Linda Dahl

Clinician's Guide to Breastfeeding

Evidenced-based Evaluation and Management

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For the two women who influenced me the most:
My mother, Maysoun, who nursed me for 2 years;
and my daughter, Lucy, who could barely nurse
at all.

Preface

Everyone agrees that breastfeeding is best. The benefits are countless, and more and more mothers are trying to nurse their babies. We are told that breastfeeding is an inherent skill that mothers and babies just naturally know how to do. For the most part this is true. But not always. When breastfeeding doesn't happen easily, it can be due to a simple problem, such as an improper latch or a sleepy baby. But often there are more significant problems: Once-full breasts now only produce a few ounces of milk… the baby takes leisurely hour-long feeds, then gets hungry an hour later… the baby cries at the breast and becomes frantic… the mother experiences pain every time her baby latches on. Talk to a mother with cracked, bleeding nipples, and watch her cringe at the mere thought of her crying baby's mouth, and you'll see how bad it can get.

I discovered these symptoms myself with the birth of my daughter 12 years ago, while I was at the end of my residency. Memories of that time are a blur of exhaustion and frustration. Lucy nursed almost constantly, every hour for 45 min. My nipples were raw, cracked, and very painful, but because my baby seemed healthy, I thought this was normal. Lucy's pediatrician and my own doctor both told me that everything was fine and that I should just "wait out" the pain—it would stop eventually. She was gaining weight slowly, but within normal parameters.

After about 3 weeks, I visited a breastfeeding support group run by a lactation consultant (LC). She disagreed with the doctors and said that there was indeed a problem, and that I should pump and supplement with formula. She also suggested I see an LC privately. Money was tight back then, but I was determined to give my daughter the best start possible. So I paid the LC fee of $250 per visit, and I rented a hospital-grade breast pump for $80 per week.

I pumped frequently and regularly, even when there was nowhere to do it privately—there is no oasis of quiet in a hospital for a resident. But, to my horror, I was never able to get more than 2 oz of milk a day from both breasts combined. I was starving my baby. I sought help from doctors and told them that I wasn't making enough milk. Every one of them dismissed my concerns, saying, "Oh, you have milk" (but I didn't) or "Everyone can breastfeed, you must be doing something wrong." I was a breastfeeding failure. No one listened to me. But even if they had, I was naïve to the fact that no one had answers.

Breastfeeding is unique in medicine in that there is no specialty dedicated to diagnosing and treating issues with breastfeeding. Every other human function has medical specialists trained to understand its intricacies and fix problems. Not so for breastfeeding. Lactation consultants, as good as they are, vary in training and experience. As of now, although there is board certification (IBCLC), there is no licensing board.

In the past, women turned to their mother or grandmother for help. The community of women knew how to make it work, what tricks to try. But after formula became available and women went to work, fewer mothers breastfed. Babies were born in hospitals instead of at home with midwives. Over time, the art of breastfeeding was lost. It seems reasonable nowadays to ask your doctor for advice, but what doctor knows anything practical about breastfeeding? Your OB/Gyn gets you as far as the delivery, and then the pediatrician takes over. Somewhere in the middle is that mother–baby unit. Depending on the training and personal experience, you will get widely variable—and often wrong—information.

Look beyond the clinician and you can see another reason why there is such a gap in our medical knowledge. Breastfeeding has a lot of "moving parts." In the mother, there are hormones, specialized breast tissue, breast anatomy, and even the psychological contributions to milk production. In the infant, there are anatomical configurations, the gape, the reflexes, and the suck. Mother and baby must function properly independently *and* together as a breastfeeding unit. As if that wasn't enough of a challenge, the dynamics of breastfeeding change over time, from the first latch through weaning. Medical research provides us with many details regarding discrete slices of the breastfeeding experience, but since there is no dedicated specialty, the disparate findings are left unconnected to a whole picture.

My training was as an Ear Nose and Throat surgeon (Otolaryngologist). The first breastfeeding case I saw in practice was referred by an LC who believed that the baby had tongue tie (ankyloglossia), when the lingual frenulum is so short, thick, or tight that the tongue cannot move freely. Tongue tie was just beginning to be recognized as an important breastfeeding issue—the first tangible anatomic abnormality to break through the fuzzy mist of psychological rationalizations for why some mothers and their babies had a difficult time establishing a breastfeeding connection. My daughter was not even a year old at the time, so my breastfeeding failure was still fresh. It was a rush not only to be able to identify why the baby couldn't feed but also fix the problem.

I began to get more and more referrals from LCs and—eventually—from pediatricians for babies with various feeding problems. I started trying to quantify the breastfeeding experience by measuring everything that was measurable: infant gape, facial angle, frenulum thickness, palate arch, jaw size, breast shape, nipple size, et cetera. In the early days, all the cases were for tongue tie. Now, mother–baby dyads are referred to me for a number of different problems, but I see myself in all the mothers…and I see my daughter in all the infants. I want to keep as many mothers as possible from being labeled breastfeeding "failures."

After spending more than a decade researching and treating breastfeeding problems, I now know that there is no way I could have breastfed Lucy successfully at that time, no matter how much I pumped or how much money I paid. There was no one to diagnose and treat us. And even if there had been, by the time I realized there was a problem, it was too late.

Since then, I have treated thousands of babies, with a success rate of approximately 90 %…and most requiring only one office visit. I have developed a methodology to help bring mothers and infants together without pain, frustration, or multiple consults. In cases where surgery is necessary, it is possible to offer evidence (and advice) that will help the mother come to a decision more quickly and with less doubt than she might otherwise experience.

Notes About This Book

It is stipulated and acknowledged that breastfeeding is good for infants, mothers, families, and communities. This book does not discuss the specific value of breastfeeding; the value is recognized and assumed to be generally true. Instead, this book focuses on the interactive act of breastfeeding—what it should look like and what happens when something goes wrong.

Because this book reveals so much new information, it is not always possible to provide source references for the information given. The work simply hasn't been done outside my own clinical practice and research.

Final note: When discussing mother–infant interactions, I will use masculine pronouns (he, him) for the baby. This is done only to avoid subject confusion, given that the mother always takes the feminine pronouns (she, her). It's a grammatical choice, not a political one.

New York, NY, USA Linda Dahl

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Contents

Part I
Normal Nursing

Chapter 1
Breastfeeding Basics

1.1 Breastfeeding: Desire Versus Reality

Much of the information that has been taught to and by healthcare practitioners about what constitutes "normal" or "ideal" breastfeeding is wrong (Ogburn et al. 2011).

Let that soak in for a moment. Operationally, this means that if a new mother has breastfeeding concerns—as 92 % of nursing mothers in the United States do (Wagner et al. 2013)—she is likely to receive advice that is misguided, misleading, or confusing. This proliferation and dissemination of misinformation by inadequately trained practitioners has contributed to a culture of breastfeeding failure. As a result, the breastfeeding rates in the United States are *less than half* of those globally. While 79 % of mothers in the United States start out breastfeeding their newborns, only 40 % are exclusively breastfeeding at 3 months and that drops to 18.8 % at 6 months (CDC Breastfeeding Report Card 2013). In many countries in Africa, where the infant mortality rate is 31 per thousand births, although over 95 % of women begin breastfeeding, only 33 % of infants are exclusively breastfed by 6 months (WHO-1: Global Data Bank on Infant and Young Child Feeding). This is significantly more than in the United States, but hardly stellar rates for a part of the world where successful breastfeeding is a matter of life or death.

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It is critically important that we, as healthcare professionals, examine why breastfeeding rates are so dismally low. It certainly can't be blamed on lack of encouragement. In 1991 The World Health Organization (WHO-3) and the United National Children's Fund (UNICEF) launched a global program called the Baby Friendly Hospital Initiative that rewards and encourages hospitals to provide the highest levels of support for infant feeding and bonding between mother and infant. In their statement, entitled *Protecting, Promoting and Supporting Breastfeeding: The Special Role of Maternity Services*, they illustrate the Ten Steps to Successful Breastfeeding (WHO-2). While the intentions are good, these types of initiatives tend to serve merely as talking points for the *concept* of breastfeeding—why breastfeeding is the best and healthiest option for mother and baby, and how healthcare practitioners can encourage mothers to breastfeed exclusively. Any information provided about *how* to breastfeed properly is frequently confusing or, in some cases, wrong (Pound et al. 2012).

I've heard many first-time mothers joke that they wish their infant came with a set of instructions. Is this really a joke? Or is it, perhaps, a subtle call for help? We devote more instruction hours to teaching teenagers how to drive a car than we do helping women feel more confident about caring for a tiny human being. Why is that? Some might argue that breastfeeding is natural, and therefore it should happen automatically. It is true that breastfeeding is natural, but "natural" doesn't mean automatic, simple, or certain (Bergmann et al. 2014). Childbirth is another "natural" human process, a true miracle of nature. And yet, birthing is the second leading cause of death in women of childbearing age worldwide. Few of us would forego—or recommend that a patient forego—medical intervention in preference of "natural" childbirth if the baby or mother were in danger. Breastfeeding is no different. Not all infant-mother pairs "fit" easily, as evidenced by the need for wet nurses in the years before formula became available. But for the most part, despite all the statistics and the quiet, joking insecurity, the experience of breastfeeding has largely been left up to nature (Geddes 2013).

One of the ways in which current breastfeeding instruction gets it wrong is in its reliance on *subjective interpretation* of infant behaviors. For example, Li et al. (2008) examined the reasons why mothers discontinued breastfeeding. Between 44 and 56 % of mothers believed their babies were not satisfied from nursing alone, and 47 % felt that their babies self-weaned after the third month because the babies lost interest in nursing. Those reasons are subjective, based solely on what the mothers *believed* their babies were trying to tell them through their behaviors. But imagine if we could dispel those myths and replace them with objective information about how breastfeeding can and should work for the majority of women who wish to breastfeed…and then provide clinically proven ways to increase the odds of breastfeeding success.

Of course, it is meaningless to instruct healthcare providers to show mothers how to breastfeed if the providers themselves haven't had appropriate training. While it is desirable for hospitals and pediatric staff to encourage breastfeeding and implement the Ten Steps, we have yet to examine what happens when breastfeeding doesn't work even if all the rules are followed. There is a large gap between breastfeeding goals—of a mother, a country, or an organization—and breastfeeding success rates past 3 months (Neifert and Bunik 2013; Ramakrishnan et al. 2014).

I posit that 80–90 % of mothers can breastfeed successfully. I have seen those numbers in my own practice, where I deal specifically with cases of "failed" breastfeeding. What this requires, however, is a clear understanding of the objective, medical processes involved in breastfeeding, and a shift away from subjective terminology and measures.

1.2 The Dyad in Focus

Breastfeeding is a complex phenomenon masquerading as a simple, singular act.

First, breastfeeding involves two people: the mother–baby dyad. If there is a problem, there is no medical specialty that addresses evaluation and treatment. There are obstetricians before the baby is born, a primary care physician or gynecologist for the mother after the baby is born, and a pediatrician for the baby. By the time a breastfeeding mother and infant arrive in my office, they have been seen by many health care practitioners, but not one medical expert who specializes in breastfeeding.

Second, many experts (and all first-time mothers) have no frame of reference with which to evaluate breastfeeding advice because they, themselves, have never done it. Imagine trying to learn to ski based on instructions written by someone who has only watched the sport on television—any success would likely be due to luck rather than valuable guidance. Conversely, one person's subjective experience nursing cannot necessarily be extrapolated to fit the needs of a diverse group of individuals. Even mothers who have nursed more than one baby can have a different experience each time.

Finally, despite the highly tactile nature of breastfeeding for mothers and infants, most of what goes on during nursing is internal and invisible. To the outside observer, it seems like a natural coupling of parts, but breastfeeding is an intricate and intangible biological dance. Therefore, much of what we pass off as knowledge about the process is little more than inference based on external—and therefore indirect—observations. From that limited perspective, experts draw conclusions about a baby's behavior or a mother's feelings, and that speculation has informed our expectations of what is "normal" during breastfeeding. The more cynical among us might call it a science of guesstimates.

When it comes to the health of mothers and babies, we want better than educated guesses. But medical knowledge has been hampered by a reliance on describing the typical breastfeeding experience. Until recently, no one was quite sure what was happening, how it happened, or why it happened that way. We now know that what *commonly* happens during nursing is not necessarily what is *supposed* to happen. Thanks to technological advances, we have a better understanding of what occurs in that invisible space, so we can better help mothers and babies successfully breastfeed.

1.3 Components of Successful Breastfeeding

There are three basic and essential components to successful nursing:

1. There must be ample milk supply.
2. The baby must have the desire to go to the breast.
3. The baby must be able to transfer milk from the breast.

These three factors are intricately interlaced, with fulfillment of each dependent on the other two. For example, if a baby cannot properly transfer milk, he will eventually stop going to the breast for nourishment, and the mother's milk supply will dwindle. If she lets her supply dwindle, then even though the baby can transfer milk, he will not get the reward of his efforts and will eventually learn to avoid the breast and choose other food sources.

However, the one factor common to all three components is that the *baby must latch on correctly*. Despite what most new mothers (and many untrained physicians) believe, the perfect latch requires more than just putting a nipple in the mouth and sucking. While there are many ways to latch a baby onto the breast, this description is what I consider to be the "perfect latch."

A perfect latch results in the most efficient milk transfer, which predicates every other outcome in breastfeeding. If a baby cannot latch on correctly and transfer milk efficiently, then none of the "rules" of breastfeeding apply. Until "perfect" is understood, it is impossible to effectively evaluate problems that occur in breastfeeding. This is a general overview of what the ideal latch should look like:

1.3.1 Finding the Breast

At birth, neonates are functionally blind. Their orientation to the world is primarily through smell, but also through touch. It is natural for neonates to want to be prone on the mother, and immediate skin-to-skin contact is universally recommended to establish bonding between infant and mother, and to promote exclusive breastfeeding. Therefore, the baby should be placed on the mother's breast. More specifically, the newborn's chest needs to be in contact with the mother's skin (Bramson et al. 2010).

1.3.2 The Gape

Babies are born with inherent reflexes specific for nursing. First—and singularly most important—is the gape reflex, the over-wide opening of the mouth that occurs when a baby's chin is brought to the skin of the mother's breast, allowing him to feel his mother's skin on his face. This reflex will also happen if you merely touch the infant's chin, but it is more pronounced near the breast (Webber et al. 1986). The gape reflex is quite different from the rooting reflex, in which an infant will turn his head and open his mouth slightly in response to a touch on the cheek.

The gape is very difficult to measure objectively, as it often happens in a split second (see Fig. 1.1). For a neonate, gaping involves opening the mouth wide enough to fit over all of the nipple and most of the areola. The gape must be so wide that

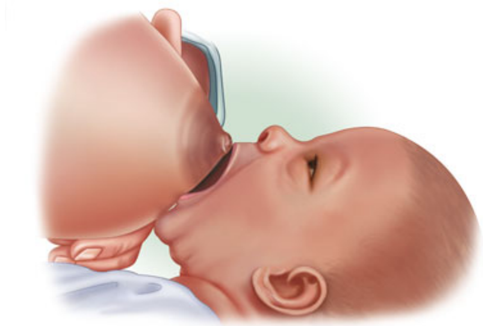

Fig. 1.1. The gape must be wide enough to fit over all of the nipple and most of the areola, with the jaw in an almost dislocated position. The lower lip should be aligned with the bottom of the areola so the baby can reach his mouth over the top of the nipple.

the jaw is almost dislocated, allowing the breast to enter and fill the mouth sufficiently for nursing.

When neonates are born, they reflexively open their mouth as wide as they physically can. If a baby is not able to open wide enough at birth, he will not "learn" or "grow into" the ability. It also does not mean he is "lazy" if he can't do it. Pulling the jaw down or attempting to flange out his upper lip on the breast also does not help his gape. Either he has it, or he doesn't.

As is discussed in later chapters, a baby that cannot gape widely at birth requires medical evaluation and probable intervention in order to breastfeed. If the gape is too narrow or tight at birth, the sooner it is treated the better. An infant without an appropriate gape will be inefficient or unsuccessful in transferring milk from the breast. If he tries and fails repeatedly, he may lose the gape reflex within weeks or even days, depending on the situation. Bottle-fed babies adapt quickly away from the gape reflex and purse their lips to fit the small (artificial) nipple into their mouths. This is a common cause of what is called "nipple confusion," when the baby has adapted to the new food source (the bottle) and loses the reflex to gape wide for the breast.

1.3.3 Breast Position and Suck Reflex

First, the breast should be primed:

- Position the fingers of one hand 180° from each other on either side of the areola.
- Press the fingers back toward the chest wall, and squeeze toward the center and forward toward the nipple to express the milk sitting in the superficial ducts.
- Hold the breast as if it is a sandwich, with the nipple pointing away from the midline.
- Bring the baby to the breast, not vice versa. (Most new mothers bring the nipple to the baby's mouth.) With the baby's lower lip aligned to the lower edge of the areola and the baby's chin against the mother's breast skin, the gape reflex will be elicited, causing the neonate to reach

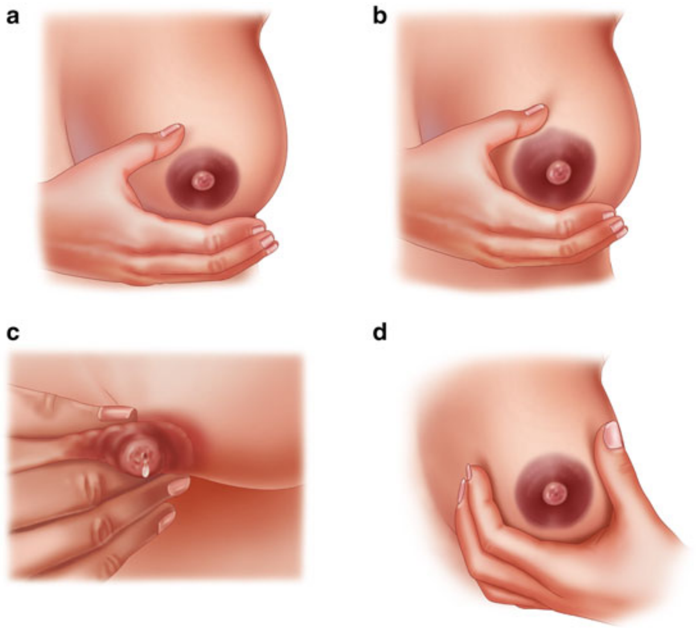

Fig. 1.2. Priming the breast. (*a*) Position the fingers of one hand 180° from each other on either side of the areola. (*b*) Press the fingers back toward the chest wall. (*c*) Squeeze toward the center and forward toward the nipple to express the milk sitting in the superficial ducts. (*d*) The breast should then be held as if it is a sandwich, with the nipple pointing away from the midline.

his mouth over the top of the nipple. The upper and lower lips flange out on the breast, a by-product of the wide gape (see Fig. 1.2) (see also Morton video: http://newborns.stanford.edu/Breastfeeding/FifteenMinuteHelper.html).

In the perfect latch, the nipple sits all the way at the back of the throat, at the junction of the hard and soft palate. In that position, the nipple ducts open directly over the esophagus. The base of the breast is held between the baby's tongue and upper gum (Ardran et al. 1958). This is the "locked in" position (see Fig. 1.3).

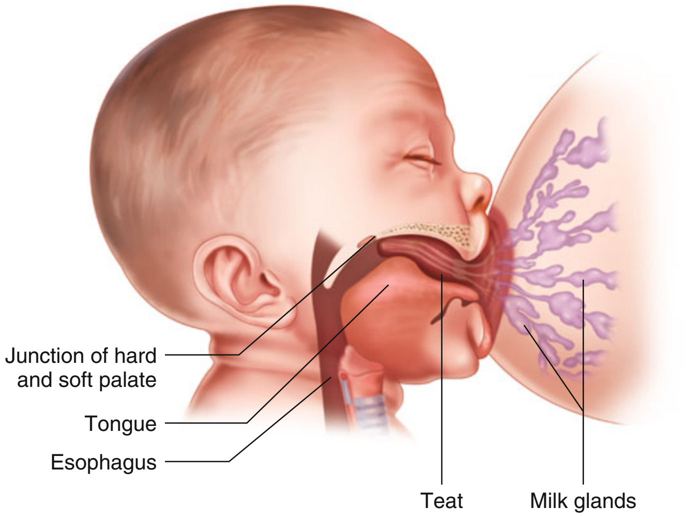

Fig. 1.3. The "locked in" position. The nipple sits at the back of the throat, at the junction of the hard and soft palate, where it opens directly over the esophagus. The base of the breast is held between the baby's tongue and upper gum to form a seal.

When the hard palate is filled with breast tissue, the second reflex—the suck reflex—is elicited. Filling the hard palate stimulates the suck reflex, no matter what fills the space, such as a bottle, finger, or pacifier. Conversely, if the hard palate is not filled because there is an insufficient amount of breast or a too small bottle nipple, or if the palate is very high and arched, then the suck reflex will not be elicited as easily.

During sucking, the nipple and areola (teat) are stretched and increase in size by about 50 %. This happens because the suck reflex causes the baby's tongue to compress the breast tissue against the hard palate, beginning at the front of the mouth and progressing toward the back of the throat in a peristaltic wave. The anterior rim of the tongue curves upward as the lower jaw is elevated to trap milk into the ducts and prevent backflow. Because of the position of the breast in the baby's mouth, the milk from the nipple flows directly into the esophagus, and the baby swallows the milk. The soft palate rises, closing off the nasal cavity, so that breathing and swallowing can occur simultaneously. The larynx moves forward and upward to further protect the airway while the bolus is propelled to the esophageal inlet. Then the larynx moves back into position, leaving the airway patent.

With the teat in the optimal, "locked in" position, the only friction on the breast comes from the tongue compressing the breast skin. Positive pressure is the main mechanism of milk transfer. There is a variability of negative pressure maintained by the seal created by the border of the mouth and the lowering of the tongue in the pharyngeal space before the swallow. Elad et al. (2014) analyzed ultrasound movie clips of the tongue dynamics of babies nursing, and developed a 3D biophysical model of the breast that mimics what happens to the breast during nursing. This study demonstrated that babies create time-varying subatmospheric pressures in the oral cavity. The tongue moves periodically: The anterior tongue moves with the cycling movement of the mandible, while the posterior tongue moves like a peristaltic wave, which is more similar to smooth muscle for swallowing (Geddes et al. 2010; Sanches 2004).

Throughout the suck, the nipple remains immobilized in the back of the baby's throat, with no friction from the infant's tongue, lips, or mouth. No friction on the nipple means no nipple pain. This is why *breastfeeding with a perfect latch is not painful*, and why painful nipples are always a symptom of a problem in the latch.

Once the suck reflex starts, the hormone oxytocin from the mother triggers the milk ejection reflex, actively sending milk into the baby's mouth. This ejection is only maintained if the baby can efficiently transfer milk with positive pressure. In addition, the unsuckled breast is prevented from ejecting milk by the same hormone, oxytocin, to maintain positive pressure so that the baby can later nurse from that breast as well.

1.3.4 Keeping the Breast in Position

Neonates don't always have enough oral strength to hold an appropriately large amount of breast tissue in their mouth while they nurse. Sometimes the weight alone is enough to pull the breast out of position. To keep the teat in the baby's mouth without friction, it's helpful to support the weight of the breast from underneath or to squeeze it into "sandwich" shape to support as much breast in the infant's mouth as possible. Most mothers immediately drop the breast once the baby is latched on, which can allow the breast to slip out and result in a shallow latch. The more breast that can be supported in the baby's mouth, the easier it is to sustain a deeper latch (see Fig. 1.4).

Fig. 1.4. To keep the teat in the baby's mouth, it's helpful to support the weight of the breast from underneath or to squeeze it into a "sandwich" shape.

1.3.5 *Observing the Latch*

If the baby has been latched on correctly and is sucking, the angle between the jaw and neck should be at ninety degrees. This angle gives the baby enough room to pull his jaw down during swallowing. The mother can also watch the baby swallow to further confirm the infant is latched on correctly and transferring milk. If the baby's neck is too flexed, there will be no room for jaw excursion and the swallow will be limited. Hyperextension of the neck will result in stretching of the neck muscles and make it more difficult to pull the milk down with the jaw.

With this perfect latch, nursing takes 10–15 min on each breast every 2–3 h. Over time, the mother's milk supply increases to match the needs of the growing baby, so the timing may vary throughout the day. The net result is a neonate who gains weight and has appropriate solid and liquid waste output, and a mother who is pain-free and feels the emptying of her breasts with each nursing.

While nothing is absolutely perfect, most experiences with nursing can fall into this type of pattern, with some variability. The key is understanding that the perfect latch allows both mother and baby to experience nursing success.

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Chapter 2
Anatomy and Physiology of Breastfeeding

2.1 Anatomy

This overview is not meant to be comprehensive. Rather, it contains key factors that help provide a context in which to discuss breastfeeding. There are many books that describe breast anatomy and changes during pregnancy and lactation for those who would like to delve more fully into the subject. Some of those resources are listed at the end of this chapter.

2.1.1 Anatomy of the Infant

The anatomy of newborns is different from that of adults, or even of toddlers. These anatomical differences make breastfeeding possible.

All babies are born with a small degree of retrognathia, or physiologic jaw retraction. This results in a relative posterior positioning of the base of the tongue, and renders the newborn a predominantly obligate nasal breather. The tongue is also larger in neonates than adults relative to the jaw. The base of the tongue sits far back in the throat over the epiglottis. The newborn's larynx is in a higher position relative to an adult and sits near the soft palate (see Fig. 2.1).

This anatomy allows an infant: (1) to breathe even with a teat filling his mouth and his nose pressed up against the breast;

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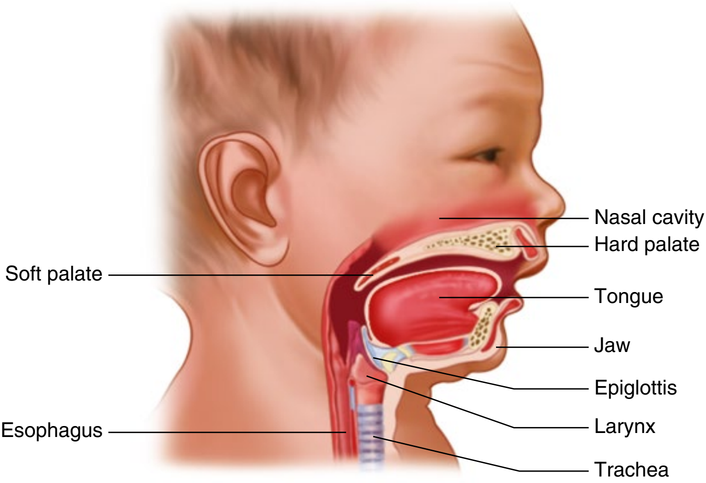

Fig. 2.1. Babies are born with a small degree of retrognathia, which results in a relative posterior positioning of the base of the tongue. The tongue is larger in neonates relative to the jaw, and the larynx is higher and sits near the soft palate.

and (2) to swallow milk without worry of having the liquid spill into the trachea. However, this also means that the newborn has to coordinate sucking, swallowing, and breathing in a very specific way with little margin of error (Sanches 2004).

