RELATIONSHIP BETWEEN DENTURE PLAQUE ACCUMULATION AND ABO BLOOD TYPES IN DENTURE WEARERS- AN INVIVO STUDY

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Abstract:

Several studies have shown an association between ABO blood types and susceptibility to certain infections. Other investigators, however, reported that blood type O, or non secretion of antigen might be a risk factor for increased candidal colonization. As, not much of the literature is available on such a relationship, this invivo study was carried out to determine the relationship between degree of denture plaque accumulation as one of the risk factor for increased candidal carriage and ABO blood types among denture wearers.

Aim: Was to determine the correlation between degree of denture plaque accumulation and ABO blood types in denture wearers.

Materials and method: Complete denture wearing patients (n=210) with age range of 50-65 years reporting to the department of Prosthodontics fulfilling the inclusion criteria were included. Before start of the prosthodontic treatment, demographic details as well as a questionnaire on the concerned diseases and denture hygiene were recorded. Denture hygiene was assessed by modified plaque index (Tarbet) and blood groups were determined by direct agglutination method.

Statistical analysis used: chi square, student t-test, one way ANOVA and tukey HSD.

Result: Significant differences were observed in the degree of denture plaque accumulation among various blood groups.

Conclusion: Blood group O shows higher degree of denture plaque accumulation (grade 3,4) as compared to other blood groups. Research should be pursued in various aspects of ageing and age related oral health problems, including epidemiological studies to measure the burden of oral diseases.

Keywords: Candidiasis, colony forming unit (CFU), Denture stomatitis.

Introduction

Candidiasis is a complex, multi factorial process[5,6,7,8] that occurs when the host defence system is compromised. Presence of dentures also serve as a predisposing factor for Candida associated denture stomatitis.[4] Both the plaque accumulation on the denture and poor denture hygiene contributes to the virulence of Candida offering its clinical picture.[4]

Nikawa et al (1991) demonstrated inter relationship between ABO blood types of denture wearers, denture plaque accumulation and degree of oral Candidal colonization.[9] In Indian context, data was lacking on such an association. So, study aimed at looking into such association.

Aim and objective

It has been reported that both the plaque accumulation on the denture and poor denture hygiene contributes to Candida associated denture stomatitis and an inter relationship exists between ABO blood types of denture wearers, denture plaque accumulation and degree of oral Candidal colonization. However, this relationship in clinical dentistry has not been extensively studied. So,

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aim of this study is to determine the relationship between degree of denture plaque accumulation and ABO blood types among denture wearers.

Materials and methods:

This in vivo study "To determine the correlation between degree of denture plaque accumulation and ABO blood types in denture wearers" was carried out in the Department of Prosthodontics of the institute. It included 210 patients for identification of denture hygiene and blood samples using standard protocol by using- Direct Heamagglutination test.

Materials used for collection of blood sample: Blood grouping and typing reagent (Eryscreen, India), Disposable gloves for Specimen handling, Sterile disposable syringe with needle (two ml, Dispovan, India), Glass slide (25x75 mm), Test tubes (8x50 mm), Disposable applicator sticks, Normal saline, Pasteur pipettes, Sodium or calcium hypochlorite solution (five %) to wipe and disinfect the spills, Disposable waste bag to collect and dispose used accessories and waste

Source of data collection: Complete denture patients (sample size of 210 subjects) reporting to the department of Prosthodontics of the institute.

Inclusion Criteria: Subjects who give their consent for the study. Completely edentulous, healthy individuals with no denture wearing history-comprises the control group (group A). Completely edentulous, healthy individuals, with atleast six months denture wearing history comprises the study group (group B)

Exclusion Criteria: Subjects with any antifungal therapy. Subjects with any systemic diseases (immunocompromised, diabetics) or those taking antibiotics for more than two weeks or hypoglycaemic or hypertensive drugs. An informed consent was obtained from these subjects before carrying out the study.

