CHAPTER 3

Infant Anatomy and Physiology for Feeding

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OBJECTIVES

- Describe and assess infant orofacial structures and identify abnormal presentations.
- Identify infant reflexes related to feeding and describe abnormal presentations.
- Describe infant motor functions for sucking and swallowing.

DEFINITIONS OF COMMONLY USED TERMS

ankyloglossia A condition involving an atypically short, thick, or tight frenulum that tethers the bottom of the tongue to the floor of the mouth, restricting the range of motion of the tongue.
cleft Abnormal fissure or opening resulting from failure of fusion during embryonic development; used in this chapter to describe cleft lip or palate.
dysphagia Swallowing disorder characterized by difficulties swallowing foods or liquids.
dysrhythmic Having an irregular rhythm.
frenectomy Resection of the lingual frenulum to improve tongue movement.
frenotomy Release of the tongue by revising the lingual frenulum with scissors.
frenulum A small fold of tissue that helps secure or restrict the movement of a semimobile body part. Frenula can be found throughout the body, but in the oral cavity, it is located under the tongue and between the upper lip and gums (maxillary gingiva) medially.
hypertonia A condition of muscle rigidity or too much (increased) muscle tone.
hypotonia A condition of muscle flaccidity or decreased muscle tone.
macroglossia An abnormally large tongue.
micrognathia A condition of having a smaller than normal lower jaw.

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DEFINITIONS OF COMMONLY USED TERMS *(continued)*

Pierre Robin sequence A sequence of abnormalities beginning in utero, primarily consisting of a small lower jaw (micrognathia), a retracted or displaced tongue (glossoptosis), and airway obstruction. A majority of the time, cleft palate occurs as part of this sequence.

peristaltic A term commonly used by lactation consultants and feeding therapists to describe the wavelike motion of the tongue which assists in removing milk from the nipple and facilitates swallowing.

retrognathia A condition of having a recession of one or both of the jaws (mandible and the maxilla), but more commonly the lower jaw (mandible).

Overview

This chapter provides an overview of the structures and functions of an infant's face and mouth, with an emphasis on their roles in the process of breastfeeding. It outlines typical and atypical presentations of anatomy and function and their impact on feeding-related behaviors. Infant reflexes and the suck–swallow–breathe pattern that is integral to infant feeding are also discussed to provide a comprehensive understanding of infant anatomy and physiology.

Any use of the term *mother*, *maternal*, or *breastfeeding* is not meant to exclude transgender or nonbinary parents who may be breastfeeding their infant.

I. Oral Assessment of the Infant

A. An oral assessment of the breastfeeding infant begins following global assessments of the infant's tone and color, state, behavior, symmetry, and respiration.

B. The oral assessment focuses on the following elements:
   1. Observation of the infant's orofacial anatomy
   2. Identification of deviations in infant oral anatomy and consideration of how those deviations may contribute to dysfunctional or poor feeding behaviors
   3. Observation of the infant's feeding reflexes and identification of abnormal presentations
   4. Observation of the effectiveness of feeding (i.e., suck–swallow–breathe coordination)
   5. Observation of the "fit" between the infant's mouth and the nipple

II. Anatomy of the Infant's Oral Cavity

A. Feeding, respiration, dentition, and speech are influenced by the anatomy of the mouth. Feeding is further affected by the tone and functioning of the muscles of the face, neck, and trunk.
   1. Some aspects of infant orofacial structure and function vary from typical presentations as a result of various factors, including prematurity, minor injuries (e.g., traumatic birth process), congenital malformation, neurological deficits, and illness.
   2. Variations or abnormalities in the orofacial structure or function can negatively affect breastfeeding. The presence of risk factors indicates the need for a more focused assessment, and they increase the potential need for lactation support.[1,2]

B. The lips assist the tongue in drawing in the nipple and stabilizing it in the mouth.[2]
   1. Typically, lips are intact with no evidence of a cleft; they appear mobile, well defined, and expressive. A bow-shaped upper lip with a well-defined philtrum generally indicates a typical presentation.
   2. The lips remain in a neutral position (neither retracted nor overly flanged) and seal smoothly around the breast during breastfeeding.
   3. Abnormal presentations include the following:
      a. Hypotonic (abnormally low muscle tone) lips:
         i. Hypotonia or weakness, often due to prematurity, neuromuscular deficits, or illness, may result in a weakened ability to maintain a lip seal around the breast. This may impact the

amount of suction the infant can generate and increase the work of feeding, contributing to milk loss and fatigue as feedings progress.

b. Hypertonic (abnormally high muscle tone) lips or overuse of lips:
   i. Hypertonic lips, or even a reliance on increased lip activity to hold the breast in the mouth, may reflect a neurological abnormality or injury of the tongue, jaws, or facial nerves.[3]
   ii. Increased lip activity while breastfeeding may be compensatory due to muscular weakness in the cheeks, jaw, or tongue, or reduced lingual or labial mobility secondary to a tight labial frenulum or ankyloglossia (i.e., tongue-tie).
   iii. Restricted lip movement may be sensory in nature (i.e., hypo- or hypersensitive).[4]

c. Tethered maxillary frenulum, commonly referred to as an *upper* or *superior* labial frenulum (tightness or thickness in the band of tissue that attaches the upper lip to the upper gum):
   i. This is classified as a minor midline congenital defect. A tight or thick labial frenulum exhibiting low-lying attachment with restriction may affect dentition (e.g., may create a diastema, or gap, between the front teeth) and increase the risk of dental caries.[5]
   ii. If the maxillary frenulum is nonelastic and restricts labial movement, it may contribute to lip *curling*, reduced mobility, or a poor seal during breastfeeding. This may add to latch difficulties, causing friction trauma to the nipples and potentially reducing the overall transfer of milk.[5-8] Research in this area is limited but ongoing.
   iii. Treatment may be warranted if restriction is noted along with apparent breastfeeding or dental difficulties and the cause of the restriction is determined to be from the tethered labial frenulum. If a restriction is present with no apparent dental or breastfeeding difficulties, treatment is most likely not warranted.[5-8]

d. Cleft lip (a fissure or opening, in the upper lip that may extend into the nose; may be unilateral or bilateral):
   i. A cleft lip is a congenital midline defect that is generally repaired in the first few months of life.
   ii. It is the second most-common birth defect in the United States.[9]
   iii. Cleft lip often does not significantly interfere with breastfeeding[10] when proper support and assistance with optimal positioning are provided.

