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Original Article

Comparative study of evaluation of the oral stereognostic ability between diabetic and nondiabetic complete denture wearers with and without denture

Kalarani Gnanasambandam[1], Suma Karthigeyan[1], Syed Asharaf Ali[1], Mohan Govindharajan[2], Krishna Raj[1], R. Murugan[3]

Departments of [1]Prosthodontics, [2]Pedodontics and Preventive Dentistry and [3]Oral and Maxillofacial Surgery, Rajah Muthiah Dental College and Hospital, Annamalai University, Cuddalore, Tamil Nadu, India

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Address for correspondence:
Dr. Kalarani Gnanasambandam, Department of Prosthodontics, Rajah Muthiah Dental College and Hospital, Annamalai University, Chidambaram, Cuddalore, Tamil Nadu, India.
E-mail: natshamohan5213@gmail.com

ABSTRACT

Background: The diabetic subjects would have impaired oral stereognostic ability (OSA) compared with normal subjects due to diabetic neuropathy and microcirculatory disturbances. This study was conducted to compare the OSA between diabetic and nondiabetic complete denture wearers with and without denture.

Materials and Methods: In this *in vivo* study the present comparative study comprised of seventy edentulous subjects (36 males and 34 females), aged from 35 to 84 rehabilitated with complete dentures (among them 35 were diabetic and 35 subjects were nondiabetic complete denture wearer). The OSA tests were conducted using acrylic test samples of 12 shaped forms, which were placed in patient's mouth for a given period of time for identification and scored according to three-point scale as OSA score and the identification time was also recorded. The data obtained were analyzed using Chi-square test, *t*-test, and Pearson's correlation coefficient ($P < 0.05$).

Results: In this study, diabetic complete denture wearers got the mean OSA score of 12.43 ± 3.93 without dentures, which was lower than nondiabetic complete denture wearer group (14.82 ± 4.44). There was a significant difference ($P = 0.020$*) in the identification of test pieces.

Conclusion: Within limitations of this study, diabetic complete denture wearers showed decreased OSA than nondiabetic subjects, particularly it was significant while not wearing dentures. Oral stereognosis may be used as one of the clinical aids in predicting patient's performance to a prosthesis. Based on their response, we can educate the patient about the prognosis.

Key Words: Complete dentures, diabetic, stereognosis

INTRODUCTION

Oral stereognosis is defined as the ability to sense the form or shape of an object in the mouth by means of touch.[1] Oral perception can be evaluated by oral stereognostic ability (OSA) which is widely used in many studies reported in the literature.[1] Grossman[1] was probably the father of this concept and paved the way to assess oral perception by means of stereognosis tests.

OSA score is a good yardstick to infer the oral perception of the patients. It has a direct relationship

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with denture performance. High score in OSA indicates that the complete denture wearers could perceive full and accurate information about what is going on in his mouth and could exhibit more complaints in the postinsertion phase. Most importantly, the patient knows where the foreign body and what is doing so that they can control it properly. Low score indicates their perception about anything to their mouth and patients have fewer or no complaints in the insertion phase.[1,2]

Much work had been done in the past in studying the OSA of complete denture wearers with respect to age, gender, duration of edentulism, and satisfaction with denture using several methods.[3] However, the effect of systemic diseases, particularly diabetes mellitus, has not been evaluated yet with OSA of complete denture wearers.

The common problems observed with diabetic patients are reduced salivary flow and/or xerostomia, altered saliva composition, inflammation, loss of sensation, changes in taste perception, numbness, burning mouth syndrome, and lesions of oral mucosa and tongue.[4] It is widely assumed that diabetic neuropathy and microcirculatory disturbances also lead to alterations, particularly sensations in the oral cavity. Histopathologic and histochemical changes also occur in the denture bearing mucosa that supports masticatory pressure.[5]

Due to prolonged diabetics, the complete denture wearers may be greatly affected by clinical challenges such as denture adaptation problems and lack of awareness of developing ulcers.[5] However, to date, there is no comprehensive study available in literature to measure the OSA in diabetic complete denture wearers.

The objective of the present study is to compare the OSA in diabetic and nondiabetic complete denture wearers. The null hypothesis was there is no difference in OSA between diabetic and normal subjects.

MATERIALS AND METHODS

In this *in vivo* study comprised of seventy edentulous subjects (thirty six males and thirty fourfemales), aged from thirty five to eighty four rehabilitated with complete dentures, at the Department of Prosthetic Dentistry of Rajah Muthiah Dental College and Hospital, Annamalai University, Chidambaram. Among them, thirty five were diabetic complete denture wearers and thirty five subjects were nondiabetic complete denture wearers. All complete dentures were fabricated and inserted by the postgraduate students of our department. They had an average denture wearing experience of >3 months at the time of the study. All patients who visited the clinic for a recall appointment were examined. The patients chosen were free from acute or chronic pain that might relate to the stomatognathic apparatus, without lesions of the oral mucosa, or problems of a neuromuscular nature. All subjects gave written informed consent for participation in this study. The following information about the patients was obtained such as age and sex, duration of the period of edentulism, number and wearing period of dentures, blood glucose level, and duration of diabetes and associated diseases.

