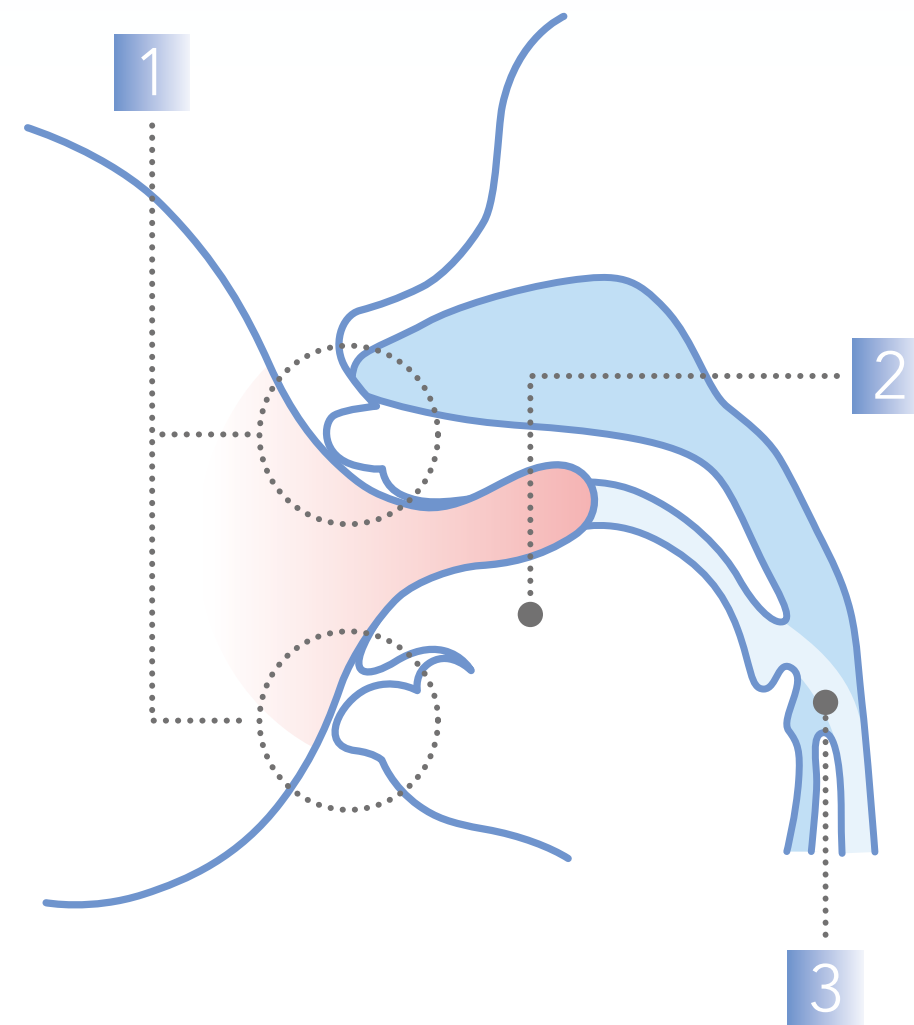


Pigeon incorporated the “three key factors of sucking” into the design of bottle teats that promote a sucking motion similar to direct breastfeeding.



For successful combined feeding, the tongue movement used in direct breastfeeding must be promoted during bottle-feeding. Pigeon has investigated numerous materials and designs to develop just such teat.

**Bottle teats that permit the baby to closely promote the tongue movement used in direct breastfeeding makes bottle feeding easier to combine with breastfeeding<sup>1)</sup>**

Newborns and infants can be fed in two ways. The first is direct breastfeeding, in which the infant directly sucks from the mother's nipple, and the other is device-feeding, in which the infant is fed breast milk or formula from devices such as bottle teats. Sometimes, direct breastfeeding and bottle-feeding are used in combination. This is called “combined feeding”.

When combined feeding works well, the device is used temporarily, and the infant can smoothly return to direct breastfeeding.