COLLECTION OF SAMPLE: All complete denture wearing patients reporting to the department of Prosthodontics fulfilling the inclusion criteria were included in the study. Before start of the Prosthodontic treatment, demographic details as well as a questionnaire on the concerned diseases and denture hygiene was recorded. Before starting the study, ethical clearance was obtained from the institute. For assessing denture hygiene, modified plaque index was used as described by Tarbet. Blood groups were determined by direct Heamagglutination method, using monoclonal antibodies against human A and B blood group antigens. (Department of Oral Pathology). Clinical Assessment- Inspection of the condition of oral mucosa was carried out under dental chair light. Upper and lower complete denture evaluation was done for grading their cleanliness according to prosthesis hygiene index by Tarbet. In this method, the maxillary denture was removed from the mouth and soaked in a bowl of water for one minute to remove food debris. 0.1% neutral red solution was painted on the fitting surface and left for one minute. The denture was rinsed under running tap water to remove the unbound dye. The disclosed denture plaque on the fitting surface of the denture was then scored.

It is graded as:

- no plaque

- light plaque (25% of the fitting surface covered)

- moderate plaque (26- 50% of the fitting surface covered)

- heavy plaque (51-75% of the fitting surface covered)

- very heavy plaque (76-100% of the fitting surface covered)

Observation and Result- This prospective study was carried out to evaluate the relationship between 'ABO' blood types and degree of denture

plaque accumulation in denture wearers.

For the study, individuals requiring complete dentures were selected at random from the O.P.D of the department of Prosthodontics. Age range of samples vary between 40 -90 years Sex predilection favoured predominantly males.

Individuals requiring complete dentures with at least six months of denture wearing history comprise the study group (n=105). While, the individuals with no denture wearing history comprise the control group (n=105). Blood type of each individual was then determined (Dept. of Oral and maxillofacial pathology). The samples were again subdivided according to their blood types (A/B/AB/O).

Table 2: demonstrates the age range (among various blood groups) for which patients were wearing dentures. Table 3: shows the degree of denture plaque accumulation among various blood groups. Table 5: demonstrates the degree of oral Candidal colonization (CFU/ml) among various blood groups. table 3: shows tendency of blood group O to be a risk factor for increased denture plaque accumulation. Therefore whether the denture wearers in blood group O have a high risk or not was examined using more sensitive

Blood group	Study group				Control group			
	Mean	Range	±SD	Mean	Range	±SD		
		Min.	Max.				Min.	Max.
'B' blood group								
Age	60.9	46.0	80.0	9.2	56.0	42.0	90.0	11.3
Dental age	6.0	0.5	25.0	4.7	0.0	0.0	0.0	0.0
Denture plaque	2.3	0.0	4.0	1.1	0.0	0.0	0.0	0.0
'O' blood group								
Age	65.4	50.0	80.0	7.6	56.3	40.0	75.0	10.5
Dental age	9.1	0.5	25.0	6.2	0.0	0.0	0.0	0.0
Denture plaque	3.3	1.0	4.0	0.7	0.0	0.0	0.0	0.0
'A' blood group								
Age	59.5	47.0	83.0	9.0	53.7	40.0	74.0	9.6
Dental age	4.6	0.5	10.0	3.1	0.0	0.0	0.0	0.0
Denture plaque	1.7	0.0	3.0	0.8	0.0	0.0	0.0	0.0
'AB' blood group								
Age	62.1	48.0	75.0	8.1	54.1	44.0	72.0	8.7
Dental age	5.1	1.5	10.0	3.0	0.0	0.0	0.0	0.0
Denture plaque	1.9	1.0	3.0	0.7	0.0	0.0	0.0	0.0

Table 1: Mean and range values of various parameters in study and control groups with different blood groups.

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statistical analysis. It was revealed that the amount of denture plaque was significantly higher in blood group O than in those subjects having other blood types (p<0.05; Table 4) Furthermore, the population with marked plaque accumulation (grade 3, grade 4) was significantly higher in blood group O than in those with other blood groups (p<0.05; table 4) Discussion: Each individual has a number of microorganisms in their oral cavity but this microbial flora changes with respect to presence or absence of teeth.

