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Objective Methods for Feeding Assessment in Children with Cerebral Palsy: Narrative Review

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ABSTRACT

Background: A set of long-term abnormalities in posture and motor development that limit activities is known as cerebral palsy (CP). Oromotor dysfunction affects up to 92% of children with CP. Children upsuffering from dysphagia may exhibit a variety of swallowing difficulties that impact one or more swallowing processes. Utilising diagnostic imaging techniques, the physiology of deglutition must be investigated in order to address swallowing issues.

Objective: This review aimed to discuss the objective methods for feeding assessment in children with CP as, videofluoroscopic swallow study (VFSS), flexible endoscopic evaluation of swallowing (FEES), ultrasonography (US), upper gastrointestinal series and endoscopic evaluation.

Methods: We searched PubMed, Google Scholar, and Science Direct for the following keywords: CP, Feeding assessment in children, VFSS, FEES, and ultrasonography. The authors additionally screened references from the relevant literature, including all of the identified research and reviews but only the most current or full study was chosen.

Conclusion: The VFSS provides dynamic visualisation of the oral, pharyngeal, and upper esophageal phases of swallowing throughout the contrast bolus passage, whereas the FEES allows for direct examination of the pharyngeal and laryngeal structures, as well as airway protection, without the need for barium or radiation exposure and with the ability to perform bedside exams. US may be used to quantitatively assess the oral and laryngeal stages of swallowing. US can accurately assess relative laryngeal movement.

Keywords: Cerebral palsy, Feeding assessment in children, VFSS, FEES, US.

INTRODUCTION

Cerebral palsy: Definition and Classification:

A collection of common, clinically significant, and distinguishable non-progressive permanent neuromotor diseases arising from damage to the growing or immature brain are known as CP, and they are characterised by matching activity limits with relation to posture and movement. It is the most frequent reason why children experience serious physical disabilities [1]. It causes debilitating alterations in posture and gait [2].

The frequency of CP varies across high-income and low- to middle-income nations and geographic regions, ranging from 1.5 to 3 per 1,000 live births [3].

Based on motor impairment, the disorder is classified into four types: ataxic type (4%) represents involuntary movement, including dystonia and choreoathetosis, mixed type (7%) manifests by combination of these features; and spastic type (85%) represents the most common type [1]. Spastic type is determined by the topographic distribution of impairment: 40–60% of cases are unilateral (one side of the body affected), 10–36% of cases are bilateral (both sides of the body affected) and 24–31% of cases are quadriplegia [4].

In addition to mental retardation, epilepsy, persistent primitive reflexes, attention, memory and learning, emotional problems, and irregularities in language and speaking were also reported [2].

Children with CP frequently experience cognitive and behavioural abnormalities, oromotor and speech deficiencies linked to muscular stiffness, and late development of musculoskeletal issues in addition to motor function impairment, excessive muscle tone, and tiredness disorders [5]. These may result in related issues such as trouble eating, ineffective bowel and bladder control, and respiratory issues [2].

Oromotor problems in children with CP:

Oromotor dysfunction affects up to 92% of children with CP. This oromotor dysfunction is characterised by deficiencies in the range, strength, coordination, dissociation, and timing of mouth motions. As a result, drooling and dysphagia are tightly linked to the compromised oromotor function associated with CP [6].

When fed orally, these children run the danger of aspiration, which might have lung effects and raise mortality and morbidity [7]. Most children with CP struggle with eating and experience gastrointestinal issues including constipation, gastric reflux disease, and oropharyngeal dysfunction [1].

Children with spastic quadriplegia or other generalised severe motor impairments are more prone to experience long, frustrating mealtimes, swallow and feeding difficulties, and a significant risk of aspiration with potential pulmonary sequelae. This group is prone to oral motor abnormalities, such as weak lips, poor tongue movement and closure, an excessive tongue thrust, biting reflex with oral hypersensitivity, and weak sucking [4].

In children with CP, growth and nutrition issues are prevalent. Although all children with CP may

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exhibit them, their frequency rises as the severity of motor impairments increases [1].

Children with major motor disabilities are prone to experience feeding issues and challenges more frequently. Malnutrition is the end outcome of consuming insufficient calories as a result of this [8]. Malnutrition has a number of detrimental impacts, including weakened respiratory muscles, compromised immune system, compromised circulation, and reduced brain function [1]. Its effect is more widespread and can negatively affect one's quality of life, relationships with peers, self-esteem owing to drooling, and carer stress from extended mealtimes [6].

