

Relationship among local and functional factors in the development of denture stomatitis in denture wearers in northern Brazil

*Relação entre fatores locais e funcionais no desenvolvimento de estomatite protética
em usuários de dentadura no norte do Brasil*

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Resumo

Objetivo: O objetivo deste estudo foi avaliar a relação entre fatores funcionais e qualitativos no desenvolvimento da estomatite protética (EP) (de acordo com a classificação de Newton) em usuários de dentadura acrílica residentes no norte do Brasil. **Material e método:** Um total de 99 pacientes, que usavam dentadura superior de resina acrílica parcial ou total, foi incluído neste estudo. Os participantes preencheram um formulário de dados epidemiológicos, que incluiu gênero, idade, fatores locais (hábitos de higiene, retirar a dentadura ao dormir, uso de colutório, condição atual da dentadura, idade da dentadura) e fatores funcionais (dimensão vertical de repouso, dimensão vertical de oclusão, oclusão, retenção, estabilidade estática e dinâmica). Para detectar leveduras, amostras foram coletadas da superfície interna da dentadura e da mucosa palatal em contato com esta. Posteriormente, as amostras foram cultivadas em ágar Sabouraud dextrose, observando-se características macro e microscópicas. **Resultado:** No presente estudo, não foi encontrada relação significante entre gênero e início da doença. Baseada na classificação de Newton, 36,3% dos pacientes apresentaram EP e 89,0% foram colonizados por leveduras; destes indivíduos, 50% tiveram lesões tipo I, 33,3% tiveram lesões tipo II e 16,6% tiveram lesões tipo III. Todos os fatores locais e qualitativos, exceto o uso de colutório, foram clinicamente relevantes para o desenvolvimento da doença. **Conclusão:** Estomatite protética em usuários de dentadura do norte do Brasil foi multifatorial, associando fatores locais, funcionais e microbiológicos.

Descritores: Dentaduras; estomatite; higiene bucal; *Candida*.

Abstract

Objective: The aim of this study was to evaluate the relationship among functional and qualitative factors in the development of denture stomatitis (DS) (according to Newton's classification) in acrylic-based denture wearers residents from northern Brazil. **Material and method:** A total of 99 patients who wore partial or total acrylic resin-based upper dentures were included in this study. The subjects completed an epidemiological data form that includes the patient's gender, age, local factors (hygiene habits, remove denture to sleep, use of mouthwash, present condition of the denture, age of the denture) and functional factors (vertical dimension at rest, vertical dimension of occlusion, occlusion, retention, and static and dynamic stability). To detect yeasts, samples were collected from the inner surface of the dentures and from the palatal mucosa in contact with it. Subsequently, the samples were cultured on Sabouraud dextrose agar, observing macro and microscopic characteristics. **Result:** In the present study, we did not find any significant relationship between the gender and disease onset. Based on the Newton classification, 36.3% of the patients presented with DS and 89.0% were colonized by yeasts; of these subjects, 50% had type I lesions, 33.3% had type II lesions, and 16.6% had type III lesions. All of the qualitative and local factors, except the use of mouthwash, were clinically relevant to the development of disease. **Conclusion:** Denture stomatitis in denture users in northern Brazil was multifactorial, involving local, functional and microbiological factors.

Descriptors: Dentures; stomatitis; oral hygiene; *Candida*.

