Objective Clinical Assessment of Change in Swallowing Ability of Maxillectomy Patients when Wearing Obturator Prostheses

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Purpose: Evaluation of treatment outcome is important in maxillofacial rehabilitation. Although eating is one of the oral functions that most strongly influences patients' quality of life, only a few reports exist on the objective assessment of swallowing for maxillectomy patients. The purpose of this study was to identify changes in the swallowing ability of maxillectomy patients when wearing obturator prostheses through the use of an objective clinical assessment. ***Materials and Methods:*** The swallowing ability of 38 postmaxillectomy patients consecutively treated with obturator prostheses was objectively evaluated with the "water-drinking test" that was developed for the assessment of dysphagia patients after cerebrovascular disease. In this test, the subjects were instructed to drink 30 mL of water in one swallow. The profile was evaluated with the combination of the time required for drinking the water and the incidence of cough reflex. Statistical analysis was performed using the Wilcoxon signed-rank test, the paired *t* test, and the Chi-square test with StatView 5.0 for the Macintosh. ***Results:*** Performance improved significantly when the patients wore prostheses ($P = .0026$, Wilcoxon signed-rank test). The mean drinking times without and with prostheses were 8.2 ± 6.3 s and 5.0 ± 3.5 s, respectively. Drinking time was shortened significantly when the prosthesis was worn ($P = .0002$, paired *t* test). The assessment of behavior and episodes revealed that the swallowing ability of the maxillectomy patients was significantly improved when a prosthesis was worn ($P = .0002$, Chi-square test). ***Conclusion:*** The swallowing ability of maxillectomy patients was quantitatively and qualitatively improved with obturator prostheses. *Int J Prosthodont 2005;18:475–479.*

According to a nationwide survey in Japan, patients with maxillary defects accounted for 785 of 2,067 (38.0%) maxillofacial prosthetic cases from 170 clinics. The ratios of the patients with maxillary defects who suffered from chewing, speech, and swallowing disability were 29.9%, 29.0%, and 14.3%, respectively.[1] To identify the most suitable treatment, it is important to evaluate oral function and to estimate the improvement provided by maxillofacial rehabilitation. Therefore, various methods have been applied to evaluate chewing[2–5] and speech[6–8] in this field. However, there are few widely accepted objective methods for evaluating the swallowing ability of maxillectomy patients. A disability in swallowing is considered to be one of the most troublesome problems for maxillectomy patients.[1]

Recently, a swallowing ability test for dysphagia paralytica in cerebrovascular disease was developed in Japan,[1] and it was widely applied as a clinical test for dysphagia. Accordingly, this test was applied as a clinical assessment method for maxillectomy patients. The purpose of the present study was to objectively assess improvements in swallowing ability of maxillectomy patients while utilizing obturator prostheses.

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Materials and Methods

Subjects

Thirty-eight patients who had undergone maxillectomy and had been treated with obturator prostheses to eliminate oronasal communications were recruited for this study. Patients were consecutively enrolled from all the maxillectomy patients who received maxillofacial prosthetic treatment in Kyushu University Dental Hospital between 1998 and 2003. All patients received obturator prostheses without implant retention. Each subject was informed about the aim and procedure of this study, and informed consent was obtained before beginning the experiment.

Test Protocols

Swallowing ability was examined with the "water-drinking test," which had been developed as a clinical assessment method for determining the swallowing ability of patients who were dysphagic as a result of cerebrovascular disease.[9] The test was performed twice for each subject—without prosthesis and with prosthesis—under very careful observation to prevent adverse problems for them. In the test, subjects were instructed to drink 30 mL of water in one swallow. The profile of each subject while drinking water was categorized in accordance with the specific criteria of this test:

- Normal = able to drink the water in one swallow within 5 seconds without experiencing a cough reflex
- Suspected disability = able to drink the water in one swallow in more than 5 seconds without a cough reflex, or able to drink the water in several swallows without a cough reflex
- Disability = unable to drink the water without experiencing a cough reflex

In addition, the time required to drink the water, ie, from the moment when water was poured into the mouth to when the larynx returned to the original position, was recorded with a stopwatch. The behavior and episodes during the test were also observed and characterized as follows:

- Natural drinking = able to drink water without problems
- Sucking = sucking water (sip and/or suck in)
- Holding = holding water in the mouth
- Compulsory drinking = drinking water compulsorily with unnatural head posture
- Careful drinking = drinking water carefully

