Mechanics of Feeding

About this Document

This document is a resource to the course: **Core Measure 7 Optimizing Nutrition**, Lesson*: Mechanics of Feeding*.

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Mechanics of Feeding

The seventh neuroprotective core measure of the Neonatal Integrative Developmental Care Model is “Optimizing Nutrition.” Feedings both by breast and bottle are essential life sustaining activities for infants. Although most premature infants will bottle-feed at some point during their NICU experience, it is a well-known fact that breast milk is the optimal nutrition for NICU infants and any breast milk the infant receives is valuable (AAP, 2012; Phillips, 2012).

Maturational and developmental issues in premature infants affect oral feeding success because only 53 % of brain cortical volume is present at 34 weeks gestation when an infant is just beginning oral feeds (Kinney, 2006). Persistent poor feeding can result in hospital readmissions.

Mechanics of Feeding

Because caregiving has a cumulative effect on each infant, preparation for successful oral feeding begins at birth. Consistent, developmentally supportive care may optimize the medical, neuromotor, neurobehavioral, and oral motor status of the infant, providing an advantage when mastering the difficult task of oral feeding. Safe oral feeding requires adequate maturity and active participation by the infant. “Force feeding” an immature or passive infant increases the risk of physiological instability, disorganized feeding mechanics, potential aspiration, and, sometimes, oral aversions (Hunter & L’Huillier, 2007).

Anatomical Differences between Full-term and Pre-term Infants

A full-term neonate has several anatomical features that support safe and efficient feeding. The anatomical differences of young infants may be summarized as:

- Proportionately large soft-tissue structures
- Relatively small openings
- Shorter passageways of smaller diameter
- Higher resting position of the larynx under the base of the tongue

Changes in these features with growth are balanced by improved neurologic control associated with maturation in infants. The length and diameter of the pharynx and larynx are proportionately shorter and smaller in the infant, which cause the larynx to be higher under the base of the tongue, where the airway receives maximal natural protection. Since the larynx rests higher under the tongue base, it serves as a valve to prevent aspiration into the airway. The hard palate forms the roof of the mouth; the nipple is compressed between the tongue and the hard palate during sucking. Prolonged oral intubation may create a deep groove in the hard palate that interferes with sucking compression. The tongue is elevated and retracted in the preterm infant; therefore, has greater difficulty with forming a midline groove; which collects and controls a bolus of liquid and propels it onward.

Early suckling is enhanced by a relatively large tongue in a small oral cavity and by the added firmness of sucking pads in the cheeks. The tongue, soft palate, and epiglottis are in approximation for the first few months of life, thereby allowing nasal respiration while the liquid bolus is collected in the posterior oral cavity (between soft palate and tongue) and sometimes in part of the anterior pharynx (between the soft palate and epiglottis, in the valleculae) during a sequence of sucks before a swallow (Hunter & L'Huillier, 2007).

Maturational Issues

Many premature infants have difficulty with successful feeding in the neonatal intensive care unit (NICU), and data indicate that premature infants are at increased risk of eating problems even after discharge. Maturational and developmental issues in premature infants affect oral feeding success because only 53 % of brain cortical volume is present at 34 weeks gestation when an infant is just beginning oral feeds (Kinney, 2006). The risk of poor feeding outcomes increases with decreased gestational age (Ross & Browne, 2013). Medical and procedural interventions necessary for treating the hospitalized infant present challenges for the development of successful eating skills in the NICU and may have long-lasting effects on the ability and desire to eat well throughout childhood.

Eating has been described as a neurodevelopmental process that follows a predictable sequence of acquisition of eating skills, and which relies upon the infant's organization of autonomic function, motor and muscle tone and movement patterns, behavioral state, and ability to regulate all of these processes simultaneously (Browne & Ross, 2011). The term "feeding" refers both to the experience and the actions of the caregiver, and the term "eating" refers to the actions of the infant.

The extent of prematurity, severity of illness and the number of medical interventions all are positively correlated with a delay in acquisition of eating skills (Pickler, et al., 2005; Pickler, et al., 2006). While the infant begins to establish a foundation for successful eating within the NICU setting, eating skills continue to develop and new skills must be acquired for the infant to transition to solid food. If the infant was successful at eating sufficient quantities for discharge from NICU to home without the need for supplemental feedings via a nasal-gastric or gastrostomy tube, the staff of the NICU often believe that the infant is not at further risk of feeding problems. Consuming adequate volumes by mouth at discharge does not ensure or predict successful eating after discharge.

Due to immature digestive systems, preterm infants often struggle with achieving adequate nutrient absorption and gut tolerance of feedings (Altimier & Phillips, 2013). These medical issues, coupled with pressure to increase intake for adequate weight gain, often cause feedings (whether oral or tube) to be unpleasant and stressful for the infant. Significant feeding and nutritional problems may persist long after NICU discharge and into childhood (Ross & Browne, 2013; Schmid, et al., 2011).

Feeding method

Feeding method for the infant will depend on the infant's gestational age, weight, clinical condition, and the experience of the nursing staff (AAP Committee on Nutrition 2012). Transition to oral feeding should not be an "all or none" endeavor. Initially a five-minute quality feeding may be all the new feeder can manage competently and that might be considered successful. The suck and swallow reflex develops by 32-34 weeks gestation for most infants, the coordination of this pattern with respirations begins around 35-36 weeks gestation (Anderson, 2014).

