

Ada Kantczak, Ireneusz Bielecki, Agata Gierlotka,
Grzegorz Dawiec, Dorota Górny, Wiktor Kruczek

Received: 02.05.2024
Accepted: 29.10.2024
Published: 21.07.2025

The use of flexible endoscopic evaluation of swallow in the paediatric population

Zastosowanie endoskopowej oceny zaburzeń połykania w populacji dziecięcej

Department of Paediatric Otolaryngology, Head and Neck Surgery, Department of Paediatric Surgery, Faculty of Medical Sciences in Katowice, Medical University of Silesia in Katowice, Katowice, Poland
Correspondence: Ada Kantczak, Department of Paediatric Otolaryngology, Head and Neck Surgery, Department of Paediatric Surgery, Faculty of Medical Sciences in Katowice, Medical University of Silesia in Katowice, Medyków 16, 40-752 Katowice, Poland, e-mail: adakantczak@gmail.com

 <https://doi.org/10.15557/PiMR.2025.0013>

ORCID iDs

1. Ada Kantczak <https://orcid.org/0000-0001-5338-0412>
2. Ireneusz Bielecki <https://orcid.org/0000-0002-6846-8019>
3. Agata Gierlotka <https://orcid.org/0009-0008-0436-1766>
4. Grzegorz Dawiec <https://orcid.org/0000-0002-4536-2270>
5. Dorota Górny <https://orcid.org/0009-0000-7940-6967>
6. Wiktor Kruczek <https://orcid.org/0009-0008-5193-2074>

Abstract

Swallowing disorders in the paediatric population are often multifactorial in origin, necessitating diagnosis and management by specialists from multiple medical disciplines. Currently, two diagnostic modalities are considered the “gold standard” for assessing these disorders in children: flexible endoscopic evaluation of swallowing (FEES) and videofluoroscopic swallowing study (VFSS). FEES consists of three stages. The first stage involves an assessment of the anatomy and physiology of the nose, nasopharynx, oropharynx, hypopharynx, and larynx. The second stage involves evaluating the swallowing of foods with varying consistencies, allowing for the identification of problems related to residue retention and aspiration. The third stage assesses the effectiveness of therapeutic interventions. FEES enables the assessment of residue and aspiration risk, particularly in populations such as exclusively breastfed infants and patients for whom VFSS is contraindicated or not feasible. The procedure is safe and well-tolerated by children and can be performed at the patient's bedside. Because it does not expose the patient to ionising radiation, FEES can be repeated at short intervals. It is important to note that there is no universal protocol for all paediatric patients; the FEES protocol must be individualised to accommodate the patient's age, developmental level, and general clinical condition. It is important to emphasise that FEES and VFSS are complementary techniques rather than substitutes for one another. A centre specialising in the diagnosis of dysphagia should have the capability to perform both tests.

Keywords: children, dysphagia, swallowing disorders, flexible endoscopic evaluation of swallowing, FEES

Streszczenie

Zaburzenia połykania u dzieci mają często wieloczynnikowe podłoże, co sprawia, że ich diagnoza i leczenie wymagają zaangażowania specjalistów z różnych dziedzin medycyny. Obecnie za złoty standard w ocenie tych zaburzeń u dzieci uznaje się dwa badania – endoskopową ocenę połykania FEES (*flexible endoscopic evaluation of swallowing*) i wideofluoroskopowe badanie połykania VFSS (*videofluoroscopic evaluation of swallowing study*). FEES składa się z trzech etapów. Pierwszym jest ocena anatomii i fizjologii nosa, nosogardła, gardła środkowego, gardła dolnego oraz krtani. Drugi polega na ocenie aktu połykania pokarmów o różnej konsystencji, co pozwala na identyfikację problemów związanych z zaleganiem i aspiracją pokarmów. Z kolei trzeci obejmuje ocenę skuteczności zabiegów terapeutycznych. FEES umożliwia ocenę stopnia zalegania i ryzyka aspiracji pokarmu nawet u niemowląt karmionych wyłącznie piersią czy u pacjentów, których stan ogólny uniemożliwia wykonanie badania VFSS. Jest to bezpieczne i dobrze tolerowane przez dzieci badanie, które można wykonać przy łóżku pacjenta. Ponieważ nie naraża na promieniowanie rentgenowskie, może być często powtarzane. Należy pamiętać, że nie ma jednego uniwersalnego protokołu badania dla wszystkich pacjentów pediatrycznych, a plan badania wymaga dostosowania do indywidualnych potrzeb pacjenta w zależności od wieku, stopnia rozwoju i stanu ogólnego. Należy podkreślić, że FEES i VFSS wzajemnie się uzupełniają, a nie zastępują. Ośrodek specjalizujący się w diagnostyce dysfagii powinien dysponować możliwością wykonania obu tych badań.

