



STOMATOLOŠKI GLASNIK SRBIJE

SERBIAN DENTAL JOURNAL

Vol. 65 • Number 3 • July-September 2018





STOMATOLOŠKI GLASNIK SRBIJE

SERBIAN DENTAL JOURNAL

Vol. 65 • Number 3 • July-September 2018

Adresa uredništva
Srpsko lekarsko društvo
Kraljice Natalije 1
11000 Beograd
Srbija

Telefon: +381 (0)11 409 27 76
Email: stomglas@bvcom.net

Address of the Editorial Office
Serbian Medical Society
Kraljice Natalije 1
11000 Belgrade
Serbia

Phone: +381 (0)11 409 27 76
Email: stomglas@bvcom.net

Časopis izlazi četiri puta godišnje.
The journal is published four times a year.

Cene preplate za 2018. godinu su: 2.400 dinara za pojedince, 4.800 dinara za ustanove i 50 evra za čitače van Srbije. Preplata se može uplatiti Srpskom lekarskom društvu, ul. Džordža Vašingtona 19, 11000 Beograd, na tekući račun 205-8041-21 (Komercijalna banka AD, Beograd), sa pozivom na broj 04/1710, imenom časopisa i godinom za koju se pretplata uplaćuje. Sve dodatne informacije mogu se dobiti na telefon 011/3245-149.

Subscriptions prices for the year 2018 are: 2,400 RSD for individuals, 4,800 RSD for institutions, and 50 Euros for readers outside Serbia. Subscription order: Serbian Medical Society, Džordža Vašingtona 19, 11000 Belgrade; details of payment: bank account number 205-8041-21 (Komercijalna banka AD, Belgrade), invoice number 04/1710, with the name of the journal and the year for which you subscribe; beneficiary: Serbian Medical Society. For further information, please contact us on stomglas@bvcom.net.

Finansijsku podršku izdavanju časopisa pruža
Ministarstvo prosvete, nauke i tehnološkog razvoja Republike Srbije i Stomatološka komora Srbije.

The publishing of the Journal is financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia and Serbian Dental Chamber.

 sciendo

Copyright © 2018 Srpsko lekarsko društvo.
Sva prava zaštićena.
Copyright © 2018 by the Serbian Medical Society.
All rights reserved.

ISSN 0039-1743
ISSN Online 1452-3701
COBISS. SR-ID 8417026
UDC 616.31

www.stomglas.org.rs



Stomatološki glasnik Srbije **Serbian Dental Journal**

Izдавач Srpsko lekarsko društvo
Publisher Serbian Medical Society

Osnivač Stomatološka sekcija Srpskog lekarskog društva
Founder Dental Section of the Serbian Medical Society

Glavni i odgovorni urednik
Editor-in-Chief
Slavoljub Živković

Zamenik urednika
Associate Editor
Ario Santini

Uređivački odbor
Editorial Board
Zoran Aleksić
Larisa Blažić
Božidar Brković
Milanko Đurić
Mihajlo Gajić
Nina Japundžić-Žigon
Vukoman Jokanović
Vitomir Konstantinović
Vojkan Lazić
Dejan Marković
Milan Petrović
Branka Popović
Jelena Popović
Milica Popović
Ivana Šćepan
Dušan Živković

Međunarodni uređivački odbor
International Editorial Board
Ivan Anžel (Slovenia)
Oscar Bolanos (USA)
Marco Ferrari (Italy)
Markus Haapasalo (Canada)
Maja Dutor Sikirić (Croatia)
Petros Koidis (Greece)
Alessandro Leite Cavalcanti (Brazil)
Predrag C. Lekić (Canada)
Matthias Reinicke (Germany)

Lektor za engleski jezik
English Language Editor
Sonja Stojićić

Lektor za srpski jezik
Serbian Language Editor
Divna Prodanović

Administrativni pomoćnik
Administrative Assistant
Mirko Rajić

Prelom teksta i priprema za štampu
Layout & Prepress
Jasmina Živković

Štampa
Printed by
JP „Službeni glasnik”, Beograd

Broj primeraka
Number of copies
500

Contents / Sadržaj

REČ UREDNIKA	117
ORIGINAL ARTICLES / ORIGINALNI RADOVI	
Mirjana Đuričković, Mirjana Ivanović, Mira Samardžić, Olivera Jovičić, Zorica Popović	
Periodontal health in children with diabetes mellitus type 1 in Montenegro.....	119
Parodontalno zdravlje kod dece obolele od dijabetesa melitusa tipa 1 u Crnoj Gori	
Jelena Popović, Tatjana Cvetković, Tanja Džopalić, Marija Nikolić, Aleksandar Mitić, Radomir Barac, Slavoljub Živković	
The role of interleukin-6 in pathogenesis of chronic periapical lesions.....	126
Uloga interleukina-6 u patogenezi hroničnih periapeksnih lezija	
Marina Milinković, Tanja Ivanović, Predrag Nikolić, Ljiljana Stojanović, Željko Milosavljević, Jovana Samardžija Hrisa, Aleksandra Šarac	
Frequency of malocclusion and condition of dental health among eight-year-old children in the municipality of Foča.....	133
Učestalost malokluzija i stanje dentalnog zdravlja kod osmogodišnjaka na području opštine Foča	
Katarina Radović, Rade Živković, Jovana Kuzmanovic Pficer, Ljiljana Tihaček Šojić, Aleksandra Milić Lemić	
Unilateral complex partial denture performance evaluation: 5 years follow up clinical study	140
Procena uspešnosti terapije jednostranom kompleksnom skeletiranom parcijalnom protezom: petogodišnja klinička studija	
Vanja Opačić Galić, Jovana N. Stašić	
Efficacy of different irrigation techniques on calcium hydroxide removal from the root canal.....	148
Efikasnost različitih tehnika irigacije u uklanjanju kalcijum-hidroksida iz kanala korena	
 DA LI STE PAŽLJIVO ČITALI RADOVE?	
UPUTSTVO AUTORIMA ZA PRIPREMU RADA	159
INSTRUCTIONS FOR AUTHORS	161

*Onaj koji zna ne govori.
Onaj koji govori ne zna.*
Lao Ce

Živimo u vremenu gde je životna egzistencija narativno sve bolja, ali je surova stvarnost oštrotičnja demantuje u svakom segmentu našeg bitisanja. Stručnost, kompetentnost i hrabrost su kvalifikacije kojih kao da nema ni u nauci, ni u obrazovanju, ni u kulturi. Sadržajna bezidejnost je suština onih koji kreiraju našu stvarnost.

Tamo gde visokokvalifikovani i kompetentni odlaze iz zemlje a odgovorni ne čine ništa da ih zadrže, tamo gde su narod i društvo važni samo zarad sopstvenih i ličnih interesa, tamo gde se „neguje nasilje“ nad neistomišljenicima, tamo gde se hrabrost ispoljava brutalno i snagom a ne mudrošću, siguran je znak da društvo nezadrživo juri ka dnu. U svakom segmentu ovog našeg „zlatnog doba“ dominiraju brojke i neka „čudna statistika“. Protagonisti ovakve matematike i besmislenih brojeva koji se baziraju na „imaginarnim“ parametrima, našu egzistenciju poistovećuju sa političkom stvarnošću. A poznato je od davnina da su najveće slabosti svakog sistema upravo bezidejnost i „siromaštvo“ znanjem.

Najveći kapital u svakom segmentu društva je čovek od integriteta (Čitaj čovek sa moralnim, intelektualnim i obrazovnim kvalitetima) koji uz neznatnu hrabrost (bazira se na mudrom poimanju stvarnosti i nadarenosti da kritički misli i odgovorno stvara), jedino može promeniti pravac aktuelnog puta u bezizlaz.

Ali tamo gde je politika sve, tamo gde dominira laž, tamo gde je istina „igla u plastu sena“, tamo gde se na važne funkcije „ustoličavaju“ intelektualno i obrazovno vrlo insuficijentni (čitaj politički poslušni) male su šanse da se probudi kolektivna besvest. Tamo gde je sistem vrednosti potpuno naopak i gde je statistika osnovni parametar za kvalitet života (a ne realna stvarnost), tamo gde su rijaliti kulturna paradigma a estrada i primitivizam najvažniji kulturni i društveni kvalitet, tamo gde su neuki daleko „iznad“ akademika, bolje sutra je nedostićan cilj. Jedan prijatelj je ovo vrlo jasno i slikovito predstavio konstatacijom da oni koji ne znaju da čitaju uglavnom pišu jako dobre, stručne kritike aktuelne poezije i proze. Istina je da jedino mogu da pišu zakone i propise u kojima se potencira isključivo ono što može uvećati ličnu korist.

Politika i njeni protagonisti često su „nasilni“ prema onima koji misle, prema sećanjima i istoriji, prema svemu različitom od njihovih postulata (prema mudrima i slobodoumnima), jer izlaze iz okvira sadašnjeg trenutka.

Uprkos svemu, ovaj civilizacijski paradoks mogu razrešiti upravo oni koji su sa sasvim drugaćijim stavovima od aktuelne politike estrade. Treba biti samo dovoljno hrabar (a hrabrost je vrlina učenih i slobodoumnih) i istrajati na postulatima da jedino znanje, odgovornost i posvećenost mogu raspršiti svaku društvenu anomaliju.

Možda ovo najbolje potvrđuju reči velikog vladike Nikolaja Velimirovića: „Optimizam i pessimizam jednog čoveka ne zavise od njegove sitosti ili gladi, no od broja i kvaliteta svetova koje on doseže svojom vizijom“.

Prof. dr Slavoljub Živković

Periodontal health in children with diabetes mellitus type 1 in Montenegro

Mirjana Đuričković¹, Mirjana Ivanović², Mira Samardžić³, Olivera Jovičić², Zorica Popović¹

¹University of Montenegro, Faculty of Medicine, Department of Dentistry, Podgorica, Montenegro;

²University of Belgrade, Faculty of Dental Medicine, Clinic of Preventive and Pediatric Dentistry, Belgrade, Serbia;

³Institute for diseased children, Podgorica, Montenegro

SUMMARY

Introduction Separation of instruments in the root canal is one of the challenges in endodontic treatment. More specifically, nickel-titanium (NiTi) rotary instruments usually separate without previous deformation. The aim of this pilot study was to assess the effect of torsional stress on endodontic NiTi rotary instruments separation in simulated clinical conditions.

Materials and methods Research was conducted on a sample of 20 human teeth in laboratory conditions. Experimental procedure consisted of determining canal curvatures for each root on digital radiographs and root canal treatment using endodontic NiTi rotary instruments. Out of 20 teeth (60 canals), two groups were formed with similar root canal curvatures (10 pairs of teeth) and instrumented using NiTi rotary instrument with or without torque control.

Results Wilcoxon matched pair test showed no statistically significant difference in average number of instruments use with or without torque control ($p>0.05$).

Conclusion Even though there is no statistical significance in instrument separation when instruments were used with or without torque, there is tendency to experience sudden fracture of instruments after work without torsional control even after only few uses in clinical work.

Keywords: nickel-titanium rotary instruments; torque; separation

INTRODUCTION

Diabetes mellitus (DM) is systemic metabolic disorder characterized by hyperglycemia (a persistent increase in blood glucose level) resulting from insulin secretion disorder, disturbance of its function or both [1, 2]. It is one of the most common endocrine disorders, with prevalence in the constant rise especially in developed countries. This is due to the modern lifestyle and increase in the number of external etiological factors, among which obesity is particularly noticeable. DM is most common in older age as a result of general degenerative and sclerotic changes in the body (which also involve pancreas) while in children it may be due to genetic disorders or pancreas damage in certain infectious diseases [1, 2].

The incidence of DM in childhood is constantly increasing. The number of children with DM doubles every other decade. Every ten seconds in the world one person dies of diabetes, and two new ones get sick. Children in 98% of cases experience unstable, ketosis-related, insulin-dependent diabetes mellitus (type 1), which is most commonly diagnosed in puberty [2, 3]. Like all systemic diseases, DM gives many complications. The significant impact of this disease is on oral health.

Large number of studies has shown that prevalence, progression and severity of periodontal diseases have been significantly increased in patients with DM. The on-

set and progression of periodontitis in patients with DM is probably caused by diabetic microangiopathy, impaired immune response and reduced resistance to infection. In patients with DM, periodontal disease occurs at younger age compared to healthy population. In children with DM, periodontal damage is usually manifested in adolescence, and very often earlier [4, 5].

The aim of this study was to determine whether periodontal health of children with type 1 diabetes mellitus was different from healthy children.

METHODS

Ethical Committee of the Clinical Center in Podgorica, Montenegro approved this research. One dentist performed all examinations. Kappa values evaluated after the study for inter-rater agreement amounted to 0.94.

The study included 87 children of both genders, aged 10-15 years, suffering from Type 1 diabetes mellitus (DMT1) from all over Montenegro. These children were treated at the Institute of Child Diseases in the Clinical Center of Montenegro. Only those children whose parents had given their consent were included in the examinations. Data about history of disease, including the type of DM and values of glycosylated hemoglobin (HbA1c) not older than six months, were obtained from the medical

records of patients. These children were included in one group (DMT1).

The control group included 90 healthy children of both genders; age 10–15 years, selected by random sampling method, and attending elementary school in the area of Podgorica municipality. Their parents also signed informed consent. All children who participated in the study were examined with standard dental diagnostic tools on dry teeth, with artificial lighting in dental chair.

The condition of oral hygiene was determined by Green-Vermilion plaque index, which determines the absence or the presence, quantity and distribution of dental plaque and other soft deposits on representative permanent teeth [6]. Loe-Silness gingival index was used for the clinical assessment of gingival tissue health on vestibular, oral, mesial and distal surfaces of each tooth [7]. Community Periodontal Index [8] was used to assess the condition of periodontal tissue according to the recommendations of the British Association for Periodontology and the British Association for Pediatric Dentistry (Guidelines for Periodontal Screening and Management of Children and Adolescents Under 18 Years of Age) [9]. For this purpose, special periodontal probe marked at 1, 2, 3, 5, 7, 9 and 10 mm, with 0.5 mm diameter ball at the end was used. This graduated probe was adapted for precise measurement of the clinical attachment level or periodontal pockets.

During examination, with slight pressure, the probe was introduced into the space between the teeth and gingiva, with the anatomical configuration of the teeth being monitored. The pressure at this measurement was 15–20 g and much lighter than the pressure used in usual probing of periodontal pockets [8]. For this purpose, the following representative teeth were examined: upper and lower first permanent molars, upper right first permanent incisor and lower left first incisor. For each tooth the following four measurements were conducted: mesiobuccal, bucal, distal and oral. Depending on the clinical finding, each quadrant received appropriate score. The scoring was done as follows:

Score 0 – healthy periodontal tissue;

Score 1 – gingival bleeding after probing;

Score 2 – the presence of solid deposits on teeth (supra and subgingival calculus) or the existence of prominent edges of the fillings;

Score 3 – shallow periodontal pockets 4 – 5 mm;

Score 4 – deep periodontal pockets (6 mm or more).

Out of these four, the finding indicating the worst condition of periodontal tissue was recorded. For each quadrant, only one digit 0 - 4 was determined, which represented the worst condition in that quadrant. If some of the representative teeth were missing, that quadrant was not taken into account. Thus, for each respondent, the individual maximum value of this index was determined and it indicated the need for and type of necessary treatment.

It should be emphasized that it is not recommended to measure the pockets depth in children 7 to 11 years old. In children under 12 years of age, periodontal health was determined based on the clinical state of gingiva and presence of solid deposits [9].

In our study, children under the age of 12 also did not have CAL measured, while for children older than 11

years the same teeth were used as for CPI index [9]. The measurement was performed by graduated dental probe with a ball on the top, in the middle of the vestibular surface and at the connection of mesial and vestibular surface. The probe was placed in the sulcus parallel to the longitudinal tooth axis [9]. The measurement results were given for each representative tooth.

For descriptions of parameters and depending on their nature, the descriptive statistics were used: mean value, standard deviation (SD) and percentage. To test statistical significance of average values between two independent samples, Student's t-test and Mann-Whitney test were used. P values of less than 0.05 were considered statistically significant. Statistical data processing was done in SPSS v.11.5 for Windows.

RESULTS

A total of 177 children aged 10–15 years participated in the study. The average age of children suffering from DMT1 was 12.7 ± 1.6 , while the average age of children from the control group was 12.8 ± 1.6 .

In the sample of children with DM, the mean PI was 1.31 ± 0.55 , while the average value of this indicator in the control group of children was 1.03 ± 0.51 . Children with diabetes had significantly higher average plaque index values compared to healthy children (Table 1).

Table 1. Values of Plaque Index (PI), Community Periodontal Index (CPI) and Clinical Attachment level (CAL) in both groups

Tabela 1. Vrednosti plak indeksa, zajedničkog parodontalnog indeksa i nivoa pripojnog epitela u obe grupe

Parameter Parametar	DMT1		Control group Kontrolna grupa
	Mean \pm sd Srednja vrednost \pm sd	Mean \pm sd Srednja vrednost \pm sd	
PI	$1.31 \pm 0.55^*$	$1.03 \pm 0.51^*$	0.001
CPI	$1.36 \pm 1.12^*$	$0.59 \pm 0.84^*$	0.000
CAL NPE	$1.33 \pm 0.60^*$	$0.66 \pm 0.53^*$	0.000

* statistical significance of Student's t-test

* statistička značajnost Studentovog t-testa

Of the total number of children in the group DMT1, healthy gingiva was found in 6.8%, mild inflammation in 17.2%, moderate inflammation in 58.6%, and severe inflammation in 17.2% of children. In the control group, healthy gingiva had 26.7% of children, mild inflammation 43.3%, moderate inflammation 22.2% and severe 7.8%. Respondents from the DMT1 group had the highest percentage of moderate and severe gingival inflammation while subjects in the control group had more healthy gingiva and mild inflammation (Table 2). There was significant difference in gingival health between control and DMT1 group ($p < 0.05$; Mann-Whitney test).

Significantly higher percentage of children with healthy periodontal tissue was registered in the control group 55.6% ($p < 0.05$; Mann-Whitney test). On the other hand, in children with DM, the highest percentage of children had gingival bleeding (36.7%) which was statistically

Table 2. Gingival health of children in both groups
Tabela 2. Zdravlje gingive kod dece u obe grupe

Gingival index (GI) Gingivalni indeks (GI)	Group Grupa			
	DMT1		Control group Kontrolna grupa	
	n	%	n	%
Normal gingiva Zdrava gingiva	6	6.8*	24	26.7*
Mild inflammation Blaga upala	15	17.2*	39	43.3*
Moderate inflammation Srednja upala	51	58.6*	20	22.2*
Severe inflammation Jaka upala	15	17.2*	7	7.8*
Total Ukupno	87	100	90	100

* p < 0.05; Mann-Whitney test

* p < 0.05; Man-Vitnijev test

Table 3. CPI index in children of both groups
Tabela 3. CPI u obe grupe ispitivane dece

CPI	Group Grupa			
	DMT1		Control group Kontrolna grupa	
	n	%	n	%
0	21	24.1*	50	55.6*
1	32	36.7	28	31.1
2	15	17.2*	7	7.8*
3	19	21.8*	5	5.6*
4	0	0	0	0
Total Ukupno	89	100	90	100

* p < 0.05; Mann-Whitney test

* p < 0.05; Man-Vitnijev test

significant ($p < 0.05$; Mann-Whitney test). Healthy periodontal tissue in DMT1 group was recorded in 24.1% of children, while the presence of solid deposits was registered in 17.2%. The presence of periodontal pockets of 4-5mm was found in 21.8%. Respondents from the control group had bleeding after probing in 31.1%, solid deposits in 7.8%, and 4-5 mm pockets in 5.6% of examined children (Table 3). Children with DM compared to children in the control group had significantly worse periodontal disease ($p < 0.05$; Mann-Whitney test). The score 4 for CPI index value was not registered in any group.

The average value of CPI index in the DMT1 group was 1.36 ± 1.12 and it was significantly higher ($t = 5.58$; $p = 0.000$) compared to members of the healthy group (0.59 ± 0.84) (Table 1).

The mean value of CAL in children with DMT1 was 1.33 ± 0.60 while in healthy children it was 0.66 ± 0.53 (Table 1). Healthy children had significantly lower clinical attachment level than children with DM ($t = 5.58$; $p = 0.000$).

DISCUSSION

The results of studies found in literature indicated that children with DMT1 had poorer oral hygiene, higher incidence and severity of gingivitis compared to healthy

children. Likewise, we found that healthy children had more often healthy periodontal tissues. Gingival bleeding after probing was more common in the group of DMT1. Most studies concluded that the incidence of gingivitis in patients with DMT1 was significantly higher than in healthy population and increased with age [10]. In her research, Dakovic found that children with DMT1 in Serbia had more dental plaque, gingivitis and periodontal destruction, which is in agreement with the results of our study [11]. In large Brazilian study, it was found that children with DM had higher percentage of gingivitis and periodontitis compared to healthy children [12]. Children with DMT1 in Lithuania and Turkey had more dental plaque and worse gingival health than healthy children, which is in correlation with the results of our study [13, 14]. Increased glucose levels in gingival fluid and blood and decreased salivary secretion in patients with DM changes micro flora causing qualitative changes in bacteria that are responsible for the occurrence of periodontal problems [13, 15]. Karjalainen et al. noted that unbalanced glucose metabolism in diabetic patients is in direct correlation with the degree of gingival inflammation [16]. The pronounced gingival bleeding due to hyperglycemia can be explained by immunological changes occurring due to reduced resistance to organic deposits in dental plaque. Periodontal disease is reported as the sixth complication of diabetes mellitus [4]. The prevalence, severity and progression of periodontal disease are higher in these patients compared to healthy subjects [10, 17-21]. Dakovic et al. obtained similar results in children with DMT1 in Serbia [11]. Also, the study of Lalla et al. confirmed higher periodontal destruction in children with DMT1 than in healthy children [17]. Nevertheless, the results of certain studies have not found significant difference in periodontal disease between children with well-controlled DM and healthy children [19, 22]. Oral hygiene habits play an important role in preservation and health of periodontal tissues and prevalence of this disease varies depending on the health habits of each person.

Periodontal disorders begin very early in these children, with tendency to deteriorate periodontal tissues in adolescence. DMT1 adolescents develop earlier and advanced inflammatory reaction of gingiva compared to similar bacterial challenge in healthy children. In addition, it has been shown that severe damage of periodontal tissue occurs more frequently in patients with DM who are poorly metabolically regulated [10, 11, 17, 18, 19]. Therefore, programs for prevention of disease and promotion of periodontal health should be available as soon as possible to this population group [10, 11, 23].

DM is chronic metabolic disease that affects the entire body, as well as oral health. Health habits are very important in the prevention of oral diseases. Dentists should be focused on promoting good health and oral habits, performing periodic dental examinations and ensuring good oral hygiene in this population group. Dentists must minimize the risk factors for the occurrence of periodontal tissue diseases caries and other soft tissue disorders, as well as to carry out continuous health work and motivation of these patients with regards to oral hygiene [13].

CONCLUSION

The results of the current study indicate that children with type 1 diabetes mellitus in Montenegro have more dental plaque, more gingivitis and periodontal disorders than healthy children. It is necessary to propose a plan of preventive activities aimed to educate and implement prophylactic measures related to reduction of dental plaque and dental calculus.

REFERENCES

1. Patterson C, Gyrs E, Rosenbauer J, Cinek O, Neu A, Schober E, et al. Trends in childhood type 1 diabetes incidence in Europe during 1989–2008: evidence of non-uniformity over time in rates incidence. *Diabetologia*. 2012; 55(8):2142–7. [DOI: 10.1007/s00125-012-2571-8] [PMID: 22638547]
2. Samardžić M, Martinović M, Nedović-Vuković M, Popović-Samardžić M. Novi podaci o incidenciji dijabetesa tipa 1 u Crnoj Gori: bolest počinje u mlađoj životnoj dobi. *Acta Clin Croat*. 2016; 55:63–8. [DOI: 10.20471/acc.2016.55.01.10]
3. Samardžić M, Popović N, Popović-Samardžić M, Nedović-Vuković M. Rising incidence of childhood type 1 diabetes in Montenegro. *Srp Arh Celok Lek*. 2016; 144(7-8):408–12. [DOI: 10.2298/SARH1608408S] [PMID: 16641173]
4. Loe H. Periodontal disease: the sixth complication of diabetes mellitus. *Diabetes Care*. 1993; 16:329–34.
5. Novotna M, Podzimek S, Broukal Z, Lencova E, Duskova J. Periodontal diseases and dental caries in children with type 1 diabetes mellitus. *Mediators Inflamm*. 2015; 2015:379626. [DOI: 10.1155/2015/379626] [PMID: 26347009]
6. Greene JC, Vermillion JR. The Simplified Oral Hygiene Index. *J Am Dent Assoc*. 1964; 68:7–13. [PMID: 14076341]
7. Loe H. The Gingival Index, the Plaque Index and the Retention Index Systems. *J Periodontol*. 1967; 38:610–6. [DOI: 10.1902/jop.1967.38.6.610] [PMID: 5237684]
8. World Health Organization. Oral Health Surveys. Basic Methods, 4th edn. Geneva: World Health Organization, 1997.
9. Clerehugh V. Periodontal disease in children and adolescents: *Brithis Dental J*. 2008; 204:469–71.
10. Lalla E, Cheng B, Lal S, Tucker S, Greenberg E, Goland R, et al. Periodontal changes in children and adolescents with diabetes. *Diabetes Care*. 2006; 29:295–9. [DOI: 10.2337/diacare.29.02.06.dc05-1355] [PMID: 16443876]
11. Daković D, Pavlović MD. Periodontal disease in children and adolescents with type 1 diabetes in Serbia. *J Periodontol*. 2008; 79(6):987–92. [DOI: 10.1902/jop.2008.070549] [PMID: 18533774]
12. Xavier ACV, Silva IN, Costa DO, Correa DS. Periodontal status in children and adolescents with type 1 diabetes mellitus. *Arq Bras Endocrinol Metab*. 2009; 53(3):348–54.
13. Siudkiene J, Machiulskiene V, Dobrovolskiene R, Nedzelskiene I. Oral hygiene in children with type 1 diabetes mellitus. *Stomatologija*. 2005; 7(1):24–7. [PMID: 16254474]
14. Orbak R, Simsek S, Orbak Z, Kavrut F, Colak M. The influence of type 1 diabetes mellitus on dentition and oral health in children and adolescents. *Yonsei Med J*. 2008; 49(39):357–65. [DOI: 10.3349/ymj.2008.49.3.357] [PMID: 18581583]
15. Klokkevold PR, Maeley BL, Carranza FA. Influence of systemic disease and disorders on the periodontium. In Newman MG, Takei HH, Carranza FA, editors. *Carranza's clinical periodontology*. 9nd ed. Philadelphia: Saunders; 2002. p. 204–28.
16. Karjalainen KM, Knuttila ML. The onset of diabetes poor metabolic control increases gingival bleeding in children and adolescents with insulin-dependent diabetes mellitus. *J Clin Periodontol*. 1996; 23(12):1060–7. [DOI: 10.1111/j.1600-051X.1996.tb01804x] [PMID: 8997648]
17. Lalla E, Cheng B, Lal S, Kaplan S, Softness B, Greenberg E, et al. Diabetes mellitus promotes periodontal destruction in children. *J Clin Periodontol*. 2007; 34(4):294–8. [DOI: 10.1111/j.1600-051X.2007.01054x] [PMID: 17378885]
18. Lal S, Cheng B, Kaplan S, Softness B, Greenberg E, Goland RS, et al. Gingival bleeding in 6 to 13 – year – old children with diabetes mellitus. *Pediatr Dent*. 2007; 29(5):426–30. [PMID: 18027779]
19. Pinson M, Hoffman WH, Garnick JJ, Litaker MS. Periodontal disease and type 1 diabetes mellitus in children and adolescents. *J Clin Periodontol*. 1995; 22:118–23. [PMID: 7775667]
20. Arheimam A, Omar S. Dental caries experience and periodontal treatment needs of 10- to 15-year old children with type 1 diabetes mellitus. *Int Dent J*. 2014; 64(3):150–4. [DOI: 10.1111/idj.12091] [PMID: 24506709]
21. del Valle LML, Ocasio-López C. Comparing the oral health status of diabetic and non-diabetic children from Puerto Rico: a case-control pilot study. *Puerto Rico Health Sci J*. 2011; 30(3):123–7. [PMID: 21932712]
22. Iughetti L, Marino R, Bertolani MF, Bernasconi S. Oral health in children and adolescents with ID DM – a review. *J Pediatr Endocrinol Metab*. 1999; 12:603–10. [DOI: 10.1515/JPEM.1999.12.5.603] [PMID: 10854189]
23. Rafatjou R, Razavi Z, Tayebi S, Khalili M, Farhadian M. Dental health status and hygiene in children and adolescents with type 1 diabetes mellitus. *J Res Health Sci*. 2016; 16(3):122–6. [PMID: 27840339]

Received: 08.05.2018 • Accepted: 14.08.2018

Parodontalno zdravlje kod dece obolele od dijabetesa melitusa tipa 1 u Crnoj Gori

Mirjana Đuričković¹, Mirjana Ivanović², Mira Samardžić³, Olivera Jovičić², Zorica Popović¹

¹Univerzitet Crne Gore, Medicinski fakultet, studijski program Stomatologija, Podgorica, Crna Gora;

²Univerzitet u Beogradu, Stomatološki fakultet, Klinika za dečju i preventivnu stomatologiju, Beograd, Srbija ;

³Institut za bolesti djece, Podgorica, Crna Gora

KRATAK SADRŽAJ

Uvod Dijabetes melitus (DM) u dečjem uzrastu može negativno da utiče na oralno zdravlje. Cilj ovog istraživanja je bio utvrđivanje stanja zdravlja parodoncijuma kod dece obolele od dijabetesa melitusa tipa I u odnosu na zdravu decu.