INTRODUCTION

The rehabilitation of totally or partially edentulous patients requires them to carefully adhere to prescribed clinical and laboratory regimens so that the dentures can integrate more harmoniously, thereby restoring the stomatognathic system function and aesthetics and preserving the oral mucosa and underlying bone structures¹. Iatrogenic factors, such as trauma caused by ill-fitting dentures, poor hygiene, and inadequate occlusal dimensions, facilitate the onset of pathological processes in the oral cavity, the most common of which is denture stomatitis (DS)^{2,3}. Other factors also contribute to the onset of disease, such as a change in the resin polymerization (although the criteria for the liquid-to-powder proportions recommended by the manufacturer and polymerization cycles are followed); these areas are sites of disease onset because of the pores that remain within the resin due to compression and roughness of the surface, which favors the adherence and colonization of microorganisms^{4,5}. Dağistan et al.⁶ described DS as an inflammatory process that primarily involves the palatal mucosa (PM) when it is fully or partially covered by dentures, affecting 60-100% of acrylic denture users. Barbeau et al.⁷ noted that the etiology of DS is multifactorial and includes advanced age, decline in the defense mechanisms of the immune system, systemic diseases, smoking, the use of dentures while sleeping, poor oral hygiene resulting in the accumulation of plaque on the denture, poorly fitting dentures, and functional factors related to the occlusion. Pattanaik et al.¹ reported that DS may be triggered by an allergy to residual resin monomers and is always associated with yeast from the genus *Candida*, particularly *Candida albicans*, which is a dimorphic fungus that has two major forms: a yeast form (commensal) and a hyphal form (pathogenic). *C. albicans* is frequently found in patients who wear full or partial dentures, immunocompromised patients, patients who have undergone antibiotic therapy, and patients who take medications that induce xerostomia⁸.

Pattanaik et al.¹ reported that because the etiology of DS is multifactorial, the treatment is complex and must include the use of effective antifungals, denture removal while sleeping, and efficient control of biofilm. Patients with DS typically present the clinical signs described by Newton⁹, which may include unusual symptoms such as pain, halitosis, or an itching and burning sensation. These symptoms are often associated with *C. albicans* spp. that express high levels of exoenzymes, which predominantly include proteinases that facilitate adhesion modulated by host factors such as saliva, pH, and other microorganisms in the oral environment¹⁰. In the present study we evaluated functional factors (such as vertical dimension at rest (VDR), vertical dimension of occlusion (VDO), occlusion, retention, and static and dynamic stability) and microbiological in the thermopolymerized acrylic resin-based denture wearers for possible correlations between these variables and the onset of DS.

MATERIAL AND METHOD

Patients

The present study included 99 patients who wore partial (class I of Kennedy¹¹ up to four tooth) or total upper acrylic resin-based dentures and were examined at the School of Dentistry, Federal University of Para in 2012. This investigation was approved by the Research Ethics Committee at the Evandro Chagas Institute (CEP/IEC 032/10). All of the study participants signed an informed consent form. The subjects also filled out a form that included epidemiological data such as gender, age, local factors (i.e., hygienic habits, use at night, use of mouthwash, present denture condition, denture age), and functional factors (i.e., VDR, VDO, occlusion, retention, and static and dynamic stability). The hygiene evaluation was based on the presence of biofilm, for which the patient's hygiene was considered unsatisfactory when there was biofilm on the denture surface. The present condition of the dentures was considered unsatisfactory when there were fractures, loss of structures and/or teeth, or the presence of stains or wear. The VDR evaluation was performed using a Willis gauge (Jon Ltd., São Paulo, Brazil) (with the patient at rest), of which the horizontal shafts were used to measure the distance from the base of the nose to the lower base of the chin, with its vertical shaft leaning against the chin of the patient. With the gauge still in position, the patients were asked to occlude, and the measurement thus obtained corresponded to the VDO. For occlusion and the open- and closed-mandibular movements, the laterality and protrusion were evaluated and was deemed satisfactory in patients who had denture stability during these movements (i.e., bilateral balanced occlusion). The retention and dynamic stability were considered satisfactory when there were no complaints of denture displacement during the normal function of the stomatognathic system (e.g., speech, swallowing, articulatory phonetics, or facial expressions). For retention and static stability, gentle vertical and horizontal tension was applied to the incisors in the premolar region, and slight pressure was applied using fingers placed against the soft tissue at the Denture Base (DB). The absence of movement and/or dislocation of the dentures were considered satisfactory for this examination.

To diagnose DS, the following criteria proposed by Newton⁹ were considered: type I, slight color change of the Palatal Mucosa (PM) to a punctate hyperemia; type II, diffuse hyperemia; and type III, granular hyperemia.

