

## Complementary Nutrition Methods in Newborn

### Abstract

It is ideal for all newborns to feed their mothers' milk. Due to weak oral-motor functions, being neurologically and physiologically immature, sucking-swallowing-breathing coordination, some newborns cannot immediately breastfeed and are hence unable to obtain oral nutrition. Therefore, it is necessary to initiate proper nutrition in those newborns who are not breastfeeding. In the graves of the Nile basin, items such as cups, cow horns and ceramic cups dating to 500 BC have been found, indicating the earliest search for alternative options for infant feeding. Today, this search continues, with parenteral and oral or nasogastric tubes; enteral feeding methods include feeding with a bottle, plate, spoon, finger, syringe, or dropper. It is preferred to total parenteral nutrition. For newborn nutrition, enteral and parenteral nutrition could also be applied together. However, even with the most appropriate method, feeding newborn infants could be very difficult. Hence, every newborn nurse should know the preterm and term newborn feeding methods and should have the ability to apply these methods properly. The purpose of this article is to update the nurses on newborn feeding methods.

*Keywords: Newborn, preterm, term, enteral nutrition, parenteral nutrition*

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### Introduction

Nutritional requirements vary according to age and each individual's health status, both in children and in adults. However, the age group in which nutrition is most important is the fastest-growing stage of newborns, especially premature infants. Suction develops 15-18 in intrauterine life. It is seen in the form of lip squinting at the gestational week, after the 27th gestational week if the extrauterine is alive, and is fully organized at the 32nd week. While breastfeeding is a unique way for an infant to grow and develop, the anatomical and physiological immaturity of the organs and systems of preterm infants and the many problems they encounter in their lives cause them to be unable to perform the sucking function.<sup>1,4,28</sup> Especially, preterm infants are given care in the neonatal intensive care unit (NICU); feeding problems are common in these infants.<sup>5-7</sup> Some infants may be unable to breastfeed immediately after birth due to poor sucking, cleft palate or cleft lip, drowsiness due to the anesthetics used during delivery, and the mother's inability to breastfeed the infant due to pain or other reasons such as cesarean delivery or her inability to use the right breastfeeding techniques.<sup>8,9,32</sup> It is known that preterm infants have weak sucking and tire easily; there is also no clear criterion for when to switch to oral feeding.<sup>10,28</sup> For this reason, until these infants can easily suck the mother's breast, enteral nutrition types are followed. It is fed using methods such as a bottle, spoon, cup, finger, injector, or dropper. It is also fed parenterally in preterm and term infants who are not suitable for enteral nutrition.<sup>7,12,29</sup> The purpose of feeding preterm and term infants is to provide nutrients that are met from the placenta in intrauterine life. According to the gestational age of the infant, one of the parenteral or enteral complementary feeding methods is started immediately; as tolerated, parenteral nutrition should be reduced and enteral nutrition increased.<sup>14</sup> Neonatal nurses should be able to evaluate the nutritional status of the infant well, and should have sufficient knowledge about and equipment for enteral feeding of premature and term infants. It is very important for the neonatal nurse to follow the infant as to which complementary feeding methods may be more appropriate according to the gestational week, weight, neuro-motor developmental status of the infant and what to pay attention to while feeding the infant and to follow the infant closely. This review will increase the knowledge of newborn nurses and mothers about complementary feeding methods in the light of studies. It is aimed to provide guidance on which type of complementary feeding

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method will be beneficial according to the condition of the newborn infant.

