Assessment and Treatment of Feeding in Children and Youth with Cerebral Palsy

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Marianne E. Gellert-Jones

Contents

Abstract

A significant number of children diagnosed with cerebral palsy (CP) present with early and ongoing histories of feeding dysfunction. This condition may cause stress and present challenges to both children and caregivers and may create barriers to enjoying social

M. E. Gellert-Jones (✉)
Clinical Feeding Specialist/Speech Language Pathologist, HMS School for Children with Cerebral Palsy, Philadelphia, PA, USA
e-mail: mjones@hmsschool.org

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mealtime experiences. CP may result in the need for intensive medical interventions to support nutritional and hydration needs over time. The severity of the motor disturbance in CP is often highly correlated with the degree of feeding dysfunction. The link between CP and the functional activity of feeding requires a holistic approach to assessment and treatment. The use of the International Classification of Functioning, Disability, and Health (ICF) framework (WHO 2007) to inform assessment and intervention needs for the child and caregiver relies on understanding the interplay among body structure and function to support the physiological demands of feeding, the ability of the professionals and caregivers to create opportunities for participation in feeding and mealtime activities, the appropriate modifications being made to the environment, and the considerations of the caregiver and child relationship and the personal concerns that may support or limit the activity of feeding for children with cerebral palsy. Feeding assessment and treatment is often cyclical throughout the course of effective intervention as reassessment informs adjustments to treatment. The management of positioning provides the cornerstone that supports respiration, promotes swallowing safety, and improved alignment of feeding structures. Experiential training and the engagement of an interdisciplinary team that includes all stakeholders including the caregivers are among the most important elements for success in treatment of feeding.

Keywords

Cerebral palsy · Feeding dysfunction · Postural stability · Interdisciplinary team · Caregiver training

Introduction

Feeding, eating, and engaging in enjoyable mealtimes are hallmarks of what most would consider as essential to a full and satisfying life. Children and youth with cerebral palsy (CP) often present with significant barriers to participating in mealtimes and oral feeding across environments. Feeding creates unique challenges for both families at home and the professionals serving these children and their families in medical, educational, and community settings. Comprehensive assessment and treatment of feeding dysfunction within this challenging population can create opportunities for children who present with varying degrees of neuromuscular involvement to engage in oral feeding experiences across all environments.

Natural History

CP is described as a static impairment, though it does have an expected progression of motor disturbance, which may impact the feeding abilities of children with this diagnosis (Haak et al. 2009). Children who present with more severe motor dysfunction are most vulnerable to changes in body structure and function over time. As with all children, there is an ever-increasing demand for fluids and calories to support adequate development and growth. Children with CP who present with feeding and swallowing needs often present with increased challenges to adequate oral consumption to meet nutritional and hydration requirements. As these children age, the struggles surrounding nutritional and hydration sufficiency may become more pronounced. Implementation of supplemental tube feedings is not uncommon in children with more severe motor disturbances to sustain their growth and hydration needs. Many of these children present with significant illnesses or orthopedic concerns resulting in the need for hospitalizations and potential surgeries. These illnesses and surgical interventions may be problematic for the child to endure if they do not have sufficient hydration and nutritional stores to withstand the physical stress of healing and recovery.

Calis et al. 2008 reported that dysphagia, in varying degrees of severity, was present in up to 99% of children presenting with a diagnosis of CP. Within this population nearly all present with feeding disruptions at some point in their lives, and most disruptions are present at birth. Medical and technological advances result in greater numbers of children with prematurity (and significant medical needs) surviving with feeding difficulties

(Arvedson 2008). Feeding dysfunctions become more significant resulting in under- or malnourishment in nearly all children presenting with more severe forms of CP (Gross Motor Function Classification System (GMFCS) IV and V) (Penagini et al. 2015). Difficulties with hydration and maintaining sufficient calories for growth most often result in supplemental tube feedings, particularly as these children begin to age and require additional calories to see them through the recovery of pending medical procedures, illnesses, and growth into adulthood.

Goday et al. 2019 proposed a new definition that highlights the multifaceted nature of pediatric feeding disorders and aligns this definition with components identified in the ICF. The result is a definition that is more thorough in scope and thus assists in developing a treatment model f that is more inclusive of all the potential components that impact feeding including the medical, nutritional, feeding abilities and psychosocial aspects of feeding. This holistic definition considers issues that are present within families and creates opportunities to engage in training and shared decision-making and address familial concerns. Additionally, Goday et al. (2019) identify a common terminology that will translate across disciplines, a beneficial aspect of the new definition.

Assessment remains a driving force in planning treatment to address feeding needs in children with complex neuromuscular presentations (Arvedson 2008; Manno et al. 2005). Thorough assessment with observation and input from families along with interdisciplinary medical involvement and diagnostic measures will help identify the prioritization and the method and scope of treatment. Ongoing assessment, and active inclusion of all team members, will help monitor and interpret the results of treatment, so goals and interventions will advance along with the needs of the child and caregiver (Sheppard 1995; Morris and Klein 2000; Arvedson 2008, 2013).

Assessment

Effective treatment programs designed to address the feeding needs of children with CP should be created based upon the results of a comprehensive and individualized evaluation. Such assessments must include a thorough survey of the child's history so issues and concerns may be fully explored and addressed before initiating treatment (Manno et al. 2005; Arvedson 2008; Andrew et al. 2012).

The ICF Framework (WHO 2013) can provide a concise basis for the treatment of the feeding needs of children with CP (ASHA 2016). The ICF places the functional activity of feeding squarely at the center of the model and demonstrates the manner in which each of the components (health condition, personal dimensions of body structures and function impairment, activity limitation and participation restrictions, and environmental and personal factors) interacts and influences an individual's ability to function in activities of daily living. This view of the interactions among all areas of the ICF allows the examiner to develop a more holistic view of the strengths, limitations, and needs of the child with CP across the many environments in which the child is expected to function (Imms et al. 2015). It is the intent of this chapter to use the ICF framework as a comprehensive tool to guide practitioners in their assessment and provision of services to children with CP who present with feeding needs. Below each component will be individually examined, and examples of specific areas of need that may be considered will be identified. The culmination will be a completed framework that demonstrates the active interplay among the various areas of the ICF that must be considered to promote optimal assessment and intervention surrounding the feeding needs of children with CP and their families.

Examples of How the Health Condition (CP) May Impact Feeding

Assessment begins with understanding the *health condition* of the child with CP. The presentation of the condition and overall evaluation of the child's tone and the structures impacted must be defined (Paulson and Vargus-Adams 2017). Understanding the severity and degree of motor dysfunction can be a significant factor, as Benefer et al. (2017a) determined in their study which reported that in the preschool years, two in three children

diagnosed with CP also presented with oropharyngeal dysphagia. Children who tend to resolve their oropharyngeal dysphagia within the first 5 years of life have less severe forms of CP (GMFCS levels I and II), while children who present with more significant motor dysfunction (GMFCS levels III, IV, and V) tend to persist with oropharyngeal dysphagia, along with concerns related to their nutritional needs, respiratory issues, and parental stressors (Benefer et al. 2017b). Additionally, the degree to which children present with increased motor dysfunction as defined by the GMFCS is associated with the level of dysfunction described by the Eating and Drinking Ability Classification Scale (EDACS) (Sellers et al. 2013; Paulson and Vargus-Adams 2017). Understanding the progression of CP and potential manifestations of abnormal muscle tone within this population will aid the examiner in planning for and addressing feeding needs (Ferluga et al. 2019).

Examples of Body Function and Structure impairments that may impact the feeding ability of children with CP are listed below. These factors may be identified on physical exam, through assessment of the child's medical history and reports, and clinical or school-based therapy reports.

Body Function and Structure

Tonal abnormalities (strength, control, and endurance)
- Positioning and alignment challenges
- Cardiac defects
- Dysphagia
- Respiratory concerns
- Congenital abnormalities (syndromes)
- Neurological concerns (seizure disorder, ASD, etc.)
- Secretion management and drooling
- Gastrointestinal concerns (GER, constipation, etc.)
- Food intolerances and allergies
- Nutrition, hydration, and growth challenges
- Cognitive status
- Sensory needs
- Impact of illness and hospitalization
- Other medical issues

The *body function and structure* component of the ICF is derived from the health condition of the child with CP. Children diagnosed with CP present with multiple systems that are impacted by their diagnosis of neurological impairment. A complete medical history is essential and may reveal areas of concern that may be missed otherwise and that may affect the child's ability to engage in successful feeding treatment. Examining reports from other team members regarding the child's medical and therapeutic history provides valuable insight. Thorough medical and therapy record review will inform the feeding professional of care plans that are currently active and other care plans that may have been implemented. An examination of current and previous medications and procedures that the child has undergone is part of obtaining a complete medical history. Additionally, a review of hospitalizations, emergency department visits, and a list of current medical concerns is of paramount importance in obtaining a completed examination of the child's medical history.

Summary information from medical appointments provides a history of the child's growth patterns across their lifespan which provides a more thorough understanding of health, nutritional status, and the severity of feeding challenges and needs. It is essential to note the growth trends of the child and to determine if they are accepting sufficient nutrition to support growth (Kuperminc et al. 2013). Often the point at which feeding begins to impact the child will show as the point at which they fall below growth curve trajectories. Children with significant neurological impairments may not present with weight or growth patterns that match their typically developing peers. Most often adequate growth patterns will be determined based upon the child's maintenance of their own growth curve over time (Kuperminc et al. 2013). Some consideration may be given to the use the

CP-specific growth charts when plotting growth trajectories and trends in children with CP (Brooks et al. 2011).

