Assessment of Salivary Flow and Anxiety in Patients Rehabilitated with Implant-Supported Prostheses

Abstract

Background: The aim of this study was to verify, through self-assessment questionnaires, the influence of implant-supported prosthesis in salivary flow and anxiety of patients rehabilitated with them. **Materials and Methods:** Visual analog scale (VAS) questionnaire about xerostomia and State-Trait Anxiety Inventory were applied before (T1) and after 2 days (T2) and 3 weeks (T3) of prostheses installation. The study included patients rehabilitated with implant-supported prostheses containing three or more dental elements. A total of 17 patients were evaluated. **Results:** In VAS questionnaire, there was a significant increase in the difficulty of speaking and swallowing with dry mouth. The other VAS questions showed no statistically significant difference, indicating no changes in patients' salivary flow. **Conclusions:** It was concluded that the installation of implant-supported prostheses does not lead to major changes in patients' perception about their salivary flow and psychological state, causing no improvement or worsening in the characteristics evaluated.

Keywords: *Anxiety, dental implants, prostheses and implants, saliva, surveys and questionnaires, visual analog scale*

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Introduction

Saliva is an essential substance for maintaining oral health, with multiple functions in oral and pharyngeal environment.[1] In patients with removable complete dentures, it is believed that there is an increase in flow rate due to the presence of mechanoreceptors in the support mucosa, with the pressure exerted by prosthesis basis producing a reflex which stimulates saliva production.[2,3] Moreover, the prosthesis installation can enhance occlusal force, making it possible for patients to chew hard food and in greater quantity, encouraging the increase in salivary flow.[3] In these patients, especially in removable complete dentures wearers, lack of salivary lubrication can produce traumatic ulcerations on the mucosa[4] due to contact with the prosthesis.[5,6] These factors can lead to failure in prosthetic treatment and to extreme discomfort for the prosthesis wearers.[7]

Evidence suggests that the psychological aspect can be a major factor in reducing salivary flow and subjective dry mouth.[8,9] In addition to anxiety issue related to personal problems, some individuals have difficult in adapting to the dentures even after years of use, leading to stress and anxiety manifestations. Some patients do not complain but are not completely satisfied and frequently does not consult a dentist. There are also patients who cannot tolerate the prosthesis even if they have been properly installed, and others, thanks to a high psychogenic tolerance threshold, spend their whole lives without complaining of a prosthesis that is not in excellent condition. The intolerance to prostheses may be often caused by disorders such as anxiety and depression.[10,11]

Much is known about the influence of conventional removable complete dentures in stimulating salivation and in patient expectations; however, these aspects are very little discussed when it comes to rehabilitation with implant-supported prosthesis. As the success of rehabilitation treatment depends on the integration of objective and subjective aspects, the aim of this study is to verify, through self-assessment questionnaires (visual analog scale [VAS] and State-Trait Anxiety Inventory),[1,12] the influence of implant-supported prosthesis installation

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in salivary flow and anxiety of rehabilitated patients. The null hypothesis is that the presence of implant-supported prosthesis will increase salivary flow and reduce the anxiety on the patients.

Materials and Methods

This study was independently reviewed and approved by the Research Ethics Committee in human beings, certificate presentation number 20200313.3.0000.5420. Patients were informed about the study and signed a written informed consent form to participate.

Two questionnaires about salivation and anxiety were applied to the patients treated at Araçatuba Dental School, São Paulo State University at implant-supported prosthesis clinic, during the years 2012–2013.

The inclusion criteria for patients in this study were patients who would be rehabilitated with implant-supported prostheses of three or more dental elements; physical and psychological statuses that allow the patient to answer questionnaires without assistance. Patients who had >3 dental elements to be rehabilitated with implant-supported prosthesis and/or could not answer the questionnaires on their own were not included in the study.

