

Evaluation of Denture Stomatitis in Croatian Adult Population

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ABSTRACT

Denture stomatitis (DS) is often found under the removable partial dentures (RPDs). There are many factors influencing it, such as patient's age and gender, smoking habits, denture age, denture material, denture wearing habits, denture hygiene habits, oral hygiene instruction, denture cleanliness and denture plaque accumulation. The aim of this study was to find out the influence these factors have on the prevalence of DS under RPDs and complete dentures (CDs). A total of 200 patients took part in this study. Half of the examined patients (100) wore CD and the other half (100) RPDs. There were 63 males and 137 females, aged between 45 and 83 years. Different smoking habits, denture wearing habits, denture hygiene habits, denture cleanliness and oral hygiene instructions had significant influence on the degree of DS in CD wearers ($p < 0.01$). In the RPD wearers, denture material and denture support had a significant influence on DS ($p < 0.01$). The significant correlation was found between the denture plaque accumulation and the DS in complete maxillary and mandibular ($r_U = 0.85$; $r_L = 0.61$) and removable maxillary and mandibular partial dentures ($r_U = 0.45$; $r_L = 0.62$).

Introduction

DS is a common oral disease in denture wearers and quite characteristic of advanced age. Multiple etiological and predisposing factors are believed to be responsible for its initiation and progression^{1,2}.

The inflammatory changes are characterized mainly by erythema and are found under complete or partial dentures in both

jaws, but more frequently in the maxilla. Lesions of the oral mucosa associated with wearing of removable dentures may represent acute or chronic reactions to microbial denture plaque, a reaction to constituents of the denture base material, or a mechanical denture injury³.

DS is divided into three types³⁻⁵: Type I shows localized inflammation or pinpoint hyperemia; type II shows more diffused erythema and type III is a non-neo-

plastic papillary hyperplasia with inflammation to a varying degree. Type I DS is commonly due to trauma from the dentures (occlusion, undercuts, residual monomer, stability etc.) to the denture bearing area, whereas type II and III are mostly associated with candida and/or bacterial infection^{5–7} together with mechanical trauma. The prevalence of the three types of DS in different groups of elderly population has been reported to vary in the range of 10–65 %^{2,7–9}.

The majority of the denture-wearers report cleaning their denture frequently. Regardless of their cleaning efforts, however, soft debris, bacterial plaque and dental calculus are often found on the denture surfaces^{1,11}. In the study of 303 subjects, older than age 60, Bergman et al.¹² found that 91–96 % of the dentate subjects required improvement in their oral hygiene habits. Abelson¹³ pointed out that the plaque on the tissue fitting is the most commonly cited trias associated with DS (ill-fit, trauma and unclean dentures). Thus, the factors that promote the build-up or maintenance of the contact of the denture plaque with oral mucosa will propagate the disease. Jeganathan et al.¹ concluded that differences between the DS group and the control group were statistically significant for the following factors: denture hygiene habits, denture wearing habits and denture cleanliness.

The association between DS and denture plaque is now well documented^{14,15} and is further supported by clinical and epidemiological studies that show a correlation between denture plaque scores and the presence and severity of DS^{16,17}. Nikawa et al.¹⁸ claimed that the denture plaque containing *Candida* could cause not only oral candidiasis like oral thrush or denture-related stomatitis, but also crown caries, root caries and periodontitis of the abutment teeth of a partial denture.

The aim of this study was to access the relationship of patients' age and gender, smoking habits, denture age, denture material, denture wearing habits, denture hygiene habits, oral hygiene instructions, denture cleanliness, denture plaque accumulation and the presence of DS in CD and RPD wearers.

Material and Methods

A total of 200 patients took part in this study. Half of the examined patients (100) wore CDs and the other half (100) RPDs. All of the patients were examined at the Department of Removable Prosthodontics, School of Dental Medicine, University of Zagreb. There were 63 males and 137 females, aged between 45 and 83. The patients had 66 maxillary RPDs, 81 mandibular RPDs, 88 maxillary CDs and 88 mandibular CDs.