4. Assess the lips to observe for shape and positioning during feedings.
   a. Properly position the infant and observe for the presence of a possible tight maxillary frenulum by gently lifting the upper lip. Observe for blanching of the frenulum, attachment of the frenulum at the gum line, and overall tension (i.e., reduced lip movement).[6]
   b. Apply gentle digital pressure against the lips; there should be some resistance.
   c. Observe an entire feeding to determine whether the infant can seal the lips smoothly around the breast and maintain the seal during feeding without evidence of early fatigue.
      i. Listen for breaks in the seal while the infant feeds. Abnormal tongue movements and abnormally wide jaw excursions can cause breaks in the lip seal. Although these factors do not directly involve the lips, they can affect the lip seal.
      ii. Observe for lip retraction and lip tremors.
      iii. Observe for leaking milk (during breast and alternative feeding).
   d. Assess for other events related to the lips.
      i. Observe the infant while crying for signs of neonatal asymmetric crying facies, which is a relatively common condition (1 per 160 live births) that is marked by asymmetrical lip movement seen when the infant cries.[11]
      ii. Determine if sucking blisters are present. Sucking blisters are believed to be caused by friction resulting from retracted lips during breastfeeding or by a tight maxillary frenulum that restricts upper lip mobility. Blisters may also be secondary to other causes, such as a tight lingual frenulum (tongue-tie) or hypertonia.

5. Methods of assisting when the feeding problem results from structural abnormalities or abnormal tone of the lips include the following:
   a. Provide firm pressure stimulus (i.e., tapping) on the lips prior to feeding to improve tone and strengthen the lip seal.[12]

b. Insert a clean finger or a round, somewhat firm pacifier, then partially pull it out of the infant's mouth to induce the infant to pull it back. This resistance training exercise may lead to improved strength in the lips and other oral musculature, which may facilitate improved breastfeeding.
c. Observe the infant for stress cues when engaging in these activities (see Chapter 4, *Normal Infant Behavior*). Discontinue attempts when the infant becomes fatigued or distressed so the experience stays positive.
d. When a cleft lip is present, teach the parent to use a finger or shape the breast tissue to seal the cleft.
    i. If the infant prefers one breast over the other, guide the parent to slide the infant to the other breast without repositioning the infant. Use pillows for support as needed.
    ii. Communicate with cleft lip and palate teams to facilitate support for breastfeeding.
    iii. Share research that documents the fact that postoperative breastfeeding after cleft lip repair is safe and results in better weight gain than bottle feeding.[13]
e. If the upper lip is observed to curl or tuck under during feeding, demonstrate to the parent how to use a fingertip to gently flip out the baby's upper lip to improve the seal on the breast. The parent can manually return the lip to the neutral position as often as needed, especially if lip retraction causes nipple pain or reduces the seal on the breast.
f. If a tight labial frenulum appears to require a release to facilitate breastfeeding, provide referrals to appropriate specialists for evaluation.
g. Reassure parents that feeding skills typically improve with maturity and growth. Pumping or hand expression may be necessary to maintain milk production during this time.
h. Provide a referral to a speech-language pathologist or occupational therapist who specializes in infant feeding and has additional knowledge about breastfeeding and lactation. The feeding therapist can provide an assessment and remediation as needed for difficulties that are unresolved or fall outside the lactation consultant's scope of practice.

C. The buccal pads, or subcutaneous fat deposits in the cheeks, help provide structural support for an infant's oral and pharyngeal activity.[1,2]
1. Low facial tone or poorly developed buccal pads, due to prematurity or low birth weight, can result in difficulty creating or sustaining adequate levels of suction for feeding.
2. Abnormal presentations of the cheeks include hypotonia and thin cheeks.
    a. Facial hypotonia can contribute to decreased cheek stability due to decreased resistance against pressure, which can further hinder the seal on the breast.
    b. Thin cheeks (i.e., underdeveloped buccal fat pads or musculature) can contribute to decreased cheek stability due to increased intraoral space. As a result, the infant must create a greater vacuum to generate and sustain suction, further increasing the work of feeding. The infant can become fatigued before the feeding is complete.
3. An assessment of the cheeks includes the following[2,14]:
    a. Assess the buccal pads in the cheeks by placing a gloved finger inside the infant's mouth and placing a thumb on the outside of the cheek to sense the thickness of the fat pads. In babies with thin cheeks, the finger and thumb almost touch.
    b. Observe the shape of the cheeks at rest and during feeding.
        i. Look for deep creases under the infant's eyes; these are a marker for thin cheeks.
        ii. If the cheeks are weak, thin, or unstable, they will collapse while the baby sucks. Identify any cheek collapsing by looking for dimples.
    c. Observe the overall efficiency of the feeding and signs of fatigue, such as reduced active sucking and swallowing or early discontinuation of feeding, such as falling asleep early during the feeding.
    d. Early discontinuation of feeds secondary to fatigue is a risk factor for poor infant intake and poor stimulation of milk production. Test weights, or weighted feeds, with an appropriate digital scale can be useful, when conducted properly, to help reveal the entire breastfeeding picture.[15,16]
4. Methods of assisting when feeding problems or slow growth result from thin cheeks, reduced cheek strength, or low facial muscle tone include the following:
    a. Use the Dancer hold to provide external cheek support during feeding. Teach parents how to support the breast while supporting the infant's jaw and cheeks during feeding to improve stability.[16] (See Chapter 24, *Breastfeeding Devices and Topical Treatments,* for information about the Dancer hold.)

b. Closely monitor the infant's weight gain and overall growth. Provide supplementary feedings as necessary, ideally with expressed milk, to improve infant growth. As the fat pads develop in the cheeks, the cheek stability may improve, which can lead to an improvement in breastfeeding skills and infant growth.

D. The jaw provides stability for movements of the tongue, lips, and cheeks.[2,13,16,17]
   1. Normal jaw movements are neither too wide nor too narrow during feeding, and they are smooth and graded.
   2. Preterm infants often exhibit jaw instability due to immature or underdeveloped muscles and hypotonia.
   3. Abnormal presentations of the jaw include the following:
      a. Micrognathia (abnormally small lower jaw) and retrognathia (abnormally receding lower jaw) can be familial. They are associated with chromosomal disorders or can result from intrauterine positioning that prevents the jaw from growing larger or moving forward (as in certain breech presentations).
         i. Some degree of mandibular retrognathia is characteristic in infants. Dramatic forward growth usually occurs during the first few months of life.[18]
         ii. Severe micrognathia or retrognathia positions the tongue posteriorly, where it can obstruct the airway, as in Pierre Robin sequence.[19]
         iii. A receding jaw can contribute to nipple pain, nipple damage, or latch difficulties. Tipping the infant's head back in a slightly extended position may bring the chin closer to the breast and help attain a more comfortable latch.
         iv. Jaw asymmetry contributes to poor jaw function and unstable feeding, including difficulty or inability to breastfeed. It can be caused by birth trauma, congenital or acquired torticollis, injury, paralysis, breech position, or structural deformity.[20] Note how the face of the infant in **FIGURE 3-1** droops to the right. Jaw asymmetry and low facial tone can contribute to inefficient feeding and failure to thrive.
      b. In abnormally wide jaw excursions, poor grading of the jaw movements can cause breaks in the seal formed at the breast, resulting in loss of suction and increased work of feeding that can affect overall milk intake.
      c. Infants may clench their jaws to manage rapid milk flow; however, jaw clenching can also be a sign of hypertonia or weakness in a different area (e.g., poor tongue or lip function). Jaw clenching can contribute to nipple pain and damage.
   4. An assessment of the jaws should include the following:
      a. Observe for asymmetry.
      b. Identify micrognathia or retrognathia.
      c. Observe breastfeeding to identify jaw grading, clenching, or tremors.

