

ASSESSMENT AND MANAGEMENT OF SUCKING-SWALLOWING DIFFICULTIES IN NEWBORNS AND INFANTS WITHOUT NEUROMUSCULAR DISEASE

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ABSTRACT

Difficulties in sucking, swallowing and feeding have been extensively studied among the pediatric population with congenital or acquired condition. The severity and variety of signs and symptoms guide in the evaluation and treatment with a relatively low complexity, if the necessary specialists and equipment are available. The confrontation of swallowing and feeding disorders in newborns and infants who do not have neurological, genetic or metabolic conditions becomes a major challenge. Difficulties are related to failures in the safety, efficiency and behavior of the child when feeding. This article reviews the development of feeding, the relation with the digestive air tract and the impact on speech acquisition. Assessment and treatment criteria are also detailed, with emphasis on the management of multidisciplinary teams and active family incorporation.

Key words: swallowing, feeding disorders, infants.

INTRODUCTION

In full term newborns, the functions of breathing and feeding are interdependent from the point of view of the structures involved and the level of neurological integration, which favors the perfect coordination between suction, swallowing and breathing, enabling an appropriate weight and height development, product of obtaining the greatest amount of milk with the lowest energy expenditure, protecting the airway (1).

The feeding process allows for adequate hydration and nutrition, satisfies the requirements for the development of all systems, generates a significant initial bonding experience, and installs early oral motor patterns, necessary for the subsequent development of babble, speech and language (2). Difficulties in feeding and swallowing in the pediatric

population correspond to an emerging problem and are an increasingly frequent reason for consultation. The wide variety, lower frequency and intensity of signs and symptoms presented by newborns and infants without neurological pathology, makes their identification more complex. Although these difficulties do not necessarily impact the quantitative variables of development, they can have a negative impact on the quality of family life. Therefore, it is relevant to have detection elements and refer to a specialized team that intervenes with individualized and effective plans to minimize the negative effects in the short and long term.

Feeding development

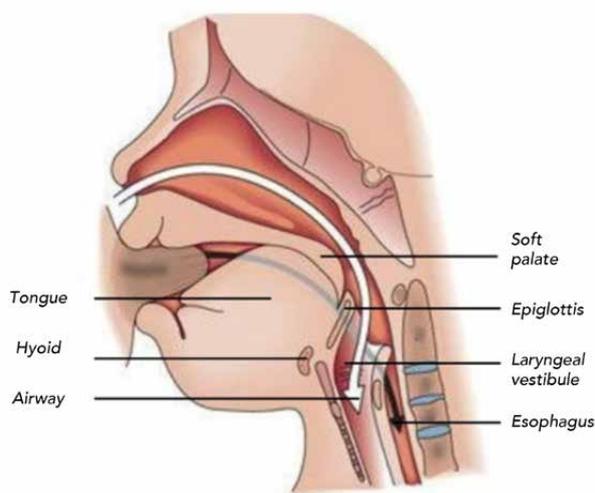
Swallowing is a complex neuromuscular activity with participation of the central and peripheral nervous system. It corresponds to a continuous process, which in the 1980s Dr. Logemann (3) divided into 4 stages: oral preparatory, oral transit, pharyngeal and esophageal. The passage of the bolus of food must be coordinated, safe and effective, so it describes a system of valves located throughout the

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digestive tract, which ensures the passage of the bolus from the mouth to the stomach, protecting the airway. There are two mechanisms of airway protection: central inhibition of breathing, which occurs 100 to 150 ms after the triggering of the oropharyngeal motor response (swallowing reflex), generating apnea by direct action of the brainstem; and the mechanical protection of the airway in the laryngeal zone, produced by the laryngeal ascent, descent of the epiglottis, chordal closure and positive subglottic air pressure (laryngeal vestibule closure) (Figure 1) (4).

Figure 1. Side view of an infant, shows the structures and aerial flow with the white arrow and the flow of milk with the gray arrow.



Suction is the initial and complex motor sensory ability of the newborn, whose function is to provide food in the first months of life, it can be nutritious (NS) when its purpose is to extract milk from the chest or bottle, or non-nutritive (NNS) to regulate the newborn by means of a pacifier or as a stimulation strategy. The sucking reflex occurs from birth to approximately 4 months of age, then it becomes a voluntary activity. The coordination of suction-swallowing with breathing is established at 35 weeks of gestational age (WGA) (5).

