



STOMATOLOŠKI GLASNIK SRBIJE

SERBIAN DENTAL JOURNAL





STOMATOLOŠKI GLASNIK SRBIJE

SERBIAN DENTAL JOURNAL

Vol. 66 • Number 3 • July-September 2019

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 11 409 27 76
Email: stomglas@bvcom.net

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

Cene preplate za 2019. 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 2019 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 © 2019 Srpsko lekarsko društvo.
Sva prava zaštićena.
Copyright © 2019 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
300

Contents / Sadržaj

| | |
|--|-----|
| REČ UREDNIKA | 111 |
| ORIGINAL ARTICLES / ORIGINALNI RADOVI | |
| Igor Radović, Nikola Stojanović, Jelena Krunic, Lado Davidović, Jelena Lečić, Vukoman Jokanović, Slavoljub Živković | |
| Antibacterial activity of newly synthesized endodontic nanomaterial based on calcium aluminate | 113 |
| Antimikrobnna aktivnost novosintetisanog endodontskog nanomaterijala na bazi kalcijum-aluminata | |
| Zorica Popović, Mirjana Đuričković | |
| Oral health behavior and oral hygiene habits of elderly population in Podgorica, Montenegro | 120 |
| Oralnozdravstveno ponašanje i oralnohigijenske navike starih osoba u Podgorici, Crna Gora | |
| Ljuburn Kurtiši, Mira Jankulovska, Meri Pavlevska, Elizabeta Gorgjevska, Ana Sotirovska Ivkowska, Sonja Apostolska, Vasilka Rendžova, Vesna Ambarkova, Marija Jankulovska | |
| Microleakage assessment of a resin based sealant after acid etching and Er: YAG laser treatment – an <i>in vitro</i> study | 132 |
| Procena mikropustljivosti zalivača na bazi smole nakon nagrizanja kiselinom i tretmana laserom Er: YAG – <i>in vitro</i> studija | |
| Ilija Mikić, Bogdan Lisul, Đurica Grga | |
| Dental anthropological status of the human population found in the Roman site of Viminacium necropolis “Kod Koraba” | 140 |
| Dentalnoantropološki status humane populacije antičkog lokaliteta Viminacijum – nekropolja „Kod Koraba“ | |
| CASE REPORT / PRIKAZ IZ PRAKSE | |
| Srđan Milanović, Nikola Milošević, Marko Dožić, Dušan Ristić, Goran Stojković, Nebojša Miletić | |
| Ewing sarcoma with initial presentation in mandible – a case report | 148 |
| Juingov (Ewing) sarkom sa inicijalnom prezentacijom u mandibuli – prikaz slučaja | |
| DA LI STE PAŽLJIVO ČITALI RADOVE? | 153 |
| UPUTSTVO AUTORIMA ZA PRIPREMU RADA | 156 |
| INSTRUCTIONS FOR AUTHORS | 158 |

*Nametnuti svoju volju drugima je nasilje,
a nametati sebe samog vrhunac je nasilja.*

Lao Ce

Uposlednje vreme teme i ideje za urednički komentar ne „manjkaju“ već, naprotiv, „izviru“ iz svakog segmenta naše svakodnevice, pa je, u stvari, jedini problem u izboru najaktueltnije. Misao velikog filozofa je mudrost za sva vremena, ali i istovremeno paradigma našeg aktuelnog trenutka, jer najbolje oslikava našu stvarnost.

Naš društveni ambijent je toliko politički unapređen da su nam „medijsko nasilje“ i svakojake nenormalnosti postali jedina realnost. U tom kontekstu kreativna i kritička misao i ideje su „izopštene“ iz sfere svekolikog životnog, socijalnog, kulturnog ali i naučnog miljea.

Naša realnost je u stvari imaginarna slika stvarnosti. U takvoj stvarnosti dominiraju laž, obmane i neistina, a „nasilje nad zdravim razumom“ se predstavlja kao demokratija. Politički uticaji sa pritiscima, partijskim vezama i nepotizmom su „najvažniji zakoni“ i u zdravstvu, i u prosveti, i u pravosuđu. Institucionalno, moralno, etičko i svako drugo posrnuće postali su standard. U vremenu proizvoljnosti, licemerja, laži i nemoralna caruju neukus, prostakluk i mediokriteti sa sumnjivom školskom spremom ili plagiranim doktoratima.

Tamo gde „ne postoji problem“ prilikom nepoštovanja zakona, tamo gde nije ništa „sporno“ ukoliko se krše moralne, etičke, kulturne, profesionalne i naučne norme (koje oblikuju normalno društvo) – siguran je put u imaginarnu budućnost. Bešašće akademske zajednice bazira na „legalizaciji nedozvoljenih radnji“ (falsifikovanje, plagiranje) i „pohvalama“ na račun skandala vezanih za polaganje male mature. Moralni sunovrat ide toliko daleko da je za lažne diplome sa nepostojećih fakulteta najvažniji parameter „problem što se proces pokreće posle 15 godina“, a ne sama suština postojanja takvih diploma. Ovako šizofrena situacija ne šalje dobru sliku mladima, koji s razlogom odlaze u zemlje sa institucionalno uređenim sistemima, gde se poštuje zakon i normalno živi.

„Pseudologija fantastika“ u glavama „preučenih“ i „sveznajućih“, koji vole jedino sebe i ne haju za „zakon“, siguran je put u „zlatno doba“ (čitaj: „bezizlaz“ i imaginarnu budućnost).

Psiholozi bi verovatno mogli objasniti koliko je smisleno verovati u iskrenost plagijatora, odnosno onih kojima je neistina najvažnija osobenost. Ali svako razume da zec ne može sačuvati šargarepu niti vuk može brinuti o ovцима.

Sloboda i hrabrost, odnosno čestitost i odgovornost pojedinaca u svakom segmentu života jedini su odgovor na svekolike izazove sadašnjeg trenutka. Do uspeha je moguće izborom pre svega kompetentnih, obrazovanih i nadasve moralnih. Jedino u okruženju sa najboljima i najsposobnijima može se sivilo „izbeliti“ i munjeviti prodror ka dnu zaustaviti.

Prof. dr Slavoljub Živković

Antibacterial activity of newly synthesized endodontic nanomaterial based on calcium aluminate

Igor Radović¹, Nikola Stojanović¹, Jelena Krunic¹, Lado Davidović¹, Jelena Lečić¹, Vukoman Jokanović², Slavoljub Živković³

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

²Vinca Institute of Nuclear Sciences, Department of Atomic Physics, Belgrade, Serbia;

³University of Belgrade, Faculty of Dental Medicine, Belgrade, Serbia

SUMMARY

Introduction Materials used for root canal obturation and root perforation are expected to have, in addition to preventing apical, lateral and coronal leakage, antimicrobial effects on microorganisms that are not accessible to chemomechanical instrumentation and intra-canal medications. The aim of this study was to evaluate the antimicrobial effect of a novel calcium aluminate-based endodontic nanostructured biomaterial (ALBO-MCCA) using agar diffusion test.