FIGURE 3-1 Facial asymmetry and low facial tone.

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d. Insert a gloved pinkie finger in the corner of the infant's mouth between the posterior gum pads.
   i. Count the number of reflexive bites (chews) elicited.
   ii. The infant should respond with approximately 10 little chews on each side.
   iii. Observe for difficulty producing these reflexive bites or for infant stress cues during this assessment.
   iv. Weakness of the jaw is revealed by an inability to perform the activity.[17]

5. Methods of assisting when a feeding problem relates to abnormalities, weakness, or injury involving the jaws include the following:
   a. Provide external jaw support with a finger placed under the bony part of the lower jaw to control and stabilize the distance of jaw excursions while breastfeeding.
   b. Work carefully to identify feeding positions that emphasize postural stability.
      i. Hip flexion and stabilization of the infant's trunk facilitates stable feeding.[21]
      ii. Position the infant carefully and maintain head extension as a strategy to bring the lower jaw closer to the breast.
   c. Exercise the jaws several times a day, using the same assessment method described previously to elicit an increased number of reflexive bites. Avoid stressing the infant.
   d. Refer the infant for physical therapy or bodywork (e.g., chiropractic care, craniosacral therapy, myofascial release) if issues relating to abnormal muscular tension impinge on jaw activity.
   e. Refer the infant for speech or occupational therapy for assessment and remediation as needed for feeding difficulties that do not resolve with intervention or fall outside the lactation consultant's scope of practice.

E. The tongue helps the lips draw the nipple into the oral cavity, sealing the cavity to maintain suction. It also forms a central groove that provides a channel to organize the bolus of milk for safe swallowing, and it aids suck–swallow–breathe coordination.[2,17,22,23]
   1. The neonatal tongue typically presents with less fat and soft tissue than an adult tongue. Its musculature also differs from that of the adult tongue in ways that appear to be specialized for suckling.
   2. Many professionals who work with infants believe the position of the tongue at rest and while feeding shapes the structures in the mouth, particularly the hard palate, which may further impact dentition and speech.[24] Additional research is needed in this area.
   3. As part of the suckling cycle, tongue movement in conjunction with mandible oscillation generates adequate negative intraoral pressure in the oral cavity while the peristaltic or wave-like movements of the posterior portion of the tongue aid in coordinating swallowing and breathing.[22,25-27]
      a. The tongue must be able to elevate freely and to compress and elongate the nipple against the hard palate so that with each subsequent lowering of the tongue, an adequate enlargement of the oral cavity generates negative pressure.[22]
      b. The tongue tip extends over the lower gum ridge, providing a degree of padding during breastfeeding that helps protect the nipples while allowing the infant to compress the areola. The tongue must also extend, draw in the nipple, and stabilize it against the palate.
   4. When the tongue moves improperly, the infant may not be able to maintain an optimal seal on the breast and often cannot suck, swallow, and breathe in a coordinated, efficient manner.
      a. The work of feeding increases in such cases, putting the infant at risk for early discontinuation of feedings and limited intake, secondary to inefficient or uncoordinated feeding and fatigue.
      b. Limitations in the mobility or strength of the tongue require the infant to use compensatory activities (e.g., jaw clenching or lip retraction) to feed, which often damage the nipples.
   5. Abnormal presentations of the tongue include the following:
      a. Ankyloglossia, or tongue-tie, is a congenital midline anomaly in which the lingual frenulum, a membrane extending from the floor of the mouth to the underside of the tongue, is tight or thick and limits the tongue's range of motion.[28,29]
         i. In tongue-ties with anterior attachment, there is typically a heart-shaped indented appearance to the tongue tip at rest or with extension. Tongue-ties with posterior attachment

can be more difficult to visualize; they may also interfere with breastfeeding if they affect tongue mobility and range of motion.[6,30-32]

ii. The incidence of ankyloglossia ranges from 0.02 to 10.7 percent of infants, occurring more commonly in males.[31] It is theorized that the incidence would be higher if studies included posterior tongue-ties, but this claim has not been substantiated.

iii. Typically, ankyloglossia is an isolated anatomic variation and can run in families. Current discussions exist regarding the potential connection between ankyloglossia and specific gene mutations, but additional research is needed.

iv. Ankyloglossia appears with increased frequency in association with various congenital syndromes and other midline defects.[28,33]

v. Approximately 50 percent of infants diagnosed with ankyloglossia can breastfeed without difficulty.[31] In other cases, ankyloglossia may negatively impact comfort during breastfeeding. Ankyloglossia may decrease milk transfer, which can then impact milk production and the infant's milk intake and growth.[6,32,34,35]

vi. Either frenotomy (simple release achieved by revising the lingual frenulum) or frenectomy (resection of the tongue) may be curative by changing the latching abilities and sucking dynamics of the breastfeeding infant.[6,36] There are currently no in-depth studies comparing outcomes using various techniques.

- Frenotomy is often performed without anesthesia as an in-office procedure and has a high satisfaction rate and few complications.[37,38]
- Laser frenectomy is a simple in-office procedure that is performed with or without local anesthesia. This technique is commonly utilized by pediatricians, otolaryngologists, and dentists. It is considered a safe alternative to scissors,[6] with more predictable results and fewer postoperative complications.[36]

b. A bunched or retracted tongue can be caused by a traumatic birth process, tightness and asymmetries (e.g., torticollis), ankyloglossia, hypertonia, and the early introduction of bottles for some infants.

c. Tongue protrusion may result from abnormal tongue development such as macroglossia (an abnormally large tongue) or hypotonia (as in Down syndrome, or trisomy 21). Tongue protrusion contributes to poor coordination of sucking and swallowing.

d. Tongue-tip elevation is an adaptive compensatory behavior that can make latching to the breast frustrating and difficult. It is often seen in babies who were born prematurely, experienced birth trauma, or present with hypotonia, ankyloglossia, or respiratory involvement. This behavior may be associated with airway protection, increased work of breathing, or increased respiratory rate, especially in the preterm infant.[39,40]

e. Tongue asymmetry can result from injury (e.g., forceps trauma resulting in damage to the nerves controlling the tongue)[3] or central nervous system involvement (e.g., cerebral palsy). Tongue asymmetry may also be associated with syndromic conditions, and it can be seen in infants with torticollis secondary to positioning in utero or a traumatic birth process.