Diet History and Bowel/Bladder Elimination

Requesting a detailed diet history and record of bowel and bladder elimination patterns from the caregiver can provide meaningful information about feeding processes for the child with CP. It may also offer additional information about food preferences, variety, volumes, food textures, and feeding regimens. Diet histories gathered for children with feeding dysfunction often reveal inadequate intake of food and fluids (Penagini et al. 2015). Input from a dietitian can assist in completing an individualized assessment for each child including their optimal nutritional and hydration needs for weight gain and growth.

Patterns of bowel and bladder elimination can provide further information about tolerance of feeds, bowel and bladder function, and the overall health of the child. Constipation is often an issue in children with CP secondary to their motor deficits (Penagini et al. 2015). It is also a concern and can be compounded when children have decreased fluid intake, less total volume, and limited fiber in their diets. When children diagnosed with CP do not have adequate bowel management, they may experience ongoing issues with bowel elimination and gastrointestinal dysmotility (Andrew et al. 2012). Gastroesophageal reflux and developing a sense of hunger and satiety may also be related to constipation.

Bladder elimination patterns characterized by small volumes, incontinence, and concentrated urine may be indicative of poor hydration. Hydration also may have a direct influence upon the regularity of bowel elimination patterns. It has been reported that as many as 60% of children with CP present with feeding and gastrointestinal issues surrounding and complicated by constipation (Caramico-Favero et al. 2018). Establishing a complete understanding of oral intake and elimination patterns is essential to recognizing potential barriers to comfort, overall health, and successful feeding.

The following table presents examples of some activity limitations and participation restrictions that may be detected when using a holistic examination and should be addressed in the plan of care to improve feeding ability in the child with CP.

Activity and Participation

Activity – Child's functional motor ability to complete feeding/eating tasks during these events

Participation – Adaptation of the environment for the child to participate with family, friends, and classmates

Daily meal and snack time celebrations and socialization

Peer interactions

Educational activities in school and community activities outside of the home

important to examine and include in a plan of care to address the feeding needs of the child with CP.

Listed below are examples of potential environmental and personal factors that may be important to examine and include in a plan of care to address the feeding needs of the child with CP.

Environmental and Personal Factors

Personal Factors (Family, Teacher, Trainer)

Familial stressors and attitudes

Food preferences

Feeder preferences

Behavioral concerns

Cultural factors and family customs

Financial needs

Ability to attend school (willingness and training of feeders)

Safety across environments when feeding

Food preparation and texture modifications for individual needs

Environmental Factors (Equipment, Setting, Food Availability)

(continued)

Appropriate seating/positioning availability
Adequate time allowance to feed
Appropriate utensils availability
Appropriate supports available for feeding needs
Availability and access to appropriate and affordable foods
Access to medical care
Access to training and support for families and feeders

Feeding History/Caregiver Interview

The *participation*, *environmental,* and *personal factors* that impact feeding may be detected via a comprehensive caregiver interview. The caregiver interview may be helpful in understanding the child's developmental progression and the duration and scope of current feeding problems (Sheppard 1995; Morris and Klein 2000; Manno et al. 2005; Andrew et al. 2012). The feeding problem from the perspective of the caregiver and the priorities of the family regarding treatment may be identified. The caregiver may provide more information about cultural and family customs as well as socioeconomic factors that may impact feeding and mealtime routines. The description of the routines involved in typical mealtimes provide additional information regarding structure, feeding difficulties, volumes, and the time it takes to feed a child. It is also helpful to understand the variety of environments in which the child is fed and the number of individuals involved in the feeding the child.

Parental reports of stressful mealtimes are highly correlated with severity of motor disturbances and the severity of feeding difficulties in children with neurological impairments (Sullivan et al. 2000; Benefer et al. 2017). It is essential to identify the stress experienced by the child and family to fully understand the impact of the child's feeding dysfunction. Caregiver reports of lengthy mealtimes; failure to advance texture; observance of choking, gagging, and vomiting during meals; or concerns of respiratory distress are significant indicators of severe feeding dysfunction in children with CP (Arvedson 2008). Other red flags surrounding feeding may be concerns about weight gain, overall health, nutrition, and hydration needs.

When there has been a history of unsuccessful mealtimes, it may create challenging psychosocial issues for families and children with feeding needs. When the caregiver provides a complete history surrounding the child's feeding dysfunction, a more detailed timeline of the feeding issues and concerns may emerge. Studies document that feeding concerns are present in almost all children with CP beginning in the neonatal period. In a study by Reilly et al., 60% of children who were later diagnosed with CP initially presented with significant feeding dysfunction. Of the children studied, 57% presented with issues related to coordination of sucking, while 38% had issues concerning swallowing problems in the first 12 months of life. They reported that 80% of the children had been fed non-orally on at least one occasion and greater than 90% had clinically significant oral motor dysfunction. One in three of these children was severely impaired and therefore at high risk of chronic undernourishment (Reilly et al. 1996).

Clinical Assessment

Clinical assessment must examine the whole child with CP. While the assessment of oral motor skills is essential in understanding the integrity and function of oral-facial structures during feeding and swallowing, a thorough assessment will include identification of issues affecting respiration, postural stability, and tone in the child diagnosed with CP (Woods 1995).

Feeding and swallowing are activities that involve multiple body systems. Precise and well-coordinated interactions among these structures are required to produce optimal function. Postural stability, postural alignment, and muscle tone significantly impact the alignment and function of the oropharyngeal musculature and the gastrointestinal and respiratory systems involved in feeding and swallowing. Pelvic alignment influences

the alignment of the trunk, head, and neck and will impact the child's ability to function optimally in numerous functional activities including feeding and swallowing (Woods 1995). Pelvic alignment directly influences function for feeding, respiration, and coordination for safe and efficient swallowing (Manno et al. 2005).

Assessment of the trunk and development of the muscles of respiration that aid in ribcage stability are valuable to consider secondary to the need for respiratory coordination and control during feeding and swallowing (Manno et al. 2005). Postural support for adequate alignment of the trunk, engagement of all the muscles of feeding and swallowing, and the recruitment of effective cough techniques are all impacted by the development of trunk musculature and the muscles that help shape and stabilize the ribcage. Children with a wide repertoire of controlled movement in the structures and musculature of the trunk typically have a ribcage that is more typically shaped and developed. Conversely, children presenting with more significant motor impairments that limited a variety of movements often present with notable chest wall deformities that limit the overall function of respiration and postural stability and may adversely influence all phases of the cough. The cough is an essential compensatory technique to employ during feeding and swallowing. Assessment of the phases of the cough may provide insight into potential areas of need regarding the child's secretion management and ongoing respiratory health (Mishra et al. 2018; Massery 2006).

The interaction between the gastrointestinal and respiratory systems needs to be considered when assessing the trunk and ribcage. These two systems share space within the thoracic cavity and are contained within the ribcage. The diaphragm, which is the primary muscle of respiration, provides a separation between the abdomen and the lungs. The descent of the diaphragm upon inhalation creates pressure changes within the thoracic cavity. It also causes the displacement of internal organs, which can influence postural, respiration, comfort, and peristalsis throughout the gastrointestinal system. The ribcage and trunk are not in themselves sturdy structures, but they are dependent upon positive pressures within the thoracic cavity to promote postural support. Glottal closure and the musculature of the pelvic floor help provide constant positive pressure in the trunk. Any disruption in the maintenance of that positive pressure can cause collapse or instability of the trunk. Therefore, children who present with uncoordinated vocal fold closure, tracheostomies, or other issues allowing for a disruption in the constant positive pressures in the trunk are more vulnerable to problems with respiratory control, pulmonary hygiene, gastrointestinal dysmotility, trunk control and stability, and other associated issues. Adequate ventilation, secretion management, and pulmonary hygiene may also be at risk, secondary to reduced ability to recruit sufficient inspiratory support and control to engage in effective cough techniques. The ability to protect and clear the airway via cough or strong vocalization improves the child's ability to participate in compensations that can improve safety in the swallowing of secretions, food, and liquids. Pressure imbalances within the thoracic cavity may also impact endurance, muscle tone, and postural stability (Massery 2006).

When the diaphragm descends appropriately, it also approximates the lower esophageal sphincter (LES) providing a point of increased pressure. The increased pressure allows compression of stomach contents and decreases the possibility of esophageal reflux. If the diaphragm is poorly aligned, secondary to abnormal ribcage development (See Fig. 1), it is also likely that as the pressure at the LES may be reduced. The cases such as this, the diaphragm may not promote peristalsis or provide any increase in pressure at the LES. When such imbalances exist in the thoracic cavity, then gastrointestinal issues and respiratory support for feeding and swallowing are not able to be adequately managed by the body systems (Massery 2006). A description of various atypical ribcage presentations, and the potential impact on respiration, gastrointestinal function and positioning may be found in below (Table 1).