Słowa kluczowe: dzieci, dysfagia, zaburzenia połykania, endoskopowa ocena zaburzeń połykania, FEES

INTRODUCTION

Dysphagia, or swallowing disorders, as defined by the American Speech-Language-Hearing Association, may involve impairments of the oral, pharyngeal, or oesophageal phases of swallowing⁽¹⁾. In children, dysphagia can manifest with symptoms

Structural defects	Nose and nasopharynx: • choanal stenosis/atresia • pyriform aperture stenosis • tumours • midface hypoplasia • inferior turbinate hypertrophy • pharyngeal tonsil hypertrophy
	Oral cavity and oropharynx: • shortened lingual frenulum • micrognathia/retrogenia • cleft lip/cleft palate • macroglossia • high-arched palate • tumours
	Lower pharynx and larynx: • laryngeal flaccidity • vocal cord paresis/paralysis • laryngotracheal cleft • laryngeal stenosis • laryngeal cleft • vascular rings • vascular malformations • tumours
	Trachea and oesophagus: • oesophageal atresia • tracheoesophageal fistula • tracheobronchomalacia • pyloric stenosis • vascular rings • tracheal stenosis
Prematurity	• low gestational age • low birth weight • comorbidities associated with prematurity
Neurological disorders	• Microcephaly • Hydrocephalus • Intraventricular haemorrhage • Periventricular leukomalacia • Cerebral palsy • Spinal muscular atrophy type 1b (SMA 1b) • Craniofacial trauma • Central nervous system tumours • Epileptic disorders • Muscular dystrophy
Cardiopulmonary disorders	• Congenital heart defects • Bronchopulmonary/pulmonary dysplasia • History of cardiac surgery
Gastroenterological disorders	• Gastroesophageal reflux disease • Eosinophilic esophagitis
Metabolic disorders	• Pompe disease
Iatrogenic causes	• Nasogastric tube feeding • Tracheostomy • Prolonged intubation • Mechanical ventilation
Oesophageal damage	• Ingestion of a button cell battery • Chemical burn of the oesophagus

Tab. 1. Factors predisposing to feeding disorders and dysphagia in children and infants^(3,4)

corresponding to dysfunction in any of these phases. The diagnosis and management of oropharyngeal dysphagia are commonly addressed by ENT specialists, whereas oesophageal dysphagia typically falls within the scope of gastroenterology. This paper focuses specifically on oropharyngeal dysphagia.

Limited data is available on the prevalence of swallowing disorders in children. The estimated incidence of dysphagia in the United States alone is approximately 9 cases per 1,000 children per year⁽²⁾. Extremely premature infants; patients with neurological, cardiopulmonary, or metabolic disorders; and children with craniofacial or respiratory anomalies are at increased risk of dysphagia⁽³⁾. Conditions predisposing to swallowing disorders are summarised in Tab. 1. Swallowing disorders in children may be congenital or acquired, with a frequently multifactorial aetiology. Their diverse etiopathogenesis prompts interdisciplinary diagnostic and therapeutic approaches. Accurate diagnosis and effective treatment depend on comprehensive clinical evaluation, including instrumental assessments. Flexible endoscopic evaluation of swallowing (FEES) and videofluoroscopic swallowing study (VFSS) are currently considered the gold standard for assessing swallowing disorders in children⁽⁴⁾.

FEES – ADVANTAGES AND LIMITATIONS

VFSS and FEES are complementary procedures that together provide a comprehensive assessment of the swallowing process, including its safety and efficiency. During VFSS, the patient ingests test boluses of varying consistencies mixed with a radiopaque contrast agent, such as barium or a water-soluble alternative, while real-time fluoroscopic imaging captures the dynamic swallowing process. VFSS enables the evaluation of the oral, pharyngeal, and, to some extent, oesophageal phases of swallowing, thereby offering a comprehensive assessment of swallowing disorders. Unlike FEES, VFSS does not involve the “white-out” effect, i.e. a brief period during the swallow when the endoscopic view is obscured due to contact of the endoscope with the tongue base, epiglottis, and the bolus itself⁽⁵⁾.