Xerostomia visual analog scale questionnaire

The subjective salivary flow assessments were verified by the VAS questionnaire, consisting of eight questions relating to xerostomia, which were answered by the patient. The xerostomia VAS questionnaire[1] subjectively evaluates two main aspects of salivary flow such as dryness of oral mucosa (Questions 4 to 7) (lips, mouth, tongue, or throat) and oral functions affected by the sensation of dry mouth (Questions 1 and 2) (difficulty in swallowing and speaking). Furthermore, two global items regarding mouth dryness are analyzed salivary quantity and thirsty level (Questions 3 and 8). Patients were instructed to answer each item, marking a vertical line on a horizontal scale of 100 mm. The lines were measured at the marking held by the patients and values were recorded.

State-Trait Anxiety Inventory

The anxiety level of the patients was assessed using the State-Trait Anxiety Inventory (STAI) questionnaire.[12] This self-evaluation questionnaire consists of two parts, namely (1) Trait anxiety (STAI-T), which evaluates the patient's personality, referring to relatively stable individual differences in propensity to anxiety and (2) state anxiety (STAI-S), which evaluates the current behavior of the patient, being considered transient in nature and characterized by feelings of tension, apprehension, and nervousness. Each scale (Trace/State) consists of 20 items (1 ± 20, 21 ± 40), each with a rating of 1 ± 4, and a system of points ranging from 20 (no anxiety) to 80 (extreme anxiety).[8,10] The total score is characterized by low (20–30), mean (31–49), and high level of anxiety (50 or more).

The application of both questionnaires was carried out in three periods: T1 – before prostheses installation, T2 – 2 days postinstallation, and T3 – 3 weeks postinstallation.[2]

Personal data (age and gender) and prostheses information (previous use of prosthesis type of prosthesis used, type of prosthesis to be installed, and number of implants) were also collected and descriptively evaluated. For data obtained from questionnaires, one-way ANOVA analysis of variance was performed to identify statistically significant differences between the periods. Tukey test was conducted as *post hoc*. Data were evaluated at a 5% significance level.

Results

A total of 17 patients (13 female and 4 male) were evaluated, aging between 27 and 71 years old (mean age = 55.24). Eight patients have not used any type of prosthesis before treatment and nine patients had been using conventional removable prostheses and were replacing them with fixed implant-supported prostheses [Table 1]. The types of prostheses used and the implant-supported prostheses installed are described in Table 1. Patients presented 55 maxillary implants and 47 mandibular implants installed.

Regarding the values found in xerostomia VAS questionnaire, there was statistically significant difference for questions 1 (T1 and T2 compared to T3) and 2 (T1 compared to T2 and T3), with an increased score, which means that patients exhibited a greater difficulty at speaking and swallowing with dry mouth after prostheses installation. For the remaining questions (3–8), there was no statistically significant difference between the periods; however, numerically, these issues showed an increase in scores 3 weeks after prostheses installation, indicating an increase in the perception of saliva amount and at the same time, an increase in the sensation of dry mouth, throat, lips and tongue, and thirst [Table 2].

The scores of state and trait anxiety of the 17 patients were also evaluated in three periods (T1, T2, and T3) as shown in Table 3. The scores were submitted to ANOVA and there was no statistically significant difference between the periods for both state and trait ($P = 0.960$ and $P = 0.901$), indicating that the scores of state and trait anxiety did not change during this study. However, numerically, there was an increase in the level of state anxiety between baseline (T1) and 3 weeks after prostheses installation (T3) and a decrease in average levels of trait anxiety, when comparing the periods.

Discussion

Over the periods evaluated, no statistically significant differences were observed in questions 3 to 8 of xerostomia VAS questionnaire, indicating no change in patient's salivation sense after prosthesis installation [Table 2].

Table 1: Previous use of prostheses, type of prostheses used, and type of implant-supported prostheses to be installed

Previous use of prostheses (no/yes)	Type of prostheses used	Implant-supported prostheses installed (maxillary/mandibular)
No	None	Complete maxillary denture/mandibular overdenture
No	None	Fixed partial prosthesis
No	None	Maxillary complete denture
No	None	Fixed partial prosthesis
No	None	Mandibular overdenture
No	None	Single crown/fixed partial prosthesis
No	None	Fixed partial prosthesis/single crown
No	None	Fixed partial prosthesis
Yes	Bimaxillary complete denture	Mandibular overdenture
Yes	Maxillary complete denture	Mandibular complete denture
Yes	Maxillary complete denture	Mandibular overdenture
Yes	Bimaxillary complete denture	Mandibular overdenture
Yes	Maxillary complete denture	Maxillary complete denture
Yes	Mandibular overdenture	Maxillary complete denture
Yes	Maxillary complete denture	Complete maxillary denture/mandibular overdenture
Yes	Maxillary partial removable prosthesis	Mandibular complete denture
Yes	Maxillary complete denture	Complete maxillary denture/mandibular overdenture

