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Salivary flow rate and oral health status in type 2 diabetics

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SUMMARY

Introduction Decreased salivary flow is frequently associated with numerous diseases such as diabetes mellitus and may lead to numerous oral diseases. The aim of this study was to compare salivary flow rate and oral health status in type 2 diabetics and healthy controls.

Material and methods The study involved 90 patients, divided into the three groups: 30 with well controlled (HbA1c<9%), 30 will poorly controlled (HbA1c≥9%) diabetes and 30 healthy subjects. The following clinical parameters were determined: decayed, missing and filled teeth (DMFT); plaque index (PI), sulcus bleeding index (SBI), probing pocket depth (PPD) and clinical attachment level (CAL). Culture of *Candida spp.* specimens were obtained from tongue dorsum and inoculated into Sabouraud Dextrose Agar. Saliva was collected using "a spit technique".

Results Highest mean of unstimulated salivary flow was in healthy subjects; however significant difference between groups was not observed. Stimulated salivary flow results indicate significant reduction in diabetics as well as significant relation between metabolic control and salivary flow. Unstimulated and stimulated salivary flows were negatively and significantly correlated with periodontal parameters and DMFT.

Conclusion The present findings indicate that decreased salivary flow rate could have a significant impact on oral health status in type 2 diabetics.

Keywords: diabetes mellitus; salivary flow; dental caries; periodontitis; candidiasis

INTRODUCTION

Diabetes mellitus (DM) is metabolic syndrome characterized by chronic hyperglycemia caused by absolute or relative lack of insulin. Chronic hyperglycemia leads to many complications, which underlines the importance of adequate metabolic control. Glucose metabolism control significantly impacts the extent and severity of diseases associated with diabetes including those in oral cavity.

Saliva is biological fluid of fundamental importance for the preservation of oral health. Consequently, decreased salivary flow is frequently associated with numerous oral diseases. There is clear evidence that the prevalence, severity and progression of periodontal disease are higher in diabetics, although mechanisms for such association are not clearly understood [1, 2]. The main etiological factor for the development of periodontal disease is dental plaque (biofilm). Increased amount of plaque in patients with diabetes is a result of increased salivary glucose and decreased salivary secretion. Bacteria from biofilm appear to act directly or indirectly, via cell and humoral components of specific and non-specific host responses [3]. It is well known that periodontal disease can have negative impact on metabolic control and the incidence of diabetes complications, but also the treatment of periodontal disease can favorably affect glycemic regulation [4, 5]. The role of saliva in the maintenance of tooth integrity is also of great importance, as confirmed by Leone et al. [6]. The authors examined the influence of saliva on the occurrence as well as development of dental caries and concluded that the flow of saliva, undoubtedly, presents most important factor for the development of cavities. Due to reduced secretion of saliva, caries lesions develop rapidly affecting even the places that are not caries susceptible. A review of the literature reveals reduced salivary flow rate in patients with diabetes [7], which could explain increased dental caries incidence in this population. Some of the early, nonspecific signs of poorly-controlled diabetes include oral candidiasis and other opportunistic infections [8]. Oral candidiasis is frequently a sign of systemic immunosuppression. In fact, reduced salivary secretion combined with high concentration of glucose in saliva can accelerate the growth of fungi and their adherence to oral mucosal epithelial cells. Oral candidiasis is reported to be more prevalent especially in diabetic denture wearers [9], who do smoke and have poor glycemic control [10].

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Table 1. Sociodemographic and clinical characteristics of patients
Tabela 1. Sociodemografske i kliničke karakteristike pacijenata

Parameter Parametar		HbA1c < 9%	HbA1c ≥ 9%	HS ZO	p
Age (years) ($\bar{X}$± SD) Starost (godine) ($\bar{X}$± SD)		59.50 ± 6.64	60.73 ± 5.89	52.50 ± 6.27	p* < 0.05
Gender (%) Pol (%)	Male Muški	53.3	43.3	30	p*** > 0.05
	Female Ženski	46.7	56.7	70	
Diabetes duration (years) ($\bar{X}$±SD) Trajanje dijabetesa (godine) ($\bar{X}$± SD)		8.57 ± 7.44	9.18 ± 6.97	-	p** > 0.05
HbA1c ($\bar{X}$± SD)		7.67 ± 1.02	10.54 ± 1.59	-	p** < 0.05

*ANOVA; **t-test; ***χ^2 test
HS – healthy subjects
ZO – zdrave osobe

The aim of this study was to compare the salivary flow rate and oral health status in type 2 diabetics and healthy controls.