6. An assessment of the tongue should consider the following:

a. Sometimes a poor infant head position during feeding negatively influences the tongue position. Correct the positioning at the breast before evaluating the tongue during feeding.

b. While the infant is breastfeeding, gently pull the breast away from the cheek and observe the corners of the lips. While breastfeeding, the tongue is visibly cupped at the corners of the mouth, helping the lips form a seal to preserve suction.

c. Listen for breaks in the seal, which cause clicking or smacking sounds.

i. A weak tongue or a tongue with reduced mobility (such as tongue-tie) can interfere with maintaining a seal at the breast; however, a typical infant who is struggling with rapid milk flow may deliberately break the seal at the breast.

ii. In a compromised infant, clicking or smacking sounds often mean the tongue has lost contact with the breast (e.g., intermittent loss of suction). A visual assessment of the tongue shape and position at rest, or when the infant is crying, may provide additional information regarding tongue-tie and other abnormal presentations.

d. Examine the tongue's function using gentle pressure of a clean, gloved fingertip to the surface of the tongue at the midsection.
   i. There should be some resistance to gentle pressure, and the examiner should sense the tongue pressing up against the finger.
   ii. The insertion of a finger and the gentle placement of a finger pad against the roof of the mouth should elicit sealing and sucking. Sense whether the tongue extends and cups around the finger, with an anterior-to-posterior peristaltic, rhythmic movement of the tongue.

e. With the baby's mouth open wide, observe the elevation of the tongue past the midline of the mouth; it is ideal to observe when the baby is crying. A limited elevation suggests possible ankyloglossia, even without visualization of an overtly anteriorly attached lingual frenulum.[30]

f. Observe the tongue extension by tapping the tongue tip or by rubbing the bottom gums to elicit tongue protrusion. Some infants may even imitate tongue extension. Notice whether the infant can extend the tongue beyond the gum, and ideally the lower lip line. An inhibition of extension may suggest ankyloglossia.

g. Observe tongue lateralization by providing a stimulus to the left and right bottom gums. The tongue should lateralize toward the examiner's finger as it moves from side to side. Limited lateralization, or twisting of the tongue with lateralization, may suggest ankyloglossia.

7. Methods of assisting when a feeding problem results from dysfunction or anomalies of the tongue include the following:
   a. Specific oral motor exercises, such as resistance training with a finger or pacifier, may be appropriate depending on the presentation of symptoms and the infant's response to exercises.
   b. Short, frequent feedings provide recovery time if the infant exhibits fatigue during feedings or if feedings are prolonged.
   c. Positioning the infant with the head in extension brings the lower jaw close in to the breast. Reducing the distance that a short or restricted tongue must reach to extend over the lower gum ridge can help protect the nipples from trauma and help the infant to more readily access the breast.
   d. Inform the parent of ways to treat sore or damaged nipples (e.g., topical treatment to heal damage and help avoid infection).
   e. Refer the infant to a specialist for evaluation to release ankyloglossia. Appropriate specialists include pediatricians, family practice doctors, pediatric otolaryngologists, or pediatric dentists.
   f. It may be appropriate to refer the infant to a speech or occupational therapist specializing in infant feeding. This professional can facilitate improved function if the tongue is weak, uncoordinated, or dysfunctional secondary to injury, paralysis, a genetic condition, or if the infant is recovering from a frenotomy or frenectomy and improvements are not seen with traditional interventions.
   g. Reassure the parents that although some infants exhibit immediate improvements in feeding skills following tongue-tie revisions, other infants require longer recovery times.
   h. Supplement feedings with expressed milk if needed to stabilize infant growth and protect milk production as long as necessary.

F. The infant's hard and soft palate play an integral role in effective milk transfer.[2,41-46]
   1. The hard palate assists with positioning and stability of the nipple within the mouth.
      a. The hard palate should be intact with no evidence of a cleft. Its slope should be moderate and smooth, approximating the shape of the tongue.
      b. Small, round, white cysts (Epstein pearls; see **FIGURE 3-2**) are often observed along the ridge of the hard palate and occasionally along the gums, where they may resemble teeth. Although they are sometimes mistaken for oral thrush, these cysts are benign, resolve around 2 months of age, and do not interfere with feeding.[25]
   2. The soft palate creates the posterior seal of the oral cavity in conjunction with the tongue, allowing suction to occur.
      a. The soft palate should elevate during swallowing.
      b. The soft palate is composed of tissues and muscles with an intact uvula projecting from the back of the roof of the mouth.

FIGURE 3-2 Epstein's Pearls on the palate (sometimes mistaken for thrush).

Reproduced with permission from Wilson-Clay B, Hoover K. *The Breastfeeding Atlas*. Austin, TX: LactNews Press; 2008.

FIGURE 3-3 Bubble palate (note limited tongue elevation).

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3. The shape of the palate can be influenced by hereditary and genetic factors or may result from circumstances that prevent typical shaping of the hard palate during gestation.
   a. A high-arched, grooved, or bubble-shaped hard palate can make it difficult for the infant to properly position the nipple and to compress it with the tongue. **FIGURE 3-3** shows an infant after a frenotomy to revise an anteriorly attached lingual frenulum. However, the infant still demonstrates limited ability to elevate the tongue to the upper gum ridge.[30] Note the bubble shape of the hard palate that may have resulted from ankyloglossia. Many professionals believe that the palate is shaped in utero while the infant is learning to suck and swallow; thus, if an infant presents with reduced lingual mobility, the result may be a higher, arched bubble-shaped palate. Research supporting this theory is lacking, and it may be correlative rather than causative in nature.
   b. Long periods of intubation, or syndromic conditions such as Down or Turner syndrome, can create grooves in the hard palate that may contribute to the higher incidence of breastfeeding problems in these infant populations.[47]
4. A cleft palate is a congenital midline defect resulting from incomplete fusion of orofacial structures in utero.
   a. Clefts of the hard and soft palates exhibit the following characteristics:
      i. Clefts can be unilateral or bilateral and are classified as partial or incomplete, or complete. They can involve the hard palate, soft palate, or both.
      ii. A partial or incomplete cleft is isolated.
      iii. A complete cleft extends from the upper lip to the soft palate and may also involve the nose.
   b. Regardless of the size, clefts of the hard or soft palate make it difficult or impossible for the infant to breastfeed.
      i. The infant is unable to seal the oral cavity to generate suction, which negatively affects milk transfer.
      ii. Some infants with wide palatal clefts exhibit additional swallowing problems due to atypical tongue movements because the palatal back guard is absent.[47]
      iii. An infant with a cleft may feed constantly and often sleep at the breast.
   c. Submucosal clefts are defects in the closure of the hard palate shelves.
      i. They are difficult to identify due to a layer of tissue that has grown over the cleft.
      ii. Possible indicators of a submucosal cleft include a bifid (or forked) uvula, absent or notched posterior nasal spine, a zona pellucida (or blue zone), and a paranasal bulge (i.e., transverse bony ridge alongside the nose).