Metode U studiju je bilo uključeno 177 dece uzrasta 10–15 godina. Ispitanici su podeljeni u dve grupe. Osamdeset sedmoro dece obolelo od dijabetesa melitusa tipa 1 (DMT1) bilo je uključeno u prvu grupu. Drugu, kontrolnu grupu, njih 90, predstavljala su zdrava deca. Samo ona deca čiji su roditelji svojim potpisom dali saglasnost bila su uključena u studiju. Za utvrđivanje oralne higijene primenjivan je plak indeks (PI) po Green-Vermillionu. Stanje zdravlja gingive procenjeno je pomoću gingivalnog indeksa (GI), opisanog po Löe-Silnessu. Procena stanja parodoncijuma registrovana je primenom CPI indeksa (Community Periodontal Index) i merenjem nivoa pripojnog epitela (NPE).

Rezultati Prosečna vrednost PI za obolelu decu iznosila je $1,31 \pm 0,55$, a za zdravu populaciju $1,03 \pm 0,51$, što je bilo statistički visoko značajno ($p = 0,001$). Ispitanici iz grupe dijabetičara imaju procentualno najviše zastupljenu umerenu i tešku inflamaciju gingive, dok ispitanici iz kontrolne grupe imaju najviše zastupljenu zdravu gingivu i blagu inflamaciju ($p < 0,05$). Prosečna vrednost CPI indeksa u grupi dece sa DM bila je $1,36 \pm 1,12$, a u kontrolnoj grupi dece $0,59 \pm 0,84$, što je bilo statistički značajno ($p = 0,000$). Prosečna vrednost nivoa pripojnog epitela za decu obolelu od dijabetesa melitusa iznosila je $1,33 \pm 0,60$ i bila je znatno viša ($p = 0,000$) u odnosu na pripadnike kontrolne grupe $0,66 \pm 0,53$.

Zaključak Deca obolela od dijabetesa melitusa tipa 1 imaju više dentalnog plaka, lošje zdravlje gingive i više promena na parodoncijumu u odnosu na decu iz kontrolne grupe.

Ključne reči: deca; dijabetes melitus tip 1; oralna higijena; gingiva; parodoncijum

UVOD

Šećerna bolest je neizlečivi sistemski poremećaj metabolizma, a karakteriše se hiperglikemijom (trajno povećanim nivoom glukoze u krvi), nastalom kao posledica poremećaja sekrecije insulina ili poremećajem njegove funkcije, ili delovanjem oba činioca istovremeno [1, 2]. Dijabetes se danas ubraja među najčešća endokrinološka oboljenja, sa prevalencom u stalnom porastu posebno u razvijenim zemljama sveta. To je posledica modernog stila života i povećanja broja spoljašnjih etioloških činjenica, među kojima se posebno izdvaja gojaznost. Šećerna bolest se najčešće javlja u starijem životnom dobu kao posledica opštih degenerativnih i sklerotičnih promena u organizmu (koje zahvataju i pankreas), a kod mlađih osoba i dece može nastati usled genetičkih poremećaja ili oštećenja pankreasa kod određenih infektivnih oboljenja [1, 2].

Učestalost šećerne bolesti u dečjem uzrastu je u stalnom porastu. Broj novoobolelih uđovostručuje se svake druge decenije. Svakih deset sekundi u svetu jedna osoba umre od dijabetesa, a dve nove se razbole. Deca u 98% slučajeva oboljevaju od nestabilnog, ketozi sklonog, insulin-zavisnog dijabetesa melitusa (tip 1), koji se najčešće javlja u pubertetu [2, 3]. Kao i sva sistemska oboljenja, dijabetes daje mnoge komplikacije. Značajan uticaj ove bolesti je na oralno zdravlje.

Brojne studije su pokazale da su prevalencija, progresija i težina oboljenja parodoncijuma značajno povećane kod pacijentata sa dijabetesom. Dijabetes je važan faktor rizika za nastanak oboljenja parodoncijuma. Početak i progresija parodontitisa kod pacijenata sa DM verovatno su izazvani dijabetičnom mikroangiopatijom, oštećenim imunim odgovorom kao i manjom otpornošću na infekcije. Kod obolelih od DM, oboljenja parodoncijuma se javljaju u mlađem uzrastu u odnosu na zdravu

populaciju. Kod dece sa DM, oštećenja parodoncijuma se obično manifestuju u adolescenciji, a vrlo često i ranije [4, 5].

Cilj ovog istraživanja je bio da se utvrdi da li je parodontalno zdravlje dece obolele od dijabetesa melitusa tipa 1 drugačije od onog kod zdrave dece.

METODE

Za ova istraživanja je dobijena saglasnost Etičkog komiteta Kliničkog centra Crne Gore u Podgorici. Sve kliničke preglede obavio je jedan stomatolog. Kappa vrednosti procenjene nakon ponovnog pregleda za intrakonzistenciju istraživača iznosila je 0,94.

Ispitivanjem je obuhvaćeno 87 dece oba pola, uzrasta 10–15 godina, obolele od dijabetesa melitusa tipa 1 iz svih krajeva Crne Gore. Ova deca se leče na Institutu za bolesti dece Kliničkog centra Crne Gore. U ispitivanja su bila uključena samo ona deca čiji su roditelji svojim potpisom dali saglasnost. Podaci o istoriji bolesti, uključujući DMTI vrednosti glikoziliranog hemoglobina (HbA1c), ne stariji od šest meseci, dobijeni su iz medicinske dokumentacije bolesnika. Ova deca su sačinjavala jednu grupu (grupa dijabetičara D) ispitanika.

Drugu, kontrolnu grupu, predstavljala su zdrava deca oba pola, uzrasta 10–15 godina, ukupno njih 90, izabrana metodom slučajnog uzorka, a koja pohađaju osnovnu školu na području podgoričke opštine. Realizacija studije je otpočela nakon dobijanja pisмене saglasnosti roditelja. Sva deca koja su učestvovala u istraživanju pregledana su standardnim stomatološkim dijagnostičkim sredstvima na suvim zubima, pri veštačkom osvetljenju na stomatološkoj stolici.

Stanje oralne higijene utvrđeno je pomoću plak indeksa po Greene-Vermilionu, kojim se utvrđuju odsustvo, odnosno prisu-

stvo, količina i rasprostranjenost dentalnog plaka i ostalih mekih naslaga na reprezentativnim stalnim zubima [6]. Za kliničku ocenu stanja gingive primenjivan je Loe-Silnessov indeks. Pomoću njega stanje gingive je ocenjivano sa vestibularne, oralne, mezijalne i distalne strane svakog prisutnog zuba [7].

Za procenu stanja parodoncijuma korišćen je CPI indeks (Community Periodontal Index) [8] po preporukama Britanske asocijacije za parodontologiju i Britanske asocijacije za dečju stomatologiju (Guidelines for Periodontal Screening and Management of Children and Adolescents Under 18 years of Age) [9]. Pri određivanju ovog indeksa korišćena je posebna parodontalna sonda specijalno graduisana na 1, 2, 3, 5, 7, 9 i 10 mm, koja na vrhu ima kuglicu prečnika 0,5 mm. Zahvaljujući ovoj kuglici sprečava se prodiranje vrha sonde između ćelija pripojnog epitela. Ovakva podela sonde je prilagođena preciznjem merenju nivoa pripojnog epitela odnosno parodontalnih džepova.

Prilikom pregleda sonda je uz blag pritisak unošena u prostor između zuba i gingive, pri čemu je praćena anatomska konfiguracija zuba. Pritisak pri ovom merenju je 15–20 g i mnogo je manji od pritiska koji se koristi pri uobičajenom sondiranju parodontalnih džepova [8]. Ovom prilikom pregledani su sledeći reprezentativni zubi: gornji i donji prvi stalni molari, gornji desni prvi stalni sekutič i donji levi prvi stalni inciziv. Na svakom zubu vršena su četiri sondiranja i to: meziobukalno, bukalno, distooralno i oralno. U zavisnosti od kliničkog nalaza, za svaki kvadrant je određen odgovarajući broj bodova. Bodovanje je vršeno na sledeći način:

0 bodova – zdrav parodoncijum;

1 bod – krvarenje gingive posle sondiranja;

2 boda – prisustvo čvrstih naslaga na zubima (kamenac ili subgingivalni konkrementi) ili postojanje prominentnih ivica ispuna;

3 boda – prisutni plitki parodontalni džepovi 4–5 mm;

4 boda – prisutni dubli parodontalni džepovi 6 i više mm.

Od ova četiri, upisivan je nalaz koji označava najteže stanje parodoncijuma. Za svaki kvadrant je utvrđivana samo jedna cifra od 0 do 4 koja predstavlja najteže utvrđeno stanje u tom kvadrantu. Ukoliko je neki od reprezentativnih zuba nedostajao, taj kvadrant se nije uzimao u obzir. Tako su za svakog ispitanika utvrđene najveće individualne vrednosti ovog indeksa, na osnovu kojih je bilo moguće odrediti potrebu za lečenjem i vrstu neophodnog tretmana.

Treba naglasiti da se deci uzrasta 7–11 godina ne preporučuje merenje dubine džepova, tako da se ta preporuka ispoštovala i u ovoj studiji. Naime, kod dece ispod 12 godina starosti stanje parodoncijuma se određivalo na osnovu kliničkog stanja gingive i eventualnog prisustva čvrstih naslaga [9].

U ovoj studiji nivo pripojnog epitela nije meren deci mlađoj od 12 godina, a za merenje deci starijoj od 11 godina poslužili su isti zubi kao kod CPI indeksa [9]. Merenje je vršeno graduišanom stomatološkom sondom sa milimetarskom podelom, sa kuglicom na vrhu, na sredini vestibularne površine zuba i na spoju mezijalne i vestibularne površine. Sonda je postavljana u sulkus paralelno sa uzdužnom osovinom zuba [9]. Rezultati merenja su unošeni za svaki reprezentativni zub.

Za opis parametara od značaja i u zavisnosti od njihove prirode, korišćene su mere deskriptivne statistike: srednja vrednost, standardna devijacija (SD) i procenti. Za testiranje statističke značajnosti u prosečnim vrednostima između dva nezavisna uzorka korišćen je Studentov t-test i Man-Vitnijev test. Vred-

nosti p manje od 0,05 smatrale su se statistički značajnim. Statistička obrada podataka urađena je u programu SPSS v.11.5 for Windows.

REZULTATI

U istraživanju je učestvovalo ukupno 177 dece uzrasta 10–15 godina. Prosečna starost dece obolele od šećerne bolesti iznosila je $12,7 \pm 1,6$, dok je prosečna starost mališana iz kontrolne grupe bila $12,8 \pm 1,6$.

U uzorku dece koja boluju od dijabetesa prosečna vrednost PI iznosila je $1,31 \pm 0,55$, dok je prosečna vrednost ovog indikatora u kontrolnoj grupi dece iznosila $1,03 \pm 0,51$. Deca obolela od šećerne bolesti imala su znatno više prosečne vrednosti plak indeksa u odnosu na zdravu decu (Tabela 1).

Od ukupnog broja pregledane dece iz grupe D, zdravu gingivu ima 6,8%, blagu inflamaciju gingive ima 17,2%, umerenu inflamaciju 58,6%, a tešku inflamaciju 17,2%. U grupi K zdravu gingivu ima 26,7% dece, blagu inflamaciju 43,3%, umerenu inflamaciju 22,2%, a tešku 7,8%. Ispitanici iz grupe dijabetičara imaju najviše procentualno zastupljenu umerenu i tešku inflamaciju gingive, dok ispitanici iz kontrolne grupe imaju najviše zastupljenu zdravu gingivu i blagu inflamaciju (Tabela 2). Razlike u pogledu stanja zdravlja gingive su značajne u korist kontrolne grupe ($p < 0,05$; Man-Vitnijev test).

Značajno veći procenat dece sa zdravim parodoncijumom registrovan je kod zdrave dece – 55,6% ($p < 0,05$; Man-Vitnijev test). Nasuprot njima, kod dece obolele od dijabetesa procentualno je bilo najzastupljenije krvarenje nakon sondiranja 36,7%, što je bilo statistički značajno ($p < 0,05$; Man-Vitnijev test). Zdrav parodoncijum u grupi D registrovan je kod 24,1% populacije, dok je prisustvo čvrstih naslaga registrovano kod 17,2%, a prisustvo parodontalnih džepova od 4–5 mm kod 21,8% populacije. Ispitanici iz kontrolne grupe imali su prisutno krvarenje nakon sondiranja kod 31,1%, prisustvo čvrstih naslaga kod 7,8% i džepove dubine 4–5 mm kod 5,6% populacije (Tabela 3). Deca sa DM u odnosu na decu iz kontrolne grupe imala su značajno lošije stanje parodoncijuma ($p < 0,05$; Man-Vitnijev test).

Vrednost 4 CPI indeksa nije registrovana u obe grupe.

Prosečna vrednost indeksa CPI u oboleloj grupi iznosila je $1,36 \pm 1,12$ i bila je znatno viša ($t = 5,58$; $p = 0,000$) u odnosu na pripadnike zdrave grupe ($0,59 \pm 0,84$). Ovo se jasno može videti u Tabeli 1.

Prosečna vrednost nivoa pripojnog epitela za decu obolelu od dijabetesa iznosila je $1,33 \pm 0,60$. Izmerena prosečna vrednost nivoa pripojnog epitela kod zdrave dece iznosila je $0,66 \pm 0,53$ (Tabela 1). Zdrava deca imala su znatno niže vrednosti nivoa pripojnog epitela od obolele dece ($t = 5,58$; $p = 0,000$).

DISKUSIJA

Rezultati ovih istraživanja ukazuju na to da deca obolela od DMT1 imaju lošiju oralnu higijenu, veću učestalost i težinu gingivita u odnosu na zdravu decu. Isto tako, utvrdili smo da među zdravom decom ima značajno više ispitanika sa zdravim parodoncijumom. Krvarenje gingive nakon sondiranja bilo je procentualno najzastupljenije kod obolele populacije, dok je zdrav parodoncijum procentualno prednjačio kod kontrolne

grupe. Većina studija zaključila je da je incidencija hroničnog gingivita kod pacijenata sa DMT1 značajno veća u odnosu na zdravu populaciju i povećava se sa godinama [10]. U svojim istraživanjima Daković je utvrdila da su deca sa DMT1 u Srbiji imala više dentalnog plaka, gingivita i parodontalne destrukcije, što je u saglasnosti sa rezultatima ove studije [11]. U velikoj brazilskoj studiji ustanovljeno je da deca obolela od DM imaju procentualno više gingivita i parodontitisa u odnosu na zdravu decu [12]. Deca sa DMT1 u Litvaniji i Turskoj imaju više dentalnog plaka i lošije stanje gingive u odnosu na decu iz kontrolne grupe, što je u korelaciji sa rezultatima ove studije [13, 14]. Naime, povećan nivo glukoze u gingivalnoj tečnosti i krv i smanjeno lučenje pljuvačke kod pacijenata sa DM menja sredinu mikroflore uzrokujući kvalitativne promene kod bakterija koje su odgovorne za nastanak parodontoloških problema [13, 15]. Karjalainen i saradnici su primetili da je neuravnotežen metabolizam glukoze kod dijabetičara u direktnoj korelaciji sa stepenom inflamacije gingive [16]. Izrazito krvarenje gingive usled hiperglikemije može se objasniti imunološkim promenama koje se javljaju kod domaćina zbog smanjene otpornosti prema organskim naslagama dentalnog plaka.

Oboljenja parodoncijuma se navode kao česta komplikacija dijabetesa melitus-a [4], a prevalencija, težina i napredovanje oboljenja potpornog aparata zuba veći su kod ovih bolesnika. Rezultati brojnih studija, kao i ovog istraživanja, ukazuju da deca obolela od dijabetesa imaju procentualno više promena na parodonciju u odnosu na zdravu decu [10, 17–21]. Slične rezultate dobili su Daković i sar. za decu sa DMT1 u Srbiji [11]. U svojim istraživanjima Lalla i sar. zaključuju da je stepen destrukcije parodoncijuma kod dece sa DMT1 značajno viši u odnosu na zdravu decu [17]. Pa ipak, rezultati određenih istraživanja ne nalaze značajnu razliku u oboljenjima parodoncijuma između dece sa dobro kontrolisanim dijabetesom i zdrave dece [19, 22]. Naime, oralno-higijenske navike imaju značajnu ulogu u očuvanju i održavanju potpornog aparata zuba, a pre-

valencija ove bolesti varira u zavisnosti od zdravstvenih navika svake osobe.

Parodontalna oboljenja počinju veoma rano kod ove dece, sa tendencijom pogoršanja u adolescenciji. Adolescenti sa DMT1 razvijaju raniju i veću zapaljenu reakciju gingive na sličan bakterijski izazov nego pripadnici zdrave kontrolne grupe. U skladu sa ovom činjenicom, proširene studije su pokazale da se ozbiljnija oštećenja parodoncijuma češće javljaju kod onih pacijenata sa DM koji su loše metabolički regulisani [10, 11, 17, 18, 19]. Zato programe za promovisanje prevencije oboljenja parodoncijuma i lečenje treba obezbediti što ranije ovoj populacionoj grupi [10, 11, 23].

Dijabetes je hronična metabolička bolest koja utiče na ceo organizam, naročito remeteći oralno zdravlje. Zdravstvene navike su veoma značajne u prevenciji oralnih oboljenja. Zadatak svakog stomatologa trebalo bi da bude usmeren ka negovanju dobrih zdravstveno-oralnih navika, obavljanju periodičnih stomatoloških pregleda i obezbeđivanju dobre oralne higijene kod ove populacione grupe. Ovi uslovi znatno utiču na oralno zdravlje dijabetičara. Stomatolozi moraju da svedu na minimum faktore rizika za nastanak oboljenja parodoncijuma, karijesa i mekih oralnih tkiva, kao i da sprovode kontinuiran zdravstveno-vaspitni rad i motivaciju ovih pacijenata u vezi sa oralnom higijenom [13].

ZAKLJUČAK

Rezultati ovih istraživanja ukazuju da deca obolela od dijabetesa melitus-a tipa 1 u Crnoj Gori imaju više dentalnog plaka, više gingivitis i oboljenja parodoncijuma u odnosu na decu iz kontrolne grupe. Neophodno je predložiti plan preventivnih aktivnosti usmerenih na edukaciju i primenu profilaktičkih mera, koje se odnose na smanjenje akumulacije dentalnog plaka i zubnog kamenca, individualno u stomatološkim ordinacijama.

The role of interleukin-6 in pathogenesis of chronic periapical lesions

Jelena Popović¹, Tatjana Cvetković², Tanja Džopalić³, Marija Nikolić¹, Aleksandar Mitić¹, Radomir Barac¹, Slavoljub Živković⁴

¹University of Niš, Faculty of Medicine, Clinic of Dentistry, Department of Restorative Dentistry and Endodontics, Niš, Serbia;

²University of Niš, Faculty of Medicine, Institute of Biochemistry, Niš, Serbia;

³University of Niš, Faculty of Medicine, Institute of Immunology, Niš, Serbia;

⁴University of Belgrade, School of Dental Medicine, Clinic of Restorative Odontology and Endodontics, Belgrade, Serbia

SUMMARY

Introduction Cytokine network plays an important role in pathogenesis of chronic periapical lesions. The aim of this study was to determine the concentration of interleukin-6 (IL-6) in tissue homogenates of human periapical lesions and correlate its levels with symptomatology and size of the lesions.

Materials and Methods 93 samples of chronic periapical lesions were obtained after extraction of teeth. Samples were divided according to the clinical presentation as symptomatic and asymptomatic, and according to the size as large and small. The concentration of IL-6 was analyzed using ELISA.

Results Statistically significant difference in IL-6 concentration was observed in symptomatic lesions compared to asymptomatic ($p<0.001$). Analysis showed statistically higher concentration in large symptomatic lesions compared to large asymptomatic lesions ($p<0.001$), and in small symptomatic lesions compared to small asymptomatic ($p<0.05$). Higher production of IL-6 was observed in large lesions compared to small but this difference was not statistically significant.

Conclusion Higher concentration of IL-6 in lesions with expressed clinical symptoms as well as in large lesions indicates that IL-6 is an important factor responsible for the progression of lesions and bone resorption.

Keywords: Periapical lesions; cytokines; IL-6

INTRODUCTION

Periapical lesions are inflammatory disorders that develop as a result of an immune response to continuous antigen stimulation from the root canal. Their development and progression to chronic lesions with concomitant bone resorption occur as a result of inability of host defense mechanisms to remove infection [1]. Chronic periapical lesions represent inflamed granulation tissue infiltrated by different inflammatory cells, which produce a variety of mediators. Cytokine network plays an important role in the regulation of non-specific and specific immune responses. Many studies have demonstrated the production of various cytokines in the periapical lesions [2, 3].

Interleukin 6 (IL-6) is a cytokine that influences the antigen-specific immune responses and inflammatory reactions, and has the role of proinflammatory and anti-inflammatory cytokine [4]. IL-6 is the "myokin", a cytokine produced in the muscles in response to contraction. It increases significantly with exercise, and prior to the occurrence of other cytokines in the bloodstream. IL-6 production is proven in human periapical lesions [5] and in marginal inflammation of periodontal tissues [6]. The literature data suggests that IL-6 is multifunctional cytokine produced by several types of immune cell- monocytes,

macrophage, Th-2 cells, activated B cells, and polymorphonuclear cells [7]. Production of IL-6 is carried out under the influence of IL-1, TNF- α and INF- γ , however, it also regulates the secretion of IL-1 and is opposed by some of its effects. IL-6 is secreted by osteoblasts during stimulation of osteoclast formation. IL-6 stimulates the formation of osteoclast precursors and increases the number of osteoclasts *in vivo*, leading to systematic bone resorption [8]. Along with TNF- α and IL-1, it belongs to the group of major proinflammatory cytokines. Numerous data indicate that IL-6 also has anti-inflammatory activity. The antiinflammatory role of IL-6 is mediated through the inhibitory effects of TNF- α and IL-1 [9].

The aim of this study was to determine the concentration of interleukin-6 (IL-6) in tissue homogenates of human periapical lesions and correlate its levels with symptomatology and size of the lesions.

MATERIALS AND METHODS

The study included 93 patients from the Clinic of Dentistry, Niš, who were diagnosed with chronic periapical lesions using clinical and radiographic methods. The study was approved by the Ethical Committee of the Medical

Table 1. Periapical lesions according to symptomatology and size
Tabela 1. Podela ispitivanih lezija u grupe prema simptomatologiji i veličini

	Large lesions Velike lezije	Small lesions Male lezije	Total Ukupno
Symptomatic lesions Simptomatske lezije	23	23	46
Asymptomatic lesions Asimptomatske lezije	23	24	47
Total Ukupno	46	47	93

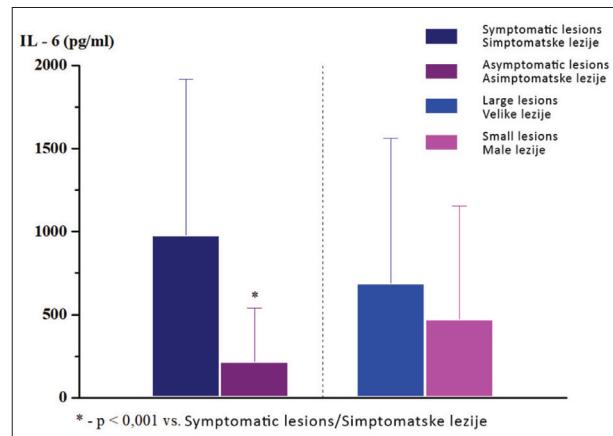


Figure 1. Concentration of IL-6 in tissue homogenates of periapical lesions in relation to symptomatology and size

SLIKA 1. Koncentracija IL-6 u homogenatu tkiva periapeksnih lezija u odnosu na simptomatologiju i veličinu

Faculty, University of Niš, Serbia (no. 01-2066-5). Periapical lesions were collected from teeth that were determined as non-salvageable and indicated for extraction.

From each patient, dental history including symptomatology and medications was collected and clinical exam was performed. Other inclusion criteria were healthy patients not suffering from acute or chronic diseases that could lead to immunodeficiency, and who were not taking antibiotics and anti-inflammatory medications in the last two months.

Only teeth with periapical lesions that did not show moderate or severe form of marginal periodontitis were included in the study. According to subjective symptoms of patients, lesions were divided into the two groups: symptomatic and asymptomatic. Clinically symptomatic lesions were characterized by swelling, pain, discomfort when chewing or sensitivity to percussion and palpation whereas asymptomatic lesions showed no symptoms. The size of periapical lesions was measured in millimeters using a ruler and divided into the two groups: small (≤ 5 mm) and large (≥ 6 mm) (Table 1). Since periapical lesions contain granulomatous inflammatory tissue that replaces normal bone there was no equivalent tissue that could be used as negative control.

Before administering local anaesthetics, teeth, gingiva and mucosa around the tooth were cleaned using 0.12% chlorhexidine and the patient rinsed mouth with 0.12% chlorhexidine for 30 seconds. Samples of periapical lesions removed from the root apex were collected immediately after the extraction using sterile scalpel, then washed in sterile saline solution, dried with sterile cotton, placed

Table 2. IL-6 concentration in symptomatic and asymptomatic lesions

Tabela 2. Koncentracija IL-6 u okviru grupa simptomatskih i asimptomatskih lezija

Symptomatic Simptomatske	n n	Mean \pm SD Sr. vr. \pm SD	Median Mediana	Min.–Max. Min.–Max.
Large lesions Velike lezije	22	1162.40 \pm 1002,40	884.90	8.79–2649.63
Small lesions Male lezije	19	759.11 \pm 836.24	427.30	17.28–2423.72
Asymptomatic Asimptomatske				
Large lesions Velike lezije	21	189.24 \pm 205.39	74.90	27.35–759.62
Small lesions Male lezije	23	232.86 \pm 408.21	107.57	11.07–1670.97

in a sterile plastic Eppendorf tubes and frozen at -70°C. Using teflon crusher in an iced phosphate buffer at pH 7.4, samples were homogenized with volume adapted to weight of the tissue obtaining the final concentration of 10%. Larger debris was sedimented by centrifugation at 1400 rpm for 1 minute at -40°C. The supernatant was frozen at -70°C until further analysis was performed.

The concentration of IL-6 was measured using ELISA test (R&D Systems Inc. Minneapolis, USA) according to the manufacturer's instructions. The sensitivity of ELISA test for IL-6 was from 0.7 pg/ml, and the concentration of cytokine was analyzed in relation to the size and symptomatology of periapical lesions. Statistical analysis was performed using the Mann-Whitney Rank Sum test in the software SigmaStat and Origin. The results were expressed as mean \pm standard deviation. P<0.05 was considered statistically significant.

RESULTS

All tissue homogenates of periapical lesions showed significant concentration of IL-6 cytokine. Figure 1 shows the concentration of IL-6 in the tissue homogenates of all samples that were analyzed with respect to the size and symptomatology. In symptomatic lesions average concentration of IL-6 was 975.51 pg/ml, while in the group of asymptomatic lesions the average value was 212.04 pg/ml. Analysis of the concentration showed that there was significantly higher concentration of IL-6 in symptomatic lesions (p<0.001). In the group of large lesions, average concentrations of IL-6 amounted to 687.14 pg/ml, while in the group of small lesions average value was 470.92 pg/ml. The difference was observed but not statistically significant.

Table 2 shows the concentration of IL-6 within the group of symptomatic and asymptomatic lesions, and the concentration of cytokines in each of the groups were analyzed with respect to the size. The average concentration of IL-6 in the large symptomatic lesions amounted to 1162.40 pg/ml, while in the small symptomatic lesions it was 759.11 pg/ml. A statistically significant difference in the concentrations of IL-6 was not observed in the symptomatic lesions in relation to the size. In the group of asymptomatic lesions, statistically significant differ-

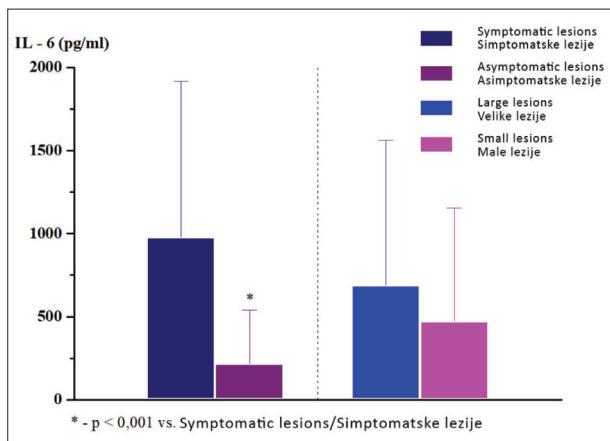


Figure 2. IL-6 concentration in large and small lesions
Slika 2. Koncentracija IL-6 u okviru grupa velikih i malih lezija

ence in concentration of IL-6 was also not observed in relation to the size. The average concentration of IL-6 in large asymptomatic lesions amounted to 189.24 pg/ml, while in small asymptomatic lesions it was 232.86 pg/ml.

