

ORIGINAL ARTICLE

Oral Dryness Examinations : Use of an Oral Moisture Checking Device and a Modified Cotton Method

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Clinical significance

An easy examination for oral dryness in dental patients is needed. This study suggested that oral dryness can be examined using either an oral moisture checking device or a modified cotton method.

Abstract

Purpose: This study compared oral dryness measured using an oral moisture checking device and the modified cotton method.

Methods: Oral moisture was measured at the lingual mucosa (LM) and the buccal mucosa (BM) using an oral moisture checking device in 13 healthy adults (HA) and 13 patients with oral dryness (OD). The modified cotton method was performed in the same subjects by placing cottons under and over the tongue for 30 seconds and measuring the weight of the saliva absorbed by the cotton. Differences between groups were examined using the Mann-Whitney U-test.

Results: The moisture percentage at the LM in the HA and OD groups was $30.0 \pm 0.5\%$ and $28.6 \pm 1.1\%$, respectively, while the percentage at the BM was $30.3 \pm 0.2\%$ and $29.6 \pm 0.7\%$, respectively. The amount of hypoglossal salivary secretion in the HA and OD groups was 0.339 ± 0.172 g and 0.036 ± 0.033 g, respectively, while the amount of salivary secretion on the tongue's surface was 0.059 ± 0.023 g and 0.011 ± 0.007 g, respectively. Both oral moisture and the amount of saliva at rest were significantly different between the HA and OD groups ($P < 0.05$).

Conclusion: Both the oral moisture checking device and the modified cotton method were useful for measuring oral dryness. An oral moisture level of 30% or less, less than 0.1 g of saliva collected at the hypoglossus within 30 seconds, or less than 0.02 g of saliva collected from the surface of the tongue within 30 seconds may indicate oral dryness.

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Received on June 29, 2005 / Accepted on November 21, 2005

Key words: oral dryness, oral moisture checking device, modified cotton method

Introduction

Xerostomia¹ reduces salivary secretion, which can lead to other symptoms of the oral cavity and pharynx.²⁻⁸ Most patients with oral dryness are elderly persons,⁹ so an easy examination for oral dryness that can be performed independent of oral function and overall physical condition is needed.^{10,11} The chewing gum test or the Saxon test¹² have been used to evaluate oral dryness, but these examinations measure the amount of stimulated saliva and require a lengthy examination. Additionally, these tests can be difficult to perform in dental patients, and the amount of saliva at rest tends to be lower than normal in most patients with oral dryness.¹³

The utility of an oral moisture checking device, which measures oral mucosa moisture within 2 seconds, has been confirmed.¹⁴ In addition, the cotton method, which consists of placing a cotton under the tongue for 30 or 60 seconds, has been used to measure the amount of resting saliva.¹⁵ A modified cotton method, in which the cotton is placed both under and over the tongue for 30 seconds, has also been developed. Oral dryness can be easily measured during clinical procedures using either the oral moisture checking device or the modified cotton method, and such measurements can be performed regardless of oral function or physical condition. The present study compared oral dryness measured using an oral moisture checking device and the modified cotton method.

Materials and methods

Thirteen healthy adults (HA group; mean age, 27.7 years) and 13 patients with subjective oral

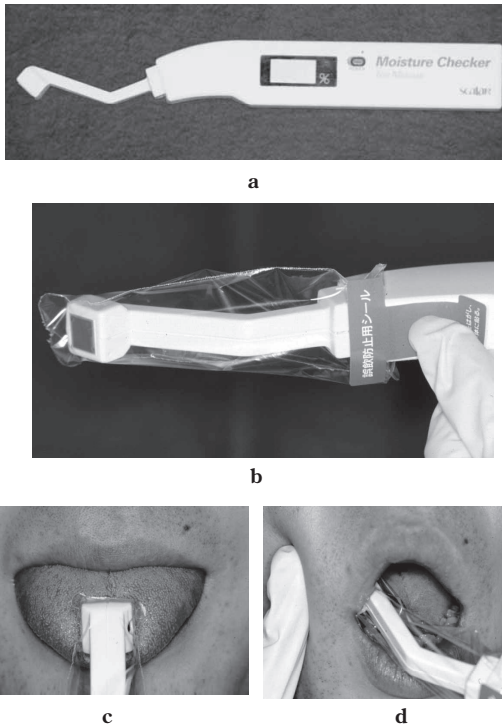


Fig. 1 (a) Oral moisture checking device, (b) Device with sensor cover, (c) Measurement at the lingual mucosa, (d) Measurement at the buccal mucosa.