5. A weak or dysfunctional soft palate presents feeding challenges.
   a. Generalized hypotonia resulting from prematurity, structural differences, neurologic involvement, or a syndromic condition can negatively impact soft palate function.
   b. Velopharyngeal dysfunction, an inability to close the nasal cavity from the oral cavity due to abnormalities in the anatomy or movement of oral structures, may adversely affect swallowing coordination and quality of feeding.
   c. Poor infant stamina can influence the function of the soft palate. As the infant tires and loses muscle control, coordination of the soft palate may become disorganized and further affect the suck–swallow–breathe pattern.
6. Assessment of the hard and soft palates includes the following:
   a. A family history of cleft lip or cleft palate should cue the lactation consultant to carefully examine the palate.
   b. A visual assessment of the palate should identify intact structures and the presence of a well-formed uvula. A bifid or absent uvula indicates possible abnormal formation of the soft palate.
   c. Gently slide a gloved fingertip along the hard palate, starting just behind the upper gum ridge. Assess the slope of the hard palate for bony prominences, clefts, or abnormally prominent rugae (ridges).
   d. Observe an entire feeding and elicit information regarding nasal regurgitation, which may indicate a weak soft palate seal or, more rarely, the presence of a submucosal cleft.[48]
7. Methods of assisting when a feeding problem results from abnormalities of the hard or soft palates are as follows:
   a. Breastfeeding an infant with a cleft palate is possible and should be encouraged when feasible. However, in most situations, exclusive breastfeeding is not likely due to the infant's inability to obtain a closed seal, which significantly impacts the ability to effectively access milk from the breast.
   b. Clefts of the soft and hard palates are typically not surgically corrected until at least 10 months of age. A palatal obturator is a prosthetic device that may be used to assist with breast or bottle feeding prior to surgical revision; however, it is not routinely used, especially in developing countries. There is conflicting evidence to support the use of palatal obturators to improve feeding efficiency.[46,49,50]
   c. Help the parent with suggestions to assist with feedings.
      i. Upright positions, such as the seated straddle, may be effective.
      ii. Demonstrate chin support to stabilize the latch.
      iii. Teach the use of rhythmic breast compressions for expressing milk into the infant's mouth.
   d. If an infant with a cleft palate is exclusively or primarily breastfeeding, the overall growth should be closely monitored. Weighted feeds using an accurate scale should be included in assessments to ensure adequate intake.
   e. Ideally, supplement feedings with expressed milk or banked milk. The incidence of chronic otitis media, a risk for infants with cleft defects, is increased when infants are not fed human milk.[13,51]
   f. Protect milk production by establishing an appropriate pumping schedule.
   g. If necessary, help the parent experiment to find an alternative method of feeding that is effective and does not stress the infant.
      i. Specially designed bottles for infants with cleft palates, typically bottles with one-way valves, are often used in addition to or in place of the breast. They allow the infant to solely use compression to access milk in the absence of creating a seal.
      ii. Teach the parent to observe the infant for stress cues to prevent the development of feeding aversions.[52]
      iii. A gastrostomy tube (G-tube), in addition to oral feedings at the breast or with a specialty bottle, may be necessary in certain cases when oral feeding is either not possible or not sufficient for growth. Oral feeding and G-tubes are not mutually exclusive.
   h. Provide referrals to appropriate specialists, including cleft palate teams and speech pathologists.

G. Occlusion of nasal passages can interfere with effective breastfeeding.[2,12,14,53]
   1. Although infants are typically nose breathers, they can switch to mouth breathing if the nasal passages are occluded. If nasal breathing is impaired, the infant will present with difficulty breastfeeding, and may even resist feeding, because breathing is prioritized.
   2. Abnormal presentations of the nasal passages are as follows:
      a. Nasal congestion, in the absence of respiratory illness, can reveal dried accumulations of milk that were nasally regurgitated during feedings.
      b. A deviated nasal septum may impact breathing while feeding.[54]
      c. Rarely, abnormally small nasal openings are observed. Choanal atresia is a congenital condition in which the openings of one or both of the nasal cavities are partially or completely blocked by a bony or membranous occlusion.
      d. Facial bruising (e.g., resulting from birth trauma or instrument-assisted delivery) can cause swelling of the nose and impair breathing.
   3. Assessments of the nasal passages should include the following:
      a. The nasal passages should be visually assessed if the infant's breathing sounds congested or if the infant struggles, pulls away, or gasps while feeding.
      b. Elicit information from the parent about the birth process, instrument-assisted delivery, bruising, nasal regurgitation, recent illnesses, and so forth.
   4. Methods to assist an infant with feeding problems related to the nasal passages include the following:
      a. Baby-strength saline nose drops or breastmilk can help clear the nasal passages. Note that bulb syringes used to extract nasal debris can inadvertently increase internal swelling.
      b. Employ external pacing methods during feedings as needed to protect respiratory and physiological stability.
      c. Refer the infant to a primary medical care provider or pediatric otolaryngologist for further assessment if a problem related to the nasal passages interferes with feeding.

III. Oral Reflexes

A. The infant's reflexes provide important information regarding the infant's sensory, motor, and neurological status.[55]
   1. When assessing an infant's neurobehavioral responses, it is important to take note of the infant's state of arousal.
   2. Closely observe for any indicators of stress, including hiccupping, sneezing, mottling of skin, and behaviors that are often used for self-regulation (e.g., eye aversion or changing to a lower state of arousal). If an infant exhibits these behaviors or physiological changes secondary to stress, it is important to slow or cease the examination and allow adequate recovery time.[56]

B. Adaptive reflexes assist the infant with facilitating feedings.
   1. The rooting reflex[2] is elicited when the infant's lips or cheek are touched or stroked. The infant's head turns toward the stimulus and the mouth opens (gape response). Rooting helps the infant locate the nipple.
      a. This reflex appears at 32 weeks gestation; it typically integrates between 4 to 6 months but may persist longer in breastfed infants.
      b. An absent or diminished rooting reflex can signal poor tactile receptivity or poor neural integration.
      c. A hypersensitive or hyperactive rooting reflex can interfere with latching.
   2. The sucking reflex is elicited with a light touch of the nipple or a finger to the infant's lips or tongue, resulting in the complex movements of the suckle.
      a. This reflex appears between 15 and 18 weeks gestation; it fully integrates between 6 and 12 months.
      b. It is categorized into two modes: nutritive sucking and nonnutritive sucking.[57]
      c. Nutritive sucking is organized into a series of sucking bursts and pauses and occurs solely with the presence of oral fluid.
         i. The sucking rate is slower during nutritive sucking than during nonnutritive sucking to allow coordination of breathing and swallowing.

ii. The breathing rate increases during pauses that occur between sucking bursts.[2,12,17,27]
- Infants with a weak or immature suck are not able to sustain long sucking bursts (e.g., 10 sucks per burst),[17,58] but this can be secondary to respiratory compromise.
- Short sucking bursts due to prematurity often normalize with maturation occurring at about 36 to 38 weeks,[17] but they may persist past 40 weeks in some preterm newborns. Sucking problems secondary to other factors may endure longer and be more difficult to resolve.

d. Nonnutritive sucking is characterized by fast, shallow sucks and a typical ratio of six to eight sucks to one swallow. Nonnutritive sucking occurs for reasons other than feeding.
i. It stimulates the milk ejection reflex (MER).
ii. It regulates the physiological state and helps the infant to self-soothe.
iii. It increases peristalsis of the gastrointestinal tract and enhances secretion of digestive fluids.
iv. It helps to manage pain and to reduce the risk of sudden infant death syndrome.[12,17,55,59-62]
v. The American Academy of Pediatrics currently recommends delaying the use of pacifiers until breastfeeding is firmly established.[63]

e. Absent or diminished sucking may indicate central nervous system immaturity or maldevelopment (e.g., various trisomies), prematurity, delayed maturation, prenatal central nervous system insults (e.g., drugs in labor, asphyxia or hypoxia, or trauma), or systemic congenital problems (e.g., cardiovascular abnormalities, sepsis, or infant hypothyroidism).[64]

f. A weak suck may indicate central nervous system abnormalities associated with hypotonia, genetic conditions such as Down syndrome, abnormalities of the muscles resulting in weak oral musculature, or, rarely, conditions such as medullary lesions, myasthenia gravis, or botulism.[64]
i. A weak suck may also be present in a sleepy, ill, malnourished, or jaundiced infant and has also been seen in babies with tongue-tie.
ii. An infant with a weak suck may provide inadequate breast stimulation, increasing the risk of rapid, early down regulation of milk production.[65]
iii. Close monitoring of infant growth is required for infants with a weak suck. They may need supplemental feedings with an alternate feeding method, preferably with expressed milk.