For assessing OSA, tests were conducted following the method of Garrett *et al*.[6] and Hirano *et al*.[7] The test pieces comprised of 12 shaped forms, which included circle, ellipse, semicircle, square, rectangle, and triangles of both large (12 mm × 12 mm × 3 mm) and small (8 mm × 8 mm × 2 mm) sizes.[7] The test pieces were prepared with base plate wax corresponding to each shape. Their size was verified with the digital vernier caliper (zoom digimatic caliper) and processed by clear acrylic resin (DPI-RR cold cure, Dental Products of India, a division of the Bombay Burmah Trading Corporation Limited, Mumbai, India, ISO 9001; 2008 certified) with intrinsic staining. Twenty sets of test pieces were prepared and these were disinfected with 2% glutaraldehyde solution after each use.

The test was carried out in a quiet environment where the subject was seated comfortably in an upright position. The test pieces were kept out of the subjects' sight during the test. Before the OSA test, the procedures were explained to the subjects and the enlarged pictures of all test pieces were shown to them on a chart, and they were instructed to point out the corresponding picture for each shape at the time of testing. Subjects were told that they should use their tongue and palate to identify the shape. The object was placed on the middorsal surface of the tongue by tweezers [Figure 1]. They were instructed to respond as quickly as possible and to avoid biting on the test pieces and pushing it against the lips and cheeks. To prevent learning effect, no practice trials were held. The test was done with and without denture for each patient [Figure 2]. Each of the 12 pieces was presented twice. The 24 presentations

Figure 1: Test pieces kept in mouth – with denture.

Figure 2: Test pieces kept in mouth – without denture.

were made in random order, and the same order was used for each test. Participants were not informed of the correct answers at any point during testing.

The six shape forms were grouped into three pairs of similar forms: circles and ellipse, square and rectangle, and triangle and semicircle.[7] The duration time for recognition was noted, and the answers were recorded using a three-point scale.[8] A correct identification was carried two points; an incorrect identification within the same group of forms was carried one point; and an incorrect identification of a dissimilar form was scored as zero**.** The score of the responses and the length of time needed for identification were analyzed as the OSA score and response time, respectively.

The data were analyzed using systat SYSTAT 12 software, (SYSTAT Software Inc, San Jose, CA 95110). As the OSA score and response time were normally distributed, Chi-square test, *t*-test, and Pearson's correlation coefficient were used to examine differences with regard to each of the individual explanatory variables. $P < 0.05$ was considered to be statistically significant.

RESULTS

In this study, diabetic complete denture wearer got the mean OSA score of 12.43 ± 3.93 without dentures, which was lower than nondiabetic complete denture wearer group (14.82 ± 4.44). When comparing these groups, there was a significant difference ($P = 0.020$*) in the identification of test pieces. With dentures also, diabetic complete denture wearer got the mean OSA score of 13.89 ± 4.04, which was lower than nondiabetic complete denture wearer group (15.71 ± 5.39). However, it was not statistically significant ($P = 0.269$).

Diabetic complete denture wearer group took less mean time for the identification of all shapes with denture (100.73 ± 42.99 sec) than the nondiabetic denture wearer group (109.00 ± 43.12 sec), which was not statistically significant ($P = 0.424$). Without dentures also, there was no significant difference between these groups ($P = 0.583$).

DISCUSSION

In this study, diabetic complete denture wearers showed lower OSA score than nondiabetic complete denture wearer. This finding substantiated the fact that the diabetic subjects possess altered sensation due to diabetic neuropathy and microcirculatory disturbances which may be predisposed to clinical challenges such as denture adaptation problems. This would also emphasize on the amount of care required for the fabrication of dentures to the diabetic complete denture wearers. It was also found that the diabetic complete denture wearers showed statistically significant difference in OSA score while not wearing dentures ($P = 0.020$*) [Table 1]. Even though the diabetic denture wearers obtained lower OSA scores than nondiabetic denture wearers with dentures, it was not statically significant. This was due to wide variation in the denture wearing period of the sample group studied and smaller sample size.

However, Shinkai *et al*.[5] found that the diabetic subjects showed slightly superior intraoral sensitivity

compared with nondiabetic adults at the posterior tongue and soft palate sites, which was not significant statistically.

In this study, the overall OSA score of both diabetic and nondiabetic complete denture wearers' groups without dentures was lesser than with denture [Table 1]. For edentulous subjects, the oral sensorimotor function may be influenced by the quality of dentures and denture-wearing period because they lose their teeth and the sensory endings within the periodontal tissues that play a fundamental role to recognize foods. In this study, denture wearing improved the OSA score like Ikebe *et al*.[9] However, Mantecchini *et al*.[3] reported that more score was obtained by the subjects without dentures. Oral discrimination depends primarily on the anterior lingual area. Covering the palate with denture may exclude the palatal mucosa from sensorial mechanism. So by practice, complete denture wearers may use this as rigid support against which the tongue can manipulate the object to be identified.