Table 2: Mean values of xerostomia visual analog scales questionnaire and *P* value obtained through one-way ANOVA analysis of variance for the three evaluation periods

VAS question	T1	T2	T3	*P*
1. Rate the difficulty you experience in speaking due to dryness	1.21	2.35	3.88*	0.038
2. Rate the difficulty you experience in swallowing due to dryness	0.91*	3.29	3.38	0.014
3. Rate how much saliva is in your mouth	6.65	6.35	7.62	0.417
4. Rate the dryness of your mouth	2.29	2.24	2.79	0.778
5. Rate the dryness of your throat	2.47	2.97	3.00	0.850
6. Rate the dryness of your lips	3.15	4.44	4.76	0.352
7. Rate the dryness of your tongue	2.06	2.76	3.00	0.647
8. Rate the level of your thirst	4.76	5.03	5.29	0.883

P<0.05 indicates statistically significant difference. *Indicates the value that differs from the others in the same line through Tuckey test. T1: Before prostheses installation; T2: 2 days postinstallation; T3: 3 weeks postinstallation; VAS: Visual analog scales

The absence of an improvement feeling in salivation can be attributed to the fact that nine patients evaluated had been the wearers of conventional prostheses before undergoing the rehabilitation treatment with implant-supported prostheses [Table 1]. These data are similar to the study of Márton *et al*. in 2004,[13] which evaluated the salivation of patients with conventional dentures before and 1 week after the installation of new prostheses and concluded that the new prostheses did not influence the salivary flow since patients had already been denture wearers for >5 years. Peltola *et al*. in 1997[14] also found no influence of new prostheses in patients salivary flow. Therefore, when new prostheses are installed in patients with old dentures, only minor changes can be expected in salivary flow.[2]

A well-known phenomenon that accompanies the insertion of conventional complete dentures is the increase in salivary flow.[2,15] Studies such as Yurdukoru *et al*.[16] found an increase of 1.5 to 2 times in salivary flow immediately after new prostheses installation. According to Wolff *et al*. 2004,[2] increased salivation may occur due to chronic stimulation of mechanoreceptors located below the denture base, which can increase the salivary reflex due to the pressure caused by the base.[17] However, in our study, with the exception of overdentures, which are supported by the implants and mucosa, the prostheses evaluated were exclusively implant-supported, not exerting significant pressure on the tissue, and therefore, not causing a salivation increase [Table 1].

Although not statistically significant, patients reported an increased amount of saliva in their mouth over the evaluation periods (Question 3) [Table 2]. According to Yurdukoru *et al*.,[16] the prostheses are perceived by the

Table 3: State and trait anxiety scores at different time points

	Mean±SD			
	State anxiety		Trait anxiety	
Time points				
T1 (before prosthesis installation)	36.41	10.441	36.29	9.419
T2 (2 days postinstallation)	36.00	10.204	35.24	9.922
T3 (3 weeks postinstallation)	37.06	12.070	34.82	9.690

SD: Standard deviation

organism as a foreign body and, thereby, more saliva is required and subsequently secreted to provide better lubrication and defense, which would explain the feeling of increased amount of saliva reported by the patients of this study.

