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The Dynamic Process of Assessing Infant Feeding Readiness

Elise M. Holloway, MPH, OTR/L, IBCLC

Occupational Therapy Clinical Specialist, Childrens Services, Huntington Memorial Hospital, Pasadena, CA, USA
Occupational Therapy Consultant, Early Start Program, Eastern Los Angeles Regional Center for Developmental Disabilities, Alhambra, CA, USA

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ABSTRACT

For many preterm and convalescing infants in the neonatal intensive care unit, often one of the last barriers to going home is being able to successfully feed from the breast or bottle. Parents frequently ask staff: when will my baby be ready to go to breast or start taking a bottle? In the past, the answer was based on the infant's medical condition and age alone. However, this approach to infant feeding readiness is changing and it is now acknowledged as a dynamic and multifactorial process.

When newborn infants are discharged from the neonatal intensive care unit (NICU) to home with their families, they continue a process of maturation, recovery, and becoming a family member that began in the hospital. One criterion for being discharged to home is the infant's ability to successfully feed, from breast or bottle, so as to sustain growth and development.[1] A challenge for NICU healthcare professionals is determining when any particular infant is ready to begin the oral feeding process that ultimately leads to discharge. While integrating physiologic function and neurobehavioral abilities to successfully feed is a complex process for any infant, it is even more challenging for immature, neurologically compromised, or chronically ill infants.

Research has shown that infants with younger gestational ages or those who have morbidities, such as chronic lung disease, require oral feeding opportunities over a longer period of time before they are consistent in their oral intake.[2–5] The literature reports various strategies for assisting infants to achieve the goal of full oral feedings; but before an interventional approach can be selected, one must determine when an infant is "ready" to begin feeding by bottle or breast. This paper focuses on strategies to determine an infant's readiness for oral feedings. An optimal approach promotes ongoing infant and parent skill development in addition to oral intake volume.

Oral Feeding Readiness Factors

Suck-Swallow-Respiration Coordination

In the past, after an infant achieved cardiopulmonary and thermoregulatory stability, he was deemed "ready" to begin feeding by mouth based on post-menstrual age (PMA) and weight.[6] PMA was selected because of the appreciation that an infant must be mature enough to be able to coordinate his suck-swallow-respiration cycles. Past research indicates that sucking abilities, swallowing function, and their coordination with breathing is maturational, a developmental process. There is a general time frame for the development of these important aspects of feeding. Fetal ultrasound demonstrates that sucking and swallowing first occur as relatively separate actions and over time become inter-related.[6,7]

Effective suck and swallow requires exquisite timing of sequential movement among the lips, tongue, mandible, soft palate, pharynx, larynx, and esophagus. The earliest sucking behaviors usually consist mostly of compression, or what is called positive pressure, on the object being sucked (i.e., finger, pacifier, nipple). Over time, the suck matures from primarily nipple compression to a combination of both nipple compression and suction, negative pressure.[8–11] Suck positive pressure is the result of tongue anterior–posterior movement while elevating to press the nipple against the palate. Suck negative pressure results with the infant's ability to seal off the oral cavity via lip closure and soft palate elevation while enlarging the oral cavity via tongue and mandibular depression. These movements create a vacuum, all during rhythmical tongue anterior–posterior movement. This negative pressure vacuum that is created by tongue and mandibular movement results in suction that draws fluid from the breast or bottle nipple. The tongue then propels the fluid posteriorly in the mouth, eliciting a swallow.[8–11]

Early coordination of suck-swallow begins about 32–34 weeks. With maturation, around 34–37 weeks PMA, the infant becomes more rhythmical, fluid, and efficient in alternating suck positive pressure and negative pressure (i.e., compression and suction components), resulting in improved ability to sustain stronger suck pressures which lead to more effective expression of fluid from the bottle, nipple, and breast.[12–14]

There is some evidence that experience with non-nutritive sucking during gavage feedings promotes growing efficiency of suck-swallow responses; although there continues to be questions about the role of the interplay between overall neurodevelopmental maturation and experience.[15,16] Non-nutritive sucking indicates a certain level of

PO Box 5184, Torrance, CA 90510-5184.
E-mail address: elise.holloway@huntingtonhospital.com.

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sucking maturity but does not necessarily correlate with the nutritive sucking coordination necessary for suck-swallow-breathe synchrony.[11]

As suck efficiency improves, resulting in larger amounts of fluid expressed, another maturational process is taking place: maturation of coordination between suck, swallow, and respiration.[9,11–14] At the end of a suck, the infant transfers expressed breast milk or formula posteriorly in the mouth and then initiates a swallow. Additionally, the infant must integrate this suck-swallow sequence with his respiratory cycles of inspiration and expiration. It has been reported that as infants develop this suck-swallow-respiration sequence, the timing of swallow changes in response to the added respiratory demand.[12] Accomplishing this is a complex challenge for the more immature infant, who may demonstrate either: several continuous suck-swallow sequences associated with inhibition of respiration (frequently called feeding-related or deglutition-induced apnea); or variable timing of respirations ranging from the end of an expiration to the end of an inspiration cycle. Either of these changes in the timing of respiration may result in blood oxygen level desaturation.