2.1.2 External anatomy of the breast

On the exterior of the breast are the areola, nipple, and Montgomery glands. The areola is the circular, pigmented area of the breast. Centered in the areola is the nipple. The nipple is composed of horizontal and longitudinal smooth muscle fibers that contract in response to touch. Nipples carry the openings (galactophores) of the lactiferous ducts, which transport and store milk. There are 6–10 such openings in each nipple, corresponding to the 6–10 lobes of milk-producing glandular tissue in each breast (see Fig. 2.2: External and Internal breast anatomy).

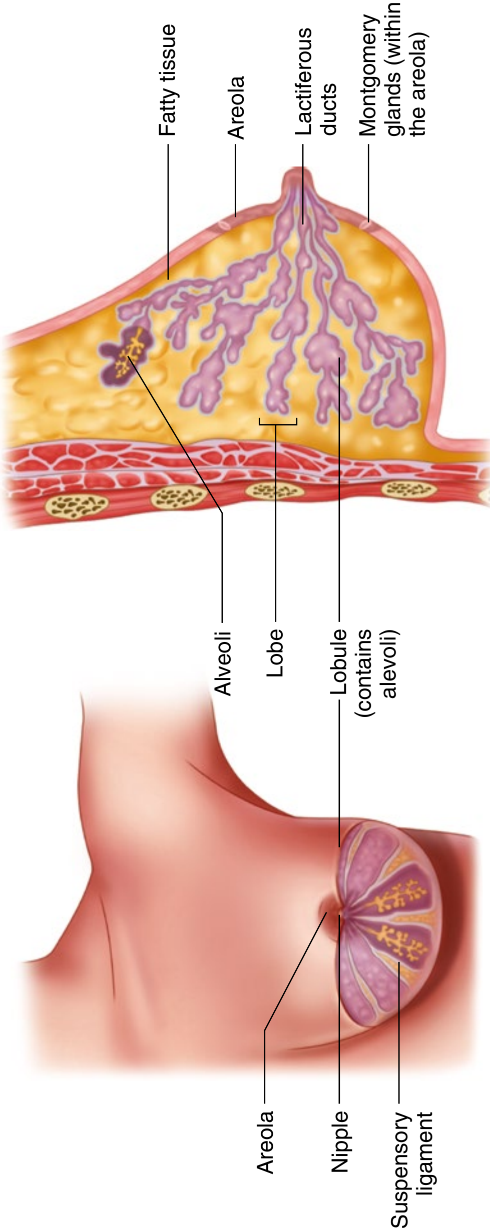

Fig. 2.2. External and Internal breast anatomy.

Surrounding the nipple, within the areola, are Montgomery glands, which secrete an oily liquid in the lactating breast. The yellow liquid creates a seal on the delicate nipple to prevent damage, but it may actually do much more. Decades of research have shown that the breasts of lactating women secrete compounds that affect newborn behavior. They can elicit arousal in sleepy babies (Sullivan and Toubas 1998; Russell 1976; Soussignan et al. 1997), and calm fussy ones (Schaal et al. 1980; Sullivan and Toubas 1998). The odor can also induce appetite (Russell 1976; Soussignan et al. 1997), directional crawling (Varendi and Porter 2001) and head turning behavior (Schaal et al. 1980; MacFarlane 1975; Makin and Porter 1989). The source of these compounds has been disputed, but Doucet et al. (2009) determined that these powerful compounds may come from the oily liquid secreted from the Montgomery glands.

2.1.3 Internal anatomy of the breast

In 1840, Sir Astley Paston Cooper published *On the Anatomy of the Breast*, the most advanced medical text of the time (Cooper 1840). Cooper was a passionate surgeon with a keen interest in dissection, going so far as to steal his neighbors' corpses in order to continue his self-directed education (Burch 2010). (He would also perform public dissections of executed criminals in a combination of egoism and showmanship.)

Cooper injected varying colors of wax into ducts and blood vessels of the breasts of recently deceased women to better understand the internal structures of the breast—including the lactating breast—and to visualize their relationships (see Fig. 2.3).

Cooper's study was so detailed that it became the definitive medical model of the breast, and remained so until 2005. Many physicians practicing today learned all they know about the breast from data that was more than 150 years old.

In 2005, researchers published the results of a study examining the breasts of lactating women using high-resolution

Fig. 2.3. Ducts and glandules. “Ducts and glandules,” from: *On the anatomy of the breast*, by Sir Astley Paston Cooper, 1840. Courtesy of Thomas Jefferson University, Archives & Special Collections.

ultrasound imaging (Ramsay et al. 2005). This study, as well as others that followed (Geddes 2009; Hassiotou and Geddes 2013), have highlighted inconsistencies in the anatomical literature that impact breast physiology and breastfeeding management, including differences from one of the most venerated texts, *Gray's Anatomy*. The information in this chapter is drawn from the newest research, based on state-of-the-art technologies.

The breast is composed of fatty and glandular tissues. Throughout pregnancy, estrogen causes the breast to change from predominantly adipose tissue to being made up primarily of glandular tissue. Studies have shown that a lactating breast transforms from having twice as much adipose as glandular tissue to having twice as much glandular tissue as adipose, although the percentage can vary greatly from woman to woman. These changes, called *lactogenesis I*, are complete by gestational week 22 in most women, but there is enormous variation in timing and degree (Cox et al. 1999). Mothers with preterm babies younger than 28 weeks may not have fully experienced the breast changes required for lactation. Therefore lactation may be delayed in preterm births (Cox et al. 1999).

The glandular tissue is comprised of alveolar sacs (also called alveoli) and the milk duct system. These tissues are made up of two layers of epithelial cells. The inner layer contains cuboidal cells, which can differentiate into milk-secreting cells called lactocytes under the influence of progesterone and estrogen. The outer layer is made of myoepithelial cells, which have the properties of smooth muscle and contract in response to hormones. The alveolar and ductal tissues are supported within the breast by a loose framework of fibrous connective tissues called Cooper's ligaments, named for the same Sir Astley Cooper who was so fond of dissection.

In the lactating breast, tracing inward from the nipple, the terminus of each duct forms into alveoli, which produce and store most of the milk. Alveoli contain lactocytes in the luminal layer, and myoepithelial cells in the outer layer (Sternlicht 2006; Watson and Khaled 2008). Lactocytes are predominantly present in the alveoli and directional, in that they point toward the lumen where milk is secreted (Fig. 2.2: External and Internal breast anatomy).

During lactation, the milk is transported from the alveolar sacs via the ductal system to the nipple, where it is expelled through the nipple ducts.

Ductal structures are loosely associated into lobules, each of which contain between 10 and 100 alveoli (Hartmann 1991). In turn, these lobules are arranged into lobes. Each lobe is surrounded by dense fibrous connective tissue with embedded fat cells, referred to as intra-lobular stroma. This stroma contains mesenchymal cells that are highly responsive to hormonal cues (i.e., oxytocin), and which are associated with the development of lactating breasts (Bissell et al. 1999; Wiseman and Werb 2002). The lobes of glandular tissue are intertwining and of varying sizes, with up to 30-fold differences in volume (Moffat and Going 1996). It was formerly thought that alveolar sacs swell to form "pools" of milk in large sacs, but the size of the alveoli remain relatively consistent—about 0.12 mm in diameter each (Hartmann 1991). There are just more of them to contain more milk in lactating breasts.

Most of the glandular tissue is in the anterior part of the breasts, directly underneath the areola, and therefore more easily accessible to the infant.

In addition to these changes in glandular tissue, estrogen also causes an increase in blood flow to the breasts. By 24 weeks of pregnancy, blood flow is doubled compared to pre-pregnancy. This change persists throughout lactation. Most of the extra blood flow comes from the two main vessels supplying the breasts: the Internal Mammary Artery (IMA) and the Lateral Thoracic Artery (LTA). The breast is additionally fed by the intercostal arteries and the thoracoacromial artery. Superficial veins also become more prominent in pregnancy and throughout lactation. The ratio of blood flow to milk yield is approximately 500:1 (Linzell 1960; Christensen et al. 1989).

Nerve supply to the breasts comes from the second to sixth intercostal nerves, which divide into superficial and deep branches (Cooper 1840). The deep branches supply the glandular tissue and nipple, and the superficial branches supply the nipple and areola (although sensory innervation is predominantly found in the nipple). Nerves have been identified along major ductal systems, but not near smaller ducts. There is motor innervation of the smooth muscle of the areola and nipple, (Courtiss and Goldwyn 1976) and of the mammary arteries (Cowie 1974). But there is no motor innervation of the lactocytes or myoepithelial cells, which means they are under hormonal, not neurological control.

2.2 Physiology

2.2.1 Hormone Effects and Regulation

The main hormones responsible for the production and maintenance of milk supply are progesterone, prolactin, oxytocin, cortisol, and Feedback Inhibitor of Lactation (FIL).

During pregnancy, high levels of *progesterone* suppress the production of milk by inhibiting the release of prolactin. Within 48–72 hours after birth, progesterone levels decrease, triggering prolactin release (Suzuki et al. 2000; Czank 2007; Pang and Hartmann 2007).

Prolactin is stimulated by infant suckling and occurs 7–20 times a day. It is produced in the anterior pituitary gland, and is positively and negatively regulated (it can be inhibited by progesterone, estrogen, norepinephrine, and dopamine). Prolactin causes stimulation of mammary glandular growth and epithelial cell proliferation, as well as milk production (Neville et al. 2002).

Serum prolactin levels are high during the first few weeks, but wane after that. After about week 3, prolactin returns to near prepregnancy levels. This is one of the reasons why early evaluation of potential breastfeeding problems is so crucial. During the first week, frequent stimulation of touch receptors on the breast stimulates an increase in prolactin receptors. With more available prolactin receptors, even as prolactin levels naturally decrease, milk production can be maintained for the duration of nursing (Jacobs 1977; Cox et al. 1996).

Initially, the circulating levels of prolactin vary throughout the day, with the highest level occurring about 1 h after sleep, and the lowest level in midmorning. Prolactin levels peak 30 min after the beginning of a feeding, preparing the breast for the next feeding.

If milk accumulates in the breast, the binding of prolactin is reduced. It is hypothesized that this is due to change in lactocyte shape when the alveoli are filled with milk, effectively deactivating the prolactin receptor (Berry et al. 2007). Full alveoli have lowered uptake of prolactin, and empty alveoli have higher binding affinity of prolactin (Cox et al. 1996; Cregan et al. 2002; Daly et al. 1993). When prolactin cannot bind, milk synthesis slows, so full breasts result in an inhibitory effect on milk production. As the alveoli empty, prolactin can again bind, which allows the alveoli to again fill with milk.

In addition to prolactin, infant suckling also stimulates *oxytocin*, resulting in milk ejection, or "letdown." It also results in uterine contraction to help the uterus shrink back down to pre-pregnancy size. By suckling, the infant stimulates touch receptors around the areola and nipple, which create impulses that activate the dorsal root ganglia, spinal cord, and hypothalamus, resulting in oxytocin release from the posterior pituitary gland. When oxytocin is released, it binds to receptors on the myoepithelial cells that line the alveolar ducts, causing these cells to contract and expel the stored milk from alveoli into larger ducts (Prime et al. 2007; Cowie 1974). This is called the milk ejection reflex.

The milk ejection reflex is transient, lasting between 45 s and 3.5 min. It is also pulsatile, meaning that oxytocin is secreted more than once, resulting in multiple ejections during nursing or pumping (Drewett et al. 1982; McNeilly et al. 1983; Uvnas-Moberg et al. 1990). Prior to the milk ejection reflex, very little milk can be removed, so it is critical for successful nursing (Young et al. 1996; Kent et al. 2008). This is why mothers often get less milk from pumping alone: because the touch receptors on the areola are not stimulated in the same way as by the baby's mouth so there is less oxytocin release and therefore less milk ejection. Oxytocin also prevents the unsuckled breast from ejecting milk to maintain positive pressure in that breast so the baby can nurse more easily from that side when the time comes.

Mothers can sense the milk ejection reflex happening with feelings of warmth, pain, tingling, pressure, and related sensations. The first letdown results in the strongest sensations and the largest volume of milk (Isbister 1954; Prime et al. 2007; Geddes 2009). Gardner et al. (2015) showed that milk ejection occurs asynchronously, suggesting that the timing of myoepithelial cell response differs, resulting in heterogeneous emptying of the breast.

It's important to note how amazing, reciprocal, and layered this oxytocin process is. In addition to milk ejection, oxytocin also induces a state of calm in the mother and promotes bonding between the mother and her infant. And this warm emotional state, in turn, affects oxytocin levels. While oxytocin is triggered by a suckling infant, levels are also influenced by the mother's subjective feelings and sensations. Smelling, touching, seeing, or even thinking lovingly about her baby or hearing her baby's cry can stimulate oxytocin release. Conversely, oxytocin is inhibited by emotional or physical pain.

Cortisol is a steroid hormone produced in the adrenal glands. It is secreted in response to stress, which includes pain. High levels of cortisol can delay the production and secretion of milk—another way that a mother's psychological and pain states can affect nursing ability.

In addition to these systemic controls, milk production is also regulated locally. A whey protein called *Feedback Inhibitor of Lactation* (*FIL*), first in identified in goat's milk, inhibits milk secretion in a reversible, concentration-dependent manner. FIL is produced by lactocytes along with other constituents of milk, and it reversibly blocks secretion by those same lactocytes. (This is called autocrine control.) FIL also affects other aspects of lactation: It disrupts membrane trafficking, resulting in down-regulation of prolactin receptors, which then causes a decrease in epithelial cell differentiation into lactocytes (Peaker and Wilde 1996; Wilde et al. 1998).

In other words, removal of milk from the breast prevents collection of FIL, allowing milk production and secretion to continue. Thus, an empty breast produces milk faster than a full one. But if FIL is *not* removed—if the breast remains full—then the FIL concentration increases, preventing further milk secretion. The longer a breast is left full, the more FIL accumulates, inhibiting further milk production, thus helping mothers to avoid the harmful effects of engorged breasts, such as mastitis and plugged ducts. In this way, FIL fine tunes and regulates the volume of milk so the mother produces the amount of milk needed by her baby, without excess or shortfall (Daly et al. 1993). Interestingly, FIL controls milk production independently in each breast, so if a mother has difficulty nursing from one breast (due to injury, for example), she can continue to nurse from the other side without risk to either breast.

2.2.2 Lactogenesis

By mid pregnancy, breasts begin to differentiate into milk-producing glands by increasing alveolar cells, ductal proliferation, and myoepithelial cell hypertrophy. About 12 weeks before delivery, mammary tissues grow, and breast size and weight increase. For many women *colostrum*, or "first milk" production begins.

Colostrum is produced in small quantities, only about 20–40 ml/day, but it is very rich in nutrients. It contains the antibodies IgA, IgG, and IgM, white blood cells, and a higher concentration of minerals, protein, and vitamins than later milk. It is also low in carbohydrates and fat, and acts as a mild laxative, helping the neonate pass meconium. All these factors make colostrum ideal for the neonate's immature digestive system—it is all the nutrition an infant needs for the first few days.

By Day 3 after birth, progesterone levels are sufficiently low, so breasts begin making *transitional milk*. This is the onset of *lactogenesis II*. Compared with colostrum, transitional milk is lower in proteins and immunoglobulins, and higher in calories, fat, and lactose.

Initially, the volume of milk increases regardless of whether the mother is nursing. By Day 3 or 4, breasts produce around 300–400 ml/day of milk. By Day 5, most breasts produce about 500–800 ml/day of milk. While production increases, the amount actually secreted varies widely based on several factors, including maternal wellbeing and fatigue. Maternal stress and pain can cause increased levels of norepinephrine, dopamine, and cortisol, which inhibit the synthesis of prolactin and decrease overall milk supply.

By about 10–14 days after birth, the breast produces *mature breast milk*. Mature breast milk is often delineated into foremilk and hindmilk, but this delineation is misleading. Breasts only make one type of milk. However, when milk is produced, the fatty component sticks to the walls of the alveoli, while the liquid component travels down the ducts and mixes with any leftover milk from the previous feeding. When the infant begins a feeding, he first encounters the watery *foremilk*, which has a higher concentration of lactose and less fat (which was left behind in the alveoli). As the infant continues to nurse, the milk ejection reflex is triggered, and the fattier hindmilk is squeezed out of the alveoli into the ducts.

Therefore, the composition and amount of milk an infant transfers from the breast depends on the volume of milk mom produces, how long the baby nurses on each breast, and the amount of time between feedings. For example, if the mother produces a large volume of milk and the infant nurses for a short time, he may fill up on mostly foremilk before getting to the hindmilk. This can result in increased gas, colic, and lower weight gain.

Regardless of how healthy or unhealthy a mother's diet is, mature breast milk is generally made of the following breakdown of nutrients (Ballard and Morrow 2013):

2.2.2.1 Kcalories

60–75 kcal/100 ml

2.2.2.2 Water

90 g/100 ml water

2.2.2.3 Protein

0.8–1.3 g/100 ml of protein, which includes 30 % casein and 70 % whey proteins. Whey proteins include alpha lactalbumin, lactoferrin, lysozyme, serum albumin, secretory immunoglobulin

IgA (sIgA), insulin, epidermal growth factor (EGF), and many enzymes. These proteins serve many functions, such as host defense, nutrition, and enzymatic activity. Specifically oligosaccharides protect the gut from bacterial attachment; immunoglobulins, primarily sIgA, protect the gut lining from infection; and whey proteins kill bacteria, viruses, and fungi.

Casein has low solubility and can turn into clots or curds. Whey proteins are soluble and remain in liquid form, making them more easily digestible. Human breast milk is lower in casein than most animal milks, such as cow's milk, which has 18 % whey and 82 % casein. Excessive casein can overwhelm the infant's maturing kidneys. Lactoferrin, sIgA, lysozyme, and alpha lactalbumin are found only in human milk. Human milk does not contain beta-lactoglobulin, found in cow's milk, which infants often cannot digest. For all these differences in composition, a cow's milk-based formula is a common cause of infant intolerance.

2.2.2.4 Carbohydrate

6.9–7.4 g/100 ml of carbohydrates, which is 90–95 % lactose. After colostrum transitions to mature milk, the lactose concentration remains constant. It is mainly used as an energy source, but a small amount is not absorbed and promotes softer stools. It also contains 1 g/100 ml of 100 or more oligosaccharides. These are carbohydrate polymers that control intestinal flora by promoting certain bacterial strains to grow in the gut, therefore protecting against infection.

2.2.2.5 Fat

3–5 g/100 ml of fat, mostly in the form of palmitic and oleic acids. Fats provide 50 % of the calories in human milk and therefore are a major source of energy. The fat content of milk is variable throughout the day and increases over the course of breastfeeding. It is present mostly in the alveolar sacs and distal ducts, so the infant must first drain the "foremilk" to get to this fat rich "hindmilk." Lipids are present in fat globules and many essential fatty acids in the form of triglycerides. Certain fatty acids are of interest—DHA (docosahexaeonic acid) and ARA (arachnidonic acid)—because they are found only in human milk. They are important in neurological and visual development of the infant.

2.2.2.6 Vitamins and Minerals

It contains 0.2 g/100 ml in total, including:

- 25 mg/100 ml calcium,
- 9 mg/100 ml phosphorus
- 200 mg/100 ml sodium
- 3.5 mg/100 ml magnesium
- 5 mg/100 ml vitamin C
- smaller amounts of iron, copper, zinc, vitamin A, pantothenic acid, nicotinic acid, iodine
- Trace amounts of vitamins K, D, E, and B

There is a high concentration of zinc initially, but it declines over the first 6 months of nursing. Also, there is a low concentration of iron. Infants are born with sufficient iron stores at birth, but they decline over the first 6 months of life. Similarly, vitamin D is present in low concentrations in human milk and is not easily supplemented to the mother. Current recommendations from the American Academy of Pediatrics (Perrine et al. 2010) include vitamin D supplementation for infants who are exclusively breastfed for the first 6 months of life. Solid foods are introduced at 6 months, resolving the need for iron and zinc supplementation.

2.2.2.7 Cellular Elements

Breast milk contains maternal cells (such as leukocytes) and epithelial cells, such as stem cells, lactocytes, myoepithelial cells, and progenitor cells. Neutrophils are present in greater concentrations in colostrum. They decrease in mature milk and are replaced by macrophages and lymphocytes to address the changing needs of the infant immune system (Hassiotou et al. 2013).

2.2.3 Galactopoesis (Maintenance of Lactation)

Very quickly after the baby begins nursing (around Day 2 or 3), milk supply transitions from endocrine to autocrine control. Therefore, production changes from being mostly under global hormonal control (via oxytocin and prolactin) to functioning mostly by supply and demand (with the help of FIL). Continual removal of milk from the breasts maintains the supply. More detailed explanation of maintenance of lactation is discussed in Chapter 4.

With so many factors in play, the timing, quality, and frequency of nursing in the first few weeks are critical to establishing a successful nursing pattern.

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Chapter 3
Milk Supply and Regulation

Once anatomy of the breast and infant are understood, it is possible to begin a more in-depth discussion of the physiology of breastfeeding. This chapter covers the topics of milk supply, global and local regulation of supply, and oversupply, with a brief discussion of how milk is affected by maternal nutrition.

3.1 Milk Supply

Any discussion of milk supply is complex. First, the supply must be established, then it must be maintained. And during this time, two variables are in play: the breast's ability to produce milk and the baby's ability to transfer it efficiently. These two forces must act synergistically to sustain milk production for the duration of breastfeeding.

Further complicating the situation is that while the breast and the baby influence each other, they are also self-regulating. For this discussion of milk capacity, I will assume that the baby is transferring milk efficiently. This way, it is possible to understand the issue of milk supply from the

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perspective of the breast alone. Factors to consider in any discussion of milk-making ability and sustenance are:

- The breast's milk-making capacity—how much is made and stored at each feeding;
- global regulation—endocrine function;
- local regulation—autocrine function;
- how timing and degree of emptying affect the whole process.

3.1.1 The Breast's Milk-Making Capacity

Breast's milk-making capacity is different from breast milk production. The breast's capacity to produce milk is directly related to the amount of glandular tissue present in the breast. This is not to be confused with the size of the breast, which may be due to fatty tissue. Large breasts do not necessarily mean lots of glandular tissue and small breasts may be mostly glandular. Breast capacity is *the maximum volume of milk a breast can make and hold at a given point in time*. Milk production and storage capacity varies widely, not only between women, but also for the same woman between months, between pregnancies, and for multiparious births. This is because of natural variations and changes in the development and maintenance of glandular tissue in the breast. Breast milk production is the total amount of milk a breast can produce during a 24 h period, which is discussed below.

First, consider just the capacity.

Unfortunately, there is no clinically easy way to determine the milk-making capacity of a particular mother. Since the milk-making capacity of the breast increases over the first month, full capacity is not always apparent until week 4. Also, if mother-baby pairs do not regulate together early on, the capacity of the breasts does not always develop to its full potential. If the baby is in the NICU, for example, and the mother does not pump or hand express, she may miss an important window to maximize her milk-making potential. When it comes to capacity, every day during the first month matters. Interestingly, each breast has its own capacity, independent of the other breast. So if one breast has damage or mastitis, the other can continue to produce milk.

In the past, researchers attempted to determine capacity by test-weighing the infant, mother, or both. But these measures really tested infants' transfer ability, not mothers' milk-making capacity (Daly and Hartmann 1995a, b). Also, Arthur et al. (1987) found that evaporative water loss (EWL) can result in an overestimate of the amount of milk transferred by an infant. In test-weighing mothers, EWL accounted for a wide range of the weight difference (3–94 %). In test-weighing infants, 3–55 % of the weight change was attributable to EWL.

Pumping the breast is one direct measure of capacity, but a single pumping session is not reflective of the full capacity. The volume of stored milk varies throughout the day, so 24-hour collective pumping is more reflective of the breast's abilities than one pumping session. For example, Benson (2001) found that during the first week, babies nurse most frequently from 3:00 am to 9:00 am, which correlates with increased prolactin levels in mothers, which in turn creates more overnight milk (Cregan et al. 2002). Additionally, different pump vacuum pressures and timing of emptying result in different degrees of removal. The pump also cannot extract milk from the breast as well as an efficiently suckling infant.

Dr. Peter Hartmann and the Human Lactation Research Group at the University of Western Australia developed a research tool for indirectly measuring milk capacity at a particular feeding, called the Computerized Breast Measurement (CBM) system. It utilizes hardware and software to measure the distortion of light patterns by glandular breast tissue to measure changes in breast volume. The change in breast volume before and after breastfeeding was then compared to the amount of milk removed by the infant as determined by test-weighing. They found a close relationship between the removal of milk by the infant and the change in breast volume on CBM in infants who are successfully nursing.

The CBM system does not determine absolute breast volume, but rather measures a relative volume of the part of the breast that produces the most milk. They did a series of studies using this system to study how milk production is regulated. It is important to note, however, that these studies were done on women who were already successfully nursing (during months 1–6). This means that patterns had already been established, and the mother and baby had already regulated to one another. The results do not pertain to the first month of nursing, when the patterns are being set. Further, the sample sizes were quite small (n = 4–11). However limited, these studies laid the groundwork for much of our understanding of global and local regulation of milk supply.

3.1.2 Global Regulation: Maternal

The first month of milk production is the most critical. This is because global hormonal regulation in the mother lays the groundwork for future milk production. After the first month, it is possible to increase the supply, but there is a limit to the degree of increase, and it is more difficult to accomplish. De Carvalho et al. (1983) discovered that the more frequently babies nursed before the 35th day, the more milk was transferred and the more weight they gained. Seems completely logical. However, after day 35, there was no increased weight gain or milk intake from more frequent feedings. Let's walk through why this is so.

The first few days after birth, colostrum is produced by the breast because progesterone levels drop and prolactin peaks. Touch receptors on the breast, stimulated by infant suckling, increase the number of prolactin receptors at the breast. This only happens for the first few days, then that window for more prolactin receptors closes. Touch receptors also stimulate release of oxytocin, which results in myoepithelial cell contraction and the milk ejection reflex. This reflex happens several times during each nursing session and is responsible for fully emptying the breasts. When the baby nurses, prolactin is released 30 min afterwards, to stimulate lactocytes to produce more milk for the next feeding.