g. A disorganized suck is characterized by an immature pattern of short sucking bursts (i.e., 3 to 5 sucks) with varying pauses between each burst.[55] A dysrhythmic and uncoordinated suck may be present.

h. A dysfunctional suck is characterized by unusual or inconsistent movements while sucking.[55]

3. The swallowing reflex is elicited by a bolus of fluid contacting the sensory receptors of the soft palate, tongue, and back of the mouth.
a. The swallowing reflex plays a role in the regulation of amniotic fluid volume and composition, regulation of solutes from the fetal environment, and maturation of the fetal gastrointestinal tract.[66]
b. The reflex appears between 9 and 14 weeks gestation and persists into adulthood.

4. The tongue thrust reflex occurs when the tongue moves down and forward in anticipation of grasping the breast and drawing it into the mouth. It appears at 28 weeks gestation and typically integrates by 6 months of age.

C. Protective reflexes help prevent choking and aspiration.
1. The gag reflex is elicited in the newborn at the mid- to posterior tongue and is the first line of defense to help prevent choking.
a. It appears at 18 weeks gestation and persists into adulthood.
b. A gentle exam with a gloved finger can identify a hyperactive gag reflex (i.e., triggered by shallow oral stimulation).
i. A hyperactive gag reflex may indicate immaturity.
ii. Constant activation of the gag reflex due to invasive procedures can create oral and feeding aversion.
iii. Some infants with a hyperactive gag reflex may require speech or occupational therapy to facilitate acceptance of objects in the mouth.

2. The cough reflex protects the airway from aspiration of liquids.
   a. Research indicates that this reflex is often not observed at birth as it is only seen in 25 percent of preterm infants and 25 to 50 percent of term infants at birth. 90 percent of newborns exhibited a fully functioning cough reflex by 1 to 2 months of age.[67,68]
      i. A delayed cough reflex can contribute to an increased risk of penetration (to the level of the vocal folds) or aspiration (past the vocal folds and into the airway) of liquids.
      ii. Silent aspiration (i.e., aspiration of fluids without coughing) can occur in immature infants.[69]
   b. Coughing during feeding may be in response to the penetration or aspiration of fluids.
      i. To date, there is no scientific evidence that attributes increased lung damage to aspiration of small amounts of human milk.
      ii. Intermittent coughing while breastfeeding is considered normal for many typically developing infants, especially toward the beginning of feedings and when milk ejection is fast.

D. Other newborn behaviors and reflexes persist up to 6 months of age.
   1. The stepping reflex is a response used to crawl to the breast.[70]
   2. The palmar grasp reflex is the closing and grasping of fingers in response to stimulus to the palm. It is typically fully integrated by 5 to 6 months of age.
   3. The moro response (startle reflex) is the extension of arms, legs, and fingers in response to being startled or a feeling of falling. It is typically fully integrated by 3 to 6 months of age.
   4. Predictable hand movements are used to stimulate, move, and shape the breast.[71,72]

IV. Suckling Cycle

A. Recent studies regarding the biomechanics of breastfeeding suggest that effective breastfeeding involves a cycling motion of the mandible and the anterior portion of the tongue; rhythmic peristaltic movement of the posterior portion of the tongue; and milk ejection (see **FIGURE 3-4A** and **FIGURE 3-4B**).[22,26,27,73]
   1. Downward movement of the posterior portion of the tongue increases negative intraoral pressure (i.e., increases vacuum).
   2. Peristaltic movements, which are visible along the midline of the tongue via 3-D ultrasound imaging, aid in the coordination of swallowing and breathing.
   3. Effective breastfeeding is achieved by the combined contributions of both intraoral pressure cycles (i.e., alternating positive and negative pressure changes) and peristaltic tongue movements.

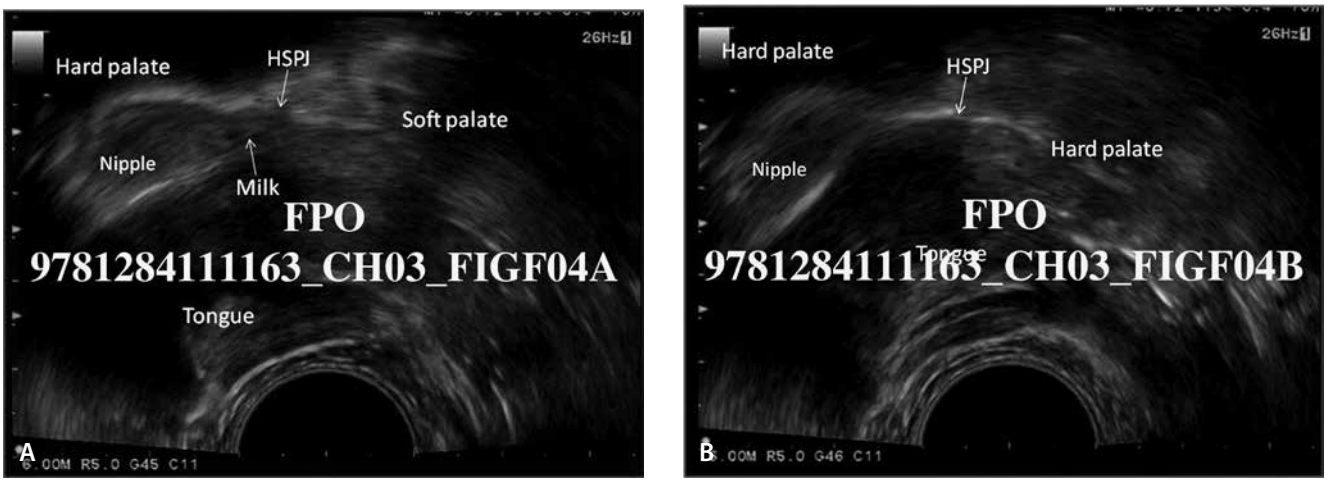

FIGURE 3-4 A. *Tongue up:* A baseline vacuum is applied and the nipple is positioned about 6–8mm from the hard and soft palate junction. The nipple is compressed and elongated. No milk is evident as the tongue is in contact with the palate. **B.** *Tongue down:* In the first half of the suck cycle the nipple expands and moves closer to the hard and soft palate junction and milk flows into the oral cavity as vacuum strength increases.