Positioning in seating begins with a full assessment of the child's pelvic alignment in their current seating system or feeding chair. An understanding of the manner in which current equipment promotes or inhibits adequate

positioning needs for feeding and swallowing is vital. Obtaining a list of seating equipment to which the child has access is a necessary part of an evaluation of feeding needs. Achieving adequate alignment is essential to the overall health, function, and well-being of every child who presents with motor challenges regardless of their ability to engage in oral feeding. Identifying equipment that is available to the child, when and how it was purchased, will inform the team about what equipment for positioning is available for the child to use. It will identify when new equipment may be ordered if the fit and function of the current equipment is not working for the child. For more information on postural control and stability, please refer to ▶ Chap. 165, "Postural Control in Children and Youth with Cerebral Palsy" (See Therapy Management: Body Structures and Function.) (Figs. 2 and 3).

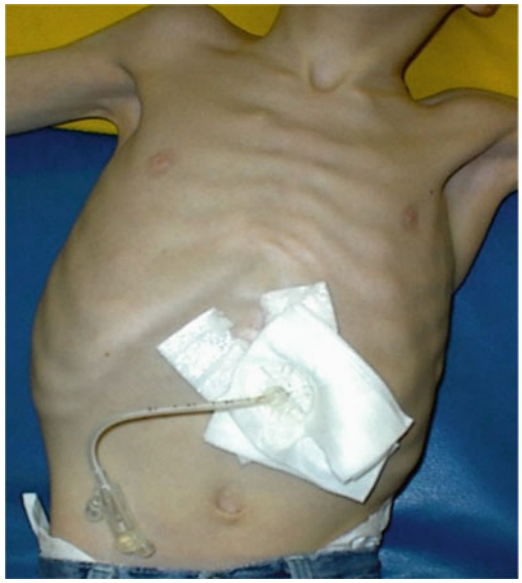

Fig. 1 Chest wall deformity associated with decreased thoracic stability and management of gastrointestinal and respiratory function to support feeding (note: the feeding tube)

Oral Motor Assessment

Assessment of oral structures begins with an assessment of overall oral-facial tone and symmetry. It is important to note if there are asymmetries of the skull. Asymmetry or plagiocephaly may provide information about the resting position of the head, the influence of gravity on structures of the face, and muscle imbalances that the child may be experiencing in the trunk, head, and neck. Children with more significant limitations in mobility are more vulnerable to increasing asymmetry of the oral-facial structures overtime, due to persistent positioning and poor postural control of

Table 1 Ribcage presentation and potential impact

Ribcage presentation	Possible causes	Potential impact of chest wall deformities on function
Triangular shape	Decreased upper extremity (UE) weight bearing, poor shoulder girdle development, decreased postural stability and control	• ↓ trunk and ribcage mobility, decreased ribcage compliance • Inefficient respiratory patterns for cough, secretion management, and coordination of respiration and swallowing • Fatigue and inability to sustain adequate ventilation during all ADL's • Collapse of ribcage limiting optimal volume for respiration • Paradoxical breathing patterns increasing negative pressure in upper thoracic cavity • Inefficient descension of the diaphragm • ↑ opportunities for gastroesophageal reflux secondary to imbalances of inter- thoracic and inter-gastric/abdominal pressures • ↑ in use of accessory musculature for breathing
Pidgeon chest or barrel shape	Increased tightness in UE range of mn and approximation to lateral portions of ribcage, prolonged positioning in side-lying	
Flattened chest in sagittal plane or pectus excavatum	Neuromuscular weakness, prolonged periods of reclined positioning	
Bell-shaped or flaring of lower ribs	Decreased activation of abdominal musculature and neuromuscular weakness	
Asymmetry of ribcage	Scoliosis, postural, and pelvic asymmetry or malalignment	

the pelvis, trunk, head, and neck musculature (Kawakami et al. 2013). The impact of gravity when positioning is static also has a significant impact on all the structures that influence overall function within the body as well as feeding, swallowing, and respiration.

Oral-facial structures should be assessed for symmetry and for function at rest and in movement (Sheppard 1995). The functional movement and grading of oral structures will provide important information regarding the efficiency and control of feeding and swallowing structures. If the child is able to perform volitional motor skills upon request, this may be a potential avenue for treatment and the development of compensatory strategies to improve safety and function.

A complete evaluation of oral structures will describe labial tone, lip closure and opening, labial mobility, and strength of labial musculature. The child's ability to employ a variety of oral postures including labial opening, closure, rounding, pursing, and retraction of lips may indicate range, mobility, and control of this primary oral structure. The efficiency of labial closure and the retention of secretions, food, and liquids may be impacted by the child's positioning, postural stability, and control (Sheppard 1995).

Drooling and loss of secretions may be an important indicator of decreased oral functioning. Drooling may be present in children who have challenges in creating sufficient anterior closure to initiate a swallow or children who have sensory issues related to the awareness of pooled or overflowed secretions (Sheppard 1995). Drooling may occur in all instances, in specific positions, or solely when the child has motor challenges. The viscosity of the drool may also give insight into the child's hydration needs. Some children diagnosed with CP have undergone surgeries and botulinum injections or are on medications to assist with secretion management. Because control of secretions involves many aspects of providing feeding treatments to a child with neuromuscular

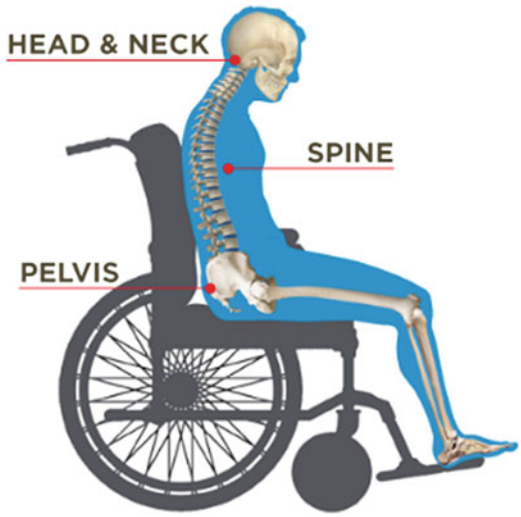

Fig. 2 Postural malalignment with a posterior pelvic tilt

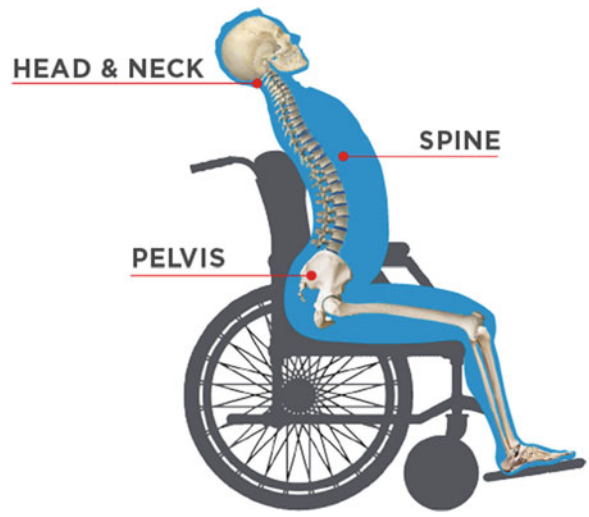

Fig. 3 Postural malalignment with an anterior pelvic tilt

impairments, all factors involved must be identified. Everything from the ability to break down foods during oral feeding to issues with pulmonary hygiene and aspiration and even social interactions are potential concerns surrounding drooling issues for children with CP and their families. For additional information on drooling, please refer to ▶ Chap. 53, "Medical Management of Sialorrhea in the Child with Cerebral Palsy" (Section 2: General Medical: Ear, Nose, and Throat).

Dental condition, alignment, and oral hygiene provide insight into the child's ability to use the teeth for feeding tasks. Lip closure and approximation of oral structures for feeding, bolus manipulation, and transport may be impacted. The presence of dental caries and dental disease is greater for those children presenting with increased motor severity (Sedky 2017). Dental caries and decay may result in increased levels of bacteria in oral secretions. Aspiration of bacteria-laden secretions is an associated risk for aspiration pneumonia (Ueda 2011). Malalignment of dentition may result from a persistent suckle or tongue thrust pattern which may result in dentition being pushed forward. Dental malalignment can interfere with labial closure and function. Bruxism or teeth grinding is common among children with significant oral sensory and cognitive needs. Some children with significant bruxism present with worn dentition, gum swelling or gingiva, and oral pain that may result in resistance to oral feeding. For more information regarding dental concerns, please refer to ▶ Chap. 75, "Dental Hygiene for Children with Cerebral Palsy" (Sect. 2: General Medical: Dental).

Lingual mobility at rest and in functional activities provides information about the child's ability to manage secretions, foods, and liquids. Lingual protrusion, retraction, spreading, narrowing, lateralization, and tipping and rolling the tongue bilaterally should be included in the examination, and the child should be able to imitatively or volitionally perform these tasks. In the absence volitional performance of these movements, functional tongue mobility and movement patterns may be described as they are displayed within the feeding observation and examination. In typically developing children, lingual control of lateral movement and rotational patterns (tipping and rolling) of the tongue are preceded by the development and control of lateral and rotational movement patterns within the trunk. Many children with CP diagnosed with more severe movement dysfunction (GMFCS levels IV–V) display movement patterns that are dominated by symmetry in the upper and lower extremities, and their trunk movements may be limited to flexion and extension patterns. Most often these children will display lingual mobility that mirrors the symmetrical and midline movement patterns observed in the trunk. The immature anterior-posterior suckle patterns that dominate lingual movements in these children are insufficient to manage more advanced food textures. In contrast, children who present with greater trunk control and a more varied repertoire of movements throughout the body (GMFCS I–III), including control of lateral and rotational movements in the trunk and independent sitting balance, tend to display a greater variety of lingual movement patterns for feeding (Sullivan et al. 2000; Calis et al. 2008; Weir et al. 2013). They may also present with more refined grading and control of oral musculature during feeding, thus improving efficiency in feeding. Children with improved control of the trunk mobility and greater experience with varied movement typically present with better prognosis for advancing texture, increasing volumes, and engaging in sufficient feeding to support their nutritional, growth, and hydration needs (Brackett et al. 2006).