The anxiety level of patients was measured using the STAI developed by Spielberger and Luchene in 1970.[12] The state anxiety is a transient emotional state consisting of tension and apprehension feelings consciously perceived and hyperactivity of the autonomic nervous system. The state-anxiety scores fluctuate over time and vary in intensity according to the perceived danger. On the other hand, the trait anxiety has relatively stable individual differences in the tendency to react to situations perceived as threatening. Thus, trait-anxiety scores are less sensitive to changes arising from environmental conditions, remaining relatively constant over time.[18]

In this study, patients were classified with medium anxiety level in all periods. There was no statistically significant difference in levels of trait anxiety as well as in state anxiety [Table 3], which was expected since the trait anxiety is a personality component and may reflect the momentary emotional state of the patient. In the study of Hashem *et al.* in 2006,[18] which evaluated through the STAI, the anxiety of 18 patients before and after 3 and 6 days of implant placement surgery, there were no statistically significant differences in trait anxiety over the evaluation period; however, the state anxiety presented elevation peaks soon after surgery. In our study, the absence of peaks in state anxiety can be derived from the noninvasive nature of prosthetic procedures, unlike the surgical specialty, which tends to cause physical and psychological effects, leading to greater stress experiences on the individual.[19]

Although no statistically significant differences were observed in anxiety levels, there was a slight increase in state anxiety between the initial period (before installation) and 3 weeks after prosthesis installation [Table 3]. This result is similar to Branchi *et al.* 2001,[10] who examined 20 patients before and 1 month after the installation of single crowns or a bridge prosthesis consisting of no more than three parts and reported increased anxiety levels 1 month after prostheses installation. This small increase in anxiety state level can be derived from personal problems

experienced by patients at the time of interview since the state anxiety refers to transient emotions based on what the patient is going through at that moment or even from factors related to the installed prosthesis.[12] Some individuals have difficulty in adapting to the prostheses even after 2 years of use and 5% of patients cannot tolerate the prosthesis. There are also patients who do not tolerate the prosthesis even if they have been properly installed.[10]

The mental stress in healthy people can induce phenomena such as dry mouth, tongue adherence to the palate, and swallowing difficulties.[20,21] In our study, contrary to the feeling of increased amount of saliva (Question 3) [Table 2], the sensation of oral dryness and thirst increased numerically (Questions 3 to 8) [Table 2], the difficulty in speaking and swallowing with dry mouth increased significantly (Questions 1 and 2) [Table 2] over the periods, and as already mentioned, the state anxiety also showed numerical increase in scores [Table 3]. Naumova *et al.* 2012[22] evaluated the relationship between stress and the level of salivary secretion and found no relationship between them, that is, the stress did not reduce salivary flow. However, when evaluating the proteins present in saliva, they observed an increase in their concentration after exposure to stress, leading to the conclusion that the main cause for the sensation of dry mouth in stressful situations is not the decreased salivary flow, but changes in saliva composition which could justify the feeling of increased amount of saliva opposed to the general sense of oral dryness in our study.

There is another fact that could justify this slight increase in the sensation of oral dryness observed in this study. Four patients have replaced conventional maxillary complete dentures for fixed implant-supported complete dentures. These prostheses have no extension to the palate, providing less contact with the mucosa, and not exerting pressure thereon. This factor may have increased the oral dryness sensation [Table 1].

There was no significant interaction between gender and anxiety during the periods evaluated. However, this data could be validated with a larger sample of patients since several studies have reported higher anxiety levels in female patients when compared to males.[18,19,23] This statement leads to claim that a limitation of this study was the small population of patients evaluated, although other studies related to salivary flow and anxiety in patients wearing prostheses were also conducted with a similar number of patients.[2,10,17,18]

In addition, the VAS questionnaire itself may present limitations. Although VAS is considered of simple understanding and fulfillment by patients and easy data tabulation by researchers, some of its limitations are as follows: the subjective evaluation of patients, the nonunderstanding of VAS scale, the lack of quantitative data, and figures cannot be measured or interpreted directly, which could account for the results obtained in this study.[24]

Conclusions

Considering the limitations of this study, it can be concluded that there was no significant interference of implant-supported prostheses in the general perception of the patients about their salivary flow as well as in state- and trait-anxiety levels recorded during the periods evaluated.

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Conflicts of interest

There are no conflicts of interest.