A questionnaire was devised for the purpose of this study, divided in two parts and completed both by dentist and patient. In the first part, patients were required to answer questions on gender (male, female), age (group 1 = from 1 to 50 years old, group 2 = from 51 to 70 years old and group 3 = more than 70 years old), smoking habits (yes/no), dentures' age (group 1 = to 1 year old, group 2 = from 2 to 5 years old and group 3 = more than 5 years old), dentures' wearing habits (group 1 = all the time, group 2 = during the day, group 3 = during the meal and group 4 = only for going out), denture hygiene habits (group 1 = tooth brush, paste and water, group 2 = tooth brush and water, group 3 = water, group 4 = tablets, group 5 = tooth brush, paste, water and tablets and group 6 = tooth brush, water and tablets), denture cleanliness (group 0 = never cleaning, group 1 = once a day, group 2 = twice a day and group 3 = three or more times a day) and the reception of oral hygiene instructions from the therapist (yes/no).

In the second part of the questionnaire, the dentist determined the sort of the denture material (acrylic/metal), denture support (tooth/mucosa), the accumulation of the denture plaque-Tarbet index (TI)¹⁴ and the degree of the DS-modified Newton's index (NI): 0 = no inflammation; 1 = pin-point hyperemia; 2 = diffuse erythema; and 3 = papillary hyperplasia)^{4,5} in the complete and RPDs.

Statistical analysis was made by using the statistical software SPSS 10.0 for Windows. Descriptive statistics were made and the normality of distribution was tested by the one-way Kolmogorov-Smirnov test. To test significance between different variables the Kruskal-Wallis test was used. To test the correlations between the Tarbet and the Newton index completely and RPDs the Spearman rank correlation analysis was made.

Results

A number of factors that might be related to the occurrence of DS were studied: age and gender of patients, smoking habits, denture age, denture material, denture wearing habits, denture hygiene habits, oral hygiene instruction, denture cleanness and denture plaque (TI).

Table 1 shows the distribution according to age and gender in wearers of CDs and RPDs.

Nineteen percent of the RPD wearers were smokers and 81% were non-smokers, while 57% of the CD were smokers and 43% were non-smokers.

The distribution in percentages of the dentures' age is shown in Table 2.

Most of the maxillary RPDs (60,6%) were metal-made of alloy, while 39,4% of the RPDs were acrylic. In the group of the mandibular RPDs, 69,1% of the dentures were metal dentures and 30,9% were acrylic dentures. In the CD wearers the results were reverse. In the maxillary CDs, the highest percentage of the dentures were acrylic (80,7%) and only 19,3% were metal dentures, while in the mandibular CDs 87,5% were acrylic and 12,5% were metal dentures. Considering the denture support, in the maxillary RPDs 78,8% of the dentures were tooth supported and 21,2% of the dentures were mucosa supported. In the mandibular RPDs, 72,8% were tooth supported and 27,2% were mucosa-supported dentures. All of the maxillary and mandibular CDs (100%) were mucosa supported.

Table 3. shows the distribution of the dentures wearing habits. Most of the maxillary and mandibular RPD wearers were wearing their dentures during the day only (48.5% and 51.9%), while the majority of the maxillary and mandibular CD wearers wore their dentures day and night (56.8% and 47.7%), respectively.

TABLE 1
DISTRIBUTION IN PERCENTAGES (%) ACCORDING TO AGE AND GENDER
IN CD* AND RPD** WEARERS

Patient's age	CD* wearers		RPD** wearers	
	Men	Women	Men	Women
< 50 years	2	2	2	2
51–70 years	13	37	11	40
> 70 years	15	31	20	25
Total (%)	30%	70%	33%	67%

* complete denture;