METHODS

Study design and participants

The study involved 90 patients, 60 with type 2 diabetes and 30 without diabetes (control subjects), aged 45-65 years. With respect to level of HbA1c diabetic subjects were divided into the two groups: 30 better-controlled (HbA1c<9%) and 30 poorly-controlled (HbA1c≥9%), recruited from the Department of Endocrinology University Hospital Foca, Bosnia and Herzegovina. The 9% of HbA1c cut-off point has been suggested to represent an indicator for ineffective blood glucose management in type 2 diabetes [11]. The control group consisted of 30 healthy subjects who visited Dental Clinic, Faculty of Medicine Foca, University East Sarajevo, for regular checkups. The study was approved by the institutional committee of ethics (No. 01-8/140) and was conducted in accordance with the Helsinki Declaration of 1975, as revised 1983. The presence of severe mental or systemic disorder, pregnancy, signs or symptoms of AIDS and antibiotic administration during the last 6 months were exclusion criteria in this study. After the study was explained to the patients, written informed consent was obtained from all patients recruited in the study.

Oral clinical examination was performed at the Dental clinic, Faculty of Medicine Foca, University of East Sarajevo, Bosnia and Herzegovina according to WHO criteria [12]. The examination was conducted using a dental mirror and both dental and periodontal probes. The following was determined: decayed, missing and filled teeth (DMFT); plaque index (PI), sulcus bleeding index (SBI), probing pocket depth (PPD) and clinical attachment level (CAL). Periodontal parameters were assessed at four sites around each tooth (mesiobuccal, distobuccal, mesiolingual and distolingual locations). Culture specimens to *Candida spp.* were obtained from dorsum of the tongue using a sterile cotton-tipped swab and inoculated into Sabouraud Dextrose Agar for 48 hours.

All patients were asked to abstain from eating for 2 hours before saliva collection [13]. Both unstimulated and stimulated saliva were collected using "a spit technique". Stimulated saliva was collected using 10% citric acid that was dropped onto the tongue [14]. Each patient was instructed to seat in dental chair with head tilted forward and instructed not to speak, do any head movements or swallow any saliva if present in the mouth during the procedure. After that, the patients were asked to spit in a sterile cup every minute for 5 minutes. Salivary flow was calculated in ml/min.

Statistical analyses

All statistical analyses were performed using SPSS version 19.0 for Windows. Results were expressed as mean values ± standard deviation (SD). The differences between the groups were assessed by ANOVA or chi-square test. Relationships between variables were evaluated by Pearson correlation coefficient. The value of $p<0.05$ was considered statistically significant.

RESULTS

Sociodemographic and clinical characteristics of all subjects are presented in Table 1. Study included 64 (57.8%) female and 26 (42.2%) male subjects. The mean age of the study population was 57.58±7.19. The healthy subjects had slightly more unstimulated salivary flow rate than well-controlled diabetics, although the difference was not statistically significant. Poorly-controlled diabetics had statistically significantly lower unstimulated and stimulated salivary flow rate than healthy control (Table 2).

Table 3 shows periodontal and dental health in all patients. Diabetic patients had poor periodontal health. A statistically significant difference was observed between the groups. In fact, both poorly and better-controlled diabetics had deeper periodontal pockets, more attachment loss, more bleeding on probing and higher mean value of plaque index than healthy subjects. Type 2 diabetics with poor metabolic control had significantly more decayed teeth and higher mean value of DMFT index than healthy control. Better-controlled diabetics had more decayed

Table 2. Mean values of USFR and SFR in subjects with different metabolic control of diabetes mellitus type 2 and healthy patients
Tabela 2. Srednje vrednosti PNSP i PSP kod ispitanika sa različitom metaboličkom kontrolom dijabetesa melitusa tipa 2 i zdravih pacijenata

	HbA1c < 9%	HbA1c ≥ 9%	HS ZI	p*
USFR (ml/min) ($\bar{X}$±SD) PNSP (ml/min) ($\bar{X}$±SD)	0.23 ± 0.14	0.19 ± 0.11	0.30 ± 0.16	1:3 > 0.05 2:3 > 0.05
SFR (ml/min) (X–±SD) PSP (ml/min) ($\bar{X}$±SD)	0.70 ± 0.34	0.60 ± 0.33	0.85 ± 0.33	1:3 < 0.01 2:3 < 0.01

*ANOVA
USFR – unstimulated salivary flow; SFR – stimulated salivary flow
PNSP – protok nestimulisane pljuvačke; PSP – protok stimulisane pljuvačke

HbA1c – glycosylated hemoglobin
HbA1c – glikozilisani hemoglobin

HS – healthy subjects
ZI – zdravi ispitanici

teeth and higher mean value of DMFT index than healthy control, but statistically significant differences between the groups were not observed. Also, the difference in prevalence of missing and filled teeth was statistically significant between the groups.