Over the past decade, an increasing percentage of NICU's are using evidence-based practices to move away from a "traditional" feeding approach (where a relatively stable preterm infant who has reached a certain age or weight is expected to consume a preset volume of milk within a preset time frame). Individual infant readiness and performance now more often guide caregivers in initiation and progression of oral feedings. Feedings are typically still based on a set number of calories and fluid volume per kilogram of body weight, but in many NICU's oral feedings are no longer given on a set schedule around the clock because infants mature at different rates, and developing biorhythms may not coincide with the NICU clock. Too often, the result of strict feeding schedules has resulted in feeds given when the infant is not ready to participate; consequently a caregiver may manipulate and stimulate and use techniques to "force" completion of a feeding. Forceful tactics, however, can decrease feeding safety and promote the development of oral aversions (Hunter, Lee, & Altimier, 2014).

Patterns of Sucking

Sucking and swallowing develop in the third trimester (McGrath & Braescu, 2004). Physiologic maturation appears to have a greater influence on the development of nutritive sucking (NS) abilities and swallowing than "experience" with bottle feeding, although there is evidence to support experience playing a complementary role in the development of NS (Pickler, Best, & Crosson, 2008). The swallowing reflex is not completely functional until 34 weeks PMA. NS can be demonstrated in infants by 26 weeks, but a rhythmic pattern is not developed until 32 – 34 weeks. True synchrony of suck, swallow, and breath in a 1:1:1 pattern does not occur until 36 – 38 weeks PMA (McGrath, Medhoff-Cooper, Hardy, & Darcy, 2010).

Non-nutritive sucking (NNS)

Non-nutritive sucking or "dry" sucking without fluid, such as on a fist or pacifier/dummy, is present but disorganized in infants younger than 30 weeks; sucking rhythm generally improves by 30 to 32 weeks' post-conception. Because non-nutritive sucking does not interrupt breathing, it is usually (but not always) established before an infant has the neurologic maturation to coordinate sucking with swallows and breathing. Clinically, the presence of a rhythmic non-nutritive suck does not guarantee that an infant will orally feed well, and some infants with a poor non-nutritive suck may actually feed without difficulty (Hunter, Lee, & Altimier, 2014).

NNS has been described as a self-soothing activity. Benefits of NNS have been summarized as increased oxygenation, faster transition to nipple feeding, and better bottle-feeding performance. Infants who engage in NNS during tube feeding experience:

- Less time in fussy and awake states
- Quicker settling after feedings
- Less defensive behaviors during tube feeding
- A significantly decreased hospital stay.

An evidence-based systematic review on the effects of oral motor interventions on feeding demonstrated that NNS was consistently associated with significant positive changes on measures of swallowing physiology and reducing the number of days to reach total oral feeding in preterm infants (Arvedson, et. al 2010).

Nutritive Sucking

Nutritive sucking is stimulated by the presence of fluid that must be swallowed; suck and swallow must be coordinated with breathing. Nutritive sucking patterns (Palmer, 1993; Meier & Palmer, 1994) are typically characterized as:

- Mature Sucking Pattern
- Immature Sucking Pattern
- Transitional (Disorganized) Sucking Pattern
- Dysfunctional Sucking Pattern

Infants with organized sucking patterns (mature or immature) that can coordinate sucks and swallows with breathing are generally safe feeders when behavioral cues are respected. Transitional or disorganized feeding patterns are common in preterm or ill NICU infants learning to orally feeding; these infants have difficulty coordinating sucks and swallows with breathing, and benefit from caregiver interventions such as slow-flow nipples and pacing to force breaks for breathing (Hunter, Lee & Altimier, 2014).

Instead of having the 1:1:1 or 2:1:1 suck-swallow-breathe coordination seen in term babies, infants with an immature sucking pattern often cluster three to five sucks together while holding their breath, swallow the accumulated bolus, then cluster several rapid recovery breaths. Observed in healthy preterm infants as young as 32 ½ weeks, this pattern is slower and not as efficient as mature sucking, but is may appear organized, as sucks and swallows alternate with breathing in a coordinated manner. Breath-holding during sucking is believed to be related to the infant's instinct to protect the airway from penetration by the liquid bolus (Hunter, Lee, & Altimier, 2014).

Oral feeding compromises oxygenation and ventilation during nutritive sucking because the airway briefly closes during every reflexive swallow. This compromise is more significant during continuous sucking than during intermittent sucking, and worse with an indwelling oro/nasogastric tube. Preterm and ill infants frequently demonstrate physiologic and neurologic immaturity, respiratory compromise, disorganized sucking, and inadequate endurance (Amaizu et al 2008). Disorganized sucking and breathing often persist in the infant with chronic lung disease because the need to breathe supersedes the infant's efforts to suck.

Improvement in feeding-induced apnea, often associated with multiple swallows without breathing, appears to correlate more with advancing age (maturation) than with practice. Traditionally this has been interpreted to mean that additional time to mature is more beneficial than more frequent opportunities to "practice" oral feeding for younger preterm infants (Hunter, Lee, & Altimier, 2014). Initiation of bottle feeding at 30 to 33 weeks' postcenceptual age (PCA) has increased in some NICU’s, but the possibility of silent aspiration during bottle feeding at 30 to 32 weeks' PCA has not been studied with definitive modified barium swallow studies and therefore the ultimate safety of these early feedings is not known (Laptook, et al., 2005; Samara, Marlow, & Wolke, 2008; Hunter, Lee, & Altimier, 2014).

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