Exposure to ionising radiation, which is of particular concern in paediatric patients, is a limitation of VFSS. Additionally, the child’s clinical condition must allow for safe transport to the department of radiology⁽⁶⁾. Furthermore, the examination may be challenging because the radiological contrast agent is not a natural food, and young patients may refuse to ingest it. The literature emphasises that radiological contrast agents used in VFSS differ from natural foods, which should be taken into account when interpreting findings⁽⁷⁾.

In infants, VFSS contrast agent is administered via a bottle, which limits its applicability for evaluating swallowing disorders in exclusively breastfed children. This is due to the differing suck–swallow–breathe coordination required for breastfeeding vs. bottle-feeding; as a result, VFSS findings may be less reliable in predominantly breastfed infants⁽⁸⁾.

FEES is performed using a flexible nasal fiberscope. The procedure begins with an evaluation of the nasal anatomy and physiology, followed by an assessment of pharyngeal and laryngeal structures. Assessment of laryngeal protective reflexes is conducted, followed by swallowing trials with foods of varying consistencies. FEES also allows for the evaluation of therapeutic manoeuvres that are individually tailored to each patient⁽⁹⁾. Unlike VFSS, FEES does not involve exposure to ionising radiation, allowing it to be repeated as often as clinically necessary. This is particularly important in newborns with swallowing disorders, who may require repeated instrumental assessments as they grow and develop. Additionally, FEES permits the use of natural foods, which is particularly advantageous in children with food selectivity^(9,10). FEES is currently the only diagnostic tool that enables the assessment of aspiration and penetration in exclusively breast-fed infants⁽¹¹⁾. Owing to its portable equipment, FEES can be done at the patient's bedside, providing an alternative for individuals who cannot be safely transported to the radiology department or for children unable to assume the body position required for VFSS. Capability to assess both aspiration and clearance of secretions is one of the primary advantages of FEES. FEES enables the assessment of swallowing in infants or children unable to orally ingest sufficient volumes of VFSS contrast agent, as secretion retention can be evaluated during spontaneous swallows without the need for administered food or contrast agents⁽¹²⁾. If secretion retention is identified during FEES, oral trials with food should be avoided to prevent aspiration. The presence of secretions in the laryngeal vestibule has been shown to be associated with an increased risk of aspiration⁽¹³⁾.

The limitation of FEES is that it primarily focuses on analysing the pharyngeal phase of swallowing. The tool assesses oral phase disorders only indirectly, due to the white-out effect. Limitations of FEES further include the inability to evaluate the oesophageal phase of swallowing⁽⁹⁾. A summary of the advantages and limitations of FEES is provided in Tab. 2.

FEES carries potential risks, including injury of the upper airway mucosa, epistaxis, choking, and, in rare cases, laryngospasm. However, long-term observations indicate that complications associated with the procedure are uncommon. Over 25 years of performing FEES in paediatric patients, Miller and Willging reported no complications other than minor, self-limiting epistaxis⁽¹⁴⁾. Similarly, Zang et al. described FEES as a safe and easy procedure in children⁽¹⁵⁾, however, it should be noted that successful examination requires a certain degree of patient cooperation. FEES should be conducted in a setting equipped with cardiopulmonary resuscitation equipment and staffed by personnel trained in airway management. This requirement arises primarily from the fact that patients undergoing FEES often present with multiple comorbidities, rather than from a high risk associated with the procedure itself⁽¹⁶⁾.

It is important to note that FEES and VFSS are complementary diagnostic tools, and their findings may differ.

