

The Effects of Prosthetic Treatment on Oral Candidiasis

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Received date: March 04, 2017; Accepted date: April 11, 2017; Published date: April 18, 2017

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Abstract

Background: Oral candidiasis is known as an infection that not only causes various oral symptoms but also affects the entire body. Since salivary flow is involved, we investigated whether the improvement of salivary flow by denture treatment could counteract the symptoms of oral candidiasis.

Methods: The study population consisted of 46 denture-wearing patients (mean age: 74.8 ± 2.2 years) who were examined at Kanagawa Dental University Hospital. We tested *Candida*, salivary flow measurement, oral symptom confirmation, and masticatory performance, and conducted denture treatment. We compared test results with measurements taken after completion of the denture treatment.

Results: The individuals in whom candida was present exhibited significantly decreased salivary flow during both rest and stimulation. In addition, they exhibited several oral symptoms along with decreased masticatory performance. However, after completion of denture treatment, all test items improved and the causative organism disappeared.

Conclusions: Patients in whom candida was present exhibited several oral symptoms, likely because poorly fitting dentures led to decreased masticatory performance; thus, decreasing the salivary flow. Denture treatment led to improved salivary flow, decreased levels of candida, and the disappearance of oral symptoms. These results suggest that denture treatment could be a means of treating oral candidiasis that is thought to be caused by masticatory dysfunction due to poorly fitting dentures.

Keywords: Oral candidiasis; Masticatory disturbance; Salivary flow; Prosthetic treatment

Introduction

Oral candidiasis is an opportunistic infection caused by *Candida*. It has been suggested that in patients wearing dentures, particularly patients with poor oral hygiene, *Candida albicans* can affix to the resin, form denture plaque, and become for lead to diseases in the entire body, such as aspiration pneumonitis [1-30]. In addition, oral candidiasis is known to cause various oral symptoms, such as mucous membrane ulcers and sores, pain, angular stomatitis, and dysgeusia [4-6].

Systemic factors and local oral factors are involved in the onset of oral candidiasis. Salivary flow is also known to be strongly involved because decreased volume of salivary flow, with its cleaning and antibacterial effects, exhibits a relationship with bacterial counts and signs of oral candidiasis [7-9].

Salivary flow has been reported to both decrease [10,11] and not decrease with age [12,13]. An epidemiological survey in Europe and America found that approximately 25% of the population was aware of xerostomia or dry mouth syndrome [14], while in Japan, an estimated 8million to 30 million patients are known to be unaware [15]. Elderly patients are believed to be prone to oral candidiasis because they have

more factors acting to suppress salivary flow and exhibit decreased infection-protective mechanisms and lowered systemic resistance [16-18].

However, it must be remembered that aging does not affect the salivary glands themselves; however, decreased masticatory strength due to muscle weakness or denture problems may cause the decreased salivary flow [19,20]. Previously, we reported that decreased salivary flow was strongly related to oral symptoms and that denture treatment was an effective method of improving this condition [21].

The present study investigated whether prosthetic treatment of elderly individuals wearing dentures could improve the salivary flow, thereby improving the symptoms of oral candidiasis.

Patients and Methods

Patients

The study population comprised 46 denture-wearing patients (22 males, 24 females) who were examined at the Kanagawa Dental University Hospital and who consented to participating in the study after being given a sufficient explanation of its purpose and content. Their ages ranged from 64 to 86 years (mean: 74.8 ± 2.2 years), and none had any systemic disorders.

Determining the presence of *Candida*

At the initial examination, *Candida albicans* was detected with using STOMASTAT (SANKIN Industry, Tokyo, Japan). The results obtained were used to classify participants into a healthy group (hereinafter “control group”), in which *Candida albicans* was absent, and a disease group (hereinafter “candida group”), in which the organism was detected. The control group comprised 21 cases (11 males, 10 females) and the candida group comprised 25 cases (11 males, 14 females) (Table 1). Also at the final examination, a similar test was conducted. As a result, reduction of *Candida albicans* was confirmed. Histopathological examination was also performed at the same time for diagnosis.

Variables	Control group	Candida group
Age (years)	73.4 ± 2.1	76.2 ± 2.4*
Gender (male/female)	11/14	10/14
Systemic disease (%)	0	0
Prosthetic treatment (number)		
Partial denture	19	29
Full denture	10	15
*P<0.05		

Table 1: Characteristics of the patients: data regarding age, gender, systemic disease, and type of prosthetic device. *Significant difference between control group and candida group (P<0.05).