Figure 2 shows the concentration of IL-6 in the groups of large and small lesions where the statistical significance was analyzed in relation to symptomatology. The average concentration of IL-6 in large symptomatic lesions amounted to 1162.40 pg/ml, while in large asymptomatic lesions it was 189.24 pg/ml. The difference was statistically significant ($p<0.001$). The analysis showed significantly higher concentration in small symptomatic (759.11 pg/ml) compared to small asymptomatic lesions (232.86 pg/ml) ($p<0.05$).

DISCUSSION

Periapical lesions develop as a result of persistent inflammatory response induced by prolonged exposure of periapical tissue to root canal microorganisms, causing an immune reaction. In this local defense mechanism different inflammatory mediators play a complex and central role in the regulation of immune response. While proinflammatory cytokines, such as IL-1, IL-6, TNF- α , TNF- β , chemokines and Th1 cytokines, promote inflammation in the periapical tissues and activate osteoclastic bone resorption [10, 11], the role of antiinflammatory cytokines is important for suppression of inflammatory processes and repair processes within the periapical lesions [2, 3, 12].

In the early inflammatory cascade IL-1 and TNF- α induce production of IL-6. IL-6 has many molecular forms, and each molecule has a different function if secreted by various cells in different situations. The finding that polymorphonuclear cells in the periapical tissues produce IL-6, which was specified by the Euler et al. [13], suggest that IL-6 can contribute to the tissue injury at the site of inflammation. IL-6 is an integral mediator of the acute phase response to injury and infection that stimulate expression of acute phase protein [14]. Examination of various cytokines, such as TNF- α , IL-6, IL-3, GM-CSF, IL-11, IL-17, IL-18, in human and animal models have demonstrated their potential role in the pathogenesis of osteo-

lytic diseases [2, 15]. It has been shown that inflammatory cytokines IL-6 and TNF- α have the capacity to trigger osteoclastic bone resorption and their role can express synergistically with IL-1, causing activation or osteoclast differentiation and production, as well as secretion of prostaglandins by numerous cell types, including fibroblasts and osteoblasts [2]. Several authors have published the expression of IL-6 production in human periapical granulomas and cysts. Results of our study showed the presence of IL-6 in all tissue samples of periapical lesions that is in accordance with data from the literature [9, 16].

Studies have shown that the level of IL-6 is significantly increased in the infection and pain conditions. In the study of De Jongh et al. [17] important role is attributed to IL-6 in the pathophysiology of pain. Due to this fact, in our study we analyzed correlation between levels of IL-6 and symptomatology. The results of our investigations indicated statistically significant difference in IL-6 production in the symptomatic compared to asymptomatic lesions, while the average concentration of cytokines was higher in the large lesions compared to small, but the difference was not statistically significant.

The study of Gazivoda et al. [18] showed higher production of IL-6 in symptomatic and large lesions primarily emphasizing its proinflammatory aspect. However, experiments on IL-6-deficient mice showed conflicting results, indicating protective effect of this cytokine to bone destruction [14]. These differences may be explained by the fact that IL-6 has both proinflammatory and antiinflammatory role and its final effect depends on the target cells and coordination with additional cytokines.

Inflammatory reaction in patients with apical periodontitis is not limited to periradicular region [19]. It is known that dental infection can have negative impact on general health in patients with risk [20]. Blood analysis in patients after endodontic treatment of teeth with apical periodontitis showed the presence of bacteria that originate from root canal [21]. Spreading oral bacteria through the bloodstream is not the only way for mediation-targeted effects of oral focal infections. More significant effect on distant tissues and organs function may be induced by certain cytokines. Although the majority of members of the cytokine superfamily exhibits short-term effects, IL-1, IL-6 and TNF have been shown that locally produced within the tissues of periapical granulomas, can be carried by the bloodstream to distant places. These cytokines can cause acute phase response, which includes fever, increased erythrocyte sedimentation rate, and change in serum proteins synthesized by hepatocytes. Some authors examined elevated levels of acute phase protein in patients with chronic periapical granulomas. Their level was lowered to the normal value after the surgical removal of lesions by apicoectomy [10, 22].

CONCLUSIONS

High concentration of IL-6 in lesions with expressed clinical symptoms, as well as in large lesions, indicate its important pro-inflammatory activity and key role of

strong mediator responsible for the progression of lesion and stimulation of bone resorption in the pathogenesis of periapical lesions.

REFERENCES

- Walker KF, Lappin DF, Takahashi K, Hope J, Macdonald DG, Kinane DF. Cytokine expression in periapical granulation tissue as assessed by immunohistochemistry. *Eur J Oral Sci* 2000; 108:195–201. [DOI: 10.1034/j.1600-0722.2000.108003195.x] [PMID: 10872989]
- Danin J, Linder LE, Lundqvist G, Andersson L. Tumor necrosis factor-alpha and transforming growth factor-beta1 in chronic periapical lesions. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2000; 90:514–17. [DOI: 10.1067/moe.2000.108958] [PMID: 11027390]
- Čolić M, Gazivoda D, Vučićević D, Vasilijić S, Rudolf R, Lukić A. Proinflammatory and immunoregulatory mechanisms in periapical lesions. *Mol Immunol*. 2009; 47:101–13. [DOI: 10.1016/j.molimm.2009.01.011] [PMID: 19232436]
- Heinrich PC, Behrmann I, Haan S, Hermanns HM, Müller-Newen G, Schaper F. Principles of interleukin-6-type cytokine signalling and its regulation. *Biochem J*. 2003; 374:1–20. [DOI: 10.1042/bj20030407] [PMID: 12773095]
- De Sá AR, Pimenta FJGS, Dutra WO, Gomez RS. Immunolocalization of interleukin 4, interleukin 6, and lymphotoxin α in dental granuloma. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2003; 96:356–60. [DOI: 10.1016/S1079-2104(03)00067-2] [PMID: 12973294]
- Yamazaki K, Nakajima T, Gemmell E, Polak B, Seymour GJ, Hara K. IL-4 and IL-6-producing cells in human periodontal disease tissue. *J Oral Pathol Med*. 1994; 23:347–53. [DOI: 10.1111/j.1600-0714.1994.tb00074.x]
- Abdolsamadi HR, Vahedi M, Esmaeili F, Nazari S, Abdollahzadeh S. Serum interleukin-6 as a serologic marker of chronic periapical lesions: A case-control study. *J Dent Res Dent Clin Dent Prospects*. 2008; 2:43–7. [DOI: 10.5681/joddd.2008.009]
- Azuma MM, Samuel RO, Gomes-Filho JE, Dezan-Junior E, Cintra LTA. The role of IL-6 on apical periodontitis: a systematic review. *Int Endod J*. 2014; 47:615–21. [DOI: 10.1111/iej.12196] [PMID: 24224782]
- Prso IB, Kocjan W, Simić H, Brumini G, Pezelj-Ribarić S, Borčić J, et al. Tumor necrosis factor-alpha and interleukin 6 in human periapical lesions. *Mediators Inflamm*. 2007; 2007:38210. [DOI: 10.1155/2007/38210] [PMID: 17497030]
- Márton IJ, Kiss C. Protective and destructive immune reactions in apical periodontitis. *Oral Microbiol Immunol*. 2000; 15:139–50. [DOI: 10.1034/j.1399-302x.2000.150301.x] [PMID: 11154396]
- Nair PNR. Pathogenesis of apical periodontitis and the causes of endodontic failures. *Crit Rev Oral Biol Med*. 2004; 15:348–81. [DOI: 10.1177/154411130401500604] [PMID: 15574679]
- Kawashima N, Stashenko P. Expression of bone-resorbing and regulatory cytokines in murine periapical inflammation. *Arch Oral Biol*. 1999; 44:55–66. [DOI: 10.1016/S0003-9969(98)00094-6] [PMID: 10075151]
- Euler GJ, Miller GA, Hutter JW, D'Alessandro MM. Interleukin-6 in neutrophils from peripheral blood and inflammatory periradicular tissues. *J Endod*. 1998; 24:480–4. [DOI: 10.1016/S0099-2399(98)80051-4] [PMID: 9693575]
- Balto K, Sasaki H, Stashenko P. Interleukin-6 deficiency increases inflammatory bone destruction. *Infection and Immunity* 2001; 69:744–50. [DOI: 10.1128/IAI.69.2.744-750.2001] [PMID: 11159963]
- Silva TA, Garlet GP, Lara VS, Martins W, Silva JS Cunha FQ. Differential expression of chemokines and chemokine receptors in inflammatory periapical diseases. *Oral Microbiol Immunol*. 2005; 20:310–6. [DOI: 10.1111/j.1399-302X.2005.00232.x] [PMID: 16101967]
- Barkhordar RA, Hayashi C, Hussain MZ. Detection of interleukin-6 in human dental pulp and periapical lesions. *Endod Dent Traumatol*. 1999; 15:26–7. [DOI: 10.1111/j.1600-9657.1999.tb00744.x] [PMID: 10219150]
- De Jongh RF, Vissers KC, Meert TF, Booij LHD, De Deyne CS, Heylen RJ. The role of interleukin-6 in nociception and pain. *Anesth Analg*. 2003; 96:1096–103. [DOI: 10.1213/01.ANE.0000055362.56604.78] [PMID: 12651667]
- Gazivoda D, Dzopalic T, Božić B, Tatomićević Z, Brkić Z, Colić M. Production of proinflammatory and immunoregulatory cytokines by inflammatory cells from periapical lesions in culture. *J Oral Pathol Med*. 2009; 38:605–11. [DOI: 10.1111/j.1600-0714.2009.00788.x] [PMID: 19453841]
- Gomes MS, Blattner TC, Filho MSA et al. Can apical periodontitis modify systemic levels of inflammatory markers? A systematic review and meta-analysis. *J Endod*. 2013; 1205–17. [DOI: 10.1016/j.joen.2013.06.014] [PMID: 24041380]
- Stashenko P, Teles R, D'Souza R. Periapical inflammatory responses and their modulation. *Crit Rev Oral Biol Med*. 1998; 9:498–521. [DOI: 10.1177/10454411980090040701] [PMID: 9825224]
- Debelian GJ, Olsen I, Tronstad L. Electrophoresis of whole-cell soluble proteins of microorganisms isolated from bacteremias in endodontic therapy. *Eur J Oral Sci*. 1996; 104:540–6. [DOI: 10.1111/j.1600-0722.1996.tb00139.x] [PMID: 9021323]
- Stashenko P. Role of immune cytokines in the pathogenesis of periapical lesions. *Endod Dent Traumatol*. 1990; 6:89–96. [DOI: 10.1111/j.1600-9657.1990.tb00400.x] [PMID: 2079017]

Received: 10.04.2018 • Accepted: 18.07.2018

Uloga interleukina-6 u patogenezi hroničnih periapeksnih lezija

Jelena Popović¹, Tatjana Cvetković², Tanja Džopalić³, Marija Nikolić¹, Aleksandar Mitić¹, Radomir Barac¹, Slavoljub Živković⁴

¹Univerzitet u Nišu, Medicinski fakultet, Klinika za stomatologiju, Služba za bolesti zuba i endodonciju, Niš, Srbija;

²Univerzitet u Nišu, Medicinski fakultet, Institut za biohemiju, Niš, Srbija;

³Univerzitet u Nišu, Medicinski fakultet, Institut za imunologiju, Niš, Srbija;

⁴Univerzitet u Beogradu, Stomatološki fakultet, Klinika za bolesti zuba, Beograd, Srbija

KRATAK SADRŽAJ

Uvod Mreža citokina igra značajnu ulogu u patogenezi hroničnih periapeksnih lezija. Cilj studije je bio da se odredi koncentracija IL-6 u tkivnim homogenatima hroničnih periapeksnih lezija i da se proveri korelacija sa simptomatologijom i veličinom lezija.

Materijal i metode Ispitana su 93 uzorka hroničnih periapeksnih lezija dobijenih nakon ekstrakcije zuba. Uzorci lezija su podeljeni prema simptomatologiji pacijenata na simptomatske i asimptomatske, a prema veličini na velike i male. Koncentracija IL-6 je ispitivana pomoću ELISA testa, a dobijene vrednosti su analizirane u odnosu na grupe.

Rezultati Statistički značajna razlika u koncentraciji IL-6 je uočena u grupi simptomatskih lezija u poređenju sa asimptomatskim ($p < 0,001$). Analiza je pokazala i statistički značajno veću koncentraciju u velikim simptomatskim lezijama u odnosu na velike asimptomatske ($p < 0,001$) i u malim simptomatskim lezijama u odnosu na male asimptomatske ($p < 0,05$). Zapažena je i povećana produkciju IL-6 u velikim lezijama u odnosu na male, međutim, razlika nije bila statistički značajna.

Zaključak Veća koncentracija IL-6 u lezijama sa izraženim kliničkim simptomima kao i velikim lezijama ukazuje na njegovu važnu ulogu u progresiji periapeksnih lezija i koštane resorpције.

Ključne reči: periapeksne lezije; citokini; IL-6

UVOD

Periapeksne lezije su inflamatorna oboljenja koja nastaju kao rezultat imunog odgovora na kontinuiranu antigenu stimulaciju iz kanala korena. Njihov razvoj i progresija u hronične lezije sa posledičnim gubitkom kosti nastaju kao rezultat nemogućnosti mehanizama odbrane domaćina da ukloni infekciju [1]. Tkivo hroničnih periapeksnih lezija predstavlja inflamirano granulaciono tkivo infiltrisano različitim inflamatornim ćelijama koje producuju brojne medijatore. Mreža citokina ima značajnu ulogu u regulisanju nespecifičnih i specifičnih imunih odgovora. Mnoge studije su dokazale produkciju različitih citokina u periapeksnim lezijama [2, 3].

Interleukin 6 (IL-6) je citokin koji utiče na antigen-specifične imune odgovore i inflamatorne reakcije i ima ulogu i proinflamatornog i antiinflamatornog citokina [4]. IL-6 je i „miokin“, citokin produkovan u mišićima u odgovoru na mišićnu kontrakciju. Značajno se povećava vežbanjem, a prethodi i pojavi drugih citokina u cirkulaciji. IL-6 je dokazan u humanim periapeksnim lezijama [5] i u inflamiranim marginalnim parodontalnim tkivima [6]. Podaci iz literature govore da je IL-6 multifunkcionalni citokin koga produkuje nekoliko tipova imunih ćelija – monociti, makrofagi, Th-2 limfociti, aktivirane B ćelije i polimorfonuklearne ćelije [7]. Producija IL-6 se odvija pod uticajem IL-1, TNF-α i INF-γ, međutim, on istovremeno reguliše sekreciju IL-1 i suprotstavlja se nekim njegovim efektima. IL-6 sekretuju i osteoblasti prilikom stimulisanja osteoklastne formacije. IL-6 stimuliše formiranje osteoklastnih prekursora i povećava broj osteoklasta *in vivo*, dovodeći do sistemskog pojačanja koštane resorpције [8]. Zajedno sa TNF-α i IL-1, pripada grupi glavnih proinflamatornih citokina. Brojni podaci pokazuju da IL-6 poseduje i antiinflamatorne aktivnosti. Uloga IL-6 kao antiinflamatornog citokina posreduje kroz inhibitorne efekte TNF-α i IL-1 [9].

Cilj ove studije je bio da se odredi koncentracija IL-6 u homogenatima tkiva periapeksnih lezija i da se proveri korelacija sa simptomatologijom i veličinom lezija.

MATERIJAL I METODE

U istraživanje su bila uključena 93 pacijenta Klinike za stomatologiju Medicinskog fakulteta u Nišu kod kojih je kliničkim i radiografskim metodama postavljena dijagnoza hronične periapeksne lezije. Studija je odobrena od strane Etičkog odbora Medicinskog fakulteta u Nišu (br. 01-2066-5). Periapeksne lezije analizirane u studiji uzimane su sa korenova zuba koji su zbog nemogućnosti lečenja indikovani za ekstrakciju. Od svakog pacijenta su uzimani anamnestički podaci o toku i trajanju oboljenja, simptomatologiji, uzimanju lekova, a inspekcijom i palpacijom je utvrđeno eventualno postojanje lokalnog otoka ili otoka limfnih žlezda. Pored prisustva periapeksne lezije, uslov za uključenje pacijenata u studiju je bio da ne boluju od akutnih ili hroničnih oboljenja koja dovode do stanja imunodeficijacije i da u prethodna dva meseca nisu uzimali antibiotsku i antiinflamatornu terapiju. U istraživanje su uključivane periapeksne lezije onih zuba koji nisu pokazivali umeren ili ozbiljan oblik marginalnog parodontitisa.

Ispitivane lezije su prema subjektivnim simptomima pacijenata bile podeljene u dve grupe – simptomatske i asimptomatske lezije. Klinički su se simptomatske lezije karakterisale otokom, bolom, nelagodnošću pri žvakaju ili osetljivošću na perkusiju i palpaciju, dok asimptomatske lezije nisu pokazivale znake ili simptome akutnih periapeksnih oboljenja u vreme studije. Periapeksne lezije su merene milimetarskim lenjirom i u odnosu na veličinu podeljene u dve grupe: male (≤ 5 mm) i velike (≥ 6 mm) (Tabela 1). S obzirom na to da periapeksne lezije obuhvataju reaktivno tkivo koje se sastoji uglavnom od granulomatoznog inflamatornog tkiva koje zamenjuje normalnu kost, nije postojao pravi tkivni ekvivalent koji bi služio kao negativna kontrola.

Pre davanja lokalnog anestetika, zubi, gingiva i sluzokoža oko zuba su očišćeni 0,12% hlorheksidinom, a pacijent je ispirao usta 0,12% hlorheksidinom 30 sekundi. Uzorci periapeksnih lezija su odmah po ekstrakciji sterilnim skalpelom odstranjeni sa vrha korena zuba, isprani u sterilnom fiziološkom rastvoru,

prosuošeni na sterilnoj vati, stavljeni u sterilnu plastičnu ependorf epruvetu i zamrzavani na -70°C. Homogenizacija je vršena teflonskim tučkom u ledenom fosfatnom puferu pH 7,4 čija je zapremina prilagođena težini tkiva, tako da finalna koncentracija homogenata iznosi 10%. Krupniji detritus je sedimentiran centrifugiranjem na 1400 obrtaja tokom 1 minuta na -4°C. Supernatant je nakon toga smrznut na -70°C do izvođenja odgovarajućih biohemijских analiza.

Koncentracija IL-6 je određivana ELISA testom (R&D Systems Inc. Minneapolis, USA) prema uputstvu proizvođača. Senzitivnost ELISA testa za IL-6 je iznosila od 0,7 pg/ml, a koncentracija je analizirana u odnosu na simptomatologiju i veličinu lezije. Statistička analiza je urađena pomoću Mann-Whitney Rank Sum testa korišćenjem programa SigmaStat u Origin. Rezultati su izraženi kao srednje vrednosti \pm standardna devijacija. Statistički značajnim razlikama su smatrane one koje su bile pri $p < 0,05$.

REZULTATI

Ispitivanje koncentracije IL-6 u homogenatima uzoraka tkiva periapeksnih lezija je pokazalo značajnu koncentraciju citokina u svim uzorcima. Na Slici 1 prikazana je koncentracija IL-6 u homogenatima tkiva svih uzoraka, analiziranim u odnosu na simptomatologiju i veličinu. U grupi simptomatskih lezija prosečna koncentracija IL-6 je iznosila 975,51 pg/ml, dok je u grupi asimptomatskih lezija prosečna vrednost bila 212,04 pg/ml. Analizom koncentracija ustanovljeno je da postoji statistički značajno veća koncentracija IL-6 u simptomatskim lezijama ($p < 0,001$). U grupi velikih lezija prosečna koncentracija IL-6 je iznosila 687,14 pg/ml, dok je u grupi malih lezija prosečna vrednost bila 470,92 pg/ml. Razlika je postojala, ali nije bila statistički značajna.

U Tabeli 2 prikazane su vrednosti koncentracije IL-6 u okviru grupa simptomatskih i asimptomatskih lezija, a koncentracija citokina je u svakoj od grupa analizirana u odnosu na veličinu. Prosečna koncentracija IL-6 u simptomatskim velikim lezijama je iznosila 1162,40 pg/ml, dok je u simptomatskim malim lezijama koncentracija IL-6 iznosila 759,11 pg/ml. Nije zapažena statistički značajna razlika u koncentracijama IL-6 u grupi simptomatskih lezija u odnosu na veličinu. U grupi asimptomatskih lezija, takođe, nije ustanovljena statistički značajna koncentracija u odnosu na veličinu. Prosečna koncentracija IL-6 kod asimptomatskih velikih lezija je iznosila 189,24 pg/ml, dok je kod asimptomatskih malih lezija iznosila 232,86 pg/ml.

Na Slici 2 prikazana je koncentracija IL-6 u okviru grupa velikih i malih lezija, gde je statistička značajnost analizirana u odnosu na simptomatologiju. Prosečna koncentracija IL-6 kod velikih simptomatskih lezija je iznosila 1162,40 pg/ml, dok je kod velikih asimptomatskih iznosila 189,24 pg/ml. Ustanovljena razlika je bila statistički značajna ($p < 0,001$). Analiza je pokazala i statistički značajno veću koncentraciju u malim simptomatskim lezijama (759,11 pg/ml) u odnosu na male asimptomatske (232,86 pg/ml) ($p < 0,05$).

DISKUSIJA

Periapeksne lezije nastaju kao rezultat perzistentnog inflamatornog odgovora indukovanoj prolongiranim izloženošću periapeksnih tkiva mikroorganizmima kanala korena, što izaziva

imunološku reakciju. U ovom lokalnom mehanizmu odbrane različiti inflamatori medijatori igraju složenu i centralnu ulogu u regulisanju imunog odgovora. Dok proinflamatorni citokini, kao što su IL-1, IL-6, TNF- α , TNF- β , hemokini i Th1 citokini, propagiraju inflamaciju u periapeksnim tkivima i aktiviraju osteoklastnu koštanu resorpciju [10, 11], uloga antiinflamatornih citokina je važna za supresiju inflamatornih procesa i procese zarastanja unutar periapeksnih lezija [2, 3, 12].

U ranoj inflamatornoj kaskadi stvaranje IL-6 indukuju IL-1 i TNF- α . IL-6 ima mnoge molekularne forme i svaki molekul ima drugačiju funkciju kada ga sekretuju različite ćelije u različitim situacijama. Nalaz da polimorfonuklearne ćelije u periapeksnim tkivima produkuju IL-6, što je navedeno od strane Eulera i saradnika [13], ukazuje da IL-6 može doprineti tkivnoj povredi na mestu inflamacije. IL-6 predstavlja integralni medijator u akutnoj fazi odgovora na povredu i infekciju kada stimuliše ekspresiju proteina akutne faze [14]. Ispitivanje različitih citokina, kao što su TNF- α , IL-6, IL-3, GM-CSF, IL-11, IL-17, IL-18, na humanim i animalnim modelima pokazala su njihovu potencijalnu ulogu u patogenezi osteolitičkih oboljenja [2, 15]. Dokazano je da inflamatorni citokini IL-6 i TNF- α imaju kapacitet da aktiviraju osteoklastnu koštanu resorpciju, a svoju ulogu mogu da ostvaruju sinergistički sa IL-1, izazivajući aktivaciju ili diferencijaciju osteoklasta i produkciju, odnosno sekreciju prostaglandina od strane brojnih ćelijskih tipova, uključujući fibroblaste i osteoblaste [2]. Više autora je objavilo ekspresiju IL-6 u humanim periapeksnim granulomima i cistama. Rezultati ove studije su dokazali prisustvo IL-6 u svim tkivnim uzorcima periapeksnih lezija, što je u skladu sa podacima iz literature [9, 16].

Istraživanja su pokazala da je nivo IL-6 značajno povećan kod infekcija i bolnih stanja. U studiji De Jongh i saradnika [17] važna uloga je pripisana IL-6 u patofiziologiji bola. Zbog te činjenice, u ovoj studiji je analizirana korelacija između nivoa IL-6 i simptomatologije. Rezultati ovog istraživanja su ukazali na statistički značajno veću produkciju IL-6 u simptomatskim lezijama u odnosu na asimptomatske, dok je prosečna koncentracija ovog citokina bila veća u velikim lezijama u odnosu na male, ali ova razlika nije bila statistički značajna.

U istraživanju Gazivode i saradnika [18] uočena je jača produkcija IL-6 u simptomatskim i velikim lezijama, naglašavajući pre svega njegov proinflamatorni aspekt u ovom oboljenju. Međutim, eksperimenti na IL-6 deficitnom mišu pokazuju suprotne rezultate, ukazujući na efekat zaštite ovog citokina od koštane destrukcije [14]. Ove razlike mogu se objasniti činjenicom da IL-6 poseduje i proinflamatorne i antiinflamatorne osobine i da njegov krajnji efekat zavisi od ciljnih ćelija i sadejstva drugih citokina.

Inflamatorne reakcije kod pacijenata sa apeksnim parodontitima nisu ograničene samo na periradiksnu regiju [19]. Poznato je da dentalne infekcije mogu imati negativni uticaj na opšte zdravlje kod pacijenata sa rizikom [20]. Analiza krvi pacijenata nakon endodontske terapije zuba sa apeksnim parodontitima je pokazala prisustvo bakterija za koje je dokazano da vode poreklo iz kanala korena [21]. Širenje oralnih bakterija putem krvotoka nije jedini put za posredovanje u ciljanim efektima oralnih fokalnih infekcija. Mnogo značajniji uticaj na funkciju udaljenih tkiva i organa može biti izazvan pojedinim citokinima. Iako većina članova superfamilije citokina ispoljava kratkotrajne efekte, IL-1, IL-6 i TNF su pokazali da, lokalno produkovani unutar tkiva periapeksnih granuloma, mogu biti nošeni putem krvotoka do udaljenih mesta. Ovi citokini mogu

da izazovu akutnu fazu odgovora koji podrazumeva povišenu telesnu temperaturu, povećanu sedimentaciju eritrocita i promenu u serumskim proteinima sintetisanih od strane hepatocita. Pojedini autori su pratili povećane nivoje proteina akutne faze kod pacijenata sa hroničnim periapeksnim granulomima. Njihov nivo je snižen na normalne vrednosti nakon hirurškog uklanjanja lezije apikotomijom [10, 22].

ZAKLJUČAK

Veća koncentracija IL-6 u lezijama sa izraženim kliničkim simptomima, kao i velikim lezijama, ukazuje na njegovu važnu proinflamatornu aktivnost i ključnu ulogu snažnog medijatora koji je odgovoran za progresiju lezije i stimulaciju koštane resorpcije u patogenezi periapeksnih lezija.

Frequency of malocclusion and condition of dental health among eight-year-old children in the municipality of Foča

Marina Milinković¹, Tanja Ivanović¹, Predrag Nikolić², Ljiljana Stojanović², Željko Milosavljević², Jovana Samardžija Hrisa¹, Aleksandra Šarac³

¹University of East Sarajevo, Faculty of Medicine, Department of Dentistry, Foča, Bosnia and Herzegovina;

²University of Belgrade, School of Dental Medicine, Department for Orthodontics, Belgrade, Serbia;

³Health Center Sokolac, Bosnia and Herzegovina

SUMMARY

Introduction Caries and orthodontic anomalies in school-age children lead to disturbed aesthetics, oral functions (chewing, swallowing, and speech), predisposition to trauma and the onset of periodontal diseases.

The aim was to assess dental health and frequency of orthodontic anomalies in children aged 8-9 years in the municipality of Foča.

Methods The research was conducted in the primary school Sveti Sava in Foča, where the total of 112 children age 8-9 years were examined. An informed consent was obtained from parents and school director for each student. Dental examination was performed using standard dental method, a mirror and a probe under artificial lighting. Children received instructions on proper nutrition, oral hygiene, tooth protection and elimination of bad habits.

Results Among 112 examined boys and girls of selected ages, very high person caries index (PCI) was found (78.57%). A total of 548 caries affected teeth were found (boys 331 (24.62%), girls 217 (16.14%) ($p < 0.05$)). Fifty-nine children had caries lesions on permanent teeth (boys 39 (2.9%), girls 20 (1.5%) ($p < 0.05$)). Sagittal abnormalities of the bite were present in 39 (34.82%) children, while 38 (33.92%) anomalies were related to vertical bite irregularities, 10 (8.92%) of them had open bite and 28 subjects (25%) had deep bite ($p > 0.05$).

Conclusion Large number of teeth was affected with caries lesions (548) in eighth-year-olds, while orthodontic anomalies, mostly sagittal abnormalities of bite were found in 39 subjects.