Normal swallowing: Definition and phases:

Swallowing is a multi-phase process driven by intricate neuromuscular mechanisms. The integrity of the cognitive, motor, and sensory nerve systems is necessary for the synchronisation of the anatomical structures of the respiratory, oral, pharyngeal, laryngeal, and esophageal regions during a "normal" swallow [9].

The four stages of normal swallowing are pharyngeal, esophageal, oral preparation, and oral [10]. When preparing to swallow orally, food is crushed and combined with saliva to create a bolus. The bolus is moved to the throat during the oral phase. During the pharyngeal phase, the swallowing reflex is triggered, which causes the larynx to close to prevent aspiration, the pharyngeal constrictors to contract from superior to inferior, the larynx to elevate and the epiglottis to invert, and the crico-pharyngeus to relax to allow the food bolus to pass into the oesophagus. The bolus is moved into the stomach at the last stage by the esophageal muscles' peristalsis [11].

Dysphagia: Definition, causes and mechanism:

Any disruption in the swallowing process that jeopardises the security, effectiveness, or adequate intake of food is referred to as dysphagia. Oral, pharyngeal, and esophageal dysphagia are the results of swallowing difficulties that can manifest in children with dysphagia in a variety of ways that impact any or all phases of swallowing [12].

People of any age might be affected by dysphagia. Dysphagia can affect a wide range of patient groups, including children with acquired brain damage or other neuromuscular problems, people with respiratory, cardiac, or gastrointestinal diseases, and those with craniofacial or airway anomalies [12- 13].

A variety of factors, such as neurological abnormalities, oral motor dysfunction, decreased muscle tone, gastroesophageal reflux, delayed or disordered swallowing reflexes, sensory issues, structural abnormalities, and environmental factors, can contribute to the multifactorial mechanisms of dysphagia in children with CP. A unique dysphagia may arise from the interaction and mutual influence of these elements [14]. This condition is characterised by disruptions in the control and coordination of the swallowing muscles, which can lead to issues with oral intake, feeding, and general nutrition [14].

The jaw, face, lips, tongue, palate, and throat muscles may be affected by the neurological lesion linked to CP, potentially resulting in functional difficulties with swallowing, eating, drinking, speaking, and controlling saliva. Specific patterns of oral, pharyngeal, and esophageal abnormalities during eating may occur in children with CP [15].

Reduced capacity to remove food particles from the mouth, poor bolus transit, prolonged oral transit time (more than 3 seconds), excessive tongue thrusting, and restricted tongue lateralization necessary for chewing solids are some of the impairments that may occur during the oral phase of swallowing. Numerous issues can arise from having poor lip control, such as difficulty taking the bolus, difficulty sucking through a straw or bottle, anterior food loss from a poor lip seal, excessive saliva loss, and poor mastication, which causes the bolus to be transferred for anterior-posterior projection by a palpitating action rather than a rotational movement [16].

Children may also exhibit deficiencies associated with the pharyngeal phase, including incomplete or delayed airway closure after swallowing, oropharyngeal aspiration of food or liquid, and pharyngeal residue from meal [15].

Oropharyngeal dysphagia (OPD), the most common eating problem, is characterised by a malfunction of the oral and pharyngeal stages of swallowing, leading to laryngeal penetration and aspiration of solid or liquid food. OPD is more common in children who are premature, have anomalies of the central nervous system, have neurodevelopmental delays, or have craniofacial abnormalities [17].

Evaluation of dysphagia:

A test that is both widely available and accurate is necessary to evaluate dysphagia and aspiration in this group. Utilising diagnostic imaging techniques to examine the deglutition physiology is necessary for the treatment of swallowing disorders [18].

A physician's comprehensive history and physical examination are the first steps in evaluating a child with a feeding condition. A trained feeding expert next does a clinical swallow assessment to add to the evaluation. Comprehensive data are gathered about the anatomy and physiology of the upper esophageal swallow complex, larynx, pharynx, and mouth. The most popular tests are upper gastrointestinal series (UGI), endoscopic assessment, US, FEES, and VFSS[19].