At day 3–7, colostrum converts to transitional milk, and milk volume increases. From week 1–2 transitional milk changes to mature milk and circulating prolactin levels begin to drop. At this point, the lactiferous ducts are mostly filled with foremilk, which is watery and has a higher concentration of lactose. The alveoli contain more fatty milk, or hindmilk. So the heavier milk is the last to leave the breasts. Oxytocin continues to work as it has, stimulating the myoepithelial cells, which surround the alveoli to squeeze out the hindmilk and push the foremilk forward and out. When the hindmilk is finally removed, the baby gets full. By 1 month, the volume of breast milk reaches its peak and stays consistent throughout the remainder of breastfeeding. This is because the volume required by the infant also stays constant.

By 6–10 weeks, circulating prolactin is back down to near pre-pregnancy levels. Having lower amounts of circulating prolactin means that the breasts must have a lot of prolactin receptors so they remain very sensitive to the hormone's effects as breastfeeding continues (Neville et al. 1988). In this way, tiny surges in prolactin in month 2 stimulate the same amount of milk production as larger prolactin surges in week 2, simply because there are so many more receptors in the lactocytes of the breast. Again, it cannot be stressed enough that this is why breastfeeding problems need to be addressed as quickly as possible, preferably in the first 2 weeks, so that milk capacity can be optimized.

This system is fine-tuned by the fullness of the breast. Bound prolactin causes an increase in milk production, resulting in fuller breasts. As the breasts fill with milk, the prolactin receptors stretch, changing shape so prolactin no longer binds and milk production slows (Cregan et al. 2002).

3.1.3 Local Regulation: Infant

Once the groundwork has been established after the first several weeks, the regulation of milk production transitions from global to local control. While global controls may still be active in the background, the milk supply becomes more dependent on the infant's milk removal than the mother's ability to make milk (Daly and Hartmann 1995a, b, part 1 and part 2). In other words, the breasts continue to provide as much milk as the infant needs by refilling in response to milk removal. But there are parameters of milk removal that must be considered: The frequency, degree of emptying, and duration of milk removal ultimately determine milk production and regulation.

There is an optimal pattern that maximizes the milk production available to the infant.

Frequency of nursing is important to a certain degree. Daly et al. (1996) showed that milk synthesis remained constant if the breasts were emptied every 1–6 h. After 6–18 h, milk production was reduced compared to when the breasts were emptied more frequently. This correlates with the mother's milk-making capacity, because if she can store a lot of milk, then less milk will be made if the milk is not removed. If the breasts are not emptied in 24 h, the tight junctions between cells break down and the glandular tissues in the breast involute. Breasts go back to their pre-pregnancy status and milk production eventually ceases.

Many studies have established that the milk supply responds not only to the frequency of nursing, but even more so to the degree of emptying (De Carvalho et al. 1982, 1983; Butte et al. 1984, 1985; Dewey and Lönnerdal 1986; Dewey et al. 1991; Pinilla and Birch 1993). In other words, the more thoroughly the breast is emptied, the more milk is produced.

The duration of milk removal has been studied in the context of pumping, since the volume of milk removal over time can be more objectively measured. Ramsay et al. (2005) showed that nearly half of the total volume of milk is removed during the first milk ejection, which happens in the first few minutes of nursing. This finding was corroborated by Prime et al. (2012), who showed that milk flow rate is reduced after the first 8 min of pumping, and recommended against long nursing times because they result in less effective milk removal. Mitoulas et al. (2002) echoed that result, showing that, although the rate of milk expression varied between mothers, it remained constant for the first 2.5 min of milk removal.

Studies that defined these parameters led to the discovery of the Feedback Inhibitor of Lactation (FIL). FIL, a polypeptide, is produced by lactocytes along with milk and, once secreted into the alveolar lumen, blocks the lactocytes from producing more milk. When milk is removed from the breasts, FIL is removed with it so milk production can once again commence. FIL also results in down-regulation of prolactin receptors and decreases epithelial cells from differentiating into lactocytes (Peaker and Wilde 1996; Wilde et al. 1998). This is how milk production is controlled locally, not only in each breast, but also in each breast independently of one another. Infants can ultimately regulate their own milk intake with each breast (Daly et al. 1992).

In summary, complete breast emptying in less than 10 min on each breast with intervals of less than 6 h will allow for the maximum milk production available for the infant. But breast milk capacity must also be factored into the equation.

Breasts with lower milk-making capacity can have a high total milk production if they are emptied more frequently (Daly et al. 1996). Breasts with larger milk-making capacity that are emptied less often can still fulfill the needs of the infant. In fact, a mother's available supply may be several-fold higher than her infant's needs. Cox et al. (1996) found that only 64 % of total milk production is utilized by the infant in a 24 h period. Daly et al. (1992) also showed that the amount of milk available in the breast is not necessarily an important determinant of the amount of milk removed by the infant at a given breastfeed. So even with an efficiently nursing infant, more milk can be available than is removed. Conversely, if the baby is not transferring milk efficiently, a mother's supply may not be sustainable past a certain point, usually 6–10 weeks, when local control is in full effect.

3.2 High-Volume Milk Producers: Oversupply, or Hyperlactation

Now that the dynamics of milk supply and emptying have been laid out, it is important to note the exception to the rules. While the focus of most breast milk research is on preventing a low milk supply, it has already been established that many mothers have more milk than their babies can utilize. In fact, there are some women who produce such copious amounts of milk—with increased rates of letdown, flow, and/or volume—that the recommended patterns of milk removal may not apply.

We do not know why this happens, whether it is due to more glandular tissue or hormonal regulation, or both. Other than hyperprolactinemia, where prolactin is over-secreted by the pituitary, or purposefully increasing milk capacity by frequent pumping and breast stimulation early on, no other cause has been identified. In the discussion section of their paper on prolactin and milk synthesis, Cox et al. (1996), the authors commented on a mother with oversupply who consistently showed no relationship between milk prolactin and degree of breast fullness. They posited that, in her case, there was a lack of response to local feedback inhibition, i.e., a resistance to the effects of FIL. This may be a good hypothesis for a study to determine the cause and definition of oversupply.

In fact, there is no definition for what constitutes oversupply, other than subjective descriptions. There are also no epidemiological studies to determine the prevalence of women who have oversupply. Yet, it is described and discussed in breastfeeding guidebooks and among lactation consultants with defined symptoms and treatments based on the findings of one paper. In 1996, a Canadian physician (Livingstone 1996) reported on his clinical experience working with 8000 breastfeeding families. He described overproducers as women who produced more than 60 ml/h of breast milk. In his practice, there was a 15 % incidence of this phenomenon. He coined the diagnosis of Maternal Hyperlactation Syndrome because mothers with a lot of milk experienced increased incidence of milk stasis, mastitis, plugged ducts, and breast abscess. He also noted that their infants experienced excessive colic, frequent and rapid feedings, choking and coughing at the breast, diarrhea, and sometimes weight loss, despite the excess supply. However, it is unclear whether these problems were due the excessive supply of milk, the infant's inability to transfer milk efficiently, or a combination of both. Perhaps many more mothers have an abundant supply, but if their baby can transfer milk efficiently they will sync up more easily. In light of the fact that studies have shown there is often more milk available in the breast than the baby needs, the prevalence of oversupply is probably higher than 15 %. Of course, this depends on how it is defined.

Overproducers make more of both foremilk and hindmilk. Since foremilk has a higher concentration of lactose, it does not satiate the baby and can cause diarrhea, et cetera—all of the symptoms of Infant Hyperlactation Syndrome. So if a mother has an oversupply, the optimal pattern of feeding is different than it is for mother with normal or low supply. In mothers with oversupply, it is more advantageous to empty one breast completely with each feeding, sometimes even removing some of the foremilk by pumping before nursing the baby. This way, the baby gets more hindmilk and not excessive amounts of foremilk. Another effective method is to completely empty both breasts first thing in the morning, then feed the baby on one breast at time for 10 min every 2–3 h (van Veldhuizen-Staas 2007). This is called block feeding.

Additionally, when a mother has oversupply and her baby struggles at the breast, it can be tricky to assess whether it is because he is unable to transfer milk efficiently, or because he is drowning in the oversupply. With oversupply, the baby can gain weight regardless of his struggle. But in many women, this time of overproduction is limited. Eventually their supply wanes if the baby is not completely emptying the breast. The precise mechanism is not known, but may be related to increased effects of FIL as prolactin's role in milk production wanes.

3.3 Maternal Nutrition

Resting, drinking more water, and eating a healthy diet are often recommended to nursing mothers. While these factors affect the available vitamins, they do not impact the amount and quality of breast milk. However, they do affect the mother. The mother's nutritional requirements for most nutrients are substantially increased by breastfeeding. The lactating breast uses 30 % of the mother's daily energy requirements and has a higher energy requirement than the brain. The duration and extent of lactation ultimately determines the extra needs of the mother.

In general, maternal nutrition does not impact the nutritional composition of milk, with a few exceptions. While most macronutrients remain constant in breast milk regardless of maternal intake, the proportions of different fatty acids vary with maternal dietary intake. Human milk fatty acids show extreme sensitivity to maternal nutrition and are implicated in neurological development, specifically docosahexaenoic acid, DHA (Innis 2014). Major mineral concentration (Ca, Mg, Ph, Na, K) is not affected by maternal intake (Kent et al. 2009). However, vitamin content is dependent on maternal stores and intake. Certain nutrients, such as folate and calcium, may be maintained in breast milk at the expense of the mother. Conversely, increasing nutritional supplements beyond RDA recommendations does not increase the levels in breast milk, with the exception of vitamin B6, vitamin D, iodine, and selenium. It is possible that poor maternal nutrition results in a decrease in host resistance factors, such as immunologlobulins.

Lactating women typically lose 0.5–1.0 kg (1–2 lb) per month for the first 4–6 months of breastfeeding. This weight loss is mostly physiologic (Nutrition During Lactation 1991). Lean body mass can be preserved in breastfeeding women by increasing dietary protein to promote skeletal muscle conservation (Motil et al. 1990, 1998). But not all women lose weight, and approximately 20 % maintain or actually gain weight.

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Chapter 4
The Progression of Nursing

The anatomy and physiology of breastfeeding takes us only part of the way toward understanding the ideal progression of nursing, from the initial latch on the first day…to the first week…to the first month…through long-term maintenance. This chapter describes how the mother—infant dyad need to work in order to create a successful breastfeeding experience for both. This sets up the ideal nursing situation, and delineates issues that may be useful for the practitioner in a clinical setting.

4.1 Early Breastfeeding: The First Week and Month of Nursing

The first month of nursing is the most critical, because what happens during this time can determine the overall success or failure of nursing. Wagner et al. (2013) found that 92 % of breastfeeding mothers expressed concerns at day 1 and 3. The most common concerns were milk quantity (40 %), breastfeeding pain (44 %), and infant feeding difficulties at the breast (52 %). Mothers were at greatest risk of stopping nursing at day 7 due to infant feeding difficulty, and at day 14 due to poor milk quantity. For these reasons, Taveras et al. (2003) recommended that breastfeeding interventions should focus on counseling during mothers' postpartum hospitalization

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and shortly after mother and baby are discharged. Timing is critical, but it is important that, in addition to providing education and support, that we offer sound clinical advice that will result in breastfeeding success, and not confusing recommendations.

This time can be very challenging for mothers. They may avoid asking for help in these early days because, not having any other experience, they assume that what is happening for them is "normal." They may glean expectations from common lore, guidebooks, the internet, or friends and family. If they do seek professional help, they may be told to "wait it out" or focus only on one parameter, such as baby weight gain or wet diapers, and miss the window of opportunity for intervention. Or they may not recognize the pattern of a problem, since the first weeks are a time of transition—each day may be different from the last.

During the first week, the pace and duration of nursing is set. Infants begin to make associations between their time at the breast and satisfaction of their needs. In addition, as explained earlier, the mother's physiology changes—she develops more prolactin receptors in her breasts in response to infant suckling.

After the first month, milk production shifts from global to local control. This does not mean that nursing will fail if things don't go perfectly, but there is a limit to the improvement that is possible after the first several weeks. Furthermore, many of the breastfeeding problems that appear later have roots in issues that could have been corrected during the first week or month.

This chapter describes the ideal progression of nursing during the first week, month, and thereafter, as well as signs that signal a budding problem. It's important to remember the multidimensional, highly individual nature of breastfeeding. It is possible for the same circumstances to result in different behaviors in different mothers and babies, leading to different nursing outcomes. "Normal" must be redefined for each mother—baby dyad, without subjective interpretation of the infant's behavior or generalization from previous cases.

4.1.1 *The Initial Latch*

The ideal latch was described in Chap. 1. It is critical to note that if the baby is not able to latch on and nurse in the most efficient manner, then the expectations of normal nursing cannot be met. The latch must be corrected *first*, and at the earliest possible time, to allow breastfeeding to proceed as expected. The latch can be corrected with intervention or positioning, but it will *not* correct itself. The "wait and see" approach may result in successful nursing, but that is the exception, not the rule. Using the skiing analogy, if the equipment is not properly fitted, then there is a limit to ones success in going down the mountain. Ill-fitting equipment will never adapt to the skier. You may be able to make it down a few bunny hills, but you will never be able to progressively ski or make it down a black diamond.

So, how can we know whether or not the baby has a good latch? Merely observing a mother/baby dyad nursing is most commonly used, but external observations can be misleading. A study by Côté-Arsenault and McCoy (2012) showed that there is a poor association between number of swallows and infant milk intake in the first few days of life. Merely observing a baby nursing does not give an accurate assessment of intake. And since we cannot see inside a baby's mouth we cannot tell how deep the latch is from the outside.

One of the most obvious indicators of a shallow latch can be elicited through the mother's initial observation. Mothers notice right away if their baby cannot gape widely enough to latch. They try to follow breastfeeding books or professional nursing advice, but the baby simply does not open his mouth wide enough. This can result in the baby falling off the breast or frequent relatching. Sometimes mothers are told to hold the jaw down, or the baby may be labeled as lazy. Neither is the case. At birth, a baby will open his mouth as wide as he possibly can. If the gape is not there on day 1, it will not improve without intervention.

Perhaps the most reliable, common, and immediate indication of an incorrect latch is nipple pain. It is among the primary reasons women choose to stop nursing. Pain is the biggest deterrent to nursing, but it is also a very early indicator that something is wrong and needs fixing right away. The nipple is the most sensate part of the breast. It is supposed to fit all the way in the back of the throat, away from any moving parts or friction. It opens over the baby's esophagus so milk can move efficiently into the stomach. If the nipple is not correctly positioned, it moves around in the baby's mouth and that friction causes pain. In this way, the pain elicited by the nipple acts as an alarm for the mother, signaling that something is wrong.

If the mother experiences pain while nursing, indicating a shallow latch, many typical first-month baby behaviors can be misread. For example, if the baby nurses frequently but the mother experiences severe pain with each latch, then the pattern of frequent feeding on demand will actually *decrease* milk supply. This is because the breasts are not being emptied, so prolactin is not being released and FIL is building up. Pain can also trigger the release of cortisol, a stress hormone, which further suppresses milk production and can lead to increased stress and postpartum depression.

The main exception to the rule of pain is if a baby has a high, arched palate. In this case, the mother may feel no pain, even though the baby is not properly latched. The nipple may not reach the palate to be compressed, so the pain alarm is not triggered even though the palate and mouth are insufficiently filled with breast tissue and the baby easily falls off the breast.

With a sufficiently deep, locked-in latch with efficient milk transfer, this is how the first week and month of nursing should progress:

4.1.2 Week 1

At birth, an infant has all the reflexes necessary to begin nursing immediately. The immediate time after birth is a "sensitive period," which can predispose mother and infant to bonding if they are in intimate, close contact. Therefore, skin-to-skin contact (SSC) with the mother is strongly recommended. It has been shown that infants who are allowed SSC and self-attach may continue nursing more effectively. Ideally, the naked baby is placed prone on the mother's bare chest immediately after birth. In full term, healthy babies, this triggers a series of innate behaviors (Moore et al. 2012).

Widstrom et al. (2011) described nine behaviors that occur as a result of early SSC: birth cry, relaxation, awakening and opening the eyes, activity (looking at the mother and breast, rooting, hand to mouth movements, soliciting sounds), a second resting phase, crawling towards the nipple, touching and licking the nipple, suckling at the breast and finally falling asleep. Dani et al. (2015) confirmed the specific behavioral sequence and observed another, tenth behavior, of the infant massaging the mother's breast with his hand.

Even during the first week, infants provide several hunger indicators. The earliest cues are rooting and putting the hand to the mouth (American Academy of Pediatrics Statement on Breastfeeding 2012). It is best to feed the baby when he exhibits these early cues and not wait for later cues, such as crying or becoming frantic, which can make latching on more challenging. It also makes the whole process of nursing more stressful.

Once the baby is able to latch on and does not cause pain for the mother or fall off the breast, feeding patterns can emerge over the first week based on the amount and type of milk available from the mother, and the size and age of the baby.

At birth, babies are born waterlogged from being immersed in a fluid-filled womb. It is expected that 7–10 % of the birth weight will be lost during the first 3–7 days due to release of this excess fluid (Noel-Weiss et al. 2008). The greatest amount of weight loss should be at day 4. A 1-day-old baby's stomach is about the size of a large marble and can accommodate 5–10 ml of milk at each feeding. It begins to stretch on day 3, when it grows to the size of a ping-pong ball, allowing the baby to take in a commensurate amount of milk.

From Days 1 to 3, the mother produces only colostrum. The amount of colostrum produced at each feed is equal to the size of the baby's stomach. In total, it amounts to 20–40 ml a day. During these first few days, stimulation of the touch receptors on the mother's breasts is critically important. The baby's mouth against the mother's breast skin is usually what stimulates touch receptors, but in cases where the baby cannot suckle, which might happen if the infant is placed in a NICU, hand stimulation has been shown to mimic this effect. Increased stimulation of touch receptors on the nipple and areola increases the density of prolactin receptors in the lactocytes of the breast.

At birth, babies nurse most frequently between 3:00 am and 9:00 am (Benson 2001), which correlates with the mother's cycle of prolactin production. Benson (2001)) found a diurnal pattern to nursing, so babies feed frequently in the mornings when the mother has an increased supply and cluster feed in the evenings when mothers have a lower supply. Cregan et al. (2002) found that milk production is highest in the morning seemingly because prolactin levels are highest overnight from emptying the breasts totally in the evenings. It is not known why this happens, from physiologic variation or inefficient milk transfer resulting in low supply and excessive hunger in babies. It is common but may not be normal.

Non-painful touch receptor stimulation on the breast also stimulates the hormone oxytocin, resulting in milk ejection or "let down." Let downs occur after a few seconds to a few minutes of stimulation. They happen an average of 2.5 times with each nursing session, and have been recorded up to 12 times. The first ejection results in the most milk removal. Milk cannot be fully removed without the let down reflex.

Babies are remarkably good at following the rule of "what goes in must come out." During the first 24 h, this usually means one wet diaper and one black, tarry stool (meconium passing). The number of stools and wet diapers increases each day so that by day 4, babies will make 4 stools and 4 wet diapers a day. Keep in mind, however, that newer, very absorbent diapers can hold more urine than is apparent. If the baby is dehydrated, there may be orange urate crystals. By day 5, the stool should turn yellow (Shrago et al. 2006), an indication that the bowels are working properly and the intestinal flora is being established.

During the first week, milk production increases from an average of 30 ml (1 oz) a day of colostrum to 300–360 ml (10–12 oz) a day of transitional milk (Hartmann and Prosser 1984). During this time, the baby's stomach increases from being able to take 5–10 ml to being able to take 30–45 ml at each feeding. The baby should make six to seven wet diapers and at least four stools a day by the end of the first week.

The frequency, degree of breast emptying, and duration of nursing will vary the most during the first week. This is due to factors that have already been discussed, but by the end of the first week, the baby should be able to nurse for 10 min on each breast every 2–3 h, and completely empty the breast after each feeding. Although cluster feeding can happen, it is an indicator of the mother's supply not matching the baby's needs, and therefore should not be ignored or considered normal.

4.1.3 Weeks 2 Through 4

After the first couple of weeks, the amount of prolactin made by the pituitary gland decreases, so smaller amounts of circulating prolactin are available to stimulate milk production. In this way, the density of prolactin receptors created during the first week sets the sensitivity and determines the amount of milk the mother can make for the duration of breastfeeding.

After the hormone-based groundwork is laid, the system transitions from endocrine to autocrine control, in which nursing frequency and duration, and quality of emptying sets each breast's production. The breasts must be emptied fully and quickly at fairly consistent intervals so FIL can be removed, milk can be produced, and prolactin can bind to receptors. Milk production mimics the removal of FIL, with slow removal resulting in slow filling. Quick bursts of complete removal in 2–3 h intervals allows for production of maximum milk capacity.

Feeding patterns may vary through the day. Baby-led feeding is the current recommendation, but a Cochrane review study (Fallon et al. 2014) showed no correlation between successful nursing and baby-led or other types of scheduled feedings. This is because these studies didn't first control for a deep latch and efficient milk transfer or the mother's supply, so there is no way to accurately interpret the behavior of the babies. A baby who is hungry continuously or nurses every hour is either not getting enough intake or working very hard to get what he is getting. This may or may not correlate with breast pain, milk supply, or weight gain…but it usually does. For example, if mom has a high milk supply, but the baby is not able to transfer milk well from the breasts, he may compensate by nursing continuously and sleeping frequently through the feed. He may, in fact, gain weight, but he is working very hard to do so. It is like giving him a steak to chew on instead of a milkshake to drink.

Therefore, assuming the mother has an adequate milk supply, 10 min of nursing at each breast every 2–3 h is the optimum timing, duration, and frequency for the duration of nursing. Mothers with an oversupply may not fit this rule, and will be discussed separately.

How does a baby regulate his sleep/eat cycles? It is thought that the hormone cholecystokinin (CCK) plays a major role. CCK is a peptide produced in the central nervous system and small intestine. It has many effects, including pancreatic and gastric acid secretion, slowing of gastric emptying, production and release of bile, and suppression of food intake. It also stimulates appetite centers in the brain to help regulate satiety (Little et al. 2005). CCK is released in response to fat entering the proximal small intestine, and to afferent stimulation of the vagus nerve. CCK has been shown to result in satiety and feeding-associated sleepiness in rats. (Gibbs et al. 1997; Antin et al. 1975).

Uvnäs-Moberg et al. (1993) showed that there is a biphasic release of CCK in response to breastfeeding. Initial sucking activates the vagus nerve in the baby, which triggers immediate release of CCK. This CCK declines over the next 10 min of nursing. Within 30–60 min after breastfeeding, CCK levels rise again in response to fat entering the small intestine. High CCK levels make the baby sleepy so when the baby is full he will fall asleep and not overfeed.

The younger the infant, the higher the basal levels of CCK. It is thought that this allows the baby to sleep and feel sated in the first few days of life when little food (i.e., colostrum) is available. When babies suck on pacifiers, they may also trigger the vagus nerve, releasing CCK. Similarly, if babies are nursing on the breast and not transferring milk, they can fatigue and fall asleep quickly, but then wake up shortly thereafter feeling hungry. This is because there is not enough fatty milk in the small intestine to trigger the second release of CCK. This effect is mimicked when babies get too much foremilk when their mothers have oversupply—they ingest less fatty hindmilk, so the second release of CCK is not triggered. Even though they seem to be getting a good volume of milk, they wake up hungry shortly after nursing.

By weeks 2–3, a baby's stomach can hold approximately 60–90 ml (2–3 oz) at each feeding, with a total of 600–750 ml (20–25 oz) per day. Women with excess supply produce much more than this. Anecdotally I have accounts of mothers producing over 10 oz with each pumping session

By week 4, baby takes 90–120 ml (3–4 oz) per feeding, and 750–1050 ml/day (25–35 oz). By the first month, mothers make 1100 ml/day, and the amount remains constant for the remainder of nursing (Hartmann and Prosser 1984).

4.2 Long-term Changes

From 1 to 6 months, the baby still only needs 32 oz a day. By 1 month, he can take up to 4 oz at a time, but his stomach grows as he gets older. Kent et al. (2013) showed that from 1 to 3 months, the frequency of nursing sessions decreased in breastfeeding mother infant pairs, but the babies transferred more milk per session. Over the next 3–6 months, the duration of nursing remained constant, but the net effect was that, even with shorter nursing sessions, the total 24-hour volume of intake remained the same—babies can take more milk at each feeding and require fewer feedings, and still get the same amount of milk. Sakalidis et al. (2013) confirmed that babies become more efficient at nursing during the first 4 months. They pause less, have longer suck bursts, and apply weaker vacuum levels.

Another study (Kent et al. 1999) showed that for month 1–6 the breast volume and storage capacity remained high, and milk production stayed constant. But after month 6, all three parameters decreased. Most interestingly, at 15 months the breasts still produced a substantial amount of milk, but they returned to preconception size, indicating redistribution of breast tissue so that more glandular tissue was present than before pregnancy. The breasts were still able to produce significant amounts of milk, making them more efficient.

Growth spurts for the baby happen at 2–3 weeks, 6 weeks, and 3 months.

The following weight changes are expected for the first year:

Birth to day 4: 7–10 % loss of birth weight

4 days to 4 months: gain of 2 lbs/month (7–8 oz/200–225 g/week)

4–6 months: gain of 1 lb/month (4–5 oz/113–142 g/week)

6–12 months: gain of ¾ lb/month (3–4 oz/85–113 g/week)

This concludes the description of the background of "normal" or "expected" breastfeeding. The next obvious step for clinicians is to know how to begin the process of evaluating the mother–infant dyad in the event of breastfeeding problems or concerns.

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Part II
Abnormal Nursing

Chapter 5
Breastfeeding Evaluation: The History

5.1 Importance of the Evaluation

When breastfeeding is not going smoothly, most mothers seek help. By the time a breastfeeding pair—mother and infant—comes to see me in my office, they have usually already seen several health care practitioners: the pediatrician in the hospital, their own pediatrician, the nurses in the hospital, and one or more lactation consultants. Often, the mother reports having received large amounts of conflicting information. She tries to follow all of the instructions and advice, but there is still a problem. Or, sometimes, the mother struggles through long feedings and pain, but is told that everything is fine because the baby is gaining weight. If a mother complains that her baby is frustrated at the breast and causing her pain with nursing, telling her everything is "fine" or advising her to "to wait it out" or "just give the baby a bottle" will set her up for failure.

This chapter describes how to use a detailed medical and breastfeeding history to evaluate a mother—infant pair. This is the first half of the evaluation. Chapter 6 describes what to look for in a physical examination. Taken together, these two chapters provide health care providers—especially those on the front lines—with a thorough understanding of what portions of an evaluation are necessary and sufficient in assessing whether breastfeeding is working correctly so that timely intervention can be offered.

