

Clinical implications of taste thresholds in patients with odontogenic maxillary sinusitis

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Abstract. Patients with odontogenic maxillary sinusitis (OMS) often complain of reduced taste sensitivity as well as nasal obstruction. The filter paper disc method (the conventional gustatory test) was applied to nine patients who underwent sinus surgery to open the inferior nasal meatus and sinus drainage, on three different days: 1 day prior to surgery, 7 days postoperative, and 28 days postoperative. The same test was applied to nine non-clinical participants with or without clipping the nose to interfere with smooth nasal airflow on two different days. Acquired recognition thresholds for the four basic tastes of sweet, salty, sour, and bitter were assessed. In OMS patients, the recognition thresholds for all four tastes were markedly decreased at 7 and 28 days postoperative, and subjective taste sensitivity and the elimination of nasal obstruction was improved. The mean recognition threshold for the four tastes correlated negatively with taste satisfaction scores. Clipping the nose in non-clinical participants induced increases in gustatory detection and recognition thresholds. Despite the small sample size and different ages and sexes of the study subjects, it was demonstrated that nasal obstruction in OMS patients and nose clipping in non-clinical subjects reduce taste reactivity, and surgical intervention to promote nasal airflow recovers impaired taste reactivity.

Key words: odontogenic maxillary sinusitis; gustatory threshold; taste sensitivity; nasal patency; nasal airflow; sinus inflammation; stress.

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Many patients suffer odontogenic maxillary sinusitis (OMS), which can occur with conditions such as infection, pathological entities, and trauma to the maxillary teeth and jaws, or iatrogenically as a complication of oral and maxillofacial surgery, including dental implant and orthognathic surgery, together with violation of the sinus membrane^{1–4}. OMS patients manifest inflammatory symptoms including

rhinorrhoea and maxillary tenderness, and symptoms of sensory dysfunction such as impaired taste and smell. The Caldwell–Luc operation, described by George Caldwell in 1893 and Henri Luc in 1897, is a treatment for maxillary sinus disease. This was the main procedure applied for chronic, recurrent maxillary sinusitis and postoperative odontogenic maxillary cysts until the introduction of

functional endoscopic sinus surgery, which improved physiological drainage from the natural orifice.

Accurate perception of taste and olfactory information plays an important role in maintaining the palatability of food⁵. A reduction or elimination of olfactory function changes taste sensitivity during ingestion⁶. In daily clinical experience, the present authors have noticed that some

OMS patients presenting nasal obstruction also complain of impaired taste accuracy. This suggests that impaired taste sensitivity might be affected by the nasal patency associated with OMS. However, whether OMS symptoms relate to taste accuracy has yet to be completely elucidated.

The purpose of this study was to investigate the relationship between OMS and taste reactivity, to clarify whether taste sensitivity in OMS patients is changed by surgical intervention, and how the temporary impairment of olfactory function by nasal clipping affects gustatory thresholds in non-clinical subjects.

Materials and methods

Participants

Two experiments were performed in this study. Nine patients participated in experiment 1. Seven were male and two were female; their mean \pm standard error of the mean (SEM) age was 50.8 ± 4 years and body mass index (BMI) was 23.1 ± 0.8 kg/m². These patients had symptoms of chronic OMS and underwent sinus surgery through the Caldwell–Luc approach.

A total of nine healthy medical staff participated in experiment 2. One was male and eight were female; their mean \pm SEM age was 35.2 ± 2.4 years and BMI was 21.4 ± 1.1 kg/m². These subjects were recruited at Saiseikai Matsusaka General Hospital. All subjects in experiment 2 were in good health according to the results of a physical examination and none had any history of head trauma, hypogeusia, or otolaryngological disease.

After receiving an explanation about the study, all 18 provided written informed consent to participate. The study was performed in accordance with the ethical standards for human experimentation described in the Declaration of Helsinki. The study was approved by the ethics committee at Saiseikai Matsusaka Hospital.