Instrumental assessment used in pediatric dysphagia:

Video fluoroscopic swallow study:

Patients of all ages who have been referred with dysphagia can benefit from the dynamic fluoroscopic imaging test known as the VFSS, commonly referred

to as the modified barium swallow. Everyone agrees that the VFSS is the preferred gold standard instrumental assessment. The VFSS aims to achieve both therapeutic and diagnostic objectives. Determining the ideal consistency for oral intake, spotting structural irregularities, evaluating the physiological swallow function, and making choices about hydration, assistive nutrition, and quality of life are some of these objectives. The VFSS also supports education for both the person and others who have an impact on patient care, as well as research into the results of compensatory and restorative intervention programs. In addition to the definition of cricopharyngeal dysmotility and the comprehension of the movement of the hyolaryngeal complex [20-22].

Using the VFSS, the movement of the pharyngeal, laryngeal, oesophageal, and oral structures may be seen and captured in real time during the contrast bolus transit. During the examination, the patient is given a range of liquid and food textures orally along with barium or other contrast media while seated or partially seated. Regarding the proper presenting sequence of the various food consistencies (from thin liquids to solids) to be evaluated, there are differing approaches. Some choose to start with the least likely to leave residue after swallowing (liquids), some prefer to start with the safest consistency (puree/soft food), and yet others prefer to start with their child's favourite meal in order to get them to comply. Usually, the texture that raises the most concerns is the one that is looked at first. Fluoroscopy is used to check for aspiration or penetration of the airway during swallowing of the different consistencies during intake[23-24].

The ability to see the oral, pharyngeal, and oesophageal phases of swallowing is one of VFSS's clear benefits. It also offers an assessment of the invisible part of swallowing. It has shown to be the most trustworthy approach when looking into deglutition diseases. The only objective technique that verifies penetration and aspiration is this process [20-22].

VFSS carries a number of dangers, including radiation exposure; the longer the examination takes, the more radiation the child will get and the greater the chance of aspirating the contrast medium. For these reasons, even at medical institutions, using VFSS is not simple [21, 25].

When VFSS is clinically contraindicated or unavailable to those with swallowing issues, other treatments including FEES have shown clinical usefulness [26].

Fiberoptic endoscopic evaluation of swallow (FEES):

The industry standard for evaluating instrumental evaluations of swallowing function is the FEES. One test used to assess swallowing ability and diagnose dysphagia in both adults and children is the FEES. The pharyngeal and laryngeal structures may be directly examined during swallowing thanks to a real-time imaging method called FEES. It is widely employed to assess a range of swallowing issues, such as dysphagia in CP children [14, 24, 27].

With a flexible nasopharyngoscope, the nasopharynx, oropharynx, hypopharynx, supraglottis, and glottis are all examined. This examination provides a thorough assessment of the patient's upper aerodigestive tract anatomy. Additionally, it has been validated for a number of demographics, such as myasthenia gravis patients, tracheostomized patients, vocal fold paralysis patients, patients with head and neck malignancies, and particular neurological populations [24, 27].

The FEES evaluation method is often broken down into three stages: the first involves closely examining the structure, secretions, and breathing and speaking motions of the nasal structures. A few techniques involve stroking the endoscope in particular areas to gauge sensitivity in the oropharyngeal region. Offering food and beverages in different consistencies and directly evaluating swallowing comprise the second step. In order to determine food consistencies and postures that promote oral intake in a safer manner, the third step involves validating postural manoeuvres, observing fluctuations in consistencies, and analysing eating behaviours [27].

It is carried out by skilled phoniatric professionals with a flexible nasendoscopy with a diameter of 2.2 mm, along with a light source, camera, monitor, and DVD recorder. Topical viscous lidocaine and nasal decongestants are administered at age-appropriate dosages. In order to do a functional and morphological examination of the pharyngeal phase, the child can sit upright on her mother's lap, if feasible, with the nurse holding their head until the endoscope is inserted via the nasal airway into the nares, past the velum, and into the pharynx. Usually, nasogastric tubes are left in place. Developmentally appropriate test boluses in non-standardized bolus sizes, provided by spoon, cup, bottle, or syringe, with varied consistencies (e.g., fluid, thickened fluid, nectar thick or honey-thick, puree and solid). The majority of the children' favourite dishes were brought from home and were very mildly coloured green [27-28].

When assessing dysphagia in paediatric populations, FEES is a reliable and secure method. Children at any age might undergo FEES. FEES works well for bedside assessment. The FEES test does not need radiation exposure or barium ingestion, in contrast to the VFSS [12, 24].

FEES has several limitations, such as the patient's capacity to tolerate having a nasal endoscope passed over them, the inability to see the oral phase of swallowing, the potential for tissues to contract during swallowing and cause a "white out" that might impair the examination, and the inability to identify microaspiration [24].