Kelly et al. compared the severity of penetration and aspiration of food and saliva using the Penetration-Aspiration Scale (PAS) as assessed by both FEES and VFSS. They demonstrated that patients assessed with FEES received higher PAS scores compared to those evaluated with VFSS. The researchers emphasised that FEES and VFSS should not be used interchangeably, as doing so may lead to misinterpretation of the patient's clinical condition; apparent improvement or deterioration in swallowing function may simply arise from the use of a different instrumental technique⁽¹⁷⁾. As with many diagnostic procedures, most infants and young children may have limited tolerance for instrumental methods, including FEES and VFSS. Just as some patients may be unable to tolerate radiologic contrast agent during VFSS, others may not accept transnasal insertion of an endoscope in FEES. A centre specialised in the diagnosis of swallowing disorders should have access to both FEES and VFSS, with the choice of procedure individualised based on each patient's clinical needs. The most common indications for FEES in paediatric patients are summarised in Tab. 3, while contraindications are presented in Tab. 4.

CLINICAL ASSESSMENT PRIOR TO FEES

FEES should be preceded by a thorough medical history, including comorbidities and symptoms suggestive of swallowing disorders, such as regurgitation, feeding-related fatigue, interruptions in feeding due to crying, choking, coughing, vomiting, sensation of a foreign body, or pain on swallowing. The child's nutritional status should be evaluated both quantitatively and qualitatively, with attention paid to feeding habits and taste preferences.

Pre-FEES clinical assessment should include observation of the child during feeding in the presence of caregivers, under conditions that closely resemble the home setting, as well as observation before and after the meal⁽¹⁸⁾. Observation during a meal may reveal compensatory body positioning or avoidance of specific food consistencies, as well as signs indicative of impaired swallowing efficiency or safety.

In adult patients, the diagnostic process for swallowing disorders often includes a screening for aspiration, such as the 90 mL water swallow test⁽¹⁹⁾. Suiter et al. demonstrated the utility of this test in the paediatric population, reporting a sensitivity of 100% for detecting aspiration. However, the researchers emphasised that the test is characterised by low specificity⁽²⁰⁾. Depending on the patient's age, aspiration screening can be performed using the Daniels Test or the Volume-Viscosity Swallow Test (V-VST). The Daniels test comprises a clinical evaluation of dysphonia, dysarthria, abnormal or absent pharyngeal reflexes, the ability to voluntarily elicit a cough, and a water swallowing assessment. During the swallowing test, the patient is given increasing volumes of water, each volume twice (5 mL, 10 mL, and 20 mL). After each portion, the patient is asked to phonate a prolonged "a" sound, and voice quality is assessed for approximately one minute. The test is considered

Advantages	Limitations
Low invasiveness	Provides an indirect assessment of dysphagia
Can be done the patient's bedside	White-out effect
Can be repeated at short time intervals	Cannot assess the oesophageal phase of swallowing
Inexpensive	The presence of a fiberscope in the nose results in conditions of examination that are not fully physiological
Can assess aspiration and secretion retention	Anxiety and lack of cooperation during examination of infants and young children
Can be used to practice therapeutic manoeuvres using natural foods	
Can assess aspiration and penetration in breastfed infants	

Tab. 2. Advantages and limitations of FEES^(6,11,12,14)

positive when two or more of the following six abnormalities are present: dysphonia, dysarthria, abnormal pharyngeal reflex, weak or absent voluntary cough, coughing during the water swallow test, or a change in voice quality after swallowing. A positive result indicates a high risk of aspiration⁽²¹⁾. During V-VST, the patient ingests increasing volumes (5 mL, 10 mL, 20 mL) of test substances with varying consistencies. Simultaneously, blood oxygen saturation is monitored using a pulse oximeter. After the administration of each portion, the patient is monitored for signs such as coughing, changes in voice quality, or a decrease in oxygen saturation of $\geq 3\%$. The presence of any of these symptoms is indicative of aspiration. During the challenge, substances of varying consistencies are administered in a specific sequence: first a nectar-thickened liquid, followed by an unthickened liquid (water), and finally a pudding-thickened liquid⁽²²⁾. Modified Evans Blue Dye Test (MBDT) is used in patients with a tracheostomy tube. Before initiating the test, secretions from both the tracheostomy tube and the oral cavity must be thoroughly suctioned. A blue-coloured test substance is administered, after which tracheal secretions are aspirated. The presence of blue dye in the aspirated secretions indicates aspiration⁽²³⁾.

Additionally, prior to qualification for FEES, the child should undergo evaluation by a speech therapist to assess oral motor function and determine feeding milestones, including the ability to suck, bite, chew, ingest various food textures, and drink from a cup⁽¹⁸⁾.