Regarding the frequency of oral candidiasis, there was statistically significant difference between poorly controlled diabetics and healthy subjects. No statistically significant difference was found between well-controlled diabetics and healthy subjects in regards to candida isolation (Table 3).

Pearson correlation analyses revealed statistically significant negative correlation between unstimulated salivary flow rate (USFR) as well as stimulated salivary flow rate (SFR) and DMFT index, plaque index (PI), sulcus bleeding index (SBI), clinical attachment loss (CAL) and probing pocket depth (PPD). Negative but non-significant correlation was observed between USFR as well as SFR and oral candidiasis (Table 4).

Table 3. Oral health status of patients
Tabela 3. Stanje oralnog zdravlja ispitanika

	HbA1c<9%	HbA1c≥9%	HS/ZI	p
PI/IP	2.10 ± 0.71	2.64 ± 0.37	1.13 ± 0.68	1:3 < 0.001*
($\bar{X}$±SD)				2:3 < 0.001*
SBI/IKG	1.97 ± 0.83	2.79 ± 0.59	0.87 ± 0.77	1:3 < 0.001*
($\bar{X}$±SD)				2:3 < 0.001*
CAL/NPE	3.99 ± 1.65	4.74 ± 1.27	1.49 ± 1.32	1:3 < 0.001*
($\bar{X}$±SD)				2:3 < 0.001*
PPD/DPDŽ	4.51 ± 1.54	5.85 ± 0.81	3.10 ± 1.11	1:3 < 0.001*
($\bar{X}$±SD)				2:3 < 0.001*
Decayed teeth Karijesni zubi	2.10 ± 0.71	2.64 ± 0.37	1.13 ± 0.68	1:3 > 0.05*
($\bar{X}$±SD)				2:3 < 0.001*
Missing teeth Izvađeni zubi	1.97 ± 0.83	2.79 ± 0.59	0.87 ± 0.77	1:3 < 0.05*
($\bar{X}$±SD)				2:3 < 0.01*
Filled teeth Plombirani zubi	3.99 ± 1.65	4.74 ± 1.27	1.49 ± 1.32	1:3 < 0.05*
($\bar{X}$±SD)				2:3 < 0.001*
DMFT KEP	4.51 ± 1.54	5.85 ± 0.81	3.10 ± 1.11	1:3 < 0.05*
($\bar{X}$±SD)				2:3 < 0.001*
Positive oral candidiasis Pozitivna oralna kandidijaza	23.40	43.30	10.00	1:3 > 0.05**
(%)				2:3 < 0.05**

*ANOVA; ** χ^2 test

HS – healthy subjects; PI – plaque index; SBI – sulcus bleeding index; CAL – clinical attachment level; PPD – probing pocket depth; DMFT – decayed, missing and filled teeth

ZI – zdravi ispitanici; IP – indeks plaka; IKG – indeks krvarenja gingive; NPE – nivo pripojnog epitela; DPDŽ – dubina parodontalnog džepa; KEP – indeks karioznih, ekstrahovanih i plombiranih zuba

Table 4. Correlation of USFR and SFR with parameters of oral health
Tabela 4. Korelacija PNSP i PSP sa parametrima oralnog zdravlja

	DMFT KEP	PI IP	SBI IKG	CAL NPE	PPD DPDŽ	OC OK
USFR PNSP	-0.405**	-0.423**	-0.407**	-0.391**	-0.311**	-0.062
SFR PSP	-0.329**	-0.472**	-0.385**	-0.475**	-0.271**	-0.134

Pearson correlation; **p < 0.01
Pirsonova korelacija; **p < 0,01

USFR – unstimulated salivary flow; SFR – stimulated salivary flow; DMFT – decayed, missing and filled teeth index; PI – plaque index; SBI – sulcus bleeding index; PPD – probing pocket depth; CAL – clinical attachment level; OC – oral candidiasis