Feeding corresponds to the general function that involves the processes of sucking, chewing and swallowing; feeding characteristics; feeding situation and relationship of the child with his feeder.

According to the MINSAL (Chilean Ministry of Health) Feeding guide for children under two (7), exclusive breastfeeding should be tried to be ensured for the first 6 months. Then the start of complementary feeding is

indicated, considering the variables related to neuromotor development and dental eruption, in this way the first foods should be offered in small quantities and gradually increase their volume. As it is a new texture, in general children can show some initial rejection behaviors such as faces, returning with their tongues, spitting and even arching as part of the neophobia (8). The idea is to indicate that the food is offered systematically without obligating. At 8-9 months, when the incisors have come in, pure consistency can be offered, so that at 12 months, associated with the eruption of the first molar, ground foods with a fork can begin to be offered.

From 12 to 24 months, the objective is to incorporate the child into family feeding, beginning with a ground consistency; chopped and in soft pieces. Upon completing the temporary dentition with the eruption of the second molars at 2 years of age, all children with normal neuromuscular development would be able to receive whole foods.

The child's eating behavior will be the product of the experiences of food consumed by the mother, transferred during pregnancy; the link established during breastfeeding; the quantity, variety and opportunity of presentation of food; the ability to offer challenges according to oral sensorimotor development and child feeding interaction.

A newborn or infant who does not feed orally, accumulates the loss of valuable hours of oral motor sensory stimulation and bonding, being able to interfere in the proper development of the global posture, the tone of pharynx structures, dentition and bite, oral reflexes and the formation of the textures, flavors and odors map in the somatosensory cortex. Negative experiences of this process could generate food aversion, alteration of family dynamics, participation difficulties and social isolation (8).

EVALUATION PROCESS

The purpose is to determine the presence of alterations at a safety level, that is, the operation of the airway protection mechanisms; efficiency related to weight/height development as a product of the amount of food ingested and the feeding time, and finally pleasure levels in regards to the set of behaviors that the child shows at the time of feeding.

Regarding the history, it is relevant to know about the nutritional status, diet history, including the route (oral, orogastric/ nasogastric or nasojejunal), consistency, use of utensils and feeding routine, presence of respiratory, cardiac, gastrointestinal or neurological comorbidities (8).

CLINICAL EVALUATION

The clinical evaluation continues with the observation of alertness, postural tone and global psychomotor development, given its relationship with the development of feeding skills. The anatomy of oral structures is analyzed by determining

structural indemnity, tone, sensitivity, strength, scope and coordination of lips, tongue, cheeks, lingual frenulum, teeth, jaw, bite, hard palate, soft palate and tonsils (Figure 2). The most frequent difficulties in oral structure when referring to low muscle tone are hypotonia that hinders the previous oral seal and lingual hypertrophy, which interferes with the bolus transit of foods, losing content due to lingual protrusion. Extra and intraoral tactile sensitivity is assessed directly by touching the perioral and intraoral region, in addition to asking parents about tolerance to tooth brushing or excessive salivation. Gagging associated with brushing indicate intraoral hyperreactivity, while excess drooling after 2 indicates sialorrhea (9).

Figure 2. Clinical examination of anatomical structures involved in feeding. Difficulties in the development of feeding impact on the development of teething and bite. In the figure you can see an alteration in the alignment and dental eruption.



Oral reflexes are genetically programmed to appear and remain until they are integrated into a superior oral function, thanks to systematic sensory exposure.

In premature newborns over 35 WGA we observe the coordination of suction-swallowing breathing looking for signs of safety disturbance, such as prolonged pauses, desaturation, choking, breathing or wet voice. Signs of efficiency are related to resistance during nutritive suction, that is, if the new born manages to maintain the suction-swallowing-breathing activity to ingest the expected milk volume in an adequate time. When it is disturbed (usually by incoordination) prolonged feeding periods are observed accompanied by fatigue; increase in energy expenditure and difficulty in weight gain. When incorporating complementary

feeding, we must include the analysis of the swallowing stages of oral preparatory, oral transit, pharyngeal and esophageal testing with liquids of different viscosity in the bottle, sippy cup, cup and straw; and solid foods of different consistencies such as porridge, chopped and whole, in addition to the use of the utensil according to oral motor sensory development and handling capacity (8).