In this study, nondiabetic complete denture wearers needed more time than diabetic complete denture wearers to identify test pieces [Table 2]. This might be a factor ascribed to personal character as well as oral sensorimotor ability to determine the response time. Without dentures, both groups needed more identification time than with dentures (104.1 ± 53.4, 111.1 ± 52.7, and 100.72 ± 42.9, 109.00 ± 43.12) like previous studies done by Ikebe *et al*.,[9] van Aken,[10] Mantecchini,[3] and Garret *et al*.[6] This is thought to be the result of a sudden change in the oral environment.

As reported previously by van Aken[10] and Mantecchini,[3] large test pieces showed higher OSA score than small pieces [Table 3] while wearing dentures in both diabetic and non diabetic groups. However in subjects without dentures the OSA scores were similar with large and small test pieces in both diabetic and non diabetic groups. Both diabetic and nondiabetic complete denture wearers needed more identification time for larger shapes than small shapes [Table 4]. Hirano *et al*.[7] also found the same results except for triangles.

In this study, test pieces of different sizes measuring 12 mm × 12 mm × 3 mm and 8 mm × 8 mm × 2 mm, with different shapes such as square, rectangle, circle, semicircle, ellipse, and triangle were used. The selected shapes in this study provided sufficient difficulty, which was evident from a wide range of discrimination among complete denture-wearing groups. Only one nondiabetic subject could identify all test pieces correctly. None of the diabetic complete denture wearer correctly identified all shapes. Highest score of diabetic complete denture wearer with and without denture was twenty two. This would suggest that the test was valid.

We recorded the health status of all diabetic and nondiabetic complete denture wearers. While ten of them in diabetic complete denture wearers group and five of them in nondiabetic complete denture wearers had hypertension and take a daily medication. In nondiabetic complete denture wearers, two asthmatic patients and one cardiac patient in diabetic complete denture wearers were found. However, there was statistically no significant difference in OSA score or response time was found relative to chronic general diseases in this study population like Shinkai *et al*.[5]

From the results of this stereognosis tests with and without complete dentures, we found that correct

Table 1: Oral stereognostic ability score for both two groups with and without denture

Study subjects	Mean±SD		*t*	*P*
	Diabetic	Nondiabetic		
With denture	13.886±4.042	15.171±5.387	0.137	0.269
Without denture	12.429±3.935	14.829±4.442	2.392	0.020*

SD: Standard deviation *P<0.05 was considered as statistically significant

Table 2: Identification time (s) for both two groups with and without denture

Study subjects	Mean±SD		*t*	*P*
	Diabetic	Nondiabetic		
With denture	100.726±42.999	109.000±43.123	0.804	0.424
Without denture	104.097±53.373	111.086±52.687	0.551	0.583

SD: Standard deviation

Table 3: Oral stereognostic ability score for large and small samples

Shape	With denture (mean±SD)		*t*	*P*	Without denture (mean±SD)		*t*	*P*
	Diabetic	Nondiabetic			Diabetic	Nondiabetic		
Large samples	7.600±2.511	7.771±3.182	0.26	0.803	6.229±2.289	7.571±2.783	2.27	0.029*
Small sample	6.286±2.296	7.400±2.820	1.622	0.109	6.200±2.194	7.257±2.313	1.960	0.054

SD: Standard deviation *P<0.05 was considered as statistically significant

Table 4: Identification time (s) for both large and small shapes

Shape	With denture (mean±SD)		*t*	*P*	Without denture (mean±SD)		*t*	*P*
	Diabetic	Nondiabetic			Diabetic	Nondiabetic		
Large samples	51.451±19.746	55.271±23.575	0.735	0.465	49.78±23.195	54.52±27.36	0.782	0.431
Small sample	49.957±26.625	52.97±23.244	0.506	0.615	53.651±32.715	56.563±28.267	0.398	0.692

SD: Standard deviation

rehabilitation is a determinant in improving the OSA in edentulous patients. Litvak *et al*.,[11] Garrett *et al*.,[6] and Ikebe *et al*.[9] found an enhancement of stereognostic ability in denture wearers with their dentures in place. Grossmann[12] reported that oral discrimination depends primarily on the anterior lingual surfaces, whereas the mucosa covering the hard palate acts mainly as a rigid support against which the tongue can manipulate the object to be identified. However, Mantecchini[3] found increased OSA score in patients without denture.

Limitation of the study

We used a relatively small number of convenient individuals who were healthy and able to visit a clinic by themselves. Consequently, the results reported here may be specific to this study sample and should not be generalized until these associations have been confirmed in other studies of a similar population.

Similarly, studies are needed to investigate the process that reduced sensory function in diabetic complete denture wearers in a large population.

CONCLUSION

Within limitations of this study, diabetic complete denture wearers showed decreased OSA than nondiabetic subjects, particularly it was statistically significant while not wearing dentures. With this source of information, the dentist may educate the patient about the prognosis of the prosthesis, and we can mentally prepare the patient about its limitations.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or nonfinancial in this article.

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