The hard palate and velum may be assessed for size, shape, and function. The hard palate is examined for structural integrity and any abnormalities, such as a cleft or abnormal shaping which may potentially impact bolus collection, and control and transport during the oral phase of feeding. The appearance of a highly arched palate may be the cause for concerns of palatal packing and issues with mouth cleaning, particularly in the child with limited lingual control and range. Likewise, a flattened or wide palate presents with increased area that may require lingual pumping or lingual contact to sufficiently clean of foods.

Adequate velar length and rise are required to create sufficient intraoral pressure for bolus collection and transport. Adequate velar rise will ensure that the bolus does not enter the nasopharynx as it passes into the pharyngeal vestibule. Children who present with velopharyngeal incompetence often display sneezing during the course of the meal or have increased nasal secretions and possibly food or liquid draining from the nose. Velopharyngeal incompetence may also result in difficulty achieving labial closure secondary to increased nasal secretions. This limits nasal breathing patterns and necessitates an open mouth posture for breathing. The posterior oral cavity should be examined to view tonsillar tissue. Persistent enlargement of tonsillar or adenoidal tissue may be related to gastrointestinal reflux (GER), infection, or allergies. The enlargement of tonsils and adenoids may impact the comfort of swallowing and ease of respiration and influence the ability for the child to achieve adequate velar rise. The chart below (Table 2) provides some commonly observed structural oral motor abnormalities, causes, associated issues, and the potential impact that these impairments present on function for feeding.

Assessment of vocalization strength, control, quality, and cough may provide some ideas of the child's ability to protect the airway. If the child presents with a weak voice, is continuously hoarse, or is aphonic, then a full examination of vocal fold function may be warranted. The vocal fold function is a mechanism for the protection of the airway. The closure of the vocal folds is essential for the development of the increased subglottal pressure needed for productive coughing and voicing. Focusing on the development of an effective cough or vocalization upon imitation or instruction for the child with secretion management and feeding concerns is a worthwhile goal. Children with reliable and effective strength in coughing or vocalizations can recruit such skills as a compensation to manage secretions, foods, or liquids that have pooled or penetrated the laryngeal vestibule.

The assessment of the structures related to motor output and sensory responses involve the assessment and understanding of cranial nerve function (Sheppard 1995; Andrew et al. 2012). Neuromuscular impairments may impact cranial nerves. The chart below (Table 3) describes the cranial nerves' influence on the sensory and motor aspects of feeding and swallowing. There are additional cranial nerves that impact vision and smell, and these may impact feeding function and mealtime interactions and enjoyment.

Feeding Observation

The feeding observation provides an opportunity to view both the child and the caregiver engaged in the functional activity of feeding (Morris and Klein 2000). If the observation is not taking place in the home, or in a location of familiarity, responses may be atypical and not representative of everyday mealtime experiences within the home. The seating for the feeding observation should match the system that is used in the home. If the child's positioning equipment for feeding is not available, a detailed description, photo, or video of the child in the seating system during feeding is helpful to understand the impact it may have on feeding. Attention to the caregiver's ability to utilize equipment to promote safe positioning and the overall condition and fit of the positioning equipment is appropriate and should include an assessment of the use of straps, trays, and supports within the seating system. Customization of seating systems may be a significant need to address the child's individual postural and positioning needs. A physical therapist may be instrumental in making effective individualized adjustments that provide improved positioning for the child. Often children will be reclined or tilted within their seating system in preparation for feeding to assist in decreasing bolus spillage. However, the impact of gravity on the flow of the bolus and the ability to which the child may actively participate in feeding may make positioning with varying degrees of tilt or recline extremely challenging for children with oral motor needs (Woods 1995; Marques and Sá 2016). It is essential to match the degree of positional and postural support the child requires across all environments. Considerations about

Table 2 Commonly observed structural oral motor abnormalities, causes, associated issues, and the potential impact on the function for feeding

Structures and common presentation	Causes and/or related issues	Potential impact on function
Head shape • Asymmetry • Plagiocephaly	Structural abnormalities Immobility Impact of gravity on structures Persistent reclined or recumbent positioning Pelvic and trunk asymmetry	↑ asymmetry of oral-facial structures ↓ function of oral-facial structures
Lips • Labial asymmetry • Upper lip retraction • Open mouth posture • Swelling or abrasions on the lips • Labial fasciculations	Structural abnormalities Poor alignment of the pelvis and trunk Asymmetries of head and oral-facial structures Hypotonic oral-facial tone Hypertonic oral-facial tone Decreased sensory awareness Inability to breathe through the nose Enlarged tonsillar/adenoidal tissue Allergies/cold or respiratory issues Lip biting Break down and chapped lips	↓ management of secretions, foods, and liquids ↓ ability to create oral closure to engage in efficient bolus collection, control, manipulation, and transport ↓ containment of saliva/drooling Drooling impacting hydration, hygiene, and social interaction ↓ ability to participate in feeding in public or settings outside the home ↓ ability to approximate the lips or achieve closure to efficiently use cups/straws/utensils ↓ ability to self-feed ↓ ability to manage a variety of textures ↓ independence in feeding
Dentition • Malocclusions • Dental caries • Dental decay • Missing teeth • Bruxism	Structural abnormalities in dentition eruption Lingual patterns Infected, inflamed, or irritated gingiva Macroglossia Poor oral hygiene Limited lingual mobility for mouth cleaning Gastroesophageal reflux Frequent vomiting Medications that impact dentition Sensory issues contributing to bruxism or making oral hygiene challenging Micrognathia Palatal shape Asymmetry of the pelvis, trunk, head, and oral-facial structures	Impact ability to achieve labial closure ↓ ability to approximate dentition for chewing and food management Oral pain ↑ in bacteria in oral secretions ↑ risk of aspiration pneumonia Refusal to feed Refusal to engage in tooth brushing Sensitivity to temperature, texture, or sugar content in foods Swallowing foods whole ↓ texture advancement ↓ oral intake Tonic bite/biting to improve stability
Tongue • Limited tongue range • Poorly graded tongue movements • Decreased tongue mobility	Structural abnormalities Persistence of immature suckle pattern Midline tongue movements Decreased dissociation of tongue and jaw movements Decreased variety of lingual movement (lateral, tipping and rolling of tongue, tongue elevation, lingual protrusion)	↓ mouth cleaning ↓ ability to clean foods from lips or dentition Packing of foods in the cheeks, under the tongue, or in the palate ↓ ability to advance texture ↓ ability to accept, collect, manipulate, and transport bolus ↓ control of secretions, saliva or foods

• Abrasions of the tongue • Lingual fasciculations	Decreased repertoire of lingual shaping (narrowing, spreading, cupping, posterior lingual control) Asymmetry of the pelvis, trunk, head, and oral-facial structures Decreased postural stability or control Poor positioning of the pelvis, trunk, head, and neck structures Hypo- or hypertonicity in the tongue Limited variations in lateral, rotational, and graded movements of trunk Sensory issues and awareness Biting the tongue Persistent presentation of foods at midline	Swallowing foods whole Oral stasis Expelling foods and liquids ↓ intraoral pressure Premature spillage of foods over the base of the tongue Use of head position and movements to move food and liquids in the oral cavity Drooling ↓ efficiency in feeding Fatigue and lengthy mealtimes ↓ ability to feed outside the home
Hard palate • High arch • Asymmetry • Flattened • Abrasions	Oral-facial weakness Congenital abnormalities Structural abnormalities Strong persistent suckle pattern Limited sucking and feeding skills Poor positioning of the pelvis, trunk, head, and neck structures Dentition alignment and development Micrognathia Ineffective chewing skills Poor oral hygiene	Palatal packing of foods ↓ mouth cleaning Inefficiency in bolus collection, control, management, and transport Oral pain or pain with feeding Fatigue during mealtimes
Velum • Velopharyngeal incompetence	Poor or absent velar rise Enlarged tonsillar and adenoidal tissue Increased pressure at the upper esophageal sphincter Gastroesophageal reflux Structural abnormalities	Nasopharyngeal reflux Food and secretions coming from the nose Sneezing Inability to engage in nasal breathing Inefficiency in bolus collection, control, management, and transport Pain when swallowing Issues in controlling, swallowing, and respiration Increased swelling and irritation of nasal tissue ↓ desire to eat

Table 3 Cranial nerves' influence on the sensory and motor aspects of feeding and swallowing (Costa 2018; Cranial Nerves with a Focus on Swallowing and Voice 2019)