References

1. Pai S, Ghezzi EM, Ship JA. Development of a Visual Analogue Scale questionnaire for subjective assessment of salivary dysfunction. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2001;91:311-6.
2. Wolff A, Ofer S, Raviv M, Helft M, Cardash HS. The flow rate of whole and submandibular/sublingual gland saliva in patients receiving replacement complete dentures. J Oral Rehabil 2004;31:340-3.
3. Matsuda K, Ikebe K, Ogawa T, Kagawa R, Maeda Y. Increase of salivary flow rate along with improved occlusal force after the replacement of complete dentures. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;108:211-5.
4. Turner M, Jahangiri L, Ship JA. Hyposalivation, xerostomia and the complete denture: A systematic review. J Am Dent Assoc 2008;139:146-50.
5. Yontchev E, Carlsson GE. Long-term follow-up of patients with orofacial discomfort complaints. J Oral Rehabil 1992;19:13-9.
6. Eisbruch A, Kim HM, Terrell JE, Marsh LH, Dawson LA, Ship JA, *et al.* Xerostomia and its predictors following parotid-sparing irradiation of head-and-neck cancer. Int J Radiat Oncol Biol Phys 2001;50:695-704.
7. Dabas N, Phukela SS, Yadav H. The split denture: Managing xerostomia in denture patients: A case report. J Indian Prosthodont Soc 2011;11:67-70.
8. Bergdahl M, Bergdahl J. Low unstimulated salivary flow and subjective oral dryness: Association with medication, anxiety, depression, and stress. J Dent Res 2000;79:1652-8.
9. Davies BM, Gurland JB. Salivary secretion in depressive illness. J Psychosom Res 1961;5:269-71.
10. Branchi R, Boddi V, Corti D, Hardoy MJ. Can a prosthesis cause psychological disturbances? J Oral Rehabil 2001;28:1133-8.
11. Johnke G. Psychogenic denture intolerance. Psychogenically induced denture intolerance – The causes and diagnostic possibilities. Schweiz Monatsschr Zahnmed 1991;101:1438-47.
12. Spielberger C, Luchene R. STAI Manual for State-Trait Anxiety. Palo Alto, CA: Consulting Psychologist Press; 1970.
13. Márton K, Boros I, Fejérdy P, Madléna M. Evaluation of unstimulated flow rates of whole and palatal saliva in healthy patients wearing complete dentures and in patients with sjogren's syndrome. J Prosthet Dent 2004;91:577-81.
14. Peltola MK, Raustia AM, Salonen MA. Effect of complete denture renewal on oral health – A survey of 42 patients. J Oral Rehabil 1997;24:419-25.
15. Jensen JC, Brodin P, Orstavik J. Parotid salivary flow rates in two patients during immediate denture treatment. J Oral Rehabil 1991;18:155-62.
16. Yurdukoru B, Terzioğlu H, Yilmaz T. Assessment of whole saliva flow rate in denture wearing patients. J Oral Rehabil 2001;28:109-12.
17. Streckfus CF, Brown LJ, Ship JA, Brunelle J. Stimulated parotid gland flow rates in healthy, elderly dentulous and edentulous individuals. J Prosthet Dent 1993;70:496-9.
18. Hashem AA, Claffey NM, O'Connell B. Pain and anxiety following the placement of dental implants. Int J Oral Maxillofac Implants 2006;21:943-50.
19. Eli I, Schwartz-Arad D, Baht R, Ben-Tuvim H. Effect of anxiety on the experience of pain in implant insertion. Clin Oral Implants Res 2003;14:115-8.
20. Shigeyama C, Ansai T, Awano S, Soh I, Yoshida A, Hamasaki T, *et al.* Salivary levels of cortisol and chromogranin A in patients with dry mouth compared with age-matched controls. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;106:833-9.
21. Siedek V, Zengel P, Berghaus A. Therapy and prognosis of xerostomia. MMW Fortschr Med 2008;150:31-3.
22. Naumova EA, Sandulescu T, Al Khatib P, Thie M, Lee WK, Zimmer S, *et al.* Acute short-term mental stress does not influence salivary flow rate dynamics. PLoS One 2012;7:e51323.
23. Smyth JS. Some problems of dental treatment. Part 1. Patient anxiety: Some correlates and sex differences. Aust Dent J 1993;38:354-9.
24. Gould D, Kelly D, Goldstone L, Gammon J. Examining the validity of pressure ulcer risk assessment scales: Developing and using illustrated patient simulations to collect the data. J Clin Nurs 2001;10:697-706.