** removable partial denture.

TABLE 2
DISTRIBUTION (%) IN RELATION TO DENTURES AGE IN CD* AND RPD** WEARERS

Dentures' age	CD* wearers		RPD** wearers	
	Maxillary	Mandibular	Maxillary	Mandibular
less than 1 year	5.7%	10.2%	13.6%	23.5%
between 2–5	40.9%	37.5%	65.2%	63%
years over 5	53.4%	52.3%	21.2%	13.5%
Total (%)	100%	100%	100%	100%

* complete denture;

** removable partial denture.

TABLE 3
DISTRIBUTION OF THE EXAMINED PATIENTS ACCORDING TO DENTURES' WEARING HABITS

Dentures' wearing habits	CD* wearers		RPD** wearers	
	Maxillary	Mandibular	Maxillary	Mandibular
all the time	56.8%	47.7%	42.4%	39.5%
during the day	39.8%	46.6%	48.5%	51.9%
during the meal	–	–	3%	2.5%
only when going out	3.4%	5.7%	6.1%	6.1%
Total	100%	100%	100%	100%

* complete denture;

** removable partial denture.

Most of the RPD wearers (63%) reported that they clean their dentures using a tooth brush, tooth paste and water, 23% clean them with the combination of the tooth brush, tooth paste, water and tablets, 11% clean them only with the tablets, and only 1% clean them with tooth brush and water, only with water, or with the tooth brush, water and tablets. Most of the CD wearers (26%) reported that they clean their dentures with tooth brush and water, 23% clean them with the tooth brush, tooth paste and water, 18% clean them with the combination of the tooth brush, tooth paste, water and tablets, 16% rinse them only in water, 11% clean their dentures with the combination of the tooth brush, water and tablets, and 6% clean them only with the tablets. The frequencies of dentures

cleaning results were different in the RPDs and CDs ($p < 0.01$). In the RPD group, most of the patients brushed their denture more than 3 times a day (52%), 38% brushed them 2 times a day and 10% brushed their dentures only once a day. None of the patients reported they never brush the dentures. In the CDs group, most of the patients (41%) brushed their dentures only once a day, 29% brushed them 3 times a day, 28% brushed them 2 times a day and 2% never brushed their dentures. Sixty-eight percent of the RPD wearers reported to have received the oral hygiene instructions from the therapist while 32% of them have not. Half of the CD wearers (50%) received and the other half did not receive the information about the hygiene from their therapist.

TABLE 4
DISTRIBUTION OF THE PLAQUE ACCUMULATION IN CD* AND RPD** WEARERS

TI	CD* wearers		RPD** wearers	
	Maxillary	Mandibular	Maxillary	Mandibular
0 = no plaque	27.3%	49%	6%	13.6%
1 = light plaque	25%	20.7%	37.4%	43.2%
2 = moderate plaque	28.4%	21.7%	34.8%	34.6%
3 = heavy plaque	11.3%	8.6%	19.2%	7.4%
4 = very heavy plaque	8%	–	3.4%	1.2%
Total	100%	100%	100%	100%

* complete denture;

** removable partial denture.

TABLE 5
DISTRIBUTION OF THE DS IN CD* AND RPD** WEARERS

NI	CD* wearers		RPD** wearers	
	Maxillary	Mandibular	Maxillary	Mandibular
0 = no inflammation	51.2%	80.7%	70.5%	86.3%
1 = pin-point hyperemia	22.7%	15.9%	20.9%	11.3%
2 = diffused erythema	17%	3.4%	9.6%	2.4%
3 = papillary hyperplasia	9.2%	–	–	–
Total	100%	100%	100%	100%

* complete denture;

** removable partial denture.

TABLE 6
KRUSKAL-WALLIS TEST FOR THE SIGNIFICANCE OF THE DIFFERENCE IN RPD*

RPD* material: NI in maxillary RPD*		RPD* support: NI in maxillary RPD*	
Mean ranks	Number	Mean ranks	Number
48,86	25 ACRYLIC = 1	30,19	52 TOOTH = 1
37,49	56 METAL = 2	45,79	14 MUCOSA = 2
—		—	
p < 0.01		p < 0.01	

* removable partial denture;

NI = Newton index.