dryness (OD group; mean age, 67.0 years) were enrolled in the study. Oral moisture was measured at the lingual mucosa (LM: the surface of the tongue 10 mm from the apex linguae) and buccal mucosa (BM: 10 mm from the angle of the mouth) using an oral moisture checking device (Moisture-Checker-for-Mucus[®]; Scalar, Tokyo, Japan). These sites were selected because many patients complain of oral dryness in these regions and because measurements at these sites can be easily performed. To perform the measurements, a sensor cover was placed over the sensor of the device, which was then brought into vertical contact with the oral mucosa at a pressure of about 200 g. For the LM measurement, the subjects were asked to stick out their tongue; for the BM measurement, the outside of the cheek was supported with the operator's finger (Fig. 1). To control the measuring pressure, a trial stopper was attached to the device (Fig. 2). Each measurement was repeated 5 times, and the mean value was calculated.

The modified cotton method was performed by placing cotton (Dental-mate[®]; Unicharm, Tokyo, Japan) under the tongue and, simultaneously, one cotton over the tongue (Fig. 3). The subjects were then instructed to close their mouths for 30

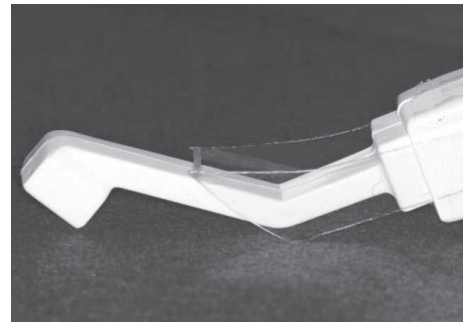


Fig. 2 Trial stopper.

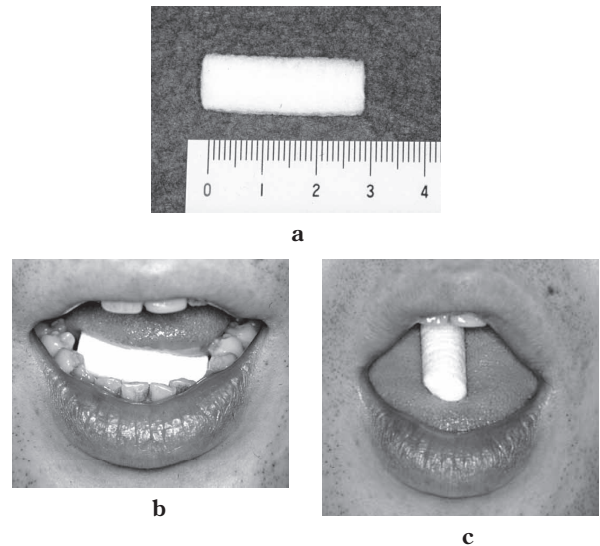


Fig. 3 (a) Cotton, (b) Placement of the cotton under the tongue, (c) Placement of the cotton on the tongue.

seconds, after which the cottons were removed. The amount of saliva absorbed by the cotton was then measured using an electronic reading balance (Libror EB-280[®]; Shimadzu, Kyoto, Japan), with the weight of the dry cotton used as the baseline value. The modified cotton method was performed once in each subject.

These examinations were performed two hours after the subject's previous meal.

Group differences in oral mucosal moisture and the amount of saliva at rest were compared using the Mann-Whitney U-test.

Results

Figure 4 shows the oral moisture at the LM in each subject. The average moisture percentage at the LM in the HA and OD groups was $30.0 \pm 0.5\%$ and $28.6 \pm 1.1\%$, respectively; the difference be-

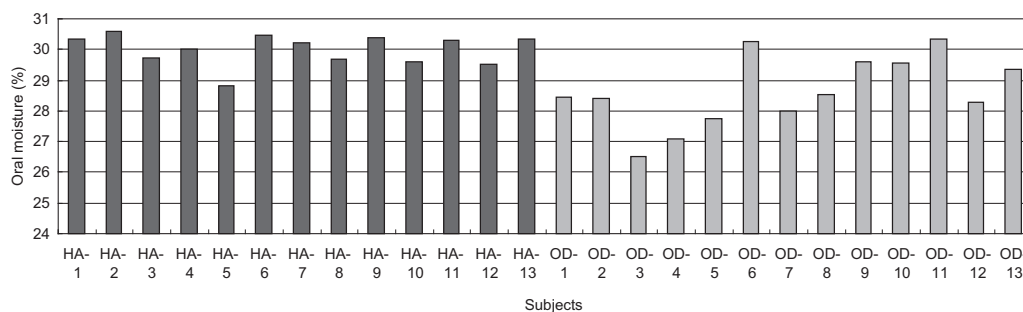


Fig. 4 Oral moisture at the lingual mucosa. HA: Healthy adults, OD: Patients with subjective oral dryness.