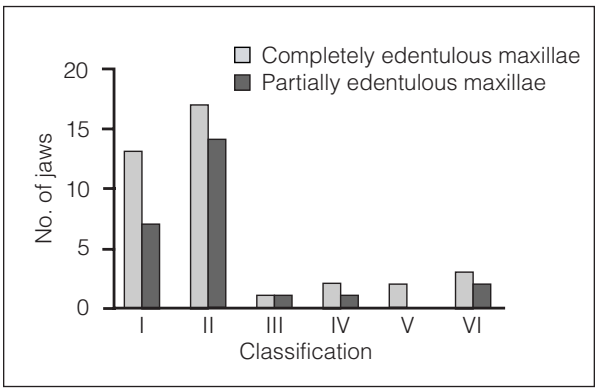


Fig 1 Subjects' edentulism profiles in accordance with Aramany's classification.

- Drooling = drooling water from the mouth
- Nasal leakage = leaking water into the nose

A subject who exhibited natural drinking without any compensatory behavior (eg, sucking, holding, compulsory drinking, and careful drinking) or peculiar episodes (eg, drooling, nasal leakage) was categorized as "normal," and one who exhibited at least one of the above-mentioned behaviors or episodes was categorized as "abnormal."

Data Analysis

Each subject's profile while drinking water was graded as follows: 3 = normal; 2 = suspected disability; and 1 = disability. A Wilcoxon signed-rank test was then performed to see whether the profile while drinking water was improved when the patient wore the prosthesis. The drinking time was compared (without versus with prosthesis) using a paired *t* test. With regard to the behavior and episodes while drinking water, a Chi-square test was applied to determine whether wearing the prostheses resulted in improvement. All statistical analyses were performed with StatView v. 5.0 (SAS Institute) for the Macintosh.

Results

Thirty-eight patients, 14 men and 24 women with a mean age of 67.8 years (SD 11.4), were included in the study. They exhibited 13 complete and 25 partially edentulous maxillae. The profiles of the patients, in accordance with Aramany's classification,[10] are shown in Fig 1.

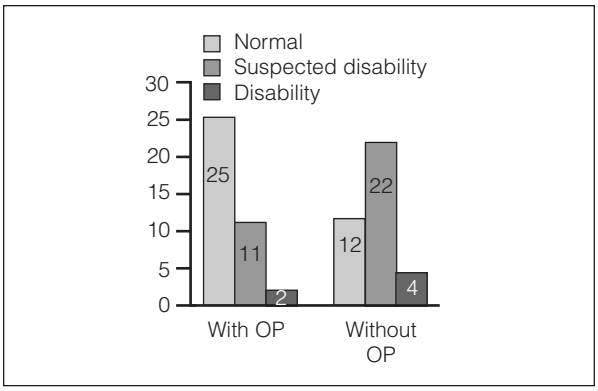


Fig 2 Distribution of the subjects' profiles during the water-drinking test. (OP = obturator prosthesis)

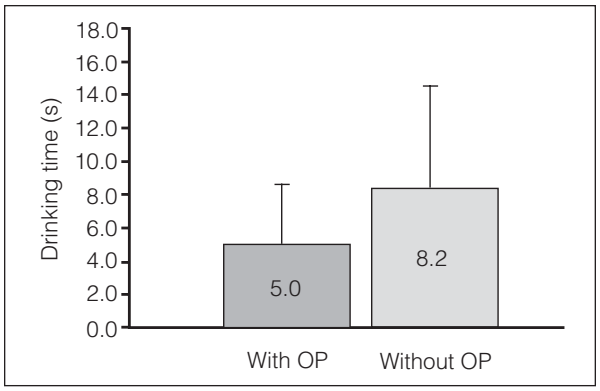
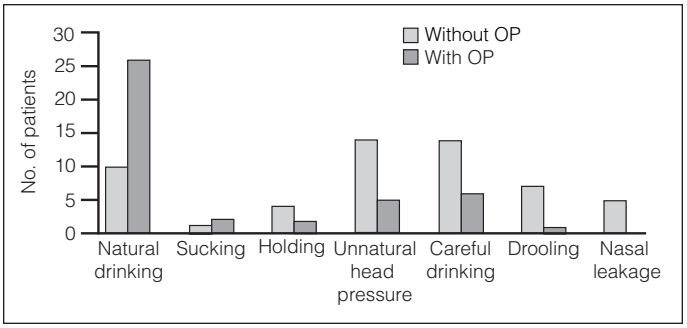