The plaque accumulation (TI) and the presence and the severity of DS (NI) in CD wearers and RPD wearers are shown in the Table 4 and in the Table 5.

RPD wearers had significantly lower degree of mucosal inflammation (p <

0.01), although they had significantly higher plaque accumulation on the denture surfaces than CD wearers (p < 0.01).

In the Table 6, the variables and their ranks with significant differences in RPD wearers are listed (p < 0.01). In the Table

TABLE 7
KRUSKAL-WALLIS TEST FOR THE SIGNIFICANCE OF THE DIFFERENCE IN CD*

Smoking habits: NI in maxillary CD*		Smoking habits: NI in mandibular CD*	
Mean ranks	Number	Mean ranks	Number
48,34	50 YES = 1	45,69	50 YES = 1
39,45	38 NO = 2	42,93	38 NO = 2
—		—	
p < 0.01		p < 0.01	

Denture wearing habits: NI in maxillary CD*		Denture wearing habits: NI in mandibular CD*	
Mean ranks	Number	Mean ranks	Number
56,79	50 NIGHT AND DAY = 0	50,93	41 NIGHT AND DAY = 0
26,07	35 DAY = 1	38,23	42 DAY = 1
54,67	3 OUTGOING = 2	44,50	5 OUTGOING = 2
—		—	
p < 0.01		p < 0.01	

Denture hygiene habits: NI in maxillary CD*		Denture hygiene habits: NI in mandibular CD*	
Mean ranks	Number	Mean ranks	Number
34,90	21 HYGIENE = 1	36,00	16 HYGIENE = 1
53,82	22 HYGIENE = 2	48,24	25 HYGIENE = 2
71,67	15 HYGIENE = 3	61,50	14 HYGIENE = 3
69,80	5 HYGIENE = 4	50,17	6 HYGIENE = 4
23,00	16 HYGIENE = 5	36,00	16 HYGIENE = 5
23,00	9 HYGIENE = 6	36,00	11 HYGIENE = 6
—		—	
p < 0.01		p < 0.01	

Denture cleanliness: NI in maxillary CD*		Denture cleanliness: NI in mandibular CD*	
Mean ranks	Number	Mean ranks	Number
77,50	2 CLEANLINESS = 0	61,50	2 CLEANLINESS = 0
63,47	38 CLEANLINESS = 1	53,87	39 CLEANLINESS = 1
33,21	24 CLEANLINESS = 2	36,00	18 CLEANLINESS = 2
23,00	24 CLEANLINESS = 3	36,00	29 CLEANLINESS = 3
—		—	
p < 0.01		p < 0.01	

Oral hygiene instructions: NI in maxillary CD*		Oral hygiene instructions: NI in mandibular CD*	
Mean ranks	Number	Mean ranks	Number
35,33	44 YES = 1	37,89	44 YES = 1
53,67	44 NO = 2	51,42	44 NO = 2
—		—	
p < 0.01		p < 0.01	

* complete denture;
NI = Newton index.

TABLE 8
SPEARMAN RANK COEFFICIENT TO TEST ASSOCIATION BETWEEN DENTURE PLAQUE
AND DENTURE STOMATITIS ($p = 0.01$)

	URPD ¹	LRPD ²	UCD ³	LCD ⁴
Spearman's coefficient ()	0.45	0.62	0.85	0.61

¹maxillary removable partial denture; ²mandibular removable partial denture; ³maxillary complete denture; ⁴mandibular complete denture.

7 the variables and their ranks with significant differences in CD wearers are listed. The significant differences were found between the RPD material and RPD support and the degree of DS for maxillary RPD ($p < 0.01$) (Table 6). In the CD wearers the significant differences were found between the denture wearing habits, denture hygiene habits, denture cleanness, oral hygiene instructions, and the degree of DS, both for the maxillary and the mandibular CDs ($p < 0.01$) (Table 7).