FEES PROTOCOL

FEES is performed using a flexible fiberoptic endoscope connected to a visual monitoring system. The endoscope size should be chosen based on the child's age and the dimensions of the nasal passages to maximise comfort during the examination. If passing the endoscope through the nasal passages poses difficulty, an endoscope with a smaller diameter may be required.

Indications for FEES

- Assessment of spontaneous saliva swallowing and airway protection during swallowing
- Assessment of readiness to initiate oral feeding in patients who do not consume food or who take only minimal amounts orally
- Assessment of swallowing in children prior to airway reconstruction
- Suspected or known anatomical defects in the head or neck region affecting swallowing function, e.g. cleft palate, laryngeal laxity, vocal cord paralysis
- Suspected pharyngeal or laryngeal sensory disorders
- Diagnosis of swallowing disorders in patients with:
 - congenital defects
 - cerebral palsy
 - neurological diseases
 - neuromuscular diseases
 - history of neurosurgery
 - tracheostomy
 - history of surgical procedures in the head and neck area
 - pulmonary conditions, chronic cough
 - history of trauma and burns of the upper respiratory tract and upper gastrointestinal tract
- As a complementary test in the case of abnormal VFSS findings
- As an alternative to VFSS in the case of:
 - the need to repeat the examination within a short period of time to avoid exposure to ionising radiation in patients who cannot be transported to a radiology unit
 - in the case of difficulties in assuming the required body position by the patient
 - in children who are unable to absorb the appropriate volume of contrast necessary for VFSS
 - in children who are exclusively breastfed
- Evaluation of the effectiveness of therapeutic manoeuvres, modification of food texture and fluid density
- Recommendation of the optimal route of nutrition (enteral/parenteral) and feeding method (oral/feeding tube/gastrostomy/jejunostomy)
- To assess therapeutic progress

Tab. 3. Indications for paediatric FEES^(6,14–16)

Contraindications to FEES

- Nasal obstruction/choanal atresia preventing endoscope insertion
- Micrognathia/posteriorly displaced tongue preventing visualisation of the hypopharynx
- Severe general clinical condition of the patient (e.g. prematurity, haemodynamic instability, respiratory failure)
- Significant agitation and potential lack of cooperation during the examination
- Prohibition of oral feeding for reasons other than dysphagia
- Recent nasal trauma, nasal or sinus surgery
- Coagulation disorders or recent severe epistaxis

Tab. 4. Contraindications to paediatric FEES^(6,14–16)

To enhance visualisation of liquids and foods during endoscopic evaluation of swallowing disorders, food dyes are employed as contrast agents. The most commonly used dye is green, although white dye may be used as an alternative. According to Marvin et al., green dye enhances visualisation of solid food boluses, while white dye better visualises liquids⁽²⁴⁾. In contrast, Miller et al. reported that white dye leaves a residue on the mucous membranes after ingestion, facilitating the assessment of penetration and aspiration⁽²⁵⁾. The comfort of the examination, and consequently the cooperation of the young patient, may be enhanced by the use of a local anaesthetic. However, local anaesthesia should not be employed routinely as it may alter FEES findings by reducing sensation in the nasopharynx, oropharynx, and hypopharynx⁽²⁶⁾. When local anaesthesia is indicated, options

include applying 2% lignocaine to the tip of the endoscope, using lignocaine spray, or administering a mixture of oxymetazoline and lignocaine. Combining oxymetazoline with lignocaine enhances the visual field through vasoconstrictive effect and reduces discomfort⁽²⁷⁾. To avoid pharyngeal anaesthesia during the application of local anaesthesia, the child should, if possible, be in a sitting position with the head in neutral alignment.

FEES should be performed by trained medical personnel, typically including a physician (such as an ENT specialist, phoniatrist, or neurologist), a speech therapist, and a nurse. During the examination, the caregiver or parent sits in a chair with the child on their lap; older, cooperative children may sit unassisted. The child faces the examiner throughout the procedure. The nurse can help maintain the child's position during the examination by supporting their head in a neutral position. It is well known that posture influences the act of swallowing. Postural abnormalities impair the patient's ability to maintain proper head and trunk position, causing cervical spine misalignment and resulting in improper positioning of the mouth, pharynx, and larynx⁽²⁸⁾. It is therefore important to perform FEES in the position most natural to the patient while eating. After inserting the endoscope through the nasal cavity into the nasopharynx and appropriately positioning the tip, the child's posture can be adjusted to their typical feeding position. This approach is especially important when assessing infants who may feed in side-lying, semi-recumbent, or cradle positions. FEES is a three-stage procedure. Stage I involves assessing the anatomy and physiology of the nose, pharynx, and larynx, evaluating laryngeal sensation, and secretion retention. Stage II focuses on observing swallowing of various food and liquid consistencies. Stage III evaluates the effectiveness of therapeutic interventions. Based on recent publications from centres with extensive experience in paediatric FEES, further in the paper we outline the procedure in children^(14,16).