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5.2 Taking the History

As with medicine in general, most of the diagnosis of a problem with breastfeeding comes from the history, with confirmation coming from the clinical examination. A physical exam alone cannot predict success or failure of breastfeeding because there are three exams—the mother/breasts, the baby, and the two of them together. For breastfeeding to succeed, the baby and the breast have to lock together in a very specific way. External observation alone, such as watching a baby nurse, cannot indicate a "good latch," since we can't observe what is happening inside the infant's mouth.

The questions listed here are meant to be comprehensive enough to provide a clear picture of the state of breastfeeding. It's important to note that eliciting too much information can be confusing to a practitioner and new mother alike. For example, mothers often keep detailed diaries of feeding times and length of feedings, but they have no sense of how much the infant is actually drinking. Similarly, it is not enough to ask *whether* a baby is gaining weight. It is also important to know *how* that weight gain is being achieved. If a baby must nurse every hour in order to gain weight, there is a breastfeeding problem that must be addressed.

NOTE: This Breastfeeding History questionnaire is a tool for the health care provider, not a form to be completed by the mother in isolation. It should only be used to guide the clinical evaluation conversation.

5.2.1 Breastfeeding Questionnaire

Questions About the Baby

- How old is the baby?
- What was the birth experience?
- Does the baby have any medical problems? Did the baby spend time in the NICU?
- Was the baby premature?
- Is the baby a twin?

- Does the baby have appropriate weight gain?
- How many wet/soiled diapers does the baby make a day?
- Has the baby experienced dehydration or jaundice?
- How long does the baby take to nurse at each feeding?
- How often does the baby nurse in a 24-hour period?
- After nursing, do you have reason to believe that the baby still hungry?
- How does the baby behave at the breast? (Can he/she open his/her mouth wide enough to latch on? Is he/she fussy? Does he/she fall asleep often? Does he/she seem to get frustrated? Does he/she fall off the breast and need re-latching? Does he/she reject the breast?)
- Is the baby able to eat from a bottle or other food source?
- Does the baby have excessive gas, reflux, or colic?

Questions About the Mother

- Are you having pain with nursing? One or both breasts? How severe?
- How is your milk supply?
- Are you pumping? When? For how long? How much milk do you get with each pump? How much total per day? Do you pump after or instead of nursing?
- Have you experienced painful engorgement, plugged ducts or mastitis?
- Have you ever had breast surgery?
- What is your medical history?
- Are you taking any medications? Supplements?
- When did you get your first menses, and when, if ever, did you start birth control or estrogen?
- Have you worked with a lactation consultant?

5.3 Evaluation of the History: infant

How old is the baby?

This first question sets the context for all questions that follow. When it comes to breastfeeding, the infant's age is everything. How a baby behaves at 1 week is very different from how he will behave at 4 or 11 weeks.

During the first week, every day can be different, but patterns can develop as quickly as 2–3 days. The most variation in breastfeeding happens in the first 4 weeks. Because the baby's stomach expands as the mother's milk supply increases, there can be periods of catch up when the baby cluster feeds. The baby can also be sleepy at first and not hungry because they retained extra fluid from birth and produce extra cholecystokinin (CCK), so they do not wake up to nurse on a regular schedule. In very efficient nursers and if mothers have a large milk supply, nursing times can be shorter but just as efficient. The optimal nursing schedule is 10–15 min of nursing on each breast every 2–3 h. Even if the baby does not feed every 2–3 h, the mother should be emptying her breasts with a pump at least this often during the first 4 weeks so her breasts can meet their milk making potential.

After the first 4 weeks, the breastfeeding stage is set. During the first week, prolactin receptors propagate from touch receptors on the nipple, *not* pain receptors. Prolactin is at its maximum in the first 2 weeks, then wanes to near prepregnancy levels, leaving less circulating prolactin available to stimulate the receptors. There is some room for a later increase, but the greatest potential for maximizing milk production exists in the first month. This is why it is critically important to identify and correct problems as early as possible. If a baby shows signs of poor weight gain and excessive hunger in the first week, and the mother is given wrong advice, it can affect the whole outcome of breastfeeding: the mother may not become a full producer, and the baby may develop an aversion to the breast, which can be quite difficult to correct.

Conversely, just because a baby is breastfeeding and gaining weight at age 4 weeks, that doesn't mean that all breastfeeding issues have been resolved. Frequent, prolonged feedings with current or resolved nipple pain means the baby has an inefficient latch. If the mother has a large or oversupply, she can compensate during the first 6–10 weeks because her milk production is regulated by her hormones. There will be a waning effect, however, and her supply will slowly decrease over time. After 6–10 weeks, milk production transitions to local control by breast emptying and removal of FIL. So if the baby has an inefficient latch when the mother has oversupply, the negative effects are often not noticed until much later, sometimes when it is too late. In these circumstances, babies often go on “feeding strikes” and refuse the breast concurrent with the mother losing her supply. The mothers might have thought everything was fine because the baby was gaining weight, but when questioned about the *experience* of breastfeeding, it’s simple to see that the clues to a problem were there all along.

How was the birth experience? Did the baby spend time in the NICU?
Does the baby have any medical problems?
Was the baby premature?
Is the baby a twin?

The answers to these questions are often interrelated, so they will be considered as a group.

The birth history is important not merely for the physical effects it has on the baby. The medications used and the type of birth can impact or delay lactogenesis. Ahluwalia et al. (2012) studied the relationship between breastfeeding and method of delivery using data from the Longitudinal Feeding Practices Study (n = 3026). They compared rates of breastfeeding (to any degree, not just exclusive) in spontaneous vaginal, induced vaginal, emergency cesarean, and planned cesarean. They found no significant association between delivery method and the initiation of breastfeeding. However, there was great variation in breastfeeding *duration* depending on delivery method. According to the article, median breastfeeding duration was 45.2 weeks among women with spontaneous vaginal, 38.7 weeks among planned cesarean, 25.8 weeks among induced vaginal and 21.5 weeks among emergency cesarean deliveries (Ahluwalia et al. 2012).

Vaginal birth can result in deformities in the skull, as with vacuum or forceps deliveries, or from the skull bones overlapping to fit through the birth canal. This can affect the movement of the skull structures and/or create compression of the hypoglossal nerve at the craniocervical junction (see Chap. 7, Cranial Osteopathy section for more information).

Cesarean section delivery is a known risk factor for delayed breastfeeding and possibly a 10–20 % reduced overall rate of breastfeeding (Zanardo et al. 2010; Dewey et al. 2003; Rowe-Murray and Fisher 2002). One study (Kutlucan et al. 2014) found that general anesthesia caused an increase in post-birth prolactin in the mothers, and also delayed initial latch because of the need for maternal recovery. Similar delays were found by Zanardo et al. (2010). Post birth oxytocin levels were highest in vaginal births, and there was no delay in breastfeeding with epidural or spinal anesthesia. At one time, breastfeeding post-anesthesia was delayed for 12–24 h, but Kranke et al. (2011) demonstrated that a single dose of common anesthetics results in "vanishingly small" concentrations in colostrum compared to transplacental exposure. They found no reason to delay breastfeeding once the mother is sufficiently awake. The American Academy of Pediatrics (AAP) and American Congress of Obstetricians and Gynecologists (ACOG) concur (American Academy of Pediatrics 2013).

Traumatic or prolonged birth can result in maternal exhaustion, which may delay nursing. Babies who spend time in the NICU also often have a delay in nursing. Anemia, retained placenta, and post-partum bleeding or hemorrhage can also compromise lactation.

Intrapartum pain medications can make breast milk unsafe for babies, but it can also have a sedative effect on the infant. In the United States, 83 % of mothers receive labor pain medications. Lind et al. (2014) showed that 23.4 % of mothers in the study who took these medications experienced a delay of lactation of more than 3 days, regardless of delivery method.

A note about pain medications: Meperidine is lipophilic and has a long half-life in newborns, so it can accumulate. Morphine is also transferred to milk, but less so because it is hydrophilic. Nalbuphine and butorphanol both have low excretion in milk and a short half-life, so they are preferred.

Postpartum pain medications, such as nonsteroidal anti-inflammatory drugs (NSAIDs) and acetaminophen, are considered safe because extremely low amounts are secreted into breast milk. (Aspirin is an exception because infants cannot secrete it quickly—it should not be taken by nursing mothers.) Oral narcotics are considered compatible with nursing at the lowest possible dose and for the shortest possible duration, usually less than 3 days (American Academy of Pediatrics 2013). However, Madadi et al. (2009b) developed guidelines for maternal use of codeine during breastfeeding, arguing that newborns are more sensitive to opioids than older infants. Also, some women are hypermetabolizers of codeine so their body converts 20 % of it to morphine (as opposed to 7–10 % by normal metabolizers). Hydrocodone is a safer alternative because it is metabolized through a different pathway (Hale and Rowe 2014).

Maternal exposure to oxycodone has been shown to result in 20 % rate of CNS depression in infants (Lam et al. 2012), resulting in a very sleepy baby with limpness and poor weight gain. Usually the CNS depression symptoms are most obvious at day 4 of codeine use and continuous nursing (Madadi et al. 2008, 2009a). The mother herself will have CNS depression symptoms that correlate strongly with her infant's symptoms (Madadi et al. 2009a). Also, since opioids decrease the mother's pain, she may not seek to correct a painful latch until the medication wears off.

Signs of neurological impairment are not always obvious at birth. Sometimes the process of trying to nurse makes the impairment apparent. The baby cannot seem to coordinate his tongue movements with swallowing. He cannot form a seal on the breast or bottle. He doesn't seem to exhibit early hunger cues or reflexes. The whole process of feeding is difficult no matter what the source (bottle, breast finger, etc.). These babies are special cases and need proper evaluation by a feeding specialist.

If the baby was premature, then consideration should be given to the gestational age of the baby. Preterm babies may not have fully developed nursing reflexes (Smithers et al. 2003).

However, one of main barriers to breastfeeding preterm infants is lack of breast milk (Callen et al. 2005), because the mother's breasts may not have had enough time to develop sufficient glandular tissue (Lactogenesis I). In addition, the mothers' brains may not be secreting prolactin and oxytocin in amounts that are beneficial and necessary for breastfeeding.

Twins are often born premature, and require more milk from the mother and more time to nurse two babies. They can also provide an excellent comparison, if one twin seems to be nursing more effectively than the other.

Does the baby have appropriate weight gain?
How many wet/soiled diapers does the baby make a day?
Has the baby experienced dehydration or jaundice?
How long does the baby take to nurse at each feeding?
How often does the baby nurse in a 24-hour period?
After nursing, do you have reason to believe that the baby is still hungry?

This set of questions is about quantifying and qualifying the baby's experience at the breast.

Most health care providers focus on weight gain alone as a measurement of successful nursing. If the baby is gaining weight, it is assumed that everything is "fine." If a baby is not gaining weight, then the mother is told either to supplement with formula or to nurse more often to improve the baby's weight gain. But these suggestions can result in poor outcomes if they are presented without a complete look at the baby's breastfeeding history.

Weight gain is a quantitative and qualitative measure. It can be measured directly and should fall on the growth curve. But the absolute amount of "weight gain" doesn't tell us everything about the success of breastfeeding. The baby's *rate of growth*, on or off the growth curve, can indicate how easy or difficult it is for the baby to transfer milk. For example, if an infant starts off in the 90th percentile and drops to the 50th percentile after 2 weeks, he is still on the curve, but his growth rate indicates that he may be working too hard to get milk, or that the milk may not be available in adequate quantities.

A baby's weight gain is a result of the whole process of nursing. It takes into account the mother's supply and the baby's willingness and ability to transfer milk from the breast. The process should be effortless for the baby and painless for the mother. It should also happen in quick bursts that are adequately timed so maternal hormonal and local regulators can work in sync with breast emptying. If it takes the baby an hour to nurse and he is hungry an hour later, or if the mother is having pain with nursing, it is lucky that the baby is gaining weight. It is never normal for a baby to nurse every hour. It is also not normal for a baby to nurse for long periods of time and remain hungry, even during the first few days when there is only colostrum. In these situations, either the mother is not making enough milk, or the baby cannot transfer the milk from the mother's breast, or both. These are early indications of a problem that could eventually lead to breastfeeding failure.

During the first month, babies should nurse an average of 10–15 min every 2–3 h. They may nurse more frequently in the first week in the early morning hours between 3:00 am to 9:00 am. (No one knows exactly why this happens, but maternal hormone regulation follows this pattern early on, as well.) They may go for longer periods without nursing later in the day, but feedings should average out into that pattern, which equates to 8–12 feedings in each 24-hour period.

After the first month, the baby's stomach stretches to hold more milk. Once this happens, the baby can take more milk from the breast with each feeding, and may therefore nurse less often. As the baby drains more from the breasts, the mother's milk supply grows to meet the extra demand. As time goes on, babies become more efficient nursers, so they may actually nurse a shorter amount of time while getting more milk at each feeding.

The cadence of output is another crude measure of intake. Mothers are often told to count the number of wet diapers, which, with today's highly absorbent diaper technology, can be misleading. These diapers are so absorbent that it takes a lot of output to make them appear wet. Soiled diapers should occur 3–4 times a day in the first few days and increase as the days go on, They should progress from seedy yellow to dark and soft in consistency. Hard stools may mean dehydration, and runny stools may mean excess foremilk and oversupply with inefficient milk transfer.

Jaundice and dehydration are also indicators of poor intake. Usually these problems are a result of infrequent nursing, but not always. Jaundice will be easily recognizable as the infant's skin and eyes take on a yellow color. Dehydration can result in a sleepy baby and excessive weight loss. Recommendations are often made to increase the frequency of nursing, assuming it will increase intake. However, if a baby nurses continuously and develops jaundice or dehydration, that indicates a problem with milk production, transfer, or both.

Can he/she open her mouth wide to latch on?

Gape is always mentioned but never fully discussed in breastfeeding literature, yet it is the single greatest cause for failure to latch.

At birth, babies gape as wide as they possibly can. They must be able to gape so wide that they almost dislocate their jaw to fit as much breast tissue in their mouths as possible. If the gape is not there at birth, it will not magically appear, stretch, or grow without intervention or specific positioning. The problem is not due to a "small mouth," and babies will never develop a wider gape on their own.

A small gape will always result in a shallow latch. If a baby cannot open his mouth wide enough, the breast (teat) cannot "lock" into position at the back of the baby's throat, and the palate will not fill with sufficient breast tissue to elicit a normal suck reflex. With a small gape and shallow latch, the baby has to work much harder to transfer milk and sometimes cannot transfer milk at all. The tongue sometimes cannot reach the palate to sufficiently compress the breast tissue. As a result, the nipple gets caught in the front of the mouth, where the suck reflex causes abrasion and damage because the nipple moves around in the baby's mouth.

Even first-time mothers can identify a small gape as a problem, especially when they try (and fail) to follow the recommendations of breastfeeding guidebooks and lactation consultants. Mothers are often told to hold the baby's jaw down or flip the upper lip up to artificially create a gape. They are also taught different breast compression methods or ways to hold the baby to encourage him to get as much breast in the mouth as possible, with variable success.

Conversely, a baby with a wide gape can fit almost any shaped breast into his mouth. Some women have nipple shapes that fit more easily to many different mouth openings. I once had a mother claim that, although her baby was unable to latch successfully onto her breasts, he was able to easily nurse on her friend's breasts. Which brings us back to the notion of fit. The mother's breast must fit her baby's mouth. We cannot change the shape of the breast, but now there are safe interventions to release the structures of the infant's mouth so that the baby can reach the appropriate gape. This will be discussed more in Chap. 7.

How does the baby behave at the breast?
Is he/she fussy?
Does he/she fall asleep often?
Does he/she get frustrated?
Does he/she fall off the breast and need re-latching?
Does he/she reject the breast (i.e. nipple confusion)?

The baby's behavior at the breast provides valuable clues to breastfeeding problems. He should exhibit early hunger cues, such as turning toward the breast, increased alertness, flexion of the extremities, rooting, cooing, and putting his hands and fingers in his mouth. Babies that cry to be fed, especially in a panicked state, are likely working too hard for their food and feeling too hungry. If they are working too hard, usually from a poor latch and/or low supply (which go hand in hand), they will become frustrated at the breast. They will latch and relatch. They will fall off the breast and require repositioning. They may get so frustrated they hit the breast and cry even when brought near it.

One common and damaging myth is that the mother's temperament or behavior is the cause of the baby's frustration.

A mother of a frustrated baby is often told that she is transferring her own stress to the baby, that she is overthinking nursing and therefore hindering the baby's reflexes and natures course. It is not that simple. In some cases this may be true, but it is rare. The baby is usually frustrated because he cannot latch. If the baby can't latch, there will be frustration for both mother and baby. Since poor latching and frequent relatching usually also causes maternal pain or a feeling that her baby is rejecting her, the mother can develop a negative association with nursing her baby, so her stress does feed back to the baby. Do not underestimate the pain and suffering a mother will endure to nurse her baby. Encouraging her to continue through the pain and blaming her for her baby's frustration is not only cruel, it is setting her and her baby up for failure in the long run because it is not correcting the underlying problem.

Babies do not inherently reject their mothers, but there are instances where the baby won't latch on at all. No one knows why this happens. In my experience, it is mostly because babies cannot gape wide enough to latch. If the gape is corrected early enough, the baby's reflexes can be used to get them back onto the breast. It can be corrected later as well, and I have had 6- and 7-week-old babies latch for the first time after the gape was corrected. But the earlier the problem is addressed the better.

A common scenario that can develop when babies are frustrated at the breast is *nipple confusion* or *aversion*. Here's a common scenario for how that can happen: The baby tries to nurse at the breast immediately at birth, but cannot latch on efficiently. He nurses every hour for the first few days. After several days, he falls off the breast easily and has to relatch often, sometimes screaming and hitting the breast. It can take hours of struggling to latch the baby on, and once he does latch, he falls asleep from exhaustion after a few sucks. The mother or health care provider may interpret this behavior as breast rejection or colic. The mother may feel as if her baby is rejecting her and her milk, but what is really happening is the baby cannot transfer milk from the breast. The baby is given a viable food source but is unable to get the food out, leading to frustration. It's common for babies to simply give up due to conditioned behavior after continually being offered an inaccessible food source. The baby "learns" that his mother's breast will not feed him.

If the baby is quickly given an easy food source, such as a bottle, he will become further conditioned away from the breast. This situation is often called nipple confusion, but it is really breast aversion. Studies trying to define nipple confusion or breast aversion are inconclusive and offer little insight to health care providers because the mechanism of causation is not well understood or defined in the literature. Regardless, alternative feeding methods, other than the bottle, are frequently recommended (Neifert et al. 1995). In truth, it doesn't matter what the easy food source is, only that it is not the mother's breast. *Nothing* else feels or smells like a mother's breast. Spoon, finger, cup or syringe feeding may prevent the baby preferring the bottle, but they won't make the baby any more or less averse to the breast. I once had an infant patient who would only finger feed. She rejected all other food sources, including a bottle, because she had learned what fed her. She was not confused at all. If a baby smells his mother and is able to transfer milk from the breast, he will prefer her as a food source. If he smells his mother but is unable to transfer milk, he will learn a negative association, sometimes as quickly as the first day of life (Neifert et al. 1995).

Treatment for nipple aversion is covered in Chap. 7.

Is the baby able to eat from a bottle or other food source?

This is an important to question because it is a quick way to determine if the baby has appropriate oromusculature strength and coordination to feed. If a baby is having a hard time at the breast but is able to bottle- or finger-feed normally, there is a good chance he has good muscular tone and good coordination of the suck-swallow reflex. One exception is babies with high palates. If a baby has a high palate, he can sometimes have difficulty nursing from a bottle, although his strength and coordination are normal. This happens because the bottle nipple is too small to fill the palate so the baby cannot reach it with his tongue. He may appear to have poor coordination, but the problem is really due to the high palate. A larger bottle nipple that fills the space will resolve the issue.

Babies who cannot latch on to nurse and also have trouble with a bottle may have a problem with coordinating the suck-swallow reflex. They gag on the milk, and it leaks out of their mouths. They take a long time to eat and usually have slow or poor weight gain. They need slow-flow nipples and frequent, small feedings. They don't seem to know what to do with the food source, no matter what it is. These babies may later be diagnosed with a congenital or neurological abnormality, or be found to have a structural abnormality, such a Pierre Robin syndrome or cleft palate. While there is very little research on babies with these types of abnormalities regarding breastfeeding, the little there is demonstrates disruption of the suck-swallow reflex (Baudon et al. 2002).

In my practice, the number of babies with low oromotor tone or poor coordination is small. And even when it is noted, most of the time, the tonal and coordination issues are limited to perinatal feeding. With appropriate supportive care they resolve with time. In some cases, babies are later diagnosed with a form of developmental delay such as sensory integration disorder. Regardless of the cause, these babies require specialized care and referral to a neonatal feeding specialist (Sanches 2004).

Does the baby have excessive gas, reflux or colic?

Gastroesophageal reflux occurs in 70–85 % of infants within the first 2 months of life (Czinn and Blanchard 2013). By 1 year of age, 95 % of reflux resolves. But depending on the severity, it may be pathologic, causing excessive crying, colic, and pain, as well as failure to thrive and feeding and sleeping problems (Henry 2004). Reflux results in regurgitation, vomiting, and excess gas in infants. They often arch their backs from the pain of abdominal distention that occurs when the air in their GI tract does not move up or out.

The mother's diet plays an important role in infant reflux. Certain foods, such as broccoli and garlic, are known to increase infant gas. Allergenic foods—such as eggs, gluten and excess sugar—may affect the baby through breast milk. Cow's milk protein allergy is a common corollary to gastroesophageal reflux disease (GERD). It may coexist in 42–58 % of infants with reflux, perhaps as a cause of the reflux itself (Czinn and Blanchard 2013). In these cases, the cow's milk is either fed directly to the infant through formula or transferred to breast milk through the mother's diet.

GERD also can occur from pyloric stenosis and secondarily from genetic syndromes, birth defects, and chromosome abnormalities. It is extremely common in babies with neurological disorders (Berthet et al. 2014), such as Sandifer syndrome (Czinn and Blanchard 2013). It can also happen as a result of constipation or infection. Reflux can also be caused by anatomic issues, specifically transient relaxation of the lower esophageal sphincter, causing leakage of the gastric contents upward.

A commonly overlooked cause of colic and reflux in babies is from swallowing air while bottle- or breastfeeding. Excess gas is a typical sign of a shallow latch. The breast may not fill the hard palate completely, so every time the baby swallows, he takes in a large gulp of air. Medications for reflux cannot help relieve this type of gas because the cause is mechanical. Correcting the latch so the breast fills the palate, or changing the nipple shape when bottles are used, can effectively reduce gas caused by a high arched palate. It is important to take a thorough history, including the manner in which the baby is fed, in order to treat without causing further harm or exposing the baby to unnecessary medication.

Until recently, a baby's digestive system was thought to be pristine at birth, but gut colonization may start in utero (Digiulio et al. 2008). It continues to become populated with bacteria based on the birth method. Vaginal births result in *Lactobacillus*, *Prevotella*, or *Sneathia*, whereas C-section births result in *Staphylococcus*, *Corynebacterium*, and *Propionibacterium* (Dominguez-Bello et al. 2010). During the first week of life, the infant gut develops different flora, usually *Escherichia*, *Clostridium*, *Bacteroides* or *Bifidobacterium* (Vallès et al. 2012). Among breast-fed infants, *Bifidobacterium* is the dominant bacteria, unlike infants fed with formula (Lara-Villoslada et al. 2007). The bacterial population affects the infant's digestion. Perinatal medications, especially antibiotics, can impact gut flora early on by killing all bacteria. Probiotics are recommended in preterm infants because they have been shown to reduce the time to full feeding. They are also associated with better weight gain and fewer episodes of food intolerance. However, the dose, duration and strains of bacteria are still under dispute (Athalye-Jape et al. 2014).

5.4 Evaluation of the History: Mother

Are you having pain with nursing? One or both breasts? How severe?

The most common complaint from mothers who nurse is pain. Pain with the latch, pain during nursing, pain after nursing. It cannot be said enough times: Pain during nursing means that something is wrong. Pain is usually accompanied by physical evidence of nipple trauma and injury. Nipples can be compressed into a lipstick shape, have cracking and scabbing, bleed, become bruised, or develop milk blisters. This injury can lead to plugged ducts and mastitis. It can also cause emotional trauma, which interferes with the mother's daily activity and bonding with her infant.

A study by McClellan et al. (2012) examined objective measures for pain in breastfeeding women. There was great variability in severity of pain, but it affected much more than breastfeeding. The mood, sleep, and general activity in the mother were also compromised for the duration of nursing. This makes sense if you consider the hormonal effects of pain. Pain stimulates the secretion of cortisol, a stress hormone, not oxytocin, which promotes maternal relaxation and bonding with her infant. Pain with breastfeeding has not been clinically quantified, but it can feel as mild as a pinch, or as severe as prolonged burning and throbbing. A mother's desire and dedication to nursing her infant can lead her to suffer terrible damage if the infant is poorly latched.

Pain is valuable as a diagnostic symptom and should never be ignored. It happens very early on, so steps can be taken to correct the problem before it is too late. The cutaneous nerve supply to the breast is mainly located at the nipple. The nipple should sit safely in the throat of the infant, away from the peristaltic movements of the tongue and any friction. Pain means that the baby is not latched onto the breast deeply enough, so the nipple is moving around when it should be locked into position.

On the plus side, pain with nursing is a good indicator that the baby has strong muscular tone and control, so low oromotor tone and coordination issues in the infant can be ruled out. On the negative side, breast pain when nursing always means the baby is not latched on correctly.

Pain may subside over time, but not because the baby is nursing more efficiently. It usually decreases because there is sufficient damage to the breasts that the pain receptors no longer respond to the stimulus. While there are women who are able to nurse through pain, sometimes for years, these cases are not common because most women lose their milk due to inefficient milk removal if they do not pump. Usually pain in nursing causes women to stop nursing early and lose their milk. It is not recommended to nurse with pain. More importantly, it is not necessary.

How is your milk supply?

Are you pumping? When? For how long? How much milk do you get with each pump? How much total per day? Do you pump after or instead of nursing?

Most new mothers do not know how to respond to the question of milk supply. They notice things like breast fullness or milk dripping from the breast when the baby cries. They may also mention whether or not the baby has wet diapers. Since they have no reference point, they understandably don't know what is normal or to be expected, and they usually state this in the history. Experienced mothers have past nursing as a reference base, but how they define "normal" also depends on prior success or failure with nursing. If they had a low supply and pain with prior nursing, they will likely be able to produce more milk if the circumstances are optimized. Also, many women are asymmetric producers, and one breast produces more than the other.