Cranial nerve V trigeminal	*Sensory:* Information about pain, temperature, touch, and proprioception from the face, cheeks, lips, jaw, as well as the jaw and temporal-mandibular joint, and deep structures of the face, palate, tongue, and pharynx *Sensory:* Feedback regarding the size, shape, and texture of foods in the mouth *Motor:* Jaw control, jaw opening, closing, chewing, jaw lateralization, rotational patterns Assists in superior-anterior laryngeal rise, tongue retraction, posterior approximation of the tongue to soft palate, velar rise, and posterior pharyngeal wall constriction
Cranial nerve VII facial	Facial expressions, cheek movements Taste Lip mobility, control, and strength Salivation (submandibular and sublingual glands) Lower jaw depression Assists with hyoid elevation
Cranial nerve IX glossopharyngeal	*Motor:* Elevation of the larynx and pharynx and widening of the pharyngeal wall mobility; contributes to epiglottic movement and inversion *Sensory:* Taste and sensory information to the posterior 1/3 of the tongue, sensation to the tonsils, soft palate, and upper pharynx Sensory information for pharyngeal gag and cough Salivation (parotid gland)
Cranial nerve X vagus	*Motor:* Elevation and depression of the velum, elevation of posterior portions of the tongue, elevation and closure of the larynx/vocal folds, lowering of the larynx after swallow muscles of intrinsic larynx, and activation of the cricopharyngeal muscle (upper esophageal sphincter – UES) *Influences:* Swallowing function and coordination, voicing, resonance, movement of the pharynx (pharyngeal contraction), relaxation of cricopharyngeal muscle, esophageal peristalsis, cardiac issues, GI tract, respiration *Sensory:* Feedback to the palate, pharynx, larynx, trachea, lungs, and epiglottis Taste receptors in posterior oral cavity Recurrent laryngeal nerve (RLN): Sensation of aspiration below vocal folds Superior laryngeal nerve (SLN): Posterior tongue and larynx for bolus control and penetration into laryngeal vestibule
Cranial nerve XII hypoglossal	All intrinsic musculature in the tongue Cupping, spreading, shortening, narrowing, and flattening of the tongue

the efficiency and safety of feeding may be appropriate to discuss, if children are feeding while on the caregiver's lap. A review of all positioning equipment that is in use for feeding across various environments may enlighten the team about the seating used in the home versus what is available for them to use at school or out in the community. Controlling this variable in the child's care may serve to improve consistency and function across settings.

Feeding observations provide opportunities to view oral skills, coordination of respiration, bolus collection, transport, and swallowing. The child's ability to manage and accept foods or liquids and to identify which foods or liquids may be more challenging will help define concerns. Exploration of observed and reported food preferences may be present secondary to multiple issues. Food preferences related to undiagnosed food intolerances or allergies are most concerning when identifying related medical issues. Some children present with additional diagnoses that influence the child's ability to engage in the flexible acceptance of a variety of foods (i.e., autism spectrum disorders). The sensory properties of preferred foods (i.e., highly seasoned or bland, cold or warmer, pureed or solids, thicker or thinner) may help to identify consistent patterns of acceptance. Consistent sensory properties of preferred foods may be related to the physical and sensory properties of food texture, or they may be more related to the child's oral motor abilities to manage those textures (Morris and Klein 2000). The condition of the teeth may result in sensitivity

to temperatures of foods. Ability to process the smell or taste of foods may create additional sensory challenges for some children. The caregiver may provide additional information about the development of preferences and food selectivity. Food preferences also may be related to cultural or customary foods for the family.

Utensils that are typically used and familiar to both the child and the feeder should be examined by the clinician along with the techniques to feed the child at home with these utensils. The ability with which the feeder and the child can successfully and efficiently use utensils from home will provide information regarding the match of the utensil (spoons, forks, bowls, plates, and cups) to the oral motor and developmental needs of the child (Morris and Klein 2000; Marques and Sá 2016). The appropriate utensil width for the child's mouth and the shape and depth of the spoon bowl influence the child's ability to clean the spoon. If there is insufficient upper lip activation, there may be inadequate contact to clean the spoon, and the child may fatigue or need more spoon presentations, which in turn may lengthen mealtimes. Longer mealtimes may result in a more significant expenditure of energy to complete the meal. Additionally, if the child is ineffective in cleaning the spoon, the feeder may likely increase the bolus size to compensate for poor contact with the spoon which may lead to the presentation of a bolus that is too large for the child to manage safely. The safety and use of utensils and the child's response to utensils can provide valuable information in the development of an effective feeding plan.

Requesting that the caregiver provide foods for the assessment will allow options that are familiar to both the child and feeder. Foods that the caregiver would like the child to be able to eat or "goal" foods may give some insight about the goals of the caregiver and their understanding of the child's current and potential feeding abilities and needs. When the caregiver supplies food, expectations of accepted food textures, food preferences, and typical volume that the child is to consume may be revealed. Presenting a trial using new foods and textures during the assessment allows the clinician to view the child's ability in managing textures that may not typically be eaten, such as dissolvable solids or thickened liquids.

A detailed description of the feeding observation includes the functional use of oral-facial structures to engage in feeding. The ability to accept the food; manipulate the bolus within the oral cavity; use the lips, tongue, cheeks, and teeth in a coordinated manner to manage the foods; and transport the foods for swallowing are all necessary components. Feeding and swallowing should be well-coordinated with respirations. The number of swallows the child requires to clear certain foods and liquids from their mouth is a clear indicator of efficiency with those foods. The evaluation may include descriptions of any evidence of gastrointestinal dysfunction surrounding feeding. Children with gastrointestinal concerns may gag, vomit, cry, indicate there is pain with feeding, or display arching during meals. Effortful swallows and burping can also be a symptom of gastrointestinal issues. If there is frequent coughing, wet vocal quality, or evidence of declining respiratory status, the foods with which this occurs and the point during the observation when these issues arise may be important indicators of sustainable and safe oral feeding. For more information on gastrointestinal issues, please refer to ▶ Chap. 51, "Gastroesophageal Reflux in the Child with Cerebral Palsy." (See section 2: General Medical: Gastro-Intestinal.)

Caregiver responses to the child's difficulties such as the use of pacing of the food presentation, bolus size, and placement of foods as well as any support provided by the feeder (i.e., cheek support, verbal cues, reinforcement) should be described. The inclusion of any observations, verbalizing of stressors, or mealtime concerns on the part of the caregiver is essential. As the observation progresses, examiners may want to confirm that the feeding is representative of mealtime presentations in the home. Understanding what occurs during a "typical" mealtime for the child may provide insight into many issues surrounding feeding (Wilson and Hustad 2009). The mealtime routine, schedule, expected volumes, and locations of the meals all may be factors that can influence intake, comfort, and safety of feeding for the child with neuromuscular impairments. It

is appropriate to include as much detail as possible regarding the observation.

Communication between the child and caregiver may decrease or become disrupted when feeding the child with significant difficulties. Interactions and cues provided by both the feeder and the child may reveal difficulties with the psychosocial aspects of feeding (Harding and Cockerill 2014). Refusals or negative disruptions (crying, gagging, pushing away, hitting, yelling) are common learned behaviors that may be an outgrowth of difficulties feeding. These behaviors often are a response to requests for acceptance of foods that are challenging for the child secondary to medical or physical issues. Describing any disruptions that occur within the meal, foods/liquids that cause the disruption, or the point in the meal at which the disruption occurs can be valuable in determining issues related to acceptance. Any signals that may precede disruptions or trigger refusals (coughing, choking, hard swallows) contribute to the understanding of causes related to negative disruptions. The management of refusals or negative disruptions and understanding what is common to the feeding and what is unique to a specific meal, food, or environment is helpful. If the mealtime observation is atypical, it would be advantageous to understand the ways in which it differs from what usually occurs. Fatigue, discomfort, upset, and anger of the child and/or caregiver are all apparent symptoms of feeding dysfunction. The feeding observation can provide the examiner with valuable evidence upon which to base treatment.

Self-Feeding

Some children are able to self-feed all or portions of a meal. The mealtime setup, the foods the child is able to self-feed (i.e., only finger foods, drinking independently), how utensils are utilized and adapted for use, and the efficiency or labor-intensive aspects of self-feeding for the child are all appropriate details to include in your examination and evaluation on feeding abilities and needs. During a feeding treatment, if a child is a competent self-feeder and refuses foods and that is a concern, then there may need to be a discussion and change in the child's autonomy in food choice. A child's refusal may require a change in food texture to foods that are less likely to be expelled. For additional information on self-feeding, please refer to ▶ Chap. 187, "Activities of Daily Living Supports for Persons with Cerebral Palsy." (See Section 4: Therapy Management: Adaptive Technology and Supports.)

Trial Therapy

Providing an opportunity to engage in trial therapy can be an important element in the assessment process. It will provide the examiner with information regarding the child's ability to process and respond to changes and treatment. When effective the examiner's approaches in trial interventions will provide a model for the caregiver to observe the impact of intervention and potential for improvement. For example, changes in positioning can improve trunk alignment and allow the child to function more efficiently during mealtimes. Providing manual support to assist with head position and labial closure can promote improvement in bolus control, management, and transport. When caregivers view these interventions, it may facilitate discussion of shared goals and allow for improved problem-solving together as a team. Such interactions may also lay the groundwork for caregiver training. Follow-through with recommendations is positively impacted when there is a positive relationship between caregiver and the rest of the treatment team. Carryover and training are also improved by involvement in the treatment process.