Fig 3 Results of drinking time test. $P < .001$ (paired t test). (OP = obturator prosthesis)

Fig 4 Frequency of behavior and episodes during the water-drinking test. (OP = obturator prosthesis)



Profiles in the Water-Drinking Test

The results of the profiles from the water-drinking test are shown in Fig 2. The profiles improved significantly when the subjects wore prostheses ($P = .0026$, Wilcoxon signed-rank test). Eleven of 22 "suspected disability" subjects and 2 of 4 "disability" subjects without prostheses exhibited "normal" profiles when wearing prostheses, and 1 of 4 "disability" subjects exhibited "suspected disability" with prostheses.

In total, 14 of 26 maxillectomy patients who did not have normal drinking ability (53.8%) without their prostheses exhibited improved swallowing ability by wearing prostheses. Only 1 subject in the "suspected disability" category deteriorated into "disability" by wearing a prosthesis. The other 11 subjects did not show any change in their swallowing ability.

Drinking Time

The drinking time data for 5 subjects could not be obtained because they had a temporary cough reflex during the test without prostheses, and one had a cough reflex even with the prosthesis. With the data for these 5 subjects omitted, the drinking time results of 33 subjects are shown in Fig 3. The mean drinking times without and with prostheses were 8.2 seconds (SD 6.3 seconds) and 5.0 seconds (SD 3.5 seconds), respectively. The drinking time was thus significantly shortened when wearing the prostheses ($P = .0002$, paired t test).

Behavior and Episodes in the Water-Drinking Test

The behavior and episodes exhibited by patients during the water-drinking test are shown in Fig 4. The swallowing ability evaluated by the behavior and episodes during the water-drinking test improved significantly when the patients wore prostheses ($P = .0002$, Chi-square test), ie, the number of patients who were categorized as "normal" increased from 10 (26.3%) to 26 (68.4%), whereas those who were categorized as "abnormal" decreased from 28 (73.7%) to 12 (31.6%). In detail, 14 patients rapidly drank water with a backward head posture, and 14 others drank carefully and slowly without prostheses. When wearing prostheses, 9 of the former and 8 of the latter drank naturally. Seven patients drooled water from the mouth and 5 leaked water into the nose without prostheses, whereas only 1 patient drooled and none leaked water when wearing prostheses.

Discussion

Eating is an important oral function that influences overall satisfaction with daily life.[11] It is easy to imagine that maxillectomy patients would have moderate to severe disabilities in oral functions when appropriate obturator prostheses are not applied. On the other hand, well-functioning obturator prostheses significantly contribute to improvement in the quality of life (QOL) of maxillectomy patients.[12] It was also reported that oral prostheses for head and neck cancer patients were important for the patient's overall QOL.[13]

Eating is known to be a complex activity that consists of taking in foods, chewing, forming boluses, and swallowing. There are a few reports on the mastication of patients with maxillofacial defects[2] and of mandibulectomy patients.[3–5] A number of studies have discussed the swallowing ability of patients who received resection of the tongue or the floor of the oral cavity[14–18] and that of head and neck cancer patients.[19–21] However, clinically objective evaluations of the swallowing function of maxillectomy patients have not been conducted. In fact, it was frequently observed that most maxillectomy patients had difficulty or disability in swallowing by dropping food from the mouth and nasal leakage without obturator prostheses. Therefore the swallowing ability of maxillectomy patients was the focus of this study.

To evaluate the swallowing function, ultrasound imaging,[15,18] fiberoptic endoscopy, and/or videofluoroscopy[16,19,20,22] are generally used for the quantitative examination. In particular, videofluorographic assessment is an accurate and widely accepted method for evaluating dysphagia patients.[23] Swallowing rehabilitation has been evaluated via videofluorography of oropharyngeal swallowing in head and neck cancer patients.[19] However, videofluorographic evaluation requires a special device and is extremely difficult to carry out at bedside or in regular clinical settings. To assess swallowing ability, beneficial and simpler clinical methods that do not require special instruments are needed in the clinic. Therefore, the water-drinking test that was originally developed for dysphagia paralytica in cerebrovascular disease was newly applied to estimate the improvement in the swallowing ability of maxillectomy patients with obturator prostheses. One of the advantages of this test was that the swallowing ability of the subject could be quantitatively and qualitatively evaluated using the time required to drink 30 mL of water, and the observational data obtained during the test was also useful.