There is no commercially available way to measure breast capacity in the office. Breast size is not an indicator of milk making capacity. Large breasts may have more fat but little glandular tissue (and therefore low milk output), and small breasts may be mostly glandular and result in high milk output. Office-based ultrasound is not practical and is primarily used in research. But the truth is that there is no absolute way to determine breast capacity because breastfeeding is a supply-and-demand process. Each breast has a milk-producing potential that can only be realized by a perfect fit of the baby's mouth and efficient, timely milk transfer by the baby (or pump).

So we are left with indirect measurements of quantity, management, and trends in supply. It is important to know the state of the milk supply at the time of the visit and correlate that with expectations of supply:

- Day 1–3: colostrum (20–40 ml)
- Day 3–14: Transitional milk (300–360 ml)
- Day 14 on: Mature milk (1100 ml).

During the first month, the stage is being set for future milk production. In women with a sensitive milk supply, such as those that tend toward a low supply or in whom the milk has yet to come in, the earlier the process is maximized the better. There is less room for improvement when the baby is over 1 month because some critical factors (i.e., prolactin receptors) have already been established.

These questions can help the mother articulate what she might know about milk capacity (some overlap with the baby's history):

- Do your breasts ever feel engorged?
- Do your breasts feel full before nursing and empty after nursing?
- Is the baby comfortable at the breast or fussy/sleepy?
- Is the baby continuously hungry during or after nursing?

- Is there milk left in the breast after the baby nurses i.e. if you pump after nursing can you still remove more milk?
- Are you able to feed your baby and also store milk?
- Is the baby gaining weight? Do they have appropriate wet/soiled diapers?

The best measure of breast capacity we have is via pumping, but it is not a perfect measure. Pumping doesn't always remove all the milk from the breast, and for some women, the baby can transfer more milk from the breast than a pump can. Mechanical pumping alone does not stimulate touch receptors (like a baby's mouth) to up-regulate prolactin receptors during the first few weeks or stimulate oxytocin adequately for a sufficient let down. Because the breast varies in supply during the day, a single pumping session does not reflect breast capacity—a woman must pump exclusively and thoroughly for 24 h to get a more accurate assessment of her milk supply. Pumping recommendations are discussed in Chap. 7.

When considering how regular pumping might affect milk supply, there are other factors to consider:

- Stronger vacuums are more efficient at removing milk than commercially available pumps (Ramsay et al. 2005).
- Interval and length of time pumping, as well as degree of breast emptying, affect milk output and can affect breast milk-making capacity (Prime et al. 2011).
- Pumping both breasts at the same time results in more efficient extraction. It is faster, but does not affect capacity (Prime et al. 2009).

Low supply can manifest as failure of engorgement—the breasts never feel full. In extreme cases, it can result in minimal conversion to transitional milk. In these mothers, inherent causes of low supply should be explored and treated. Prematurity can also cause delay of lactogenesis II and is handled separately.

More often, mothers start off with a good supply that then diminishes. As long as the mother has sufficient glandular tissue, this is almost singularly caused by incomplete milk removal either by the baby, a pump, or both. Mothers are often unaware of this problem, but they state that their baby is fussy or sleepy at the breast. The baby is hungry often and wants to feed for prolonged periods of time. Then they fall asleep and wake up crying from hunger. If a mother feeds her baby for more than 10–15 min on each side and then has to supplement with another food source, clearly the baby is not getting enough milk.

When babies are behaving in this manner it is important to differentiate between poor milk transfer alone and poor milk transfer with low supply, which often go hand in hand. A good way to spot check the supply is to ask what happens when the mother pumps after nursing the baby. If she pumps and gets milk after nursing, the supply is not the issue. If she pumps and gets very little milk then low supply can be confirmed.

When questioning a mother, it is important to know *if* she is pumping, *how much* she is pumping, *how often*, and if it is after or instead of nursing. If a mother skips some feedings and pumps instead, she should get an amount commensurate with the needs of the baby at a given age. If a baby nurses for 15 min and is still hungry, but the mother can still pump 2 oz of milk, then her supply may be fine, but the baby is not able to transfer well. If she pumps every 2 h without nursing and only makes 10 oz a day at 2 weeks, her supply is low.

Hyperlactation, or oversupply, can involve larger than usual rates of letdown, flow, or volume…all three…or in any combination. We do not know why some women have a large or oversupply, whether it is due to more glandular tissue, hormonal regulation, or both. Usually the symptoms of oversupply are obvious to the mother and include leaking milk between feedings, a feeling of overfullness, and a tendency toward engorgement and plugged ducts. Infants of these mothers can struggle at the breast, choking and sputtering if the flow is too great. They can feed continuously and have insufficient or excessive weight gain. They often spit up and have green, explosive stools with gas and colic. These problems are due to excess foremilk transfer and not enough hindmilk. Foremilk has a higher concentration of lactose and lower concentration of fat, resulting in rapid gastric passage and increased concentrations of lactose in the small intestines. This can lead to gas, explosive foamy stools, diarrhea, frequent hunger, and poor weight gain despite frequent feeding (van Veldhuizen-Staas 2007).

Some women overproduce and excrete milk regardless of whether milk is removed or not. In some cases, hyperlactation may be caused by hyperprolactinemia (abnormally high levels of prolactin in the blood) or excessive pumping, but usually no causative factor is found. They can store large amounts of milk and even donate to milk banks. In the past, they probably served as wet nurses for families or communities. No one knows why some women have a very large supply of milk.

For overproducers, the precise mechanics of the latch and milk transfer by the baby are not critical—they can nurse incorrectly for a prolonged time. Because milk was so abundant throughout the first few months of nursing, the baby could nurse to satisfaction, so there was no need to assess the latch. This is why poor latch symptoms, such as nipple pain, are common in oversupply situations. It has also been suggested (Livingstone 1996) that the infant learns to regulate an overabundant milk flow by releasing a proper latch to clamp down on the nipple, which slows the flow (at the expense of the mother's nipple).

However, not all overproducers can weather inefficient milk transfer beyond 6–10 weeks. Early on, their supply compensates for the baby, thereby masking the problem. However, around 6–10 weeks these mothers often present with a baby who "suddenly" becomes more fussy at the breast, and her milk supply noticeably wanes. This happens because 6–10 weeks is the time when maternal hormonal regulation is replaced by the local effects of FIL, transitioning the process from endocrine to autocrine control (Livingstone 1996). Incomplete breast emptying causes the breasts to fill up less with each nursing session. Over time, the overall supply decreases.

Have you experienced painful engorgement, plugged ducts or mastitis?

Engorgement first occurs when the breasts fill with transitional milk during the first week. If the breasts are not emptied or fill too quickly to be emptied, it can result in venous congestion. It can also cause compression of the ducts and make it difficult to extract milk. After the first week, engorgement is possible anytime the breasts fill with milk that is not extracted.

Plugged ducts occur when milk is not fully extracted from the ductules so they swell and prevent continued milk flow. This can happen from engorgement or just because the breasts are not emptied. It can also lead to mastitis.

Mastitis can occur as a progression of engorgement or plugged ducts, but it can also happen independently. A recent study described how inflammation, more than bacterial induction, determines severity of mastitis (Ingman et al. 2014). Damaged nipples and breast tissue from poor latching and perturbed milk flow are common causes of inflammation. Bacteria can then enter through the broken skin and create an infection. Mastitis can happen suddenly and make the mother very ill, so aggressive early treatment is important. It can also result in a sudden drop in milk supply.

If any of these occur in a breastfeeding mother, it is indicative of insufficient milk extraction. This can happen because her baby is not transferring the milk completely or because she has such a large supply her baby doesn't need all the milk she is making and she isn't pumping it out to relieve her breasts. As mentioned previously, mothers with a large supply can be more predisposed to mastitis, engorgement, and plugged ducts even if the baby seems to be transferring milk effectively, so this history must be taken into account.

Have you had breast surgery?

Breast surgery can be cosmetic (augmentation or reduction) or medical (tumor removal, breast cancer).

Breast augmentation surgery does not decrease milk supply inherently, especially if the implant was placed underneath the pectoralis muscle. However, enhanced breasts can camouflage other breast abnormalities, such as hypoplastic breasts, so it is important to know the mother's surgical history.

Breast reduction surgery always results in a decrease in glandular tissue. However, reduction surgery should not result in significant decrease in milk-making capacity as long as the blood and nerve supplies were conserved during the surgery. Most surgeons today use conservative techniques. The mother may not know what technique was used, but if the incision on the breast looks like a lollipop (around the nipple and straight down the middle of the underside of the breast) and the mother still has touch sensation on her nipples, a conservative approach was used.

In cases of tumor removal, the size and degree of breast tissue removed is important. Although one breast may be compromised, the other can often make up for the difference.

What is your medical history? Are you taking any medications that may affect or be unsafe for nursing?

During pregnancy, the mother's medical history is fully evaluated and followed. When assessing a mother—baby dyad for breastfeeding problems, the main concerns are identifying maternal disorders that will depress or limit milk-making capacity, and/or make the mother's milk unsafe due to medication intakes.

It is also important to look for disorders, medications, and other factors that have the potential to reduce milk supply or production.

Non-medication Factors That May Limit Milk Production

Hypoplastic breast syndrome (Insufficient Glandular Tissue)
Breast reduction surgery
Breast cancer
Breast tumor removal—cancer or fibroadenoma
Radiation exposure to the chest
Trauma: Brown Sequard syndrome (Liu and Krassioukov 2013)
Polycystic ovary syndrome (Marasco et al. 2000)
Hypothyroidism (Speller and Brodribb 2012)
Insulin dependant diabetes—low insulin results in low milk production (Zhang et al. 2015)

Eating disorders (Carwell and Spatz 2011)
Gastric bypass surgery (Motil et al. 1994)
Obesity: Women with BMI > 30 are less likely to initiate lactation, have delayed lactogenesis II, have lower prolactin response to suckling in first week postpartum, and are prone to early cessation of breastfeeding (Rasmussen and Kjolhede 2004; Jevitt et al. 2007; Keely et al. 2015).

In terms of medications, it is well established that all drugs are excreted into breast milk, however, most medications appear in only small amounts. There are comprehensive established guidelines for what is safe and unsafe in breastfeeding. The following resources are the most accurate and helpful:

- *Medications & Mothers' Milk* (Hale and Rowe 2014)
- LactMed, the U.S. National Library of Medicine's Drugs and Lactation Database (http://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm).

Common Medications That Limit Milk Production

Alcohol. Large amounts of alcohol temporarily inhibits oxytocin release. Small amounts of beer can increase prolactin, not from alcohol, but because of the grain components. Therefore, nonalcoholic beer may also be beneficial as a galactagogue.
Bromocriptine and Ergotamine. Ergot-like drugs are dopamine agonists that can suppress prolactin secretion for 8–12 h. Bromocriptine has been used to suppress lactation in women who do not want to breastfeed, but it is no longer approved in the United States because of adverse cardiac side effects.
Methergine. Methergine is a dopamine agonist that prevents secretion of prolactin. It acts directly on the smooth muscle of the uterus to shorten the third stage of labor and reduce blood loss after birth. It not only reduces breast milk, but it is also unsafe for newborns, so milk should be discarded for 12 h after it is administered.
Diuretics such as Lasix and hydrochlorothiazide. Intense diuresis might decrease lactation, and no information on the safety of this drug during pregnancy is available.

Decongestants such as pseudoephedrine. Pseudoephedrine is thought to decrease serum prolactin, and a single dose can cause immediate reduction in milk production. Continued use can lead to cessation of breastfeeding. It should be avoided in mothers wishing to breastfeed, especially in the first 4–6 weeks postpartum. Combination over-the-counter cold medications with first-generation antihistamines may have an even greater effect.

Birth control medicines with hormones, especially estrogen. Estrogen suppresses prolactin, so contraceptives containing these hormones can decrease milk production and breastfeeding duration. Early use and doses of 30 mcg per day more prominently affect milk production.

Nicotine. Nicotine through smoking or any other method of ingestion causes lowered serum prolactin, thereby reducing milk production (Andersen et al. 1982). Nicotine is also unsafe for newborns because it reduces dopamine in the carotid bodies, resulting in the infant being unable to autoresuscitate during hypoxic episodes (Alm et al. 2006).

Antidepressants. Selective serotonin reuptake inhibitors (SSRIs) may impact serotonin regulation in the breast, thereby delaying establishment of lactation for the first few days (Marshall et al. 2010).

Herbs such as sage, jasmine, peppermint, and parsley in large amounts are believed to decrease milk production, but the evidence is mainly anecdotal (Shrivastav et al. 1988).

When did you get your first menses and when, if ever, did you start birth control or estrogen?

Glandular breast tissue develops during the first 12–18 months after a woman's first menses. After that the breasts enlarge from increased connective and fatty tissue. If a young girl takes birth control or estrogen early on, her natural estrogen can be suppressed, which can result in decreased glandular breast tissue. So when she becomes pregnant and wished to nurse, she may be a low milk producer (Lauwers and Swisher 2010).

Have you worked with a lactation consultant, midwife or doula? If so, when and why?

Lactation consultants (LC's) have varied backgrounds in training. Midwives and doulas are often certified in breastfeeding support as well as the birth experience, but tend to have less specialization. LC's are more prevalent in the northeastern part of the United States. They can work independently, for physicians, or with groups such as La Leche League. LC's are valuable resources for mothers and can provide supportive care that is otherwise missing in the modern day breastfeeding world. Physicians and even birthing ward nurses have very little training in breastfeeding, and LC's can fill a large part of this void.

Although there are certification programs, there is no licensing body as of yet. There is also variable consistency in training and recommendations made to mothers having difficulty. However, in general, LC's are excellent resources for breastfeeding mothers, especially when resolving breastfeeding difficulties that do not require medical intervention. Well-trained LC's can also determine when intervention is necessary because they have tried all of their "tricks" and nothing seems to be working.

Knowing whether or not a mother has worked with a breastfeeding specialist is important because it gives you an idea of what the mother has tried, what has worked, and what has not. It can also elucidate her concerns (why she sought help in the first place) and when those concerns became apparent.

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Chapter 6
Breastfeeding Evaluation: The Physical Exam

The breastfeeding physical exam has three components:

1. Mother's breasts
2. Baby
3. Mother and baby nursing

It is important to complete examinations of all three components before attempting to diagnose a problem. Most breastfeeding issues are complex and arise from a combination of factors—don't rush to determine a cause before all aspects of the mother—baby dyad have been described.

6.1 The Mother's Breasts

6.1.1 Flat or Inverted Nipples

About one-third of mothers have flat or inverted nipples during pregnancy. This shape makes formation of a teat more challenging as the baby has to have a very large gape to get around all the tissue. Flat nipples are not necessarily inverted. One way to differentiate the two is by performing a pinch test: Pinch the areolar tissue an inch behind the nipple. If the nipple protrudes it is simply flat and not inverted.

Inversions occur when the nipple adheres to the underlying tissue at the base, preventing protrusion and formation of

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a normal teat. It is usually congenital, but can also occur from previous nursing, surgery, breast cancer, infection, or breast drooping. One or both breasts may be affected. In most cases, drawing out the nipple with massage resolves the problem. But the tethering may be more severe, so that after protruding the nipple, the tissue falls back into inversion. In these cases, fibrosis causes the milk ducts to be retracted into the breast. Truly inverted nipples, which are rare, are permanently adherent and never protrude. These cases usually require surgical correction to stretch or lengthen the milk ducts and allow milk to flow out of the breast (see Fig. 6.1).

6.1.2 Breast Size

Very soft, pendular breasts can be difficult for baby to get his mouth around. There is no specific size or level of softness to look for—just note the size and shape, and flag as a possible

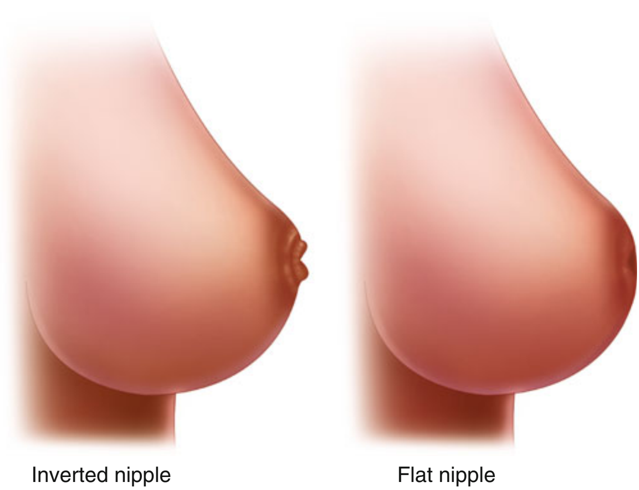

Fig. 6.1. One-third of mothers have flat or inverted nipples. Flat nipples follow the curve of the breast but can be pulled out to form a teat. Inverted nipples result from adherence to the underlying tissue, preventing protrusion and formation of a normal teat.

diagnostic factor. Large breasts may contain more fat than glandular tissue, and small breasts may be mostly glandular, so size does not determine the milk making capacity. Large areolas or breasts can require a wider gape from the baby.

6.1.3 Hypoplasia

Hypoplasia, or insufficient glandular tissue (IGT), has been widely discussed in the plastic surgery literature as a tuberous breast. Mothers with IGT have breasts that have less glandular tissue, and therefore less milk-making capacity. Their breasts are small, tubular often asymmetric, and widely spaced on the chest. The areola tends to be large for the breast size. Huggins et al. (2000) found that mothers with hypoplasia demonstrated breast asymmetry, wide intramammary spacing, stretch marks that developed during puberty without significant breast growth, low breast growth during pregnancy, and little engorgement during the first week postpartum (see Fig. 6.2). These findings were commonly associated with poor milk production. About 85 % of mothers with hypoplastic breasts produced less than half of the milk required by their baby during the first week. Early identification of women with hypoplasia is important because milk production can be increased with early and frequent breast emptying, even if they don't develop a full supply (Huggins et al. 2000; Neifert et al. 1985).

6.1.4 Breast Scars

Scars typically indicate surgery from implants, breast reduction or lift, biopsies, or cancer treatment. Typical implant scars are under the breast or in the armpit. Breast mass removal scars can be in any location. Breast reduction and breast lift scars tend to be circular, around the areola, and from the lower edge of the areola to the infra-mammary crease, resembling a lollipop. Since breast fat and glandular

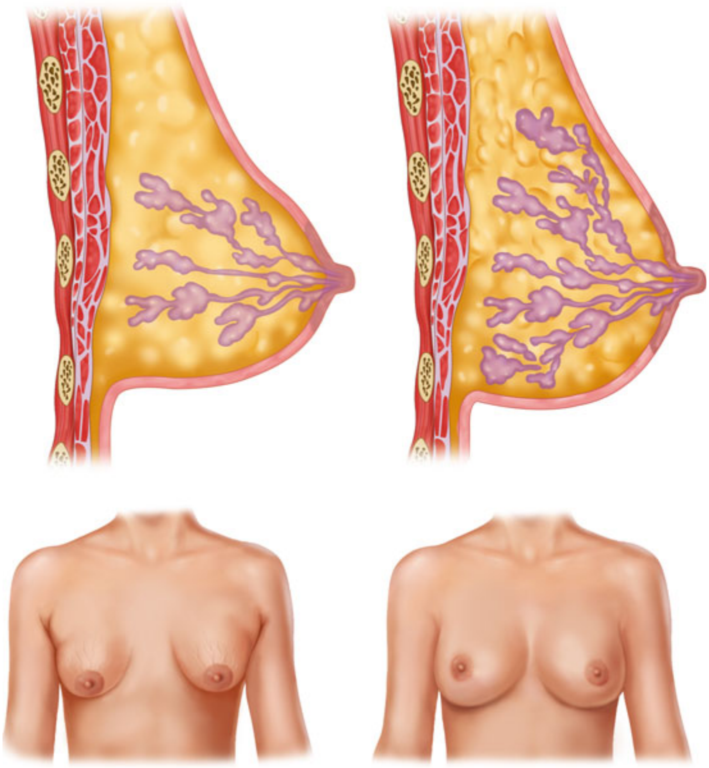

FIG. 6.2. Hypoplastic (IGT) breasts are small, tubular, asymmetric, widely spaced on the chest, have large areola for breast size, wide intra-mammary spacing, and stretch marks.

tissue is interspersed, it is impossible to reduce the breast size without removing some glandular tissue.

Mothers can have had breast implants *and* a lift, so it is important to get a complete history and not make assumptions based solely on the incision. While breast augmentation does not interfere with nursing, if a lift was also performed it may interrupt the touch receptors on the nipple to a certain degree. Augmentation can also mask IGT or small breasts.

6.1.5 *Nipple Piercing(s)*

Some researchers have found that nipple piercing may damage milk ducts, making it difficult for the baby to transfer milk. It can also disrupt ducts if the nipple is pierced horizontally (Garbin et al. 2009). Removal of the piercing usually corrects the problem, but surgical repair may be necessary.

6.1.6 *Breast Engorgement or Tautness*

Engorgement causes the breasts to appear symmetrically firm and edematous. There is vascular congestion, tenderness, erythema and warmth. Sometimes there is an accompanying low-grade fever and flattened nipples due to the swelling. The symptoms are generalized and not localized to one area. Engorgement is often a sign of inefficient emptying, especially from day 3–7, when transitional milk comes in, and during the first few weeks when the baby's needs and mother's supply are just beginning to sync.

6.1.7 *Raynaud's Phenomenon*

Approximately 20 % of women of childbearing age experience Raynaud's phenomenon. It is caused by vasospasm of arterioles, and affects extremities like fingers and toes and nipples (Flavahan 2015; Wu et al. 2012). It can cause very painful stinging or pinching precipitated by cold temperature and compression. It causes blanching of the nipple, followed by erythema and/or cyanosis (Barrett et al. 2013). To accurately diagnose Raynaud's, in addition to pain, occurrence of symptoms during pregnancy or when not breastfeeding, biphasic or triphasic color changes, and onset with cold temperature must also be present (Anderson et al. 2004). Raynaud's phenomenon is often confused with damage from a shallow latch or candida infections but does not respond to antifungals. It is usually a diagnosis of exclusion and symptoms resolve with nifedipine.

6.1.8 Inflammation

Inflammation can be generalized or localized, and is not necessarily indicative of infection. Assess for damaged nipples—nipples that are compressed into a lipstick shape, or cracked and bleeding. They may be swollen, erythematous, and tender. They may have scabbing and bruising. Often mothers use creams or other agents to soothe nipple pain, which may help but may also lead to other problems, such as allergic or irritant contact dermatitis (Heller et al. 2012).

The breasts should be evaluated for hard, tender cords limited to one area of the breast, which can indicate plugged ducts. Also, note any milk blebs, which are blister-like collections of milk at the end of a duct, and indicate a blocked duct. They can occur on one or both breasts. Blocked ducts cause stasis of milk flow and therefore can lead to decreased milk supply. Repeated or prolonged blockage can lead to infection.

6.1.9 Infection

Infection can occur superficially at the nipple and areola, or involve the breast tissue. It can be viral (*Herpes simplex*), bacterial, fungal, or mixed. In serious cases, an infection could require hospitalization. Note any nipple damage and broken skin, which may be the source of infection. Assess for breast erythema, warmth, vascular streaking, or fever, which may indicate mastitis. Localized pain with swelling, fever, and erythema is more likely to be mastitis than a plugged duct, but breast abscess must also be ruled out. Yeast infections are common on the nipples and areola, and tend to be less painful than bacterial infections, but only a culture or empiric treatment can discern the two.

6.2 Infant

In the baby, all of the structures in the head and neck form relative to one another in the womb. They also change in shape and size as the baby develops. Therefore anatomy of the newborn is different from the anatomy of a 6-month-old baby, and even less like that of a toddler or adult. This specific anatomy lends itself neonatal functions, such as breastfeeding. As such, a non-nursing toddler or small child cannot breastfeed if they have not been nursed from birth.

6.2.1 Head

The bones of the neonatal skull are not connected at the sutures. This is so that the skull can grow to accommodate the growth of the infant's brain, and so that the bones of the skull can overlap to fit through the birth canal. After birth, the bones of the skull do not always return to their natural positions. The shape of the head can also indicate birth trauma, such as hematoma by vacuum or forceps delivery (see Osetopathic Cranial Academy website).

Babies born by C-section do not travel through the birth canal and therefore are not subjected to those types of injuries. However, in utero, the skull can mold into a certain position and shape. In those cases, travel through the birth canal can free the skull bones, so babies born by C-section do not have that benefit.

6.2.2 Jaw

The size and position of the jaw are important because it will impact not only feeding, but also breathing and facial symmetry. The anatomy of newborns is different from that of adults. At 6 weeks gestation, the mandible begins to ossify. At birth, it is relatively retrognathic to the maxilla so it appears small, but it is really just set back. All babies are born with varying degrees of retrognathia, called physiologic jaw retraction. Movement of the muscles of mastication and swallowing movement of the tongue provide the stimulus for forward movement of the mandible over time, as the neonate grows. While there are no measurements for variants of "normal" retrognathia, there are measurements for what is considered pathologic retrognathia, found in some syndromes, such as Pierre Robin.

One objective assessment of retrognathia has been studied through intrauterine ultrasound. Rotten et al. (2002) describe retrognathia using the "inferior facial angle, defined on a mid-sagittal view, by the crossing of: (1) the line orthogonal to the vertical part of the forehead at the level of the synostosis of the nasal bones (reference line); (2) the line joining the tip of the mentum and the anterior border of the more protruding lip (profile line)." The mean value of the inferior facial angle was 65.5°. Consequently, an inferior facial angle value below 49.2° defined retrognathism. Palit et al. (2008) describe the frontal naso-mental angle having a mean of 146.74° in neonates.

It is important to differentiate between retrognathia and micrognathia. In micrognathia, the jaw is not merely set back, it is smaller, as in Pierre Robin Sequence and Stickler syndrome. Micrognathia can be assessed through the calculation of the mandible width/maxilla width ratio on axial views obtained at the alveolar level. Mandible and maxilla widths should be measured 10 mm posteriorly to the anterior osteous border. A mandible width/maxilla width ratio < 0.785 defines micrognathism (Rotten et al. 2002). Baudon et al. (2002) showed that babies with Pierre Robin sequence have dysfunction in motor organization of the tongue, pharynx and esophagus during feeding. Micrognathia does not self correct and must be addressed separately by appropriate specialists.