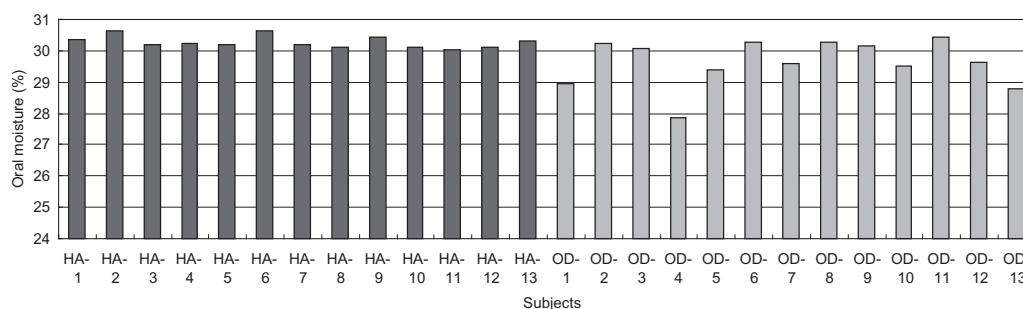


Fig. 5 Oral moisture at the buccal mucosa. HA: Healthy adults, OD: Patients with subjective oral dryness.

tween the groups was significant ($P < 0.01$). Figure 5 shows the oral moisture at the BM measured in each subject. The average moisture percentage at the BM in the HA and OD groups was $30.3 \pm 0.2\%$ and $29.6 \pm 0.7\%$, respectively; this difference between the groups was also significant ($P < 0.05$). Figure 6 shows the amount of hypoglossal salivary secretion in each subject. The average amount of hypoglossal salivary secretion in the HA and OD groups was 0.339 ± 0.172 g and 0.036 ± 0.033 g, respectively; the difference between the groups was significant ($P < 0.01$). Figure 7 shows the amount of salivary secretion on the tongue's surface in each subject. The average amount of salivary secretion on the tongue's surface in the HA and OD groups was 0.059 ± 0.023 g and 0.011 ± 0.007 g, respectively; this difference between the groups was also significant ($P < 0.01$).

Discussion

The oral moisture checking device used in this study was developed from a skin moisture checking device, already in general use. The oral moisture checking device measures the moisture of the epithelium to a depth of several tens of mi-

croimeters within the area of a squared centimeter. According to the manufacturer's manual, the oral moisture checking device measures the moisture of the epithelium by determining the capacitance. The dielectric constant of water is much higher than that of other substances; therefore, the percentage of water in the epithelium can be checked by measuring the epithelium's dielectric constant, and the epithelium's capacitance is determined from the dielectric constant. The weight of the moisture in the protein membrane is used as the standard against which the measured value (%) is compared. Use the dry weight method, the moisture percentage is calculated as follows: $B/(A+B) \times 100\%$, where A is the weight of the dried protein membrane and B is the weight of the water. Thus, a value of 100% represents pure water. However, the oral moisture checking device is only accurate within a range of 15 to 65%. The indicated value is reliable because the correlation coefficient against the standard sample between the percentage of the dry weight method and the measured value of the oral moisture checking device is 0.98. In general, an oral mucosal moisture reading of over 30% is normal, 29 to 30% is borderline, 27 to 29% is low, 25 to 27% indicates moderate oral dryness, and 25% or less indicates severe oral dry-

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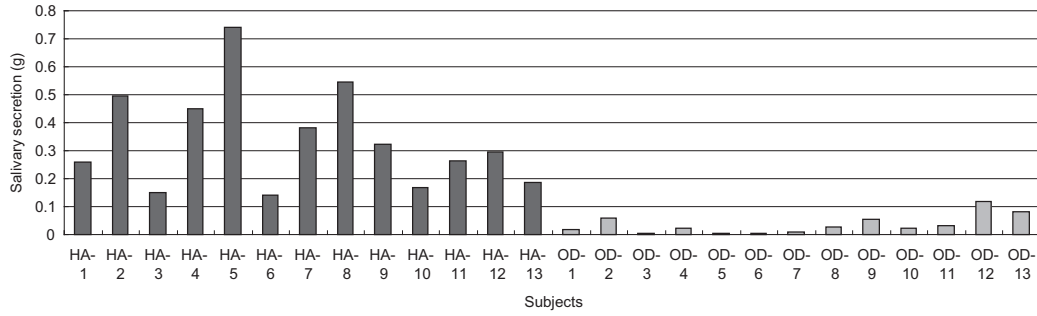


Fig. 6 Amount of hypoglossal salivary secretion. HA: Healthy adults, OD: Patients with subjective oral dryness.