The 30-mL volume of water may be too much for patients with neurogenic dysphagia, and aspiration or suffocation may occur. But few of the subjects in this study had neurogenic dysphagia; most of them had anatomic defects of the oral cavity. Therefore it was considered that this test could be applied, using careful observation, to the subjects in this study. In addition, this test is similar to the Frenchay Dysarthria Assessment,[24] in which the subjects are asked to drink one half cup of water and eat a cookie as quickly as possible.

According to the analysis of the profiles in the water-drinking test, 31.6% of maxillectomy patients had normal swallowing ability without prostheses, regardless of the type of maxillary defect. This may be because the size and location of the maxillary defects and the number of existing teeth varied among the subjects in this study. While 14 of 26 patients who did not have normal drinking ability without obturators (53.8%) exhibited an improvement in swallowing ability by wearing prostheses, the residual half did not. Moreover, one subject coughed temporarily both with and without the prosthesis, while another with suspected disability without an obturator had a cough reflex with the prosthesis. The residual 10 subjects were able to drink water without a cough reflex but not within 5 seconds or in one swallow, both with and without prostheses.

The drinking time was significantly shortened, from 8.2 to 5.0 seconds, by wearing prostheses. This was considered to be evidence, proved by the quantitative analysis, that the swallowing ability of maxillectomy patients could be improved by wearing obturator prostheses. The drinking times obtained from 10 normal individuals were reported as 2.8 ± 0.7 seconds for patients in their 50s, 3.4 ± 0.7 seconds for patients in their 60s, and 4.0 ± 0.8 seconds for patients over 70 years of age.[9] A significant correlation between the data of this test and videofluorigraphic findings was also demonstrated. Consequently, 5 seconds was defined as the cut-off point for normality.[9] Thus the swallowing ability of maxillectomy patients improved to the borderline for normality by wearing obturator prostheses. However, it should be noted that the data for 5 subjects were excluded since these subjects temporarily had a cough reflex during the test and could not drink the water.

With regard to the results of the behavior and episodes, the notable features observed in the test without prostheses were “compulsorily drinking” and ”carefully drinking.” These 2 features were regarded as compensatory behavior. In the former it seemed that the subject tried to pour water directly into the pharyngeal portion of the tongue (base of tongue) to avoid the problem caused by the maxillary defect. The latter could be a different behavior pattern, whereby the subject slowed down the pace to avoid leakage into the defect.

Most of the subjects were able to drink water naturally with obturator prostheses. Although some subjects had acquired compensatory behavior without obturators, they could drink 30 mL of water naturally when

wearing prostheses. The physical closure of the perforation between the oral and nasal cavities might directly effect this improvement of drinking behavior. Specifically, 7 subjects (18.4%) had drooling and 5 (13.2%) had leakage without prostheses, and they improved to a natural drinking style by wearing prostheses.

It is notable that in this study no patients had leakage when wearing the prostheses, which is better than that of a previous report,[12] in which 29% of 47 maxillectomy patients had eating problems with leakage when swallowing liquids on the basis of an Obturator Functioning Scale. In that report, the authors found that a well-functioning obturator significantly contributes to improving the QOL of maxillectomy patients.[12]

The results of this study indicated that wearing maxillofacial obturator prostheses clearly improved the swallowing ability of maxillectomy patients quantitatively and qualitatively. This improvement in the swallowing function when wearing obturator prostheses might contribute to the improved overall function of maxillectomy patients.

Conclusion

The swallowing ability of maxillectomy patients was objectively evaluated with the water-drinking test, demonstrating:

1. Patient profiles during the water-drinking test improved significantly when they wore obturator prostheses.
2. The time required for drinking 30 mL of water was significantly different when an obturator was used versus when it was not used. Time was reduced significantly when the obturator was used.
3. The behavior and episodes were significantly qualitatively improved by wearing obturator prostheses.

Acknowledgment

The authors appreciate the participation of all subjects very much. Special thanks are given to Dr M. Hayashida, Dr R. Ohta, and Dr S. Habu for their assistance in the series of studies.

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