Ultrasonography:

Picture is possible to clinically assess the oral and pharyngeal stages of swallowing using US, a quantitative technique. Additional abnormalities in the oral stage, such as poor bolus control, early oral leakage, impaired tongue propulsion, movement, muscle mass, thickness, and structure, can be seen with US. Treatment efficacy may be assessed by comparing the results before and after the intervention. Furthermore, US is a quick assessment method that may be utilised to evaluate swallowing function and screen high-risk individuals [18].

An increasing number of uses of US are being developed for the diagnosis and treatment of dysphagia. These include the evaluation of pharyngeal residue, aspiration, and upper esophageal sphincter (UES) function, as well as guided intervention for UES dysfunction. By evaluating the length of the swallow, the thickness of the tongue, and the tone of the tongue muscles, it can be used to assess dysphagia in CP patients [24, 29].

In addition to providing excellent resolution in reflecting the musculature of the neck and orofacial area and allowing observations of the cricopharyngeal muscle, ultrasonography has been utilised to monitor movement of the vocal folds and airways [29].

With good reproducibility equivalent to VFSS findings, the US is a promising quantitative approach for clinical assessment of laryngeal elevation during swallowing. The distance between the two swallowing muscles may be used to quantify hyolaryngeal movement (hyoid–larynx approximation ratio) and observe the anatomy of the thyroid cartilage and hyoid bone using US [30].

In the last several decades, a variety of ultrasonographic techniques have been employed to evaluate the movement and structures of the oropharynx, including B-mode dynamic scanning, pixel analysis, M-mode, Doppler, 3D reconstruction, and sonoelastography. On the testing techniques and clinical consequences, there is still a need to reach an agreement, albeit [29].

Because Image US is portable, easily accessed, has no effect on normal swallowing, and can be used at the bedside, it is gaining traction as a possible tool for assessing swallowing function. Additionally, owing of its low cost, safety, speed, and lack of radiation exposure, it is often employed in clinical practice. Furthermore, the US may be done as often as needed because it is non-invasive [18, 25, 29].

Comparing the US test to the VFSS evaluation reveals certain drawbacks. While US can provide low-range imaging, VFSS offers wide-field imaging with a panoramic picture. Transducer may compress tissues in the US. Getting the transducer in position and keeping it there might not be easy. The practitioner must thus exercise patience. The research design has certain structures without anatomical markers. The primary drawback of US is its reliance on the operator[18].

Upper gastrointestinal tract series:

When a barium-impregnated food bolus is swallowed, the oesophagus, stomach, and duodenum are examined radiographically in the upper gastrointestinal tract series. The esophageal phase of swallowing and the anatomical features of these structures may both be assessed by means of this investigation [19].

Endoscopic evaluations:

In order to fully diagnose a patient with suspected penetration and aspiration and pharyngeal or esophageal dysphagia, direct laryngoscopy, bronchoscopy, and esophagoscopy are necessary. Endoscopies may not always be required when oral dysphagia is isolated. With collaboration from the otolaryngology, pulmonology, and gastrointestinal teams, the exams can be conducted in the operating room during the same procedure. Endoscopic assessment offers physicians an unmatched analysis of the anatomy of the patient. An otolaryngologist can examine for anatomic abnormalities of the subglottis, supraglottis, glottis, and oral cavity using direct laryngoscopy. It is possible to detect airway conditions such vocal fold immobility, laryngomalacia, and vallecular cysts [24].

CONCLUSION

In children with CP, oral motor impairment is a prevalent problem. Severe motor impairment increases the likelihood of eating, drooling, sucking, swallowing, and chewing issues in children. In order to accurately diagnose and guide care, children with CP present with a wide spectrum of eating and swallowing issues require thorough examination and ongoing monitoring by a multidisciplinary team. Instrumental evaluation instruments include VFSS, FEES, US, UGT, and endoscopic examination are examples of common assessment approaches.

When it comes to paediatric dysphagia, the most often utilised instrumental evaluations are the VFSS and FEES. While the FEES allows for direct examination of the pharyngeal and laryngeal structures and airway protection without the need for barium or radiation exposure, as well as the option to perform bedside examinations, the VFSS provides dynamic visualisation of the oral, pharyngeal, and upper esophageal phases of swallowing throughout the contrast bolus passage. Oral and laryngeal stages of swallowing can be clinically assessed quantitatively using US. The laryngeal movement can be effectively measured by US.

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