STAGE I – EVALUATION OF NASAL, PHARYNGEAL AND LARYNGEAL ANATOMY

The flexible fiberoptic endoscope is inserted through the nasal cavity into the nasopharynx, following the path of least resistance. During insertion, the nasal septum, nasal patency, posterior choanae, and the size of the pharyngeal tonsil are evaluated. After the endoscope passes through the posterior choanae, palatopharyngeal closure should be assessed during swallowing and, in older children, during phonation by instructing the patient to say "papa". The patient should be checked for potential pathologies that may affect swallowing function, such as laryngomalacia, cysts, vocal fold paralysis, a deep interarytenoid notch, and laryngeal cleft^(14,16,25). If any abnormalities are identified, further ENT evaluation may be needed.

An assessment of laryngeal defence reflexes, such as pushing and coughing, as well as laryngeal sensation, evaluated

by observing the child's response to the introduction of the endoscope, is an essential component of the examination. In order to assess laryngeal sensation, the tip of the endoscope may briefly contact the mucosa of the posterior pharyngeal wall, the arytenoid region, or the lateral surface of the epiglottis to elicit the laryngeal adductor reflex (LAR), also known as the glottic closure reflex⁽²⁹⁾. Observation of patient's response to the mere presence of the endoscope is generally sufficient to assess laryngeal sensation in children under 6 months of age.

Before assessing the swallowing of foods with different consistencies, the patient's ability to clear secretions from the throat should be evaluated. Under normal conditions, no secretions should accumulate in the lower pharynx. The child's response to these secretions should be observed. An absence of clearing reflexes indicates reduced laryngeal sensation, which often accompanies swallowing disorders in children⁽³⁰⁾.

STAGE II – SWALLOWING ASSESSMENT

The assessment of anatomical and physiological structures, as well as the patient's ability to clear laryngeal secretions is followed by feeding trials. In newborns and infants, readiness for feeding trials depends on the presence of adequate orofacial reflexes (sucking, rooting, and swallowing), the ability to achieve and maintain an alert state, and the capacity to sustain an appropriate respiratory rate (typically an average of 30–60 breaths per minute)⁽³¹⁾. As previously noted, FEES can be performed during both breastfeeding and bottle feeding. Feeding should begin with small volumes, which are gradually increased. If airway protective reflexes are observed during feeding, the administered volumes are gradually increased⁽¹⁴⁾.

In children of all ages, the volume, type, and consistency of administered food depend on the patient's general condition, presented symptoms, and problems observed by the clinical professionals during the examination. The patient's age and developmental level should also be considered. The International Dysphagia Diet Standardisation Initiative (IDDSI) classification is a useful tool for assessing the consistency of liquids and foods⁽³²⁾. In the case of patients on partially oral feeding, liquids and solids most frequently consumed by the patient are most commonly used. Currently, there is no single standardised protocol for the paediatric population, and the examination is tailored to the individual needs of each patient.

During the examination, pathological swallowing phenomena that increase the risk of dysphagia complications are assessed. Particular attention should be paid to premature swallowing, defined as passage of a food bolus into the pharynx before the normal swallowing reflex is triggered. In infants and children, laryngeal closure should coincide with the onset of swallowing. If the swallowing reflex is delayed or absent, penetration or aspiration may occur prior to swallowing. Penetration is defined as the entry of the bolus into the larynx, remaining above the vocal folds. In contrast,

aspiration occurs when the bolus passes into the airway below the level of the vocal folds. FEES also allows for the detection of silent aspiration, the most dangerous symptom of dysphagia, which is defined as entry of food into the lower respiratory tract without eliciting a cough reflex⁽³³⁾. During the endoscopic examination, the presence of middle/lower pharyngeal or oral food residues after swallowing is assessed, along with the patient's response to the residue, including coughing, expectoration, or additional swallowing.