In regards to the level of pleasure, we must ask for any type of rejection behavior before and during feedings such as: not wanting to sit in the high chair, not wanting to put on the bib, crying, not opening mouth, turning of head, hitting the spoon, keeping food in the oral cavity without swallowing, returning food, arching or even vomiting, these behaviors can be the product of some oral motor sensory difficulty; posttraumatic / reactive or a problem linked with the feeder.

In all cases of suspected food difficulties at any age, the presence of any organic alteration that interferes with the feeding / swallowing process should be ruled out: upper airway obstruction such as tonsil and / or adenoid hypertrophy or hypotonia of the soft palate, which would cause nasal pharyngeal reflux; short sublingual frenulum that could cause difficulties in nutritive suction; alterations of the lingual tone that make it difficult to transport the bolus (characteristic in children with cerebral palsy and Down Syndrome), gastroesophageal reflux disease (GERD) characterized by vomiting in a higher frequency and amount than normal, which could cause aspiration of gastric contents, esophagitis, pain and discomfort when swallowing (10).

INSTRUMENTAL EVALUATION

To complement the study of swallowing function we can use the Videofluoroscopic Swallowing Study (VFS) and the Fiberoptic Endoscopic Evaluation of Swallowing (FEES). Both exams, although different, complement each other.

The VFS (Figure 3) is a dynamic radiological study in which the user is positioned in a normal seat or wheelchair with a relative, in which progressive quantities of liquids with different viscosities, semi-solids and solids, mixed with a contrast agent, usually barium sulfate, are given. The video image shows the performance at each stage of swallowing, the functioning of the airway protective mechanisms, presence and amount of penetration, aspiration and silent aspiration, which is not possible to detect in the clinical examination, independent of the experience of the evaluator; it also allows to evaluate the effectiveness of different maneuvers and compensatory swallowing strategies. It is a complex test with children, they are generally scared and crying, it is important to consider the sedentary posture, avoid head hyperextension and the stage of oral motor sensory development, to offer the right amount, consistency and utensil to avoid false positives (8).

Figure 3. Sequence of lateral swallowing study images by VSS with a bottle. A: oral stage, bolus transport to the pharynx; B: Pharyngeal stage: where the airway protection mechanisms are activated. C: esophageal stage: the bolus is propelled through the esophagus to the stomach.