Material and methods The two materials were tested in the study. The nanostructured calcium aluminate was synthesized by the hydrothermal sol-gel method from individual components of calcium aluminate ($\text{CaO}\text{xAl}_2\text{O}_3$), calcite (CaCO_3) and barium sulfate (BaSO_4) as radiocontrast agent in the ratio of 2:2:1 according to V. Jokanovic's recipe. The other used material was calcium silicate MTA Angelus (Londrina, Brazil). The antimicrobial effect was assessed using agar diffusion test. Standard strains of *Enterococcus faecalis*, *Escherichia coli*, *Staphylococcus aureus*, cultured on blood Mueller-Hinton agar and *Candida albicans* cultivated on Sabouraud Dextrose Agar, were used as test microorganisms.

Results The best antimicrobial effect after 24 h both materials showed against *S. aureus*. The mean values of the growth inhibition zone for ALBO MCCA were 5.7 ± 0.25 mm and MTA 6.2 ± 0.4 mm. The ALBO MCCA material showed slightly stronger antibacterial effect against *E. coli* compared to MTA ($p < 0.05$), whereas none of the materials showed antibacterial effect against *E. faecalis*.

Conclusion The ALBO MCCA material showed certain antibacterial effect on *Escherichia coli*, *Staphylococcus aureus* and *Candida albicans* that was comparable to antibacterial effect of MTA.

Keywords: mineral trioxide aggregate; calcium aluminate; antimicrobial effect

INTRODUCTION

The main goal of endodontic treatment is removal of infective agents (microorganisms) from the root canal. Therapeutic procedures involving mechanical canal debridement with the use of antiseptics and topical administration of intracanal medicaments greatly reduce the number of bacteria in the root canal. However, due to complexity of root canal system, it is very difficult to remove all microorganisms with this procedure, especially from inaccessible parts and lateral canals. Infected canals are characterized by the dominance of strict anaerobic species with some facultative anaerobes and rare aerobic species [1]. Microorganisms such as *Enterococcus faecalis* and *Streptococcus* species are commonly considered responsible for the failure of endodontic treatment [2]. Due to the fact that leakage and consequent inflow of nutrient-rich fluid cannot be completely prevented by any of the materials available today, antibacterial properties of materials used in final stages of endodontic therapy are important. Therefore, materials used for permanent root canal obturation and root perforation are expected to

have, in addition to preventing apical, lateral and coronal leakage, antimicrobial effects as well.

Mineral trioxide aggregate (MTA) is the material of choice in numerous endodontic indications (retrograde root canal filling, direct pulp capping and pulpotomy, apexification and apexogenesis, lateral and inter-radicular perforation treatment). This material is characterized with optimal biocompatibility and bioactivity [3]. High pH value achieved during the set-up demonstrates potential antibacterial use of the material [4]. MTA also releases some of its components during hydration, stimulating biomineralization processes and exerting an antibacterial effect [5, 6]. However, certain disadvantages such as long setting time, difficult manipulation, tooth discoloration, release of certain toxic elements, and high market prices limit its clinical application and demand development of new materials that retain good MTA properties and overcome its existing deficiencies [3].

Use of nanoparticles has become a significant segment of material research in dentistry, with particular focus on improving mechanical properties and their antibacterial effect. In the recent years, a new nanostructured material

based on the calcium aluminate system has been synthesized at the Vinca Nuclear Research Institute. The material was obtained by hydrothermal sol-gel method and self-expanding combustion reaction. This mode of synthesis provides high particle activity, faster hydration and short setting time [7]. Calcium aluminate cements have been specifically studied for use in dentistry [8, 9, 10]. Up to date in *in vitro* studies, nanostructured calcium aluminate did not show cytotoxic and genotoxic effects in the culture of human fibroblasts MRC-5, while in an *in vivo* study in experimental animals it showed satisfactory biocompatibility [11, 12].

The aim of this study was to evaluate the antimicrobial effect of a novel calcium aluminate-based endodontic nanostructured biomaterial (ALBO-MCCA) by an agar diffusion test.

MATERIAL AND METHODS

Two materials were used in the study. The nanostructured calcium aluminate was synthesized by the hydrothermal sol-gel method from the individual components of calcium aluminate ($\text{CaO} \times \text{Al}_2\text{O}_3$), calcite (CaCO_3) and barium sulfate (BaSO_4) as a radiocontrast agent in a ratio of 2:2:1 according to V. Jokanovic's recipe. The other used material was calcium silicate MTA Angelus (Londrina, Brazil).

Antimicrobial effect was investigated by the agar diffusion test. Standard strains of *Enterococcus faecalis* (ATCC 29212), *Escherichia coli* (ATCC 25922), *Staphylococcus aureus* (ATCC 25923) and *Candida albicans* (ATCC 10231) were used as the test microorganisms. Cultures of microorganisms aged 24 h were adjusted to a McFarland density standard that corresponded to 10^6 per milliliter of microorganisms, and then seeded on appropriate substrates. *E. faecalis*, *E. coli* and *S. aureus* were cultured on Mueller-Hinton blood agar, while *C. albicans* was cultured on Sabouraud Dextrose Agar. Prior to placing the test materials, freshly seeded cultures of the microorganisms were incubated under aerobic or anaerobic conditions, respectively. The materials were mixed according to the appropriate formulations and applied on sterile paper disks in a diameter of 5 mm (6 for each material) and then placed in substrates with seeded microorganisms. The seeded plates were then left at the room temperature for 2 h to allow diffusion of the material through agar and then incubated aerobically and anaerobically, respectively, for 24 h at 37°C in a GAS-PAK ($\text{CO}_2\text{-H}_2$) system, after which the results were read. Negative controls were paper disks with no material.

Antimicrobial effect of the material was interpreted based on the growth inhibition zone diameter of the tested microorganisms expressed in millimeters. Measurements were performed on all 6 fields (3 measurements for each field). The data were processed using statistical software SPSS 20 (IBM Corp., Armonk, NY, USA). Data analysis was performed using Student's t-test.

RESULTS

The mean diameters of the microbial growth inhibition zone are shown in Figure 1. The inhibition zones were the highest for *S. aureus* after 24 h with ALBO MCCA (5.7 ± 0.25 mm) and MTA (6.2 ± 0.4 mm). The mean values of the *C. albicans* inhibition zone were measured for ALBO MCCA (4.8 ± 0.18 mm) and MTA (5.0 ± 0.35 mm), respectively. No statistically significant difference in the values between the tested materials was observed in respect to these two microorganisms. ALBO MCCA showed slightly higher antibacterial effect against *E. coli* compared to MTA ($p < 0.05$), while none of the tested materials exhibited any antibacterial effect against *E. faecalis* (Figure 1).