STAGE III

Endoscopic examination also allows for the assessment of the efficacy of therapeutic interventions, such as modifying the rate of food intake or feeding intervals, the volume or consistency of food consumed, or the position and body posture. In older children who are able to follow verbal commands, swallowing facilitation manoeuvres, such as altering head position during swallowing, can be employed to improve swallowing safety⁽³⁴⁾. The choice of therapeutic manoeuvres depends on the child's overall condition and developmental stage, the presence of sensorimotor deficits, and the severity of dysphagia.

CONCLUSIONS

FEES is a safe and well-tolerated examination in children. It enables a simultaneous assessment of the anatomy and physiology of the nose, pharynx, and larynx, as well as the mechanisms underlying dysphagia. As in adults, there is no single, universally accepted FEES protocol that can be applied to all paediatric patients. The underrepresentation of paediatric patients in the FEES literature is an additional challenge in the appropriate planning of the examination. In the paediatric population, the examination protocol must be adjusted to the patient's age, developmental stage, and overall clinical condition, as well as the clinical setting of FEES. For example, patients in intensive care units typically require continuous monitoring, whereas this may not be necessary for patients in other settings. It is important to remember that FEES and VFSS are complementary diagnostic tools rather than substitutes. Some patients may require one, while others benefit from both diagnostic tools. Therefore, centres specialising in the diagnosis of dysphagia should have access to both modalities.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organisations which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

Author contribution

Original concept of study: AK, IB. Collection, recording and/or compilation of data: AK, DG, WK. Analysis and interpretation of data: AK, IB, GD, DG, WK. Writing of manuscript: AK. Critical review of manuscript: IB, AG, GD. Final approval of manuscript: AK, IB, AG.

References

1. American Speech-Language-Hearing Association: Pediatric Dysphagia. Available from: <http://www.asha.org/Practice-Portal/Clinical-Topics/Pediatric-Dysphagia/> [cited: 28 January 2017].
2. Bhattacharyya N: The prevalence of pediatric voice and swallowing problems in the United States. *Laryngoscope* 2015; 125: 746–750.
3. Lawlor CM, Choi S: Diagnosis and management of pediatric dysphagia: a review. *JAMA Otolaryngol Head Neck Surg* 2020; 146: 183–191.
4. Dodrill P, Gosa MM: Pediatric dysphagia: physiology, assessment, and management. *Ann Nutr Metab* 2015; 66 (Suppl 5): 24–31.
5. Martin-Harris B, Canon CL, Bonilha HS et al.: Best practices in modified barium swallow studies. *Am J Speech Lang Pathol* 2020; 29: 1078–1093.
6. Jamróz B, Chmielewska-Walczak J, Milewska M: Instrumentalne metody badania zaburzeń polykania. Atlas z materiałem wideo. Wydawnictwo Medyk, Warszawa 2019.
7. Cichero J, Nicholson T, Dodrill P: Liquid barium is not representative of infant formula: characterisation of rheological and material properties. *Dysphagia* 2011; 26: 264–271.
8. Mizuno K, Ueda A: Changes in sucking performance from non-nutritive sucking to nutritive sucking during breast- and bottle-feeding. *Pediatr Res* 2006; 59: 728–731.
9. Langmore SE, Schatz K, Olsen N: Fiberoptic endoscopic examination of swallowing safety: a new procedure. *Dysphagia* 1988; 2: 216–219.
10. Langmore SE, Schatz K, Olson N: Endoscopic and videofluoroscopic evaluations of swallowing and aspiration. *Ann Otol Rhinol Laryngol* 1991; 100: 678–681.
11. Willette S, Molinaro LH, Thompson DM et al.: Fiberoptic examination of swallowing in the breastfeeding infant. *Laryngoscope* 2016; 126: 1681–1686.
12. Leder SB, Karas DE: Fiberoptic endoscopic evaluation of swallowing in the pediatric population. *Laryngoscope* 2000; 110: 1132–1136.
13. Murray J, Langmore SE, Ginsberg S et al.: The significance of accumulated oropharyngeal secretions and swallowing frequency in predicting aspiration. *Dysphagia* 1996; 11: 99–103.
14. Miller CK, Willging JP: Fiberoptic endoscopic evaluation of swallowing in infants and children: protocol, safety, and clinical efficacy: 25 years of experience. *Ann Otol Rhinol Laryngol* 2020; 129: 469–481.
15. Zang J, Nienstedt JC, Koseki JC et al.: Pediatric flexible endoscopic evaluation of swallowing: critical analysis of implementation and future perspectives. *Dysphagia* 2022; 37: 622–628.
16. AB-SSD Task Force-Pediatric Group: Miller CK, Reynolds J, Kelchner LN et al.: Tutorial on clinical practice for use of the fiberoptic endoscopic evaluation of swallowing procedure with pediatric populations: part 2. *Am J Speech Lang Pathol* 2023; 32: 55–82.
17. Kelly AM, Drinnan MJ, Leslie P: Assessing penetration and aspiration: how do videofluoroscopy and fiberoptic endoscopic evaluation of swallowing compare? *Laryngoscope* 2007; 117: 1723–1727.
18. Krogulska A, Gawel E: Zaburzenia karmienia u dzieci – codzienny problem każdego pediatry. *Pediatr Pol* 2017; 92: 75–80.
19. Suiter DM, Leder SB: Clinical utility of the 3-ounce water swallow test. *Dysphagia* 2008; 23: 244–250.
20. Suiter DM, Leder SB, Karas DE: The 3-ounce (90-cc) water swallow challenge: a screening test for children with suspected oropharyngeal dysphagia. *Otolaryngol Head Neck Surg* 2009; 140: 187–190.
21. Daniels SK, McAdam CP, Brailey K et al.: Clinical assessment of swallowing and prediction of dysphagia severity. *Am J Speech Lang Pathol* 1997; 6: 17–24.
22. 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: 806–815.