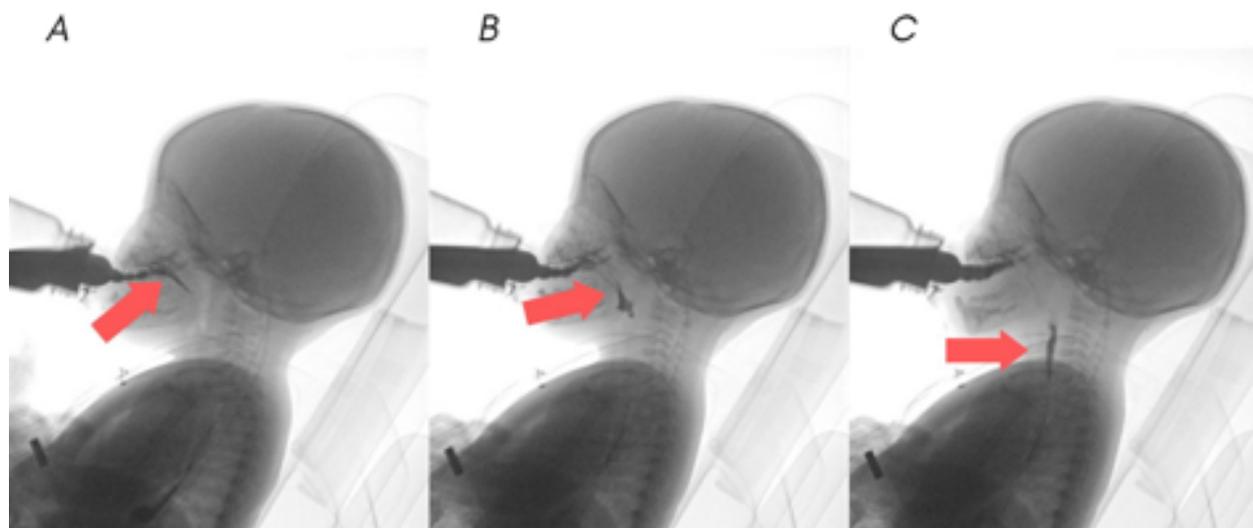
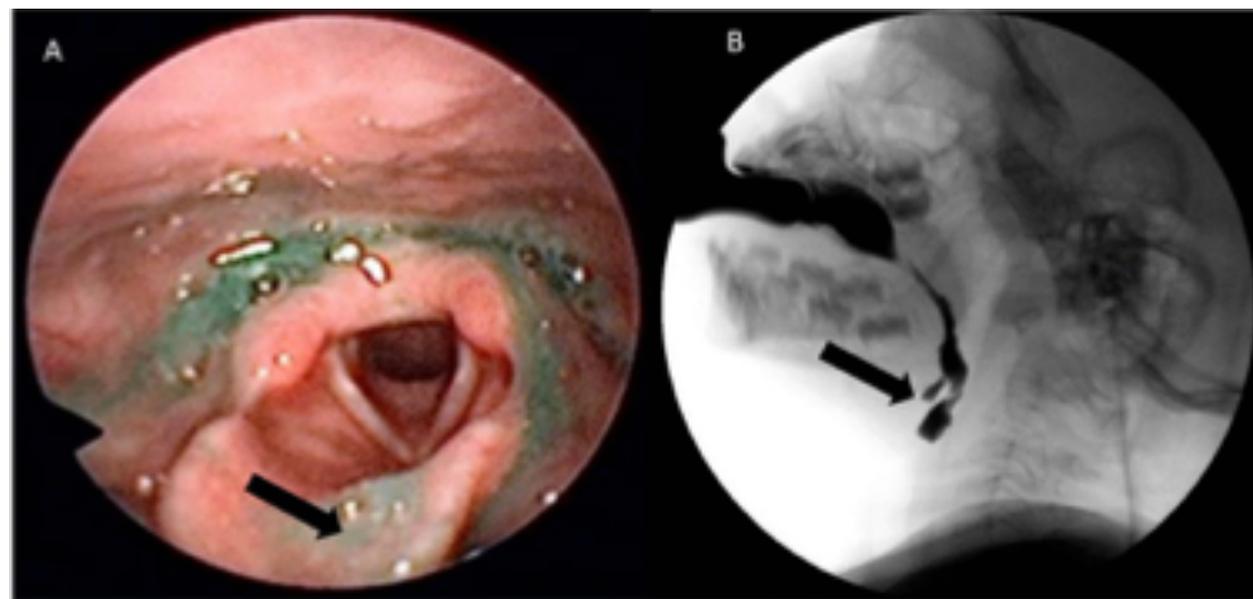


Figure 4. A: Image of a FEES (Fiberoptic endoscopy), saliva is visualized with traces of dye, which penetrates the anterior aspect of the epiglottis (black arrow). B: VFS image showing aspiration of the contrast agent to the airway.



The FEES uses a CCD camera or a fiber optic camera on a flexible tube passed through the nostril, through which a video image of the larynx is obtained, the saliva or food is stained with blue vegetable dye, the pharyngeal swallowing stage is evaluated, having more detailed information on the structure, sensitivity and residue at the pharyngeal level (11). The instrumental evaluation indication should consider the

difficulties of access, costs, radiation exposure (VFC) and discomfort (FEES).

These exams are recommended, after the clinical evaluation by a speech therapist specialist; to objectify suspicion of micro aspiration or aspiration (Figure 4), especially when there is clinical evidence and the route opposes the indication of an alternative feeding route; to

confirm the evolution of the treatment and withdraw the alternative swallowing route.

An instrumental evaluation is not recommended in patients with untreated food aversion, or who are in acute pathology (12).

DIAGNOSTICS

With the information collected in the evaluation process, three diagnostic entities can be considered (Table 1): swallowing disorder (SD), pediatric oropharyngeal dysphagia (POD) and feeding disorder (FD).