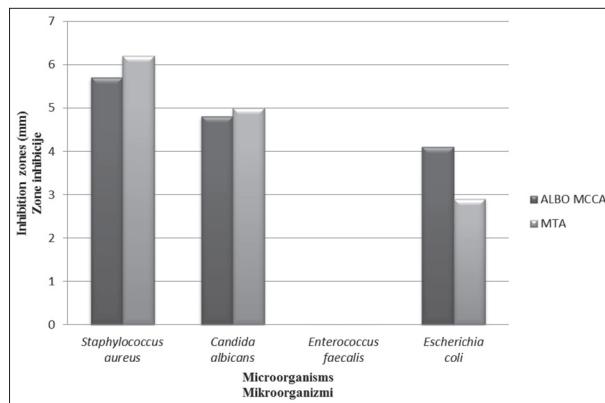


Figure 1. Mean values of microbial growth inhibition zone
Grafikon 1. Prosečne vrednosti zone inhibicije rasta mikroorganizama

DISCUSSION

Antimicrobial properties of dental materials are mainly tested in *in vitro* studies by agar diffusion test, agar dilution test and direct contact test. Agar diffusion test is the most commonly used experimental model for the evaluation of antimicrobial activity, while bacteria that are part of the infected root canal flora and present in cases of failed endodontic treatment are mainly used as a test microorganisms in endodontic research. Agar diffusion test was used to evaluate the antimicrobial activity of the tested materials, ALBO MCCA and MTA. The results obtained by this method *in vitro* in the environment can depend on a number of factors: pH, type and viscosity of the agar itself, used microorganisms and their number, incubation time, solubility of the test materials and their ability to diffuse or expand through the agar. The agar diffusion test expresses certain limitations. By this method, it is not possible to determine whether the test material exhibits bactericidal or bacteriostatic activity alone as well as the duration of the antibacterial effect. For this research, microorganisms that present integral part of the infected canal flora were selected. *Enterococcus faecalis* and *Candida albicans* are considered the most resistant microorganisms in the oral cavity and are often associated with root canal treatment failure [13, 14], while

Staphylococcus aureus is also isolated from primary and persistent secondary infection. The results of the current study showed for both tested materials that the greatest growth inhibition zones were recorded for *S. aureus*, while they showed no antimicrobial property against *E. faecalis*. Factors that could affect the antibacterial activity of both materials are baseline pH and diffusion of components and ions released into the medium [6]. High alkalinity creates an unfavourable environment for the growth of microorganisms [15], and during the hydration of MTA, released hydroxyl ions are highly reactive free radicals that together with increased pH values can cause damage to the cytoplasmic membrane and DNA of bacterial microorganisms [16].

When it comes to calcium aluminate cement, the antimicrobial effect could be due to both Ca^{2+} ions and Al^{3+} oxide nanoparticles. These nanoparticles, as positively charged ions, can bind to negatively charged bacterial cell walls and reduce cell viability. Mukherjee et al. pointed out that aluminum oxide nanoparticles could exert an inhibitory effect against *E. coli*. The same authors state that SEM analyzes have shown after the interaction of *E. coli*, *Pseudomonas aeruginosa* and *Bacillus subtilis* cells with aluminum nanoparticles, there is a change in cell morphology, and its distortion [17]. In a study by Sadiq et al. aluminum oxide nanoparticles exhibited mild antimicrobial activity against *E. coli* [18]. In a recent study, Manyasree et al. investigated the antibacterial effect of alumina nanoparticles on *E. coli*, *Proteus vulgaris*, *Staphylococcus aureus* and *Streptococcus mutans* with a minimum inhibitory concentration test. It was observed that with successful increase in the concentration of nanoparticles (10-50mg / ml), the antibacterial effect against all tested microorganisms increased as well [19]. However, the influence of calcium aluminate cement components on antimicrobial activity needs to be investigated in further studies. On the other hand, one of the factors that could limit the antibacterial activity of the tested materials is that they are cements in composition; consequently their binding makes their diffusion through the medium difficult. Absence of antibacterial effect of both materials against *E. faecalis* in our study may be explained by the fact that this microorganism is highly resistant to high pH and its elimination requires pH greater than 11.5. The main *E. faecalis* defense mechanism is a proton pump located in the cell membrane. By acidification of the cytoplasm, the proton pump maintains the pH in the physiological range and thus allows the enzymes and proteins to function normally in the cell [14]. Similar to our study, the findings of Torabinejad et al. and Estrela et al. also confirmed the absence of the antibacterial action of MTA against *E. faecalis* [3, 20]. Contrary to these claims, Lovato and Sedgley concluded that MTA exerted an antimicrobial effect against the clinical isolate of *E. faecalis* [21]. Miyagak et al. have shown that MTA and Portland cement did not exert an antimicrobial effect against *C. albicans*, *S. aureus*, and *E. coli*, which contradicts the results of our study [22]. In the study by Ribeiro et al. MTA also showed no inhibitory activity against *E. faecalis* and *E. coli* [23].

Numbers of other studies have shown contradictory results when it comes to MTA antimicrobial effect. Tanomaru-Filho et al. have shown that MTA-based materials exhibit antimicrobial activity against *S. aureus* and *E. faecalis* [4]. Similarly, in the study of Demiryürek et al. MTA Angelus exerted antimicrobial effect against *E. faecalis* and *C. albicans* [24]. MTA and novel endodontic nanostructured nanomaterials based on highly active calcium silicates exerted an antibacterial effect against *E. faecalis* and *S. aureus* [25]. Al-Hezaimi et al. examined the antifungal effect of different concentrations of two MTA commercial variants (white and gray) on *C. albicans*. The results of the agar diffusion assay showed that the concentration of the material significantly contributed to MTA antifungal activity. At 25 mg/mL and 50 mg / mL concentrations, both MTA variants exhibited antifungal activity, which was not the case when the material concentration was below 25 mg/mL [26]. In the study by Kim et al. MTA Angelus exerted antimicrobial activity on *S. mutans*, *Lactobacillus rhamnosus*, *Lactobacillus paracasei* and *Porphyromonas gingivalis*, with no inhibitory effect on *E. faecalis* [15]. Özürek and Demiryürek, by examining the antimicrobial activity of MTA Angelus against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *E. coli* and *Enterococcus faecium*, concluded that this material exhibits antimicrobial activity against all tested microorganisms [27]. Different results about MTA antibacterial property in the studies are attributed to different strains of tested microorganisms, the concentration and type of used MTA, as well as the methodological protocol itself. Some authors recommend the use of chlorhexidine instead of distilled water to improve the antimicrobial properties of MTA [28]. In the study of Holt et al., mixing MTA powder with 2% chlorhexidine gluconate contributed to an increase in the antibacterial effect against *E. faecalis* [29].