23. Donzelli J, Brady S, Wesling M et al.: Simultaneous modified Evans blue dye procedure and video nasal endoscopic evaluation of the swallow. *Laryngoscope* 2001; 111: 1746–1750.
24. Marvin S, Gustafson S, Thibeault S: Detecting aspiration and penetration using FEES with and without food dye. *Dysphagia* 2016; 31: 498–504.
25. Miller CK, Schroeder JW Jr, Langmore S: Fiberoptic endoscopic evaluation of swallowing across the age spectrum. *Am J Speech Lang Pathol* 2020; 29: 967–978.
26. Dziewas R: Swallowing endoscopy. In: Ickenstein GW, Ambrosi D, Clavé P et al.: *Diagnosis and Treatment of Neurogenic Oropharyngeal Dysphagia*. UNI-MED Verlag AG, Bremen 2014: 48–52.
27. Şahin Mİ, Kökoğlu K, Güleç Ş et al.: Premedication methods in nasal endoscopy: a prospective, randomized, double-blind study. *Clin Exp Otorhinolaryngol* 2017; 10: 158–163.
28. Alghadir AH, Zafar H, Al-Eisa ES et al.: Effect of posture on swallowing. *Afr Health Sci* 2017; 17: 133–137.
29. Borders JC, O'Dea MB, McNally E et al.: Inter- and intra-rater reliability of laryngeal sensation testing with the touch method during flexible endoscopic evaluations of swallowing. *Ann Otol Rhinol Laryngol* 2020; 129: 565–571.
30. Willging JP, Thompson DM: Pediatric FEESST: fiberoptic endoscopic evaluation of swallowing with sensory testing. *Curr Gastroenterol Rep* 2005; 7: 240–243.
31. Fleming S, Thompson M, Stevens R et al.: Normal ranges of heart rate and respiratory rate in children from birth to 18 years of age: a systematic review of observational studies. *Lancet* 2011; 377: 1011–1018.
32. Cichero JAY, Lam P, Steele CM et al.: Development of international terminology and definitions for texture-modified foods and thickened fluids used in dysphagia management: the IDDSI Framework. *Dysphagia* 2017; 32: 293–314.
33. Rosenbek JC, Robbins JA, Roecker EB et al.: A penetration-aspiration scale. *Dysphagia* 1996; 11: 93–98.
34. Kosmowska A, Sielska-Badurek E, Niemczyk K: Zasady terapii neurologopedycznej w dysfagii. *Pol Przegl Otorinolaryngol* 2015; 4: 14–20.