Tabla 1. Diagnosis and most frequent causes for each entity. BPD: bronchopulmonary dysplasia, NEC: necrotizing enterocolitis, CP: cerebral palsy, NMS: neuromuscular disease, TBI: traumatic brain injury, PRS: Pierre Robin sequence.

Diagnosis	Most frequent causes
Swallowing Disorder (SD)	Premature Low birth weight Heart disease BPD NEC
Pediatric Oropharyngeal Dysphagia (POD)	Congenital or acquired neurological difficulties (CP, NMS, TBI, meningitis sequelae, etc.) Genopathies (Down syndrome, PRS, CHARGE, DiGeorge, etc.)
Feeding Disorder (FD)	Sensory integration disorders Behavioral and emotional difficulties Long-term disuse of enteral probes

SD is characterized by the lack of coordination between swallowing, suction and breathing. Swallow suction mechanisms that should be sequenced and efficient, are disorganized or do not exist, which results in malfunction, apnea, prolonged feeding periods, signs of fatigue and failure in weight gain. Pre-term newborns with pathologies such as bronchopulmonary dysplasia, persistent ductus arteriosus and necrotizing enterocolitis, are those with the highest prevalence of SD (13).

POD is generally associated with NB and infants with a neurological condition, with a history of dysfunctional feeding, respiratory interurrences and difficulty in weight gain, as a consequence of the presence of airway penetration / aspiration.

One of the most complex detection populations corresponds to newborns and infants with recurrent respiratory disease without neurological damage. We can make erroneous decisions, how to install a gastrostomy (GTT), as a result of a VFS that shows aspiration due to errors in performing the exam, such as when there is poor posture (performing the VFS with the child lying down), crying, excess volume offered or inflammation of structures associated with acute respiratory symptoms. In these cases, it is necessary to consider the complete picture, correlate the history, nutritional level and oral motor sensory performance. It is very unlikely to find an infant without neurological compromise with specific failure in the functioning of the airway protective mechanisms. In this case, if a complete evaluation has been carried out and the aspiration is confirmed, the alternative feeding route should be considered according to the case (14).

With FD, there is generally no commitment from the pharyngeal stage, and its main feature is the difficulty in getting the child to receive the food and swallow it sequentially. It can manifest as a delay of more than 30 minutes in each feeding, rejection behaviors, disruptive behavior before and during meals, lack of consistency management and / or utensils according to the development stage and marked food selectivity and could cause nutritional compromise. A feeding disorder can be developed in a primary way or it can be installed associated with the exclusive and prolonged use of some alternative feeding route (15).

According to the nutritional status, presence and degree of severity of the alteration (s) in the dimensions of safety, efficiency or pleasure, we propose a feeding profile, associated with a diagnosis and recovery prognosis with specialized intervention.

THERAPEUTIC INTERVENTION

It has been shown that an optimal approach is obtained when decisions on the swallowing-feeding of newborns and infants are taken as a team (16). This team should be made up by specialists in neonatology or pediatrics, ENT, bronchopulmonary, gastroenterology, surgery, nutrition, speech therapy, psychology and occupational therapy.

According to the nature of the feeding problem, one of the priority objectives is to determine the feeding route, this can be: oral, by probe (NG-tube or G-tube), or mixed. When the medical team considers an alternative feeding route to be relevant, there must at least be objective information on the functioning of the esophageal sphincters complementing the esophageal transit or Upper gastrointestinal tract radiography (upper GI), along with Ph metry, an upper GI delivers predominantly anatomy information. Ideally, a Ph metry associated with high resolution impedance measurement should be performed. Subsequently, a prognosis of recovery is projected considering the patient's conditions, frequency of care and family support (17).

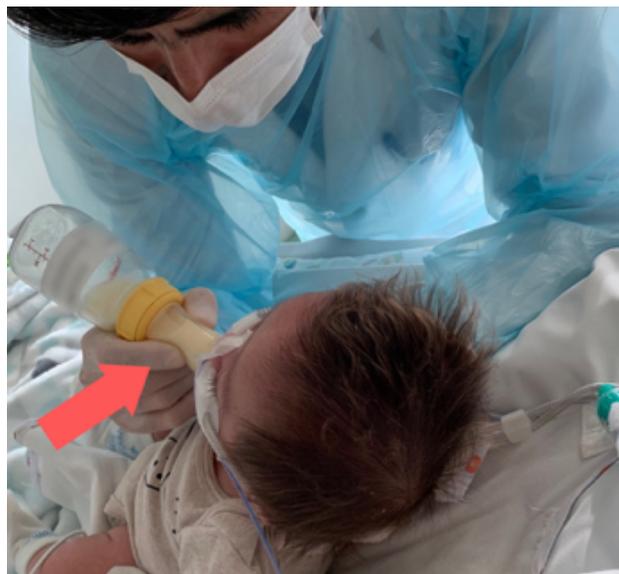
There is no consensus on the deadlines to define the type of alternative route by age range, however it is suggested to contemplate a range of between 3 and 6 months in the case of newborns maintaining an NG-Tube, and between 5