Candida species are the most common components of human oral flora. Oral candidiasis (Candidal count/ C.F.U is more than 200 cells/ml) is present clinically in many forms reflecting its ability to colonize different oral surfaces. Variety of systemic and local factors predisposes the host to increased Candidal colonization and subsequent infection. It has been shown that the presence of dentures is a predisposing factor to the onset of pathologies

related to *Candida*. Clinical studies have shown that *C. albicans* is not only able to adhere to the mucosal surfaces, but also stick to the acrylic resins of the dental prosthesis.[6] Since one of the major etiological factors of increased Candidal carriage among denture wearers is considered to be denture plaque accumulation on the denture surface, *Candida* adherence to inert surfaces or host cell surfaces is recognised as an initial step in successful colonization and development of pathogenesis.

The major human blood group system is ABO. The blood group of a person depends upon the presence or absence of two genes, A and B. the majority of ABO determinants are expressed on the ends of long polylactosamine chains. No diseases are known to result from the lack of expression of ABO blood group antigens, but the susceptibility to a number of diseases has been interrelated to a person's ABO phenotype. Such correlations remain conflicting and include the observation that gastric cancer is common in blood group A individuals, whereas gastric and duodenal ulcers occur more commonly in group O individuals.

In India, data was lacking on association between blood groups and degree of plaque accumulation among denture wearers and our study aimed at determining the same. The ultimate goal is to

Denture age	ABO blood group				Total
	B	O	A	AB	
0-8	24	13	25	13	75
9-16	5	14	5	2	26
>16	1	3	0	0	4
Total	30	30	30	15	105

Table 2: Blood groups and denture age

Denture plaque	ABO blood group				Total
	B	O	A	AB	
0	4	0	3	0	7
1	1	1	7	4	13
2	9	2	17	8	36
3	14	15	3	3	35
4	2	12	0	0	14
Total	30	30	30	15	105

Chi square=96.0 (degrees of freedom 12; p<0.01)

Table 3: Blood groups and denture plaque

Designs	Mean	Mean	't' value	'p' value	Sig/NS
B – O	2.3	3.3	3.94	0.000	HS
B – A	2.3	1.7	2.51	0.015	Sig
B – AB	2.3	1.9	1.15	0.253	NS
O – A	3.3	1.7	8.03	0.000	HS
O – AB	3.3	1.9	5.79	0.000	HS
A – AB	1.7	1.9	1.09	0.281	NS

HS = Highly significant Sig = Significant
NS = Non-significant

Table 4: 't' test for denture plaque.

determine the blood group that is more susceptible to oral Candidal carriage among denture wearers.

For the study, individuals were selected at random form the O.P.D of the department of Prosthodontics, of the institute. Patient's consent was taken prior to the onset of the study. Individuals requiring complete dentures with at least six months of denture wearing history comprise the study group (n=105). While, the individuals with no denture wearing history comprise the control group (n=105). Blood samples of each individual were collected to determine the blood type (Department of Oral and maxillofacial pathology). The samples were again subdivided according to their blood types (A/B/AB/O).

Information was obtained through the structured interview regarding personal details, chief complaint, past and present medical history. Individuals were asked about denture wearing history (denture age), denture hygiene and denture wearing habits. Assessment of the denture hygiene was done by the prosthesis hygiene index as described by Tarbet.

After obtaining the complete data, it was statistically analysed and significance was set at ($p<0.05$).

Significant differences were observed in the degree of denture plaque accumulation among blood groups A, B, AB and O. Blood group O shows higher degree of denture plaque accumulation (grade 3, grade 4) as compared to other blood groups. Nikawa et al (1992) conducted a similar study to investigate the association between degrees of denture plaque accumulation and ABO blood types in denture wearers. They too concluded that blood group O is a risk factor for denture plaque accumulation.