Reproduced from Ramsay DT, Kent JC, Owens RA, Hartmann PE. Ultrasound imaging of milk ejection in the breast of lactating women. *Pediatrics*. 2004;113(2):361-367.

B. The suckling cycle is characterized by the following mechanics:
   1. The infant draws the nipple into the mouth by means of a vacuum. The vacuum places the nipple in the optimal position (6 to 8 mm from the hard and soft palate junction) for removing milk from the breast and clearing it from the oral cavity.
   2. The lips and cheeks facilitate the formation of a seal and the creation of negative pressure in the oral cavity, while the jaw provides a stable base for the movements of other structures, including the tongue, lips, and cheeks.
   3. The tongue is drawn downward along with the soft palate, evenly expanding the nipple and increasing the diameter of the nipple duct, moving the nipple closer to the hard and soft palate junction and increasing the vacuum. As a result of this process along with milk ejection, milk flows into the infant's oral cavity, completing the first half of the suck cycle.
   4. A combination of mandibular movements, undulations of the tongue, and decreased vacuum in the oral cavity channels the milk bolus posteriorly and triggers the swallow reflex. Simultaneously, the soft palate elevates and makes contact with the posterior pharyngeal wall to seal the nasal passages and allow the milk bolus to be swallowed, completing the second half of the suck cycle.
   5. The tongue then remains in contact with the palate until the beginning of the next suck cycle.

V. Coordination of the Suck–Swallow–Breathe Triad

A. The feeding evaluation must consider all three aspects of suck–swallow–breathe coordination.
   1. Sucking, swallowing, and breathing are functionally and anatomically interrelated, with overlapping functions of cranial nerves and structures.
   2. Dysrhythmic sucking and poor coordination of the suck–swallow–breathe cycle are common, even in term infants during the first few days of life.[58]
   3. Current research suggests that the suck–swallow–breathe cycle is highly variable during breastfeeding so the infant can rapidly adapt to changing milk flow rates during milk ejection.[73]
   4. Newborn oral and pharyngeal anatomy differs from adult anatomy in that it allows close proximity among the base of the tongue, the soft palate, and the epiglottis; this is protective in nature and is believed to allow for maturation of suck–swallow–breathe coordination.
   5. The evaluation of feedings in compromised infants should include observation of the entire feeding to permit identification of fatigue, loss of rhythm, evidence of respiratory distress, and color changes.[2,12,55] The infant's behavioral state should be noted, including deep sleep, quiet alert, active sleep, active alert, drowsiness, crying, and indeterminate states.[53]

B. Suck–swallow–breathe components[65-79]
   1. Optimal coordination of the suck–swallow–breathe cycle has been described as a 1:1:1 ratio; however, much of the research has involved bottle-feeding infants. Suck–swallow–breathe coordination matures in infants so that the pattern in the first week of life differs from the patterns that present between 2 and 4 weeks of age. This is characterized by a decreased number of swallows during prolonged respiratory pauses.
   2. Sucking
      a. In breastfed infants, the number of sucks varies throughout a breastfeeding session in relation to a number of factors, including milk ejection, milk flow, milk production, and individual infant abilities.
      b. Nonnutritive sucking has been observed more often at the beginning and end of feedings, while bursts of nutritive sucking occur more often at the beginning and middle of a breastfeeding session.
   3. Swallowing
      a. The process of swallowing consists of three main phases:
         i. Oral (preparatory and transport): Milk is removed from the breast, and the bolus is propelled toward the back of the oral cavity.
         ii. Pharyngeal: After the swallow is triggered, a series of complex and protective mechanisms occurs resulting in the following: excursion of the hyoid bone and larynx, inversion of

the epiglottis over the airway, adduction (i.e., coming together) of the vocal folds, and propulsion of the bolus into the pharyngeal space. Of note, infant anatomy and physiology greatly differ from adult anatomy and physiology due to proportional differences in infants so that oropharyngeal structures are closer in proximity. This is believed to be ultimately protective in nature as the infant is learning to effectively coordinate the suck-swallow-breathe cycle. Breathing ceases for approximately 0.5 seconds while the bolus is directed toward the esophagus and away from the airway.

iii. Esophageal: The bolus then travels down the esophagus toward the stomach.

b. In infants younger than 3 months of age, drooling is associated with weak swallow control (even of the infant's own saliva) or can reveal pharyngeal or esophageal obstruction.[25]

c. Abnormalities of the tongue and palate, and discoordination of sucking, swallowing, and breathing, can increase the risk of dysphagia (i.e., difficulty swallowing) and aspiration.

i. Dysphagia can result in poor weight gain and aversive feeding responses.

ii. Dysphagia is often seen in infants who are diagnosed with reflux.

4. Breathing

a. Most full-term infants swallow in coordination with inhalation and exhalation, taking adequate respiratory pauses between sucking bursts.

b. Preterm infants are more likely to swallow mid-inhalation, increasing the risk of oxygen desaturation, bradycardia, and laryngeal penetration or aspiration.[73,75]

C. Observe feedings for the following indicators of poor feeding quality:

1. Respiratory noises:

a. Stridor is a raspy respiratory noise heard on inhalation, exhalation, or both. It is caused by narrowing, floppiness, or obstruction of the airway.

b. Wheezing is a high-pitched noise that occurs most often during exhalation, typically as a result of airway constriction. It can be secondary to inflammation or reactive airway disease.

2. Apnea: Apnea is prolonged periodic breath holding while attempting to manage swallows.[69]

3. Fatigue: An infant may fall asleep too soon during a feeding due to stress or other causes that inhibit the ability to manage the work of feeding. Research has shown that energy expenditure is typically lower when breastfeeding than when bottle feeding.[76-82]

4. Poor intake: Weighted feeds on reliable scales are critical when assessing the intake of an unstable feeder.[83,84]

5. Poor growth:

a. An infant's weight loss of 10 percent by the 5th day after birth and a failure to promptly recover the birth weight are markers for suboptimal infant feeding behavior and indicate the need for evaluation.[85]

b. Recent studies have highlighted the association between excess weight loss in breastfed infants and maternal intrapartum fluid balance.[86,87] Intrapartum fluid administration may result in an inaccurate baseline birth weight.[87] Further research into this association is ongoing.

6. Feeding aversion: A feeding aversion can result from aspiration, respiratory compromise, choking, reflux, or sensory-based factors.[17] It can also result from negative oral experiences, such as medical procedures and stressful feedings.

Key Points from This Chapter

A. International Board Certified Lactation Consultants need to have a strong foundation on the basics of typical infant oral anatomy and physiology to identify when abnormal presentations occur and negatively impact breastfeeding.

B. International Board Certified Lactation Consultants should also have a solid understanding of the following:

1. Typical presentations of newborn reflexes and their relation to feeding
2. Major components of the suckling cycle as part of the breastfeeding process
3. Major components of suck–swallow–breathe coordination
4. Indicators of poor-quality feeding

CASE STUDY

Diana brought twins, Patricia and Ryan, to be seen following an unremarkable pregnancy and vaginal birth (Ryan was born breech) at full term. APGAR scores were within normal limits and there were no other issues or concerns. The twins were discharged from the hospital exclusively breastfed. Collection of case and developmental history revealed that the twins' mother had successfully breastfed her first daughter past 2 years of age without latch or breastfeeding difficulties, weight gain concerns, or milk supply issues.