PNSP – protok nestimulisane pljuvačke; PSP – protok stimulisane pljuvačke; KEP – indeks karioznih, ekstrahovanih i plombiranih zuba; IP – indeks plaka, IKG – indeks krvarenja gingive; DPDŽ – dubina parodontalnog džepa; NPE – nivo pripojnog epitela; OK – oralna kandidijaza

DISCUSSION

Several studies reported reduced salivary secretion of both unstimulated and stimulated saliva in diabetics [15, 16]. The pathogenic mechanisms linking diabetes and hyposalivation are not fully understood. Dehydration as a result of prolonged hyperglycemia and resultant polyuria is considered to be the main cause of salivary glands hypofunction. However, dehydration by itself cannot explain functional changes in salivary glands. It is believed that the two most common degenerative complications of diabetes, neuropathy and microangiopathy are crucial for pathologic changes in the structure of salivary glands [17]. Increased concentration of calcium in parotid and submandibular saliva can explain higher prevalence of sialolithiasis in diabetics and consequently oligosialia. Also, influence of glycemic control on salivary flow is still controversy [11, 18]. The present findings show that the mean USFR was highest in healthy subjects, but there was no significant difference between groups. Similar results were presented in the study of Panchbhai et al. [19]. Results of our study indicate statistically significant SFR reduction in diabetics and significant corelation between metabolic control and salivary flow. Our results are in agreement with the study of Chavez et al. that also confirmed this relationship [20].

Recent studies clearly indicated that diabetes is an important risk factor for periodontitis [21, 22]. Diabetes is considered to promote periodontitis through an exaggerated inflammatory response to the periodontal pathogens [23]. Some studies indicate that although diabetes presents a risk factor for periodontitis, periodontitis may, on the other hand, have a negative effect on the metabolic control of diabetes. [4, 5, 24]. Results of our study demonstrated

deeper periodontal pockets, more attachment loss, more bleeding on probing and higher mean value of plaque index in poorly-controlled diabetics. These results are in accordance with the findings of Mohamed et al. [25]. Moreover, our findings indicated that both, unstimulated and stimulated salivary flow rate, were negatively and significantly correlated with periodontal parameters. It has been shown that diabetic patients with xerostomia are more susceptible to periodontal infection [26]. Some studies confirmed that periodontal disease was strongly related to salivary flow rate [27].

Previous studies reported contradictory results about relationship between dental caries and diabetes mellitus. Our results showed significantly increased number of decayed teeth in poorly controlled diabetics. Similar results were obtained in study by Bakhshandeh et al. where subjects with better glycemic control had significantly lower number of decayed teeth compared to those with poor glycemic control [28]. In contrast, Syräjlä et al. revealed no association between the HbA1c level and dental caries [29]. Apart from metabolic control of diabetes, development of dental caries is affected by many other factors, among which dental plaque presence is the most important. It is well established that development of caries is a result of metabolic events in dental plaque over time and that it can be increased in terms of impaired function of saliva. High glucose level in saliva and gingival crevicular fluid can cause increase of saliva cariogenic organisms in both supragingival and subgingival plaque in diabetics [30]. Salivary flow reduction leads to impaired antimicrobial actions of saliva as well. In our study, salivary flow rate was negatively and significantly correlated with DMFT, in contrast to the results of study by Karjalainen et al. [31]. Moore et al. reported an association between a low salivary flow rate and slightly increased incidence of dental caries [32]. As a contradictory result, Collin et al. reported higher prevalence of dental caries among those with higher salivary flow rate [33].

According to the literature, prevalence of oral candidiasis was reported to be higher in patients with diabetes type 2 compared to healthy persons [34, 35]. In addition to changes in the composition and quantity of saliva, the presence of infection with *Candida spp.* in type 2 diabetics is also associated with impaired cellular immunity. The high prevalence of *Candida spp.* is especially pronounced in diabetic denture wearers. *Candida spp*. can co-aggregate with bacteria in biofilm of denture surface that than become a reservoir of aforementioned microorganisms with further potential to colonize oral mucosa. It has been estimated that 33. 3% of diabetics in our study were diagnosed with oral candidiasis and that is in accordance with the study by Shenoy et al. [36]. Similar results were reported by Guggenheimer et al. [37]. All those findings support the role of diabetes mellitus as a predisposing factor for increased *Candida spp* colonization of oral mucosa. In accordance with the study of Navazesh et al. [38], results of our study also showed negative correlation between salivary flow rate and oral candidiasis although without statistical significance.