Patient characteristics at preoperative examination

In each case, radiographs and computed tomography (CT) scans obtained at the initial examination revealed that apical periodontitis and/or a radicular cyst of the maxillary molars had progressed to chronic sinusitis. Characteristics of the preoperative mucosal morphology in the sinus and nasal cavity on CT were evaluated in random order by experts specialized in the interpretation of radiographs and blinded to case information. Relation-

ships between taste threshold and the following parameters were examined: (1) age, (2) BMI, (3) serum levels of white blood cells (WBC), neutrophils, and C-reactive protein (CRP), (4) mucosal morphology in the sinus on CT (mucosal thickening, polyp formation, fluid accumulation, and soft tissue shadows), (5) degree of inflammation in the sinus (mild or severe), and (6) nasal mucosal thickening on CT (mild, moderate, or severe), indicating nasal patency. The degree of inflammation in the sinus was classified according to the type of mucosal morphology: 1 = mild sinusitis (mucosal thickening, polyp formation, fluid accumulation); 2 = severe sinusitis (soft tissue shadows).

An overview of the clinical characteristics of all nine cases, including pathological diagnoses, is shown in Table 1. The pathological diagnosis was chronic maxillary sinusitis in all of the OMS patients. WBC, neutrophils, and CRP were within the normal range in all patients preoperatively, indicating no acute inflammation. Preoperative CT revealed mucosal thickening, polyp formation, and fluid accumulation in the sinuses of three patients (33.3%), reflecting mild OMS. Conversely, soft tissue shadows throughout the sinus were seen in six patients (66.7%), indicating severe OMS. Furthermore, nasal mucosal thickening suggesting restrictions to nasal patency or airflow in the nasal cavity was mild in two patients (22.2%), moderate in five (55.6%), and severe in two (22.2%).

Surgical technique

For all patients, surgery was performed under general anaesthesia. The incision was designed to create a buccal advanced flap to cover the tooth extraction wound. The infraorbital nerve was protected during periosteal elevation. The maxillary sinus was opened from the canine fossa. This was followed by drainage of the fluid and curettage of the inflammatory mucous membrane, together with extraction of the maxillary molars that had caused the chronic sinusitis in each case (Table 1). After setting the opening meatus to the inferior nasal floor, the surgical site was irrigated with sterile saline, drainage gauze was inserted through the nose and placed in the maxillary sinus, and complete closure was performed with silk thread sutures. All patients were treated successfully, with minimal complications. On postoperative day 5, the gauze for the nasal tampon was removed through the nasal cavity. One week later after the operation, the resistance to nasal airflow

as well as the inflammation in the maxillary sinus were decreased.

Experimental protocol

In experiment 1, the gustatory test was applied to the nine patients who underwent the surgical intervention to open the inferior nasal meatus and sinus drainage on three different days: 1 day prior to the operation, on postoperative day 7, and on postoperative day 28.

In experiment 2, the gustatory test was performed on nine non-clinical participants on two different days during 1 week: on the first day, the conventional gustatory test was performed; on the second day, the gustatory test was performed with the nose clipped to block normal nasal airflow. Salivary α -amylase activity (s-AMY) was also measured before and after the gustatory test.

Experimental procedure

Testing method for taste acuity

The filter paper disc (FPD) method⁷ has been employed in several gustatory tests, including the whole-mouth method⁸, taste strip method⁹, and electrogustometry¹⁰. The FPD method is simple and easy to apply for the evaluation of taste acuity in different areas of the tongue, but this test takes a fairly long time to complete, possibly leading to stress. The FPD test was conducted at 17:00 in a quiet room to decrease potential circadian and environmental effects⁷. The participants did not consume food or drink other than water for 1 h before starting the experiment, and cleaned their teeth and rinsed their mouth 15 min before the start. During each test, the participant rinsed their mouth with distilled water before testing the next solution. A test disc 5 mm in diameter (Taste Disc; Sanwa Chemical, Nagoya, Japan) was placed on the right lateral area of the tongue approximately 2 cm from both the proglossis and lingual margin, in an area thought to be innervated by the chorda tympani. The substances and concentrations used to test the four tastes were as follows: sweet was tested with sucrose (0.3%, 2.5%, 10%, 20%, and 80%); salty was tested with sodium chloride (0.3%, 1.25%, 5%, 10%, and 20%); sour was tested with tartaric acid (0.02%, 0.2%, 2%, 4%, and 8%), and bitter was tested with quinine hydrochloride (0.001%, 0.02%, 0.1%, 0.5%, and 4%). Each taste concentration was serially scored from disc number 1 (lowest) to number 5 (highest). If the participant failed to detect a

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