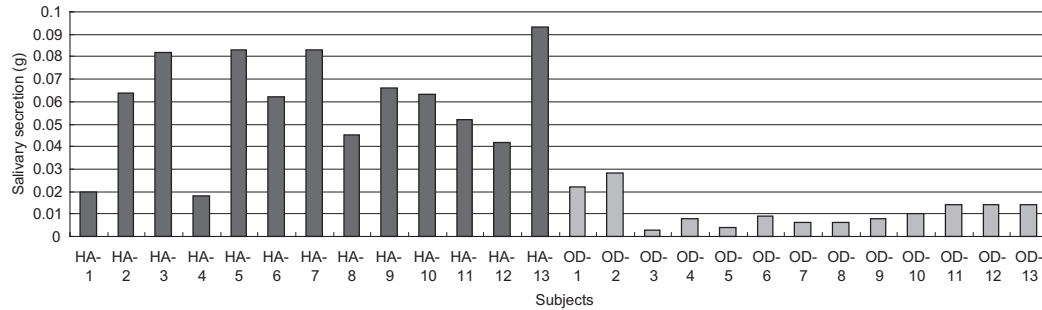


Fig. 7 Amount of salivary secretion on the tongue's surface. HA: Healthy adults, OD: Patients with subjective oral dryness.

ness.¹⁵

To measure oral mucosal moisture, the sensor of the moisture checking device is brought into vertical contact with the oral mucosa at a pressure of about 200 g. Under this pressure, the handle of the sensor starts to bend.¹⁵ Since maintaining an even pressure for each measurement was difficult, a trial stopper was attached to the device. The trial stopper was designed so that the upper surface of the sensor's handle comes in contact with the trial stopper when a pressure of about 200g is applied to the sensor's handle.

Our results clearly showed that the LM and BM moisture levels, in particular, differed between healthy adults and patients with subjective oral dryness. Therefore, these measurement sites were considered appropriate for the measurement of oral dryness.

The modified cotton method was developed to prevent, as much as possible, the cotton under the tongue from absorbing saliva from the whole mouth. The early symptoms of oral dryness often involve the tongue or palate. As the symptoms progress, the margin of the tongue or the buccal mucosa becomes involved; the last area to be affected is the hypoglossus. Because the symptoms differ according to the stage of oral dryness, the modified cotton method was performed by simul-

taneously placing one cotton under and one over the tongue. In the standard cotton method, a result of less than 0.1 g of saliva in 30 seconds or less than 0.2 g in 60 seconds suggests oral dryness.¹⁵ The results of the modified cotton method used in the present study showed that the amount of resting saliva differed significantly between healthy adults and patients with subjective oral dryness.

According to the results of the examinations using the oral moisture checking device, 2 subjects in the OD group had a normal moisture percentage at the LM and 6 of the OD subjects had a normal moisture percentage at the BM. The reason for these findings is unclear. The reason why the BM moisture percentage tends to be normal in patients with subjective oral dryness, and the possibility that a different standard value for BM moisture percentage may exist require further investigation. According to the results of the examinations using the modified cotton method, one of the OD subjects had a normal amount of saliva at the hypoglossus and 2 of the OD subjects had a normal amount of saliva on the tongue's surface.

The results of this study suggest that oral dryness should be determined based on the results of multiple examinations. In the present study,

oral dryness was only examined using the oral moisture checking device and the modified cotton method. If more than two of the four values obtained during two examinations are lower than normal, the subject may have oral dryness.

Both the oral moisture checking device and the modified cotton method were useful for measuring oral dryness. An oral moisture level of 30% or less, less than 0.1 g of saliva collected at the hypoglossus within 30 seconds, or less than 0.02 g of saliva collected from surface of the tongue within 30 seconds may indicate oral dryness.

In this study, the HA subjects were healthy adults without any diseases. Future studies will evaluate oral dryness according to the age of the patient and the presence of underlying diseases.

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