Severe**	**Total**
No	163	100	0	0	263
	61.98	38.02	0.00	0.00	100.00
Mild	11	139	0	0	150
	7.33	92.67	0.00	0.00	100.00
Moderate	0	43	35	0	78
	0.00	55.18	44.87	0.00	100.00
Severe	0	12	20	1	33
	00.0	36.36	60.61	3.03	100.00
Total	174	294	55	1	524
	33.21	55.61	10.50	0.19	100.00

Table 8. Double table comparing the P-score and the P-SCA score and the classification of risk.

The table shows that the P-SCA score tends to "increase" the severity in the category with lower risk, while in those with higher risk it tends to be more cautious, attributing a category with lower severity in comparison to P-score. Overall the patients classified as at risk of aspiration by the P-score are 50%, while the P-SCA score considers at risk 67% of the patients. Comparing the two scores it is shown that the P-SCA score tends to have a lower value than the P-score (Wilcoxon signed-rank test $p<0.001$) (Table 9).

	Frequency	**Percentage**
P-score		
No dysphagia	264	50.29
At risk	261	49.71
Total	525	100.00
P-SCA score		
No dysphagia	174	33.21
At risk	350	66.79
Total	524	100.00

Table 9. P-score and P-SCA score and risk of aspiration

The judgement expressed by the scores has been dichotomized setting the cut-off point between patients without risk and those with any kind of risk, with the purpose of comparing the evaluation of the scores with the result of the FEES (gold standard) regarding “aspiration” and to get for both, values of sensibility and specificity.

The P-score has reached values of sensibility of 96% and specificity of 60%, with an area underlying the ROC curves of 0.78, while the P-SCA score has reached values of sensibility of 98% and specificity of 40%, with an area underlying the ROC curves of 0.69. With such

dichotomization, the P-SCA score recognizes more patients at risk, resulting more sensitive than the P-score, but also less specific (more false positive).

In conclusion, the assessment of patients with deglutition disorders has to consider as many elements as are available from the clinical and instrumental evaluation (integrated clinical evaluation).

The possibility of an instrumental evaluation sharpens the diagnostic precision with margins of error that vary for every procedure, but with the possibility of over estimating the risk of aspiration. In fact, patients with higher risk according to the P-score are attributed by P-SCA score to lower risk categories. Both have a high sensibility to individualize patients with a risk of inhalation from minimum to high. Nevertheless, the P-score is more specific, more skilled in recognizing the false positive and therefore more reliable in correctly classifying patients without dysphagia and patients with a risk of any degree of dysphagia.

In other words, while in patients considered without risk by the P-score, the clinical variable considered by the P-SCA-score increases the evaluation of the risk, in patients classified by P-score in the categories of higher severity, the evaluation of such clinical variables tends to mitigate the judgement expressed by the P-score and to put back patients into the categories with lower risk.

The association of endoscopy and elements of the CSE in the evaluation of the severity of dysphagia, tends to mitigate the gravity of the clinical case, allowing a more careful estimate in a routine clinical context.

8. Conclusions

In conclusion, some observations can be made.

The first consideration is that a criterion of severity must be a complete clinical criterion, which considers as many elements as possible from the clinical non-instrumental and instrumental evaluation. In general, any event leading the team to modify the treatment programme already decided, can become element of severity. As previously said, the only CSE, however well conducted, may underestimate the severity of a swallowing disorder in relation to the inability to directly see the effectors of swallowing and their behavior during the passage of the bolus. The contribution of the instrumental examination, in this issue, is essential: It shows the clinicians what happens inside the effectors during the passage of the bolus, but it tends to overestimate the severity of the disorder, inducing in the risk of generalization of patterns that may not reflect the real functional status of the effectors.

The endoscopic examination is a versatile and well-tolerated tool, which promptly facilitates and ratifies the team's activities. The latest developments of the endoscopic investigation with the possibility of a direct visualization of the oral (O-FEES) and the esophageal (E-FEES) phase of swallowing makes FEES more complete and brings it closer to the radiological gold standard.

http://dx.doi.org/10.5772/60836

Compared to VFSS, endoscopy allows for an optimal viewing of the effectors, making us appreciate all the anatomical variations that can affect the passage of the bolus. The interpretation of the biomechanical events resulting from this passage should enable the clinician to estimate behaviors useful for therapeutic purposes.

Taken together, all this information will provide us with a complete criterion of severity, able to guide the team towards effective activities and improve the QOL of the patient.

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