Keywords: caries; malocclusion; orthodontics; eight-year-olds

INTRODUCTION

Oral diseases and disorders have an important place in human pathology and can negatively affect the quality of life in children [1]. Caries and periodontitis are the most prevalent diseases of modern age. Children are the most commonly affected with caries lesions that have profound effect on aesthetic and function of oro-facial region [2]. Different factors (general and local, internal and external) are related to the emergence of caries. These are: race, hereditary factors, individual lifespan, gender, endocrine gland function, nutrition, microorganisms, saliva, form and arrangement of teeth, iatrogenic factors, poor oral hygiene and others [3]. Malocclusion is disorder of normal occlusion [4]. It has multifactorial origin (genetic and hereditary components, irregular nutrition, teeth caries, overdose teeth and premature loss of teeth) [5].

Orthodontic anomalies and dental caries of the two most widespread dental diseases in children, and the fact that they are in constant rise, indicates their mutual relation and conditionality [6]. It is known that caries lesions and especially those on the proximal surfaces of primary teeth have major influence on orthodontic anomalies. In addition, any premature extraction of primary mo-

lars causes secondary anxiety [7]. Since the best time to start orthodontic therapy is pre-puberty, the goal of our research was to determine oral status and the presence of malocclusion in eight-year-olds in the municipality of Foca, and compare obtained results with those from other parts of B & H, countries in the region, or some more developed countries in the world.

MATERIAL AND METHODS

This study was done in the municipality of Foča, where a total of 112 children aged 8-9 years were examined (second and third grade). The selected year is relevant because of the period of mixed dentition, teeth shifting and pre-puberty growth when treatment with orthodontic mobile devices provides the best effects. The study was conducted in 2017 in the elementary school Sveti Sava in Foča. Dentists from the Department of Pediatric and Preventive Dentistry with Orthodontics carried out the examinations. Prior to the beginning of examination, parents, the school director and the Ministry of Education and Culture of Republika Srpska signed written consent for participation in the study for each child. Children who

did not have written consent from their parents were excluded from the study. The Ethics Committee of the Faculty of Medicine in Foca also approved the study. The main activities during the research were: health education of children, examination of mouth and teeth, dental card records, group health interview with children, individual health interview with parents and teachers on how to maintain oral hygiene and advise parents on correct diet.

Prior to each examination, children were lectured in the presence of teaching staff about the importance of healthy teeth for general health, the process of caries formation, the process of plaque formation, the effects of microorganisms from toothache, the importance of proper nutrition for the health of teeth, the way to maintaining proper oral hygiene, the importance and significance of fluoride prophylaxis, the importance of fissure sealants, the type of accessories necessary for the maintenance of oral hygiene, as well as the importance of control check-ups. The proper maintenance of oral hygiene was also demonstrated to the students.

The examinations were carried out in classrooms under daylight using dental probe and mirror. The Klein-Palmer System (DMFT) was used to assess the prevalence of caries. For each child the presence or absence of orthodontic anomalies was recorded. Based on the occlusal relationship between the teeth of the upper and lower jaws, the class was determined by Angle. Vertical irregularities of the bite were measured using an orthodontic millimeter liner.

For the statistical data processing, the non-parametric test, Chi-square test, and the parametric test, t-test for independent samples were used, at a probability level of 5% ($p < 0.05$).

RESULTS

Clinical examination provided data on teeth status, mutual interaction of dental cavities and the presence of orthodontic anomalies. In 112 surveyed boys and girls, 40.77% of teeth were affected with caries lesions (boys (24.62%); girls (16.14%)) ($p < 0.05$) (Table 1). Caries lesions were found in permanent teeth in 4.38% of subjects (boys (2.9%) and girls (1.5%)) ($p < 0.05$) (Table 2). Caries Person Index (CPI) was very high-78.57% (boys 55.68%; girls 34.82% ($p > 0.05$)).

Also, high percentage of orthodontic anomalies was found in examined children. Sagittal abnormalities were found in 34.82% of respondents (18.2% boys, 16.6% of girls, ($p > 0.05$). As per Angle classification the most common class found was class I in 65.17% of respondents (Table 3), where 47.32% had class I with no malocclusion while 17.85% had class I with malocclusion ($p < 0.05$).

The most frequent irregularity of biting was the class II, which was registered in 26.78% of respondents. Class II/1 characterized by distal bite with protrusion of upper teeth was found in 16.96% of children, while class II/2 with distal bite and upper teeth retrusion was registered in 9.82% of children (Table 3). The lowest number of bite irregularities was related to class III malocclusion that was

Table 1. Distribution of carious teeth in primary dentition
Tabela 1. Raspodela karijesa u mlečnoj denticiji

	K (D)	E (E)	P (F)
Boys Dečaci	331 (24.62%)	44 (3.27%)	21 (1.56%)
Girls Devojčice	217 (16.14%)	37 (2.75%)	24 (1.78%)
Total Ukupno	548 (40.76%)	81 (6.02%)	45 (3.34%)
P value P vrednost		p < 0.05	

D – decayed, E – extracted, F – filled tooth

K – karijes, E – izvaden, P – plombiran zub

Table 2. Distribution of carious teeth in permanent dentition
Tabela 2. Raspodela karijesa u stalnoj denticiji

	K (D)	E (E)	P (F)
Boys Dečaci	39 (2.9%)	10 (0.74%)	13 (0.9%)
Girls Devojčice	20 (1.5%)	8 (0.6%)	15 (1.1%)
Total Ukupno	59 (4.4%)	18 (1.34%)	28 (2.0%)
P value P vrednost		p < 0.05	

D – decayed, E – extracted, F – filled tooth

K – karijes, E – izvaden, P – plombiran zub

Table 3. Distribution of orthodontic malocclusions per Angle in boys and girls
Tabela 3. Raspodela ortodontskih nepravilnosti po Angleu među dečacima i devojčicama

	class I I klasa	class II II klasa	class II/1 II/1 klasa	class II/2 II/2 klasa	class III III klasa
Boys Dečaci	35 (31.25%)	13 (11.60%)	11 (9.82%)	5 (4.46%)	5 (4.46%)
Girls Devojčice	38 (33.92%)	17 (15.17%)	8 (7.14%)	6 (5.35%)	4 (3.57%)
Total Ukupno	73 (65.17%)	30 (26.78%)	19 (16.96%)	11 (9.82%)	9 (8.03%)
P value P vrednost			p > 0.05		

found in 8.03% of subjects ($p > 0.05$) (Table 3). A dento-alveolar class III with simple inverted incisor contacts as the most form of class III was registered in 6.72% children (Figure 1).

In relation to the vertical plane, bite irregularities were found in 33.92% of children. Open bite was present 10 (8.92%) subjects, while 28 (25%) of subjects had some form of deep bite ($p > 0.05$) (Figure 2) (Table 4).

DISCUSSION

In our study, high prevalence of caries was observed among school children in the municipality of Foča. Based on previous studies and reviewed literature, it is known that socio-demographic factors, parents and co-operation with dental service have an impact on children general health. According to the obtained high values of person caries index (PCI-78.57%), Foča municipality is among leading ones with frequent occurrence of caries lesions. These results are in accordance with the results of



Figure 1. Simple inverted bite of incisors
Slika 1. Obrnuti preklop sekutića



Figure 2. Open bite
Slika 2. Otvoreni zagrižaj

Table 4. Distribution of vertical bite irregularities in eight-year-olds
Tabela 4. Raspodela vertikalnih nepravilnosti zagrižaja među osmogodišnjacima

	Vertical irregularities in bite Vertikalne nepravilnosti zagrižaja	Deep bite Duboki zagrižaj	Open bite Otvoreni zagrižaj
Boys Dečaci	18 (16.07%)	12 (10.71%)	6 (5.35%)
Girls Devojčice	20 (17.85%)	16 (14.28%)	4 (3.57%)
Total Ukupno	38 (33.92%)	28 (25%)	10 (8.92%)
P value P vrednost		p > 0.05	

Davidović et al. [8] who found 43.5% of children with caries in the area of the eastern part of B & H. Also, Kobašlija et al. (2000) found high values of PCI (89%) in Sarajevo municipality [9]. These findings are typical for underdeveloped or developing countries to have high values of PCI (87-91%) [10], compared to developed countries where PCI is significantly lower (28.8%) [11, 12].

The above results can be related to number of carious teeth in mixed dentition in some European countries [13], where higher values of carious teeth (44.6%) were found in school children. However, European countries have significantly higher (55.4%) number of children with all healthy teeth, whereas in our country only 21.4% of children are reported with all healthy teeth. Considering that significantly large number of eight-year-olds has high frequency of carious and extracted then filled teeth, it is

clear that long-term preventive programs and systematic dental care are non-existing in our country.

Previous research in the area of Bosnia and Herzegovina and neighboring countries [8, 9, 10] showed high prevalence of caries of permanent teeth in schoolchildren (45-88.35%). Our study showed significantly lower (4.1%) frequency of caries at this age compared to previous studies, which can be explained by the fact that it was period of early mixed dentition and only recently erupting permanent teeth were present. But when we look at the distribution of DMFT, we noticed significantly more carious teeth compared to filled teeth, especially in boys, with clear indication of weaker preventive and prophylactic measures and cooperation with dentist.

In addition, orthodontic anomalies were found in 52.67% children and that was the highest frequency found compared to other similar research in domestic and foreign literature, where the percentage of these anomalies varied from 29.42-81% [8, 14].

In our study, the most common form of malocclusion according to Angle Classification was Class I (65.17%), and that is consistent with the results from earlier studies (62.9%) [14, 15, 16]. 47.32% of subjects had normal occlusion class I, which is significantly higher than in the results of other studies (6.5-10%), while malocclusion of the class I with crowding in the anterior teeth accounted for a total of 17.85%, that is lower than in the world population [14]. The frequency of the class II (26.78%) was lower in our study compared to the results of other studies where the percentage of these anomalies was significantly higher (58-65%) [17, 18]. This could be explained by the lower prevalence of bad habits and successful application of preventive and interceptive orthodontic measures in the period of deciduous dentition. Also, results showed that II/1 was more pronounced in relation to the class II/2, which is in line with previously published studies where class II/1 (35%) was more prevalent than the class II/2 (17%) [8].

Class III malocclusion was present in 8.03%, which is more than in European countries (2.5%) [19]. As higher percentage (6.72%) of this malocclusion relates to children with simple inversion of incisors, this percentage can be explained by poor application of interceptive and preventive measures at an early age that has great effect in the treatment of orthodontic anomalies [20].

Vertical bite irregularities in this study were found in a total of 33.92% subjects. In relation to the world population, where deep bite malocclusion is found in 30-50% of children, in our study deep bite was found in 25%, which is less compared to other studies [20]. Our results are similar to the study conducted by Jovic et al. [21] that showed bite depth is changing at intervals and bite becomes deeper in the period of 7-10 years. These data also coincide with the prevalence of the class II/2, which is associated with deep and distal bite. Open bite was registered in a total of 8.92% of children, which is significantly lower compared to other studies where the prevalence of this anomaly was considerably higher (26.7%) [22]. This can be explained with lower incidence of bad habits in the eighth year olds that are the main etiological factor in the onset of open bite.

CONCLUSION

The prevalence of orthodontic anomalies in the selected sample of school children in the municipality of Foča was high. The most commonly registered was class II, deep bite, anterior crowding, open bite and inverted bite of incisors. The frequency of caries in the total sample (PCI) was very high, and higher for boys than girls. In order to preserve deciduous teeth as a protector of space and supporting zone, it is necessary to introduce mandatory restoration of deciduous teeth before enrolling in schools, as well as regular preventive- prophylactic and interceptive measures in order to prevent the occurrence of serious orthodontic problems at a later age.

REFERENCES

1. Jenny J, Cons NC. Comparing and contrasting two orthodontic indices, the index of orthodontic treatment need and the Dental Aesthetic Index. *Am J Orthod Dentofacial Orthop.* 1996; 110(4):410–6. [DOI: 10.1016/S0889-5406(96)70044-6] [PMID: 8876493]
2. Shashank SG, Anjali G, Laxmikant K, Sandeep P, Vivek P, Madhura F. Dental caries and its relationship to malocclusion in permanent dentition among 12-15 year old school going children. *J Int Oral Health.* 2014; 6(5):27–30. [PMID: 25395789]
3. Onyeaso CO, Aderinokun GA. The relationship between dental aesthetic index (DAI) and perceptions of aesthetics, function and speech amongst secondary school children in Ibadan, Nigeria. *Int J Paediatr Dent.* 2003; 13(5):336–41. [DOI: 10.1046/j.1365-263X.2003.00478.x] [PMID: 12924989]
4. Mahesh Kumar P, Joseph T, Varma R, Jayanthi M. Oral health status of 5 years and 12 years school going children in Chennai city, An epidemiological study. *J Indian Soc Pedod Prev Dent.* 2005; 23(1):17–22. [DOI: 10.4103/0970-4388.16021] [PMID: 15858301]
5. Bittencourt MAV, Machado AW. An overview of the prevalence of malocclusion in 6 to 10-year-old children in Brazil. *Dental Press J Orthod.* 2010; 15(6):113–22. [DOI: 10.1590/S2176-94512010000600015]
6. Radica-Sorić V. Povezanost zubnog karijesa i ortodontskih anomalija u mlječnoj denticiji. *Acta stomatologica Croatica.* 1979; 13(3):119–23.
7. Baskaradoss JK, Geevarghese A, Roger C, Thaliath A. Prevalence of malocclusion and its relationship with caries among school children aged 11-15 years in southern India. *Korean J Orthod.* 2013; 43(1):35–41. [DOI: 10.4041/kjod.2013.43.1.35] [PMID: 23503064]
8. Davidović B, Janković S, Ivanović D, Ivanović T, Vulićević Z, Ivanović M, et al. Procjena uticaja promocije oralnog zdravlja u djece istočnog dijela Republike Srpske. *Biomedicinska istraživanja.* 2011; 2(1):11–9. [DOI: 10.7251/BII1101016D]
9. Kobašlija S, Maglajlić N, Huseinbegović A. Prevalencija karijesa u djece u Sarajevu. *Acta Stomatol Croat.* 2000; 34(1):83–5.
10. Djuričković M, Ivanović M. Stanje oralnog zdravlja kod djece uzrasta od 12 godina u Crnoj Gori. *Vojnosanitetski pregled.* 2011; 68(7):550. [DOI: 10.2298/VSP1107550D]
11. Paisi M, Kay E, Kaimi I, Witton R, Nelder R, Christophi C, et al. Obesity and dental caries in young children in Plymouth, United Kingdom: A spatial analysis. *Community Dent Health.* 2018; 35(1):58–64. [DOI: 10.1922/CDH_4214Paisi07] [PMID: 29380963]
12. Hobdell M, Petersen PE, Clarkson J, Johnson N. Global goals for oral health 2020. *Int Dent J.* 2003; 53:285–8. [DOI: 10.1111/j.1875-595X.2003.tb00761.x]
13. Luzzi V, Fabbrizi M, Coloni C, Mastrandri C, Mirra C, Bossù M, et al. Experience of dental caries and its effects on early dental occlusion: a descriptive study. *Ann Stomatol (Roma).* 2011; 2(1-2):13–8. [PMID: 22238717]
14. Patil D, Poornima P, Manoharan M. Malocclusion and dental caries experience among 8–9-year-old children in a city of South Indian region: A cross-sectional survey. *J Educ Health Promot.* 2017; 6:98. [DOI: 10.4103/jehp.jehp_24_17] [PMID: 29296599]
15. Silva RG, Kang DS. Prevalence of malocclusion among Latino adolescents. *Am J Orthod Dentofacial Orthop.* 2001; 119:313–5. [DOI: 10.1067/mod.2001.110985] [PMID: 11244426]
16. Thilander B, Pena L, Infante C, Parada SS, de Mayorga C. Prevalence of malocclusion and orthodontic treatment need in children and adolescents in Bogota, Colombia. An epidemiological study related to different stages of dental development. *Eur J Orthod.* 2001; 23:153–67. [PMID: 11398553]
17. Fundagul B, Ibrahim EG, Ahmet AC. Malocclusion prevalence and orthodontic treatment need in central Anatolian adolescents compared to European and other nations' adolescents. *Dental Press J. Orthod.* 2015; 20(6). [DOI: 10.1590/2177-6709.20.6.075-081.oar] [PMID: 26691973]
18. Redzepagic V, Ilic Z, Laganin S, Dzemidzic V, Tiro A. An epidemiological study of malocclusion and occlusal traits related to different stages of dental development. *South Eur J Orthod Dentofac Res.* 2017; (4):9–13. [DOI: 10.5937/sejodr4-1285]
19. Otto S, Patricia AS, Anna S, Adriano C. Orthodontic treatment need of austrian schoolchildren in the mixed dentition stage. *Swiss Dent J.* 2017; 127(2): 122–8. [PMID: 28266685]
20. Gudipaneni RK, Aldahmeshi RF, Patil SR, Alam M. The prevalence of malocclusion and the need for orthodontic treatment among adolescents in the northern border region of Saudi Arabia: an epidemiological study. *BMC Oral Health.* 2018; 2:18. [PMID: 29390986]
21. Jović M, Kravić K, Trifunović M. Promena dubine preklopa sekutića kod dece za vreme smene zuba. *ASCRO.* 1979; 13:147.
22. Vithanaarachchi SN, Nawarathna LS. Prevalence of anterior cross bite in preadolescent orthodontic patients attending an orthodontic clinic. *Ceylon Med J.* 2017; 62(3):189–92. [PMID: 29077365]

Received: 13.03.2018 • Accepted: 25.07.2018

Učestalost malokluzija i stanje dentalnog zdravlja kod osmogodišnjaka na području opštine Foča

Marina Milinković¹, Tanja Ivanović¹, Predrag Nikolić², Ljiljana Stojanović², Željko Milosavljević², Jovana Hriza Samardžija¹, Aleksandra Šarac³

¹Univerzitet u Istočnom Sarajevu, Medicinski fakultet, odsek Stomatologija, Foča, Bosna i Hercegovina;

²Univerzitet u Beogradu, Stomatološki fakultet, Klinika za ortopediju vilica, Beograd, Srbija;

³Dom zdravlja, Sokolac, Bosna i Hercegovina

KRATAK SADRŽAJ

Uvod Karijes i ortodontske anomalije kod dece školskog uzrasta dovode do narušene estetike, poremećaja oralnih funkcija (žvakanje, gutanje i govor), povećane sklonosti nastanku trauma i nastanku parodontalnih bolesti.

Cilj ovog rada je bio da se provere dentalno zdravlje i učestalost ortodontskih anomalija kod dece uzrasta 8–9 godina na području opštine Foča.

Metode Istraživanje je sprovedeno u Osnovnoj školi „Sveti Sava“ u Foči, gde je pregledano ukupno 112 dece uzrasta 8–9 godina. Kod svakog učenika za koga je postojao informativni pristanak roditelja i direktora škole obavljen je stomatološki pregled standarnom stomatološkom metodom, ogledalom i sondom uz korišćenje veštačkog osvetljenja. Deca su dobila upute o pravilnoj ishrani, higijeni, zaštiti zuba i eliminaciji loših navika.

Rezultati Kod 112 pregledanih dečaka i devojčica odabranih uzrasta utvrđen je veoma visok karijes indeks osoba (Klo) – od 78,57%. Ukupno je pronađeno 548 karijesom zahvaćenih mlečnih zuba (dečaci 331 (24,62%); devojčice 217 (16,14%) ($p < 0,05$)). Kod ukupno 59 ispitanika pronađen je karijes stalnih zuba (dečaci 39 (2,9%); devojčice 20 (1,5%) ($p < 0,05$)). Sagitalne nepravilnosti zagrižaja su bile zastupljene kod ukupno 39 (34,82%) dece, dok se ukupno 38 (33,92%) anomalija odnosilo na vertikalne nepravilnosti zagrižaja, pri čemu je 10 (8,92%) ispitanika imalo otvoreni zagrižaji, a 28 ispitanika (25%) dubok zagrižaj ($p > 0,05$).

Zaključak Kod osmogodišnjaka je pronađen veliki broj karijesom zahvaćenih mlečnih zuba (548) i velika zastupljenost ortodontskih anomalija, od kojih su najzastupljenije sagitalne nepravilnosti zagrižaja, koje su pronađene kod 39 ispitanika.

Ključne reči: karijes; malokluzije; zub

UVOD

Oralne bolesti i poremećaji oralnog zdravlja imaju važno место u humanoj patologiji i mogu negativno uticati na kvalitet života deteta [1]. Karijes i parodontopatija su najrasprostranjene bolesti savremenog doba. Problem karijesa je u tome što najčešće oboljevaju deca i ujedno je jedno od najčešćih infektivnih multifaktorskih oboljenja detinjstva, koje utiče na estetske i funkcionalne karakteristike [2]. Veliki broj opštih i lokalnih, unutrašnjih i spoljašnjih faktora se dovodi u vezu sa nastankom karijesa. Opšti i lokalni faktori su: rasa, nasledni činioci, životno doba pojedinca, pol, funkcija endokrinih žlezda, ishrana, mikroorganizmi, pljuvačka, oblik i raspored zuba, jatrogeni faktori, loša oralna higijena i drugi [3]. Malokluzija predstavlja stanje poremećaja normalne okluzije (zagrižaja) kod pacijenta [4]. Obično imaj multifaktorsko poreklo (genetske i hereditarne komponente, nepravilna ishrana, karijes zuba, prekobrojni zubi i prerani gubitak mlečnih zuba) [5].

Orthodontske anomalije i zubni karijes su dva najrasprostranjena stoma tološka oboljenja dece, i činjenica da se nalaze u permanentnom porastu ukazuje na njihovu uzajamnu povezanost i uslovljenošću [6]. Poznato je da karijes, a naročito onaj na aproksimalnim površinama mlečnih zuba, ima veliki uticaj na stvaranje ortodontskih anomalija. Isto tako, i svaka prerana ekstrakcija mlečnih molara uzrok je sekundarne teskobe [7]. S obzirom na to da je najidealnije vreme za početak ortodontske terapije predpubertetski uzrast, cilj našeg istraživanja je bio da se utvrde oralni status i zastupljenost malokluzija kod osmogodišnjaka na području opštine Foča, te dobijeni rezultati uporede s onima iz drugih delova BiH, zemalja u regiji, odnosno nekim razvijenijim državama u svetu.

MATERIJAL I METODE

Ova studija je urađena na području opštine Foča, gde je ukupno pregledano 112 dece uzrasta 8–9 godina (drugi i treći razred). Izabrano godište je relevantno zbog perioda mešovite dentitije, smene zuba i predpubertetskog skoka rasta, kada terapija ortodontskim mobilnim aparatima pruža najbolje efekte. Studija je sprovedena u toku 2017. godine u Osnovnoj školi „Sveti Sava“ u Foči. Preglede su obavljeni lekarima sa katedre za dečiju i preventivnu stomatologiju sa ortodoncijom. Pre početka pregleda za svako dete je postojala pismena saglasnost za učešće u studiji od strane roditelja, direktora škole i Ministarstva prosvete i kulture Republike Srbске. Deca koja nisu imala pismenu saglasnost od strane roditelja isključena su iz studije. Studija je odobrena i od strane etičkog komiteta Medicinskog fakulteta u Foči. Osnovne aktivnosti u toku istraživanja bile su: zdravstveno prosvećivanje dece, pregled usta i zuba, evidencija u stomatološke kartone, grupni zdravstveni razgovor sa decom, individualni zdravstveni razgovor sa roditeljima i nastavnicima o načinu održavanja oralne higijene i savetovanje roditelja o pravilnom načinu ishrane.

Pre svakog pregleda deci su uz prisustvo nastavnog osoblja održana predavanja o važnosti zdravih zuba za opšte zdravlje, procesu nastanka karijesa, procesu nastanka plaka, dejstvu mikroorganizama iz plaka na zube, važnosti pravilne ishrane za zdravlje zuba, načinu održavanja pravilne oralne higijene, povezanosti zdravlja zuba i higijene usne šupljine, važnosti i značaju fluor profilakse, značaju zalivanja fisura, vrsti pribora koji je neophodan za održavanje oralne higijene, kao i značaju kontrolnih pregleda za oralno zdravlje. Učenicima je i demonstrirano pravilno održavanje oralne higijene. Pregledi su obavljeni u učionicama škola, pri dnevnom

osvetljenju uz korišćenje stomatološke sonde i ogledalca. Za procenu rasprostranjenosti karijesa korišćen je Klajn-Palmerov sistem (KEP). Kod svakog deteta utvrđeno je prisustvo ili odsustvo ortodontskih anomalija. Na osnovu okluzalnog odnosa zuba gornje i donje vilice određivana je klasa po Angleu. Vertikalne nepravilnosti zagrižaja su merene pomoću ortodontskog milimetarskog linijara. Za statističku obradu podataka korišćen je neparametrijski test, Chi-square test, a od parametrijskih testova t-test nezavisnih uzorka, na nivou verovatnoće od 5% ($p < 0,05$).

REZULTATI

Kliničkim pregledom kod ispitanika dobijeni su podaci o stanju zdravlja zuba (statusu zuba), međusobnom odnosu zubnih nizova i prisustvu ortodontskih anomalija. Kod 112 pregledanih dečaka i devojčica odabranog uzrasta u ovoj studiji ukupno je pronađeno 40,77% karijesom zahvaćenih mlečnih zuba (dečaci (24,62%); devojčice (16,14%)) ($p < 0,05$) (Tabela 1). Kod ukupno 4,38% ispitanika pronađen je karijes stalnih zuba (dečaci (2,9%); devojčice (1,5%)) ($p < 0,05$) (Tabela 2). Karijes indeks osoba (KIo) bio je veoma visok i iznosio je 78,57% (dečaci 55,68%; devojčice 34,82% ($p > 0,05$)).

Analizom podataka u odnosu na ortodontske anomalije utvrđeno je da su odstupanja od normalnog zagrižaja bila zastupljena u visokom procentu. Sagitalne nepravilnosti zagrižaja utvrđene su kod ukupno 34,82% ispitanika (18,2% dečaci, 16,6% devojčice, ($p > 0,05$)). Najčešći odnos vilica po Angleovoj klasifikaciji kod dece u ovom uzrastu bila je I klasa, koja je registrovana kod ukupno 65,17% ispitanika (Tabela 3), normalan odnos I klase je zabeležen kod ukupno 47,32% ispitanika, dok se 17,85% odnosilo na iregularnosti I klase ($p > 0,05$).

U odnosu na ovu klasifikaciju, najčešća nepravilnost zagrižaja je II klasa, koja je registrovana kod ukupno 26,78% ispitanika. II/1 klasa, koja se karakteriše distalnim zagrižajem sa protruzijom zuba, bila je zastupljena kod ukupno 16,96% dece, dok je II/2 klasa sa distalnim zagrižajem i retruzijom zuba registrovana kod 9,82 (Tabela 3). U odnosu na sagitalnu ravan najmanji broj nepravilnosti zagrižaja odnosio se na malokluziju III klase, koja je pronađena kod ukupno 8,03% ispitanika ($p > 0,05$) (Tabela 3). Jednostavan obrnut preklop sekutića (Slika 1) kao dentoalveolarni oblik treće klase je bio najizraženija nepravilnost i registrovan je kod ukupno 6,72% dece.

U odnosu na vertikalnu ravan, nepravilnosti zagrižaja su utvrđene kod ukupno 33,92% anomalija. Otvoren zagrižaj (Slika 2) bio je zastupljen kod ukupno 10 (8,92%) ispitanika, dok je kod 28 (25%) ispitanika registrovan neki od oblika dubokog preklopa sekutića ($p > 0,05$) (Tabela 4).

DISKUSIJA

U ovoj studiji uočena je visoka prevalenca karijesa kod školske dece na području opštine Foča. Na osnovu dosadašnjih studija i pregledane literature poznato je da sociodemografski faktori, informisanost roditelja i saradnja sa stomatološkom službom imaju uticaja na opšte zdravlje deteta. Kada se uzmu u obzir rezultati istraživanja iz ove studije, čini se da je područje opštine Foča po učestalosti pojave karijesa, prema dobijenim vrednostima

ma karijes indeks osoba (Kio), 78,57%, među vodećim. Ovako visoke vrednosti karijes indeks osoba su u skladu sa rezultatima Davidovića i saradnika, koji su na području istočnog dela BiH pronašli ukupno 43,5% dece sa karijesom [8]. Takođe, Kobašlija i saradnici su na području opštine Sarajevo (2000) našli visoke (89%) vrednosti za (Kio) [9]. Navedeni rezultati su karakteristični za nerazvijene ili zemlje u razvoju, gde su ove vrednosti vrlo visoke (87–91%) [10], dok su vrednosti Kio u razvijenim zemljama znatno niže (28,8%) [11, 12].

Ipak, rezultati koji se odnose na karijes u mešovitoj denticiji mogu da se uporede i sa nekim evropskim zemljama [13], gde su takođe pronađene veće (44,6%) vrednosti karijesa mlečnih zuba kod školske dece. Ali u odnosu na našu studiju, evropske zemlje imaju znatno veću (55,4%) zastupljenost dece sa svim zdravim zubima, što na našim područjima nije slučaj, a to pokazuje procenat od 21,4% dece sa svim zdravim zubima. Uzimajući u obzir da znatno veći broj osmogodišnjaka ima visoku učestalost karijesnih i ekstrahovanih mlečnih zuba u odnosu na plombirane, jasno govori o problemu dugoročnih preventivnih programa i sistematske stomatološke zaštite.