and 10 months in the case of infants subject to variables such as management and probe tolerance; access, frequency and evolution of therapeutic intervention. If, due to the nature of the basic condition, the deadlines exceed those previously stated, a gastrostomy (G-Tube) should be considered.

Any child who is fed exclusively or partially through a tube should be attended by a speech therapist pathologist, who will first design a stimulation plan that includes daily activities to be carried out by the family, to avoid oral motor sensory abnormalities associated with disuse.

In the difficulties of coordination suction-swallowing breathing presented by pre-term newborn, weight gain should be privileged, so that activities that over demand and fatigue are avoided, like trying oral feeding early and for extensive periods. Modulation of oral motor sensory activity is achieved through stimulation of non-nutritive suction stimulation (NNS) for short periods of 3 to 5 minutes before each feeding. At the time of starting the nutritional suction it is possible to use special bottles (Figure 4) in which we can support the milk output by emulating the ejector reflex of the maternal breast (18).

Figura 5. Bottles for children with special needs allow to press the pacifier or the flexible bottle causing the milk to flow, emulating the ejector reflex of the maternal breast, which minimizes the fatigue of the NB and promotes weight gain.



In patients with oropharyngeal dysphagia that micro aspire or aspirate, the intervention contemplates compensatory strategies such as postural management during feeding, fractioning volumes and use of thickeners (in children older than 6 months). As for the facilitating strategies and to begin feeding orally, oral motor sensory stimulation, modulation of the reflex activity, facilitation of

the oropharyngeal motor response is performed and thus the achievement of introducing semi-solids. For the incorporation of solids, chewing is carried out following different steps. The handling of liquids with utensils from the bottle, to a sippy cup, straw, normal cup and bottle is worked (19).

In the intervention of children with eating difficulties who present aversive behavior, the identification of various causal factors such as hyper / hypo sensory response, posttraumatic or reactive and prolonged use of a probe without oral therapy is contemplated. Initial comprehensive intervention is essential, including occupational therapists who are responsible for modulating the overall response to sensory stimuli, activities of daily living and achieve self-feeding. Psychological therapy should also be offered to regulate behavior in the face of feeding, especially when there is a difficulty at a pleasure level, to increase cognitive flexibility and begin systematic desensitization, working with the child and the family environment. Once this state has been achieved, it is possible to intervene effectively from the speech therapist's point of view. Referral to centers where all specialists have experience in handling these types of difficulties is ideal (19).

CONCLUSION

Since swallowing and feeding are complex and multifactorial processes that are conditioned by biological and environmental components, in the pediatric evaluation it is not only necessary to consider quantitative indicators, it is important to inquire about the quality of the feeding situation, identifying signs of alteration of the family dynamics and that can guide a diagnosis that requires a specialized integral intervention. Early detection of these difficulties will minimize the negative impacts of weight/height development, neurocognitive development and eating behavior. The management of the optimal evaluation process involves the participation of multiple specialists that make up a multidisciplinary specialized aerodigestive team. Many feeding and swallowing problems can be handled successfully by being intervened in a timely manner by a team that works in an integrated manner.

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REFERENCES

1. Rendón Macías, M. E., & Meneses, G. J. S. Physiology of nutrient suction in newborns and infants. Medical bulletin of the Children's Hospital of Mexico 2011; 68(4), 319-327. (Fisiología de la succión nutricia en recién nacidos y lactantes. Boletín médico del Hospital Infantil de México) 2011; 68(4), 319-327.
2. Lau, C. Development of suck and swallow mechanisms in infants. Annals of Nutrition and Metabolism 2015; 66(Suppl. 5), 7-14.