Cervical Auscultation

Cervical auscultation is an additional tool that can be utilized during the clinical exam to assess swallowing efficiency and respiratory coordination with the swallow (Morris and Klein 2000). By placing the stethoscope laterally to the trachea

and superior of the cricoid cartilage, the clinician will be able to assess auditory sounds of swallowing. Initial assessment of the respiratory patterns utilized in the management of oral secretions will provide some information in advance of presenting a bolus (Mills 2004). If breath sounds are clear and coordinated when managing secretions, then a liquid or pureed bolus may be presented. Listening for evidence of premature spillage of the bolus over the base of the tongue, or delayed initiation of the swallow, or other indicators of aspiration or penetration of the bolus during the swallow may be beneficial. Changes in respiratory sounds following the swallow are essential to note. A study by Frakking et al. (2016) revealed that under cervical auscultation, the presence of wet respiratory quality and wheezing in the absence of a glottal release sound (GRS) following the swallow was highly correlated with aspiration. Clearing of wet vocal quality following a cough may assist in training compensatory cough techniques to assist in improving swallowing safety.

Instrumental Assessments

Video-fluoroscopic swallow study (VFSS) and fiber-optic endoscopic evaluation of the swallow (FEES) are commonly performed to assess the structures of feeding and swallowing when there is a suspicion of aspiration or structural abnormalities that impact upon safe swallowing. Silent aspiration occurs when there is no cough in response to material entering laryngeal vestibule, traveling past the vocal folds, and into the lungs. The VFSS or FEES studies are not considered to be "pass" or "fail" studies; instead, they are descriptive and are utilized to view the function of the structures of feeding and swallowing in the action of a simulated meal. It is important that the caregiver comprehend the goal of performing an instrumental study, as it often increases stress and fear that their child will "fail" and no longer be able to engage in oral feeding experiences. Both studies also represent a brief sample of the child's swallowing function in a situation that is outside of their typical meal. The best use of these studies will be to use them as tools to inform and direct the course of ongoing treatment. FEES and VFSS are viewed as complementary and are not viewed as mutually exclusive in their use for diagnostic purposes (Arvedson 2013).

If primary concerns surround laryngeal function and what occurs before and just after the pharyngeal swallow (Arvedson 2013; Dodrill and Gosa 2015), then FEES may be an appropriate study. FEES is appropriate for viewing upper airway function, vocal fold movement, and identifying the presence of pharyngeal residue after the swallow (Arvedson 2013). FEES may be performed at the bedside, or in an office visit, and it does not involve exposure to radiation. The invasive nature of placing the fiber-optic scope may create some tolerance issues, especially for those children with cognitive and neuromuscular challenges (Morris and Klein 2000). If a more complete view of pharyngeal structures and function is needed, the VFSS will be a more practical assessment.

The VFSS allows a view of the dynamic function of all the oral, and pharyngeal structures, and upper esophageal function. Viewing full esophageal function is not always possible. Barium is mixed in a variety of consistencies of familiar foods and fed to mimic more typical feeding scenarios. The VFSS is not without challenges, especially when performing with children who have significant positioning needs. Optimal positioning for children with significant motor disturbances may be challenging to achieve with available VFSS positioning chairs. Alternative methods of obtaining appropriate postural alignment outside of the child's wheelchair, such as the use of additional straps, pool noodles, and towel rolls, may be helpful in preparation for any seating limitations that may arise when conducting the study.

Concerns related to the comfort of the child and their caregiver may heighten stress and impact the ability to complete an instrumental assessment. Instructing the parent and the child, in all aspects and details (what, why, where, when, and how) of the study, may ease stress. A hypothesis or diagnosis on the presence of oropharyngeal dysfunction will inform decision-

making regarding the type of study and the use of various textures and positioning equipment before conducting the study. Considerations of the time involved in a VFSS are important because of radiation exposure during a VFSS, further promoting the development of a hypothesis, so that the study will result in obtaining valuable information to support the development of goals and feeding plans.

It is appropriate to work with children prior to instrumental assessments to prepare them for active participation in such assessments. When clinicians are able to work with the child prior to the instrumental assessments, it may help them to better understand the process and may also allow the clinician to identify compensatory techniques (cough or vocalization after the swallow, changes in head positioning, temperature, or texture) that may promote improved performance when implemented within the study. The clinician's role in selecting appropriate and reliable compensatory techniques may ensure that the information gained though the study is optimized and will provide insight into the value of using appropriate intervention strategies in treatment.

Changing head and neck positions (chin tuck, turning to one side) may promote optimal alignment for effective swallowing. Temperature (warm, cold, or alternating between temperatures) or intense flavors (lemon, sour, salty) to heighten sensory input or influence motor responses during swallowing may be beneficial. Some children can employ vocalizations or cough either on command or imitatively to help clear pooled material during a VFSS. Manipulating the presentation of the food by using pacing, altering bolus size, or texture modifications are common intervention strategies employed within FEES and VFSS. Issues surrounding aspiration that may be due to feeding fatigue may be "teased out" through making alterations in the progression of the study. Performance on VFSS and FEES are not always an indicator of complete safety or dysfunction. The results inform the team and caregivers of guidelines that provide the best opportunity for safety. These guidelines may or may not include a recommendation of appropriate consistencies, limitations on volumes, or limitations on how often the child may engage in oral feeding.

Instrumental assessment often results in recommendations that may include altering food textures. Using the standards and consistencies outlined within the International Dysphagia Diet Standards Initiative (IDDSI) to describe food textures will provide a more detailed understanding of each texture and liquid viscosity. When consistent use of appropriate food textures and liquids is implemented across environments, it decreases variabilities related to the textures that the child must manage when consuming foods in different places. The IDDSI guidelines present specific examples and measures to gauge the textures of all foods and liquids so uniformity of texture may be achieved. Measurements of liquids and food textures can be cumbersome to perform, and the use of the IDDSI will assure that reliable food and liquid consistencies are presented at home, in treatment, and across all settings in which the child is functioning (Steele et al. 2014).

Even when a child presents with significant evidence of aspiration on a study, it is important that the child continues to engage in opportunities to practice swallowing so they can maintain strength and coordination for swallowing secretions. Children who are unable to maintain safe oral feeding of sufficient volumes to support nutrition and hydration needs benefit from an oral hygiene program and opportunities to focus on swallowing secretions (Arvedson 2013). Continuing to experience tastes and mealtime activities through limited volumes and the presentation of dipped spoons may accompany recommendations for the initiation of supplemental tube feedings (Arvedson 2013).

Upon the completion of a full assessment, the Eating and Drinking Abilities Classification Scale (EDACS) may be utilized to help describe the degree of the swallowing dysfunction. The EDACS provides a clear model for individuals with CP, their families, and health professionals to use as in defining the abilities of the child and the associated feeding impairments (Sellers et al. 2013). The EDACS also may allow caregivers to

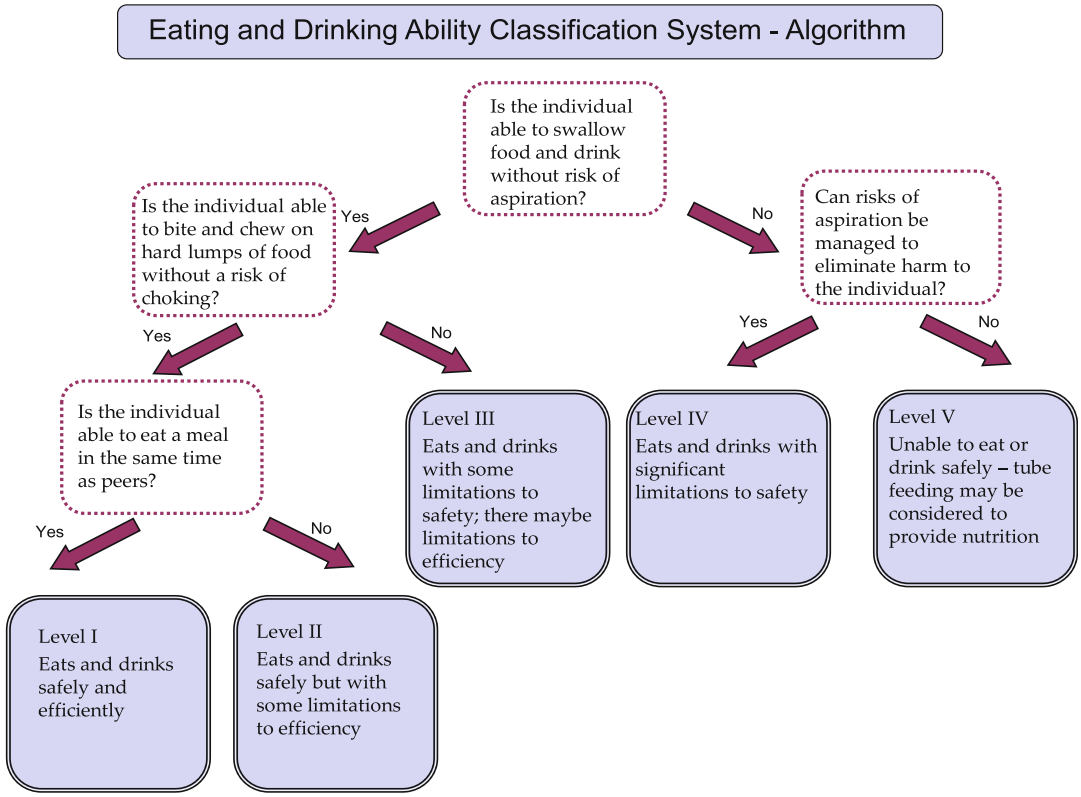

Fig. 4 EDACS Clinical Algorithm. (Reproduced by permission, D. Sellers)

view the feeding skills exhibited by their child in relation to the full continuum of abilities, thus aiding in the understanding the child's feeding abilities (Fig. 4).