Calcium aluminate belongs to the new group of endodontic materials and available literature provides little information on its antimicrobial activity. In the study by Silva et al. calcium aluminate cement (EndoBinder) and MTA exhibited antimicrobial activity against all three tested microorganisms (*Staphylococcus aureus*, *Enterococcus faecalis* and *Candida albicans*) by agar diffusion test after 24 h and 48 h [10]. In a similar study, Pires-de-Souza et al. investigated antimicrobial effect of MTA and calcium aluminate cement EndoBinder with different radiocontrast agents (bismuth oxide, zirconium oxide and zinc oxide). Their results showed that MTA exerted better antibacterial effect against *S. aureus* over all calcium aluminate formulations. The zones of inhibition against *C. albicans*, *E. coli* and *E. faecalis* were not statistically significant between MTA and calcium aluminate powder or bismuth oxide formulation. Calcium aluminate with zirconium oxide and zinc oxide did not exert an antimicrobial effect on the three mentioned microorganisms. The authors of the study attributed the antimicrobial activity of EndoBinder to calcium aluminate hydrate breakdown formed during hydration and release of calcium and hydroxyl ions. The absence of antimicrobial effect in some calcium aluminate formulations has been attributed to radiocontrast

components that are not inert but can modify hydration processes, reducing the release of calcium ions and affecting the individual physicochemical properties of the material [30].

CONCLUSION

ALBO MCCA material showed certain antibacterial effect against *Escherichia coli* ATCC 25922, *Staphylococcus aureus* ATCC 25923 and *Candida albicans* ATCC 10231 that is comparable to the antibacterial effect of MTA.

REFERENCES

- Walton RE, Rivera E. Cleaning and shaping. In: Walton RE, Torabinejad M. Principles and Practice of Endodontics. 2nd ed. Philadelphia: WB Saunders; 1996. p. 201-33.
- Peculiene V, Reynaud AH, Balciuniene I, Haapasalo M. Isolation of yeasts and enteric bacteria in root-filled teeth with chronic apical periodontitis. *Int Endod J.* 2001; 34(6): 429-34. [PMID: 11556508]
- Parirokh M, Torabinejad M. Mineral trioxide aggregate: A comprehensive literature review-part III: Clinical applications, drawbacks and mechanism of action. *J Endod.* 2010; 36:400-13. [DOI: 10.1016/j.joen.2009.09.009] [PMID: 20171353]
- Tanomaru-Filho M, Tanomaru JM, Barros DB, Watanabe E, Ito IY. *In vitro* antimicrobial activity of endodontic sealers, MTA-based cements and Portland cement. *J Oral Sci.* 2007; 49:41-5. [PMID: 17429181]
- Akbari M, Zebarjad SM, Nategh B, Rouhani A. Effect of nano silica on setting time and physical properties of mineral trioxide aggregate. *J Endod.* 2013; 39(11):1448-51. [DOI: 10.1016/j.joen.2013.06.035] [PMID: 24139272]
- Al-Nazhan S, Al-Judai A. Evaluation of antifungal activity of mineral trioxide aggregate. *J Endod.* 2003; 29:826-7. [DOI: 10.1097/00004770-200312000-00010] [PMID: 14686815]
- Jokanovic V, Colovic B, Mitric M, Markovic D, Cetenovic B. Synthesis and properties of a new endodontic material based on nanostructured highly active calcium-silicates and calcium carbonates. *Int J Applied Ceram Tech.* 2014; 11:57-64. [DOI: 10.1111/ijac.12070]
- Garcia Lda F, Huck C, Menezes de Oliveira L, de Souza PP, de Souza Costa CA. Biocompatibility of new calcium aluminate cement: tissue reaction and expression of inflammatory mediators and cytokines. *J Endod.* 2014; 40(12):2024-9. [DOI: 10.1016/j.joen.2014.08.015] [PMID: 25266467]
- Garcia Lda F, Huck C, Scardueli CR, de Souza Costa CA. Repair of bone defects filled with new calcium aluminate cement (Endobinder). *J Endod.* 2015; 41:864-70. [DOI: 10.1016/j.joen.2014.12.029] [PMID: 25720982]
- Silva EJ, Herrera DR, Rosa TP, Duque TM, Jacinto RC, Gomes BP, et al. Evaluation of cytotoxicity, antimicrobial activity and physicochemical properties of a calcium aluminate-based endodontic material. *J Appl Oral Sci.* 2014; 22:61-7. [DOI: 10.1590/1678-775720130031] [PMID: 24626250]
- Čolović B, Janković O, Živković S, Žižak Ž, Besu Žižak I, Jokanović V. A new endodontic mixture based on calcium aluminate cement obtained by hydrothermal synthesis. *Ceram Int.* 2019; 45(7):9211-8. [DOI: 10.1016/j.ceramint.2019.01.266]
- Paraš S, Janković O, Trišić D, Čolović B, Mitrović-Ajić O, Dekić R, et al. Influence of nanostructured calcium aluminate and calcium silicate on the liver: histological and unbiased stereological analysis. *Int Endod J.* 2019; 52(8):1162-72. [DOI: 10.1111/iej.13105]
- Gomes BP, Lilley JD, Drucker DB. Associations of endodontic symptoms and signs with particular combinations of specific bacteria. *Int Endod J.* 1996; 29(2):69-75. [PMID: 9206427]
- Stuart CH, Schwartz SA, Beeson TJ, Owatz CB. *Enterococcus faecalis*: its role in root canal treatment failure and current concepts in retreatment. *J Endod.* 2006; 32(2):93-8. [DOI: 10.1016/j.joen.2005.10.049] [PMID: 16427453]
- Kim RJ, Kim MO, Lee KS, Lee DY, Shin JH. An *in vitro* evaluation of the antibacterial properties of three mineral trioxide aggregate (MTA) against five oral bacteria. *Arch Oral Biol.* 2015; 60(10):1497-502. [DOI: 10.1016/j.joen.2005.10.049] [PMID: 16427453]
- Mohammadi Z, Dummer PM. Properties and applications of calcium hydroxide in endodontics and dental traumatology. *Int Endod J.* 2011; 44(8):697-730. [DOI: 10.1111/j.1365-2591.2011.01886.x] [PMID: 21535021]
- Mukherjee A, Prathna TC, Chandrasekaran N. Antimicrobial activity of aluminium oxide nanoparticles for potential clinical applications. *Formatec Res Center* 2012; 1:245-51.
- Sadiq IM, Chowdhury B, Chandrasekaran N, Mukherjee A. Antimicrobial sensitivity of *Escherichia coli* to alumina nanoparticles. *Nanomedicine* 2009; 5(3):282-6. [DOI: 10.1016/j.nano.2009.01.002] [PMID: 19523429]
- Manyasree D, Kiranmayi P, Ravi Kumar RVSSN. Synthesis, characterization and antibacterial activity of aluminium oxide nanoparticles. *Int J Pharm Pharm Sci.* 2018; 10(1):32-5. [DOI: 10.22159/ijpps.2018v10i1.20636]
- Estrela C, Bammann LL, Estrela C, Silva RS, Pécora JD. Antimicrobial and chemical study of MTA, Portland cement, calcium hydroxide paste, Sealapex and Dycal. *Braz Dent J.* 2000; 11:3-9. [PMID: 11210272]
- Lovato KF, Sedgley CM. Antibacterial activity of endosequence root repair material and proroot MTA against clinical isolates of *Enterococcus faecalis*. *J Endod.* 2011; 37(11):1542-6. [DOI: 10.1016/j.joen.2011.06.022] [PMID: 22000459]
- Miyagak DC, de Carvalho EM, Robazza CR, Chavasco JK, Levorato GL. *In vitro* evaluation of the antimicrobial activity of endodontic sealers. *Braz Oral Res.* 2006; 20(4):303-6. [PMID: 17242789]
- Ribeiro CS, Kuteken FA, Hirata Júnior R, Scelza MF. Comparative evaluation of antimicrobial action of MTA, calcium hydroxide and Portland cement. *J Appl Oral Sci.* 2006; 14(5):330-3. [DOI: 10.1590/s1678-77572006000500006] [PMID: 19089053]
- Demiryürek EÖ, Özyürek T, Gülgün T, Keskin C. Evaluation of antibacterial and antifungal activity of calcium silicate based retrograde filling materials. *Int J Applied Dent Sci.* 2016; 2(2):85-8.
- Trisić D, Ćetenovic B, Zdravković N, Marković T, Dojcinović B, Jovanović V, et al. Antibacterial effects of new endodontic materials based on calcium silicates. *Vojnosanitetski pregled.* 2019; 76(4):365-72. [DOI: 10.2298/VSP161231130T] (in press).
- Al-Hezaimi K, Naghshbandi J, Oglesby S, Simon JH, Rotstein I. Comparison of antifungal activity of white-colored and gray-colored mineral trioxide aggregate (MTA) at similar concentrations against *Candida albicans*. *J Endod.* 2006; 32:365-7. [DOI: 10.1016/j.joen.2005.08.014] [PMID: 16554214]
- Özyürek T, Demiryürek EÖ. Comparison of the antimicrobial activity of direct pulp-capping materials: Mineral trioxide aggregate-Angelus and Biodentine. *J Conserv Dent.* 2016; 19(6):569-72. [DOI: 10.4103/0972-0707.194018] [PMID: 27994321]
- Stowe TJ, Sedgley CM, Stowe B, Fenno JC. The effects of chlorhexidine gluconate (0.12%) on the antimicrobial properties of tooth-colored ProRoot mineral trioxide aggregate. *J Endod.* 2004; 30:429-31. [PMID: 15167473]
- Holt DM, Watts JD, Beeson TJ, Kirkpatrick TC, Rutledge RE. The anti-microbial effect against *Enterococcus faecalis* and the compressive strength of two types of mineral trioxide aggregate mixed with sterile water or 2% chlorhexidine liquid. *J Endod.* 2007; 33(7):844-7. [DOI: 10.1016/j.joen.2007.04.006] [PMID: 17804326]
- Pires-de-Souza Fde C, Moraes PC, Garcia Lda F, Aguilar FG, Watanabe E. Evaluation of pH, calcium ion release and antimicrobial activity of a new calcium aluminate cement. *Braz Oral Res.* 2013; 27(4):324-30. [PMID: 23903862]