The reason for this may be due to the fact that the adherence of *Candida* to bare acrylic resin surfaces or to solid surfaces is considered to be mediated mainly by non-specific interaction. The salivary proteins adsorbed to inert surfaces affect the adherence of *Candida,* and it is suggested that these proteins provide specific receptor sites. Also the in-vivo adherence of *Candida* to

Parameter	'B' group		'O' group		'A' group		'AB' group		Total	
	Denture Plaque	CFU	Denture plaque	CFU	Denture plaque	CFU	Denture plaque	CFU	Denture plaque	CFU
Denture age	0.05	0.20	0.49**	0.25	0.27	0.11	0.58*	0.46	0.42**	0.27**
Denture plaque		0.28		0.31		0.20		0.42		0.28**

*significant at 5% level of significance   **significant at 1% level of significance

Table 5: Correlation table of various parameters based on the blood groups

Parameter	Males		Females		Total	
	Denture Plaque	CFU	Denture plaque	CFU	Denture plaque	CFU
Denture age	0.38**	0.26*	0.52**	0.60**	0.42**	0.27**
Denture plaque		0.29**		0.38*		0.28**

Table 6: Correlation table of various parameters based on sex

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denture surfaces might be affected by body fluids containing immunodominant glycocompounds of some blood types.

In our study, we found that as the degree of denture plaque accumulation is increased, degree of oral Candidal colonization is also increased. This suggests that denture plaque accumulation might be a risk factor for increased Candidal carriage. The amount of denture plaque accumulation was significantly higher in blood group O than in other types (p<0.05) Thus, populations with marked plaque accumulation (Grade 3, 4) were significantly higher in blood group O than in those with other blood types.

Conclusion: Elderly individuals show a predisposition towards disease of oral cavity where the high frequency of Candidal carriage in the elderly suggests that with age the oral environment becomes permissive to *Candida*. This Candidal colonization in elderly is further enhanced by the use of dentures. Through many years researchers worked on several aspects of

presence of Candida in elderly. This study was intended to determine the relationship between degree of denture plaque accumulation and ABO blood types among denture wearers. The study consisted of 210 patients, which were divided in to study group (group A) and control group (group B). The groups were further divided into four subgroups according to ABO blood group system. Blood group A consists of 60 patients (30 study and 30 control), Blood group B consist of 60 patients (30 study and 30 control), Blood group O consist of 60 patients (30 study and 30 control), and since Blood group AB is most rarely found, sample size was limited to 30 (15 study and 15 control). Denture hygiene was accessed by Tarbet's denture hygiene index and Blood groups were determined by direct Heamagglutination method. Then the data was statistically analyzed using chi square, student t-test, one way ANOVA and tukey HSD. Our study demonstrated that the denture plaque was significantly increased in blood group O. Our study thus stated that the blood group O is more susceptible to denture plaque accumulation. The

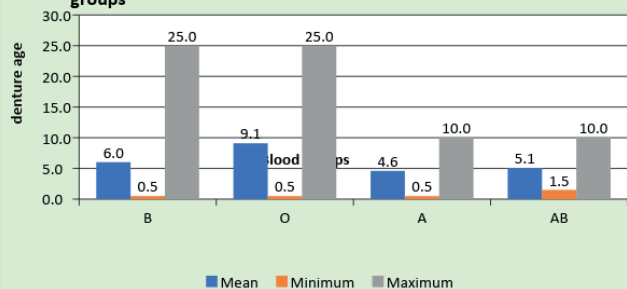Fig 1: Mean and range values of denture age in various blood groups

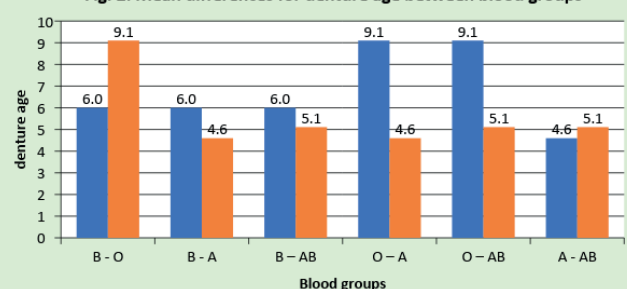Fig. 2: Mean differences for denture age between blood groups