To summarize the feeding assessment (examination and evaluation) in children with CP, let's return to the ICF model. The ICF model represents the interactive nature among personal dimensions (body function and structure impairments, activity limitations, and participation restrictions) and the contextual factors (environmental and personal) that may be impacted by a specific health condition (in our case, CP) (Mahant et al. 2018). Figure 5 illustrates the ICF model inclusive of specific items that have been discussed and should be considered in the comprehensive feeding assessment. Assessment findings will inform the development of a holistic, comprehensive treatment plan.

Intervention

The treatment needs of the child with CP are significant in terms of the scope of services that may be engaged to meet the health concerns and function of the child and family (Morris and Klein 2000; Arvedson 2008). Utilizing an interdisciplinary model has proven to be an effective format to address the feeding needs of medically complex children with neurological impairments (Sheppard 1995; Arvedson 2008). Roche et al. (2011) determined that the interrelationships between the various medical, oral, motor, sensory, behavioral, and psychosocial factors that influence feeding require an interdisciplinary team. This team is not one that merely observes the care provided by other team members; rather it is a team that is interactive in creating and sharing

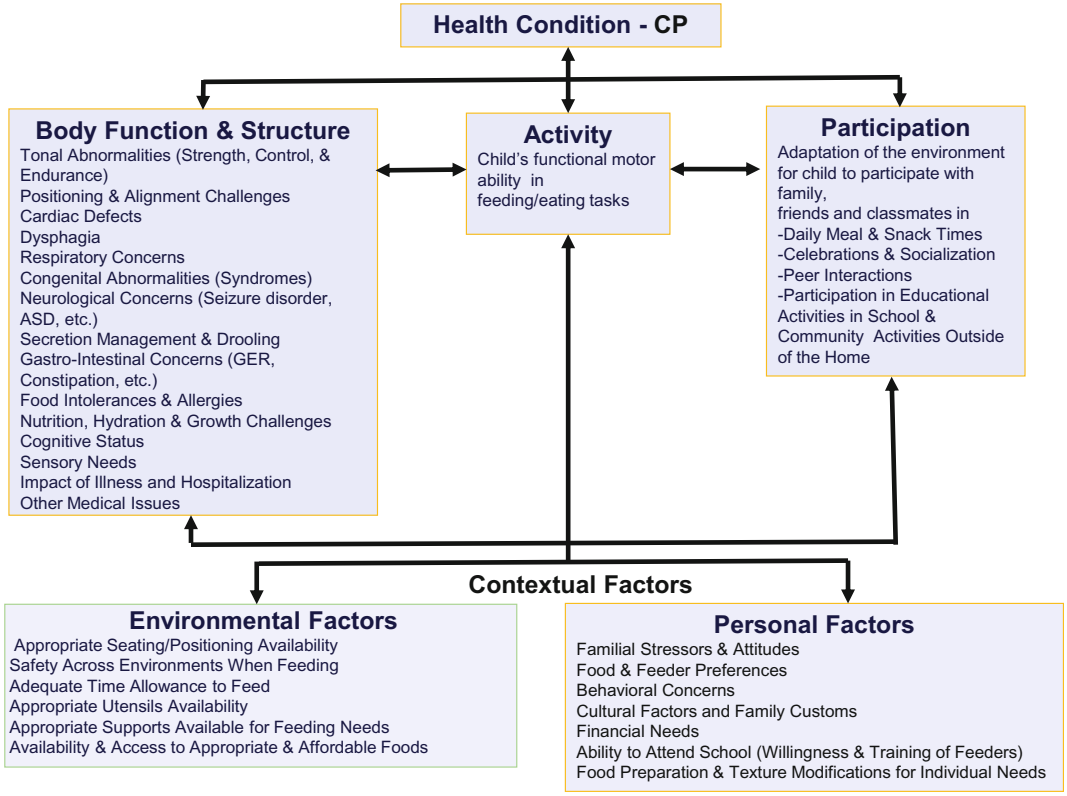

Fig. 5 IFC framework applied to a comprehensive feeding assessment

information to design and implement a care plan for the child and family. An interdisciplinary approach allows the entire team to participate in the development of goals that mutually serve the child and the family. An interdisciplinary team may consist of any and all of the following members.

Caregivers and the Child

The role of the caregiver is crucial to creating a treatment plan with shared goals that have been developed based on a comprehensive assessment. They are the experts in the care of their child. In some cases, the child can make decisions regarding their eating and food choices. Some older children who present with endurance and fatigue issues may choose to expend their limited energy on communication, interactions with peers, or mobility. They may view oral feeding as an activity that is too labor-intensive to result in enjoyable mealtimes. In cases like this, the child may self-advocate for supplemental feedings and enjoy tastes of foods orally when the opportunity arises.

Physicians, Dentists, and Physician Assistants

Depending upon the child's needs, specific medical professionals can function on the team to varying degrees. Children who present with more significant medical complexities may need additional support to coordinate medical and other team members. Medical professionals may include physicians from the following disciplines, developmental medicine, pediatrics, gastroenterology, otorhinolaryngology, pulmonology, cardiology neurology, orthopedics, and radiology, as well as physician assistants,

orthodontists, oral maxillary surgeons, and dentists.

Psychologist

Most children with significant feeding concerns present with some learned behaviors that create barriers to successful feeding. Providing the child with opportunities to engage in positive practice throughout treatment serves to reinforce feeding as a positive and enjoyable experience (Manno et al. 2005). The psychologist may develop a plan to address the negative learned behaviors that often are an outgrowth of feeding difficulties.

Dietitian

The dietitian plays a vital role in helping to manage the caloric intake and hydration and will determine the volume and types of foods and fluids required to promote growth and weight gain of the child (Morris and Klein 2000).

Speech and Language Pathologist (SLP)

There may be more than one speech and language pathologist involved in the care and treatment of the child with feeding dysfunction. They may function in a variety of capacities depending on the setting in which they work (medical, private, early intervention, school or community-based settings). The SLP is essential to the team for assessment and the development of oral motor treatment plans. They also may implement therapeutic feeding allowing for positive oral feeding experiences for children with significant swallowing needs. Focus on parental training and promoting carryover across environments are goals of treatment (Arvedson 2008). For more information on the role of the SLP in managing the child with CP, please refer to ▶ Chap. 156, "Speech, Language, and Hearing Practice Elements in the Management of the Child with Cerebral Palsy" (see Section 4: Therapy Management: Introduction).

Occupational Therapist (OT)

The role of the occupational therapist may be to provide services that address the oral, sensory, and motor needs of the child with feeding needs. Depending upon the structure of the program, the occupational therapist may be more significantly involved in the treatment of oral motor needs and the assessment of feeding via VFSS. The OT is also instrumental in the adaptation of utensils, trays, and seating and in implementing assistive technology (such as electronic self-feeders) to promote independence in self-feeding and hydration across settings. They may function in a variety of capacities depending upon the environment in which they work (medical, private, early intervention, school or community-based settings) (Manno et al. 2005). For more information on the role of the OT in managing children with CP, please refer to ▶ Chap. 155, "Occupational Therapy Elements in the Management of the Child with Cerebral Palsy." (See Section 4: Therapy Management: Introduction.)

Physical Therapist (PT)

The PT plays an essential role in the assessment of tone and motor functioning, as well as adapting and adjusting seating to match the postural needs of the child with CP during feeding. Additionally, they can provide support to the team in the management of trunk mobility and improvement of respiratory activation of the ribcage to address the strength and effectiveness of cough and improvement of secretion management. They may function in a variety of capacities depending upon the setting in which they work (medical, private, early intervention, school or community-based settings) (Woods 1995; Manno et al. 2005).

Social Worker

The social worker's role is multifaceted throughout feeding assessment and treatment. Families who include children with significant feeding needs are prone to stressors and may require

assistance in managing the demands and issues involved in a feeding treatment program. The role of the social worker as a case manager, liaison, and support for the family is indispensable to the team. They may function in a variety of capacities depending upon the setting in which they work (medical, private, early intervention, school or community-based settings) (Morris and Klein 2000; Sheppard 1995).

Educational/Support Staff

The inclusion of educational and support staff within the home or the academic setting will promote the carryover of treatment goals and care concepts across environments. It is vital for all team members to be able to interact to address treatment interventions and goals for the feeding program. Teams that share goals and work across environments will be more efficient and effective in achieving treatment outcomes (Arvedson 2008; Morris and Klein 2000).