Dosadašnja istraživanja na području Bosne i Hercegovine i susednih zemalja [8/10] pokazuju visoku (45–88,35%) prevalencu karijesa na stalnim zubima kod školske dece. Naša istraživanja pokazuju znatno manju (4,1%) učestalost karijesa u ovom uzrastu u odnosu na dosadašnje studije, što se može objasniti činjenicom da je to period rane mešovite denticije i da se radi o tek nedavno izniklim stalnim zubima. Ali kada se pogleda distribucija KEP, zapažamo znatno više karijesnih zuba u odnosu na plumbirane, naročito kod dečaka, što je jasan pokazatelj slabijih preventivno- profilaktičkih mera i saradnje sa stomatologom.

U odnosu na ortodontske nepravilnosti u toku ove studije pronađeno je ukupno 52,67% ortodontskih anomalija, što odgovara najčešće dobijenim rezultatima u toku ranije sprovedenih istraživanja u domaćoj i stranoj literaturi, gde procenat ovih anomalija varira od 29,42 do 81% [8, 14].

U ovoj studiji najzastupljeniji oblik malokluzija prema Angleovoj klasifikaciji bila je klasa I (65,17%), što je u skladu sa rezultatima iz ranijih studija (62,9%) [14, 15, 16]. U odnosu na ovu klasu, 47,32% ispitanika je imalo normalnu okluziju I klase, što je znatno više u odnosu na rezultate iz drugih studija (6,5–10%), dok se na nepravilnost I klase sa teskobom u frontu odnosilo ukupno 17,85%, što je niže u odnosu na svetsku populaciju [14].

Učestalost II klase (26,78%) niža je u odnosu na rezultate drugih studija gde je procenat ovih anomalija znatno viši (58–65%) [17, 18], što se može objasniti slabijom zastupljenosti loših navika i uspešnom primenom preventivnih mera i mera interceptivne ortodoncije u periodu mlečne denticije. U odnosu na ovu malokluziju dobijeni rezultati pokazuju da je zastupljenja II/1 u odnosu na II/2 klasu, što je u skladu sa ranije objavljenim istraživanjima u kojima je klasa II/1 (35%) bila zastupljenija u odnosu na II/2 klasu (17%) [8].

Malokluzije III klase su bile zastupljenje (8,03%), što je više u odnosu na istraživanja iz evropskih zemalja (2,5%) [19]. S obzirom na činjenicu da se veći procenat (6,72%) ove malokluzije odnosi na decu sa jednostavnim obrnutim preklopom sekutića, ovoliki procenat može da se objasni slabom primenom interceptivnih i preventivnih mera u prevenciji navedenih ne-

pravilnosti koje u ranom uzrastu imaju veliki efekat u terapiji ortodontskih anomalija [20].

Vertikalne nepravilnosti zagrižaja u ovoj studiji su bile zastupljene kod ukupno 33,92% ispitanika. U odnosu na svetsku populaciju, gde se smanjena dubina preklopa sekutića kreće oko 30–50%, u ovoj studiji dubok zagrižaj je pronađen kod ukupno 25% ispitanika, što je manje u odnosu na druga istraživanja [20], ali se ujedno poklapa sa studijom koju su sproveli Jović i autori [21], koja pokazuje da se dubina preklopa menja u intervalima i da se u periodu od 7. do 10. godine povećava dubina preklopa. Ovi podaci se poklapaju i sa prevalencom II klase, koja je povezana sa dubokim preklopom sekutića i distalnim zagrižajem. Otvoren zagrižaj je registrovan kod ukupno 8,92% dece, što je znatno manje u odnosu na istraživanja drugih autora gde je prevalenca ove anomalije znatno zastupljenija (26,7%) [22]. Ovi rezultati se mogu objasniti manjom učestalošću loših

navika kod osmogodišnjaka kao glavnog etiološkog faktora u nastanku otvorenog zagrižaja.

ZAKLJUČAK

Prevalenca ortodontskih anomalija u odabranom uzorku školske dece na području opštine Foča je bila visoka. Najčešće su registrovane II klase, zatim dubok zagrižaj, teskoba u frontu, otvoren zagrižaj i obrnut preklop sekutića. Frekvenca karijesa u ukupnom uzorku (KIo) bila je veoma visoka i to češće kod dečaka u odnosu na devojčice. Radi očuvanja mlečnih zuba kao čuvara prostora i potporene zone potrebno je uvesti obavezno saniranje mlečnih zuba pre upisa u škole, kao i redovne preventivno- profilaktičke i interceptivne mere u cilju sprečavanja nastanka ozbiljnijih ortodontskih problema u kasnijem uzrastu.

Unilateral complex partial denture performance evaluation: 5 years follow up clinical study

Katarina Radović¹, Rade Živković¹, Jovana Kuzmanovic Pficer², Ljiljana Tihaček Šojić¹, Aleksandra Milić Lemić¹

¹University of Belgrade, School of Dental Medicine, Department for Prosthodontics, Belgrade, Serbia;

²University of Belgrade, School of Dental Medicine, Department for Biostatistics and Informatics, Belgrade, Serbia

SUMMARY

Introduction Removable partial denture (RPD) is common treatment option for unilateral partially edentulous patients not indicated for implant therapy. Unilateral complex partial denture (UCPD) could be an alternative approach to RPD treatment, but there is lack of evidence about UCPD treatment outcomes during the long-term clinical performance. The aim of this study was to use periodontal, prosthodontic and participant satisfaction measures to evaluate the long-term clinical performance of UCPD.

Material and methods This 5 year follow-up clinical study evaluated pocket probing depth (PPD) and vertical clinical attachment loss (CAL-V) of direct abutment (DA), indirect abutment (IA) and control teeth (CT). Also complications and failures of UCPD were analysed using questionnaire of participant satisfaction with UCPD (stability, comfort and manipulation).

Results Evaluation of data showed that CAL-V and PPD significantly increased over time for DA, IA and CT ($p<0.0001$), but the tooth function (DA, IA and CT) did not significantly influence changes in PPD and CAL-V. The fracture of one abutment tooth and increase of the number of artificial teeth deformations ($p=0.039$) were observed after 5 years. Participant satisfaction with denture after 1 year and 5 years vs. 7 days was significantly improved.

Conclusion Despite limitations of this clinical study and assuming regular oral maintenance with proper indication, UCPD might be considered as good treatment option for Kennedy II rehabilitation in patients not indicated for implant therapy or who cannot tolerate extensive RPD design.

Keywords: denture complications and failures; periodontal parameters; participants' satisfaction; unilateral complex partial denture

INTRODUCTION

Oral rehabilitation of unilaterally shortened dental arch includes removable, fixed and implant borne restorations [1, 2, 3]. Removable partial denture (RPD) is still common treatment option for unilateral partially edentulous patients who can't be candidates for an implant treatment due to various reasons including lack of bone support with anatomical limitations such as position of maxillary sinus, inferior alveolar nerve and health condition. Evidence has shown satisfactory clinical results with clasp-retained RPDs concerning survival and extraction rate of abutment teeth [4, 5], but aesthetic outcomes for clasp-retained RPDs in comparison to precision attachment retained RPDs were low [6]. To enable proper assessment of the oral needs and treatment demands of dental patients with adequate prediction of therapeutic interventions outcomes, it is important to recognize patients' self-perception of quality of life in terms of oral-health. Namely, the presence of denture plate as a part of RPD might cause the so-called foreign body sensation and nausea whereas clasps often do not meet patients aesthetic and comfort needs [7, 8]. To overcome those problems,

unilateral complex partial denture (UCPD) without denture palate retained with latch type of attachment could be an optional treatment for unilaterally partially edentulous patients (Kennedy class II). However, the use of UCPD in dental practice might be a controversial subject, having in mind possibility of overloading abutment teeth and lack of major connector with contributing factor in denture retention. Hence, to date there have been few clinical reports concerning UCPD, while the actual impact of UCPD on oral health is not clarified yet.

The aim of this study was to use periodontal, prosthodontic and participant satisfaction measures to evaluate the long-term clinical performance of UCPD with a snap in latch attachment.

MATERIAL AND METHODS

Participants

This study design and data collection methods were approved by the Ethics Committee of the School of Dental Medicine, University of Belgrade, Serbia (No: 36/26).

Fourteen participants provided informed consent forms in accordance with the World Medical Association Declaration of Helsinki, and participated in the study (10 men and 4 women; age range: 57 to 68 years). The predefined inclusion criteria were: participants were maxillary unilaterally partially edentulous (Kennedy class II) with missing second premolar and first and second molars; not indicated for implant treatment due to lack of bone and position of maxillary sinus; refused denture with palatal plate and therefore indicated for UCPD; and available for periodic checkups every 6 months up to 5 years. Since 3 patients didn't maintain oral hygiene properly and didn't come to the clinic for regular check-ups, they were excluded from the study. Also, one patient refused to use his denture for the reason of discomfort caused by the pin of latch attachment. The final number of participants enrolled in the study was 10.

Interventions

The design of UCPD considered precision attachment retained restoration (SD snap in latch attachment, Servo-Dental GmbH & Co. KG, Hagen, Germany) consisting of free-end denture saddle attached to splinted 2 abutment teeth, canine and first premolar covered with milled crowns due to the absence of major connector. The primary part of attachment made of fully combustible plastic was integrated in a milled crown on the abutment tooth and casted together with crowns. The secondary component of attachment made of titanium was adhered into unilateral saddle and created the latch type connection of the whole restoration.

Preprosthetic procedure included the following periodontal treatment: motivation for oral hygiene; instruction in oral hygiene procedures with adequate oral hygiene manual; scaling, root planning and polishing.

The procedures for making UCPD included teeth preparation, taking impression for crowns using addition polymerization silicone material (Elite HD+, Zhermack, Italy) and try-in phase of metal framework that involved primary part of attachment and try-in ceramic. The impression for unilateral metal framework of saddle was made with the crowns placed on teeth. After casting metal framework for free-end saddle, it was evaluated intraorally. The following phases included the placement of secondary component of attachment and adhering into metal framework. Glazed crowns and finished UCPD with maximally extended free-end saddle were attached together and placed in mouth. The crowns were cemented according to standard procedures for cementing milled crowns with attachments. The participants were instructed how to use and maintain denture and additionally educated and motivated to perform appropriate oral hygiene protocols.

The patients were asked to visit the clinic every 6 months for regular check-ups. During the appointments they were re-motivated to maintain oral hygiene of the teeth and appliance.

Outcomes

After denture insertion, during the appointments after 7 days, 1 year and 5 years, trained and calibrated external examiners (in most cases in the presence of treatment coordinator) measured periodontal indices, recorded prosthetic parameters and completed the questionnaire of participant satisfaction with UCPD during the study.

Periodontal outcomes

Teeth were classified according to their relation to the attachment and free-end saddle and divided into the three groups: direct abutment (first premolar), indirect abutment (canine) and control teeth (same tooth on the opposing side of the jaw). Periodontal conditions of direct abutment (DA), indirect abutment (IA) and control teeth (CT) were evaluated using pocket probing depth (PPD) and vertical clinical attachment loss (CAL-V). The measurements of PPD and CAL-V were conducted with graduated periodontal probe at 6 sites per tooth (buccal, distal-buccal, mesial-buccal, lingual, mesial-lingual and distal-lingual). CAL-V was measured from the crown margin.

Prosthetic Outcomes

At every recall, abutment teeth and UCPD were evaluated for complications according to slightly modified standard criteria for complications and failures of RPD presented by Saito et al. [9].

1. Teeth
Fracture and/or missing teeth: yes or no
2. Attachment
Fracture and /or deformation: yes or no
3. Denture base
Fracture and /or deformation: yes or no
4. Artificial teeth
Fracture and /or deformation of acrylic veneering:
yes or no

Participants' satisfaction

The participants were asked to complete a questionnaire regarding the stability, comfort and difficulties in denture manipulation based on verbal rating scale (VRS), ranging from 1 to 5 (1= completely unsatisfied; 5= completely satisfied).

Statistical methods

All statistical analyses were performed using Statistical Package for Social Science (SPSS software package, version 18.0; SPSS Inc., Chicago, IL, USA). Mean, median, SD and range were used for descriptive data. Category variables were compared using Cochran test. Non-parametric data were analysed using Friedman and Wilcoxon test. The mixed between-within subject ANOVA was used to show the interaction of time and type of abutments. Inter-group comparisons were analysed using one-way analysis of variance (ANOVA). P value less than 0.05 was considered statistically significant.

RESULTS

The influence of three abutments (direct abutment, indirect abutment or control) on CAL-V changes during the observation period (7 days, 1 year, 5 years) is shown in Figure 1. The results showed that CAL-V significantly increased over time for all observed teeth ($p<0.0001$), but interaction between groups for each parameter did not show significant difference. Inter-group comparison did not show statistically significant differences between abutment teeth for each time separately.

Figure 2 shows PPD changes during the evaluation period (7 days, 1 year, 5 years) for each observed group of teeth (direct abutment, indirect abutment or control). PPD significantly increased in all observed groups over time ($p<0.0001$), but the results did not show statistically significant interactions between tooth function and time. The results also showed that the tooth function (direct abutment, indirect abutment or control) did not significantly influence the changes in PPD for each time separately.

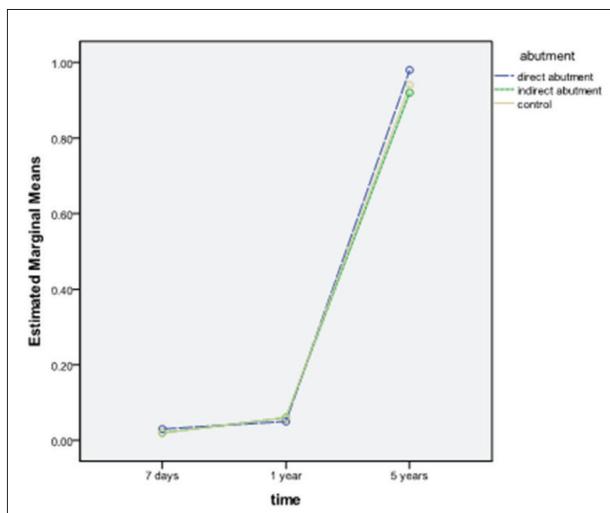


Figure 1. Abutment teeth influence on CAL-V over time
Slika 1. Uticaj zuba nosaća na CAL/V tokom vremena

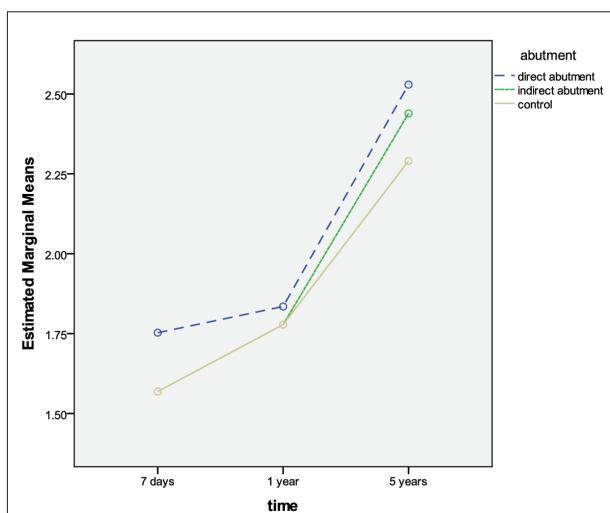


Figure 2. Abutment teeth influence on PPD over time
Slika 2. Uticaj zuba nosaća na PPD tokom vremena

The incidence of prosthetic complications and denture failures are shown in Table 1. The results showed the fracture of one abutment tooth and deformation of one retainer after 5 years of wearing UCPD, but compared to data after 7 days and 1 year it was without statistical significance. On the contrary, the number of artificial teeth deformation was significantly increased over time ($p=0,039$). During the evaluation period, denture base deformation was not identified.

Table 1. Incidence of complications and failures

Tabela 1. Učestalost komplikacija i neuspeha

Complications and failures (number) Komplikacija i neuspeh (broj)	Evaluation period Period evaluacije		
	After 7 days Posle 7 dana	After 1 year Posle godinu dana	After 5 years Posle 5 godina
Tooth fracture Prelom zuba	0	0	1
Retainer deformation Deformacija nosaća	0	0	1
Denture base deformation Deformacija baze proteze	0	0	0
Fracture of acrylic veneering Prelom akrilne fasete	0	1	4*1

¹ – Cochran test; * – statistically significant

¹ – Kohranov test; * – statistički značajno

Table 2 shows participant satisfaction with denture stability, comfort and manipulation. The results showed that all three parameters were significantly improved after 1 year and after 5 years period of denture wearing compared to the data after 7 days of denture insertion. It is evident that maximum score was given for denture stability for all evaluation periods, while patients' satisfaction after 7 days was assigned number 3 on the scale from 1 to 5. During subsequent periods of evaluation comfort and manipulation parameters achieved higher scores.

DISCUSSION

Despite various clinical options offered by dental implants, therapy with RPD is still the most common treatment option in partially edentulous patients without posterior teeth [10]. Therefore, it is very important to assess treatment outcomes with RPD considering the preservation of supporting tissues and teeth and patients' comfort and aesthetic demands. Based on our evidence, there have been only few clinical studies investigating UCPD [11, 12], which is considered to be a restoration with high functional and aesthetic values.

The results of our study showed that UCPD wearers reported high scores for all 3 measured prosthetic satisfaction parameters: stability, comfort and manipulation during the appointments after 7 days, 1 year and 5 years. Taking into account the lack of literature related to UCPD and if UCPD is compared to CFPD as a restoration also characterized by attached pontics, the result of this study is in compliance with the evidence estimating that lack of palatal base in CFPD gives advantages to RPD regard-

Table 2. Participant satisfaction with denture
Tabela 2. Pacijentovo zadovoljstvo protezom

Prosthetic parametres Protetički parametri	Evaluation period Period evaluacije			p value vrednost p
	After 7 days Posle 7 dana (min.–max.) Md	After 1 year Posle godinu dana (min.–max.) Md	After 1 year Posle 5 godina (min.–max.) Md	
Denture stability Stabilnost proteze	4 (3-5)	5 (4-5)	5 (4-5)	p=0.018*1 7vs1y, p=0.025*2 7vs5yrs, p=0.034* 1yvs5yrs,p=0.564
Comfort Komfor	3 (2-4)	5 (4-5)	5 (4-5)	p=0.001*1 7vs1y, p=0.007*2 7vs 5yrs, p=0.007* 1yvs 5yrs p=0.317
Manipulation Manipulacija	3 (2-4)	5 (4-5)	5 (4-5)	p=0.002*1 7vs1y p=0.010*2 7vs5yrs, p=0.010* 1yvs5yrs, p=0.317

Md – Median; * – statistically significant; ¹ – Friedman test; ² – Wilcoxon test
 Md – Mediana; * – statistički značajno; ¹ – Fridmanov test; ² – Vilkinsonov test

ing patient comfort and satisfaction [12]. Interestingly, the results of the present study also showed that patients' satisfaction with UCPD significantly increased over time. One may speculate that the period of 7 days was not long enough for complete patient adaptation and that was the reason for significantly lower scores for stability, comfort and manipulation after 7 days in comparison to the scores after 1 and 5 years. As the time passed the patients got used to the appliance with evident increase of the comfort and manipulation.

The overload of abutment teeth for restorations without palatal plate and attached pontics is a controversial question. The results of the present study showed fracture of one abutment tooth after 5 years of UCPD function. This is in accordance with the findings of Schmitt et al. who performed 5-year follow up study comparing unilateral and bilateral dentures retained by miniaturized attachment system [13]. According to their findings, in contrast to unilaterally retained removable dentures where splinted abutment teeth had high survival rate, fracture of abutment teeth was the most common complication and cause for failure of bilateral partial dentures (with non-splinted abutment teeth). The findings of our study are also in accordance with the finite element method (FEM) analyses of UCPD [14]. Namely, comparing the UCPD and RPD through FME stress analysis, calculations showed that applied forces are within physiological limits on splinted direct and indirect abutments of UCPD (canine and first premolar), which behaviour was similar to the behaviour of direct abutment of conventional RPD.

The results regarding the technical complications showed reparable deformation of the sprue in one latch attachment after 5 years of wearing UCPD, in contrast to the results of Schmitt et al. [13] who reported high rate of irreversible mechanical wear of male part of used attachment after 4 years of clinical function with the need for restoration replacement. According to these findings, latch attachment with sprue might be more suitable for unilateral free end saddle treatment in comparison to miniaturized attachment system. Also, type of attachment offers denture stability in unilateral cases and mouth safety, since removal is not possible unless the aforementioned button is pressed and denture is deliberately displaced. A

fracture of acrylic veneering present in our patients was also common complication similar to findings of Schmitt et al. [13]

Due to the fact that primary causes of denture abutment teeth failures are periodontal disease and caries [15, 16], periodontal status of abutment teeth involved in UCPD restoration was evaluated. The results of UCPD clinical prognosis through evaluation of periodontal status of direct and indirect abutment teeth and control teeth in the opposite side of the same jaw showed that PPD and CAL-V significantly increased for all observed groups over time. However, PPD and CAL-V values of direct abutment and indirect abutment teeth were not significantly different from control teeth that were not involved in UCPD. Therefore, we might estimate that teeth splinting increases load potential despite the presence of palatal base and latch attachment providing elastic connection between fixed and maximally extended free-end saddle. As mentioned by Jorge et al. [17] such favorable results could be attributed to well planned prosthetic treatment and properly designed removable partial dentures.

It's interesting to mention that follow-up clinical studies of RPD showed controversial findings regarding the influence of tooth function (direct abutment, indirect abutment or control) on periodontal attachment loss. Contrary to findings showing that tooth function significantly influences gingival recession and probing depth [18, 19], Drake and Beck [20] did not find difference in PPD between patients wearing RPDs and not wearing RPDs. In accordance with this, Schmitt et al. [13] even identified improvement in periodontal parameters for abutments of unilateral denture compared to the baseline values suggesting that restoration is reliable treatment modality for periodontal health.

For better prediction of clinical performance of unilateral complex partial denture it is necessary however to enrol more participants for longer evaluation time, because the main limitation of this study was the small sample size and therefore it might be considered as preliminary study. Although the sample size was small, its distribution was in accordance with previous studies [21, 22].

CONCLUSION

Despite the limitations of this clinical study and with assuming regular oral hygiene maintenance with proper indication conditions, UCPD might be good treatment option in Kennedy II rehabilitation for patients not indicated for implant therapy or who cannot tolerate extensive RPD design. Good clinical performance indicators were observed over time and patients reported adequate satisfaction, comfort and suitable manipulation.

REFERENCES

1. McKenna G, Allen PF, O'Mahony D, Cronin M, DaMata C, Woods N. The impact of rehabilitation using removable partial dentures and functionally orientated treatment on oral health-related quality of life: a randomised controlled clinical trial. *J Dent.* 2015; 43(1):66–71. [DOI: 10.1016/j.jdent.2014.06.006] [PMID: 24973731]
2. Wolfart S, Müller F, Gerß J, Heyedcke G, Marré B, Böning K, et al. The randomized shortened dental arch study: oral health-related quality of life. *Clin Oral Investig.* 2014; 18(2):525–33. [DOI: 10.1007/s00784-013-0991-6] [PMID: 23680969]
3. Pjetursson BE, Tan K, Lang NP, Brägger U, Egger M, Zwahlen M. A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years. *Clin Oral Implants Res.* 2004; 15(6):667–76. [DOI: 10.1111/j.1600-0501.2004.01120.x] [PMID: 15533127]
4. Rehmann P, Orbach K, Ferger P, Wöstmann B. Treatment outcomes with removable partial dentures: a retrospective analysis. *Int J Prosthodont.* 2013; 26(2):147–50. [DOI: 10.11607/ijp.2959] [PMID: 23476909].
5. Behr M, Zeman F, Passauer T, Koller M, Hahnel S, Buergers R, et al. Clinical performance of cast clasp-retained removable partial dentures: a retrospective study. *Int J Prosthodont.* 2012; 25(2):138–44. [PMID: 22371834]
6. Peršić S, Kranjčić J, Pavićić DK, Mikić VL, Čelebić A. Treatment outcomes based on patients' self-reported measures after receiving new clasp or precision attachment-retained removable partial dentures. *J Prosthodont.* 2017; 26(2):115–22. [DOI: 10.1111/jopr.12395] [PMID: 26618630]
7. Inukai M, Baba K, John MT, Igarashi Y. Does removable partial denture quality affect individuals' oral health? *J Dent Res.* 2008; 87(8):736–9. [DOI: 10.1177/154405910808700816] [PMID: 18650544]
8. Koyama S, Sasaki K, Kawata T, Atsumi T, Watanabe M. Multivariate analysis of patient satisfaction factors affecting the usage of removable partial dentures. *Int J Prosthodont.* 2008; 21(6):499–500. [PMID: 19149065]
9. Saito M, Notani K, Miura Y, Kawasaki T. Complications and failures in removable partial dentures: a clinical evaluation. *J Oral Rehabil.* 2002; 29(7):627–33. [DOI: 10.1046/j.1365-2842.2002.00898.x] [PMID: 12153451]
10. Tanasić IV, Tihacek-Sojić LD, Milić-Lemić AM. Prevalence and clinical effects of certain therapy concepts among partially edentulous Serbian elderly. *J Prosthodont.* 2015; 24(8):610–4. [DOI: 10.1111/jopr.12261] [PMID: 25594777]
11. Barker D, Cooper A. A novel use of a unilateral hinged partial denture. *Br Dent J.* 2006; 201(9):571–3. [DOI: 10.1038/sj.bdj.4814207] [PMID: 17099662]
12. Budtz-Jørgensen E, Isidor F. A 5-year longitudinal study of cantilevered fixed partial dentures compared with removable partial dentures in a geriatric population. *J Prosthet Dent.* 1990; 64(1):42–7. [DOI: 10.1038/sj.bdj.4814207] [PMID: 17099662]
13. Schmitt J, Wichmann M, Eitner S, Hamel J, Holst S. Five-year clinical follow-up of prefabricated precision attachments: a comparison of uni- and bilateral removable dental prostheses. *Quintessence Int.* 2011; 42(5):413–8. [PMID: 21519561]
14. Radović K, Čairović A, Todorović A, Stančić I, Grbović A. Comparative analysis of unilateral removable partial denture and classical removable partial denture by using finite element method]. *Srp Arh Celok Lek.* 2010; 138:706–13. [DOI: 10.2298/SARH1012706R] [PMID: 21365883]
15. Wagner B, Kern M. Clinical evaluation of removable partial dentures 10 years after insertion: success rates, hygienic problems, and technical failures. *Clin Oral Investig.* 2000; 4(2):74–80. [DOI: 10.1007/s007840050119] [PMID: 11218504]
16. Kern M, Wagner B. Periodontal findings in patients 10 years after insertion of removable partial dentures. *J Oral Rehabil.* 2001; 28(11):99–7. [DOI: 10.1111/j.1365-2842.2001.00788.x] [PMID: 11722713]
17. Jorge JH, Quishida CC, Vergani CE, Machado AL, Pavarina AC, Giampaolo ET. Clinical evaluation of failures in removable partial dentures. *J Oral Sci.* 2012; 54(4):337–42. [DOI: 10.2334/josnusd.54.337] [PMID: 23221159]
18. da Fonte Porto Carreiro A, de Carvalho Dias K, Correia Lopes AL, Bastos Machado Resende CM, Luz de Aquino Martins AR. Periodontal conditions of abutments and non-abutments in removable partial dentures over 7 years of use. *J Prosthodont.* 2017; 26(8):644–9. [DOI: 10.1111/jopr.12449] [PMID: 26864601]
19. Zlatarić DK, Celebić A, Valentić-Peruzović M. The effect of removable partial dentures on periodontal health of abutment and non-abutment teeth. *J Periodontol.* 2002; 73(2):137–44. [DOI: 10.1902/jop.2002.73.2.137] [PMID: 11895277]
20. Drake CW, Beck JD. The oral status of elderly removable partial denture wearers. *J Oral Rehabil.* 1993; 20(1):53–60. [DOI: 10.1111/j.1365-2842.1993.tb01514.x] [PMID: 8429423]
21. Yang TC, Maeda Y, Gonda T. Clinical performance and satisfaction of removable prostheses with self-adjusting magnetic attachments. *J Prosthet Dent.* 2014; 111:131–5. [DOI: 10.1016/j.prosdent.2013.07.001] [PMID: 24210730]
22. Shimura Y, Wadachi J, Nakamura T, Mizutani H, Igarashi Y. Influence of removable partial dentures on the formation of dental plaque on abutment teeth. *J Prosthet Res.* 2010; 54:29–35. [DOI: 10.1016/j.jpor.2009.08.003] [PMID: 19818702]

Received: 04.05.2018 • Accepted: Prihvaćen 13.08.2018

Procena uspešnosti terapije jednostranom kompleksnom skeletiranom parcijalnom protezom: petogodišnja klinička studija

Katarina Radović¹, Rade Živković¹, Jovana Kuzmanovic Pficer², Ljiljana Tihaček Šojić¹, Aleksandra Milić Lemić¹

¹Univerzitet u Beogradu, Stomatološki fakultet, Klinika za stomatološku protetiku, Beograd, Srbija;

²Univerzitet u Beogradu, Stomatološki fakultet, Departman za biostatistiku i informatiku, Beograd, Srbija

KRATAK SADRŽAJ

Uvod Parcijalna skeletirana proteza (PSP) najčešća je terapijska opcija kod jednostrane krežubosti kada nije indikovana implantološka terapija. Jednostrana kompleksna parcijalna skeletirana proteza (JKPSP) predstavlja alternativu konvencionalnoj PSP, jedino što ne postoje evidentni podaci o uspešnosti terapije nakon duže kliničke upotrebe.