To test the correlation between denture plaque and DS in the CDs and RPDs the Spearman rank correlation analysis was made. The Spearman's coefficient () between the plaque accumulation and the DS in the maxillary RPDs was 0.45; in the mandibular RPDs 0.62; in the maxillary CDs 0.85; and in the mandibular CDs is 0.61 ($p = 0.01$) (Table 8).

Discussion

Inflammation under dentures is the most frequent denture-related mucosal change and also primarily related to maxillary CDs. In the total of 200 CD and RPD wearers the prevalence of DS ranged from 19.3% (Type I and II) to 48.8% (Type I, II, and III) for the mandibular and maxillary CDs, and from 13.7% to 29.5% (Type I and II) for the mandibular and maxillary RPDs. CD wearers had significantly higher percentage of DS than RPD wearers ($p < 0.01$), which could be attributed partially to the different support or material (the biggest percentage

of the tooth supported and metal RPDs), although more plaque was registered in RPDs ($p < 0.01$).

Nevalainen, Närhi and Ainamo¹⁹, reported that the most common finding was the inflammation under the denture, which occurred alone or combined with other lesions in 25% of the CD wearers. Generally, the prevalence of three types of DS in different groups of elderly population has been reported to vary in the range from 10 to 65 %^{2,7–9,20,21}.

However, the results of this study revealed that the most frequent type of DS was type I under RPD. It is not surprising because the type I of DS is frequently caused by trauma from the old and ill-fitting denture. Yeung et al²² investigated the effects of metal RPD wearing on oral tissues. They found a low prevalence of DS although there was a high prevalence of plaque, gingivitis and gingival recession.

The denture plaque that contributes to the development of the DS is probably important and must be considered in the pathogenesis of this disease. The plaque that forms on unclean dentures has been cited as a local etiological factor for DS^{1,13}. The findings of this study show the significant correlation between the accumulation of the denture plaque and the presence of DS in CD and RPD wearers, respectively. Radford et al²³ pointed out the influence of adhesion of *Candida albicans* to denture base material in relation to denture plaque and DS. Numerous reports in the literature support the view

that the hygiene of the denture is strongly associated with *Candida albicans*^{3,18,21,24–26}.

Besides the denture plaque, influence of other factors (smoking habits, denture wearing habits, denture hygiene habits, denture cleanliness and the reception of oral hygiene instructions) on the prevalence of DS in CD wearers was also found in this study. However, age and gender of patients, denture age, denture material or denture support had no significant influence on the degree of the inflammation in CD wearers ($p > 0.01$).

Positive association between smoking habits (cigarette, tobacco) and the prevalence of DS has already been established in similar studies^{24,25,27–29}, although Fenlon et al.³⁰ found no association between systemic factors, use of pharmacological agents or smoking habits and the presence of denture related stomatitis.

Denture wearing habits of CDs have been shown to predispose patients to DS. Penhall³¹ suggested that the denture is considered to be a 'žplaque applicator'. By holding plaque masses in contact with the oral mucosa for an extended period of time, the toxic effects as evidenced by mucosal abnormalities are predictable. The findings of this study conducted on the Croatian population did not differ from earlier studies on similar populations. Night and day wearing of CDs was found to be significantly associated with prevalence of denture related stomatitis^{1,30,32}.

Denture hygiene habits in the studied population revealed that the most denture wearers cleaned their dentures mostly with tooth brush, water and denture cleansers (paste, tablets), and 16% cleaned them only with water, which is insufficient for a good hygiene. Although the majority of the denture wearers reported to clean their denture thoroughly, many of them still showed mucosal changes and a great amount of plaque. It

is obvious that reduced sight and reduced manual dexterity of the elderly will lead to poor oral hygiene¹⁹.

Daily oral hygiene has been reported to be the prime preventive method for the control of mucosal inflammation³³. Hoad-Reddick et al.³⁴ found that 79% of the subjects with CDs cleaned their dentures daily, which was lower than in our sample (98%). Nevalainen et al.¹⁹ reported 96% of those with CDs cleaning them once or more often per day. Marković et al.³⁵ established a statistically significant difference in occurrence of denture related stomatitis in patients who cleaned their dentures correctly and those who did not. They also reported that only 18% denture wearers received instructions on denture cleaning from their dentists, while in our study 50% of the CD wearers were given these instructions.