Elements of Treatment

Treatment begins with the development of and prioritization of shared goals (Mahant et al. 2018). The family and the child must have a primary role in making decisions about interventions. It is essential to recognize that caregivers are the experts when it comes to determining interventions and goals to promote feeding abilities in their children with CP (Cowpe et al. 2014). Approaching treatment without addressing caregivers' concerns or gaining their investment in the process will drastically limit the ability for the child to succeed in any form of treatment, feeding, or otherwise. Much of the team focus centers on family training. The more the caregiver is involved and understands about their child's needs, the more active they become in the shared goals and carryover of treatment strategies. One study by Hettiarachchi and Kitnasamy (2013) examined the role of caregivers in treatment and found that the use of experiential activities in feeding training and therapy promoted carryover and involvement of caregivers. It is essential to recognize that the caregivers are the "keepers" of their child's medical and feeding histories and are primarily responsible for implementing their care regimens. When the caregiver is the sole provider and "keeper" of the child's care, this may impose limitations upon the variety of environments in which the child may function. Limitations of the child's environments serve to decrease the experiences in which the child may participate. It also limits the independence of both the child and caregiver and potentially may decrease the quality of life for both individuals. The burden of daily care regimens that are well understood and practiced may be challenging for the caregiver and the child to share across environments. This can be particularly difficult to accept if certain care practices have become inefficient or a determination has been made that such routines no longer meet the child's needs. Training plans that provide experiential activities such as modeling and rehearsal of feeding protocols show greater adherence and improved consistency compared to those which include only verbal and written instruction (Mueller et al. 2003). Implementing experiential feeding activities that engage the caregiver in positioning themselves in ways that mimic the tone and posture their child displays can be a helpful tool. It may allow the caregiver to experience the full impact positioning and motor dysfunction on feeding, swallowing respiration, and endurance for safe and efficient mealtimes. There should be an expectation that these types of training efforts will be a significant portion of effective dysphagia treatment plans (Harding and Halai 2009).

Medical needs present as the most pressing issue when initiating a therapeutic feeding plan. Ruling out medical issues that may impact feeding should be a goal in the medical clinic to inform the treatment plan. (Arvedson 2013; Sheppard 1995). Ongoing assessment of interventions and the impact of treatments on a child's medical condition is crucial throughout the treatment process (Morris and Klein 2000). Once the child is deemed medically stable, the treatment process may be implemented. Figure 6 illustrates the pediatric feeding care cycle with four major components: assessment and reassessment, diagnosis and goal setting, intervention, and monitoring

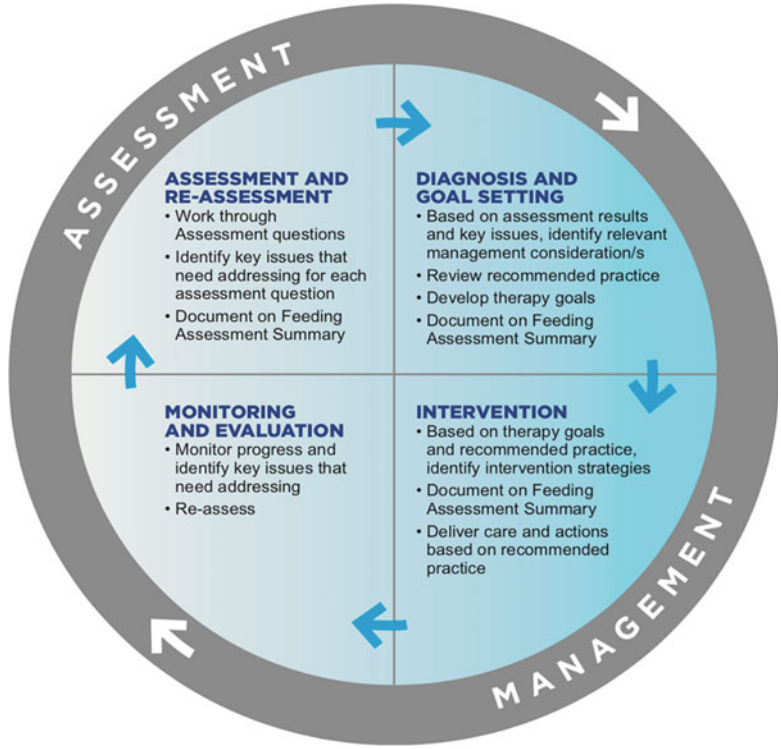

Fig. 6 Pediatric feeding care cycle. (Reproduced by permission, NSW Health © 2019)

and evaluation. Effective therapeutic feeding plans/programs for children with CP require a cyclical, dynamic process and collaborative efforts as indicated in this model from the Office of Kids and Families in Sydney, Australia (Feeding Difficulties in Children, A Guide for Allied Health Professionals). Children, regardless of their diagnoses, do not function as static beings, free from stressors, influences, growth, change, and issues that potentially may compound the presentation of their medical and feeding needs. Treatment must continuously reflect the ongoing assessment and reassessment of the feeding needs in the child with CP (Morris and Klein 2000). This ongoing assessment will influence the design of treatment plans, goals, and medical interventions throughout the child's life. There may be periods of intense feeding interventions and periods when other needs supersede active feeding treatment.

Tube Feeding

Children who receive their nutrition solely via tube feedings or utilize tube feedings as a supplemental means of achieving adequate nutrition and hydration may continue to require the care of an interdisciplinary feeding team long term. Goals related to oral motor treatments, respiratory needs, secretion management, bowel and bladder elimination patterns, and comfort accepting feedings or oral hygiene regimens may not be successfully addressed unless there is a team approach. Many of the same team members will play a role in helping the child diagnosed with CP to continue to grow and develop in the absence of oral feeding. Once a tube has been placed, intervention is still appropriate. Interventions that encourage caregivers to engage in socialization during feedings, continued oral practice, and engagement in opportunities to have safe tastes of foods will continue to be a part of the child's program (Arvedson 2013). Allowing for small tastes and oral experiences allow the child to continue to participate in family events and celebrations.

Goals of Treatment

Aligning feeding goals with the results of the assessment and the components of the ICF model will yield a comprehensive and organized

treatment plan to address the multifaceted feeding needs of children with neurological impairment. Goals must be individualized to meet the specific needs of the child and the needs of the family. If the caregiver does not view the goals as relevant, functional, achievable, or measurable, they may not be meaningful to the family. The investigations of specific methods of intervention indicate that there is poor evidence to support one form of treatment over another. Small sample sizes and heterogeneous or individualized interventions and outcome measures yield insufficient support for specific treatment protocols (Arvedson 2013). Therefore, treatment methods and effectiveness may vary widely and are dependent upon the individual responses and needs of the child. Research supports interdisciplinary team management and caregiver training as components of effective treatment for feeding dysfunction. Service providers acting independently without the support of an interdisciplinary team are less successful in addressing the global needs of the child to promote feeding (Arvedson 2013).

Treatment will likely include goals that focus on improving medical, respiratory, postural, and gastrointestinal stability. These goals have a positive impact and support the goals for feeding. Oral motor sensory treatment may be implemented after medical and postural needs are met to focus on safe and enjoyable feeding. Oral motor sensory treatment may involve the direct manipulation, stretching, and stimulation of the oral structures to influence mobility, control, and responses within therapeutic feeding. Spoon clearance, bolus transport, and efficiency of the swallow may also be measured goals. Favoring the quality of the oral motor and feeding responses in treatment over the volume or quantity the child accepts is appropriate to discuss with caregivers. Pushing a child to increase volumes may result in decompensation in skills. When this occurs, the work gained through positive practice and enjoyment of feeding will be lost. Best practice supports initiating treatment at a point in which the child can find success and comfort, before making requests for the acceptance of more challenging feeding and oral motor responses. Additional goals may include protocols for both the feeder and the child. These protocols are developed in conjunction with a psychologist and will address the learned negative behaviors that so often arise when feeding is not comfortable or enjoyable. These protocols may also focus on the acceptance of dry, dipped, and measured volumes on the spoon with strict reinforcement for positive practice, which ultimately will result in a decrease in the child's display of negative disruptions during feeding.

Once the child begins to show consistent and predictable, positive responses, the caregivers may begin to transfer those skills to "snack times." The purpose of providing practice in "snack times" outside of meals at home is to decrease the influence of the increased demands of treatment on what may already be "working" within typical meals. Eventually, newly acquired skills that are well practiced and consistent will become part of mealtime routines. Pushing for carryover of skills that have precarious and inconsistent responses sets up the caregiver for failure and reinforces the ongoing difficulties they have already experienced.

The success of the treatment depends upon ongoing assessment, adjustment of interventions, consistent interaction among team members, and the interplay among the disciplines. Informing all team members of factors impacting treatment, such as changes in medications, formulas, and feeding regimens, will generate ongoing assessment so the entire team will have an understanding of the full impact of such changes on the child's treatment.

Conclusion

Addressing the feeding needs of children and youth with CP is a complex process. Employing a rigorous and thorough assessment process is optimal in promoting a detailed understanding of the child's health condition, body function and structure impairments, activity limitations, and participation restrictions. Also, an understanding of contextual factors (environmental and personal factors) will impact the child's health condition and feeding success. By utilizing the ICF model, a robust plan may be developed to address the

variety of needs that may lead to improved feeding within these children. Considering and prioritizing the needs of the child and involving the family in the decision-making process are essential in creating shared goals. Experiential training and interventions with caregivers will promote carryover and inform decisions made about treatment goals and the care of the child. Treatment must include ongoing assessment of the child's responses in the feeding program, so the results of intervention may be fully understood. Entering into a feeding treatment program with any child, especially one with complex and varied needs, can be daunting for even the most experienced and knowledgeable caregiver. The provision of appropriate supports and meaningful training for caregivers throughout the entire process is essential for improvement. It is important to emphasize that the definition of a successful meal is not an empty plate; it is a mealtime in which both the caregiver and the child engage in safe and enjoyable oral feeding experiences. Those enjoyable and safe feeding experiences are the overarching goal for any child diagnosed with CP and complex feeding needs.

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