Cilj ovog rada bio je da se na osnovu analize objektivnih pokazatelja, odnosno analize periodontalnih i protetskih parametara, kao i na osnovu subjektivnih ocena pacijenta, izvrši provera uspešnosti JKSP retiniranim atečmenom tipa reze sa oprugom nakon petogodišnjeg praćenja.

Materijal i metod Kod deset ispitanika oba pola izvršeno je praćenje gubitka vertikalnog pripoja gingive i dubine parodontalnih džepova, kod primarnog retencionog zuba (PRZ), sekundarnog retencionog zuba (SRZ), koji su bili u sastavu JKSP i kontrolnog zuba (KZ) suprotne strane vilice. Takođe, analizirani su protetske komplikacije (fraktura zuba, gubitak veštačkih zuba) i zadovoljstvo pacijenata na osnovu popunjениh upitnika, gde su oni ocenjivali stabilnost, komfor i rukovanje JKSP.

Rezultati Nakon analize dobijnih podataka uočeno je da se vrednost dubine parodontalnih džepova i gubitak vertikalnog pripoja gingive kod PRZ statistički značajno razlikuju u odnosu na SRZ i KZ ($p < 0,0001$). Zabeležene protetske komplikacije u vidu frakture retencionog zuba i deformacije veštačkih akrilatnih zuba nisu bile statistički značajne posle pet godina praćenja. Zadovoljstvo pacijenata JKSP posle prve godine i posle pet godina nošenja se značajno popravilo u odnosu na prvih sedam dana posle predaje.

Zaključak Nezavisno od ograničenja ove kliničke studije, uzimajući u obzir adekvatnu indikaciju i pravilno održavanje higijene, JKSP se može smatrati dobrrom opcijom za rehabilitaciju krežubosti Kenedi II klase kod pacijenata kod kojih nije indikovana terapija implantatima, odnosno koji ne prihvataju prisustvo velike spojnica. Pacijenti su bili zadovoljni protezama, njihovim komforom i lakoćom rukovanja protezama.

Ključne reči: protetske komplikacije; periodontalni parametri; zadovoljstvo pacijenata; jednostrana kompleksna parcijalna skeletirana proteza

UVOD

Protetska rehabilitacija jednostrano skraćenog zubnog niza podrazumeva izradu parcijalnih proteza, fiksnih nadoknada odnosno krilnih mostova i implantatno nošenih nadoknada [1, 2, 3]. Parcijalna skeletirana proteza (PSP) još je uvek veoma česta opcija za rehabilitaciju jednostranog skraćenog zubnog niza, pogovoto kod pacijenata koji nisu kandidati za ugradnju implantata, bilo usled anatomske ili ekonomskih ograničenja, ili usled sistemskih bolesti. Razmatrajući kliničke rezultate postignute kod nosilaca konvencionalnih PSP, neosporni su zadovoljavajući efekti koji se tiču preživljavanja i očuvanja retencionih zuba [4, 5]. Međutim, estetski rezultati konvencionalnih PSP u poređenju sa kompleksnim PSP retiniranim preciznim veznim elementima veoma su loši [6]. Na osnovu navedenog može se reći da su pravilna procena pacijentovih potreba i adekvatno predviđanje uspešnosti protetske terapije od velikog značaja kako bi se uticalo na kvalitet oralnog zdravlja i zadovoljstvo pacijenta. U vezi sa tim, značajno je naglasiti da prisustvo velike spojnica PSP na nepcu uslovljava senzacije stranog tela, a u ekstremnim slučajevima mučninu, čime je umanjena komfornost pacijenta, dok metalne kukice ne zadovoljavaju estetske zahteve [7, 8]. Za prevazilaženje navedenih problema jednostrana kompleksna parcijalna skeletirana proteza (JKPSP) bez velike spojnica retinirana atečmenom tipa reze može biti uspešan terapeutski modalitet za rehabilitaciju pacijenata klase krežubosti Kenedi II. Međutim, primena JKSP u stomatološkoj praksi nije u potpunosti prihvaćena, posebno kada se uzmu u

obzir mogućnosti preopterećenja retencionih zuba i nedostatka velike spojnica i njenog učešća u stabilizaciji proteze. Uvidom u postojeću literaturu nisu uočeni klinički podaci koji se tiču uspešnosti terapije JKSP, posebno kada se uzme u obzir njen uticaj na oralno zdravlje pacijenta nosioca.

Cilj ovog rada bio je da se na osnovu analize objektivnih pokazatelja, odnosno analize periodontalnih i protetskih parametara, kao i na osnovu subjektivnih ocena pacijenta, izvrši provera uspešnosti JKSP retiniranim atečmenom tipa reze sa oprugom nakon petogodišnjeg praćenja.

MATERIJAL I METOD

Učesnici studije

Dizajn studije i prikupljanje podataka odobreni su od strane Etičkog komiteta Stomatološkog fakulteta Univerziteta u Beogradu (Br: 36/26). Četrnaest učesnika studije je dalo svoj pisani pristanak u skladu sa Helsinski dekalaracijom za učestovanje u studiji (10 muškaraca i četiri žene, starosti od 57 do 68 godina). Definisani kriterijumi za učešće u studiji bili su i) jednostrana krežubost u gornjoj vilici (klase Kenedi II) sa nedostajućim zubima: drugi premolar i prvi i drugi molari; ii) nemogućnost ugradnje implantata usled anatomske ili ekonomskih ograničenja; iii) odbijanje da nose PSP sa velikom spojnicom preko nepca. Nakon petogodišnjeg praćenja pacijenata, troje nije održavalo odgovarajući nivo oralne higijene i nisu poštovali

dolaske na redovne kontrole, dok je jedan pacijent odbio da nosi JKPSP usled nekomfornosti usled prisustva atečmena. Konačan broj učesnika bio je 10.

Protetski postupci

Dizajn JKPSP podrazumevao je jednostrano slobodno sedlo, bez prisustva velike spojnica, koji je preciznim veznim elementom (SD snap in latch attachment, Servo-Dental GmbH & Co. KG, Hagen, Germany) povezan sa frezovanim krunama na retencionim zubima – očnjaku i prvom premolaru. Patrica atečmena napravljena od plastike bila je livena zajedno sa frezovanim krunama koje su cementirane na retencione zube. Titanijumska matrica atečmena bila je sastavni deo jednostranog sedla i zajedno sa oprugom i dugmetom za stavljanje i skidanje proteze predstavljala vezu tipa reze za celu konstrukciju. Preprotetska priprema podrazumevala je odgovarajuću parodontalnu pripremu kod nadležnog specijaliste: motivaciju za održavanje oralne higijene, instrukcije o sredstvima i postupcima za održavanje oralne higijene, uklanjanje mekih i čvrstih naslaga.

Postupci u okviru protetske rehabilitacije podrazumevali su: preparaciju retencionih zuba, otiskivanje zuba za fiksne nadoknade adpcionim silikonom (Elite HD+, Zhermack, Italy), probu metalne konstrukcije sa primarnim delom atečmena i probu keramike. Otiskivanje za metalni deo JKPSP je obavljeno preko kruna postavljenih na retencione zube. Sledеći postupak podrazumevao je probu skeleta JKPSP, zatim postavljanje sekundarnog dela atečmena. Glazirane namenske krune su cementirane zajedno sa postavljenom JKPSP i u istom aktu predate pacijentima. Pacijenti su obučeni o načinu održavanja oralne higijene i dodatno motivisani kako bi poštivali odgovarajući protokol održavanja higijene usled prisustva atečmena.

Objektivni i subjektivni pokazatelji

Nakon predaje JKPSP evaluacija objektivnih parametara je izvršena posle prvih sedam dana, prve godine i pete godine. Obučeni specijalista stomatološke protetike je izvršio merenja parodontalnih parametara, evaluirao protetske parametre i sproveo popunjavanje upitnika o subjektivnom zadovoljstvu pacijenata JKPSP.

Parodontalni parametri

Retencioni zubi su u odnosu na položaj prema slobodnom sedlu i prema atečmenu podeljeni na tri grupe: direktni retencioni zub (prvi premolar), indirektni retencioni zub (očnjak) i kontrolni zubi (zubi iste klase na suprotnoj strani vilice). Parodontalni parametri mereni su na direktnim retencionim zubima (DRZ), indirektnim retencionim zubima (IRZ) i kontrolnim zubima (KZ) i to dubinom parodontalnog džepa (PPD) i gubitkom vertikalnog pripoja gingive. Merenja pomenutih parametara izvršena su pomoću graduisane parodontalne sonde na šest strana svakog pomenutog zuba (bukalno, disto-bukalno, mezio-bukalno, lingvalno, mezio-lingvalno i disto-lingvalno), dok je gubitak vertikalnog pripoja gingive meren od ivice krune.

Protetski parametri

Protetske komplikacije su sprovedene prema nešto izmenjenim kriterijumima za komplikacije i greške kod PSP koje su predložili Saito i sar. [9].

1. Zubi
Prelop i/ili gubitak zuba: da ili ne
2. Atečmen
Prelop i/ili deformacija: da ili ne
3. Skelet proteze
Prelop i/ili deformacija: da ili ne
4. Veštački zubi
Frakturna i/ili deformacija akrilatne fasete: da ili ne

Zadovoljstvo pacijenta

Učesnici studije su popunjavali upitnike odgovarajući na pitanja koja se tiču stabilizacije, udobnosti i poteškoća tokom manipulisanja JKPSP-om. Ocene su bile u rasponu od 1 do 5 na vizuelno-analognoj skali (VAS), gde je 1 značilo potpuno nezadovoljan, a 5 potpuno zadovoljan.

Statistička analiza

Sve statističke analize su izvršene pomoću programa SPSS (SPSS software package, version 18.0; SPSS Inc., Chicago, IL, USA). Srednja vrednost, medijana, standardna devijacija i raspon su korišćeni za opisivanje podataka. Varijable kategorije su poređene pomoću Kohranovog testa (Cochran test). Neparametričke analize su izvršene pomoću Fridman i Vilkokson testa (Friedman i Wilcoxon test). ANOVA je korišćena da se prikaže uticaj vremena na promene na retencionim zubima, dok je međugrupna komparacija izvršena analizom varijanse (ANOVA). Za statisitiku značajnost je uzeto da je P vrednost manja od 0,05.

REZULTATI

Na Grafikonu 1 prikazan je gubitak vertikalnog pripoja gingive (CAL-V) na direktnom retencionom zubu (prvi premolar), indirektnom retencionim zubu (očnjak) i kontrolnim zubima (zubi iste klase na suprotnoj strani vilice) evaluacijom nakon sedam dana, prve i pete godine. Rezultati su pokazali da je značajno povećan gubitak vertikalnog pripoja gingive na svim posmatranim zubima ($p < 0,0001$), ali bez statistički značajne razlike. Komparacija između grupa takođe nije pokazala statistički značajne razlike u pojedinačnim terminima evaluacije.

Na Grafikonu 2 prikazane su vrednosti za dubinu parodontalnog džepa (PPD) u terminima evaluacije (sedam dana, prve i pete godine) za svaku posmatranu grupu zuba (DRZ, IRZ, KZ). Dubina parodontalnih džepova značajno je povećana za sve posmatrane grupe tokom vremena ($p < 0,0001$), ali rezultati nisu pokazali statistički značajnu interakciju između funkcije zuba i vremena. Rezultati su takođe pokazali da funkcija zuba u odnosu na to da li je direktni, indirektni retencioni zubi ili kontrolni ne utiče značajno na promene u dubini parodontalnih džepova terminima evaluacije.

Učestalost protetskih komplikacija i oštećenja na protezi prikazana je u Tabeli 1. Rezultati su pokazali prelop jednog direktnog retencionog zuba i deformaciju jednog atečmena posle pet

godina nošenja JKPSP. U poređenju sa podacima nakon sedam dana i prve godine nošenja JKPSP, ovaj rezultat nema statističku značajnost. Broj oštećenja na akrilatnim zubima iz proteze značajno je povećan tokom vremena. Deformacija baze proteze nije uočena ni kod jednog pacijenata uključenog u studiju.

U Tabeli 2 prikazano je zadovoljstvo pacijenata protezama koje uključuje stabilnost i udobnost proteze, kao i poteškoće tokom manipulisanja JKPSP-om. Rezultati su pokazali značajno poboljšanje svih posmatranih parametara nakon prve i pete godine nošenja proteze u poređenju sa podacima merenim sedam dana po predaji proteze. Stabilnost proteze ocenjena je najvišom ocenom tokom celog perioda evaluacije.

DISKUSIJA

Parcijalno krežubi pacijenti sa skraćenim zubnim nizom najčešće se zbrinjavaju parcijalnim skeletiranim protezama i pored različitih terapijskih rešenja koja su omogućena ugradnjom dentalnih implantata [10]. S tim u vezi, od velikog je značaja uskladiti očuvanje potpornih tkiva (rezidualnog grebena i retencionih zuba) sa estetskim zahtevima i komforom kod nosilaca parcijalnih proteza. Pregledom dostupne literature, mali broj istraživanja pratio je JKPSP [11, 12], koja se može smatrati zubnom nadoknadom zadovoljavajućih estetskih i funkcionalnih vrednosti.

Rezultati ove studije su pokazali da su nosioci JKPSP ocenili visokim vrednostima sva tri merena protetska parametra: stabilnost, udobnost i način manipulisanja tokom evaluacije posle sedam dana, prve i pete godine od predaje proteze. Dizajn JKPSP sa odsustvom velike spojnica se može poreediti sa krilnim mostovima, koji pokazuju izrazite prednosti u odnosu na klasičnu PSP kada su u pitanju komfor i zadovoljstvo pacijentata [12]. Podatak da je zadovoljstvo pacijenata značajno raslo tokom vremena može se dovesti u vezu sa činjenicom da je period od sedam dana kratak za adaptaciju pacijenata na JKPSP, pa su stoga stabilnost, komfor i manipulacije tokom skidanja i stavljanja proteze bili ocenjeni nižim ocenama. Kako je vreme prolazilo, pacijenti su s lakoćom manipulisali protezom i time je rastao komfor tokom nošenja proteze. Koliko je veliko opterećenje zuba nosača nadoknada, koje u svom sastavu nemaju veliku spojnicu a nose dodate veštačke zube, predstavlja kontroverzno pitanje. Rezultati ove studije ukazali su na frakturu jednog zuba nosača nakon pet godina nošenja JKPSP. Ovaj rezultat je u skladu sa nalazima kliničke petogodišnje studije Schmitta i sar., gde su praćene jednostrane skeletirane proteze retinirane miniatečmenom i klasična PSP sa dvostranim slobodnim sedlom [13]. Rezultati navedenih autora pokazali su značajno veću učestalost frakturna nesplintiranih zuba nosača klasične PSP sa obostranim slobodnim sedlom, nasuprot jednostranoj protezi, gde su splintirani zubi imali duže vreme opstanka. Prikazani rezultati su u skladu i sa nalazima analiza opterećenja JKPSP u studiji koja je koristila metodu konačnih elemenata (MKE) [14]. Na osnovu analize MKE uočeno je da je opterećenje JKPSP-om direktnog i indirektnog retencionog zuba u fiziološkim granicama. Navedeno je u saglasnosti sa opterećenjima koje indukuje konvencionalna PSP na retencione zube.

Rezultati koji se tiču tehničkih komplikacija JKPSP pokazali su reparabilna oštećenja opruge u sastavu atečmena posle pet godina nošenja proteze. Schmitta i sar. [13] pokazali su visoku

učestalost mehaničkog trošenja patrice, bez mogućnosti reparacije korišćenog miniatečmena posle četiri godine nošenja proteze. U skladu sa pomenutim, atečmen tipa reze sa oprugom bi mogao biti pouzdano retenciono sredstvo u odnosu na miniatečmen. Ovo istraživanje je pokazalo i da atečmen tipa reze sa oprugom i dugmetom obezbeđuje dobru stabilnost proteze kod jednostranog slobodnog sedla i bezbedno korišćenje tokom funkcija s obzirom na to da je nemoguće skinuti protezu ukoliko se dugme ne prisne rukom odgovarajućom silom. Nalaz oštećenja na veštačkin zubima predstavlja učestalu komplikaciju u vezi sa JKPSP i dobijeni rezultat je u skladu sa studijom Schmitt i sar. [13].

Imajući u vidu činjenicu da su najčešći razlozi gubitka retencionih zuba karies i parodontalna oboljenja [15, 16], sprovedeno istraživanje je ukjučilo i praćenje parodontoloških parametara. Rezultati su pokazali da su gubitak vertikalnog pripoja gingive i dubina parodontalnih džepova kako na DRZ i IRZ, tako i na KZ, značajno rasli tokom vremena. Međutim, gubitak vertikalnog pripoja gingive i dubina parodontalnih džepova na DRZ i IRZ nisu se značajno razlikovali od vrednosti na KZ koji nisu bili u sastavu JKPSP. Stoga možemo pretpostaviti da povezivanje zuba nosača povećava otpornost na opterećenje nezavisno od prisustva velike spojnica. Atečmen sa oprugom tipa reze obezbeđuje elastičnu vezu između fiksног dela i maksimalno ekstendiranog mobilnog dela nadoknade obezbeđujući dobru prognozu retencionim zubima i njihovim potpornim tkivima. U skladu sa navedenim, Jorge i sar. [17] pokazali su da takvi preduslovi treba da budu uključeni u planiranje i dizajn proteza i drugih zubnih nadoknada.

Interesantno je pomenuti da su kliničke studije koje su pratile klasičnu PSP pokazale oprečne nalaze u vezi sa uticajem funkcije zuba (direktni nosač, indirektni, kontrolni zub) na gubitak parodontalnog pripoja. Nasuprot nalazima koji su ukazali na značajan uticaj funkcije zuba na gingivalnu recesiju i dubinu džepova [18, 19], rezultati Drake i Beck [20] nisu pokazali razliku u parodontološkom statusu zuba u odnosu na to da li je nošena PSP ili ne. Schmitt i sar. [13] su čak prikazali poboljšanje parodontalnih parametara zuba nosača jednostrane proteze u odnosu na početno stanje, implicirajući da splintiranje zuba i protetska rehabilitacija povoljno utiču na parodontalno zdravlje.

Za bolje i pouzdanije predviđanje kliničkih performansi JKPSP neophodno je uključiti veći broj ispitanika tokom dužeg vremena evaluacije, s obzirom na to da je glavno ograničenje ove studije mali broj uzoraka. Bez obzira na mali broj uzoraka, distribucija rezultata je u skladu sa referentnim studijama [21, 22], i može ukratko prikazati uspešnost terapije JKPSP-om.

ZAKLJUČAK

Nezavisno od ograničenja ove kliničke studije, uzimajući u obzir adekvatnu indikaciju i pravilno održavanje higijene, JKPSP se može smatrati dobrom opcijom za rehabilitaciju krežubosti Kennedy II klase kod pacijenata kod kojih nije indikovana terapija implantatima, odnosno koji ne prihvataju prisustvo velike spojnica. Pacijenti su bili zadovoljni protezama, njihovim komforom i lakoćom rukovanja.

Efficacy of different irrigation techniques on calcium hydroxide removal from the root canal

Vanja Opačić Galić, Jovana N. Stašić

University of Belgrade, School of Dental Medicine, Department for Restorative Dentistry and Endodontics, Belgrade, Serbia

SUMMARY

Introduction Calcium hydroxide (CH) is a medicament widely used in endodontic treatment due to its antibacterial, regenerative and biocompatible properties. Studies have shown that remaining CH on root canal walls and dentinal tubules can compromise sealer penetration, leading to its weak adhesion, volume change and, consequently, apical leakage.

The aim of this study was to compare the efficacy of four different techniques in removing calcium hydroxide from the root canal.

Material and Methods 32 extracted single-rooted teeth with one canal were used in this study. The canals were prepared using BioRaCe system (FKG Dentaire, Swiss) BR5 40/04 with sodium hypochlorite irrigation after each instrument. Longitudinal grooves were formed on the proximal root surfaces. All canals (except negative control) were filled with aqueous CH suspension. After seven days of incubation, the teeth were allocated into the four groups ($n=7$), plus positive and negative control. Four techniques (systems) for CH removal were tested: conventional syringe irrigation (CSI), passive ultrasonic irrigation (PUI), XP-endo Finisher (FKG Dentaire, Swiss) and Canal Brush (Roeko, Coltene) with irrigation of 5 ml 2% NaOCl and 5 ml 10% citric acid. All the roots were then split into the two halves with chisel and observed under the stereomicroscope (Boeco, Germany) at magnification of 20x. The area with remaining CH on the root canal wall surface was then divided with the total root canal surface area (%). The obtained results were statistically processed using One-way ANOVA and Tukey post-hoc test ($p<0.05$).

Results The most efficient system was XP-endo Finisher with 91.33% of clean surface, followed by PUI 88.36%, Canal Brush 87.83%, and CSI with 66.92%.

Conclusion None of the systems completely removed the traces of the medicament from the root canal. For optimal clinical success, it is necessary to combine various systems with copious irrigation.

Keywords: calcium hydroxide; irrigation; ultrasound; XP-endo finisher; canal brush

INTRODUCTION

Canal instrumentation and irrigation is not sufficient to complete full cleaning of root canals. Despite technological advancements in the instrumentation technique and irrigation systems, canal medication is still necessary phase in some cases.

Calcium hydroxide (CH) is the most often used intra-canal medicament due to its antibacterial, biocompatible and regenerative properties. Before obturation, it has to be completely removed from the root canal walls in order to allow sealer adhesion and prevent intracanal micro-leakage as a consequence. Numerous studies have dealt with the problem of CH removal from the root canals and the role of different irrigation substances [1] or different irrigant activation techniques: laser activated irrigation (PIPS) [2, 3], sonic and ultrasonic irrigant activation [4, 5], RinsEndo system [6], EndoVac system [7], SAF (Self adjusting files) [8], Gentle Wave system [9] and others.

The most described method for CH removal from the root canal walls is instrumentation of the canals with a master instrument along with excessive irrigation [3]. Research indicates that with this technique only the main

part of the canal can be cleaned and that the depth of needle plays a crucial role [10]. Passive ultrasonic irrigation (PUI) increases the efficacy of canal disinfectants by agitation of the solution, which was beforehand placed in the canal [8]. XP Endo Finisher (FKG Dentaire, La-Chaux-de Fonds, Switzerland) is a NiTi canal instrument with the size of ISO #25, and without taper (25/00). This instrument increases the penetration of the solution for irrigation in irregular root canals [11, 12]. CanalBrush (CB) (Roeko Canal Brush TM Coltene/Whaledent, Langenau, Germany) is flexible endodontic micro brush, made of polypropylene and used with endodontic motor providing efficient canal cleaning just before the obturation [8, 11].

The aim of this study was to compare the efficacy of conventional irrigation technique, passive ultrasonic irrigation, Canal Brush and XP Endo Finisher in CH removal from the root canal walls.

MATERIAL AND METHODS

Thirty-two extracted single-rooted teeth were used in this study. Water-cooled round diamond bur was used

for access cavity preparation on the palatal surface of the crown. Canal instrument K-15 (Dentsply Maillefer) was used to check patency. Working length was determined 1 mm shorter of the apical foramen. The canals were prepared using BioRaCe system (FKG Dentaire, Swiss) BR5 40/04 with 2% NaOCl irrigation after each instrument. On the buccal and lingual surfaces of the root, 1 mm deep longitudinal grooves were created using a diamond disk, taking care not to endanger the integrity of the root canal. After instrumentation and irrigation, canals were dried with paper points and filled with aqueous suspension of CH (Ca powder and distilled water), and closed with temporary filling Citodur hard (DoriDent-Dr.Hirschberg, Austria). All samples were wrapped in wet gauze soaked with distilled water and kept in an incubator at 37° C. After seven days of storage, the teeth were randomly divided into the four groups ($n=7$). Two teeth were used as positive and negative control. Positive control consisted of teeth filled with CH that was not removed from the root canal. Negative control consisted of prepared teeth with empty canals (without CH paste).

I group: **Conventional syringe irrigation (CSI)** – Medicament was removed using manual instruments (files) from K-15 to K-40 (master apical file-MAF) and irrigation.

II group: **Passive ultrasonic irrigation (PUI)** (PB-323,W&H Dentalwerk Bürmoos, Austria) – Ultrasonic needle was placed into the canal 1 mm shorter than the working length without contact with canal walls and activated 3 times for 20 sec (the frequency of 25-30 kHz). For each cycle fresh irrigant was inserted.

III group: **XP-Endo finisher (XP)** – The instrument was used with an X-smart endodontic motor (Dentsply Sirona, Ballaigues, Switzerland) at a speed of 800 rpm and torque of 1 N/cm. The instrument was placed in the canal 1 mm shorter than the working length, and used with gentle movements up and down in three cycles of 1 minute with constant irrigation.

IV group: **CanalBrush (CB)** – The canal brush size M was placed into the canal 1 mm shorter than the working length, and activated with an endo-motor at a speed of 600 rpm during 1 min for each irrigant. Gentle brushing movements with constant irrigation were used. A new brush was used for each canal.

All groups were irrigated under the same conditions, continuously irrigated with 5 ml of 2% NaOCl for 1 min, and 5 ml of 10% citric acid for 1 min. Finally, all samples were irrigated with 5 ml of distilled water.

All teeth were cut into the two halves with a chisel and observed under the stereomicroscope (Boeco BSZ-405, Germany) with an integrated digital camera at 20X magnification. Images were processed and measured in Scope Image 9.0 program (Teleskop, Austria). The total surface area of the canal (P_s) was measured, from the enamel-dentin junction to the apical foramen (expressed at 100%). Surfaces with residual medicament (P_{ch}) were measured in the same program. The percentage of clean surface of the root canal (P_c) was calculated by subtracting the obtained values ($P_s - P_{ch} = P_c$). The obtained results were statistically analysed using One-way ANOVA and Tukey post-hoc tests. P value <0.05 was considered significant.

RESULTS

The results are shown in Figures 1-5.