CONCLUSION

In conclusion, within the limitation of the cross-sectional study design, our study demonstrated that decreased salivary flow rate could have a significant impact on oral health status in patients with diabetes mellitus type 2. Due to the importance of saliva in the maintenance of tooth integrity and oral health in general, management of oral diseases in diabetics should include a comprehensive evaluation of salivary function.

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Protok pljuvačke i stanje oralnog zdravlja kod obolelih od dijabetesa tipa 2

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KRATAK SADRŽAJ

Uvod Smanjen protok pljuvačke se često dovodi u vezu sa brojnim oboljenjima, kao što je dijabetes melitus, i može dovesti do brojnih oralnih bolesti.

Cilj ove studije je bio da se uporede protok pljuvačke i status oralnog zdravlja kod obolelih od dijabetesa melitusa tipa 2 i zdravih ispitanika.

Materijal i metode rada Studija je obuhvatila 90 pacijenata, podeljenih u tri grupe: 30 bolje kontrolisanih (HbA1c < 9%), 30 loše kontrolisanih (HbA1c ≥ 9%) dijabetičara i 30 zdravih ispitanika. Određeni su sledeći klinički parametri: kariozni, ekstrahovani i plombirani zubi (KEP); indeks plaka (IP), indeks krvarenja gingive (IKG), dubina parodontalnog džepa (DPDŽ) i nivo pripojnog epitela (NPE). Uzorci kulture *Candida spp.* su prikupljeni sa dorzuma jezika i kultivisani na agaru *Sabouraud Dextrose*. Pljuvačka je prikupljena metodom sukcije i pljuvanja.

Rezultati Najveća prosečna vrednost nestimulisane pljuvačke je bila kod zdravih ispitanika; međutim, značajna razlika između grupa nije primećena. Rezultati protoka stimulisane pljuvačke upućuju na značajno smanjenje kod dijabetičara, kao i značajnu vezu između metaboličke kontrole i protoka pljuvačke. Protok nestimulisane i stimulisane pljuvačke je pokazao značajnu negativnu korelaciju sa parodontalnim parametrima i KEP-om.

Zaključak Rezultati ove studije ukazuju da smanjen protok pljuvačke može imati značajan uticaj na status oralnog zdravlja kod obolelih od dijabetesa tipa 2.

Ključne reči: dijabetes melitus; protok pljuvačke; karijes zuba; parodontopatija; kandidijaza

UVOD

Dijabetes melitus (DM) metabolički je sindrom koji se karakteriše hroničnom hiperglikemijom nastalom zbog relativnog ili apsolutnog nedostatka insulina. Hronična hiperglikemija vodi mnogim komplikacijama, što ukazuje na važnost adekvatne metaboličke kontrole. Kontrola metabolizma glukoze značajno utiče na obim i težinu bolesti udruženih sa dijabetesom, uključujući i stanja u usnoj duplji.

Pljuvačka je biološka tečnost koja je od fundamentalne važnosti za očuvanje oralnog zdravlja. Shodno tome, smanjen protok pljuvačke je često udružen sa pojavom brojnih oralnih oboljenja. Postoje jasni dokazi koji upućuju da su učestalost, težina i napredak parodontopatije više izraženi kod dijabetičara, iako sami mehanizmi te povezanosti nisu potpuno razjašnjeni [1, 2]. Osnovni etiološki faktor za nastanak parodontopatije je dentalni plak (biofilm). Povećana količina plaka kod pacijenata obolelih od dijabetesa je rezultat povišenog nivoa glukoze u pljuvački i smanjene salivarne sekrecije. Bakterije iz biofilma deluju direktno ili indirektno putem celularnih i humoralnih komponenata specifičnog i nespecifičnog odgovora domaćina [3]. Dobro je poznato da parodontopatija može imati negativan uticaj na metaboličku kontrolu i učestalost komplikacija dijabetesa, ali s druge strane, terapija parodontopatije može povoljno uticati na metaboličku kontrolu [4, 5]. Uloga pljuvačke u očuvanju integriteta zuba je od velike važnosti, što je potvrđeno u studiji Leone i sar. [6]. Autori su ispitivali uticaj pljuvačke na nastanak i razvoj karijesa i zaključili da protok pljuvačke nesumnjivo predstavlja važan faktor za razvoj karioznih lezija. Zbog smanjenog protoka pljuvačke, kariozne lezije se razvijaju brzo čak i na mestima koja nisu predilekciona za nastanak karijesa. Pregledom literature uočava se smanjen protok pljuvačke kod obolelih od dijabetesa [7], što može objasniti povećanu učestalost karijesa kod ove populacije. Neki od ranih, nespecifičnih znakova loše kontrolisanog dijabetesa uključuju oralnu kandidijazu i druge oportunističke infekcije [8]. Oralna kandidijaza je često znak sistemske imunsupresije. Zapravo, smanjeno lučenje pljuvačke udruženo sa visokom koncentracijom glukoze u pljuvački može ubrzati rast gljivica i njihovo vezivanje za epitelne ćelije oralne mukoze. Oralna kandidijaza je češća kod dijabetičara koji imaju mobilne protetske nadoknade [9], koji puše i onih koji imaju lošu glikemijsku kontrolu [10]. Cilj ove studije je bio uporediti protok pljuvačke i status oralnog zdravlja kod pacijenata obolelih od dijabetesa tipa 2 i zdravih kontrolnih ispitanika.