The exclusion criteria eliminated people with diabetes or autoimmune diseases and those who used corticosteroids.

Mycological Examination

To determine whether yeasts were present, sterile swabs (Jiangsu Suyun Medical Materials Co, Ltd, China) were used to collect samples from the PM and the inner surface of the DB. The samples were cultured on Sabouraud dextrose agar (SDA) (Difco, Laboratories, Detroit, MI), which was incubated at 35 °C and observed daily for 7 days. After, colonies that exhibited the suggestive characteristics of yeast growth, the Gram stain was

performed on a smear of the colony to ensure that there was no bacterial contamination and to confirm the yeast isolation. Identification at genus level was performed according to Sidrim, Rocha¹².

Statistical Analysis

The Bioestat version 5.3 software (Maumirauá Institute, Belém, Brazil) was used. Descriptive statistical inference of the results presented in this work were performed using nonparametric and chi-square tests, with a significance level of $p \leq 0.05$.

RESULT

Of the 99 patients enrolled (all between 29 and 83 years of age), 64 (64.6%) were female and 35 (35.4%) were male. Eighty-seven (87.8%) participants wore total dentures, and 12 (12.1%) wore partial free-end dentures. The average age of dentures was 5.3 years. We found no evidence that gender was associated with disease ($p = 0.4613$). Yeasts were isolate both from DB (58/99; 58.6%) as PM (39/99; 39.4%). Thirty-six (36.3%) patients showed signs of DS, 32 (32/36; 89.0%) of whom were colonized by yeasts, and for four of them (11.0%), yeasts were not isolated. Of the patients with DS, 18 (18/36; 50%) had type I lesions, 12 (12/36; 33.3%) had type II lesions, and six (6/36; 16.6%) had type III lesions. Upon analysis of the DS patients who were colonized, we observed that both the DB and the PM of 24 (66.6%) of these subjects were colonized. The factors related to the occlusion and denture stability were significantly related to the development of DS (Table 1). The results revealed that all the local factors analyzed in this study influenced the development of DS, except for the use of mouthwash ($p = 0.1719$). After analyzing the qualitative and functional factors of the dentures, we observed that it was not possible to correlate the disease with a single factor, as presented in Table 1. The statistical tests indicated that the age of the prosthesis was directly proportional to the onset of DS ($p=0.0055$) (Table 2).

DISCUSSION

In our study, there was no association between gender and DS, which is inconsistent with the findings of da Silva et al.¹³ and Arnaud et al.¹⁴, who reported a significant association in females. We observed that the prevalence of DS was 36/99 (36.4%), which is similar to the results reported by Arnaud et al.¹⁴, who examined 174 patients wearing acrylic-based dentures, 35% of whom had DS. However, our results are inconsistent with the findings reported by Dağistan et al.⁶, who examined 70 patients and found that 70% had DS.

The factors that contribute to DS are variable and have been associated with both local and systemic components¹⁵. Because of their chemical and physical properties, the use of poly(methyl methacrylate) dentures facilitates the colonization of various microorganisms including *Candida* spp., which are normal fungal commensals, and members of the normal oral cavity microbiota, which can become pathogenic when local and systemic changes

promote their proliferation¹⁶. Immunocompromised patients undergo changes in their oral environment that affect their immune response, resulting in the inability of these oral tissues to support the use of dentures³. Jeganathan, Lin¹⁷ and Budtz-Jørgensen¹⁸ reported that the interaction between *Candida* and oral bacteria promote the onset of the disease when combined with local factors such as temperature, pH, adhesive capacity of these microorganisms, and systemic components.

The present study evaluated several local, qualitative factors such as oral and denture hygiene, the use of mouthwash, nighttime denture use, age of the dentures and functional factors such as VDO, VDR, occlusion, retention, and static and dynamic stability. We noted that these factors alone could not lead to disease onset, but when combined with yeast presence, they promoted disease onset, which is consistent with the findings reported by Naik, Pai¹⁶.