3. Logemann, J. A. Evaluation and treatment of swallowing disorders. *American Journal of Speech-Language Pathology* 1994; 3(3), 41-44.
4. Cámpora, H. Falduti, A. Breathing-swallowing: aerodigestive crossroads. Swallowing from A to Z.(Respiración-deglución: encrucijada aerodigestiva. In Deglución de la A a la Z) *Journal*, 2 edition Argentina, 2019, pag 34-44.
5. Kelly, B. N., Huckabee, M. L., Jones, R. D., & Frampton, C. M. The first year of human life: coordinating respiration and nutritive swallowing. *Dysphagia* 2007; 22(1), 37-43.
6. Feeding Guide for Children Under Two, Chile, MINSAL, 2015 (Guía de alimentación del niño(a) menor de dos años, Chile, MINSAL, 2015.)
7. Birch, L., McPhee, L., Shoba, B., Pirok, E. & Steinberg, L. What kind of exposure reduces children's food neophobia? Looking vs. Tasting. , *Appetite* 1987 (9): 171-178.
8. Arvedson, J. C. Assessment of pediatric dysphagia and feeding disorders: clinical and instrumental approaches. *Developmental disabilities research reviews* 2008; 14(2), 118-127.
9. Clavé, P., Terre, R. D., De Kraa, M., & Serra, M. Approaching oropharyngeal dysphagia. *Revista Espanola de Enfermedades Digestivas* 2004; 96(2), 119-131.
10. Lefton-Greif, M. A., & McGrath-Morrow, S. A. Deglutition and respiration: development, coordination, and practical implications. In *Seminars in speech and language* 2007; Vol. 28, No. 03, pp. 166-179. Copyright© 2007 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA..
11. Bacco, R. J. L., Araya, C. F., Flores, G. E., & Peña, J. N. Eating and swallowing disorders in children and young people with cerebral palsy: a multidisciplinary approach. *Medical Journal Clínica (Trastornos de la alimentación y deglución en niños y jóvenes portadores de parálisis cerebral: abordaje multidisciplinario. Revista Médica Clínica Las Condes* 2014; 25(2), 330-342.
12. Dodrill, P., & Gosa, M. M. Pediatric dysphagia: physiology, assessment, and management. *Annals of Nutrition and Metabolism* 2015; 66(Suppl. 5), 24-31.
13. Vargas Sanabria, Andrea Patricia, Torra-Barajas, Oscar Leonardo, Jácome-Pérez, Nathalia, & Sanchez, Claudia Juliana Ramirez. Prevalence of suction-swallowing disorder in preterm infants born at the University Hospital de Santander during 2016 (Prevalencia del trastorno succión-deglución en neonatos pretérmino nacidos en el Hospital Universitario de Santander durante 2016.) *Medicas UIS* 2017; 30(3), 73-81.
14. Arvedson, J. C. Feeding children with cerebral palsy and swallowing difficulties. *European journal of clinical nutrition* 2013; 67(S2), S9.
15. Silverman, A. H. Behavioral management of feeding disorders of childhood. *Annals of Nutrition and Metabolism* 2015; 66(Suppl. 5), 33-42.
16. Sturdivant, C. A collaborative approach to defining neonatal therapy. *Newborn and Infant Nursing Reviews* 2013; 13(1), 23-26.
17. Canales, P. Alternatives to surgery: Nasoyejunal catheter and nasogastric tube. *Pneumol Pediatrician* 2011; 6(2), 72-74. (Alternativas a la cirugía: Sonda nasoyejunal y sonda nasogástrica. *Neumol. Pediatr* 2011; 6(2), 72-74.)
18. Fucile, S., Gisel, E., & Lau, C. Oral stimulation accelerates the transition from tube to oral feeding in preterm infants. *The Journal of pediatrics* 2002; 141(2), 230-236.
19. Bachmeyer, M. H. Treatment of selective and inadequate food intake in children: A review and practical guide. *Behavior Analysis in Practice* 2009; 2(1), 43-50.
20. Harding, C., & Cockerill, H. Managing eating and drinking difficulties (dysphagia) with children who have learning disabilities: What is effective? *Clinical Child Psychology and Psychiatry* 2015; 20(3), 395-405.