The prevalence of only the type I and the type II of DS in RPD wearers (significantly lower than in CDs, where the type III was also registered) was influenced by the denture material and the denture support. In RPDs, the high percentage of dental plaque was found. In the recent literature, information about the similar studies are uncommon. Only few studies investigated the prevalence of the DS under the RPDs²².

Removal of the denture plaque is important in the prevention of this oral condition. Dentist should accept responsibility for providing adequate instruction as the essential part of patient preparation when receiving a denture. Insertion of dentures should not be considered as the final stage of treatment, but rather, the beginning of a long-term relationship between the patient and dentist in maintaining health of the oral tissues. Thus, there is a special and constant need for regular oral hygiene reinforcement, scaling and prophylaxis among denture wearers^{1,14,36}.

Patients' opinion on their good denture hygiene is often overestimated, compared to the plaque finding under their dentures^{37–39}.

In the Asian population, Jeganathan et al.¹, pointed out an impact of denture hygiene habits, denture wearing habits and denture cleanness to the presence of the DS. In the study population smoking habits, denture-wearing habits, denture hygiene habits, denture cleanness and oral hygiene instructions had significant influence on the degree of DS.

Conclusions

Factors influencing denture plaque accumulation and the presence of DS in wearers of complete and RPDs were investigated. The prevalence of DS ranged from 19.3% (Type I and II) to 48.8% (Type I, II, and III) for the mandibular and

maxillary CDs, and from 13.7% to 29.5% (Type I and II) for the mandibular and maxillary RPDs.

The Spearman's rank coefficient indicated significant correlation between the denture plaque accumulation and the DS in total ($r_L = 0.61$; $r_U = 0.85$) and RPDs ($r_L = 0.62$; $r_U = 0.45$).

Smoking habits, denture wearing habits, denture hygiene habits, denture cleanness and oral hygiene instructions made significant influence on the degree of DS in CD wearers ($p < 0.01$). However, patient's age, gender, denture age, denture material and denture support made no significant difference to DS in CD wearers ($p > 0.01$). Denture material and the support had the only significant influence on the degree of DS in RPD wearers ($p < 0.01$). The findings of this study conducted on Croatian population did not differ from earlier studies on different population.

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OCJENA PROTETSKOG STOMATITISA U ODRASLOJ POPULACIJI HRVATSKE

S A Ž E T A K

Protetski stomatitis često se može naći kod djelomičnih proteza. Mnogobrojni faktori imaju ulogu u njegovom nastanku, kao što su dob i spol bolesnika, navika pušenja, starost proteze, materijal od kojeg je načinjena proteza, navike vezane uz nošenje proteze, navike održavanja higijene proteze, upute o održavanju oralne higijene, čistoća proteze i nakupljanje plaka na protezi. U ovoj studiji sudjelovalo je ukupno 200 bolesnika (63 muškarca i 137 žena) dobi od 45 do 83 godina. Polovica od ispitivanih bolesnika (100) nosila je totalnu protezu, a druga polovica (100) djelomičnu protezu. Različite navike pušenja i nošenja proteze, te navike održavanja higijene proteze, čistoća proteze i upute o održavanju oralne higijene pokazale su kako imaju značajan utjecaj na stupanj protetskog stomatitisa u nosioca totalnih proteza ($p < 0.01$). U nosioca djelomičnih proteza, značajan utjecaj na razvoj protetskog stomatitisa ($p < 0.01$) imali su materijal od kojeg je načinjena proteza te kvaliteta potpornog tkiva. Značajna korelacija nađena je između nakupljanja plaka na protezi i protetskog stomatitisa i kod gornjih i donjih totalnih proteza ($r_U = 0.85$; $r_L = 0.61$) kao i kod gornjih i donjih djelomičnih proteza ($r_U = 0.45$; $r_L = 0.62$).