But even babies who fall under the "normal" category of retrognathia can have exaggerated retrognathia that can impact the baby's gape and therefore affect nursing. No studies have addressed this phenomenon, although it is clinically apparent and obvious even by subjective evaluation. Babies with exaggerated retrognathia have limited ability to open wide enough for a sufficient gape. Also, Luz et al. (2006) found an association between non-nutritive sucking habits (sucking without milk transfer) and short duration of breastfeeding. They also noted that babies with retrognathia

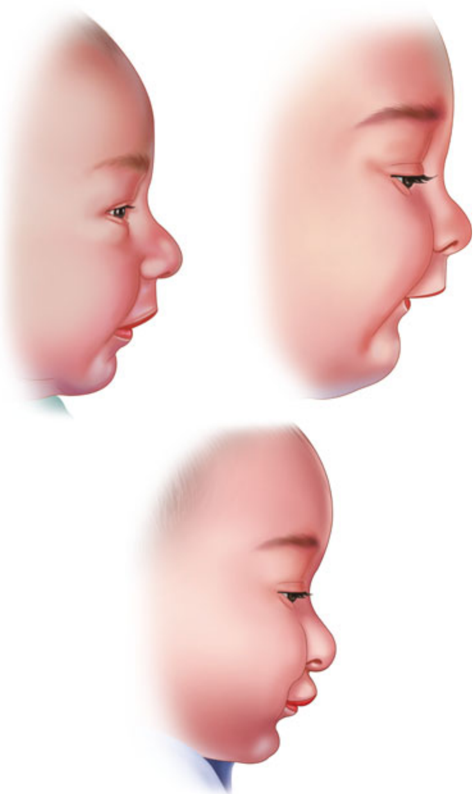

FIG. 6.3. Variations of retrognathia or physiologic jaw retraction. Even "normal" retrognathia can limit the gape and therefore affect nursing. No studies have addressed this phenomenon, but it is clinically apparent and subjectively obvious.

display more non-nutritive sucking (they do not transfer milk efficiently) (see Fig. 6.3).

Mandibular asymmetry can also impact nursing. Wall and Glass (2006) noted that mandibular asymmetry is an early indicator of torticollis, which will be discussed in a later section.

6.2.3 *Palate*

At 6 weeks gestation, the palatal shelves meet and fuse in the midline. The palate is shaped by the swallowing movement of the tongue, and by the downward and forward movement of the mandible. The shape of the palate can be noted most easily by direct visualization, and allowing the baby to suck on your finger (Fig. 6.4). Because the palate must be filled in order to stimulate the suck reflex (Glass and Wolf 1992), the shape of the palate determines how much breast is necessary for successful breastfeeding. A flat palate is easier to fill. A high and arched palate means there is more room in the mouth to fill. If the baby has a high palate and that space isn't filled with sufficient breast tissue, the baby will be more likely

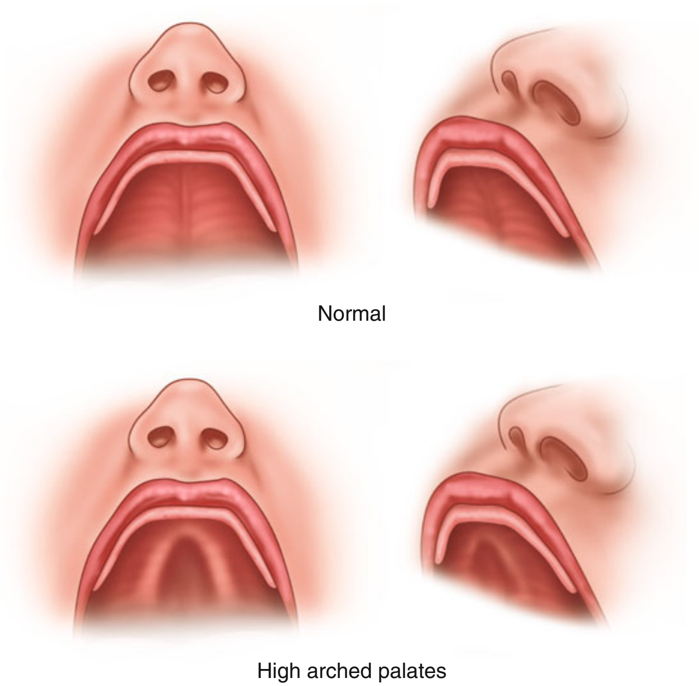

Fig. 6.4. Normal and high arched palates.

to take in air with nursing, or fail to suck entirely. Also, higher palates are farther away from the tongue. Even if the tongue is not tethered by an anterior frenulum, it may still not able to reach high enough to compress the breast against a high, arched palate. For all these reasons, babies with high palates are more likely to have an inefficient latch.

The presence of a cleft palate can cause nasopharyngeal reflux and requires adjustment of nursing position to fill the gap in the palate. There are specialized ways to feed these babies, which will not be discussed here (Reilly et al. 2013; Reid et al. 2006).

6.2.4 Upper Lip

Midline upper lip blisters can occur from friction between the lip and areola in a shallow latch. Also, the thickness and position of the labial frenulum should be noted (Fig. 6.5). It is normal for babies and small children to have an obvious labial frenulum (Baart and Bosgra 2004). There is no muscle contained in this tissue, but the purpose of this frenulum is to keep a space between the baby teeth so there is room for the permanent teeth to come in. Because this frenulum usually disappears by age 12, pediatric dentists recommend waiting to release a thick upper frenulum until age 9 or older to see whether or not the frenulum will cause a gap between the teeth (Mazzocchi and Clini 1992; Abraham and Kamath 2014). Technically there is no such thing as a “lip tie” in newborns.

Kotlow (2013) noted that, in his clinical practice, releasing this tissue allows infants to breastfeed successfully. He described restrictions of mobility of the upper frenulum as “lip tie” and created a classification system for the upper frenulum and recommendations for its release. However, the upper frenulum alone is not the cause of breastfeeding difficulty. Classification of the labial frenulum cannot predict breastfeeding success or failure. Further, cutting this frenulum alone does not correct the gape. It is part of a bigger picture regarding the gape, which is discussed later in this chapter.

FIG. 6.5. Every baby has a labial frenulum. It can vary in thickness and position but the labial frenulum alone is not predictive of breastfeeding success or failure.

6.2.5 Tongue

The tongue shape, position in the mouth at rest, and lingual frenulum should be noted.

The tip of the tongue should be round and the baby should be able to lift the tip of the tongue to the palate. A heart shaped or clefted tongue (see Fig. 6.6) indicates tethering of the tip of the tongue to the floor of the mouth. Most of the time, when there is a heart shaped tongue, an anterior lingual frenulum is noticeable, but not always.

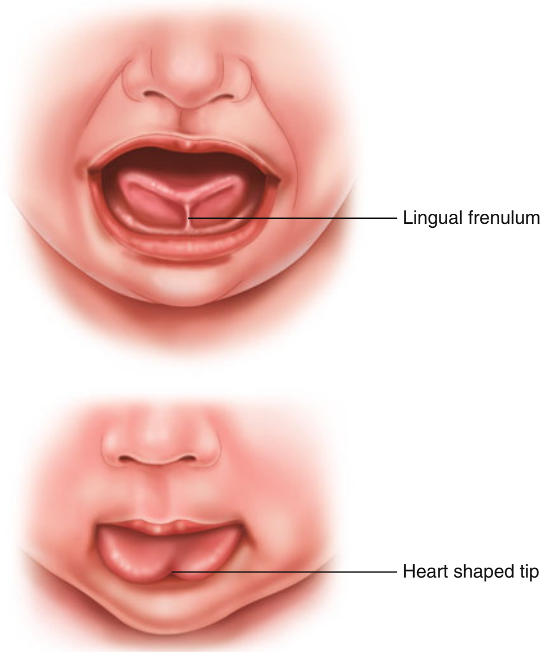

FIG. 6.6. Anteriorly based lingual frenulum and heart shaped tongue tip.

The lingual frenulum is a band of connective tissue under the tongue that covers the floor of mouth and ventral surface of the tongue. It is a three-dimensional structure that becomes more apparent when the tongue protrudes up or out of the mouth (Coryllos et al. 2004; Ricke et al. 2005; Hurst and Tucker 2013; Messner et al. 2000; Genna and Coryllos 2009; Geddes et al. 2008). At 4 weeks fetal development, the tongue forms from two lateral lingual swellings and one tuberculum impar in the center of the floor of the pharynx. The lateral lingual swellings grow and eventually fuse in the midline to form the anterior two-thirds of the tongue. Extensive degeneration of underlying tissue is supposed to occur to free the tongue from the floor of the mouth. The remaining tissue is called the frenulum. The degree of tissue degeneration will result in varying amounts of residual frenulum, but everyone has a frenulum. If there is little degeneration, the frenulum will be apparent all the way to the tip of the anterior tongue (see Fig. 6.6) and is called tongue tie, or ankyloglossia.

There has been a lot of recent research and discussion about this frenulum in breastfeeding. An anteriorly placed lingual frenulum causes restriction of tongue movement in every direction. It prevents extrusion, elevation, and retraction of the tongue. This results in future issues with speech, licking, movement of the food bolus, and crowded lower dentition. It also often results in immediate difficulty nursing.

While there is consensus that a "short" or anterior lingual frenulum causes these problems, there is no consensus on how short is too short. Genna and Coryllos (2009) described a classification system for the lingual frenulum, typing them based on the degree of attachment.

Some babies with an anterior frenulum can manage to nurse (Geddes et al. 2010), while others with very little frenulum cannot nurse. This has lead to a coining of the term, "posterior tongue tie." Posterior tongue tie has been described as a thick band of tissue that tethers the tongue in the same way as a more visible anterior frenulum (Chu and Bloom 2009). However, this type of description has led to a lot of confusion. First, it is a subjective description that is not predictive of tongue function. In other words, you cannot simply look in a baby's mouth and diagnose posterior tongue tie as you can with anterior tongue tie. Also, merely releasing the frenulum in these babies results in limited improvement in nursing. This will be more thoroughly discussed in the Treatments chapter.

As with the labial frenulum, any assessment of the tongue must be done in the context of a full exam of the rest of the head and neck. Lactation consultants often do a descriptive analysis of tongue mechanics, largely based on work by Hazelbacker (1993). While this evaluation is thorough, it has limited functional use in clinical practice in terms of diagnosing the underlying *reason* for the limited tongue movements (Amir et al. 2006). For example, if the jaw is excessively retrognathic, the tongue may be stuck in an erect position or protrude out of the mouth because there is nowhere else for it to rest. In this case, the baby may be unable to lift the tongue high enough to reach the palate, or be unable to pull the tongue back into the throat while nursing because the base of the tongue is tethered by the jaw. If the baby has a high palate, a normally positioned tongue may not be able to elevate enough to reach that far up.

6.2.6 Neck

Congenital torticollis is caused by tightening and shortening of the sternocleidomastoid (SCM) muscle on one side of the neck. Its cause is unknown, but it most likely due to positioning or crowding of the baby in utero. It is more common for first-born babies, and can occur with hip dysplasia. The SCM muscle scars from the injury, which results in a mass-like appearance in the baby's neck. The baby appears to have a twisted neck and holds and turns the head preferentially to the scarred side.

Babies with torticollis also have associated mandibular asymmetry (Wall and Glass 2006). They have a harder time with gape and positioning so they have less success in breastfeeding (LeVan 2011). They are known to struggle with latching and feeding and should be identified and treated immediately by a physical therapist or cranial osteopath (Genna 2015).

6.2.7 Gape

A wide gape is the result of optimum positioning and freedom of movement of all of the structures of the baby's head and neck. Specifically, the palate, tongue and jaw must be able to move independently of one another for the baby to be able to open wide enough to nurse.

Although nearly every reference book on breastfeeding mentions a wide gape, there is no objective measurement of it. It happens in a split second and results in an almost unhinging of the jaw. The baby must not only be able to open the mouth wide, he must be able to keep it that open while nursing. The degree of opening necessary for a baby mother pair varies as well, because the baby has to fit his mother's particular breast shape.

Gape is best assessed by trying to help the mother latch the baby on. The baby should be able to fully open the mouth to cover most of the areola, with the upper and lower lips flanged out. The mother should not have *any* pain when the baby sucks. If these criteria are met, the gape is sufficient. If not, the gape is too narrow and must be corrected before nursing can progress (see Treatments chapter).

6.2.8 Suck

Suck strength and coordination can be roughly measured by having the infant suck on your gloved finger. The baby should be able to form a seal around the finger and perform peristaltic type movements of the tongue against the finger. It should feel tight and firm. When you pull your finger out, you should feel a pop, like you are breaking the seal.

Babies with dyscoordinate suck cannot form a seal around the finger. They move their tongues in a disorganized fashion and do so on the breast *and* the bottle. They do not cause pain when they try to nurse.

6.3 Mother and infant nursing

There is a whole specialty concerning this assessment, namely the lactation consultion. I will limit my discussion to an office clinical exam by a primary caregiver.

Let the mother nurse the baby without help so you can assess both of their behaviors, noting those that help and those that hinder the process.

- Can the baby open his mouth widely and keep it open?
- Does mom hold her breast and help latch the baby on by bringing the baby to the breast and not vice versa?
- Does she put the baby on the breast and continue to support the breast, or does she immediately drop it after the baby latches?
- Is the whole areola covered by the baby's mouth?
- Can the baby stay deeply latched onto the breast, or does he fall off?
- Is the mother writhing in pain when the baby latches?
- When the baby is latched on, how does the mother support his head?
- What is the position of the baby's neck? Is it hyperextended, flexed, or at ninety degrees?
- Can you see the baby swallowing?
- Can you feel the milk being transferred by touching the baby's back?
- Do the baby's cheeks dimple while trying to nurse?
- How does the baby behave at the breast? Does he cry, resist, and arch away?

The baby can also be weighed before and after nursing to see how much milk he transferred from the breast. This measurement is crude, but helpful, and it is the most practical objective measurement we have for measuring milk transfer. Keep in mind, however, that it underestimates what the baby takes in by about 10–15 % due to evaporative water loss (Arthur et al. 1987).

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Chapter 7
Treatments

When a baby is born, breastfeeding should be assessed just like every other measure of neonate health. As discussed in previous chapters, what happens during the first week of nursing has a direct bearing on long-term breastfeeding success. But evaluation isn't enough. Mothers who have trouble breastfeeding are offered many overlapping and contradictory treatments, depending on the accuracy of the evaluation and diagnosis, and on where the treatment information comes from.

7.1 Treatment Goals

In general, the goals in treatment should be as follows:

1. Establish the milk supply through:
    a. Early stimulation of touch receptors to establish prolactin receptors and oxytocin stimulation.
        i. With nonpainful baby latching.
        ii. With hand expressing for at least the first week.
    b. Milk removal to prevent buildup of FIL and allow binding of prolactin. Milk removal should be:
        i. Efficient.
        ii. Quick bursts of 10 min on each breast, not prolonged feedings.

L. Dahl, *Clinician's Guide to Breastfeeding*,
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   iii. With a frequency of every 2–3 h at first, then less often after the first month.
   iv. By the baby if possible.
   v. By pumping if the baby cannot transfer milk efficiently.

c. Pain prevention

   i. Pain causes cortisol release that actually inhibits milk release.
   ii. Pain means that the latch is incorrect and inefficient.
   iii. Pain means nipple damage, which can lead to infection.

d. Prevention of infections/inflammation because it inhibits milk production.

   i. Engorgement and plugged ducts activate stretch receptors and cause FIL to build up.
   ii. Mastitis disrupts tight junctions and causes glandular involution.

2. Assure that the baby wants to go to the breast

   a. Try to get the baby onto the breast *transferring milk* as soon as possible to utilize the baby's innate reflexes.
   b. Avoid teaching the baby that he must work hard to get food from the breast.

      i. Avoid very frequent sessions with low supply or poor milk transfer.
      ii. Avoid long nursing sessions with low supply or poor milk transfer.

   c. Do not reinforce poor milk transfer from the breast by following difficult breastfeeding with an easy food source, such as a bottle, finger, syringe, etc.

3. Create a livable scenario for the mother

   a. Recommendations should be as efficient as possible and fit into her lifestyle.

i. Long nursing or pumping sessions should be avoided and do not help.
ii. Do not encourage nursing through pain and work to resolve painful nursing as soon as possible.

b. Avoid crutches that will not helping long term breastfeeding goals

i. Do not recommend breast shields when there is poor milk transfer.
ii. Do not recommend supplemental nursing systems (SNS) when mom has a good supply.

In this chapter I discuss treatment options, along with the background and intent of each treatment. Different and overlapping treatments are often utilized, and sometimes there is more than one option. Treatments are listed with research supporting (and sometimes refuting) recommendations that are commonly given. I then give my recommendations for how treatments are best utilized. In Chap. 8, I present actual clinical case scenarios to illustrate how treatments can be put into action.

Note: Section 7.2 for babies is organized by treatment because the same solution can be used for different diagnoses. Section 7.3 for mothers is organized by diagnosis because actual causes are easier to pinpoint and treat directly, with each diagnosis being treated separately.

7.2 Infant Treatments

7.2.1 Nursing Positions

There are many books dedicated to the subject of nursing positions, including *Supporting Sucking Skills in Breastfeeding Infants*, *2nd editions* (Genna 2012). Chapter 1 describes the most direct and efficient way to nurse a baby with the perfect latch—prone, with skin-to-skin contact with the mother's breast, and with the mother supporting the weight of the breast. This position can also be diagnostic and therapeutic. However, if the baby has a wide gape and fits easily onto his mother's breast, almost any position can be utilized. Lactation consultants are trained in these positions and situations where one position may be more helpful than another.

A study done by Blair et al. (2003) found that no single set of attributes in nursing position was more related to level of pain experienced by the mother than another. Therefore, no single aspect of positioning is more crucial than another. However, this study did not control for the latch and gape. What they did show is that, without an appropriate latch, positioning alone cannot compensate.

There is one notable exception when discussing nursing position: when mothers have oversupply. If a mother with an oversupply of milk uses the cradle hold, the let down may be too much for her infant, even with a good latch. A better position in these cases is for the mother to lie on her back, with the baby prone on top of the breast. This position allows the baby to suck the milk they can handle without the extra pull of gravity.

7.2.2 Cranial Osteopathy

In the last decade, the application of osteopathy for infant health, specifically for correcting nursing problems, has grown. Osteopathy is a form of medicine based on the concept that structure determines function. Through manual contact with the patient, structural imbalances in the body can be corrected, ultimately allowing the body to self-heal. Treatment should be done by a trained Doctor of Osteopathy who has knowledge and experience specific to cranial osteopathy in infants. Their techniques are modified and adapted for infant anatomy. Ideally, infants are seen shortly after birth and can be treated by a single visit or a series of four to eight treatments.

The first step is an evaluation of the newborn's general condition, asymmetries, and defects in posture. Then the assessment is performed using TART (Tissue alteration, Asymmetry, Range of motion, and Tenderness) criteria, a standard osteopathic technique (Ward 2002). Testing requires only passive participation from the infant.

Osteopathic manipulative treatment (OMT) techniques are used to treat the body's framework. The movements are gentle and repositioning. In infants, indirect techniques are used, where the dysfunctional body part is moved away from the body part that has restricted motion, allowing equal tissue tension in all directions. Cranial osteopathy has a demonstrated history of success in treating infants. In one study (Cerritelli et al. 2014), researchers evaluated and treated 100 preterm newborns over 8 months. Treatment was associated with a decrease in length of stay and hospital cost, and because of the adapted techniques, there were no infant injuries as a result of the treatment.

Specific osteopathic treatment has been recommended for preterm infants and babies with suck disorder. In newborns, the cranial base, mandible, and hyoid influence the position and movement of the tongue. Additionally, the 22 bones in the skull are mobile. Due to forces during birth (travel through the birth canal, forceps, vacuum) cranial nerves 9, 10, 11, and 12 may be compressed at the cranio-cervical junction. One aim of this type of treatment is to release the hypoglossal nerve where it exits the skull base the between the basilar and condylar parts of the infant occiput. Additionally, restrictions of ligamentous, fascial and vascular connections can be released to allow free movement of head and neck structures (Lund et al. 2011; Wescott 2004).

Since cranial osteopathy is safe in experienced hands, every infant can benefit from at least one treatment. In many cases, this gentle repositioning results in enough of an increase in gape that the infant can latch on successfully. However, since timing is important, I recommend that if, after a few sessions improvement is not being made, referral to a specialist be made for further intervention.

Additionally, some babies undergo surgical release of inhibitory tissues but still cannot gape widely enough to nurse. Cranial osteopathy is an excellent adjunct in these cases.

7.2.3 Nipple Shields

A nipple shield (NS) is a thin silicone device placed over the mother's nipple and areola prior to nursing. There are openings in the nipple cover to allow the baby to nurse. Variations of a NS have been used for centuries. They have been made from materials concurrent with the time, such as silver, pewter, animal skins, rubber, latex and finally thin silicone.

NS's are routinely given to mothers when babies are preterm, or if they have trouble latching the baby on and nursing. The research regarding the efficacy of NS's is contradictory, but mostly incomplete. Concerns with use of NS's are:

1. The lack of direct stimulation of the areola by the infant's mouth disrupting maternal hormonal response, namely prolactin and oxytocin. Because there is a barrier between the baby's mouth and maternal skin, use of a NS can theoretically blunt maternal hormonal responses to nursing. Amatayakul et al. (1987) studied prolactin and cortisol levels in breastfeeding women with and without thin silicone NS's, and infant suckling time and milk transfer. Maternal hormone levels did not drop, but they were only measured at 1 week postpartum and did not account for oxytocin, which may have been inhibited.

   Another study showed that prolactin and cortisol were not reduced with the NS, but the sample size was only five mothers and too few feedings were studied within the first 4 weeks. Most mothers also supplemented with formula. In other words, there were too many uncontrolled variables for these studies to have relevance (Chertok et al. 2006).
2. Reduction in milk transfer using the NS. McKechnie and Eglash (2010) reported that: "For the majority of infants in reported studies, infant weight gain was not a problem during NS use, although in general the studies did not report the amount of bottle feeding with expressed breast milk or formula. Milk transfer while using an NS should be assessed, and NS use should be discontinued if milk transfer is not good."

The study by Amatayakul et al. (1987) showed that infants transferred less milk in the same amount of time with the shield. Other studies assessed weight gain, but did not address maternal supply, pumping, or supplementation with formula. One study compared pumping with and without a NS and showed a decrease in milk transfer even with the pump, as the NS disrupts normal suck/swallow mechanisms (Auerbach 1990).

A follow up study (Meier et al. 2000) showed that babies nursing with a nipple shield had appropriate weight gain, but the author did not disclose the amount of formula given in relationship to duration of NS use, nor the amount of breast milk taken by infants whose mothers were using a NS. The authors concluded that NS use is not associated with insufficient weight gain. However, this study did not address the effect of NS use on maternal milk supply. Chertok (2009) found that by 2 months postpartum, 17 % of the mothers had weaned and 59 % were using formula, such that only 19 % of mothers were still exclusively breastfeeding. Nationally, about 30 % of babies are exclusively breastfed at 3 months, which suggests that use of NS's may be associated with insufficient lactation in the long term.

3. Masking underlying nursing problems. A comprehensive review of the literature done by McKechnie and Eglash (2010) evaluated the use of NS's. They concluded that there is no evidence for safety or effectiveness of contemporary NS use, and that attempts should be made to establish normal breastfeeding before introducing NS's. Although NS's may be an "easy fix" for stressed or frustrated new mothers, their use should not substitute for a thorough evaluation of the mother–infant dyad.

   Wilson-Clay (1996) worries that the pervasive use of NS's in the very early course of breastfeeding could relay a false message of breastfeeding success. Additionally, widespread retail access to NS's might also signal to mothers that their use is a norm that warrants little concern.

In summary, research suggests:

- If the baby cannot latch onto the breast, or there are problems associated with the latch (pain, nipple damage, poor weight gain), a NS will only mask the problem, not correct it. In some cases, maternal milk capacity can be maintained by pumping and because the mother is an ample milk producer, but a NS is not the answer. It can temporize the problem until appropriate intervention can occur, but if there is pain, that always means poor milk transfer. Breastfeeding is better served by pumping to increase/maintain the supply and not by nursing with a NS. Nipple aversion or confusion can be addressed if it occurs, but even if the baby can latch onto a NS, his ability to transfer milk is not improved by the NS. The baby will eventually associate poor milk transfer from the breast even with the NS.
- Once the latch has been corrected, if the mother has significant nipple damage but would still like to nurse, then using a NS in this way is appropriate. It can allow the mother's nipples to heal while allowing the baby to transfer milk from the breast.
- If a baby has significant nipple aversion and prefers a bottle nipple, a NS can help transition the baby back onto the breast. Again, once the latch has been corrected, if the baby associates successful milk transfer with rubber or silicone, the NS is a way to trick the baby back onto the breast.

7.2.4 Alternative Forms of Feeding and Supplemental Nursing Systems

When babies are not able to nurse on the breast efficiently, various alternative forms of feeding are often recommended, such as syringe, cup, and finger feeding. These systems provide ways to feed the baby that are thought to avoid nipple confusion because they are not bottles. But studies, including two large review studies, have shown no improvement in breastfeeding rates using cup feeding or finger feeding with nasogastric tubes. (Flint et al. 2007; Collins et al. 2008). As stated above, this is probably because nothing else feels like the breast. A baby can become conditioned to whatever feeds him.

A supplemental nursing system (SNS) is a very thin, soft silicone feeding tube attached to a bottle that contains either breast milk or formula. The tube is taped to the breast so that the opening is at the level of the nipple. The bottle is elevated above the opening of the tube to allow gravitational drainage of milk or formula. The baby is then latched onto the breast and is able to transfer milk from the breast simultaneously with supplemental milk or formula from the tube. It is a cumbersome, imperfect system.

As with the nipple shield or any other device to aid in nursing, the baby's latch must first be corrected before assuming that using an SNS is going to fix the problem. If the mother is experiencing pain and the baby cannot transfer milk from the breast, using a supplemental feeder will not help the situation. But many mothers are given the erroneous advice to nurse on the breast, pump, and then feed the baby again on the breast with the SNS. This is thought to reduce the risk of "nipple confusion." But if the breasts still need to be pumped after nursing, it is clear that the baby is not able to transfer milk. Using the SNS in these types of cases is not only a waste of time, but the pain and nipple damage experienced by the mother (due to an improper latch) can hinder her milk supply.

I make the following recommendations for the use of an SNS:

- First, establish an efficient latch and make sure the infant is able to transfer milk from the breast. In cases of abundant milk supply and low infant transfer, there is no indication for the use of an SNS. There should never be an instance where the mother is told to pump her own milk, and then use an SNS on her breast to feed her infant. She may as well pump and feed with a more efficient source, such as a bottle. This recommendation is often made with the assumption that the baby is stimulating the milk supply by simply latching onto the breast, and to prevent nipple confusion. But if the baby is not transferring milk from the breast, taking a long time on the breast, and potentially causing damage, it actually *inhibits* the milk supply. If the mother wishes to forgo bottle use, an SNS can be used to finger feed the infant. But this does not prevent nipple aversion to the breast, it just allows for nipple confusion to the finger instead of a bottle. It also takes longer and is more cumbersome.