MATERIJAL I METODE RADA

Dizajn studije i učesnici

U studiju je uključeno 90 pacijenata, 60 obolelih od dijabetesa tipa 2 i 30 bez dijabetesa (kontrolnih ispitanika) starosti 45–65 godina. U odnosu na nivo HbA1c ispitanici sa dijabetesom su podeljeni na dve grupe: 30 bolje kontrolisanih (HbA1c < 9%) i 30 loše kontrolisanih (HbA1c ≥ 9%), upućenih sa Odeljenja za endokrinologiju Univerzitetske bolnice Foča, Republika Srpska, Bosna i Hercegovina. Presek nivoa HbA1c od 9% je korišćen jer predstavlja indikator neefektivne kontrole glukoze u krvi dijabetesa tipa 2 [11]. Kontrolna grupa je obuhvatila 30 zdravih ispitanika koji su posetili Stomatološku kliniku Medicinskog

fakulteta u Foči, Univerziteta u Istočnom Sarajevu radi redovnih kontrolnih pregleda. Studija je odobrena od strane institucionalnog etičkog komiteta (No. 01-8/140) i sprovedena je u skladu sa Helsinškom deklaracijom iz 1975, revidiranom 1983. Prisustvo teških mentalnih ili sistemskih poremećaja, trudnoća, znaci ili simptomi AIDS-a i primena antibiotika tokom poslednjih šest meseci su bili kriterijumi za isključenje u ovoj studiji.

Nakon što je studija objašnjena pacijentima, pacijenti uključeni u ovo istraživanje su potpisali saglasnost za učešće u studiji.

Oralni klinički pregled je obavljen na Stomatološkoj klinici Medicinskog fakulteta u Foči, Univerziteta u Istočnom Sarajevu, Bosna i Hercegovina, u skladu sa kriterijumima SZO [12]. Pregled je obavljen uz korišćenje stomatološkog ogledalca kao i obe, i stomatološke i parodontalne, sonde. Određeni su sledeći parametri: kariozni, ekstrahovani i plombirani zubi (KEP); indeks plaka (IP), indeks krvarenja gingive (IKG), dubina parodontalnog džepa (DPDŽ) i nivo pripojnog epitela (NPE). Parodontalni parametri su procenjeni na četiri mesta oko svakog zuba (meziobukalnoj, distobukalnoj, meziolingvalnoj i distolingvalnoj lokalizaciji). Kulture uzoraka *Candida spp.* su prikupljene sa dorzuma jezika upotrebom sterilnog štapića sa vrhom obloženim vatom i kultivisane na agar *Sabouraud Dextrose* 48 sati.

Svi pacijenti su zamoljeni da se suzdrže od jela dva sata pre prikupljanja pljuvačke [13]. Obe, i nestimulisana i stimulisana pljuvačka, prikupljene su metodom sukcije i pljuvanja. Stimulisana pljuvačka je prikupljena posle aplikovanja 10% limunske kiseline na jezik [14]. Svaki pacijent je upućen da sedne na stomatološku stolicu sa glavom nagnutom napred, da ne priča, ne čini nikakve pokrete glavom, niti da guta pljuvačku prisutnu u ustima tokom procedure. Posle toga, pacijenti su zamoljeni da pljuju u sterilnu čašu svake minute tokom pet minuta. Protok pljuvačke je meren u ml/min.

Statistička analiza

Statistička analiza je izvedena u verziji SPSS 19.0 za Windows. Rezultati su izraženi kao srednje vrednosti ± standardna devijacija (SD). Razlike između grupa su procenjene sa testovima ANOVA ili hi-kvadrat. Veze između varijabli su procenjene Pirsonovim koeficijentom korelacije. Vrednost $p < 0,05$ je smatrana statistički značajnom.

