

Pilot production of a toy to evaluate infant tongue movement during sucking

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Abstract— In this study, we developed a toy to evaluate the tongue movements of infants during sucking by directly measuring the tongue force using a glove-shaped device equipped with 2 rows of miniaturized pressure sensors. By simple insertion into the oral cavity of an infant, the device can assess the tongue movements and display the evaluation results in real time.

I. INTRODUCTION

This study aimed at developing a device to assess infant tongue movement during sucking and enable visual verification by mothers. Usually, when a mother finds that her baby cannot suck milk appropriately, she might not be able to judge whether it is related to insufficient sucking ability or not. The sucking reflex is generated by insertion of a body in the oral cavity and consists in peristaltic tongue movements. As tongue movements are difficult to observe during sucking, mothers have difficulty evaluating them. When difficulties in breastfeeding emerge, early support is required for mothers to continue breastfeeding and support self-confidence^[1]. Thus, a device for objective evaluation of sucking ability would be useful to help mothers understand possible difficulties in their babies. In this study, we developed a toy that can measure infant tongue force by simply inserting a glove-shaped device into the oral cavity of the infant, providing objective tongue movement evaluation.

II. METHODS

The tongue movement evaluation toy developed in this study is shown in Fig. 1. The toy comprises a glove-shaped device, a microcomputer and a plaything part. Within the fifth finger of the glove-shaped sensor device, six miniaturized conductive pressure sensors (Inaba Rubber, INASTOMA) were arranged in two rows of three sensors each from around the distal phalanx to near the tip of the middle phalanx. Channels 1 and 4 are designed to touch the root of the tongue, and channels 3 and 6 are designed to come in contact with the tip of the tongue. The output signals from the six sensors are AD converted with a sampling frequency of 100 Hz and 12 bits resolution and analyzed by the microcomputer (Arduino). Past studies have reported that satisfactory sucking involves peristaltic movements from the tip to the root of the tongue. Accordingly, the toy was set to move when the peak of the waveform was detected first by channel 2 and then by channel 1. This rule was derived from the analysis of measurements

from more than 200 infant subjects in past studies. An exemplary output waveform measured from an infant oral cavity is shown in Fig. 2.

III. RESULTS

In this study, the tongue force during sucking was assessed using a glove-shaped device equipped with two rows of pressure sensors and incorporated into a toy for evaluating tongue motion. The operation rules used by the device to detect appropriate tongue movements were defined based on evidence from previous studies. These rules can be modified in the future in a straightforward way. In a survey among mothers having current breastfeeding experience, there were positive comments such as “because we can visually check the movement of the toy, it is easy to evaluate the tongue movement” and “it shows whether the tongue movement is normal or not, so it’ll make mothers feel easy.” By evaluating tongue movement, which is one of the conditions of satisfactory sucking, and showing mothers whether the infant has sufficient sucking ability, the toy can potentially help build a nursing environment where mothers feel more comfortable and more self-confident.

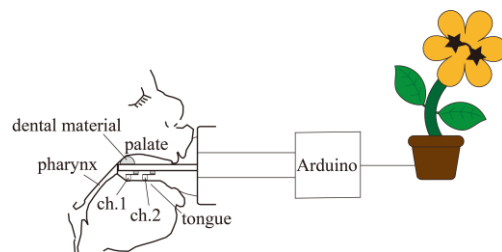


Figure 1. Tongue movement evaluation toy.

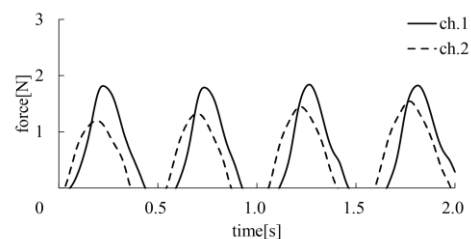


Figure 2. Exemplary output waveform measured from an infant oral cavity.

REFERENCES

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*Research supported by ABC Foundation.

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