- In cases of low maternal milk supply, once the infant latch and ability to transfer has been established, an SNS can be used as positive feedback to encourage the baby to nurse on the breast. In these cases, it can prevent and solve nipple aversion. In these cases, donor milk or formula is used for supplementation through the SNS.

7.2.5 Frenulectomy

Frenulectomy, frenulotomy, frenotomy are all different words that refer to the removal or division of the frenulum—more specifically, the lingual frenulum. The lingual frenulum is the band tissue that covers the floor of the mouth and ventral surface of the tongue. Although there is obvious indication for its division when it limits mobility of the tongue in speech, an accepted or standard degree of "tongue tie" requiring division to prevent speech issues has not been established. Crude measurements—such the as the ability to extend the tongue past the vermillion border (Jorgenson et al. 1982)—have been used by physicians for many years, but they confer no real prognostic power. Genna and Coryllos (2009) developed a classification for the lingual frenulum based on visual inspection, with Type 1 being tied anteriorly to the tip, and Type 4 merely a band of tissue across the ventral surface of the tongue with no appreciable visible frenulum on tongue extrusion.

In my practice, I release any anterior lingual frenulum that attaches to at least 75 % of the ventral surface of the tongue, or if there is a heart-shaped tongue tip, regardless of whether or not the infant is nursing. About 4–10 % of the general population has congenital anterior tongue tie that is significant enough for treatment (Segal et al. 2007).

Releasing the frenulum at birth as soon as tongue tie has been identified is helpful for many reasons. The tongue is a muscle. If it is tethered at birth, it can never fully develop into the appropriate shape and size. It cannot lift up to the palate or fully extrude. Without early release, the frenulum never stretches adequately. Tongue movement is hindered, resulting in adjustments of the head and mouth shape as the infant develops. It leads to many other consequences in the future that are not easily corrected, such as a high palate, narrowed nasal cavity, and crowded lower teeth and malocclusion (Srinivasan and Chitharanjan 2013). Tongue tie is often also accompanied by a high palate because the tongue could not flatten the palate during fetal development. In my clinical experience, the longer one waits to divide the frenulum, the lower the success rate, and the higher the regrowth and failure rate.

Releasing an obvious anterior frenulum was also found to aid in breastfeeding. Centuries ago, midwives lysed the frenulum with a long fingernail or metal object at birth. Over the years—as birthing babies moved into hospitals, formula was developed, and women went to work—the art of breastfeeding was lost and along with it, the art of the quick release of the frenulum at birth. Recently, there has been a resurgence in releasing the frenulum and several case studies followed, attesting to the benefits of the procedure (Ballard et al. 2002; Notestine 1990). Randomized controlled studies have been done in the last decade that provide significant evidence in support of the procedure (Berry et al. 2012; Buryk et al. 2011; Dollberg et al. 2014; Emond et al. 2014; Hogan et al. 2005).

Geddes et al. (2008) showed improvement in milk intake, milk-transfer rate, LATCH score, and maternal pain scores after frenulectomy. LATCH is a breastfeeding charting system that assigns a numerical score to five key components of nursing: L—latch, A—audible swallowing, T—type of maternal nipple, C—comfort level of mother, H—help needed by mother to hold the infant to the breast (Jensen et al. 1994).

Edmunds et al. (2013) studied the experiences of ten mothers with babies who had tongue tie and found devastating results in breastfeeding experience when tongue tie was not discovered and treated quickly. Mothers suffered through knowing something was wrong, seeking help, but encountering health professionals who were unable to provide appropriate advice or diagnosis. Were it not for the mothers' own perseverance in looking for answers and treatment, breastfeeding would have failed completely.

There should be no debate in regards to the merits of performing an early frenulum release when one is noted at birth. There is simply no reason to not intervene.

However, there are still many areas of contention. There is no accepted protocol for how the procedure should be done or who should be doing it. There is no training for it—practitioners gain experience by trial and error in the office. Even surgical subspecialists are not trained in the anatomy of a nursing infant and appropriate incisions beneficial for nursing. And many practitioners perform the procedure with little understanding of proper surgical technique and anatomy and no preparation for adverse outcomes. The risks associated with any procedure are directly related to the experience of the surgeon. Without a thorough understanding of the anatomy and the ability to correct for risks, babies can be harmed, sometimes terribly (Opara et al. 2012). Also, if too much or not enough tissue is released, breastfeeding outcomes can actually worsen. Scarring and thermal injury from improper use of lasers in the neonate can cause an increase in tethering. There are right and wrong ways to perform this procedure.

In addition, simply releasing the tissue does not confer success in breastfeeding. Most mothers need to be *shown* how to latch their baby onto their breast. The procedure is only the first step. The *goal* is successful breastfeeding outcomes (Douglas 2013).

Although appropriately releasing the frenulum undeniably helps nursing outcomes (O'Callahan et al. 2013), no one has yet identified *why* it is helpful. My clinical observation is that it improves nursing because it allows the baby to gape wider by releasing the tongue from the floor of the mouth. When nursing, the tongue and jaw must move independently. When they are attached by a frenulum, they move together. This observation is mimicked in babies who present with no obvious tongue tie, but have a limited gape and cannot fit around their mother's breast shape. These babies present the same way as tongue tied babies, but without obvious tongue tie. They have been referred to as having a "posterior tongue tie" because they have the same problems as tongue tied babies, but there is no visible culprit. The focus on the tongue alone confuses the real issue. Various descriptions of posterior tongue tie have been attempted, but there are no defining characteristics of a posterior frenulum that are clinically useful. The term is confusing for mothers and practitioners. Also, simply releasing the lingual frenulum in these cases is not very helpful—in my practice, I had less than 50 % improvement. It is much lower in untrained hands. Some lactation consultants, exuberant about releasing the tongue, pushed to cut deeper into the tongue muscle or raphe. But there is no evidence to show that deeper cuts are beneficial, and they risk injury to surrounding structures and excessive pain and bleeding for the infant.

My theory is that many babies have a tethered gape due to the relationships of the tongue, floor of mouth/jaw, and palate to *each other*. These structures must move independently in breastfeeding. Sometimes, due to their position in relation to each other, they don't have enough freedom of movement.

One scenario I often see is a baby with a greater degree of retrognathia than normal and a high, arched palate. These babies present with a tongue that, at rest, points upward so that the ventral surface is mostly visible. Their frenulum is a band of tissue with no anterior involvement. In these cases, the tongue is positioned posteriorly in the throat relative to the jaw so it cannot lift up and move backwards to compress the breast against the palate. Since the palate is high, the tongue has even farther to go. When these babies gape, their upper lip is pulled down by their retrognathic jaw. Their upper lip doesn't flange out as it should. In these babies, the tongue, jaw, and palate move together not independently. In tongue tied babies, the problem is more visibly obvious, but the outcome is the same: the structures are not able to move independent of one another.

Because of the low success rate of lingual frenulectomy alone when there is no obvious anteriorly based lingual frenulum, I began also cutting the labial frenulum to release the maxilla (palate) from the jaw. These babies instantly are able to gape widely and latch deeply onto their mothers' breasts. In babies with obvious anterior tongue tie who also have retrognathia and/or a high palate, releasing the lingual frenulum widens their gape, as well. [For additional reading, a study by Todd (2014) discussed the diagnostic and treatment dilemmas regarding the often confusing diagnosis of tongue tie.]

Tongue tie reflects the importance of the gape. If the gape is small and tethered, it will lead to a shallow latch and poor milk transfer. This tethered gape is due to the inability of the palate, jaw, and tongue to move independent of one another. Sometimes babies have something visible, like tongue tie. Sometimes they have retrognathia and a high palate. Sometimes there is no discernable pattern to their anatomy, but they obviously can't open wide enough to take in enough of their mother's breast. It may be due to their mother's breast shape and a different breast shape works better. And there are babies who have an obvious anterior tongue tie, but they can still gape widely enough that they can fit their mother's breast shape (Ballard et al. 2002; Chu and Bloom 2009; Coryllos et al. 2004; Kupietzky and Botzer 2005; Messner et al. 2000; Ricke et al. 2005; Segal et al. 2007).

7.2.6 Breast Aversion

The subject of *nipple confusion and aversion* is controversial. Articles about nipple aversion tend to focus on alternative methods of feeding infants as the culprit. As I have stated before, nipple aversion is a conditioned behavior that is established in infants who are unable to get sufficient milk from the breast. This can be either from a low supply or inability to transfer due to a poor latch. Once the baby has learned that he will remain hungry after nursing, he can quickly develop nipple aversion. He is not confused at all; he knows that the breast is unsatisfying.

If, after establishing that the breast provides low return for his work, the baby is rewarded with a feeding source that offers him food more easily, he will quickly adapt to that source. It doesn't matter if it is cup, bottle, or syringe (Flint et al. 2007). The converse has also been shown: If a baby is breastfeeding successfully, introduction of a non-nutrititive pacifier does not create an aversion to breastfeeding. A Cochrane review (Jaafar et al. 2011) examined the effects of pacifier use on full-term, effectively breastfeeding babies. In almost 1300 newborns in two trials, pacifier use had no significant effect on partial or exclusive nursers.

In babies who cannot breastfeed successfully, I submit that pacifier use will not encourage aversion to the breast, because the pacifier is not a food source. One study went a step further and showed that restricting pacifier use at birth *decreased* exclusive breastfeeding and increased supplemental and exclusive formula feeding. (Kair et al. 2013)

Pacifier and bottle use is recommended against by the WHO "Ten Steps" protocol, as if the exposure alone causes nipple confusion. Education is important, but if the baby is unable to latch onto the breast and transfer milk successfully, all of this education and policy change is for naught. No one is going to promote starving the baby to avoid nipple aversion (Venancio et al. 2012; Buccini et al. 2014).

7.3 Maternal Treatments

7.3.1 Flat or Inverted Nipples

Treatments, such as pumping or using breast shells to draw out the nipple can help make the fibrosis more elastic. The Hoffman Technique can also be used: Place a thumb on each side of the base of the nipple—directly at the base of the nipple, not at the edge of the areola. Push in firmly against breast tissue while at the same time pulling the thumbs away from each other. This stretches out the nipple and loosens the tightness at the base of the nipple, which will make it move up and outward. Repeat this exercise twice a day, working up to five times a day, moving the thumbs around the base of the nipple (Hoffman 1976).

7.3.2 Superficial Infections and Inflammation

Many women are told to provide supportive care for their injured breasts, but they are also encouraged to continue causing damage to their breast (by improper nursing or pumping). Prevention of nipple trauma while emptying the breasts should be the first goal, and prevention of nipple confusion comes second. Once the cause for nipple trauma has been established and treated, there are many options for topical treatments to heal the nipples.

- Glycerine gel
- Lanolin
- Breast shells
- Expressed breast milk
- All purpose nipple ointment
- Peppermint gel
- Neosporin ointment
- Antifungal cream
- Vinegar/baking soda paste

Dennis et al. (2014) reviewed studies to see if one treatment had better outcomes than another. They concluded that:

"There was insufficient evidence that glycerine gel dressings, lanolin with breast shells, lanolin alone, expressed breast milk, or all-purpose nipple ointment improved maternal perceptions of nipple pain." They went on to note that "One important finding was that regardless of the treatment used, for most women nipple pain reduced to mild levels after approximately seven to 10 days' postpartum." The researchers concluded that mothers should be told of the usual time to pain abatement as a treatment strategy.

I strongly disagree with that last bit of advice. This is the root of the myth that, when it comes to nipple pain, women should just "wait it out." Nipple pain is *common*, but it is not *normal*. The pain may indeed subside eventually, but that does not mean that the latch has improved or that nursing will be successful. It usually just means nerve endings in the nipple have been damaged (Dennis et al. 2014; Brent, et al. 1998; Melli et al. 2007). Although there is no evidence to support or refute its use, I often recommend that mothers make a paste of baking soda and white vinegar and place it on damaged nipples several times a day. This treatment can clear yeast infections naturally and soothe pain and itching.

7.3.3 Inflammation/Infection

7.3.3.1 Engorgement

Engorgement occurs when the breasts fill with an increased blood supply and production of transitional milk. It usually occurs after the first 3–7 days, once the breast stops making colostrum and starts making transitional milk, but it can also happen when there is a sudden change in the drainage pattern of the breast. It is basically a backup problem due to a sudden increase in milk supply.

In one way, engorgement is a good sign because it means that milk is coming in. But it is also painful and can lead to plugged ducts or infection, so it must be addressed. The best way to address it is to assure efficient milk removal every 2–3 h as a prevention. Once engorgement occurs, consistent milk removal is important. A key point is that, in mothers who are experiencing painful latching from their babies, the baby will not be emptying the breasts efficiently. It is important for these mothers to pump and remove the milk to prevent infection and maintain the milk supply (Chapman 2011).

7.3.3.2 Plugged Ducts

Plugged ducts occur when a ductal system is blocked or backed up. It feels like a hard cord in the breast and can be tender to the touch. One or more ducts can be blocked. Blockage is a result of milk stasis, which means milk is not being extracted efficiently. This can occur either because the mother is an over-producer, or because she is not removing the milk efficiently—by pump or baby. Regardless, plugged ducts can lead to infection and a decrease in supply. They usually improve with warm compresses and efficient milk removal (Zhao et al. 2014; Bolman et al. 2013).

7.3.3.3 Mastitis

Mastitis occurs when one or more lobules of the breast become inflamed and infected. It usually presents with warmth, tenderness, erythema, and swelling at least 10 days after birth. It can come on suddenly with a high fever, acute breast pain, and myalgias, and should be treated immediately. The reported incidence varies widely, but may be as high as 33 % (Jahanfar et al. 2009). The most common pathogen is penicillin-resistant *Staphylococcus aureus*, which is the causative agent 50 % of the time and part of the normal flora of skin. Antibiotic resistant organisms can also be present, and a breast abscess must be ruled out by doing a milk culture in cases where first line treatment is ineffective. A 2009 Cochrane review could not recommend antibiotic use for treatment based on the reviewed studies (Jahanfar et al. 2009). However, the American Congress of Obstetricians and Gynecologists (ACOG) recommends 10–14 days of antibiotics. Each case should be considered and treated based on the symptoms and severity.

As with plugged ducts and engorgement, the key to prevention is continued milk removal. It is not harmful for the baby if a mother continues nursing on a breast with mastitis. However, mastitis is common when babies cannot transfer milk efficiently, both because of breaks in skin from nipple trauma and milk stasis. So it may be more prudent to encourage a mother with mastitis to pump until the latch can be corrected. She should pump regularly and as completely as possible.

Even one bout of mastitis can greatly reduce the milk supply. Recurrent bouts of mastitis can occur from continued incomplete milk removal, or incomplete treatment of the first bout of mastitis. Solid or cystic masses/neoplasms should also be ruled out (Jahanfar et al. 2009; Beltrán et al. 2015; Ingman et al. 2014).

7.3.4 Supply Issues

7.3.4.1 Pumping Methods for Low Supply

Few women have innate reasons for low milk supply. Most supply issues are due to inadequate removal of milk (Prime et al. 2011). Studies have shown that the degree to which the breasts are emptied and the frequency of emptying during the first month will set the stage for the breasts' milk making capacity for the duration of nursing. Milk emptying should be addressed immediately after the baby is born.

Ideally, the baby has an efficient milk transfer. But pumping is often necessary to extract milk from the breasts when the baby cannot, or if the mother wants to store milk for future feedings. There are many different methods of pumping using hand techniques and/or electrical devices. Depending on the situation, certain techniques are more helpful or appropriate than others.

Dr. Jane Morton from Stanford has done several studies on the benefits of hand stimulation, especially in the first 3 days when the breasts produce small amounts of mostly colostrum. She describes how to compress the breast to express milk before starting to nurse the baby, which is very helpful in the first month (see Stanford website). Her work has been done with preterm babies. She demonstrated that hand pumping followed by electrical pumping for the first 3 days improved milk supply not just in the interim, but throughout the first 2 months.

The theory behind hand pumping is that the touch receptors are stimulated by the hand instead of the baby's mouth. Morton et al. (2012) showed that combining hand techniques with electrical pumping also changed the composition of the milk by increasing the percentage of fat, while protein and lactose levels remained the same. The results were sustained up to week 8, and mothers had increased total volume of milk. The mechanism may be the up-regulation of prolactin receptors and release of oxytocin.

An earlier study of hand pumping showed increased milk flow and total volume while pumping sequentially with a hand pump compared to simultaneous electrical pumping for a shorter duration (Fewtrell et al. 2001).

The timing and duration of pumping is important. The Human Lactation Research Group at the University of Western Australia has done a series of studies to analyze the synthesis and secretion of breast milk and its removal by electric breast pump. It is important to note that most of their studies were done on women in whom breastfeeding had already been established after the first month of nursing. One study showed that simultaneous expression stimulated more milk ejections and was a faster method of expression, with higher fat content of the milk. But the percentage of milk removed was the same regardless of method (Prime et al. 2012).

Another study evaluated different vacuum patterns of electrical pumping and found that the pattern did not change milk ejection characteristics, but nearly half of the total volume of milk was removed during the first milk ejection (Ramsay et al. 2005).

Long duration of pumping has been shown to be unnecessary. Mitoulas et al. (2002) showed that the rate of milk expression varied greatly between mothers, but remained constant during the first 2.5 min and then decreased over time.

A study by Prime et al. (2011) that showed that after the first 8 min of pumping, milk flow rate is reduced. They noted that long expression times are not necessary, and extending time between expressions results in less effective removal of milk.

Daly et al. (1996) did a very small study on four mothers and noted that longer intervals between feedings of greater than 6–18 h resulted in less milk production. Also, changes in the rate of milk synthesis were associated with the degree of emptying, not necessarily the frequency of feeds.

Vacuum strength can affect the yield and flow rate of milk. Kent et al. (2008) showed there are greater milk ejections with greater milk flow and yield when a mother's maximum comfortable vacuum was used. After 15 min, fat content of the milk also increased, indicating more complete removal of milk. But again, milk flow rate was greatest during the first ejection.

Kent et al. (2011) showed that warming breast shields before pumping increased efficiency of removal during the first 5 min of pumping and was more comfortable for the mother. It also confirmed that maximal comfortable vacuum was more efficient.

A Cochrane review of twelve studies concluded that electrical or foot-powered pumps resulted in greater milk volumes after 6 days than hand expression alone. Using a relaxation tape during the second week at least once a day also helped with milk volume. Simultaneous pumping is quicker than sequential pumping (Becker et al. 2008).

7.3.4.2 Emptying to Manage Oversupply

Oversupply is important for several reasons.

1. So much milk can be produced that without proper timing and degree of emptying, these women are more prone to mastitis, engorgement, and plugged ducts.
2. The baby often cannot handle the flow, much like wrapping his mouth around a firehose.

3. There can be so much milk the baby fills up on watery foremilk and does not get enough hindmilk. This can lead to diarrhea, poor weight gain, gas, and frequent feedings.
4. It can mask problems with the latch, usually up to 10 weeks, when suddenly the mother's supply runs out and the baby rejects the breast. By this time it is much harder to salvage breastfeeding and bring her supply back.

Some helpful practices are:

- Fully emptying both breasts by mechanical pumping first thing in the morning (Berghuijs 2000).
- Block feeding, nursing one breast to emptying at a time, allowing the baby to take in hind milk.
- Pumping some of the initial letdown for storage so the baby does not drown in the flow.
- Nursing in the lay down position so the baby can control the flow against gravity.
- Emptying the breasts with a pump or hand expression if the baby cannot to prevent plugged ducts, etc.
- Assuring the latch is appropriate and not painful to differentiate latch difficulties from difficulties managing the supply.

7.3.4.3 Galactagogues

Galactagogues are substances ingested by the mother that stimulate milk production, either for initiation or maintenance. It is generally agreed that mothers should not take galactagogues until their breastfeeding situation has been evaluated, and they have appropriate methods for milk removal. Stimulation of increased milk production without adequate and timely removal can lead to engorgement, plugged ducts, and mastitis.

Since most supply issues stem from inefficient milk transfer, and most studies do not control for this important variable, it is hard to make sense of the literature. It is even more difficult when it comes to herbal remedies, since they are culturally based and women usually begin taking them right after birth, regardless of supply issues.

Galactagogues fall into the following categories:

1. Herbs and Natural substances—Herbal treatments have been tried for centuries. Mortel and Mehta (2013) reviewed six trials evaluating five different herbal supplements: Shatavari, torbangun, fenugreek, milk thistle, and a Japanese herbal medication. These studies had small sample sizes and were poorly designed, so no recommendation regarding these herbs were made by the authors. Castoldi et al. (2014) found that galega and sylimarine improved milk production in preterm mothers so they were commensurate with the supply of term mothers. Most recommendations are anecdotal and cultural as there are no accepted dosing regimens or sources for these supplements. But since they confer little to no risk, they are recommended routinely by lactation consultants and midwives.

    a. Fenugreek. Although used for centuries, several trials have shown only mixed results for increasing milk production (Reeder et al. 2011; Swafford and Berens 2000; Turkyılmaz et al. 2011). Fenugreek is a phytoestrogen.
    b. Galega (Goat's rue). First discovered in 1900 when it was found to increase milk production in cows. It helps with insufficient glandular breast tissue (Castoldi et al. 2014).
    c. Silymarin. This is the active substance in milk thistle that has some galactagogue activity, possibly by binding estrogen receptors (Zuppa et al. 2010). It was originally used as a liver protector. There have been no scientifically valid clinical trials to support the use of milk thistle in increasing milk production (Di Pierro et al. 2008; Mortel and Mehta 2013; Forinash et al. 2012; Zapantis et al. 2012).
    d. Shatavari. This is a wild asparagus that has been used as a galactagogue in India for centuries. Clinical study results are mixed, but no adverse effects have been noted. It is included in the official ayurvedic pharmacopia

for use in normalizing lactation (Joglekar et al. 1967; Sayed et al. 2007; Chaudhury and Tennekoon 1983; Low Dog 2009).

e. Torbangun, or Coleus amboinicus Lour. This herb has been used for hundreds of years in Indonesia. The leaves are consumed for 1 month after birth to promote milk production (Damanik et al. 2006).
f. Oatmeal. There is no research to recommend or deter ingestion of oatmeal as a galactagogue. Its recommendation is primarily due to personal accounts by mothers. Its mechanism of functioning is therefore unknown.
g. Beer. In moderate amounts, beer has long been known to improve breastfeeding success. However, it is not the alcohol, but a polysaccharide from barley that stimulates prolactin secretion (Koletzko and Lehner 2000). Nonalcoholic beer has been shown to have similar effects.

2. Hormones—Hormone supplementation has been attempted with limited success and application. Also, the cost of treatment is too high to be recommended routinely. Limited studies have been attempted. Oxytocin spray has been evaluated through a randomized double blind study in 51 mothers. No difference in total milk production or fat content was found (Fewtrell et al. 2006).

   a. Human Growth Hormone (HGH)
   b. Thyrotropin Releasing Hormone (TRH)
   c. Oxytocin
   d. Medroxyprogesterone

3. Antipsychotics

   a. Chlorpromazine. This drug increases prolactin levels by antagonizing the dopaminergic hypothalamic receptors. In 2001, the AAP concluded that chlorpromazine can cause acute and chronic alterations on the development of the central nervous system. They placed chlorpromazine in the group of drugs for which the effect on nursing infants is unknown but may be of concern (Zuppa et al. 2010). Briggs et al. (2008) advised infant monitoring for possible onset of sedation.

   b. Sulpiride. This drug stimulates the hypothalamus to secrete prolactin-releasing hormone. Some studies showed improvement in milk production, but the risks and side effects preclude recommending this medication for lactation (Zuppa et al. 2010).

4. Antiemetics

   a. Domperidone—Domperidone (Motilium) is a drug that was originally created for use in gastrointestinal issues, such as nausea and vomiting. It interferes with dopamine D2 receptors in the gut and anterior pituitary gland. Dopamine also inhibits the secretion of prolactin by the pituitary gland. By interfering with dopamine, a side effect of the drug, it raises serum prolactin levels, resulting in increased milk production (Hofmeyr and van Iddekinge 1983). The FDA put out a warning against the drug in June 2004 because of possible cardiac effects. However, these effects only occurred in very sick patients taking it intravenously. It is not widely available in the United States, but can be obtained through compounding pharmacies (which are not under the regulation of the FDA) and from Canada. The only risk factor listed by the manufacturer is that chronic use in rodents has resulted in increased breast tumors. It is approved by the American Academy of Pediatrics for use in breastfeeding mothers. Studies have shown that it is safe and effective in nursing. Different dosing regimens have been assessed. Da Silva et al. (2001) did a randomized double-blind placebo-controlled study that assessed 16 mothers with premature infants. The dose used was 10 mg three times a day. The milk volume and prolactin levels increased in the domperidone group. A small amount of the drug transferred to breast milk and no adverse effects were reported (da Silva et al. 2001). Another study using only 6 subjects showed that although not all responded with increased milk production, they all had increased prolactin in response to the drug (Wan et al. 2008).

Different dosing regimens have been evaluated. Knoppert et al. (2013) compared 20 mg three times a day with 10 mg three times day and found that there was a clinical increase in milk production, but it was not statistically significant.

b. Metaclopromide—Metoclopramide (Maxeran, Reglan) affects D2 receptors and functions in the same way as domperidone. Ingram et al. 2012 compared the two medications in 80 mothers with babies in the NICU. They found that both drugs increase total milk volume, but domperidone increased it more. Side effects were low in both groups, but occurred more frequently with metoclopromide, which included fatigue, irritability and depression (Ingram et al. 2012).

Use of dopamine agonists should only be done with an experienced practitioner, and the mother should be monitored throughout its use. Dr. Jack Newman (Breast Feeding Inc. website 2009) established protocols for use of dopamine inhibitors. Most mothers are started on 30 mg three times a day on an empty stomach for 3–8 weeks. Initial effects may not be noticeable until after 3–4 days and maximum effects occurs after 2–3 weeks. Long-term use is needed by some mothers to sustain their supply.

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Chapter 8
Abnormal Nursing Case Scenarios

8.1 Common Breastfeeding Problems

There's an old saying that every story has three sides: My side, your side, and the truth. When it comes to breastfeeding problems, it is critical to examine three potential sources: The mother, the baby, and the interconnection of the mother—baby relationship. Most commonly, there will not be a solitary cause or "fix." Rather, there are usually overlapping and symptoms and treatments.