REZULTATI

Sociodemografske i kliničke karakteristike svih ispitanika su predstavljene u Tabeli 1. Studija je obuhvatila 64 (57,8%) ženska i 26 (42,2%) muških ispitanika. Srednja vrednost starosti populacije studije je bila 57,58 ± 7,19.

Zdravi ispitanici su imali nešto veći protok nestimulisane pljuvačke nego dobro kontrolisani dijabetičari, iako razlika nije bila statistički značajna. Loše kontrolisani dijabetičari su imali značajno niži protok nestimulisane i stimulisane pljuvačke nego zdrave kontrole (Tabela 2).

Tabela 3 pokazuje parodontalno i dentalno zdravlje kod svih pacijenata. Pacijenti sa dijabetesom su imali lošije parodontalno zdravlje. Između grupa je primećena statistički značajna razlika. Međutim, i loše i dobro kontrolisani dijabetičari su imali dublje parodontalne džepove, veći nivo pripojnog epitela, izraženije krvarenje na sondiranje i veće vrednosti indeksa plaka od zdravih kontrolisanih. Bolesnici sa dijabetesom tipa 2 i lošom metaboličkom kontrolom su imali značajno više karioznih zuba i veće vrednosti indeksa KEP od zdravih ispitanika. Dobro kontrolisani dijabetičari su imali više karioznih zuba i veće vrednosti indeksa KEP od zdravih ispitanika, ali nisu primećene statistički značajne razlike između grupa. Takođe, razlika u učestalosti ekstrahovanih i plombiranih zuba je bila statistički značajna između grupa.

Posmatrajući učestalost oralne kandidijaze, uočena je statistički značajna razlika između loše kontrolisanih dijabetičara i zdravih ispitanika. Statistički značajna razlika nije nađena između dobro kontrolisanih dijabetičara i zdravih ispitanika u odnosu na izolaciju kandide (Tabela 3).

Analiza Pirsonove korelacije je otkrila statistički značajnu negativnu korelaciju između PNSP, kao i PSP i indeksa KEP, indeksa plaka (IP), indeksa krvarenja gingive (IKG), nivoa pripojnog epitela (NPE) i dubine parodontalnog džepa (DPDŽ). Negativna korelacija je uočena između PNSP, kao i PSP i oralne kandidijaze, ali nije bila statistički značajna (Tabela 4).

DISKUSIJA

Nekoliko studija je objavilo prisustvo smanjene sekrecije i nestimulisane i stimulisane pljuvake kod dijabetičara [15, 16]. Patološki mehanizmi koji povezuju dijabetes i hiposalivaciju nisu potpuno razjašnjeni. Dehidratacija koja nastaje kao rezultat produžene hiperglikemije i posledična poliurija se smatraju glavnim uzrokom smanjene funkcije pljuvačnih žlezda. Međutim, dehidratacija sama po sebi ne može objasniti funkcionalne promene u pljuvačnim žlezdama. Veruje se da su dve najčešće degenerativne komplikacije dijabetesa, neuropatija i mikroangiopatija, od presudnog značaja za patološke promene u strukturi pljuvačnih žlezda [17]. Povećana koncentracija kalcijuma u parotidnoj i submandibularnoj pljuvački može objasniti veću učestalost sijalolitijaze kod dijabetičara i posledičnu oligosijaliju. Takođe, uticaj glikemijske kontrole je još uvek nerazjašnjen [11, 18]. Rezultati ove studije pokazuju da je vrednost nivoa nestimulisane pljuvačke bila najveća kod zdravih ispitanika, ali značajna razlika između grupa nije primećena. Slične rezultate su u svojoj studiji objavili Panchbhai i sar. [19]. Rezultati naše studije pokazuju statistički značajno smanjenje protoka stimulisane pljuvačke kod dijabetičara i značajnu vezu između metaboličke kontrole i protoka pljuvačke. Naši rezultati su u skladu sa rezultatima studije koju su objavili Chavez i sar., koji takođe potvrđuju ovaj odnos [20].