Fig 3 : Mean and range values of denture plaque in various blood groups
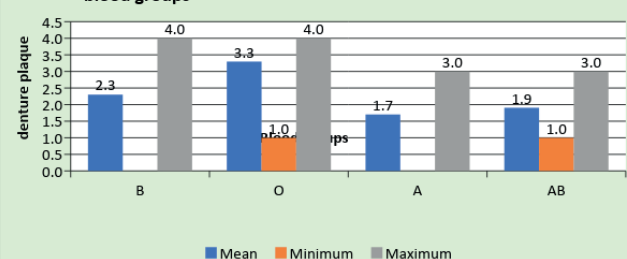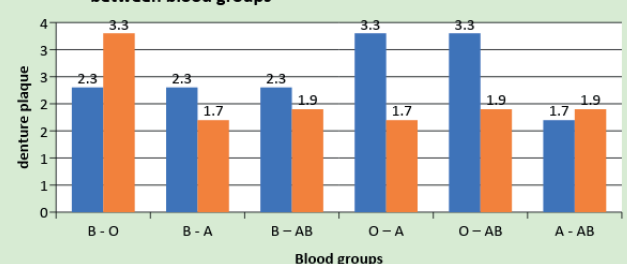

Fig. 4 : Mean differences for denture plaque between blood groups

reason behind this increased susceptibility might be due to the fact that the blood group O does not have any antibody on their blood cell surface which plays an important role against the attachment of Candidal species to the host cell surface or inert surface invivo.

The pathogenesis of *Candida* infections is complex and involves both yeast and host related factors. This aspect of host-fungal relationship is illustrated by the spectrum of clinical presentation of oral candidiasis. The repertoire of adherence mechanisms exhibited by *Candida albicans* enables it to colonize many oral niches. The ability of *Candida* strain to overcome the host clearance mechanisms and to colonize surfaces depends on the effectiveness of those mechanisms, yeast adherence, and the yeast growth rate. Progress from the adherent replicating yeast to a mucosal infection again depends upon adherence and growth rate but also involves tissue penetration. For an infection to persist, the host immune system must fail to contain the growth of the yeast. The balance among clearance, colonization, or candidiasis therefore depends upon the ability of the Candida strains to modulate expression of virulence factors in response to environmental change, combined with competence of host immune system. The precarious nature of this balance is evidenced by the significant number of people for whom oral candidiasis is recurrent problem. The key role played by adherence mechanisms suggests that further molecular analysis of *C. albicans* cell surface macromolecule expression and related functions will ultimately provide the information needed for effective prevention of oral candidiasis.

Efficient cleaning of dentures should be carried out as the fungal growth on denture surface infect and re-infect the soft tissues. The therapeutic strategy should include the use of topical (loscetar, amorolfine) and systemic antifungal drugs (nystatin, amphotericin B, miconazole and fluconazole) the use of preservatives and disinfectants (dentures immersed in two% chlorhexidine or in 0.02% sodium hypochlorite), the irradiation with microwaves and scrupulous removal and control of the plaque present on the denture and on the oral mucosa.

Good oral hygiene can be alone effective in treating *Candida*-associated denture stomatitis when used in conjunction with systemic and topical antifungal agents. The hygiene control of denture is also essential to avoid relapses of pathology following treatment with antifungal drugs, and therefore, it is an important measure for the prophylaxis of oral candidiasis. Both the prosthesis and the oral mucosa in contact with it must be involved in the procedures for oral hygiene through brushing them after each meal with or without chemicals. The patient should be instructed to remove the denture during night and to leave it dry. In addition, during therapy, the prosthesis should be removed for atleast two weeks.