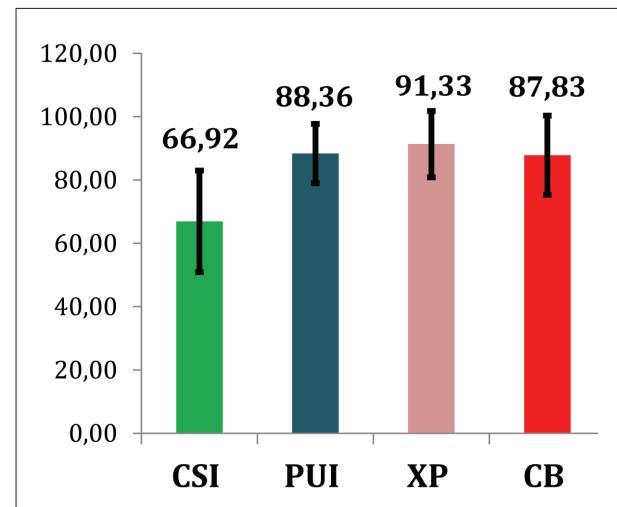


Figure 1. Mean values of clean surface of the root canals by groups
Slika 1. Srednje vrednosti očišćenih površina kanala po grupama

CSI – conventional syringe irrigation; PUI – passive ultrasonic irrigation; XP-XP Endofinisher; CB – Canal Brush
CSI – konvencionalna irigacija špricem; PUI – pasivna irigacija ultrazvukom; XP-XP Endofinisher; CB – kanalna četkica

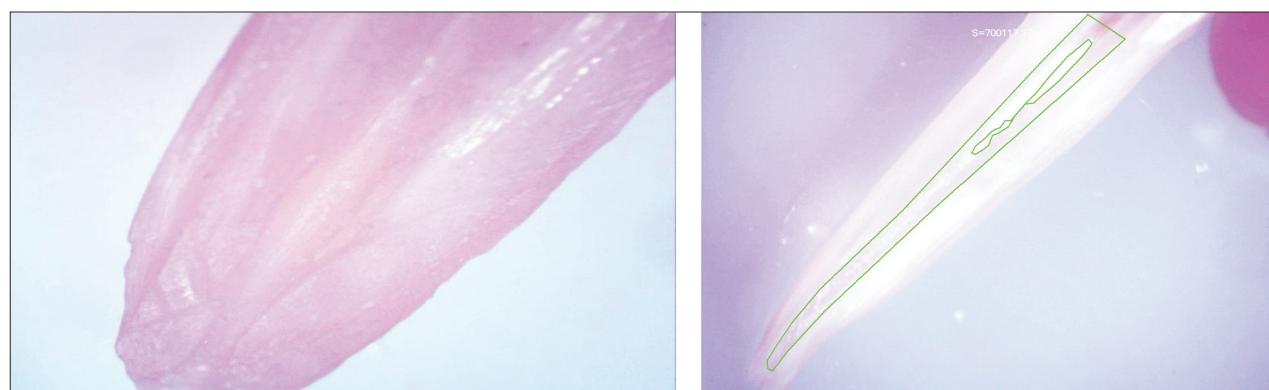


Figure 2. Completely clean root canal surface in the apical third after irrigation with XP-endo Finisher
Slika 2. Potpuno čista površina kanala korena u apikalnoj trećini posle irigacije XP-endo Finisherom

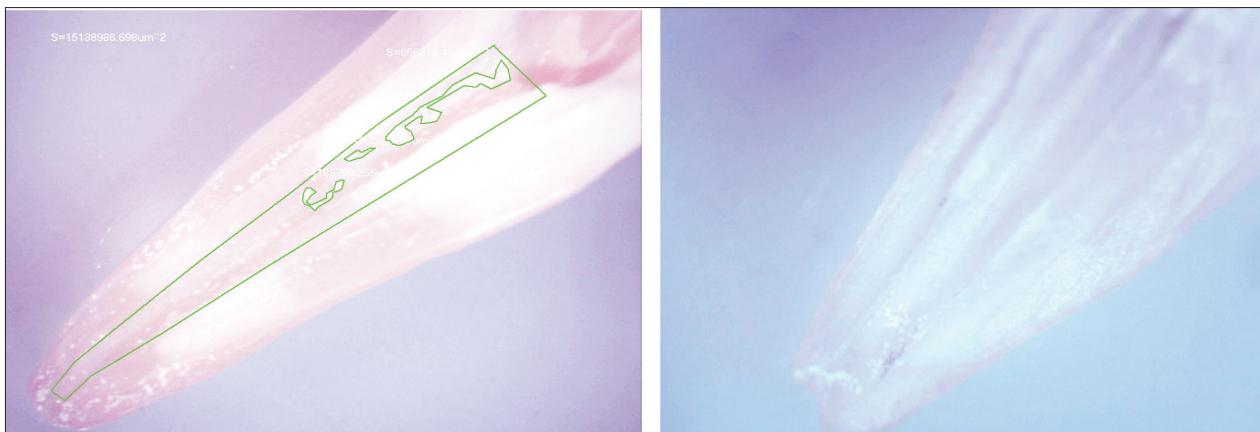


Figure 3. Well-cleaned root canal surface, especially in the apical third, after passive ultrasonic irrigation
Slika 3. Dobro očišćeni zidovi kanala korena, posebno apikalna trećina, posle pasivne ultrazvučne irigacije

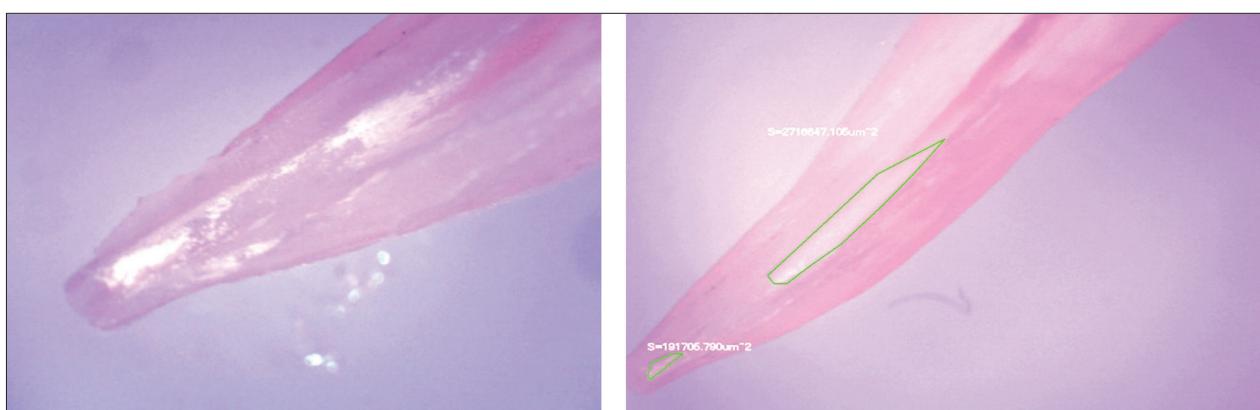


Figure 4. Residual medicament intruded into the apical third, after the use of Canal Brush
Slika 4. Zaostali medikament intrudiran u apikalnu trećinu, posle upotrebe Canal Brusha



Figure 5. Excessive quantity of residual medicament along the root canal walls, after the conventional syringe irrigation
Slika 5. Velika količina zaostalog medikamenta duž celog kanala, posle konvencionalne irigacije špricem

The mean value of clean surface of the root canals was 91.33% for XP EndoFinisher, 88.36% for passive ultrasonic irrigation, 87.83% for Canal Brush and 66.92% for conventional syringe irrigation (CSI). The third group with XP showed the highest efficacy in removing CH from the canal walls with maximum of 99.40% clean surface. For the samples from the fourth group, CB, the intrusion of CH in the apical third was observed. The lowest efficacy in the removal of CH from the canal walls was shown by conventional technique, CSI, where only 47.58% of the surface was cleaned in

some samples. CSI was significantly less effective than XP and PUI ($p<0.05$), while there was no significant difference between XP and PUI. No irrigation technique was able to completely remove medication from the canal walls.

DISCUSSION

Irrigation and medication play an important role in the root canal infection control. The most often-used intra-

canal medicament is CH. Considering necessity of removing CH from the canal there are contradictory research results [13, 14, 15]. However, the necessity of removing CH was accepted, due to its influence on dentin adhesion, and adhesion of endodontic sealers [1]. Previous studies indicated difficulties in complete removal of CH paste from the root canal system, especially from the apical third [1, 13, 16].

The current study was designed to compare the ability of different methods in removing CH from the root canal. To obtain precise results, the area of CH remnants on the canal walls was calculated in relation to the entire surface of the canal. Numerous studies used different scoring systems of 0-3 [1, 8, 11] or 1-5 [5] to calculate residual medicament, where lower values indicated clean canal, and higher values indicated canal filled with CH. These methods actually represent subjective assessment of the amount of residual medicament or clean surface of the canal. Ma and al. agreed with this and highlighted that this scoring method was not sensitive enough for comparing samples and interpretation of the results [9]. The other described method is measuring the volume of CH before and after removal from the root canal, which often requires expensive and sophisticated equipment or usage of radioactive isotopes [3, 9, 17]. In our study, quite exact method of calculating the surface of cleaned canal walls was used. The main advantage of this method is repeatability [2, 16].

No technique of irrigation and cleaning the root canal, tested in our study, completely eliminated CH from the canal, and that is in compliance with findings of other studies that found at least 2-4% residual medicament on the canal walls [3, 7, 9].

The results of our study showed that conventional technique of removing medicament with MAF and constant irrigation was the least effective. The most efficient system was the XP Endo finisher. Silva et al. found that the amount of residual CH could be between 3 to 20% [18]. In our study, with conventional technique, the canal was cleaned only about 24%, while larger parts of canal walls remained unclean, which could have a negative effect on the outcome of endodontic therapy. In this paper, XP showed the best results with over 99% clean surface of the canal. The reason for such good result could be the design of the instrument that is placed into the canal after instrumentation and with gentle extrusion and intrusion movements extended the cleaning effect up to 6 mm in diameter. An additional reason for effective canal cleaning with XP was the corresponding dimension of the apex preparation 40 / .04. CH and smear layer were removed efficiently due to the physical contact of rotating instruments and canal walls. Findings of Haman et al. indicate that XP was superior, especially in the apical third, just because of the contact with walls, and more efficient than ultrasonic irrigation [16]. At PUI sonic energy and frequency up to 30 kHz transmitted through ultrasonic extension formed cavitation bubbles. This agitation of irrigant increased its penetration, although passively without touching the walls of canal. Ultrasonic tip was placed 1 mm from the working length, and in authors'

opinion, the apical segment remained without direct effect of ultrasonic activation. This might be the reason of lagging medicament in the apical segment of the root canal [18]. Also, the efficiency of PUI does not depend only on the duration of irrigant activation, but also on the constant addition of fresh solution [5].

There was statistically significant difference between the conventional technique for CH removal and other irrigation systems in this study. Between CU, PUI and XP there was no statistically significant difference, although the Canal Brush did not prove to be effective enough, especially in the apical third. This was also pointed out by other authors [8, 17]. Canal Brush failed to effectively remove medicament from all canal walls which was even suppressed toward apex, especially those widely prepared. This could be a special problem in narrow and curved canals. The findings of our study are in accordance with other studies reporting XP and PUI as the most efficient methods for cleaning canal, without a significant difference between them [4, 8, 19, 20]. It is known that canal irrigation with NaOCl alone is not sufficient to remove CH from the root canal [21]. In addition, chelating agent (citric acid or EDTA) alone is not efficient either [22]. Topçuoğlu et al. pointed out that combination of these irrigants (NaOCl, EDTA) improved their effectiveness in removal of CH [8]. Effective removal of medicament did not depend only on irrigation technique and volume of irrigant, but also on chemical activity of irrigation agents and the size of apical preparation. The amount of used irrigant was inversely proportional to the residual medicament [17]. On the other hand, Ma et al. pointed out the importance of duration time of irrigation (up to 7 min per canal) [9].

In our paper, simple root canals were used in order to assess the efficacy of the techniques themselves, without the influence of the complexity of the root canal. The efficacy of CH removal from complicated and irregular canals is subject to further testing.

CONCLUSION

None of the irrigation techniques completely removed CH from the root canal. XP Endo finisher showed the highest efficacy in cleaning medicament from the canal walls. For optimal clinical success, it is necessary to combine various systems and copious irrigation.

REFERENCES

1. Capar ID, Ozcan E, Arslan H, Ertas H, Aydinbelge HA. Effect of different final irrigation methods on the removal of calcium hydroxide from an artificial standardized groove in apical third of root canals. *J Endod*. 2014; 40(3):451–4. [DOI: 10.1016/j.joen.2013.10.019] [PMID: 24565670]
2. Arslan H, Akcay M, Capar ID, Saygili G, Gok T, Ertas H. An *in vitro* comparison of irrigation using photon-initiated photoacoustic streaming, ultrasonic, sonic and needle technique in removing calcium hydroxide. *Int Endod J*. 2015; 48:246–51. [DOI: 10.1111/iej.12306] [PMID: 24786363]

3. Lloyd A, Navarrete G, Marchesan MA, Clement D. Removal of calcium hydroxide from Weine Type II systems using photon-induced photoacoustic streaming, passive ultrasonic, and needle irrigation: a microcomputed tomography study. *J Appl Oral Sci.* 2016; 24(6):543–8. [DOI: 10.1590/1678-775720160234] [PMID: 28076457]
4. Yayınlı IE, Kececi AD, Kaya BU. Ultrasonically activated irrigation to remove calcium hydroxide from apical third of human root canal system: a systematic review of *in vitro* studies. *J Endod.* 2015; 41(10):1589–99. [DOI: 10.1016/j.joen.2015.06.006] [PMID: 26238527]
5. Alturaiki S, Lamphon H, Edrees H, Ahlquist M. Efficacy of 3 different irrigation systems on removal of calcium hydroxide from the root canal: a scanning electron microscopic study. *J Endod.* 2015; 41(1):97–101. [DOI: 10.1016/j.joen.2014.07.033] [PMID: 25442071]
6. Rödig T, Hirschleb M, Zapf A, Hülsmann M. Comparison of ultrasonic irrigation and RinsEndo for the removal of calcium hydroxide and Ledermix paste from root canals. *Int Endod J.* 2011; 44:1155–61. [DOI: 10.1111/j.1365-2591.2011.01937.x] [PMID: 21910743]
7. Faria G, Viola KS, Kuga MC, Garcia AJ, Daher VB, De Pasquali Leonardo MF, et al. Effect of rotary instrument associated with different irrigation techniques on removing calcium hydroxide dressing microscopy research and technique. 2014; 77:642–6. [DOI: 10.1002/jemt.22382] [PMID: 24844676]
8. Topçuoğlu HS, Düzung S, Ceyhanlı KT, Aktı A, Pala K, Kesim B. Efficacy of different irrigation techniques in the removal of calcium hydroxide from a simulated internal root resorption cavity. *Int Endod J.* 2015; 48:309–16. [DOI: 10.1111/iej.12316] [PMID: 24860966]
9. Ma J, Shen Y, Yang Y, Gao Y, Wan P, Gan Y, et al. *In vitro* study of calcium hydroxide removal from mandibular molar root canals. *J Endod.* 2015; 41(4):553–8. [DOI: 10.1016/j.joen.2014.11.023] [PMID: 25596727]
10. Chou K, George R, Walsh LJ. Effectiveness of different intracanal irrigation techniques in removing intracanal paste medicaments. *Aust Endod J.* 2014; 40:21–5. [DOI: 10.1111/aej.12055] [PMID: 24330380]
11. Gokturk H, Ozkocak I, Buyukgebiz F, Demir O. Effectiveness of various irrigation protocols for the removal of calcium hydroxide from artificial standardized grooves. *J Appl Oral Sci.* 2017; 25:290–8. [DOI: 10.1590/1678-7757-2016-0414] [PMID: 28678948]
12. Alves FR, Marceliano-Alves MF, Sousa JC, Silveira SB, Provenzano JC, Siqueira JF Jr. Removal of root canal fillings in curved canals using either reciprocating single-or-rotary multi-instrument systems and a supplementary step with the XP-Endo Finisher. *J Endod.* 2016; 42(7):1114–9. [DOI: 10.1016/j.joen.2016.04.007] [PMID: 27215810]
13. Kim SK, Kim YO. Influence of calcium hydroxide intracanal medication on apical seal. *Int Endod J.* 2002; 35:623–8. [DOI: 10.1046/j.1365-2591.2002.00539.x] [PMID: 12190902]
14. Amin SA, Seyam RS, El-Samman MA. The effect of prior calcium hydroxide intracanal placement on the bond strength of two calcium silicate-based and an epoxy resin-based endodontic sealer. *J Endod.* 2012; 38:696–9. [DOI: 10.1016/j.joen.2012.02.007] [PMID: 2251590]
15. Barbizam JV, Trope M, Teixeira EC, Tanomaru-Filho M, Teixeira FB. Effect of calcium hydroxide intracanal dressing on the bond strength of a resin-based endodontic sealer. *Braz Dent J.* 2008; 19:224–7. [DOI: 10.1590/S0103-64402008000300009] [PMID: 18949295]
16. Hamdan R, Michetti J, Pinchon D, Diemer F, Georgelin-Gurgel M. The XP-Endo Finisher for the removal of calcium hydroxide paste from root canals and from the apical third. *J Clin Exp Dent.* 2017; 9(7):e855–60. [DOI: 10.4317/jced.53962] [PMID: 28828150]
17. Zorzin J, Wießner J, Wießner T, Lohbauer U, Petschelt A, Ebert J. Removal of radioactively marked calcium hydroxide from the root canal: influence of volume of irrigation and activation. *J Endod.* 2016; 42(4):637–40. [DOI: 10.1016/j.joen.2016.01.005] [PMID: 26906243]
18. Silva LJM, Pessoa OF, Teixeira MBG, Gouveia CH, Braga RR. Micro-CT evaluation of calcium hydroxide removal through passive ultrasonic irrigation associated with or without an additional instrument. *Int Endod J.* 2015; 48:768–73. [DOI: 10.1111/iej.12374] [PMID: 25156123]
19. Uygun AD, Gundoglu EG, Arslan H, Ersoy I. Efficacy of XP-endo finisher and TRUShape 3D conforming file compared to conventional and ultrasonic irrigation in removing calcium hydroxide. *Aust Endod J.* 2017; 43:89–93. [DOI: 10.1111/aej.12176] [PMID: 27862702]
20. Leoni GB, Versiani MA, Silva-Souza YT, Bruniera JF, Pecora JD, Souza-Neto MD. *Ex vivo* evaluation of four final irrigation protocols on the removal of hard-tissue debris from the mesial root canal system of mandibular first molars. *Int Endod J.* 2017; 50(4):398–406. [DOI: 10.1111/iej.12630] [PMID: 26992452]
21. Calt S, Serper A. Dentinal tubule penetration of root canal sealers after root canal dressing with calcium hydroxide. *J Endod.* 1999; 25:431–3. [DOI: 10.1016/S0099-2399(99)80273-8] [PMID: 10530245]
22. Margelos J, Eliades G, Verdelis C, Palaghias G. Interaction of calcium hydroxide with zinc oxide-eugenol type sealers: a potential clinical problem. *J Endod.* 1997; 23:43–8. [DOI: 10.1016/S0099-2399(97)80206-3] [PMID: 9594745]

Received: 18.04.2018 • Accepted: Prihvaćen 20.08.2018

Efikasnost različitih tehnika irigacije u uklanjanju kalcijum-hidroksida iz kanala korena

Vanja Opačić Galić, Jovana N. Stašić

Univerzitet u Beogradu, Stomatološki fakultet, Klinika za bolesti zuba, Beograd, Srbija

KRATAK SADRŽAJ

Uvod Kalcijum-hidroksid (CH) predstavlja medikament koji se u velikoj meri koristi u endodontskoj terapiji zbog svojih antibakterijskih, regenerativnih i biokompatibilnih svojstava. Istraživanja pokazuju da ostaci CH na dentinskim zidovima i u tubulima mogu kompromitovati prodror silera, što doprinosi njegovoj lošoj adheziji, promeni volumena, a samim tim i apeksnom curenju.

Cilj rada je bio da se uporedi efikasnost četiri različite tehnike uklanjanja kalcijum-hidroksida iz kanala korena zuba.

Materijal i metode Korišćena su 32 ekstrahovana jednokorena zuba sa jednim kanalom. Kanali su mašinski obrađeni BioRaCe sistemom (FKG Dentaire, Swiss) BR5 40/04 uz irigaciju natrijum-hipohloritom posle svakog instrumenta. Na aproksimalnim površinama korenova napravljeni su uzdužni žlebovi. Svi kanali (osim negativne kontrole) napunjeni su vodenom suspenzijom CH. Posle sedam dana u inkubatoru, zubi su podeljeni u četiri grupe ($n = 7$), uz pozitivnu i negativnu kontrolu. Testirane su četiri tehnike (sistema) za uklanjanje CH iz kanala korena: konvencionalna irigacija špricem (CSI), pasivna ultrazvučna irigacija (PUI), XP-endo Finisher (FKG Dentaire, Swiss) i Canal Brush (Roeko, Coltene), uz irigaciju 5 ml 2% NaOCl i 5 ml 10% limunskom kiselinom. Svi korenovi su dletom podeljeni na dve polovine i posmatrani pod stereomikroskopom (Boeco, Germany) na uveličanju od 20x. Od vrednosti ukupne površine kanala korena oduzimane su vrednosti neočišćene površine (%). Dobijene vrednosti su statistički obrađene one-way ANOVA i Tukey post hoc testom ($p < 0,05$).

Rezultati Najefikasniji sistem bio je XP-endo Finisher sa 91,33%, zatim PUI sa 88,36%, Canal Brush sa 87,83%, i konvencionalna irigacija špricem sa 66,92% očišćene površine kanala korena.

Zaključak Nijedan sistem nije u potpunosti uklonio tragove medikamenta iz kanala korena. Za potpuni klinički uspeh neophodno je kombinovati više sistema uz obilnu irigaciju.

Ključne reči: kalcijum-hidroksid; irigacija; ultrazvuk; XP-endo Finisher; Canal Brush

UVOD

Kanalna instrumentacija i irigacija najčešće nisu dovoljne za kompletno čišćenje kanala korena. Uprkos tehnološkom napretku u tehnikama instrumentacije i sistemima irigacije kanala korena, kliničari i dalje smatraju da je medikacija kanala u mnogim indikacijama neophodna faza u terapiji inficiranog korena.

Kalcijum-hidroksid (CH) najčešće je korišćen interseansni medikament, zbog svojih antibakterijskih, biokompatibilnih i regenerativnih svojstava. Medikament, pre opturacije, mora biti potpuno uklonjen sa zidova kanala korena kako se ne bi kompromitovala adhezija silera za zidove kanala, što za posledicu ima kanalno mikrocurenje. Brojne studije su se bavile problemom uklanjanja CH iz kanala korena i proveravana je uloga različitih sredstava za irigaciju [1] ili različitih tehnika aktivacije irrigansa: laserom aktivirana irigacija (PIPS) [2, 3], sonična i ultrasnična aktivacija irrigansa [4, 5], RinsEndo sistem [6], EndoVac sistem [7], SAF (Self adjusting files) [8], Gentle Wave sistem [9] i drugi.

Najčešće opisan metod za uklanjanje CH sa zidova kanala korena je instrumentacija kanala sa master instrumentom uz obilnu irigaciju [3]. Istraživanja ukazuju da se ovom tehnikom može očistiti samo glavni kanal i da dubina plasirane igle igra važnu ulogu [10]. Pasivna ultrazvučna irigacija (PUI) povećava efikasnost kanalnog dezinficijensa, agitacijom rastvora za irigaciju koji je prethodno plasiran u kanal [8]. **XP-endo Finisher** (FKG Dentaire. La-Chaux-de Fonds, Switzerland) jeste NiTi kanalni instrument veličine ISO #25 bez koničnosti koji nakon instrumentacije povećava penetraciju rastvora za irigaciju u iregularne prostore kanala [11, 12]. **CanalBrush (CB)** (Roeko Canal Brush TM

Coltene/Whaledent, Langenau, Germany) jeste endodontska mikročetkica, veoma fleksibilna, od polipropilena, a koristi se sa endokolenjakom i obezbeđuje efikasno čišćenje kanala neposredno pre opturacije [8, 11].

Cilj ovog rada je bio da se uporedi efikasnost konvencionalne tehnike irigacije (CSI) sa pasivnom ultrazvučnom irigacijom (PUI), CanalBrusha (CB) i XP-endo Finishera (XP) u uklanjanju CH sa zidova kanala korena zuba.

MATERIJAL I METODOLOGIJA

U istraživanju su korišćena 32 jednokorena, jednokanalna ekstrahovana zuba. Okruglim dijamantskim svrdlom uz vodeno hlađenje su ispreparisani pristupni kaviteti na oralnim površinama krunica, a kanalnim instrumentom # K-15 (Dentsply Maillefer) proverena je prohodnost kanala. Radna dužina je utvrđena 1 mm kraće od apikalnog foramina na vrhu korena. Svi kanali su mašinski obrađeni BioRaCe sistemom sa apikalnom preparacijom do 40/04. uz irigaciju 2% rastvorom NaOCl posle svakog instrumenta. Na bukalnim i lingvalnim površinama korenova dijamantskim diskom napravljeni su uzdužni žlebovi dubine 1 mm vodeći računa da se ne ugrozi integritet kanala korena. Posle obrade i irigacije kanali su posušeni papirnim poenima i napunjeni vodenom suspenzijom CH (prah CaO i destilovana voda) i zatvoreni privremenim ispunom Citodur hard (DoriDent-Dr. Hirschberg, Austria). Uzorci su tokom sedam dana bili umotani u vlažnu gazu natopljenu destilovanom vodom u inkubatoru na 37°C. Posle sedam dana zubi su nasumično podeljeni u četiri grupe ($n = 7$). Po dva zuba su bila korišćena kao pozitivna i negativna kontrola. Pozitivnu kontrolu su činili zubi ispunjeni pastom CH, koja nije uklanjana iz kanala korena, a negativnu ispreparisani zubi sa praznim kanalima (bez paste CH).

I grupa: **Konvencionalna irrigacija špricem (CSI)** – medikament je uklanjani ručnim instrumentima (turpijama) od #K15 do #K40 (master apical file-MAF) uz irrigaciju.

II grupa: **Pasivna irrigacija ultrazvukom (PUI)** (PB-323, W&H Dentalwerk Bürmoos, Austria) – ultrazvučna igla je postavljena u kanal na 1 mm kraće od radne dužine bez kontakta sa zidovima kanala i aktivirana tri puta po 20 sek. (frekvencija 25–30 kHz). Za svaki ciklus je ubacivan svež irrigans.

III grupa: **XP-endo Finisher (XP)** – instrument je korišćen sa endodontskim motorom X-Smart (Dentsply Sirona, Ballaigues, Switzerland), sa brzinom od 800 rpm i obrtnim momentom 1 Ncm. Instrument je postavljan u kanal 1 mm kraće od radne dužine, nežnim pokretima gore-dole u tri ciklusa od 1 min. sa stalnom irrigacijom.

IV grupa: **CanalBrush (CB)** – kanalna četkica veličine M je plasirana 1 mm kraće od radne dužine, sa endomotorom brzine 600 rpm po 1 min. za svaki irrigans. Korišćeni su pokreti laganog četkanja uz konstantnu irrigaciju. Korišćena je nova četkica za svaki kanal.

Sve grupe su irrigirane na isti način, kontinuirana irrigacija 5 ml 2% NaOCl u trajanju od 1 min., pa irrigacija sa 10% limunskom kiselinom 5 ml, tokom 1 minuta. Na kraju, svi uzorci su irrigirani sa 5 ml destilovane vode.

Zubi su dletom sećeni na dve polovine koje su posmatrane na stereomikroskopu (Boeco BSZ-405, Germany) sa intergrisanom digitalnom kamerom, na uveličanju $\times 20$. Slike su obrađene i izmerene u softverskom programu Scopelimage 9.0 (Teleskop, Austria). Uz pomoć navedenog softverskog programa merene su ukupne površine kanala (P_k) od gleđno-dentinske granice do foramina apikale (izraženo kao 100%), kao i površine polja sa zaostalim medikamentom (P_{ch}). Oduzimanjem dobijenih vrednosti ($P_k - P_{ch} = P_e$) izračunat je procenat očišćenih površina kanala korena (P_e). Dobijeni rezultati su statistički obrađeni One way ANOVA i Tukey post hoc testovima. P-vrednost $<0,05$ je smatrana značajnom.

REZULTATI

Rezultati istraživanja su prikazani na slikama 1–5. Srednja vrednost očišćenih površina kanala korena iznosila je 91,33% za XP-endo Finisher, 88,36% za pasivnu ultrazvučnu irrigaciju, 87,83% za Canal Brush i 66,92% za konvencionalnu irrigaciju špricem. Treća grupa sa XP je pokazala najveću efikasnost u uklanjanju CH sa zidova kanala korena sa maks. 99,40% čiste površine. Kod uzoraka iz četvrte grupe, CB, uočena je intruzija CH u apikalnu trećinu. Najmanju efikasnost u uklanjanju CH sa zidova kanala je pokazala konvencionalna tehnika, CSI, gde je tek 47,58% površine bilo očišćeno u nekim uzorcima. CSI je bila statistički značajno manje efikasna od XP i PUI ($p < 0,05$), dok između XP i PUI nije bilo statističke razlike. Nijedna tehnika irrigacije nije uspela u potpunosti da ukloni medikament sa zidova kanala.

DISKUSIJA

Irigacija i medikacija imaju značajnu ulogu u kontroli endodontske infekcije u kanalu. O neophodnosti uklanjanja CH iz kanala postoje kontradiktorni rezultati istraživanja [13, 14, 15].

Ipak, prihvaćen je stav o neophodnosti uklanjanja CH, zbog njegovog uticaja na vezu sa dentinom, kao i na vezivanje samog endodontskog silera [1]. Prethodno objavljene studije ukazuju na teškoće prilikom kompletног uklanjanja paste CH iz sistema kanala korena, a posebno apikalne trećine [1, 13, 16].

Ovo istraživanje je dizajnirano tako da se uporede sposobnosti različitih metoda čišćenja i uklanjanja CH iz kanala korena. Za dobijanje preciznih rezultata izračunavana je neočišćena površina kanala u odnosu na površinu celog kanala. Brojni radovi su za izračunavanje zaostalog medikamenta koristili različite sisteme skorovanja od 0 do 3 [1, 8, 11] ili od 1 do 5 [5], pri čemu su najmanje vrednosti označavale čist kanal, a najveće potpunu ispunjenost CH. Problem ovih metoda je dosta subjektivna procena o količini zaostalog medikamenta ili očišćene površine kanala. S ovim se slažu i Ma i sar. i ističu da ova metoda ocenjivanja nije dovoljno prihvatljiva za upoređivanje uzoraka i tumačenje dobijenih rezultata [9]. Druga opisana metoda je merenje volumena CH pre i posle uklanjanja iz kanala korena, što često zahteva skupu i sofisticiranu opremu ili upotrebu radioaktivnog izotopa [3, 9, 17]. U ovom radu korišćena je dosta egzaktna metoda izračunavanja površine očišćenih zidova kanala, što omogućava istraživačima lako ponavljanje i proveru korišćene metode. Sličnu metodologiju su koristili i drugi istraživači, smatrajući je preciznjom [2, 16].