Cruz et al.¹⁹ conducted a clinical trial comparing the efficacy of chemical and chemomechanical methods to clean dentures

Table 1. Qualitative local and functional values associated with denture stomatitis

| Factors | Stomatitis | | Chi-square test |
|----------------------|------------|----------|-----------------|
| | No = 60 | Yes = 39 | |
| Hygiene | Sat* | 2 | p < 0.0001 |
| | Unsat** | 37 | |
| Remove to sleep | Yes | 35 | p < 0.0001 |
| | No | 4 | |
| Use of mouthwash | Yes | 9 | p = 0.1719 |
| | No | 30 | |
| Conservation | Sat | 5 | p < 0.0001 |
| | Unsat | 34 | |
| VDO | Sat | 16 | p = 0.0047 |
| | Unsat | 23 | |
| Occlusion | Sat | 13 | p = 0.0040 |
| | Unsat | 26 | |
| Ret and dynamic Stab | Sat | 10 | p < 0.0001 |
| | Unsat | 29 | |

* Sat = satisfactory; ** Unsat = unsatisfactory.

Table 2. Relationship between denture age and denture stomatitis

| Age | Stomatitis | | | Chi-square test |
|---------------------|------------|----|-------|-----------------|
| | Yes | No | Total | |
| 0 - 48 months | 17 | 42 | 59 | p = 0.0055 |
| 49 - 96 months | 7 | 11 | 18 | |
| More than 96 months | 15 | 7 | 22 | |
| Total | 39 | 60 | 99 | |

in denture wearers. The researchers reported that chemical methods alone do not reduce the amount of bacterial biofilm on dentures and that the chemomechanical method is more effective at removing biofilm. Their data reinforce our findings that mouthwash use did not prevent colonization by yeasts, although in the present study was not conducted in vitro analysis of the action of mouthwash on *Candida* colonization of dentures. Identification of strains at genus level was performed according to Sidrim, Rocha¹². However, our data disagree with the findings reported by Orsi et al.²⁰ and Işeri et al.²¹, who evaluated the action of antiseptics on denture surfaces and concluded that these agents are effective in eliminating *Candida* from the resin surface. Salerno et al.¹⁵ stated that poor hygiene is one factor that promotes disease onset; they concluded that good hygiene alone alleviates the symptoms of DS and that the control of denture hygiene is essential for preventing relapse after antifungal treatments. Hygiene is therefore an important prophylactic measure against oral candidiasis manifestations, such as DS.

Ferreira et al.²² reported a highly significant association between the failure of a patient to remove his/her dentures before sleep and the development of disease. These data are consistent with our findings that wearing dentures while sleeping promotes disease onset (Table 1). Contrary to our results, da Silva et al.¹³ evaluated local factors in 102 patients and found that denture removal before sleep was not relevant to the onset of DS. Hadžić et al.²³ analyzed the denture age and colonization and noted that age was a facilitating factor for colonization because of wear, roughness, and plaque accumulation, which is consistent with our findings (Table 2). We found that the denture condition is as important as its age, which was also noted by Naik, Pai¹⁶. A study conducted by Garcia, Souza²⁴ evaluated the necessity of

replacing or relining dentures 4 years after installation. These authors noted that this procedure was not necessary in most cases after 1 year but was necessary after 3 years of use. Based on these findings, we grouped the age of the dentures into 4-year spans and found that the age of the dentures was directly proportional to the onset of DS.

A study conducted by Bomfim et al.²⁵ demonstrated that problems related to denture occlusion were significantly associated with the development of DS because of the increased likelihood of trauma that would cause tissue damage. These data are consistent with our findings that all of the functional factors promoted the onset of DS (Table 1). Overall, instructions regarding oral hygiene, denture maintenance, and regular visits to the dental surgeon are essential in maintaining the overall health of the oral cavity. Because dental surgeons can diagnose DS in their clinical practice and then either provide therapy or refer the individuals for treatment to resolve the causative factors, these patients are able to achieve increased comfort and a better quality of life.

CONCLUSION

Denture stomatitis in denture users in northern Brazil was multifactorial, involving local, functional and microbiological factors.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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