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Research Report 2021----02

Sucking research : **Latching on**

Research on opening of the lips, depth at latching on, and intraoral position during direct breastfeeding

Pursuit of a design
that enables appropriate latching on

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Latching on is the start of the sucking behavior consisting of "latching on," "tongue movement," and "swallowing" and plays the basic role for the subsequent motion of sucking and swallowing. Pigeon studies the appropriate latching on in direct breastfeeding to elucidate the significance and mechanism of "latching on" in the sucking behavior and aims to provide artificial nipples that reproduce it.

Pigeon's latching on research

Abstract of "Evaluation of latching on during sucking directly from mothers in the early stage of breastfeeding 4: Investigation of depth at latching on in the oral cavity" ¹⁾

Appropriate latching on is important for successful breastfeeding ²⁾. For effective sucking and swallowing, it is considered important for infants to have their mouth open to catch the nipple and areola deeply in the mouth instead of sucking the nipple ³⁾. However, objective criteria for "depth at latching on" were not standardized. Therefore, we quantified the depth at latching on by the intraoral observation method using visual observation and ultrasonography. As a result, the mean length of the nipple (papilla) in the mouth of an infant during direct breastfeeding estimated by the visual observation method was 22.7 ± 7.19 mm while the mean length of the lips to the tip of the nipple in the mouth of a sucking infant calculated by the new observation method was 29.1 ± 3.72 mm, suggesting that the nipple was stretched by about 1.4 times during sucking.

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Background of the research

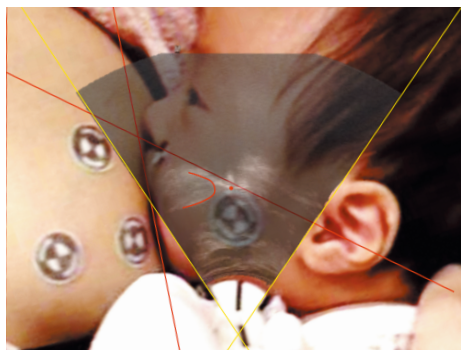
- **The importance of latching on in breastfeeding**
Trying to make an infant correctly latch on the nipple can prevent damage to the nipple, which allows mothers to sufficiently breastfeed infants. Then, milk is effectively transferred to an infant, and appropriate stimulation to the breast helps continuously produce breast milk. ²⁾
- **For latching on, it is important to open the lips and hold the nipple deeply.**
For effective sucking and swallowing, it is considered important for infants not only to suck the nipple but also hold the areola deeply in the mouth and turn the lips outward to attach to the areola ³⁾ (Figure 1). Latching on can be assessed by the angle of the opening mouth and the position of the lips by visual observation. ⁴⁾⁻⁶⁾ However, the length and position of the nipple in the mouth could not be visually observed, and there was no assessment method.

Objective of the research

We observed the infant's intraoral state during latching on and the state of the nipple and areola in the oral cavity during sucking. In addition to the assessment of the previous opening angle and position of the lips, the research was designed to measure the depth at latching on of the nipple in the oral cavity during sucking. We tried to quantify the 'depth' that reflected the actual state more by the method in which intraoral ultrasonography was added to photographing of the external view of the lips of infants during direct breastfeeding.

Figure 1 Signs of effective latching on ²⁾³⁾

- 1 The mouth is open.*
- 2 The lips turn outward.
- 3 The lower jaw contacts the breast.
- 4 Asymmetrical latching on (The areola that is seen above the infant's mouth is more than that below.)

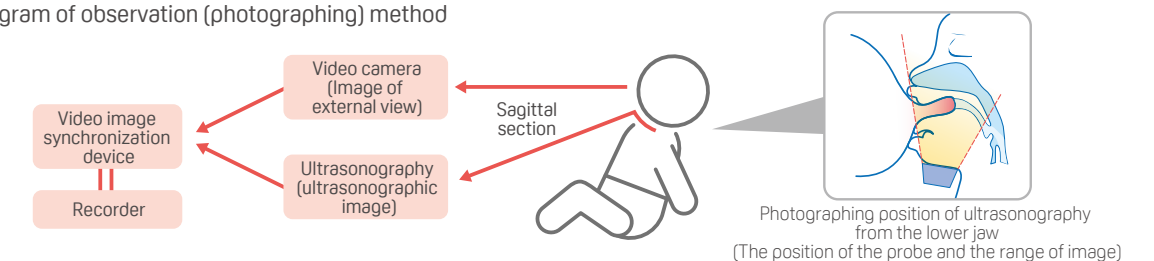


* The rough standard for the angle of the corner of the mouth for "opening the mouth widely" is 130° to 160° ³⁾, and it has been confirmed in Pigeon's research ⁴⁾⁵⁾ that the latching on evaluation results were different between infants with the angle of the corner of the mouth within the range of 130° to 160° and those out of the range.