Antimikrobnna aktivnost novosintetisanog endodontskog nanomaterijala na bazi kalcijum-aluminata

Igor Radović¹, Nikola Stojanović¹, Jelena Krunić¹, Lado Davidović¹, Jelena Lečić¹, Vukoman Jokanović², Slavoljub Živković³

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

²Institut za nuklearne nauke „Vinča“, Laboratorija za atomsku fiziku, Beograd, Srbija;

³Univerzitet u Beogradu, Stomatološki fakultet, Beograd, Srbija

KRATAK SADRŽAJ

Uvod Od materijala koji se koriste za opturaciju kanala korena i perforacija na korenju se očekuje da pored sprečavanja apikalnog, lateralnog i koronarnog curenja, poseduju i antimikrobnno delovanje na mikroorganizme, koji nisu dostupni hemomehaničkoj obradi i intrakanalnim medikamentima. Cilj ovog istraživanja je bio da se testom difuzije u agaru proceni antimikrobnii efekat novog endodontskog nanostruktornog biomaterijala na bazi kalcijum-aluminata (ALBO-MCCA).

Materijal i metode U istraživanju su korišćena dva materijala. Nanostruktturni kalcijum-aluminat je sintetisan hidrotermalnom sol-gel metodom od pojedinačnih komponenata kalcijum-aluminata ($\text{CaO}\text{-}\text{Al}_2\text{O}_3$), kalcita (CaCO_3) i barijum-sulfata (BaSO_4) kao rendgen-kontrastnog sredstva u odnosu 2 : 2 : 1 prema recepturi V. Jokanovića. Drugi korišćeni materijal je kalcijum-silikatni MTA Angelus (Londrina, Brazil). Antimikrobnii efekat je ispitivan testom difuzije u agaru. Kao test mikroorganizmi korišćeni su standarni sojevi *Enterococcus faecalis*, *Escherichia coli*, *Staphylococcus aureus*, koji su kultivisani na krvnom agaru MuellerHinton, dok je *C. albicans* kultivisana na agaru Sabouraud Dextrose.

Rezultati Najbolji antimikrobnii efekat nakon 24 h oba materijala su pokazala prema bakteriji *S. aureus*. Izmerene prosečne vrednosti zone inhibicije rasta iznosile su kod ALBO-MCCA ($5,7 \pm 0,25$ mm), odnosno kod MTA ($6,2 \pm 0,4$ mm). Materijal ALBO-MCCA je pokazao nešto veći antibakterijski efekat prema bakteriji *E. coli* u odnosu na MTA ($p < 0,05$), dok prema bakteriji *E. faecalis* nijedan materijal nije ispoljio antibakterijski efekat.

Zaključak Materijal ALBO-MCCA je ispoljio određeni antibakterijski efekat na bakterije *Escherichia coli*, *Staphylococcus aureus* i *Candida albicans* komparabilan sa antibakterijskim efektom MTA.

Ključne reči: mineral-trioksidni agregat, kalcijum-aluminat, antimikrobnii efekat

UVOD

Osnovni cilj endodontske terapije jeste uklanjanje uzročnika infekcije, odnosno mikroorganizama iz kanala korena. Terapijski postupci koji uključuju mehaničku obradu kanala uz primenu antisceptika i lokalnu primenu interseansnih medikamenata u velikoj meri smanjuju broj bakterija u kanalu korena. Međutim, zbog kompleksne anatomije kanalnog sistema ovim postupkom je veoma teško ukloniti sve mikroorganizme, pogotovo iz nepristupačnih delova i lateralnih kanala. Inficirane kanale odlikuje dominacija striktnih anaerobnih vrsta sa ponekim fakultativnim anaerobima i retkim aerobnim vrstama [1]. Mikroorganizmi, kao što su vrste *Enterococcus faecalis* i *Streptococcus*, najčešće se smatraju odgovornima za neuspeh endodontskog lečenja [2]. S obzirom na to da se mikrourenje i posledični dotok fluida bogatog hranljivim sastojcima ne mogu apsolutno sprečiti nijednim danas dostupnim materijalom, antibakterijsko svojstvo materijala koji se koriste u pojedinim završnim fazama endodontske terapije bi donekle moglo kompenzovati ovaj nedostatak. Tako se od materijala koji se koriste za trajnu opturaciju kanala korena i perforacija na korenju očekuje da pored sprečavanja apikalnog, lateralnog i koronarnog curenja, poseduju i antimikrobnno delovanje na preostale mikroorganizme, koji nisu bili dostupni hemomehaničkoj obradi i intrakanalnim medikamentima.