In instances when an immature infant's predominant compression sucking patterns limit the amount of fluid that is drawn into the mouth, the smaller amount of liquid adaptively allows him to coordinate his suck-swallow with his respiratory cycles. Even with maturation, feeding-induced apnea is often replaced with suck-swallow bursts with delayed respirations interspersed between the bursts, continuing to result in decreased respiration with resultant oxygen desaturation. Observing infant suck-swallow coordination and swallow-respiration coordination separately has been suggested as a more appropriate manner of determining overall feeding readiness and effectiveness.[11,12]

There are some instances in which an infant's medical condition influences his overall coordination in spite of his ongoing maturation. For example, as they mature, infants with chronic lung disease may demonstrate ongoing difficulties establishing smooth suck-swallow-breathe sequence since the cardiopulmonary demands of feeding interacting with their limited energy reserves make it more challenging for them to regulate the balance between the necessary inhibition of breathing and suck-swallow.[16,17] Some preterm infants have gastroesophageal reflux or demonstrate decreased endurance for the work of feeding due to low energy reserves, either of which may result in suck-swallow-breathe incoordination.

Often the infant behaviors suggesting that medical issues are impacting an infant's feeding overlap. Abrupt changes in state of arousal including shut down, pauses in sucking bursts, longer feeding times, poor self-pacing of sucking bursts, cough, apnea, bradycardia, oxygen desaturation, or aversive behaviors in response to feeding all have been reported.[11] Cautious interpretation is necessary when attempting to understand the reason behind an infant's difficulty with oral feeding and determining an intervention based on that interpretation.

Postural Stability

Infant oral-pharyngeal motor control and integration with respiration are influenced by overall motor tone and postural stability.[9,18] The refined rhythmic, sequential movements of sucking and milk transfer in the mouth, as well as the timing of swallow, require a stable, slightly tucked midline posture provided by the feeder. When an infant expends energy to sustain his body posture or is not positioned in appropriate alignment, the required initiation, sequencing, and timing of oral-pharyngeal movement are influenced, potentially resulting in poorly controlled or inefficient suck-swallow-breathe sequences. When the infant does not need to expend significant energy compensating for an unstable posture, he is better able to coordinate effective sucks and swallows with respiration and to potentially sustain his energy for a more successful feeding experience. Determining feeding readiness from this perspective is based on observing the infant's improved feeding efficiency.

Broader Neurobehavioral Influences

There is a growing number of clinicians and researchers who acknowledge the role that the young infant's overall neurobehavioral organization plays in supporting successful feeding.[3,19–25] They suggest that there is an interaction among an infant's physiological stability, motoric processes, state regulation, ability to process the sensory information that he receives from his physical and social environment, interoceptive feedback, and his feeding abilities. As such, it has been recommended that NICUs move away from monitoring only an infant's suck-swallow-breathe coordination or considering only the amount that an infant can be fed by mouth at any one point in time as the sole factors in determining readiness for oral feeding progression.

Frequently in the NICU, an infant is fed after undergoing caregiving procedures, such as diaper changes or taking vital signs. Caregiving often is viewed as a method for rousing an infant for his feeding time. In addition to the influence of any ongoing medical concerns, to feed successfully he must respond to and recover from those caregiving activities and/or potentially painful procedures by maintaining his physiological stability, regulating his state of arousal, sustaining oral-motor tone and postural alignment, controlling oral-pharyngeal function, and coordinating suck-swallow-respiration cycles. In addition, he must respond to any social-interactive demands that occur during the feeding. The adult feeding the infant may or may not recognize his attempts to maintain his neurobehavioral organization or his need for extra developmental support in any of these realms. An appreciation for the complexity of the neurobehavioral demands inherent in feeding has led some researcher-clinicians to develop strategies that acknowledge these issues when determining infant readiness to feed in general, at any one particular feeding time, and throughout any individual feeding.[3,19–25]

The Synactive Theory,[26] which provides a framework for observing and interpreting young infant neurobehavioral abilities, is generally accepted as an appropriate model for organizing one's understanding of infant behaviors and responses to caregiving. It has been suggested as a method for developing an integrated perspective of infant feeding readiness.[3,20] From this perspective, feeding readiness includes not only cardiorespiratory and thermoregulatory stability and suck-swallow-respiration coordination, but infant ability to regulate waking states, motor responses, and interactive abilities while responding to the offer of a breast or bottle as well as to manage any milk that is expressed.

While eating, an infant is continuously processing sensory information that tells him about his body via his inner ear (vestibular receptors), his muscles/joints (proprioceptive receptors) and his viscera (interoceptors). He also must process environmental information from visual input such as the parent's face or room lighting levels, auditory input such as voices and other nursery sounds, tactile experiences related to caregiving or cuddling, olfactory and gustatory experiences (smell and taste) such as oral care, being held close, or breast and bottle feeding.[3,9,20,27–29] He must be able to regulate his arousal to remain in an awake state and sustain his oral-pharyngeal control in response to this internal and external stimulation, in addition to responding to the feeding demand.

Within this context, the clinician closely watches the infant for indicators of well-regulated functioning during caregiving activities, including feeding. It is when all developmental aspects are in balance that infants then may demonstrate feeding readiness behaviors (see Table 1) such as: sustained arousal, rooting, stretching, hand to mouth activity, and suck-search.[25,30]

The Synactive Theory guides the clinician's observations and interpretation of the infant's behaviors, which then leads to intervention strategies considered to be supportive of feeding success. The feeder using this approach watches the infant prior to, throughout, and after feeding for answers to questions such as: is