### Parenteral Nutrition

Protein, fat, carbohydrate, vitamin (A, C, D, E, K, B1, B2, B6, B12, and Biotin), and electrolyte (Na, K, Cl, Ca, Mg, and P) in order to meet the need. The venous or central administration of the fluid, which is prepared by considering the weight, the week, and the parameters in the blood values, is called parenteral nutrition.<sup>14</sup> It is ideal to receive 50-55% of the newborn's energy needs from carbohydrates, 10-15% from proteins, and 30-35% from fats. In order to maintain the intra-uterine growth rate at a close level, the daily energy amount needed for the newborn is 120-130 kcal/kg. In order to keep the blood sugar level stable, 6-8 mg/kg/min infusion can be started immediately after birth. The average protein requirement is 3-3.5 g/kg/day. Lipids, on the other hand, are used as supplements for essential fatty acids and high energy needs, and can gradually increase the dose by up to 3-3.5 g/kg/day. Vitamins should also be added to total parenteral nutrition from the first day. In NICU, water-soluble vitamins should be added to the solution in the form of 1 ml/kg/day, and for fat-soluble ones, 4 ml/kg/day if < 2.5 kg- 10 ml/kg/day if >2.5 kg. The required amount of mineral is added to the total parenteral fluid according to the newborn's blood parameters.<sup>4,8</sup> Since the fluids given have hypertonic properties, the risk of thrombophlebitis is high. The fluid osmolarity, the diameter of the catheter used, the infusion rate, the presence of fluid precipitation, and air control in the set should be observed carefully and a filter should be used to prevent the passage of microorganisms.<sup>14</sup> Indications for parenteral nutrition are as follows: surgical gastrointestinal diseases (tracheoesophageal fistula, gastrointestinal fistula, hirsprung, diaphragmatic hernia, intestinal atresia, etc.), intestinal diseases (diarrhea, inflammatory bowel disease, severe malabsorption, etc.), respiratory system diseases (respiratory distress syndrome, etc.), preterm and abortion birth weight infants, hypermetabolic conditions (severe burns), malignant diseases (radiation enteritis, cancer cachexia, chemotherapy), bone marrow and organ transplantation, severe diarrhea, uncontrollable vomiting, and enteral feeding intolerance.<sup>14</sup> Treatment will take longer than 7-10 days. The central venous route is preferred in preterm and term infants, and the peripheral venous route is preferred for shorter durations.<sup>4</sup> Complications of parenteral nutrition may include sepsis, bacteremia, catheter site infection, air embolism, pneumothorax, hemothorax, thromboembolism, subclavian artery injury, hyperglycemia, hypoglycemia, hyperlipidemia, dehydration, or fluid overload. The method with such serious complications requires very good follow-up and it should be aimed to reduce parenteral nutrition and to switch to safer and natural full enteral nutrition.<sup>14</sup>

### Enteral Nutrition

Continuous or intermittent feeding of food through a tube or feeding tube placed in the stomach or small intestine is called enteral nutrition.<sup>8,15,16,33</sup> Intermittent feeding of a certain amount of food to the infant every 2-3 hours for 10-20 minutes, thanks to the effect of gravity through the feeding tube, bolus feeding, continuous feeding with an infusion pump, is called continuous feeding.<sup>17</sup> Although the importance of feeding preterm and term infants in the early period is known, minimal enteral feeding (MEB) should be started within the first 24 hours.<sup>14,19,20</sup> Minimal enteral feeding is trophic nutrition, hypocaloric feeding. It is also called feeding or initial feeding.<sup>21</sup> The aim of

minimal feeding is not to feed the infant but to increase the enteral feeding capacity of the infant, to prevent intestinal atrophy, and to ensure the maturation of the gastrointestinal tract.<sup>16,20,21</sup> Because necrotizing enterocolitis (NEC) is seen mostly in preterms fed enterally, NEC the idea that it will increase the risk of enteral nutrition is the subject of enteral nutrition. there are reservations about it. However, there is no significant difference between MEB and parenteral nutrition in studies; it is observed that it does not increase the risk of NEC.<sup>20,21</sup> The amount of nutrition required according to the ministry of national education is 10-20 mL/kg, and depending on the condition of the preterm or term infant, the infant can be fed every 2-3 hours a day.<sup>20,21</sup>