Methods

- Subjects** 14 pairs of mothers and infants aged 4 to 6 weeks who are directly breastfed and to whom a nursing bottle is used at least once a day (mothers and infants doing direct breastfeeding without problems)
- Observation method** During bottle feeding or direct breastfeeding, lateral views of infants' faces were photographed from the side using a video camera (image of external view), and at the same time, the sagittal section was photographed from the lower jaw using ultrasonography. The images of the external view and ultrasonographic images were synchronously recorded by an image synchronization device.

● Diagram of observation (photographing) method



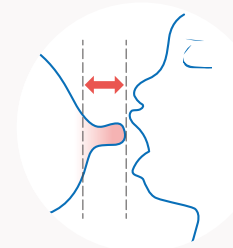
- Analytical method** The following items were calculated from the images of the external view from the side and the ultrasonographic images from the lower jaw.
 - ① Depth at latching on from the external view : Holding length (calculated from the images of the external view)
 - ② Depth at latching on in the oral cavity : Sucking length (calculated from the images of the external view and ultrasonographic images)
 - ③ Position of the tip of the nipple during sucking (calculated using ultrasonographic images)

Advantages of the new observation method

① Holding length: Depth at latching on of the nipple Conventional visual observation method

The lips position is checked in the external view image during direct breastfeeding and plotted on the still image immediately before latching on, and the distance from the tip of the nipple to the line plotted on the side of the breast is calculated as "holding length."

① Holding length

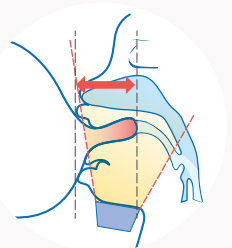


Analysis image from "images of external view"

② Sucking length: Depth at latching on of the nipple External view - oral cavity simultaneous observation using ultrasonography

The position of the nipple in the oral cavity and depth at latching on ("sucking length") during direct breastfeeding are calculated by measuring the position of the nipple in the oral cavity during direct breastfeeding by the intraoral ultrasonographic images and examining them with the images of the external view to confirm the position of the lips.

② Sucking length



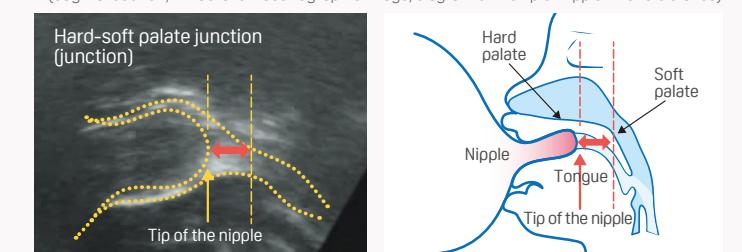
Analysis image of "images of external view + ultrasonographic images"

③ Method for measuring the position of the tip of the nipple during sucking

The distance from the tip of the nipple and the hard-soft palate junction (HSPJ) was calculated using the intraoral ultrasonographic images. It is known that the nipple is sucked close to HSPJ during sucking and there is a little gap between HSPJ and the tip of the nipple ⁷⁾⁸⁾, which is considered to help efficient sucking and swallowing.

● Tip of the nipple - HSPJ distance

(Sagittal section, intraoral ultrasonographic image, diagram of the tip of nipple - HSPJ distance)



Results

- Of 14 sets of subjects, we analyzed 10 sets of mothers and infants aged 4 to 6 weeks from whom we could obtain clear images of the external view and ultrasonography during sucking (5 male infants and 5 female infants; birth order: 4 first children, 5 second children, 1 fourth child). The mean age of the mothers was 30.6 ± 2.8 years (26-35).
- The mean holding length was 22.65 ± 7.19 mm.
- The mean sucking length was 29.06 ± 3.72 mm.
- The sucking length was 1.38 ± 0.42 times more than the holding length. Like the previous studies⁹⁾¹⁰⁾, it was shown that the nipples were stretched during sucking, and it was observed that the tips of the nipples were sucked close to HSPJ.

Based on these results,
the measurement method and measurements in this research reflect normal conditions of direct breastfeeding.

It was suggested that the sucking volume during direct breastfeeding could be quantified
by using images of the external view and intraoral ultrasonography.