Salivary secretion measurement

Resting salivary flow was measured by the spitting method [22,23], which involved collecting saliva spit into paper cups over a 15-min period and measuring the content. A result of <1.5 mL/15 min was considered as low resting salivary flow.

Stimulated salivary flow was measured by the gum test. Total saliva generated by participants chewing gum (FREE ZONE; Lotte, Tokyo, Japan) for 10 min was collected in paper cups, and the content was measured. A result of <10 mL/10 min was considered as low stimulated salivary flow.

To reduce the influence of diurnal variations, measurements were taken by the same dentist at least 1 h after the participants had their meal, at approximately 10 a.m., in a quiet environment.

Confirmation of oral symptoms

From previous study, we confirmed the presence or absence of the seven signs: furred tongue, tongue plaque, mucous membrane rubefaction, angular stomatitis (ulceration), presence of tingling pain (pain and/or burning sensation), dysgeusia, and denture plaque. Patients were assigned scores from 0 to 7 points based on whether they had these signs (sign present=1 point; sign absent=0 points), and a possible relationship between scores and candida was analyzed [24].

Masticatory ability measurement

Masticatory performance was assessed using a masticatory performance assessment gum (XYLITOL masticatory assessment gum; Lotte, Tokyo, Japan), which can be used to determine masticatory

performance by changing color. In accordance with the directions for use for denture wearers, chewing time was set at 3 min, after which results were determined by referring to the color chart that is attached above a white sheet of paper.

Results were scored according to the following:

- 1: green–yellow (poor masticatory performance)
- 2: pink (average masticatory performance)
- 3: red (good masticatory performance)

Target period and treatment method

All tests were performed at the initial examination and approximately 4 months after the new denture had been fitted, adjustments had been made, and the dentures had stabilized. Treatment involved the fabrication of new dentures by a prosthetic specialist for all patients, to improve occlusion.

Statistical Analysis

Statistical analysis was conducted by the chi-square test, the t-test, and the Mann–Whitney U test. For each of these tests, P<0.05 was considered to be statistically significant. All statistical analyses were performed using the IBM® SPSS® Statistics 21 statistical package (SPSS-IBM, Chicago, IL).

Results

Characteristics of each group

The ages of participants in the candida group were significantly higher compared with those of the control group. Gender and the type of prosthetic device were almost identical, and there were no participants with systemic disorders in either group (Table 1).

Candida changes

At the initial examination, all those in the candida group were positive for *Candida*. After treatment, all those in the candida group were decreased (the detection limit of 100 CFU/ml or less) for *Candida* (no drug therapy involving the administration of medication was conducted).

Salivary flow

For both the control and the candida groups, resting salivary flow exceeded the baseline from the initial examination, and a significant difference was observed between the two groups. Furthermore, no major changes were observed after treatment and no significant changes were observed over time. However, a significant difference was observed between the two groups.

Stimulated salivary flow exceeded the baseline in the control group at the initial examination. However, a significant difference was observed between the two groups because mean stimulated salivary flow in the candida group, at 9.07 ± 1.36 mL, did not reach baseline levels. Although hardly any changes and no significant differences were observed in the control group after occlusion improved with dentures, values in the candida group recovered to 15.92 ± 1.21 mL to exceed the baseline levels, and a significant difference was observed in

comparison with values measured at the initial examination. A P-value of significant set at <5% (Figures 1 and 2).

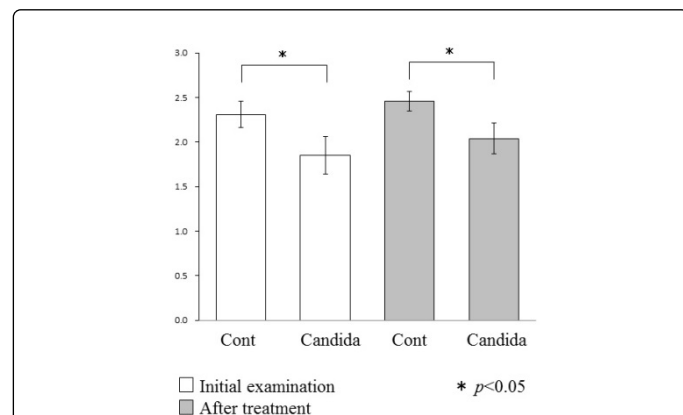


Figure 1: Changes over time in resting salivary flow volume. *Significant differences between control and candida groups at initial examination and after treatment ($P < 0.05$).