Metal base maxillary dentures and high impact acrylic resin have shown less penetration and adherence of Candidal cells as compared to conventional and tooth coloured acrylic, thus, the use of these denture base materials might be of clinical significance as a treatment alternative to patients who are more prone to higher incidence of fungal infections. Routine follow-up visits to a dentist should be performed to assess that the prosthesis maintains proper fit and function, and that users are maintaining denture hygiene instructions.

Oral health awareness and education programmes should be conducted at the community level for older population. The role and proper method of oral hygiene practice, care for artificial dentures, and self assessment of the oral cavity for early detection of diseased condition should be explained to the patient. In an effort to empower the elderly in self-help and care, the educational material

in different local languages should be produced and distributed freely. Lastly, as a preventive measure, education should be imparted to the young population so that they retain their teeth in optimal health and prevalence of dental disease will be reduced. Research should be pursued in various aspects of ageing and age related oral health problems, including epidemiological studies to measure the burden of oral diseases, the impact of oral diseases on nutrition and general health, the impact of interventions and so forth.

References:

1. Shah N: Geriatric oral health issues in India. Int. Dent J 2001; 51(3):212-18.

2. Verran J, Maryan CJ. Retention of Candida albicans on acrylic resin and silicone of different surface topography. J Prosthet Dent 1997; 7: 535-39.

3. Arirachakaran P, Piboonratanakit P, Kiatkroekkrai P, Sormai M, Srimart N. Prevalence of oral Candida carriage in denture wearers. CU Dent J 2009; 32: 101-12.

4. Martin MV, Lamb DJ. Frequency of Candida albicans serotypes in patients with denture induced stomatitis and in normal denture wearers. J Clin Pathol 1982; 35: 888-91.

5. Santarpia et al. An invivo replica method for the site specific detection of candida albicans on the denture surface in denture stomatitis patients: Correlation with clinical disease. J Prosthet Dent 1990; 63(4): 437-41.

6. Salerno et al. Candia- associated denture stomatitis. Med Oral Patol Oral Cir Bucal 2011; 16 (2): 139-43.

7. Abelson D C. Denture plaque and denture cleansers. J Prosthet Dent 1981; 45 (4): 376-79.

8. Guiliana et al. In vitro activities of antimicrobial agents against Candida species 1999; 87(1): 44-49.

9. Nikawa et al. Denture stomatitis and ABO blood types. J Prosthet Dent 1991; 66(3): 391-94.

10. Samaranayake LP, McFarlane TW. An invitro study of the adherence of the Candida albicans to acrylic surface. Arch Oral Biol 1980; 25: 603-09.

11. Neill D.J. A study of dental materials and methods employed in cleaning dentures. B Dent J 1968; 124(3): 107-15.

12. Davenport J.C. The oral distribution of Candida in denture stomatitis. B Dent J 1970; 129:151-16.

13. Arendorf T.M, Walker D.M. Oral Candidal Poplulations in Health and Disease. B Dent J 1979; 147: 267-72.

14. Walker D.M, Stafford G.D, Huggett R, Newcombe R.G. The treatment of denture stomatitis. B Dent J 1981; 151: 416-19.

15. Burns D.R, Burns D.A, Pietro G.J, Gregory R.L. Response of processed resilient denture liners to Candida albicans. J Prosthet Dent 1987; 57(4): 507-12.

16. Fouche M.H, Slabbert J.C.G, Coogan M.M. Candidal antibodies in patients undergoing treatment for denture stomatitis. J Prosthet Dent 1987; 57(5): 587-91.

17. Cardash H.S, Rosenberg M. An innovative method of monitoring denture hygiene. J Prosthet Dent 1990; 63(6): 661-64.

18. Nikawa H, Iwanaga H, Hamada T. An in vitro evaluation of simplified quantitative diagnostic aids for detection of Candida albicans. J Prosthet Dent 1992; 68(6): 629-33.