Nedavne studije nedvosmisleno upućuju na to da je dijabetes važan faktor rizika u nastanku parodontopatije [21, 22]. Smatra se da dijabetes doprinosi razvoju parodontopatije kroz izražen inflamatorni odgovor na parodontalne patogene [23]. Neke studije upućuju na to da, iako dijabetes predstavlja faktor rizika za parodontopatiju, parodontopatija može, s druge strane, imati negativan uticaj na metaboličku kontrolu dijabetesa [4, 5, 24]. Rezultati naše studije pokazuju dublje parodontalne džepove, veći nivo pripojnog epitela, izraženije krvarenje na sondiranje i veće srednje vrednosti indeksa plaka kod loše kontolisanih dijabetičara. Ovi rezultati su u skladu sa navodima Mohameda i sar. [25]. Nadalje, naši rezultati upućuju da su oba, PNSP i PSP, u negativnoj i značajnoj korelaciji sa parodontalnim parametrima. Pokazalo se da su bolesnici oboleli od dijabetesa koji imaju kserostomiju podložniji parodontopatiji [26]. Neke

studije potvrđuju da je parodontopatija snažno povezana sa protokom pljuvačke [27].

Prethodne studije izveštavaju kotradiktorne rezultate o vezi odnosa zubnog karijesa i dijabetesa melitusa. Rezultati naše studije su pokazali značajno povećan broj karioznih zuba kod loše kontrolisanih dijabetičara. Slične rezultate su prikazali Bakhshandeh i sar. u svojoj studiji, gde su ispitanici sa boljom glikemijskom kontrolom imali manje karioznih zuba u poređenju sa ispitanicima sa lošom glikemijskom kontrolom [28]. Suprotno navedenom, Syräjlä i sar. nisu našli povezanost između nivoa HbA1c i zubnog karijesa [29]. Pored metaboličke kontrole dijabetesa, na razvoj karijesa utiču i mnogi drugi faktori, od kojih prisustvo dentalnog plaka ima najveći značaj. Poznato je da je razvoj karijesa posledica metaboličkih dešavanja u dentalnom plaku u funkciji vremena i da može biti povećan u uslovima poremećene funkcije pljuvačke. Visoki nivoi glukoze u pljuvački i gingivalnoj tečnosti mogu dovesti do povećanja salivarnih kariogenih mikroorganizama u supragingivalnom i subgingivalnom plaku kod dijabetičara [30]. Smanjenje protoka pljuvačke takođe vodi ka slabljenju antimikrobne aktivnosti pljuvačke. U našoj studiji protok pljuvačke je bio u negativnoj i značajnoj korelaciji sa KEP-om, nasuprot rezultatima koje su u svojoj studiji prikazali Karjalainen i sar. [31]. Moore i sar. su u svojoj studiji objavili vezu između slabijeg protoka pljuvačke i neznatno povećane učestalosti karijesa [32]. Suprotno tome, Collin i sar. su objavili veću učestalost karijesa među ispitanicima sa većim protokom pljuvačke [33].

Prema navodima iz literature, učestalost oralne kandidijaze je veća kod pacijenata obolelih od dijabetesa tipa 2 u poređenju sa zdravim ispitanicima [34, 35]. Uz promene u sastavu i količini pljuvačke, prisustvo infekcije gljivicama iz roda kandida kod obolelih od dijabetesa tipa 2 dovodi se u vezu sa poremećenim celularnim imunitetom. Velika učestalost *Candida spp.* je posebno izražena kod dijabetičara koji nose mobilne protetske nadoknade. *Candida spp*. može koegzistirati sa bakterijama iz biofilma na površini proteza, koje tako postaju rezervoar gorepomenutih mikroorganizama sa daljim potencijalom za koloniziranje oralne mukoze. Oralna kandidijaza je potvrđena kod 33,3% dijabetičara naše studije, što je u skladu sa navodima koje u svojoj studiji daju Shenoy i sar. [36]. Slične rezultate su objavili Guggenheimer i sar. u svojoj studiji [37]. Svi ovi navodi podržavaju ulogu dijabetesa melitusa kao predisponirajućeg faktora za povećanu kolonizaciju oralne mukoze gljivicama iz roda kandida. Kao što su objavili Navazesh i sar. [38], rezultati i naše studije su pokazali negativnu korelaciju između protoka pljuvačke i oralne kandidijaze, iako bez statističke značajnosti.

ZAKLJUČAK

U zaključku, u okviru ograničenja dizajna studije preseka, naša studija ukazuje da smanjen protok pljuvačke može imati značajan uticaj na status oralnog zdravlja kod bolesnika obolelih od dijabetesa melitusa tipa 2. Zbog važnosti pljuvačke u očuvanju integriteta zuba i oralnog zdravlja uopšte, tretman oralnih bolesti kod dijabetičara bi trebalo da uključi i sveobuhvatnu evaluaciju salivarne funkcije.