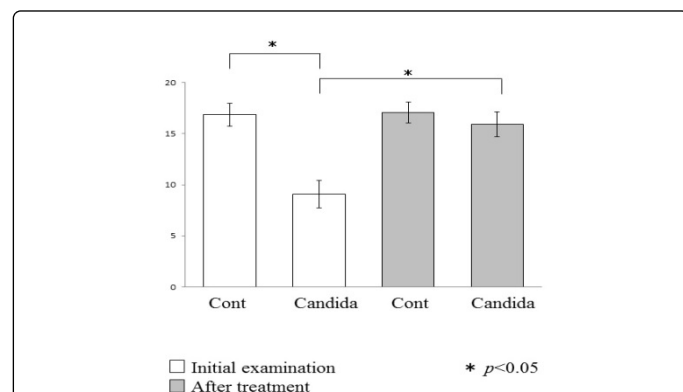


Figure 2: Changes over time in stimulated salivary flow volume. *Significant difference between control and candida groups at initial examination. In addition, stimulated salivary flow significantly increased in the candida group after treatment compared with levels at the initial examination ($P < 0.05$).

Oral symptoms

The mean oral symptom score was 3.75 in the control group at the initial examination but was significantly higher in the candida group, at 5.91. This indicated that each of the oral symptoms was common in the candida group.

After treatment, oral symptoms in both the control group and the candida group significantly decreased compared with those at the initial examination and improved to the extent that no significant differences were noted in either group (Figure 3).

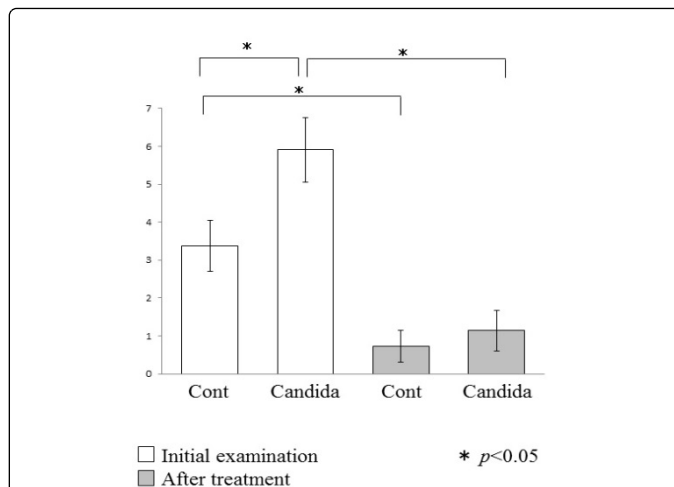


Figure 3: Changes over time in oral symptoms. *Significant difference between control and candida groups at initial examination. In addition, the number of oral symptoms significantly decreased in both the control and candida groups after treatment compared with numbers at the initial examination ($P < 0.05$).

Masticatory ability measurement

Masticatory performance, as measured with the chewing of the masticatory performance determination gum, was good (2.43) at the initial examination in the control group but was significantly lower (1.22) in the candida group because dentures appeared to be causing problems with occlusion.

After denture treatment, both the control and candida groups achieved scores of more than 2.5, with both groups exhibiting good masticatory performance, with particular improvement observed in the candida group (Figure 4).

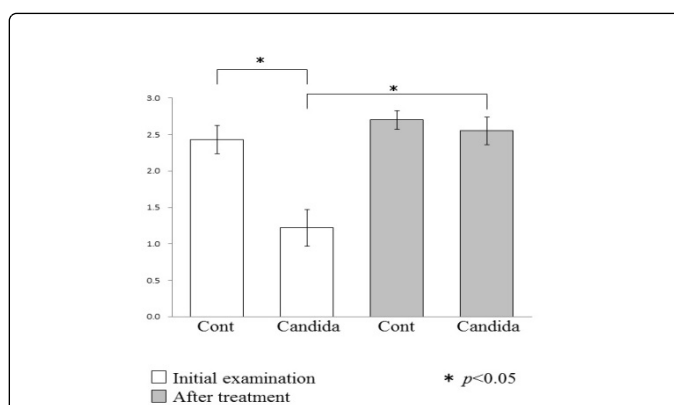


Figure 4: Occlusal contact points (number). *A significant difference was noted between the control and candida groups at the initial examination. In addition, the number of occlusal contact points significantly increased in the candida group after treatment compared with numbers at the initial examination ($P < 0.05$).