However, when the infant becomes too accustomed to feeding from the device, return to direct breastfeeding can be a struggle and can sometimes lead to the refusal of the mother's nipple.

Pigeon has focused on the shape and material of the bottle teat, especially the shape of the teat tip as a factor that can inhibit successful combined feeding. We studied the nipple in the infant's mouth during sucking, and how it relates to tongue movement.

In direct breastfeeding, ultrasound images show that the top approximately 6mm of the nipple is compressed by tongue movement, and that the maximum compression rate at the 5mm point is higher than 50% (Fig.3).

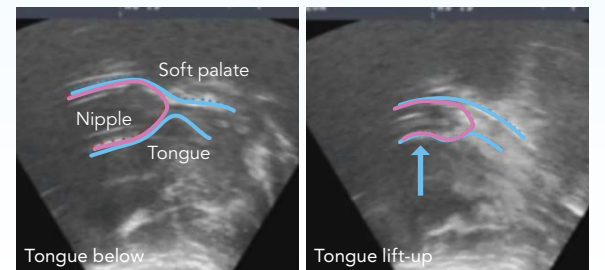
On the other hand, using a bottle teat, the compression rate of the teat by tongue movement varies according to material stiffness and shape. It was also observed that improved teat is without spherical tips show compression patterns similar to direct breastfeeding (Figs. 1&2). Because nipple compression results from tongue movement, we concluded that the improved teat better promote the tongue movement observed in direct breastfeeding, enabling smooth transition between the breast and bottle in combined feeding.

Subjects : 5 breastfeeding infants registered under the Pigeon monitor registry (4 male infants and 1 female infant, average gestational age : 39.5weeks, average birth-weight : 2,846g, average age at test : 7.6 weeks)  
 Method : The infant's lower jaw during direct breastfeeding and bottle-feeding was observed with ultrasound imaging (using an ultra-compact convex probe) to confirm the tongue position and teat state during feeding. Maximum compression rate was calculated using the right formula. The two bottle teats used were the conventional Pigeon S sized teat (“Conventional teat”; hereafter: the spherical nipple tip), and the improved SS sized teat (“Improved teat”; hereafter: straighter and smaller than conventional teat using a softer silicone material).

[Calculation of maximum compression rate]  
 Maximum compression rate (%) =  $(\text{①} - \text{②}) / \text{①} \times 100$   
 ① Usual teat diameter  
 ② Teat diameter when most compressed (5mm, 7.5mm, 10mm from tip)  
 Example : At 5mm from tip  
 ① Usual teat diameter is 12mm  
 ② Teat diameter when most compressed during sucking is 6mm  
 In this case, the maximum compression rate is  $(12 - 6) / 12 \times 100 = 50\%$

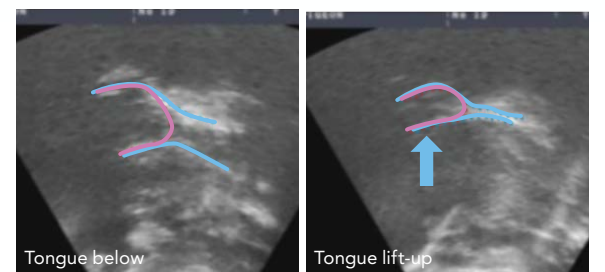
**Fig.1 Diagram of a conventional bottle teat and associated ultrasound images of tongue movement**

Using a conventional bottle teat with a hollow center, the compression rate was low around the tip of the teat (5mm from the tip), whereas the areola (10mm from the tip) was compressed by over 50%. This is substantially different from what happens during direct breastfeeding.



