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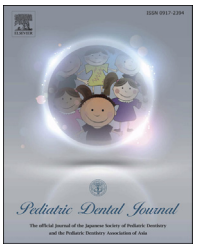

Research Paper

Effectiveness of a mouth rinsing function test for evaluating the oral function of children

Ayano Ogawa [a], Akiko Ishizaki [a,*], Takuya Asami [a], Hyosong Kwon [a,b], Kanako Fujii [a], Kimiko Kasama [a], Akinobu Tanaka [a,c], Shouji Hironaka [a]

[a] Department of Special Needs Dentistry, Division of Hygiene and Oral Health, School of Dentistry, Showa University, 1-5-8 Hatanodai Shinagawa-ku, Tokyo 142-8555, Japan
[b] K Dental Clinic, Japan
[c] Tanaka Dental Clinic, Japan

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ABSTRACT

Aim: There has been an increase in consultations related to eating and oral function of children, such as not chewing food properly and swallow without chewing; however, there have been few studies about oral function evaluation. We have devised a mouth rinsing function test (MRFT) to evaluate the oral function of children by grading mouth rinsing function into five stages. We aimed to investigate the effectiveness of MRFT for evaluating the oral function of children and to investigate factors relating to the MRFT scores.

Methods: The participants were 182 children (age 3–6 years; 98 boys and 84 girls) attending nursery school, who underwent an oral examination and evaluation of MRFT and occlusal force. Data on growth history and eating behavior were collected from parents through a questionnaire.

Results: The MRFT score significantly correlated with age and if breastfeeding or bottle-feeding was stopped earlier. Children whose parents worried about their eating habits tended to have lower MRFT scores. There was no significant correlation with occlusal force or the thickness and length of the masseter.

Conclusions: MRFT is effective for evaluating the oral function of children because the MRFT score increases with age. The MRFT score is related to eating behavior; hence, children with low MRFT scores should be supported appropriately. MRFT was not correlated with occlusal force or the thickness and length of the masseter muscle; therefore, it is necessary to examine the oral dexterity, using MRFT, when evaluating the oral function of children.

1. Introduction

During childhood, eating behaviors are established through a variety of experiences with food. These behaviors can be affected by oral function, being overweight, and socioeconomic factors and can further affect the life of an individual [1,2]; therefore, it is important to establish desirable eating behavior in childhood. Recently, however, Japan has seen an increase in consultations regarding eating problems in

* Corresponding author.
E-mail address: akiko.i@dent.showa-u.ac.jp (A. Ishizaki).
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children, such as picky eating, quick eating, and slow eating [3]. Problems of eating behavior can be related to oral function, such as not chewing or swallow without chewing. To address this problem of eating behavior in children, it is necessary for medical personnel and caregivers to focus on oral function, but as yet there is no simple evaluation of oral function in children.

Studies have reported oral function evaluations in adults and the elderly were based on the occlusal force [4–6], diadochokinesis [7], and color changeable gum tests [8]. In addition, Sumi et al. reported an oral function evaluation test based on gargling and related this to a range of factors, such as cognitive function, activities of daily living, and body mass index [9].

At our division, we have devised a mouth rinsing function test (MRFT) to evaluate oral function by grading mouth rinsing function into five steps. In this study, we assessed the usefulness of MRFT for oral function evaluation and investigated the relationship between eating behavior and oral function evaluated using MRFT.

2. Materials and methods

Ethical approval for this study was obtained from the Ethics Committee of Showa University School of Dentistry (Issue #2014-015 in 2014). This study protocol was in compliance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). A written consent was obtained from parents as well as assent from the child participants themselves.

2.1. Study design

The study was cross-sectional in design. Data were obtained in February 2016.

2.2. Participants

The participants were children aged 3–6 years from four nursery schools in Kashima city, Ibaraki Prefecture, Japan. The school staff distributed 500 letters about this study to the respective parents and collected the completed consent forms; parents were invited to talk in person with the researchers if they had any questions. The response rate was 54.0%. Of the 270 children for whom a completed consent form was received, 23 were absent from the nursery school on the test day, questionnaires were unavailable for 11, and 54 with an occlusal force below 100 N or whose tongue pressure could not be measured were excluded from the analysis (Fig. 1). Therefore, only 182 participants were included; 98 boys and 84 girls. None had any illness or a known medical history of orthopedic dysfunctions that could affect the tests.

2.3. Basic information

Data regarding the participants' age, sex, height, weight, growth history, and eating behavior were collected from the parents via a written questionnaire. This included the following questions: "1) When your child eats, does he/she chew well?" and "2) Have you worried about his/her eating?" The second question was divided into four categories: a) oral function (e.g., not chewing well, letting food out of the mouth, or cramming); b) picky eating; c) eating behavior and manners (e.g., eating while playing, or slow eating); and d) willingness to eat (e.g., overeating or undereating). An oral examination was performed on each child beforehand and all the information was recorded on a data collection form.

2.4. The mouth rinsing function test

Oral function was evaluated using MRFT. Each child was examined in the sitting position in a school chair with the neck in anteflexion and was instructed to do the following actions, which were demonstrated for the child to imitate: a) Take water (10 ml) from the cup into the mouth. b) Close the mouth, keeping the water in it. c) Move both cheeks symmetrically. d) Move the cheeks alternately. The child was observed and evaluated from taking in the water to spitting it out. MRFT was scored as follows (Table 1): 1, water cannot be taken into the mouth; 2, water can be taken into the mouth, but is swallowed or water spills out of the mouth; 3, water can be held in the mouth, but can only be rinsed around symmetrically; 4, water can be rinsed around asymmetrically, but it spills outside the mouth, or can it be rinsed around asymmetrically but slowly; 5, water can be asymmetrically rinsed around well. The children were divided into two groups according to their MRFT score: those with a score of 1–3 were defined as the "symmetry" group, and those with a score of 4–5 as the "asymmetry" group.

2.5. Thickness of the masseter muscle and fat mass

The thickness of masseter muscle and fat mass were measured using ultrasonography (Miru-Cube®, 6 MHz linear array transducer; Global Health Co, Tokyo, Japan) (Fig. 2). Ultrasound images taken at the right side of the masseter muscle were obtained using a real-time scanner. The child sat on a height-adjustable chair with the head upright. Prior to the scan, the child was asked to clench the jaw so that the examiner could palpate the origin to estimate the thickest part of the masseter [10]. The evaluation criteria were calibrated to account for inter-investigator differences. The muscles were measured when both relaxed and when contracted.

2.6. Length of the masseter muscle

The length of masseter muscle was measured by linear measurement of the skin surface using a ruler (which is not dangerous even when placed on the skin). The child sat on a chair with the head upright. After palpation of the masseter muscle and zygomatic arch, the distance from the zygomatic arch lower edge to mandible angle was measured perpendicular to the mandible lower edge [11,12].

2.7. Occlusal force and tongue pressure

The maximum occlusal force was measured using a pressure-sensitive film (Dental Prescale® 50H SS or S size, FUJIFILM, Tokyo, Japan). The occlusal force was analyzed using the Occluzer® (GC, Tokyo, Japan) [13]. Tongue pressure was measured using a tongue pressure measurement device® (JMS Co. Ltd., Hiroshima, Japan) [14,15].

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