Discussion and Conclusion

Saliva plays an important role in protecting the oral cavity because it possesses both cleansing and antibacterial effects. Lysozyme, lactoferrin, and secretory IgA are particularly known for their antibacterial effects. Proteins, such as mucin, prevent mycelial development of *Candida albicans*, and histatin is bactericidal to this organism [25-28]. Therefore, decreased salivary flow may lead to increased candida count within the oral cavity because it weakens the cleansing action and lowers local concentrations of antibacterial agents.

Increased candida count is known to cause denture-related stomatitis, particularly in denture-wearing patients [29]. With the development of denture-related stomatitis, accompanying mucous membrane pain or intraoral ulceration can induce denture dysfunction, further reducing salivary secretion and leading to additional increases in candida count. In addition, this condition is known to affect general physical status, sometimes causing conditions such as aspiration pneumonia [30].

In this study, the participants in the candida group were older than those in the control group, suggesting that age-related decreased salivary flow tended to lead to increased candida counts. In addition, we observed that candida infection was not related to gender or the type of prosthetic device. Because no study participants had systemic diseases, we could easily investigate the relationship between candidiasis and prosthetic treatment.

Salivary flow can be affected by diurnal variations and various other conditions, as well as by systemic disorders. However, no study participants had systemic disorders, and the effects of diurnal variations were eliminated as much as possible by adjustments in sampling conditions. Results indicated that resting salivary flow was significantly lower in the candida group compared with that in the control group, a result which was identical after treatment was completed. These results were consistent with those of a study by Yamachika et al., indicating that resting salivary flow is related to candida count [23]. Stimulated salivary flow was below baseline levels at the initial examination in the candida group, but improved to above baseline levels after treatment was completed. Prior to treatment, a significant difference was noted for salivary flow between the control and candida groups, demonstrating the strong relationship between decreased stimulated salivary flow and candida count. Oliveira et al. reported that symptoms of candidiasis were observed in all patients with <100 CFU/ml of candida per 1 mL of saliva [31], and it appears that when stimulated salivary flow, which is greater than resting flow, decreases, the suppressive effects of saliva on candida are also decreased.

High scores were exhibited for oral symptoms in both groups at the initial examination. Main symptoms in the control group were mucous membrane rubefaction, pain, and denture plaque, which are commonly observed in denture wearers. In the candida group, almost all items were confirmed, with significantly exhibited high values. After treatment, all symptoms significantly decreased.

From the results of masticatory performance testing, the control group was observed to exhibit sufficient masticatory ability at the initial examination, but individuals in the candida group were unable to sufficiently chew. After treatment, all participants exhibited good chewing ability, indicating that denture treatment led to sufficient recovery of masticatory performance. Therefore, it appears that denture treatment leads to the recovery of salivary flow by improving

masticatory performance, which in turn improves oral symptoms caused by candida.

The results of this study suggest that it may be possible to improve oral candidiasis with denture treatment. The reason for this appears to be that poorly fitting dentures lower masticatory performance and occlusal force; thus, weakening masticatory muscles and reducing salivary secretion, decreasing the effects of saliva on candida. Therefore, treatment with appropriate dentures improves oral conditions.

We believe that these findings are useful because they suggest that oral candidiasis can be treated in elderly individuals, several of whom wear dentures, without the prescription of additional medication, and that dental treatment can suppress the systemic effects of candidiasis.

These results suggest that oral symptoms caused by oral candidiasis are related to salivary flow, and that when salivary flow is decreased due to poorly fitting dentures, the symptoms can be improved with prosthetic treatment alone.

Acknowledgements

This study was conducted in accordance with the Declaration of Helsinki, and each subject received oral and written information about the study and provided informed consent prior to participation. The study protocol was reviewed and approved by the Human Ethics Committees of Kanagawa Dental University (approval no. 260). The authors declare no conflict of interest.

This work was supported by JSPS KAKENHI Grant Number 15K11178.

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