In enteral nutrition, breast milk is the most ideal and should be the first choice, since the nutritional requirement changes according to the age and condition of the infant.<sup>7,18,21</sup> If the infant is born preterm, the protein and sodium values in the breast milk will not be sufficient over time, and breast milk is enriched with protein, calories, minerals, and the second.<sup>16,20</sup> Breast milk fortification can usually be started following 50-100 ml/kg enteral feeding.<sup>20</sup> Although these fortifiers are currently derived from cow's milk, "breast milk-derived" fortifiers are also used partially due to the benefits of breast milk; these fortifiers are not yet common due to the high cost and ethical problems of obtaining fortified milk from the breast milk bank.<sup>20</sup> Although breast milk is the most suitable nutrient for the feeding of preterm and term infants, in cases where breast milk is not available or insufficient, donor breast milk is the first choice; however, this situation is not legal in our country.<sup>16,20,22</sup> Although donor breast milk is more advantageous than formula, considering the possible infection risk and nutritional elements, it remains in the background due to the disadvantages of immunological and nutritional elements compared to the mother's milk.<sup>22</sup> Finally, formulas that are tried to be produced close to breast milk can be preferred in the feeding of newborns. Formulas are delicious and inexpensive, and they are often easy to tolerate. In infants with malabsorption, the protein source is amino acid or peptide. For infants in need of carbohydrates, formulas with an oligosaccharide or monosaccharide source can be used, and for infants in need of fat, formulas containing triglycerides may be used. Modular formulas, on the other hand, contain one of the nutritional elements such as carbohydrate, fat, and protein; do not meet the nutritional needs; and are added to breast milk. Specialized formulas can be used in infants with hypermetabolic conditions, diabetes, and kidney or liver failure. However, these are high in terms of cost.<sup>14,20,22</sup>

### Oral Nutrition Methods

Oral feeding is the feeding method chosen for healthy newborns born after the 34th week of gestation. In order for oral feeding to be performed, the infant's sucking and swallowing reflexes should be coordinated, the clinical picture should be stable, and there should be no apnea, hypothermia, and tachypnea. Oral feeding can be given if the respiratory rate is below 60 per minute. Breastfed newborns with a younger gestational age may be more successful in oral feeding than those fed with a bottle. The neonatal nurse should make a systematic assessment to decide whether the infant is ready for oral feeding. The baby to be fed orally should have a soft stomach, normal intestinal sounds, strong sucking, and rhythmic. Whether the baby has a gag reflex, aspirates, desaturates, or develops bradycardia during feeding, should also be noted. After feeding, respiration should be re-evaluated. Premature babies should not be forced for

oral feeding. When respiratory distress is observed, feeding should be stopped immediately.<sup>1,8</sup>

### Bottle Feeding Method

Bottle feeding is a nutritive sucking method, and the caregiver should hold the infant's head with one hand while holding the bottle with the other hand and position the bottle in the infant's mouth with the index finger, while keeping the infant's head semi-upright at an angle of 45-60 degrees.<sup>32</sup> World Health Organization (WHO) and United Nations Although article 9<sup>th</sup> of the Ten Steps to Successful Breastfeeding recommended by the Children's Fund (UNICEF) recommends that pacifiers and bottles should not be given to infants. Bottle feeding is the most widely used complementary feeding method in the world, and it is known to affect breastfeeding negatively, causing difficulty in adapting to the mother's breast and causing breast confusion.<sup>6,13,29,32</sup> The term "nipple confusion" refers to the differences between the mother's nipple and the artificial nipple and the uneasiness they cause in the infant. It emerges as a result of behaviors such as crying wildly, rejecting the breast, or weak sucking.<sup>37</sup> The bottle cap, which is used as a complementary method, mixes with the breast and the infant bottle with an easy flow is preferred by the infant, which leads to a decrease in the infant's sucking skills and to withdrawal from breastfeeding.<sup>28,29</sup> In the study conducted by Cronenwett et al. with 121 bottle-fed infants, 26% of mothers stated that their infants showed signs of stress, but 17% said that this was an insurmountable problem.<sup>7</sup>

### Cup Feeding Method

In this method, when the infant is hungry, the infant's head is supported from the bottom with one hand and the infant's tongue is touched with milk by means of a cup (or glass) held with the other hand, so that the infant takes the food.<sup>4,12,34</sup> It is also used to eliminate breast confusion.<sup>8,28,29</sup> The high probability of food spilling from the corner of the infant's mouth raises concerns about insufficient intake, and in other cases, there is a risk of aspiration when it is poured into the infant's mouth.<sup>8,28</sup> It can vary according to the geography, and while the pointed rimmed container called *paladai* is used in India, a cup or a transparent, soft, wide, and smooth-mouthed container is used. At the same time, the slowness of this method may increase the workload of the mother and nurse.<sup>28,32,34</sup> In some studies, it has been found that plate-fed infants show higher daily weight gain than those fed with other methods.<sup>7</sup>