Mineral-trioksidni agregat (MTA) danas je materijal izbora u brojnim endodontskim indikacijama (retrogradno punjenje kanala korena, direktno prekrivanje pulpe i pulpotorija, apeksifikacija i apeksogeneza zuba, terapija lateralnih i interradikslnih perforacija korena). Ovaj materijal odlikuje optimalna biokompatibilnost i bioaktivnost [3]. Visoka pH vrednost postignuta tokom postavljanja ukazuje na moguće antibakterijsko delovanje

materijala [4]. MTA takođe otpušta neke od svojih komponenata tokom hidratacije, čime podstiče procese biominerizacije i ispoljava antibakterijski efekat [5, 6]. Međutim, određeni nedostaci, kao što su dugo vreme vezivanja, otežana manipulacija, prebojavanje zuba, oslobađanje pojedinih toksičnih elemenata i visoka cena na tržištu, ograničavaju njegovu kliničku primenu i uslovjavaju potrebu za razvojem novih materijala kojima bi se sačuvale dobre osobine MTA, a prevazišli postojeći nedostaci [3].

Upotreba nanočestica je postala značajan segment istraživanja materijala u stomatologiji, sa posebnim akcentom na poboljšanju mehaničkih osobina i njihovog antibakterijskog efekta. Poslednjih godina na Institutu za nuklearna istraživanja u Vinči je sintetisan novi nanostruktturni materijal na bazi kalcijum-aluminatnog sistema dobijen hidrotermalnom sol-gel metodom i samoširećom reakcijom sagorevanja. Ovakav način sinteze obezbeđuje visoku aktivnost čestica, bržu hidrataciju i kratko vreme vezivanja [7]. Kalcijum-aluminatni cementi su posebno proučavani za upotrebu u stomatologiji [8, 9, 10]. U dosadašnjim ispitivanjima u *in vitro* uslovima nanostruktturni kalcijum-aluminat nije ispoljio citotocični i genotoksični efekat u kulturi humanih fibroblasta pluća MRC-5, dok je u *in vivo* studiji na eksperimentalnim životinjama pokazao dobru biokompatibilnost [11, 12].

Cilj ovog istraživanja je bio da se testom difuzije u agaru proceni antimikrobnii efekat novog endodontskog nanostruktornog biomaterijala na bazi kalcijum-aluminata (ALBO-MCCA).

MATERIJAL I METODE

U istraživanju su korišćena dva materijala. Nanostruktturni kalcijum-aluminat je sintetisan hidrotermalnom sol-gel metodom

od pojedinačnih komponenata kalcijum-aluminata ($\text{CaO}\cdot\text{Al}_2\text{O}_3$), kalcita (CaCO_3) i barijum-sulfata (BaSO_4) kao rendgen-kontrastnog sredstva u odnosu 2 : 2 : 1 prema recepturi V. Jokanovića. Drugi korišćeni materijal je kalcijum-silikatni MTA Angelus (Londrina, Brazil).

Antimikrobnii efekat je ispitivan testom difuzije u agaru. Kao test-mikroorganizmi korišćeni su standardni sojevi *Enterococcus faecalis* ATCC 29212, *Escherichia coli* ATCC 25922, *Staphylococcus aureus* ATCC 25923 i *Candida albicans* ATCC 10231. Kulture mikroorganizama stare 24 h su podešavane na gustinu Mekfarlandovog (McFarland) standarda koji je odgovarao broju od 10^6 po mililitru mikroorganizama, a zatim su zasejane na odgovarajuće podloge. *E. faecalis*, *E. coli* i *S. aureus* su kultivisani na krvnom MuellerHinton agaru, dok je *C. albicans* kultivisana na agaru Sabouraud Dextrose. Pre postavljanja ispitivanih materijala sveže zasejane kulture mikroorganizama su inkubirane pod aerobnim odnosno anaerobnim uslovima. Materijali su zamešani po odgovarajućim recepturama i naneseni na sterilne papirne diskove prečnika 5 mm (po šest za svaki materijal), a zatim postavljeni u podloge sa zasejanim mikroorganizmima. Zasejane ploče su potom ostavljene na sobnoj temperaturi u trajanju od 2 h kako bi se omogućila difuzija materijala kroz agar, a zatim inkubirane aerobno, odnosno anaerobno tokom 24 h na 37°C u GASPAC(CO_2H_2)sistemu, nakon čega su ocitavani rezultati. Negativnu kontrolu činili su papirni diskovi bez materijala.

Antimikrobnii efekat materijala je tumačen na osnovu prečnika zone inhibicije rasta testiranih mikroorganizama, izraženog u milimetrima. Merenja su obavljena na svih šest polja (po tri merenja za svako polje). Za antimikrobnii efekat testiranih materijala uzimana je srednja vrednost izmerenih zona inhibicije rasta testiranih mikroorganizama. Statistička obrada podataka urađena je u programu SPSS 20.0 (IBM Corp., Armonk, NY, USA), a dobijeni rezultati su obrađeni Studentovim t-testom.

REZULTATI

Rezultati ispitivanja antibakterijskog efekta materijala, odnosno srednje vrednosti prečnika zone inhibicije rasta mikroorganizama, prikazani su na Grafikonu 1. Zone inhibicije su bile najveće za *S. aureus* nakon 24 h i kod ALBO-MCCA ($5,7 \pm 0,25$ mm) i kod MTA ($6,2 \pm 0,4$ mm). Izmerene srednje vrednosti zone inhibicije prema bakteriji *C. albicans* iznosile su $4,8 \pm 0,18$ mm za ALBO-MCCA, odnosno $5 \pm 0,35$ mm za MTA. Nije uočena statistički značajna razlika u vrednostima između testiranih materijala u odnosu na ova dva mikroorganizma.

Materijal ALBO-MCCA je pokazao nešto veći antibakterijski efekat prema *E. coli* u odnosu na MTA ($p < 0,05$), dok prema bakteriji *E. faecalis* nijedan materijal nije ispoljio antibakterijski efekat (Grafikon 1).