Discussion of research results

Necessity of latching on assessment based on the position of the tip of the nipple in the oral cavity

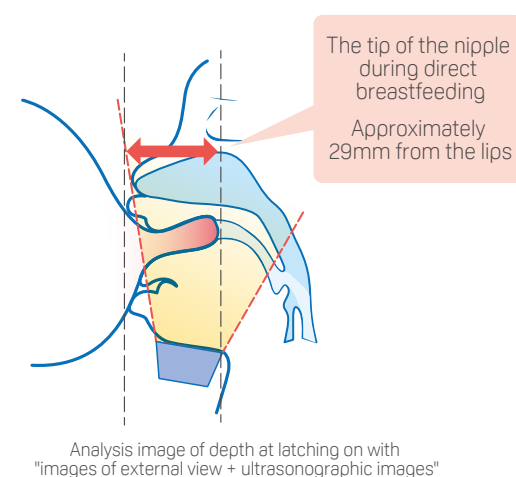
This research showed that the tips of the nipples of healthy mothers and infants at the age of 4 to 6 weeks during direct breastfeeding were positioned about 29 mm from the lips of the infants (Figure 2), and the measurement results of the distance between the tip of the nipple in the oral cavity and HSPJ were the same as the results in the previous studies⁷⁾⁹⁾. It is considered that "deep holding" is important for appropriate latching on²⁾. The results of this research suggested the possibility of quantifying the sucking length including the stretched nipple during sucking which had not been known only with the holding length as well as the necessity of latching on assessment based on the position of the tip of the nipple in the oral cavity.

The importance of appropriate latching on in breastfeeding is pointed out from various perspectives. One of the reasons for mothers to give up breastfeeding is the pain of sore or cracked nipples. Appropriate breastfeeding posture and latching on are considered effective as the prevention of these troubles and are also emphasized in UNICEF/WHO breastfeeding education¹¹⁾.

Appropriate latching on prevents sore or cracked nipples that are likely to occur due to shallow holding, prevents leakage of breast milk by maintaining the

sealing of the oral cavity because of the suction cup effect of lips, and achieves milk transfer by effective sucking. On the other hand, inappropriate latching on causes poor sucking of milk due to sore or cracked nipples and results in breast tension, which is said to increase the risk of decrease in secretion of milk³⁾. We understand that the sucking length and the position of the tip of the nipple in the oral cavity shown in this research will give suggestions for the progress of sucking research on searching for appropriate latching on.

Figure 2 Approximate holding depth



Design to achieve appropriate latching on created from the latching on research

● Visualization of depth at latching on

The results of the latching on research conducted by Pigeon¹⁾ showed the necessity of assessing the latching on based on the position of the tip of the nipple in the oral cavity in addition to holding not only the nipple but also up to the areola deeply, turning the lips outward, and firmly attaching to the areola. Although it is possible to observe holding of the nipple by turning the lips outward and attachment of the lips to the areola from the external view, how deep the nipple is sucked inside the mouth cannot be observed from the external view (Figure 3). The artificial nipple "SofTouch Series (feeling breastfeeding)" has a line that shows an appropriate position of latching on so that infant can catch the nipple to an appropriate depth when feeding (Figure 4).

● Shape to which the lips attach

The swelling of the areola is suppressed and the area from the body to the tip is formed with a smooth curve without a needless narrow part. This structure provides a wide diameter and smart shape. Because of this shape formed with one curve without a needless narrow part, an infant can hold the nipple by turning the lips outward when he/she holds it to the depth according to the size of the mouth, and thus an infant can firmly attach the lips to the areola part (Figure 5).

Figure 3 Image of the appropriate position of the tip of the nipple

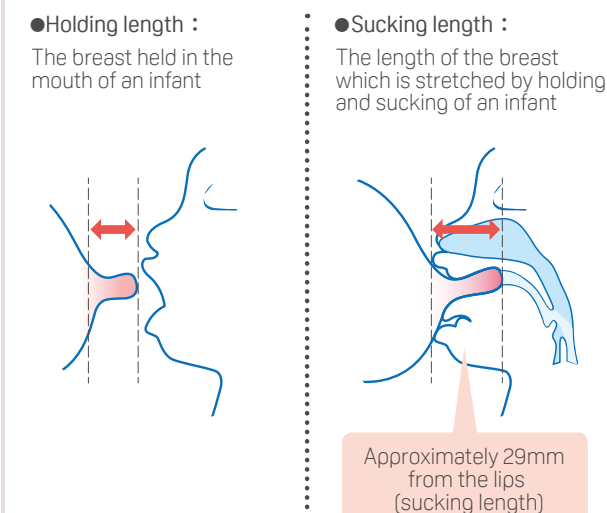


Figure 4 The latch-on lines were decided based on the research results.



Figure 5 Giving the feeling of breastfeeding by reproducing the 'function' of latching on



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