### Finger Feed Method

Finger feeding is used as both a nutritive and a non-nutritive method of sucking. In this method, the nutrient-containing catheter is fixed on the caregiver's finger, and there is a cup or syringe at the other end of the feeding probe. The finger is placed in the infant's mouth and the milk flow occurs when the infant starts to suck.<sup>34</sup> When the container is held higher than the baby, the flow is also ensured by gravity, but the risk of aspiration is very high since the flow of milk, the volume, and speed of the food cannot be controlled in this way.<sup>7,32</sup> This method is more difficult to learn by infants, because while the infant sucks the finger, spontaneous milk flow is provided by gravity.<sup>32</sup> In the case of the bottle feeding method, it is stated that finger-fed preterm or term infants have higher sucking rates.<sup>28</sup>

### Spoon Feeding Method

The food is given to the infant through a soft spoon. The infant is expected to take the food when the spoon touches the infant's lower lip.<sup>34</sup> Although the spoon feeding method is similar to the cup feeding method, the infant encounters less food, so the risk of aspiration is lower and the loss of nutrients is less.<sup>13,28,32</sup> This method too causes breast confusion.<sup>32,34</sup> Mothers, on the other hand, find this method more troublesome and a difficult choice, for it is difficult for them to get up at night and feed the infant as it takes longer than other methods.<sup>7</sup> In a study conducted in India, on comparing spoon feeding and bottle feeding of infants under 6 months old and hospitalized with complaints of diarrhea, it was observed that the nutritional intake of infants whose mothers fed with spoons was insufficient. However, spoon-fed infants have been found to have a better sucking success rate.<sup>29</sup>

### Injector Feeding Method

It is a method that allows the baby to suck and lick the amount of food delivered through the syringe, in which the food is dripped slowly into the infant's mouth using the syringe plunger. The disadvantage of this method is that the injector tip is hard and physiologically unsuitable. Also, it is not preferred because there is a risk of aspiration due to the possibility of over-tightening of the piston.<sup>7,34</sup>

### Dropper Feeding Method

Although WHO states that breastfeeding is a unique way for infants to gain weight and develop in a healthy way, this method is preferred only in cases where there is no or low breast milk. Probe stuck: The probe is taped to the mother's breast and the infant's mouth, allowing the infant to suckle with both nipple and milk stimulation. With the dropper feeding method, the mother's milk is also increased.<sup>32</sup>

### Tube Feeding Methods

Initiation of enteral nutrition in the early period ensures rapid development of gastrointestinal system (GIS) functions, shortens parenteral nutrition, accelerates growth, shortens the hospitalization period, and prevents the risks that will develop accordingly. It is very difficult to determine the most appropriate method of feeding premature infants. Infants may need to be fed two or more ways during their hospital stay 32-34 in premature infants. Coordination of sucking and swallowing is not fully developed until the week of gestation. In addition, it is not possible to feed infants who receive mechanical ventilation support orally.<sup>6,16,17</sup>

### Gavage Nutrition

It is a safe way for preterm or term infants with little or no sucking activity. Feeding is carried out through a tube inserted orally or nasogastrically. While placing the tube, the tip of the probe is measured from the lip of the baby in the orogastric region, from the root of the nose to the earlobe in the nasogastric region, and from the earlobe between the infant's umbilical stump and the midline of the xiphoid, and the probe length is adjusted and fixed with a plaster after the probe is inserted.<sup>4</sup> The orogastric route is preferred.<sup>3</sup> Injury around the lip and palate of the orogastric tube can also be seen, and the orogastric or nasogastric route is not superior to each other. In infants, 5-8 french numbered probes are generally used for feeding. When the probe materials are evaluated, polyvinyl catheters are more rigid, silicone ones are more flexible, and polyurethane ones are less

traumatizing.<sup>11,18</sup> Although there is no clear decision about whether or not the residue should be routinely checked, it has been suggested in the literature that residual screening causes unnecessary interruptions in feeding and delays the transition to full feeding. Whether there is bile in the stomach content or the probe is in the right place, the presence of bloody contents may also indicate the presence of irritation from the nasogastric or orogastric tube.<sup>20,34</sup>