Keep in mind that since there are so many variables, similar diagnoses can present in a plethora of ways. In this chapter, I present common case scenarios that illustrate this point, followed by recommended treatments.

Note: Regardless of symptoms, never tell a mother who is struggling to nurse to *wait it out*. If a mother has concerns, then they are real, and must be addressed immediately. There is always a solution.

Here is a list of common problems that come up in nursing. We will incorporate all of these difficulties into the scenarios, as they are usually overlapping and interdependent.

Infant Difficulties

1. Inability to latch

    a. Structural
    b. Behavioral

L. Dahl, *Clinician's Guide to Breastfeeding*,
DOI 10.1007/978-3-319-18194-3_8

2. Poor or shallow latch
3. Excessive gas/reflux
    a. Poor latch
    b. Food (dairy and other) allergies
    c. Structural causes
4. Falling asleep at the breast/frustration
    a. Hunger—not getting milk, low milk supply
    b. Medications
5. Poor intake—comes from low supply or poor transfer and results in
    a. Constant feeding/poor satiety
    b. Poor weight gain or weight loss
    c. Jaundice
6. Breast Aversion

Maternal Difficulties

1. Nipple pain/trauma
    a. Infectious
    b. Trauma
    c. Raynaud's
2. Reasons for Inadequate supply
    a. Gestational diabetes
    b. Hypoplasia
    c. Other hormonal causes
3. Oversupply
4. Breast pain
    a. Engorgement
    b. Plugged ducts/engorgement
    c. Mastitis—yeast or bacterial
5. Medications

8.2 Case 1

Baby is 10 days old. He was born vaginally and full term to a first time mother. The mother has a negative medical history, is 30 years old, and takes only prenatal vitamins—no medications or other supplements. Baby was put to the breast and skin-to-skin contact was established immediately at birth. Baby seemed to try to latch but could not. He bobbed his head up and down and tried to open his mouth but couldn't open it very wide. He suckled a little then fell asleep quickly.

Later that same day, the mother worked with the nursing staff in the hospital to try to latch the baby on. When the baby was brought to the breast, he was able to latch on, but it was very painful for the mother. She was told that pain is normal at first and to keep nursing every 2 h. She continued nursing every 2 h. Baby had adequate wet diapers and slept most of the time. They were discharged home.

At home, the mother's nipple pain continued. She developed cracks in her nipples with bleeding, which was much worse on the right side. The baby seemed to be hungry all the time and preferred the right breast. He nursed continuously and "ravenously" and only slept for an hour at a time. When he awoke, he cried and was hungry. He still had wet diapers, but only one soiled diaper. Mom was not pumping because she was in too much pain from nursing, and had no time to pump even if she could. She had not yet experienced engorged breasts. She did not want to give her baby a bottle because she was determined to breastfeed and felt that formula was bad for her baby.

At 1 week, the baby was seen by his pediatrician and weighed. He had lost 9 % of his birth weight and had slightly elevated bilirubin.

On evaluation, the mother has large breasts with inverted nipples, and nipple trauma with damage and scabbing. Her breasts are tender and erythematous but not engorged. They are not widely spaced and have no stretch marks.

Baby has a slightly retrognathic jaw and normally arched palate. He has a strong, coordinated suck. His left sternocleidomastoid (SCM) muscle is tight and he tends to turn his head to the left. His nose is slightly congested but clear. There is no anterior lingual frenulum. His labial frenulum is normal.

What is the diagnosis?

Relevant Facts:

- Maternal pain and nipple damage
- Large breasted mother with inverted nipples
- Possible low supply, as evidenced by lack of engorgement
- Small infant gape
- Tight left SCM muscle/torticollis
- Continuously hungry baby who wants to nurse all the time
- Excessive infant weight loss and mild jaundice

Diagnoses:

1. Shallow latch due to torticollis.
2. Poor weight gain and mild jaundice.
3. Risk of maternal low milk supply.

This baby cannot gape wide enough to fit over his mother's breasts. He also has torticollis, which is a known cause of small gape. He is nursing constantly and losing weight. With a shallow latch, the teat will sit too anterior in his mouth. This causes friction on the nipple and does not allow the baby's tongue to compress the breast against the palate. Since the mother has large breasts and inverted nipples, baby's intraoral "shape" does not fit her well. Mom has not pumped, so she doesn't know what her supply status is. Since she has not felt engorgement yet, it is probably on the low side. Also, the baby nurses all the time and he has mild jaundice and is losing weight, which also indicates a potentially low supply.

Treatment Recommendations:

Since the baby is only 10 days old, there is time to recover her milk supply and fix the situation: Mom's supply can be fully developed, she can nurse painlessly, and the baby can eventually transfer milk efficiently from the breast to gain weight and avoid nipple aversion.

The baby was immediately sent for physical therapy and cranial osteopathy to resolve the torticollis. This treatment releases the SCM muscle so the baby can move his neck freely. This will also help release the tension in the jaw and tongue to allow for a wider gape. However, torticollis may take weeks to resolve, so that solution, on its own, is not timely enough to salvage breastfeeding. If the baby continues to nurse with a shallow latch, he will lose weight, cause more nipple damage, and prevent his mother's milk supply from coming in fully. But if he is given another feeding source (such as bottle, syringe, etc.) and removed completely from the breast, he is at risk for developing nipple aversion because he has a low transfer rate from the breast. Therefore, the goal is to keep the baby happy on the breast while the torticollis is being resolved.

Since this is a first-time mother, referring her to an experienced lactation consultant (LC) is important. The LC can show her different nursing positions to optimize getting as much breast as possible into the baby's mouth. This would include how she positions the baby and how she holds her breasts.

Since the baby prefers the right breast, that means he can transfer milk a little more easily from that side. The mother can be encouraged to continue nursing on that side, but for limited amounts of time. She could also use a supplemental nursing system so the baby makes the association of being fed from her breast so he has less risk of nipple aversion.

Pumping is vital until the torticollis is resolved since the breasts fill in response to complete emptying. Even if the mother is nursing on the right side, the baby likely cannot fully empty that breast until he is healed. After limited nursing on the right side to prevent nipple aversion, she should pump both breasts for 10 min, and repeat this every 2–3 h.

To heal her breasts and prevent mastitis, the mother can use ointments/salves and air out her nipples. She can also use nipple cups and do exercises to pull out her inverted nipples.

8.3 Case 2

Baby is 8 weeks old. He was born vaginally at 38 weeks without any medical problems. This is his mother's second child, and she nursed her first child without a problem for 14 months. With this baby, the mother had some nipple pain and damage when he initially latched for the first 2 weeks. Her nipples healed, and she only has mild discomfort now. She was told that the latch "looked fine" when she was in the hospital. The baby nurses for variable amounts of time and cluster feeds overnight. He can nurse from 5 to 25 min on each breast. He also has excessive gas and colic. Because the baby is gaining weight, the pediatrician is not concerned. The doctor suggested Zantac for the gas, but it is not helping much. The baby is also getting more frustrated at the breast and sometimes bites.

The mother had an oversupply for the first month and did not pump. Over the last 2 weeks, her supply seems to be waning. She has not been pumping and has not yet given the baby bottles. She has no medical problems and takes only prenatal vitamins.

On evaluation, the mother has normal sized breasts with normal intra-mammary distance (no sign of insufficient glandular tissue). Her nipples are lipstick shaped but not otherwise damaged. There is no sign of infection or inflammation.

The baby has an appreciably retrognathic jaw, and high-arched but intact palate. His labial frenulum is normal, but he has a midline blister on his upper lip. His lingual frenulum is barely visible. When he opens his mouth his tongue seems to point up, so that the ventral surface is more visible than the dorsal surface. At rest his tongue protrudes slightly out of his mouth. He has a strong and coordinated suck.

What is the diagnosis?

Relevant Facts:

- Mom has a history of normal nursing.
- Mom had an oversupply, now it is waning.
- Mom is not pumping to maintain her supply.
- Mom had pain with nursing at first, which resolved.
- Her nipples are lipstick-shaped.
- Baby transfers milk from the breast with variable efficiency and recent frustration.
- Baby has gas and colic.
- Baby has retrognathia and a high palate with normal suck.
- Baby has an upper lip blister.

Diagnoses:

1. Shallow latch.
2. Gas and colic from the shallow latch.
3. Risk of low maternal supply following oversupply due to inefficient emptying.

When mothers have an oversupply of milk initially, it can mask other symptoms of inefficient milk transfer, or these symptoms can be ignored because the baby is gaining weight. The mother initially had pain with nursing. Although the pain resolved, it is probably because she now has damage to the nerve endings on her nipples.

The baby did not become more efficient at nursing, as evidenced by the variability in nursing time and frequency and his mother's compressed nipples. He gained weight and was not fussy at the breast initially because his mother's oversupply sustained him. Because he has a shallow latch he could not transfer milk efficiently. Because he could not transfer milk efficiently, and his mother did not pump to keep her breasts emptied and prevent FIL build-up, her milk supply waned. Since she was able to nurse her first baby without a problem, we can assume she does not have an inherent problem with milk production or capacity.

In addition, the baby has excessive gas. This is very common when the latch is shallow and the mouth and palate are not filled with breast. The baby swallows excessive air; even with antacid medication the gas continues due to a mechanical problem, not to over-production of acid.

Treatment Recommendations:

The goal in this case is to fix the shallow latch so the baby can nurse more efficiently. Since the baby has excessive retrognathia and a high palate, releasing the upper and lower frenula allow the structures of the head and neck to move more independently of one another. Therefore the baby can gape more widely and fit more of the breast into the mouth so the latch will be deep and the suck will be efficient. These releases should only be performed by appropriately trained physicians who understand the newborn anatomy and can also handle complications. Cutting too much or too little of the tissue can cause the procedure to fail and potentially ruin the infant's chance at successful nursing. It could also injure the infant.

It is not enough to merely cut the tissue. Both the mother and baby have to be retrained in how the baby should be latching. It is helpful for the mother to work with a lactation consultant to make sure the baby is latching deeply enough even after the procedure. Positioning the baby and breast is very important because, even with a wider gape, he may not have sufficient oral strength to hold the whole breast in the mouth. Weighing the baby before and after each feeding will indicate how much he is transferring from the breast, and most lactation consultants will do this as well.

Since this is the mother's second baby and she began with an oversupply, it is reasonable to expect that she can bring her supply back up with a combination of herbal galactagogues and pumping after nursing even though the baby is already 8 weeks old. Pumping for a few minutes after nursing will show that the baby is more efficient at emptying the breast (hopefully there is no left over milk in the breast after the baby nurses), and it will stimulate the breasts to fill with more milk for the next feeding.

8.4 Case 3

Baby is 3 weeks old. He was born full term by C-section to a first-time mother. He is able to latch onto the breast and seemed to be nursing fine for the first 2 weeks, according to mom. But he nursed all the time, fell asleep at the breast, and was never satisfied. Mom called him a champion nurser because he always wanted the breast. At his 2 week pediatrician visit, he had lost over 12 % of his birth weight, which caused concern. Mom was then told to bottle feed immediately. She has been pumping since then and now has a good supply. She makes more than 4 oz from each breast each time she pumps, which she does 8 times a day.

The baby took to the bottle right away and is gaining weight rapidly. But now, when mom brings him to the breast, he gets very angry and cries. He hits the breast and moves his head away. Mom tried working with a lactation consultant, but the baby still won't go back to the breast.

On exam, mom has normal breasts without stretch marks and no tenderness around the nipples. She takes prenatal vitamins and Synthroid for hypothyroidism. She had breast implants 5 years previously, with normal nipple sensation. There are small scars from incisions under her breasts where the implants were placed.

The baby has a slightly retrognathic jaw, normal palate, anterior lingual frenulum, and normal suck reflex. When the bottle or breast is brought to his mouth, he purses his lips and tries to suck in, instead of opening his mouth widely into a large gape. When he sucks from a bottle he makes clicking sounds and some milk drips from the side of his mouth.

What is the diagnosis?

Relevant Facts:

- The baby was always hungry at the breast when he did nurse
- He had to nurse all the time and fell asleep at the breast.
- The baby lost weight when only nursing.

- The baby was able to bottle feed easily and gained weight from bottle feeding.
- The baby no longer wants the breast, even though there is ample supply.
- The baby has an anterior lingual frenulum and otherwise normal suck.
- Mom is hypothyroid and has a history of breast implants.
- Mom has ample supply now after pumping, although it may have been low at first.

Diagnoses:

1. Shallow latch due to anterior tethered lingual frenulum.
2. Breast aversion.

The baby has a shallow latch caused by an anteriorly tethered tongue. Tongue tie does not always cause pain or difficulty nursing, but it frequently causes a shallow latch by limiting the baby's gape. Since his mother also had breast implants, the baby needs a wide gape to get around all the breast tissue. His small gape, paired with her breast shape caused a shallow latch and poor milk transfer, as evidenced by the baby's continuous nursing and weight loss. He tried to stay on the breast as long as he could, but he still lost weight. He also pursed his lips to suck in the breast as an adaptation to being unable to gape widely.

Because his mother had pain with nursing, we can assume his oromotor strength is good. He is also able to eat well from a bottle, so he does not have a coordination issue.

Since he was not transferring milk efficiently, his mother's supply was not able to come in until she started to pump. Even with her history of hypothyroidism and breast implant surgery, she was able to bring in a full supply from emptying her breasts with the pump, so it can be assumed that she has a normal milk-making capacity.

Because the baby learned that the breast was not an efficient source of food, when he was given an alternative food source (i.e., the bottle), he immediately adapted to it.

Neonates learn very quickly what will and will not feed them. After repeated failed attempts at the breast, when they are given an alternate source of food, from a bottle, syringe, spoon, etc., they quickly learn and adapt to what does feed them. Now, although his mother has an ample supply, he has learned to avoid the breast in favor of the bottle.

Treatment Recommendations:

He was referred to an appropriate physician for a lingual frenotomy. By releasing the lingual frenulum, his gape immediately widened. In this case, because he had an anterior lingual frenulum, even if he were not nursing, he needed the procedure to prevent future speech issues. His mother was taught how to appropriately care for the frenotomy to prevent regrowth. Although his gape was wider, the baby still refused the breast after the procedure. He cried even when milk dripped into his mouth from the breast. She was then sent to a lactation consultant to help the baby overcome breast aversion.

There is no fail safe way to overcome breast aversion, but working with a patient LC who can read the baby's reactions and comfort mom's frustrations is key to successful nursing. When babies cry and push away from their mother when brought to the breast, an erroneous assessment would be to blame the mother for being too stressed. This is not only incorrect, it reinforces the mother's feeling of rejection as her baby cries at her breast and creates more stress for her. There is no way to know how and if a baby will get over breast aversion. It really depends on the baby, and requires patience to retrain learned behavior.

Since this mother's supply was already good, she was encouraged to attempt nursing with every feed after the frenulectomy, and to pump afterwards. The pumping is important for two reasons: it will let her know how much milk the baby is transferring (less pumped milk means the baby's milk transfer is improving) and it will prevent FIL from collecting in her breasts (FIL inhibits milk production locally).

She can also try using a nipple shield because it is plastic and feels like the bottle. This can be an effective way to wean the baby back onto the breast by tricking the baby into thinking the breast is a bottle.

8.5 Case 4

Baby is 6 weeks old born by C-section at 38 weeks. Mom thinks he is nursing well, but he is always hungry. This is her third baby, and she has no medical problems, but she is obese with a BMI of 44. She was not pumping initially and did not know how her supply was, but there always seemed to be milk. She has not had pain with nursing.

At week 2, the baby had not gained back his birth weight. The mother saw a lactation specialist who recommended she begin pumping, which she did. After trying different positions, the baby was unable to transfer only 0.5 oz at a time from the breast after 30 min of nursing. The feeding regimen she was following was this: Baby nursed for 10 min on each breast, then mom pumped for 10 min on each breast and got another 0.5 oz from each side, which she then fed the baby, adding formula with each feeding. Even on the bottle, the baby took a long time to eat and milk dribbled out of the side of his mouth. He is taking in two-thirds of his daily intake (24 of 32 oz) in formula. He is also gassy. His mother is desperate to nurse and hopes she can nurse exclusively.

On exam, the mother has moderately sized breasts with normal nipples and no stretch marks. There is no nipple damage, and her breasts are not engorged or inflamed.

The baby has a slightly retrognathic jaw, a very high and arched palate, and a slightly anterior lingual frenulum. He does not form a seal around the practitioner's finger, and seems to chomp on the finger when it is placed in his mouth. However, aiming the finger up toward the palate elicits a stronger suck response and complete seal.

What is the diagnosis?

Relevant Facts:

- Baby is continually hungry.
- Baby is not gaining weight well.
- Baby takes a long time to transfer milk from the breast and the bottle.
- Mom's supply is low.
- Mom does not have pain with nursing.
- Even after nursing, mom still has milk in her breasts even though the baby is not gaining weight well.
- Mom is obese.
- Baby has retrognathia and a high arched palate.

Diagnoses:

1. Poor milk transfer due to a shallow latch and high palate, and possible dyscoordination of suck–swallow reflex.
2. Delayed onset of lactation due to obesity.
3. Low milk supply due to poor emptying and obesity.

The baby's high palate means there is more space in his mouth that has to be filled with breast tissue. It is also means that his tongue cannot reach the palate and create enough compression on the breast to compress the milk out. If he could reach his tongue up, his mother would have pain when she nurses him, but she does not. He struggles on the bottle for the same reason. The bottle nipples his parents are using are not large enough and have the wrong shape to fill his mouth, so the milk dribbles out the sides of his mouth. He has normal oromotor strength, as evidenced by the clinical exam. Without taking into account the high palate, this baby could be erroneously diagnosed with low oromotor tone or dyscoordination of his suck.

His mother is obese, which reduces her body's response to prolactin, therefore limiting her milk capacity initially. Also, since the baby was not transferring milk efficiently and she did not pump aggressively right away, her supply was further limited.

Treatment Recommendations:

First, it is important to establish his mother's goals in terms of breastfeeding and give her reasonable expectations. She is very motivated to breastfeed exclusively, but due to her obesity, low supply, and timing (the baby was 6 weeks old when seen), she may not be able to do so.

Identifying her risk of low supply from obesity and advising her to pump immediately after giving birth, even after the baby nursed, could have salvaged more of her supply. Since it is already 6 weeks into nursing and she only makes 8 oz of milk, it is possible to improve her supply somewhat, but it is unlikely that she will be able to nurse exclusively to supply all of the baby's needs without supplementing with additional formula. She also has the option of taking herbal or pharmaceutical galactagogues, such as domperidone, to increase her supply. Every woman is different, so it is impossible to give exact percentages of expected improvement. Regardless, she should continue to pump and make sure her breasts are fully emptied every 2–3 h.

To improve the baby's milk transfer, the mother should be shown how to do the perfect latch. The baby had a wide gape, and his mother's breasts are not flat or too large. However, she needs to support her breast and attach the baby deeply onto the breast to fill up his high palate. In this case, proper positioning can make a big difference in baby's ability to transfer milk.

A supplemental nursing system can reinforce the baby's affinity to the breast by making it seem to the infant that the formula coming through the tubing is really from his mother's breasts. This way, the baby has more positive feedback from nursing from his mother.

8.6 Case 5

Baby is 11 weeks old. He was born preterm at 34 weeks and was in the NICU for the first few days, where he was given formula with a bottle. He ate well with the bottle and gained weight with formula. Mom has no medical problems, and this is her first baby. She had some delay in milk production and pumped exclusively for the first week. She had a big supply, and by the end of the first week was able to pump 5 oz of milk at each session, every 3 h.

The mother transitioned the baby onto the breast at week 1, but the baby had a "terrible latch." Mom had pain and the baby fell off the breast often. She had to relatch him each time he fell off, and he got fussy after a few minutes of nursing. He nursed for long periods of time, fell asleep and woke up hungry 60–90 min later. He also had terrible gas and colic and was started on Zantac, with variable success.

At the end of week 3, mom learned about tongue tie and asked her pediatrician if her baby had this problem. She was assured that he did not have tongue tie, and that a painful latch was normal. She was sent to a lactation consultant to help her with the latch.

The lactation consultant worked with her for the next several weeks, teaching her different ways to latch the baby onto the breast. Mom and baby had little improvement, but since the baby was gaining weight, mom was told to continue nursing. She was told the pain would eventually get better and so would nursing, because babies become more efficient as they get older. She still had a good supply even though she stopped pumping after the third week.

Mom continued to have pain with nursing, long nursing sessions, and a fussy, gassy baby. He also made clicking sounds when he nursed. Finally, when the baby was 9 weeks old, she insisted on a referral to a local dentist. He said the baby had mild tongue tie because he could touch his tongue to the vermillion border. He did not work with newborns and did not feel comfortable doing anything more than a superficial procedure. He felt a "deeper procedure" would cause pain and bleeding and was dangerous for the baby. Still, the dentist used a laser to release the tongue tie anteriorly. Mom was not instructed on after care of the incision nor was the latch evaluated by the dentist or anyone in his office.

Mom returned to the lactation consultant a week later because the baby's latch did not improve after the procedure. Further, the baby no longer wanted to nurse from the breast. Over the last week (week 10), he stopped gaining weight. Mom began pumping again and found that she only produced ½ ounce of breast milk with each pump. She began supplementing with formula and bottle feeding. The baby was able to easily bottle feed. Mom was still desperate to breastfeed.

On physical exam, the mother has moderate-sized breasts that are not engorged. She does not have stretch marks, and her breasts are not widely spaced.

The baby has a high-arched palate, a slightly retrognathic jaw, and a scarred, thickened lingual frenulum. It is attached to 50 % of the tongue. He would not latch onto his mother's breast and cried when she attempted it. He was able to eat from a bottle, but chomped on the nipple with his gums.

What is the diagnosis?

Relevant Facts:

- Baby was born preterm, was in the NICU and bottle fed the first week
- Mom had a good supply at first, then it waned.
- Mom had pain with nursing the entire time.
- Baby gained weight at first, then the weight gain stopped around 10 weeks.
- Baby fell off the breast, had a lot of gas, and nursed for prolonged periods of time.
- The latch was not improved with different breastfeeding positions.
- The dentist was not familiar with breastfeeding.
- The frenulectomy procedure did not help the nursing situation.
- Mom lost her supply.
- Baby had reflux that was not improved with Zantac.
- Baby has a high-arched palate, attached lingual frenulum, and scar tissue.

Diagnoses:

1. Shallow latch due to anatomically tethered oral structures.
2. Incomplete and ineffective surgical intervention with scarring.
3. Breast aversion.
4. Current low milk supply at 11 weeks, even though it was originally very good.

Mom originally had an ample supply, but she had pain with nursing, which means the baby had a shallow latch. The baby exhibited many symptoms of a shallow latch as well, including excessive gas, prolonged feedings, and falling off the breast. Zantac was given, but didn't work. This is because the baby's gas was from nursing without a seal and swallowing a lot of air, not from excessive acid production.

Despite all of the issues the breastfeeding couple was having, the baby gained weight. This is because mom's large milk supply compensated for the baby's poor latch. Because the baby was gaining weight, mom did not pump and was not instructed to pump. As time went on, she lost most of her milk supply because the baby was not transferring milk efficiently—FIL built up and prolactin stimulated less and less milk production. At 10 weeks, her supply nearly shut down, which is why the baby started to refuse the breast. This is because her supply became solely dependent on the baby transferring milk, and her hormones alone could not sustain it. Had she been pumping and nursing, she might have managed to salvage her supply.

Despite mom's complaints and insistence on evaluation by a specialist, she was given wrong advice by both the pediatrician and lactation consultant to keep nursing through the pain. The only measurement of successful nursing was the baby's weight gain. By the time they were finally sent to the specialist, they saw someone who had no experience with breastfeeding. The dentist had some information about treating tongue tie for speech issues, but had no knowledge of how freedom of movement of the oral structures impacts nursing. Further, he did not evaluate the post-procedure latch or provide any after care instructions. The procedure performed was incomplete and inadequate. It caused unnecessary trauma to the infant, excessive scarring, and was of no benefit to nursing.

Treatment Recommendations:

At this point, the baby is already 11 week old, so mom needs to understand that she may not be able to exclusively nurse her baby. There are many strategies that can be suggested, but the outcome of treatment depends on her body's ability to re-lactate and the baby's willingness to go back to the breast.

It is possible to improve the baby's gape by releasing the scarred lingual frenulum and the labial frenulum. At 11 weeks, this would have to be done with injectable anesthetic because the procedure is more painful in older babies. In addition, the lingual frenulum requires stretching to prevent scarring, which is more difficult in a baby this age. It is more painful for the baby, and he can resist the stretching, so there is a higher failure rate. *These treatments should only be done by an appropriately knowledgeable surgeon who understands breastfeeding and is trained to perform the correct procedures*. Most surgeons have little to no training on performing frenulectomies for breastfeeding, and they do not know enough about infant anatomy to be able to handle the risks. Therefore, they perform inadequate or inappropriate procedures, cutting too little or too much tissue. The result can result in an even worse breastfeeding situation, and can be dangerous to the infant. However, appropriate releasing procedures always result in a wider gape.

Once the gape is corrected, the baby will also have to relearn how to nurse. During the first month, baby's reflexes are still more or less intact, so when the gape is corrected/released, most babies easily adapt to effective nursing. An 11-week-old baby has already learned compensatory behaviors to nurse with a shallow latch, such as clicking and rapid suck/swallows. This will have to be unlearned, and he has to be retrained by working with a lactation consultant.

The baby is also used to working very hard to get milk out of the breast, so he developed breast aversion when the bottle was reintroduced at 10 weeks. Since mom's supply is so low, it will be difficult, even with a corrected gape, to entice the baby onto the breast because the return for his effort will be so low. To overcome the breast aversion, mom can use a supplemental nursing system (SNS) to deliver formula to the breast while the baby nurses. She can also use a nipple shield because it feels like the bottle. There is no sure way of overcoming breast aversion, but regardless of the method, she will need an experienced professional for guidance, since she herself has never breastfed.

In terms of the mother's milk supply, she is well past the first 4 weeks, when supply can be most affected. However, since she is a large producer there may be more leeway. She will have to take galactagogues, herbal or medicinal, such as domperidone, and remove milk from her breast every 2–3 h. Possible milk removal scenarios are:

1. Pumping every 2–3 h for 10 min on each side and bottle feeding the baby formula and expressed milk.
2. Nursing the baby with an SNS (with formula) every 2–3 h for 10 min on each side.
3. Nursing the baby for 5 min on each breast then pumping for another 10 min on each breast every 2–3 h and bottle feeding the remainder of the feeding with formula.

It is impossible to know what will work best for this mother or how her body will respond to the treatment since every woman's breasts are different, so a little trial-and-error may be necessary.

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