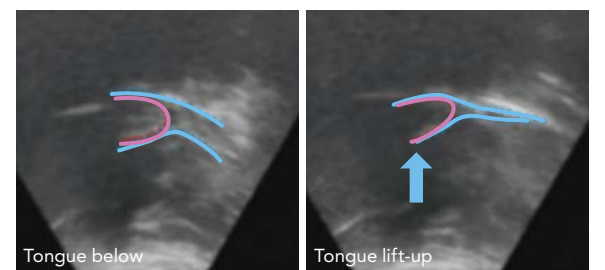
**Fig.2 Diagram of an improved bottle teat and associated ultrasound images of tongue movement**

In the improved bottle teat, a softer silicone material was used, and the spherical shape at the tip was eliminated. This structure yielded a compression pattern more similar to direct breastfeeding, with approximately 50% compression at the tip of the teat (5mm from the tip), and less compression in the areola area (10mm from the tip).



**Fig.3 Ultrasound images of tongue movement in direct breastfeeding**

In direct breastfeeding, as the tissues around the nipples are dense, the tip of the nipple (5mm from the tip) is compressed by over 50%, and the areola (10mm from the tip) is compressed by 40%-50%.



**! The compression patterns of the improved bottle teat was similar to direct breastfeeding.**

**The potential to return completely to direct breastfeeding after the usage of bottle teats in temporary weaning<sup>2)</sup>**

In a hospital in Moscow, temporarily weaning newborns and infants 1 to 10 weeks of age were monitored for 14 days by doctors to determine whether they could completely return to breastfeeding using Pigeon nursing bottles.

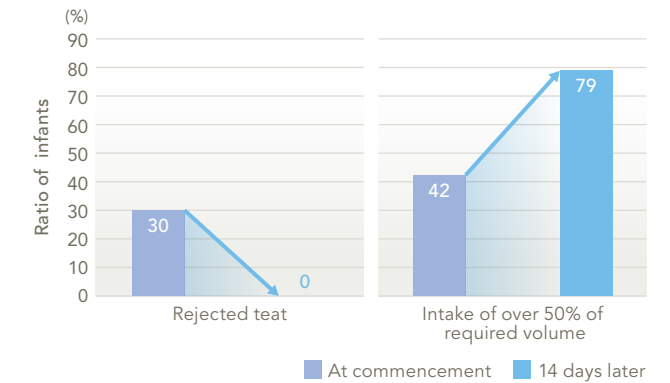
At the onset of the study, 30% of the infants rejected direct breastfeeding, and only 42% were able to consume more than 50% of the required breast milk volume\*. 14 days later, 0% of infants rejected direct breastfeeding, and 79% were able to consume more than 50% of the required intake.

These results indicate that with appropriate support, newborns and infants can fully return to direct breastfeeding even after temporary use of bottle teats.

\*The amount of breast milk required in one feeding.

Subjects : 33 newborns and infants 1-10 weeks who could suck but were undergoing temporary weaning due to issues such as insufficient milk secretion, problems latching-on, etc.  
 Method : Doctors examined mothers and infants combining direct breastfeeding and the use of Pigeon nursing bottles for 14 days, and assessed the infant's capability to return to direct breastfeeding via medical interviews with the mother. Percentage of required milk intake was determined by the doctors through the interviews.

References :  
 1) Saito et al. : 55th Annual Meeting of Japan Society for Premature and Newborn Medicine, Poster Presentation, 2010  
 2) Turti T.V. et al. : Pediatric pharmacology 11(1) : 55-58, 2014



Drawing based on Turti T.V. et al. : Pediatric pharmacology 11(1) : 55-58, 2014

**! The transition from temporal weaning into direct breastfeeding is promoted by the safe combination of bottle-feeding with breastfeeding.**

**Comments of Specialist**

- Bottle feeding is sometimes necessary because of issues arising with either mother or child, such as psychological and physiological problems, babies without mothers, working mothers, those unwilling to breastfeed, babies with CLP, or jaundiced babies. (Pediatrician, Philippines)
- The challenges encountered in bottle feeding are difficulty in sterilization, nipple confusion, risk of colic, high cost, and poor bottle quality. (Pediatrician, Philippines)

(Pigeon : Research on Pediatricians, Lactation Consultants and Neonatologists in the US and Philippines Regarding Breastfeeding, 2014)