DISKUSIJA

Antimikrobnii svojstva stomatoloških materijala uglavnom se ispituju u *in vitro* studijama, testom difuzije u agaru, testom dilucije agara i direktnim kontakt-testom. Test difuzije u agaru je najčešće korišćeni eksperimentalni model za procenu antimikrobnii aktivnosti, a kao test mikroorganizmi u endodonciji

uglavnom se koriste bakterije koje su sastavni deo flore inficiranog kanala korena zuba i koji su prisutni u slučajevima neuspelog endodontskog lečenja. Za ispitivanje antimikrobnii aktivnosti testiranih materijala ALBO-MCCA i MTA korišćen je test difuzije u agaru. Rezultati dobijeni ovim metodom u *in vitro* uslovima mogu zavisiti od niza faktora: pH, tipa i viskoznosti samog agaru, korišćenih mikroorganizama i njihovog broja, vremena inkubacije, zatim rastvorljivosti ispitivanih materijala i mogućnosti difuzije odnosno širenja istih kroz agar. Test difuzije u agaru ima i određena ograničenja. Ovom metodom nije moguće utvrditi da li ispitivani materijal ispoljava baktericidno ili samo bakteriostatsko delovanje, kao i kolika je dužina trajanja antibakterijskog efekta. Za ovo istraživanje odabrani su mikroorganizmi koji su sastavni deo flore inficiranog kanala. *Enterococcus faecalis* i *Candida albicans* se smatraju najotpornijim mikroorganizmima u usnoj dupli i često su povezani sa neuspeshom lečenja kanala korena [13, 14], a *Staphylococcus aureus* je takođe izolovan iz primarne i uporne sekundarne infekcije. Rezultati ovog istraživanja su pokazali da su kod oba testirana materijala najveće zone inhibicije rasta zabeležene prema bakteriji *S. aureus*, dok prema bakteriji *E. faecalis* nisu ispoljili antimikrobnii svojstvo. Faktori koji bi mogli uticati na antibakterijsku aktivnost oba materijala su bazne vrednosti pH i difuzija komponenata i jona koji se oslobođaju u medijum [6]. Visoka alkalnost stvara nepovoljnu sredinu za rast mikroorganizama [15], a u toku hidratacije MTA dolazi do oslobođanja hidroksilnih jona, koji kao visoko reaktivni slobodni radikalni zajedno sa povećanim pH vrednostima mogu prouzrokovati oštećenje citoplazmatske membrane i DNK bakterijskih mikroorganizama [16].

Kada je u pitanju kalcijum-aluminatni cement, antimikrobnii efekat bi mogao biti uslovlen i ionima Ca^{2+} i nanočesticama oksida Al^{3+} . Ove nanočestice, kao pozitivno nanelektrisani joni, mogu da se vežu za negativno nanelektrisane zidove bakterijskih ćelija i smanje vijabilnost ćelija. Mukherjee i sar. ističu da nanočestice aluminijsko-oksida mogu ispoljiti inhibitori efekat prema bakteriji *E. coli*. Isti autori navode da su SEM analize pokazale da nakon interakcije ćelija *E. coli*, *Pseudomonas aeruginosa* i *Bacillus subtilis* sa nanočesticama aluminijsuma dolazi do promena u morfologiji ćelija, odnosno do njihove izobličenosti [17]. U studiji Sadiqa i sar. nanočestice aluminijsko-oksida su ispoljile blagu antimikrobnii aktivnost prema *E. coli* [18]. U nedavnoj studiji Manyasree i sar. su ispitivali antibakterijski efekat nanočestica alumina na *E. coli*, *Proteus vulgaris*, *Staphylococcus aureus* i *Streptococcus mutans*, testom minimalno inhibitorne koncentracije. Uočeno je da je sa sukcesivnim porastom koncentracije nanočestica (10–50 mg/ml) rastao i antibakterijski efekat prema svim testiranim mikroorganizmima [19]. Ipak, uticaj samih komponenata kalcijum-aluminatnog cementa na antimikrobnii aktivnost potrebno je ispitati u daljim istraživanjima. S druge strane, jedan od faktora koji bi mogao ograničiti antibakterijsku aktivnost testiranih materijala je to što su oni po sastavu cementi, pa je njihovim vezivanjem otežana difuzija kroz medijum. Izostanak antibakterijskog efekta oba materijala prema mikroorganizmu *E. faecalis* u našem istraživanju mogao bi se objasniti činjenicom da je ovaj mikroorganizam jako rezistentan na visok pH i da su za njegovu eliminaciju potrebne vrednosti pH veće od 11,5. Glavni odbrambeni mehanizam mikroorganizma *E. faecalis* je protonска pumpa bakterijske ćelije koja se nalazi u ćelijskoj membrani. Acidifikacijom ci-

toplazme protonска pumpa održava pH u fiziološkom opsegu i na taj način omogućava normalno funkcionisanje enzima i proteina u ćeliji [14]. Slično našem istraživanju, *Torabinejad* i sar. i *Estrela* i sar. takođe potvrđuju odsustvo antibakterijskog delovanja MTA prema mikroorganizmu *E. faecalis* [3, 20]. Suprotno ovim navodima, *Lovato* i *Sedgley* su zaključili da je MTA ispoljio antimikrobni efekat prema kliničkom izolatu *E. faecalis* [21]. *Miyagak* i sar. su pokazali da MTA i Portland cement ne ispoljavaju antimikrobni efekat prema bakterijama *C. albicans*, *S. aureus* i *E. coli*, što je u suprotnosti sa rezultatima našeg istraživanja [22]. *Ribeiro* i sar. su u studiji ukazali na to da MTA takođe nije ispoljio inhibitorno delovanje prema bakterijama *E. faecalis* i *E. coli* [23].

Oprečnost rezultata kada je u pitanju antimikrobni efekat MTA pokazale su brojne druge studije. *Tanomaru-Filho* i sar. su pokazali da materijali bazirani na MTA ispoljavaju antimikrobnu aktivnost prema bakterijama *S. aureus* i *E. faecalis* [4]. Slično i u studiji *Demiryürek* i sar., MTA Angelus je ispoljio antimikrobni efekat prema bakterijama *E. faecalis* i *C. albicans* [24]. MTA i novi endodontski nanostrukturalni nanomaterijali na bazi visoko aktivnih kalcijum-silikata ispoljili su antibakterijski efekat prema bakterijama *E. faecalis* i *S. aureus* [25]. *Al-Hezaimi* i sar. su ispitivali antimikotični efekat različitih koncentracija dve komercijalne varijante MTA (bela i siva) na *C. albicans*. Rezultati agar difuzionog testa su pokazali da koncentracija materijala značajno doprinosi antimikotičnoj aktivnosti MTA. U koncentracijama od 25 mg/mL i 50 mg/mL obe varijante MTA su ispoljile antimikotičnu aktivnost, što nije bio slučaj kada je koncentracija materijala bila ispod 25 mg/mL [26]. U istraživanju *Kima* i sar. MTA Angelus je ispoljio antimikrobnu aktivnost na *S. mutans*, *Lactobacillus rhamnosus*, *Lactobacillus paracasei* i *Porphyromonas gingivalis*, dok je izostao inhibitorni efekat na *E. faecalis* [15]. *Özyürek* i *Demiryürek* su ispitujući antimikrobnu aktivnost MTA Angelusa prema mikroorganizmima *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *E. coli* i *Enterococcus faecium*, zaključili da ovaj materijal ispoljava antimikrobro dejstvo prema svim testiranim mikroorganizmima [27]. Različiti rezultati antibakterijskog svojstva MTA u studijama pripisuju se različitim testiranim sojevima mikroorganizama, koncentraciji i tipu MTA koji se koristio, kao i samom metodološkom

protokolu. Pojedini autori preporučuju upotrebu hlorheksidina umesto destilovane vode kako bi se poboljšala antimikrobra svojstva MTA [28]. U studiji *Holta* i sar. mešanje praha MTA sa 2% hlorheksidin-glukonatomom doprinelo je povećanju antibakterijskog efekta protiv bakterije *E. faecalis* [29].