19. Anthony M.I, William F. W. Oral Candidal infection and denture stomatitis: a comprehensive review. J Am Dent Assoc 1992; 123: 46-51.

20. Scully C. Kabir M.E. Candida and Oral Candidosis: A Review. Crit Rev Oral Biol Med 1994; 5(2): 125-57.

21. Cameron B.J, Douglas L.J. Blood group glycolipids as epithelial cell receptors for Candida albicans. Infect Immun 1996; 64(3): 891-96.

22. Cannon R.D, Holmes A.R, Mason A.B, Monk B.C. Oral Candida: Clearance, colonization, or candidiasis? J Dent Res 1995; 74(5): 1152-61.

23. Jeganathan S, Thean H.P.Y, Thong K.T, Chan Y.C, Singh M. A clinically viable index for quantifying denture plaque. Quintess Int 1996; 27(8): 569-73.

24. Webb B.C, Thomas C.J, Willcox M.D.P, Harty D.W.S. Candida-associated denture stomatitis. Aetiology and management: A review. Part 2. Oral diseases caused by candida species. Aus Dent J 1998; 43(3): 160-65.

25. Radford D.R, Challacombe S.J, Walter J.D. Denture plaque and adherence of Candida albicans to denture-base materials in vivo and in vitro. Crit Rev Oral Biol Med 1999; 10(1): 99-116.

26. Sheen S.R, Harrison A. Assessment of plaque prevention on dentures using an experimental cleanser. J Prosthet Dent 2000; 84(6): 594-601.

27. Willis A.M, Coulter W.A, Hayes J.R, Bell P, Lamey P.J. Factors affecting the adhesion of Candida albicans to epithelial cells of insulin-using diabetes mellitus patients. J Med Microbiol 2000; 49: 291-93.

28. Vitkov L, Krautgartner W.D, Hannig M, Weitgasser R, Stoiber W. Candida attachment to oral epithelium. Oral Microbiol Immunol 2002; 17: 60-64.

29. Shin ES, Chung SC, Kim YK, Lee SW, Kho HS, Rochester NY. The relationship between oral Candida carriage and the secretor status of blood group antigens in saliva. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003; 96: 48-53.

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30. Sitheeque M.A.M, Samaranayake L.P. Chronic hyperplastic Candidosis/ candidiasis. Crit Rev Oral Biol Med 2003; 14(4): 253-67.

31. Barbeau J, Seguin J, Goulet J.P, Koninck L, Avon L, Lalonde B, Rompre P, Deslauriers N, Foy S. Reassessing the presence of Candida albicans in denture-related stomatitis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003; 95: 51-59.

32. Brosky M.E, Pesun I.J, Morrison B, Hodges J.S, Lai J H, Liljemark W. Clinical evaluation of resilient denture liners. Part 2: Candida count and speciation. J Prosthodont 2003; 12: 162-67.

33. Milillio L, Muzio L.L, Carlino P, Serpico R, Coccia E, Scully C. Candida – Related Denture Stomatitis: A pilot study of the efficacy of an amorolfine antifungal varnish. Int J Prosthodont 2005; 18: 55-59.

34. Daniluk T, Tokajuk G, Stokowska W, Fiedoruk K, Sciepuk M, Zaremba M.L, Rozkiewicz D, Rokicka C.D, Kedra B.A, Anielska I, Gorska M, Kedra B.R. Occurrence rate of oral Candida albicans in denture wearer patients. Adv Med Sci 2006; 51: 77-80.

35. Lyon J.P, Resende M.A, Gerias M. Correlation between adhesion, enzyme production, and susceptibility to fluconazole in Candida albicans obtained from denture wearers. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006; 102: 632-38.

36. Perezous L.F, Stevenson G.C, Flaitz C.M, Goldschmidt M.E, Engelmeier R.L, Nicholas C.M. The effect of complete dentures with a metal palate on Candida Species growth in HIV- infected patients. J Prosthodont 2006; 15: 306-15.