### Transpyloric Nutrition

In infants with intragastric problems, the tube is inserted through the pylorus into the small intestine. Since there is no stretching as in the stomach, a continuous and less feeding method is preferred to the intermittent feeding one; therefore, fat and potassium loss can be seen in transpyloric nutrition due to frequent defecation. Feeding tubes: It can be used as nasoduodenal, oraduodenal, nasojejunal, orojejunal. It is used only in infants who cannot be fed intragastrically, since slower growth is observed compared to gavage feeding.<sup>34</sup>

### Nutrition with Gastrostomy

In this method, the feeding tube is inserted directly into the stomach. It is indicated in congenital anomalies such as short bowel syndrome and in infants with neurological disorders or the inability to switch to oral feeding.<sup>11,14,18</sup> If there is no contraindication, percutaneous endoscopic gastrostomy (PEG) is preferred.<sup>18</sup> PEG can be performed by visualizing the stomach with light with upper gastrointestinal system endoscopy, and percutaneous It is attached by placing a special catheter. Percutaneous endoscopic jejunostomy (PEJ) or postpyloric feeding can also be provided in infants at high risk of aspiration.<sup>18,34</sup>

### Non-Nutritional Suction

Non-nutritive sucking is a method that aims to improve sucking by increasing the sucking experience before, during, or after gavage feeding, usually with a pacifier or a gloved finger.<sup>11,23,24</sup> To stimulate sucking, the stimulus is given by touching the cheek, lip, tongue, gingiva, chin, and palate.<sup>11</sup> Non-nutritive sucking, that is, using false pacifiers during gavage feeding in preterm newborns, accelerates the transition to total oral feeding, increases weight gain, and reduces hospital stay.<sup>11,23</sup> Lau and Smith stated in their study that non-nutritive sucking improves sucking and regulates the digestion of enteral nutrients during gavage feeding and during the transition to the breast or bottle.<sup>11,23</sup> Non-nutritive sucking has a relaxing and calming effect on infants.<sup>3,24-26</sup> Asadollahpour et al. in a randomized controlled study investigated the transition period of pacifier use and oral stimulation application to full oral feeding in newborns. It has been observed that both methods shorten the duration of feeding with gavage and discharge from the hospital, increase weight gain, and provide nutritional experience, but it has been concluded that the pacifier method is more effective.<sup>11,26</sup>

### Oral Stimulation

Oral stimulation is a care method applied by first performing a planned series of oral-perioral stimulation interventions with a finger and then giving a stimulus with a pacifier.<sup>11,27</sup> It has been stated that the most applied oral stimulation program in the literature is the "Fucile protocol." In this protocol, 12 minutes in the supine position before gavage feeding.<sup>11,25,28</sup> It is aimed to improve the sucking coordination of preterm or term infants who are given a pacifier, which is

one of the non-nutritive sucking methods for 3 minutes after oral-perioral stimulation is given. It has been stated that it accelerates the transition to full oral nutrition.<sup>11,30,31</sup>

### Conclusion

If it is necessary to start enteral nutrition as soon as the infant is born, the most preferred method of feeding the newborn is parenteral nutrition and immediately providing the necessary energy and calorie intake for the neurodevelopment of the infant. Afterward, parenteral nutrition should be reduced and transition to full enteral nutrition should be aimed. During the increase in enteral nutrition and transition to full oral feeding, the nurse should follow the preterm or term infant very closely and be knowledgeable about which method will be more beneficial for the infant. The neonatal nurse needs to transfer this information to the mother with care and must guide the mother correctly. From a general perspective in the literature, bottle feeding is easy but the bottle is not sufficient in terms of hygiene and due to nipple confusion. Also, cup feeding is common but the risk of aspiration is high. Feeding with fingers and injectors increases the risk of aspiration as it does not provide volume control, while drip feeding is not a complete complementary feeding method. It has been seen that it is mostly aimed at increasing breast milk. Although the spoon feeding method is thought to be long and troublesome in terms of feeding time, it has been stated to be the most reliable. It should be taken into account that the first choice for food is breast milk, then enriched breast milk or, if legal, donor breast milk, and formulas may be the last resort. When using these methods, it has been learned that sucking and non-nutritive sucking and oral stimulation interventions can be used. Consequently, the advantages and disadvantages of each method should be considered. As a result of the research, it was seen that there are not enough studies on the evaluation of complementary feeding methods in our country. More randomized controlled studies are needed on this subject.

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