Breastfeeding reportedly continued to go well, without supplemental bottles or pacifiers, but breastfeeding was always painful and latch issues persisted. Diana was breastfeeding the twins on demand, often throughout the day and when they woke at night, with no limit how often they breastfed or how long they were at the breast. Around 4 months of age, weight gain began to slow. Between 6 and 9 months of age, Patricia gained only 6 oz while Ryan gained only 12 oz, and they both exhibited difficulty transitioning to solids. At 9 months, Patricia pushed food out with her tongue when offered, and Ryan also gagged, coughed, and choked on larger and lumpier food textures. The pediatrician recommended formula supplementation. Mom did not want to supplement with formula and both infants would not bottle-feed.

At 9 months of age, the twins were referred by the pediatrician to a Speech-Language Pathologist who was also an International Board Certified Lactation Consultant for concerns related to slow weight gain and persistent breastfeeding challenges. The oral structures of both infants were examined. Patricia presented with a high, arched palate, while Ryan presented with a bubble-shaped palate and retrognathic chin. Both infants presented with Type 3 posterior ankyloglossia (tongue-tie) along with low-lying, thick, and restrictive maxillary frenulum. On examination, the infants' father was also observed to present with a posterior tongue-tie (PTT) and maxillary tie (note that diagnosing ankyloglossia and maxillary restrictions are within the scope of practice of a Speech-Language Pathologist [CCC-SLP]). (Although it is not within the scope of practice of a lactation consultant, but a lactation consultant can note oral assessment findings and observations and make recommendations for referral to a healthcare provider who is qualified to diagnose.)

Latch, breastfeeding efficiency, and milk transfer were then assessed. The twins both presented with a shallow latch and narrow gape on the breast. They slipped off the breast intermittently throughout feeding and both visibly and audibly lost suction multiple times. Feedings were prolonged and appeared inefficient as exhibited by reduced milk transfer. Mom reported that feedings were somewhat painful but manageable.

All observations were shared with the parents and referring pediatrician, and the following plan of care was provided:

- Recommendation for a consult with a specialist for assessment of both lingual and labial frenula to determine if frenotomy was warranted.
- Encouragement to Diana to continue to breastfeed babies on demand.
- Encouragement to Diana to continue to offer solids, particularly more mashable, easy-to-manage foods instead of foods with more challenging textures, especially for Ryan who appeared at risk for aspiration and/or choking.
- Recommendation to begin feeding therapy for continued management of breastfeeding, transition to solids, weight gain, and development for both babies.

Maxillary and lingual frenectomies were performed on both twins at 9.5 months of age by a pediatrician specializing in frenectomies. Within 1 month post-frenectomies, both infants gained over 2 lbs each. By 14 months of age, Patricia gained 4.4 lbs and was in the 14th percentile for weight (compared to 1st percentile on initial evaluation), and Ryan gained 6.8 lbs and was in the 31st percentile for weight (compared to 0 percentile on initial evaluation) (see **FIGURE 3-5A** and **FIGURE 3-5B**). Mom Diana no longer felt nipple pain within days post-procedure. Observations revealed that both infants' latch appeared to improve almost immediately, with increased ability to maintain latch and improved gape and seal. Feedings were more efficient overall with milk transfer within normal range. In terms of solid foods, Patricia no longer pushed food out with her tongue and transitioned to solids with 1–2 additional feeding therapy sessions needed. Patricia was then discharged from feeding therapy with no further need for intervention. Ryan continued to improve with solids post-frenectomy, exhibiting significantly less gagging, coughing, and choking with solids. Both babies continued to breastfeed past 2 years of age.

Questions

1. What concerns within the infants' overall histories indicated a need for consult with a lactation consultant?
2. What major signs within feeding behaviors (breastfeeding and solids) indicated concerns for ankyloglossia?
3. What observations within the oral examinations supported those concerns?
4. What additional thoughts or recommendations do you have in addition to the ones listed?

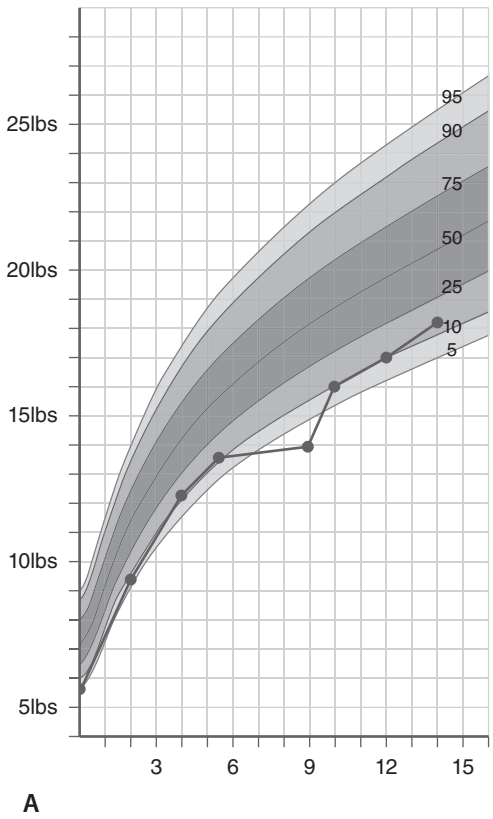

FIGURE 3-5 A. Growth trajectory for girl.

Data from WHO. The WHO child growth standards. http://www.who.int/childgrowth/standards/en/. Accessed January 9, 2018.

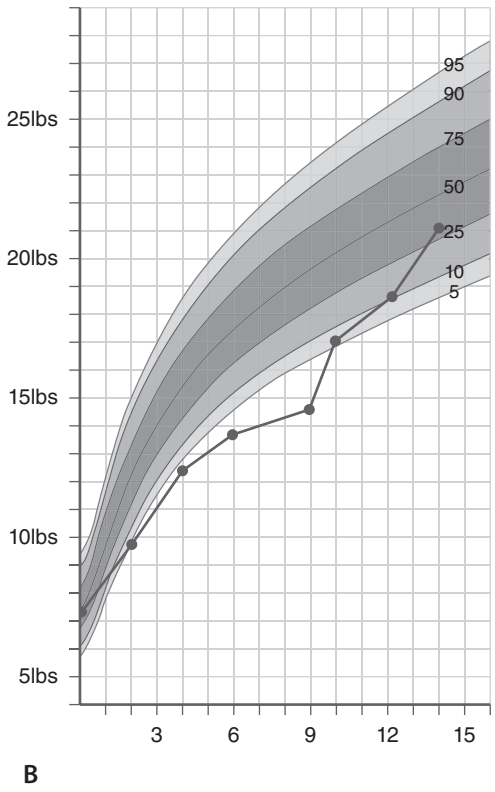

FIGURE 3-5 B. Growth trajectory for girl.

Data from WHO. The WHO child growth standards. http://www.who.int/childgrowth/standards/en/. Accessed January 9, 2018.

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