37. Pereira T, Cury A.A, Cenci M.S, Garcia R.C. Invitro Candida colonization on acrylic resins and denture liners: influence of surface free energy energy, roughness, saliva, and adhering bacteria. Int J Prosthodont 2007; 20: 308-10.

38. Emami E, Seguin J, Rompre P.H, Koninck L, Grandmont P, Barbeau J. The relationship of myceliated colonies of Candida albicans with denture stomatitis: an invivo/ invitro study. Int J Prosthodont 2007; 20: 514-20.

39. Paranhos H.F.O, Silva C.H, Venezian G.C, Macedo L.D, Souza R.F. Distribution of biofilm on internal and external surfaces of upper complete dentures: the effect of hygiene instruction. Gerodontology 2007; 24: 162-68.

40. Compagnoni M.A, Souza R.F, Marra J, Pero A.C, Barbosa D.B. Relationship between Candida and nocturnal denture wear: quantitative study. J Oral Rehab 2007; 34: 600-05.

41. Dua A, Sukanya, Kashinath K.R, Sandhya. A comapritive in-vitro microbiological study to evaluate the penetration by Candida albicans of different heat cures acrylic resins after denture brush abrasion. J Indian Prosthodont Soc 2008; 8(4): 207-12.

42. Abdollahzadeh S, Abdolsamadi H, Mortazavi H, Vahedi M. The frequency of ABO blood groups among patients with denture stomatitis. DJH 2009; 1(1): 21-23.

43. Kurita H, Kamata T, Zhao C, Narikawa J, Koike T, Kurashina K, Matsumoto. Usefulness of commercial enzyme-linked immunosorbent assay kit for Candida mannan antigen for antigen for detecting Candida in oral rinse solutions. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009; 107: 531-34.

44. Paranhos H.F.O, Silva CH, Souza R.F, Pontes K.M. Evaluation of three indices for biofilm accumulation on complete dentures. Gerodontology 2010; 27: 33-40.

45. Oliveria C.E, Gasparoto T.H, Dionisio T.J, Porto V.C, Vieira N.A, Santos C.F, Lara V.S. Candida albicans and denture stomatitis: evaluation of its presence in the lesion, prosthesis, and blood. Int J Prosthodont 2010; 23: 158-59.

46. Jose A, Coco B.J, Milligan S, Young B, Lappin D.F, Bagg j, Murray C, Ramage G. Reducing the incidence of denture stomatitis: are denture cleansers sufficient? J Prosthodont 2010; 19: 252-57.

47. Zuluaga D.J, Velandia G.O, Clauijo D.M. Denture-related stomatitis managed with tissue conditioner and hard auto-polymerizing reline material. Gerodontology 2010; 28: 258-63.

48. Gusmano R.J, Santos F.S, Neisser P.M, Jorge C.A, Faria I. Correlation between factors associated with the removable partial dentures use and Candida spp. In saliva. Gerodontology 2011; 28:283-88.

49. Gendreau L, Loewy Z.G. Epidemiology and etiology of denture stomatitis. J Prosthodont 2011; 20: 251-60.

50. Meurman J.H, Parnanen P, Seneviratne C.J, Samaranayake L.P, Saarinen A.M.J, Kari K. Prevalence and antifungal drug sensitivity of non- albicans Candida in oral rinse samples of self caring elderly. Gerodontology 2011; 28: 246-52.

51. Iseri U, Uludamar A, Ozkan Y.K. Effectiveness of different cleaning agents on the adherence of Candida albicans to acrylic denture base resin. Gerodontology 2011; 28: 271-76.

52. Raju S.B, Rajappa S. Isolation and identification of Candida from the oral cavity. ISRN dentistry 2011; 1-7.

53. Andrade I.M, Cruz P.C, Silva L.C, Souza D.F, Paranhos O.H, Candido R.C et al. Effervescent tablets and ultrasonic devices against Candida and mutans Streptococci in denture biofilm. Gerodontology 2011; 28: 264-70.