Nijedna tehnika irrigacije i čišćenja kanala testirana u ovom radu nije kompletno eliminisala kalcijum-hidroksid iz kanala, što je u saglasnosti sa nalazima i drugih istraživača, gde zaostaje bar 2–4% medikamenta na zidovima [3, 7, 9].

Rezultati ovog istraživanja pokazuju da se kao najmanje efikasna tehnika pokazala konvencionalna tehnika uklanjanja medikamenta turpijama do MAF sa stalnom irrigacijom, a najefikasniji sistem je bio XP-endo Finisher. Silva i sar. ističu da količina zaostalog kalcijuma iznosi od 3 do 20% [18]. U ovom radu, kod konvencionalne tehnike kanal je očišćen samo oko 24%, dok su veći delovi zidova ostali neočišćeni, što sigurno ima i negativan uticaj na ishod endodontske terapije. Najbolji rezultat u ovom radu pokazao je XP sa preko 99% očišćene površine kanala. Razlog za ovako dobar rezultat leži u dizajnu instrumenta koji se postavlja u kanal nakon instrumentacije i sa blagim pokretima uvlačenja i izvlačenja može da proširi efekat čišćenja i do 6 mm u prečniku. Dodatni razlog za efikasno čišćenje kanala XP-om je i odgovarajuća dimenzija apeksne preparacije – 40/04. Kalcijum-hidroksid, ali i razmazni sloj, uklanja se efikasno zbog fizičkog kontakta rotirajućeg instrumenta i zidova kanala. Nalazi Hamdana i sar. ukazuju da je XP bio superioran, posebno u apeksnoj trećini, baš zbog ostvarenog kontakta sa zidovima, i efikasniji i od ultrazvučne irrigacije [16]. Kod PUI zvučna energija i frekvencija do 30 kHz preneta kroz ultrazvučni nastavak stvaraju kavitacione mehuriće. Ova agitacija irrigansa povećava njegovu penetraciju, ali pasivno, bez dodirivanja zidova kanala. Vrh ultrazvučnog nastavka se plasira na 1 mm od radne dužine pa, po mišljenju autora, apikalni segment ostaje bez direktnog efekta ultrazvučne aktivacije, što je možda razlog zaostajanja medikamenta u apikalnom segmentu korena [18]. Takođe, efikasnost PUI ne zavisi samo od dužine aktivacije irrigansa već i od stalnog dodavanja svežeg rastvora [5].

Postoji statistički značajna razlika između konvencionalne tehnike uklanjanja CH i drugih sistema irrigacije u ovom radu. Između CB, PUI i XP nema statistički značajne razlike, iako se CanalBrush nije pokazao dovoljno efikasnim, posebno u api-

kalnoj trećini, što ističu i drugi autori [8, 17]. Mikročetkica nije uspela efikasno da ukloni medikament sa svih zidova kanala, a izraženo je čak i njegovo potiskivanje ka apeksu, koji je bio široko obrađen, tako da to može predstavljati poseban problem u uskim i zakrivljenim kanalima.

Nalazi ove studije su u saglasnosti sa drugim istraživanjima koji nalaze da su najefikasnije metode za čišćenje kanala XP i PUI, bez značajne razlike između njih [4, 8, 19, 20]. Poznato je da irigacija kanala samo sa NaOCl nije dovoljno efikasna u uklanjanju CH iz kanala [21]. Takođe, ni samo helatno sredstvo (limunska kiselina ili EDTA) nije dovoljno efikasno [22]. Topçuoğlu i sar. ističu da kombinovanje ovih iriganasa (NaOCl, EDTA) poboljšava njihovu efikasnost u uklanjanju CH [8]. Efikasno uklanjanje medikamenta ne zavisi samo od tehnike irigacije, volumena irigansa već i od hemijske aktivnosti sredstava za irigaciju i od dimenzije apeksne preparacije. Količina

upotrebljenog irigansa je obrnuto proporcionalana zaostalom medikamentu [17]. S druge strane, Haapasalo ističe i značaj vremena, odnosno trajanje irigacije (čak i do 7 min. po kanalu) [9].

U ovom radu korišćeni su jednostavniji kanali sa namerom da se ispita efikasnost samih tehnika, bez uticaja kompleksnosti kanalnog sistema. Efikasnost uklanjanja CH iz komplikovanih i iregularnih kanalnih prostora je tema daljih ispitivanja.

ZAKLJUČAK

Nijedna tehnika irigacije nije uspela u potpunosti da ukloni kalcijum-hidroksid iz kanala korena. XP-endo Finisher je pokazao najveću efikasnost u čišćenju medikamenta sa zidova kanala. Za potpuni klinički uspeh potrebno je kombinovati više sistema čišćenja kanala uz obilnu irigaciju.

Da li ste pažljivo čitali radove?

1. Stanje parodontalnog zdravlja je proveravano:
 - a) u dečjem uzrastu
 - b) kod odraslih osoba
 - c) i kod dece i kod odraslih

2. Uloga interleukina-6 je proveravana u patogenezi:
 - a) akutnih periapeksnih lezija
 - b) hroničnih periapeksnih lezija
 - c) hroničnih inflacija pulpe

3. Veća koncentracija K-6 ima važnu ulogu:
 - a) u etiologiji lezije
 - b) u progresiji lezije
 - c) u regresiji lezije

4. Parcijalna skeletirana proteza je kod jednostrane krežubosti:
 - a) najčešće rešenje
 - b) vrlo retka opcija
 - c) nezadovoljavajuće rešenje

5. Pacijenti sa PSP kod jednostrane krežubosti su posle pet godina:
 - a) bili zadovoljni komforom i lakoćom rukovanja protezama
 - b) bili nezadovoljni komforom i lakoćom rukovanja protezama
 - c) bili bez objektivnih pokazatelja poboljšanja

6. Prosečna vrednost Pi (plak indeksa) kod testirane dece iznosila je:
 - a) 1,31
 - b) 2,31
 - c) 3,31

7. Uloga citokina u hroničnim PA lezijama je:
 - a) značajna
 - b) beznačajna
 - c) neznatna

8. Učestalost molokluzija kod dece proveravana je:
 - a) kod osmogodišnjaka
 - b) kod devetogodišnjaka
 - c) kod desetogodišnjaka

9. Efikasnost PSP je proveravana na osnovu:
 - a) subjektivnih ocena pacijenata
 - b) subjektivnih ocena lekara
 - c) ocene više lekara

10. Efikasnost irigacionih tehnika proveravana je pri uklanjanju:
 - a) kalcijum-hidroksida iz kanala korena
 - b) cink-oksida iz kanala korena
 - c) paroformaldehida iz kanala korena

11. Stanje zdravlja parodoncijuma je utvrđivano kod:
 - a) dece obolele od dijabetesa tipa II
 - b) dece obolele od dijabetesa tipa I
 - c) dece obolele od bubrežnih oboljenja

12. Učestalost malokluzija kod osmogodišnje dece je ispitivana:
 - a) na području opštine Sarajevo
 - b) na području opštine Banja Luka
 - c) na području opštine Foča

13. Koncentracija IL-G je proveravana u korelaciji sa:
 - a) simptomatologijom i veličinom lezija
 - b) položajem zuba u vilici
 - c) morfolojijom zuba

14. Efikasnost PSP sa atečmenom tipa reze je proveravana posle:
 - a) jednogodišnjeg praćenja
 - b) trogodišnjeg praćenja
 - c) petogodišnjeg praćenja

15. U uklanjanju kalcijum-hidroksida iz kanala korišćeno je:
 - a) pet tehnika
 - b) četiri tehnike
 - c) tri tehnike

16. Stanje zdravlja parodoncijuma je obuhvatilo:
 - a) decu uzrasta 5–10 godina
 - b) decu uzrasta 8–12 godina
 - c) decu uzrasta 10–15 godina

17. Veća koncentracija IL-G je uočena:
 - a) kod velikih simptomatskih lezija
 - b) kod velikih asimptomatskih lezija
 - c) nije bilo razlike

18. Uloga IL-G je proveravana kod:
- a) 63 uzorka
 - b) 93 uzorka
 - c) 103 uzorka
19. PSP sa atečmenom tipa reze je tokom petogodišnjeg praćenja analizirana kod:
- a) 10 ispitanika
 - b) 20 ispitanika
 - c) 25 ispitanika
20. Za proveru četiri tehnike irigacije u uklanjanju kalcijum-hidroksida iz kanala korena korišćeno je:
- a) 35 jednokorenih zuba
 - b) 30 jednokorenih zuba
 - c) 32 jednokorena zuba
21. Istraživanje stanja parodontalnog zdravlja dece je obuhvatilo:
- a) 177 dece
 - b) 197 dece
 - c) 147 dece
22. Koncentracija IL-G je proveravana samo kod:
- a) malih lezija
 - b) velikih lezija
 - c) i malih i velikih lezija
23. Učestalost malokluzija na području opštine Foča je istraživana kod:
- a) 97 dece
 - b) 112 dece
 - c) 123 dece
24. Preparacija kanala pre punjenja kalcijum-hidroksidom urađena je:
- a) setom Bio Race
 - b) setom iRaCe
 - c) setom BT Race
25. Kontrolnu grupu u istraživanju stanja parodontalnog zdravlja dece činilo je:
- a) 60 zdrave dece
 - b) 70 zdrave dece
 - c) 90 zdrave dece
26. Koncentracija IL-G je ispitivana:
- a) EUSA pastom
 - b) pekimetrom
 - c) proverom rastvorljivosti
27. Karijes stalnih zuba kod dečaka u Foči je iznosio:
- a) 1,5%
 - b) 2,9%
 - c) 3,1%
28. Kao sredstvo za irigaciju kanala tokom instrumentacije korišćen je:
- a) hlorheksidin
 - b) hidrogen
 - c) Na-hipohlorit
29. Kod dece obolele od dijabetesa tipa I najviše je bila zastupljena:
- a) zdrava gingiva
 - b) blago inflamirana gingiva
 - c) umerena i teško inflamirana gingiva
30. Značajna razlika u koncentraciji IL-G je uočena:
- a) u malim simptomatskim u odnosu na male asimptomatske lezije
 - b) u malim asimptomatskim u odnosu na velike asimptomatske lezije
 - c) u velikim simptomatskim u odnosu na male simptomatske lezije
31. Osmogišnjaka u Foči sa dubokim zagrižajem bilo je:
- a) 15%
 - b) 17%
 - c) 25%
32. Najefikasniji sistem za uklanjanje kalcijum-hidroksida iz kanala bio je:
- a) canal brush
 - b) XP-endo Finisher
 - c) postupak irigacije špricem
33. Prosečna vrednost CPI indeksa u grupi dece sa dijabetesom je iznosila:
- a) 0,36
 - b) 1,36
 - c) 2,36
34. Veća koncentracija IL-G je uočena:
- a) u lezijama sa izraženim kliničkim simptomima
 - b) u lezijama bez kliničkih simptoma
 - c) koncentracija je bila podjednaka
35. Konvencionalna irigacija špricem je bila efikasna u uklanjanju kalcijum-hidroksida sa:
- a) 88,3%
 - b) 87,8%
 - c) 66,9%
36. Karijes mlečnih zuba kod osmogodišnjaka u Foči je iznosio:
- a) 24,62
 - b) 34,62
 - c) 14,62
37. Protetske komplikacije u vidu frakture retencionog zuba posle pet godina:
- a) bile su statistički značajne
 - b) nisu bile statistički značajne
 - c) bile su identične
38. Pasivna ultrazvučna irigacija je bila efikasna u uklanjanju kalcijum-hidroksida sa:
- a) 91,3%
 - b) 88,3%
 - c) 66,9%

39. Karijes indeks pregledane dece opštine Foča:
a) bio je mali
b) bio je visok
c) bio je veoma visok
40. PSP se uz dobru oralnu higijenu može smatrati:
a) dobrim rešenjem jednostrane krezubosti
b) neadekvatnim rešenjem jednostrane krezubosti
c) nepouzdanim rešenjem jednostrane krezubosti
41. Prosečna vrednost nivoa pripojnog epitela kod dece obolele od dijabetesa je iznosila:
a) 1,33
b) 1,36
c) 2,36
42. KIO kod pregledanih dečaka i devojčica je iznosio:
a) 78,5%
b) 68,5%
c) 48,5%
43. Osmogodišnjaka u Foči sa otvorenim zagrižajem bilo je:
a) 8,92%
b) 13%
c) 24%
44. Zadovoljstvo pacijenta sa PSP se posle prve i posle pet godina:
a) značajno popravilo
b) pogoršalo
c) ostalo nepromjenjeno
45. Gubitak vertikalnog pripoja gingive je praćen kod:
- a) primarnog retencionog zuba
b) sekundarnog retencionog zuba
c) primarnog i sekundarnog retencionog i kontrolnog zuba
46. Spinalne nepravilnosti kod pregledane dece u opštini Foča obuhvatile su:
a) 33,92%
b) 18,7%
c) 34,82%
47. Deca obolela od dijabetesa imaju:
a) više dentalnog plaka
b) manje dentalnog plaka
c) slične vrednosti dentalnog plaka kao i zdrava
48. Vertikalne nepravilnosti zagrižaja kod pregledane dece u Foči obuhvatile su:
a) 8,9% dece
b) 33,9% dece
c) 25% dece
49. Sistem CANAL BRUSH je bio efikasan u uklanjanju kalcijum-hidroksida sa:
a) 91,3%
b) 66,9%
c) 87,8%
50. XP-endo Finisher je bio efikasan u uklanjanju kalcijum-hidroksida sa:
a) 91,3%
b) 88,3%
c) 87,8%

Odgovore slati na email adresu Uredništva časopisa „Stomatološki glasnik Srbije“. Tačni odgovori na pitanja će se vrednovati u skladu s Pravilnikom o kontinuiranoj medicinskoj edukaciji zdravstvenih radnika.

Uputstvo autorima za pripremu rada

Stomatološki glasnik Srbije je časopis Srpskog lekarskog društva osnovan 1953. godine. Časopis objavljuje: originalne naučne i stručne rade, prikaze iz prakse, pregledne rade, saopštenja, istoriografske rade, prikaze knjiga, komentare i pisma uredništvu, društvenu hroniku.

Svi rukopisi se podvrgavaju recenziji. Rade recenziraju dva anonimna stručnjaka i, ukoliko je potrebno, statističar. Konačnu odluku o prihvatanju rada za štampu donosi glavni i odgovorni urednik. Autori se obaveštavaju o prijemu ili odbijanju rada najkasnije osam nedelja od podnošenja rukopisa.

Za objavljene rade se ne isplaćuje honorar, a autorska prava se prenose na izdavača. Rukopisi i prilozi se ne vraćaju. Za reprodukciju ili ponovno objavljivanje nekog segmenta rada publikovanog u „Stomatološkom glasniku Srbije“ neophodna je saglasnost izdavača.

Radovi se štampaju na engleskom i srpskom jeziku.

Opšta uputstva Tekst rada treba da bude otkucan u programu za obradu teksta *Word*, sa dvostrukim proredom, isključivo fontom Times New Roman i veličinom slova 12 pt. Sve marge treba podesiti na 25 mm, veličinu stranice na A4 format, a tekst kucati s levim poravnanjem i uvlačenjem svakog pasusa za 10 mm, bez deljenja reči. Ako se u tekstu koriste specijalni znaci (simboli), koristiti font Symbol. Podaci o korišćenoj literaturi u tekstu označavaju se arapskim brojevima u uglastim zagradama – npr. [1, 2], i to redosledom kojim se pojavljuju u tekstu. Stranice se numerišu redom u okviru donje marge, počev od naslovne strane.

Naslovna strana Na posebnoj, prvoj strani rukopisa treba navesti sledeće: naslov rada bez skraćenica, puna imena i prezimena autora bez titula, zvaničan naziv ustanova u kojima autori rade, mesto i državu; na dnu stranice navesti ime i prezime, adresu za kontakt, broj telefona i e-mail adresu autora zaduženog za korespondenciju.

Kratak sadržaj i ključne reči Druga strana treba da sadrži kratak sadržaj rada obima 100–250 reči. Kratak sadržaj originalnog rada treba strukturirati na sledeće delove: Uvod (u okvir kojeg se navodi cilj rada), Materijal i metode rada, Rezultati i Zaključak. Navode se najvažniji rezultati, numeričke vrednosti, statističke analize i nivo značajnosti. Ispod kratkog sadržaja navesti od tri do šest ključnih reči. U izboru ključnih reči koristiti *Medical Subject Headings – MeSH* (<http://www.nlm.nih.gov/mesh>).

Struktura rada Originalni rad treba da sadrži sledeće podnaslove: Uvod (sa ciljem rada), Materijal i metode rada, Rezultati, Diskusija, Zaključak i Literatura. Prikaz iz prakse čine: Uvod, Prikaz bolesnika, Diskusija i Literatura. Ne treba koristiti imena bolesnika, inicijale ili brojeve istorija bolesti. Pregledni i informativni rad čine Uvod, odgovarajući podnaslovi, Zaključak i Literatura. Pregledni rad mogu objaviti samo autori koji su izuzetno uspešni u oblasti kojom se bave i koji navedu najmanje pet autocitata rada publikovanih u časopisima s recenzijom.

Tekst rukopisa Koristiti kratke i jasne rečenice, bez stranih reči i neadekvatnih pojmoveva iz prevoda iz strane literature. Za nazive lekova koristiti generička imena. Skraćenice koristiti samo kada je to neophodno, a ne koristiti ih u naslovu. Za svaku skraćenicu pun termin treba navesti pri prvom pojavljivanju u tekstu, sem ako to nije standardna jedinica mere. Decimalne brojeve u engleskom tekstu pisati sa tačkom, a u srpskom sa zarezom. Kad god je to moguće, broj zaokružiti na jednu decimalnu. Sve rezultate hematoloških, kliničkih i biohemijских merenja navoditi u metričkom sistemu prema Međunarodnom sistemu jedinica (SI).

Obim rukopisa Celokupni rukopis rada – koji čine naslovna strana, kratak sadržaj, tekst rada, spisak literature, svi prilozi, potpisi za njih i legenda (tabele, slike, grafikoni, sheme, crteži) – mora iznositi za pregledni rad do 7.000 reči, za originalni rad do 5.000 reči, a za informativni rad i prikaz iz prakse do 3.000 reči. Provera broja reči u dokumentu može se izvršiti kroz podmeni Tools–Word Count ili File–Properties–Statistics.

Tabele Tabele se označavaju arapskim brojevima prema redosledu navođenja u tekstu, a moraju biti urađene u programu *Word*, kroz meni Table–Insert–Table, uz definisanje tačnog broja kolona i redova koji će činiti mrežu tabele. Korišćene skraćenice u tabeli treba objasniti u legendi ispod tabele.

Grafikoni Grafikoni treba da budu urađeni i dostavljeni u programu *Excel*, da bi se videle prateće vrednosti raspoređene po celijama.

Slike Slike se označavaju arapskim brojevima prema redosledu navođenja u tekstu. Primaju se isključivo digitalne fotografije (crno-bele ili u boji) rezolucije 300 dpi i formata zapisa .tiff ili .jpg. Ukoliko autori ne poseduju ili nisu u mogućnosti da dostave digitalne fotografije, onda originalne slike treba skenirati kao Grayscale (ili u boji) u rezoluciji 300 dpi i snimiti ih u originalnoj veličini.

Sheme Sheme crtati i dostaviti u programu *CorelDraw* ili *Adobe Illustrator*. Podatke u shemi kucati fontom Times New Roman i veličinom slova 10 pt.

Zahvalnica Navesti sve one koji su doprineli stvaranju rada, ali ne ispunjavaju merila autorstva. Finansijska i materijalna pomoć u obliku sponzorstva, stipendija, poklona, opreme, lekova, materijala i drugog takođe treba da bude navedena.

Literatura Spisak referenci je odgovornost autora, a citirani članci treba da budu lako pristupačni čitaocima časopisa. Stoga uz svaku referencu obavezno treba navesti DOI broj članka (jedinstvenu nisku karaktera koja mu je dodeljena) i PMID broj ukoliko je članak indeksiran u bazi PubMed/MEDLINE.

Reference numerisane arapskim brojevima navoditi prema redosledu citiranja u tekstu. Broj referenci u originalnim radovima ne bi trebalo da bude veći od 30, osim kod preglednih i informativnih radova, gde broj referenci nije ograničen. Izbegavati korišćenje apstrakta kao referenice, a apstrakte starije od dve godine ne citirati. Reference članaka koji su prihvaćeni za štampu treba označiti kao „u štampi“ (*in press*) i priložiti dokaz o prihvatanju rada.

Reference se citiraju prema Vankuverskom stilu (jednoobraznim zahtevima za rukopise koji se predaju biomedičinskim časopisima), koji je uspostavio Međunarodni komitet urednika medicinskih časopisa (<http://www.icmje.org>), čiji format koriste U.S. National Library of Medicine i baze naučnih publikacija. Primeri navođenja publikacija (članaka, knjiga, monografija, elektronskog, neobjavljenog i drugog objavljenog materijala) mogu se naći na internet-stranici http://www.nlm.nih.gov/bsd/uniform_requirements.html.

Propratno pismo Uz rukopis obavezno priložiti pismo koje su potpisali svi autori, a koje treba da sadrži: izjavu da rad prethodno nije publikovan i da nije istovremeno podnet za objavljivanje u drugom časopisu, te izjavu da su rukopis pročitali i odobrili svi autori koji ispunjavaju merila autorstva.

Autorstvo Autorstvo se zasniva na bitnom doprinosu koncepciji rada, dobijanju rezultata ili analizi i tumačenju rezultata, planiranju rukopisa ili njegovoj kritičkoj reviziji od znatnog intelektualnog značaja, te doprinosu u završnom doterivanju verzije rukopisa koji se priprema za štampanje. Finansiranje, sakupljanje podataka ili generalno nadgledanje istraživačke grupe sami po sebi ne mogu opravdati autorstvo.

Slanje rukopisa Rukopis rada i svi prilozi uz rad mogu se dostaviti imejlom (stomglas@bvcom.net), preporučenom pošiljkom ili lično, dolaskom u Uredništvo. Ukoliko se rad šalje poštom ili donosi u Uredništvo, rukopis se dostavlja odštampan u dva primerka i narezan na CD (snimljeni materijal treba da je istovetan onom na papiru).

Važna napomena Svi autori i koautori radova moraju biti članovi Srpskog lekarskog društva i pretplatnici na časopis za godinu u kojoj predaju rad za publikovanje.

Adresa:

Srpsko lekarsko društvo
Uredništvo časopisa „Stomatološki glasnik Srbije“
Ul. kraljice Natalije 1
11000 Beograd
Srbija

Telefon: +381 (0)11 409 27 76

E-mail: stomglas@bvcom.net

Internet-adresa: <http://www.stomglas.org.rs>

Instructions for Authors

Serbian Dental Journal is the journal of the Serbian Medical Society, founded in 1953. The journal publishes original scientific and professional papers, case reports, review articles, preliminary research reports, historical papers, book review, comments and letters to the Editor, social chronicle.

All manuscripts are peer-reviewed. Manuscripts are reviewed by two anonymous referees and, if necessary, a statistician. The final decision on paper acceptance for publishing is made by the Editor-in-Chief. Authors are informed of acceptance or rejection of the paper within eight weeks after manuscript submission.

Copyright is transferred from the author(s) to the publisher upon paper acceptance and no fees are paid for papers to be published. Manuscripts are not returned to the author. For any reproduction and repeated publishing of part or the whole paper, written consent from the publisher is requested.

The journal is published in English and Serbian.

General instructions The manuscript should be typed in MS Word, with double line spacing, only in Times New Roman font and letters size 12 pt. Page margins should be 25 mm, page size set to A4 format, and text typed aligned left with paragraph indentations of 10 mm. Words should not be hyphenated. If special symbols are used in the text, preferred font is Symbol. References should be marked with Arabic numbers in brackets, e.g. [1, 2], in the order of appearance in the text. Page numbers should be inserted at the bottom of the page, starting from the title page.

Title page The first page should contain: the title of the paper without abbreviations, authors' names without professional titles, authors' affiliations; the exact postal address of the corresponding author, telephone number and e-mail address must be given at the bottom of the title page.

Summary and keywords The second page should contain a structured summary of the paper with Introduction (with the aim), Material and Methods, Results and Conclusion with up to 250 words. Each of these segments should be written as a new paragraph with bold subtitles. Only the most important results should be indicated with the statistical level of significance. Following summary it is recommended to list 3 to 6 keywords related to the paper. Keywords should be chosen according to the Medical Subject Headings – MeSH (<http://www.nlm.nih.gov/mesh>).

Structure of the manuscript Original paper should have the following subheadings: Introduction (with the aim), Material and Methods, Results, Discussion, Conclusion and References. Case report should contain: Introduction, Case Report, Discussion, Conclusion and References. No patients' names, initials or record numbers should be indicated. Review and informative article consists of Introduction, subheadings, Conclusion and References. Only distinguished authors with at least five citations of their published papers are eligible to publish review articles.

Text of the manuscript Text should be written in short and clear sentences, avoiding foreign language words and inadequate terms and interpretation from the literature. Medications should be indicated by their generic names. For each abbreviation, full term should be indicated when first mentioned in the text, except for standard measuring units. Decimals should be separated with a comma in Serbian, and with a dot in English. Numbers should be approximated to one decimal place. All results of hematological, clinical and biochemical measurements should be quoted in the metrical system according to the International Unit System (SI).

Length of the manuscript The entire manuscript (title page, summary, the whole text, list of references, all enclosures including captions and legends) should not exceed 7,000 words for a review article, 5,000 words for an original paper, and 3,000 words for an informative article and case report. The number of words can be checked in MS Word using Tools–Word Count or File–Properties–Statistics options.

Tables Tables should be marked in Arabic numbers in the order of appearance in the text, and should be prepared in MS Word using Table–Insert–Table, with clearly defined number of columns and rows. Abbreviations used in a table should be explained in the legend under the table.

Graphs Graphs should be prepared in MS Excel, in order to maintain a clear view of all values within the cells.

Photographs Photographs should be marked in Arabic numbers in the order of appearance in the text. Only original digital photographs (black-and-white or color), resolution of 300 dpi, and .tiff or .jpg format, are acceptable. If authors do not possess or are not able to provide digital photographs, then the original photos should be scanned as Grayscale (or RGB color) with resolution of 300 dpi, and saved in original size.

Schemes Schemes should be drawn in CorelDraw or Adobe Illustrator programmes. The text in the scheme should be typed in Times New Roman, font size 10 pt.

Acknowledgment All contributors to the paper who are not named as authors should be acknowledged. Financial and other material support, like sponsorship, grants, gifts, medical supplies, etc., should also be mentioned.

References The reference list is the responsibility of the authors. Cited articles should be readily accessible to the journals readership. Therefore, following each reference, its DOI number and PMID number (if the article is indexed for MEDLINE/PubMed) should be typed.

References must be marked in Arabic numbers and cited in the order of appearance in the text. The number of references should not exceed 30, except in review and informative articles, when no limits are established. The use of abstracts as references should be avoided and an abstract more than two years old should not be quoted by any means. When citing accepted papers, these should be indicated as "in press" and a proof of acceptance should be provided.

References are cited according to the Vancouver style (*Uniform Requirements for Manuscripts Submitted to Biomedical Journals*), rules and formats established by the International Committee of Medical Journal Editors (<http://www.icmje.org>), used by the U.S. National Library of Medicine and scientific publications databases. Examples of citing publications (journal articles, books and other monographs, electronic, unpublished and other published material) could be found on the web site http://www.nlm.nih.gov/bsd/uniform_requirements.html.

Cover letter A cover letter should be signed by all authors and with the following content: written consent that the paper was not previously published and is not simultaneously submitted to publication in other journals, and written consent that the paper was reviewed and approved by all other co-authors.

Authorship Authorship is based only on: crucial contribution to the article conception, obtaining of results or analysis and interpretation of results; design of the manuscript or its critical review of significant intellectual value; final revision of the manuscript being prepared for publication. Funding, collection of data or general supervision of the research group alone cannot justify authorship.

Submission Manuscript and all enclosures can be sent by e-mail (stomglas@bvcom.net). If sent by registered mail or delivered in person at the Editorial Office in Belgrade, it should contain two printed copies and a CD with the version identical to that on paper.

Important notice All authors and co-authors must be members of the Serbian Medical Society and subscribers to the journal for the year in which the manuscript is being submitted.

Address:

Serbian Medical Society
Editorial Board of the Serbian Dental Journal
Ul. kraljice Natalije 1
11000 Belgrade
Serbia

Phone: +381 (0)11 409 27 76

E-mail: stomglas@bvcom.net

Web site: <http://www.stomglas.org.rs>

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

616.31

STOMATOLOŠKI glasnik Srbije = Serbian
Dental Journal / главни и одговорни уредник
Slavoljub Živković. - God. 1, br. 1 (1955)-
. - Beograd (Džordža Vašingtona 19) :
Srpsko lekarsko društvo, 1955- (Beograd :
Službeni glasnik). - 29,5 cm

Dostupno i na: <http://www.stomglas.org.rs> - Тромесечно

ISSN 0039-1743 = Stomatološki glasnik Srbije
(Štampano izd.)
COBISS.SR-ID 8417026