Kalcijum-aluminat pripada novoj grupi endodontskih materijala i u dostupnoj literaturi malo je podataka o njegovom antimikrobnom delovanju. *Silva* i sar. su u svojoj studiji ukazali na to da su kalcijum-aluminatni cement (EndoBinder) i MTA ispoljili antimikrobnu aktivnost prema sva tri testirana mikroorganizma (*Staphylococcus aureus*, *Enterococcus faecalis* i *Candida albicans*) testom difuzije u agaru nakon 24 h i 48 h [10]. U sličnoj studiji *Pires-de-Souza* i sar. su ispitivali antimikrobi efekat MTA i kalcijum-aluminatnog cementa EndoBindera sa različitim rendgen-kontrasnim sredstvima (bizmut-oksid, cirkonijum-oksid i cink-oksid). Njihovi rezultati pokazali su da je MTA ispoljio bolji antibakterijski efekat u odnosu na sve kalcijum-aluminatne formulacije prema mikroorganizmu *S. aureus*. Zone inhibicije prema mikroorganizmima *C. albicans*, *E. coli* i *E. faecalis* nisu bile statistički značajne između MTA i kalcijum-aluminatnog praha, odnosno formulacije sa bizmut-oksidom. Na pomenuta tri mikroorganizma kalcijum-aluminat sa cirkonijum-oksidom i cink-oksidom nije ispoljio antimikrobi efekat. Antimikrobnu aktivnost EndoBindera autori studije pripisuju razgradnji kalcijum-aluminatnog hidrata formiranog tokom hidratacije, pri čemu dolazi do oslobađanja kalcijuma i hidroksilnih jona. Odsustvo antimikrobnog efekta kod pojedinih formulacija kalcijum-aluminata autori su pripisali rendgen-kontrastnim komponentama koje se ne ponašaju inertno, već mogu modifikovati procese hidratacije, smanjujući oslobađanje jona kalcijuma i uticati na pojedine fizičko-hemijske osobine materijala [30].

ZAKLJUČAK

Materijal ALBO-MCCA je ispoljio određeni antibakterijski efekat na bakterije *Escherichia coli* ATCC 25922, *Staphylococcus aureus* ATCC 25923 i *Candida albicans* ATCC 10231 komparabilan sa antibakterijskim efektom MTA.

Oral health behavior and oral hygiene habits of elderly population in Podgorica, Montenegro

Zorica Popović, Mirjana Đuričković

University of Montenegro, Faculty of Medicine in Podgorica, Department of Dentistry, Podgorica, Montenegro

SUMMARY

Introduction An increase in the number of elderly users of dental services is expected in the future. The aim of the study was to examine the oral health behaviour and oral hygiene habits of the elderly population in Podgorica, Montenegro.

Materials and methods The study used a 21 closed-end question questionnaire, prepared in accordance with the recommendations of the World Health Organization. Using standard statistical methods, χ^2 test was performed ($p = 0.05$).

Results The average age of subjects was 71 ± 6.35 . 40.0% of population was edentulous; 81.90% had some kind of dentures; last visit to the dentist was less than a year ago in 25.7% and more than five years ago in 27.6%. Higher educated population had regular dental check-ups ($\chi^2 = 47.178$; $p < 0.001$). The reason for dental visit was most commonly pain or other mouth discomfort, teeth or dentures in 59.0%. 33.3% of examined population reported fear of dental interventions as the reason for the lack of dental care. 16.2% reported high cost of dental services as reason for avoiding dentist. 41.0% of population used tobacco products and 21.0% alcoholic beverages. Less than half of population (40.0%) had regular dentist. 41% of population brushed teeth and dentures three times a day, oral hygiene aids use was noted in 35.6% while 50% used denture-cleaning tablets.

Conclusion Oral health behaviour and oral hygiene habits of the elderly in Podgorica are not satisfactory. Since elderly are mostly in need of prosthetic treatment it is important to improve dental-prosthetic care in the state health care system.

Keywords: elderly; oral health; oral health behaviour; hygiene habits

INTRODUCTION

Demographic indicators point to the fact that Europe is aging rapidly. By 2060, the average European Union (EU) citizen will be 47.2 years old and there will be around 30% of 65 years old people in the EU (16% in 2010) [1]. Data from the Statistical Office of Montenegro (Monstat) also indicates a decades-long trend of population aging [2]. The percentage of over 65 years old increased from 10% (1953) to 18.3% (2011). Today, one fifth of Montenegro's population is over 65 years old. In the future, we will have significantly higher number of elderly users of dental services, which directly affects health costs and becomes a key public health problem, even in more developed countries [3].

About 30% of people in the world between the age of 65 and 74 no longer have their natural teeth [4]. Jandial et al. [5] reported that with increasing age, there are more partially edentulous people followed by completely edentulous as early as 45 years of age. They also point out the effect of missing teeth on mouth, general health, and quality of life and emphasize the importance of replacing missing teeth in a timely manner.

Among the basic guidelines of the World Health Organization (WHO) for improving oral health [6], points three and four discuss: the need for countries to develop oral health systems in accordance with the needs of users and their financial capacity; on the need to integrate oral health into national health programs with a strong need to

address health literacy of the population. The key to success lies in prevention and creation of an individual who is consciously aware. Preventive programs do not always deliver expected results due to inadequate level of health literacy of the population [7]. Health literacy is the ability to read, understand and properly use information, instructions and guidelines related to one's health [8]. Its definition refers to the three steps in its development (functional, interactive and critical) [9] and its level is not necessarily proportional to the level of formal education, as an individual may have a high level of formal education but a lack of awareness of the importance of his or her health [10].

Oral health literacy includes: knowledge and implementation of oral hygiene measures; identifying risk factors that affect oral health; awareness of the link between general and oral health and their impact on the quality of life. Also, building and maintaining various traditional and contemporary communication models of collaboration between patients and dentists for the purpose of raising oral health literacy is important [11, 12]. The results of numerous studies indicate the importance of responsible behaviour of an individual towards their own oral health [13, 14, 15]. Oral health status (representation of edentulousness), oral hygiene habits and oral health behaviours have been interesting topics for research in the region [16, 17], Europe [18] and other continents [19–29].

The elderly mostly wear dentures. Kandelman et al. [23] emphasize that care of dentures and soft tissue un-

der dentures is important for both oral and general health. Improper hygiene of dentures may cause or contribute to the occurrence of pathological changes in oral mucosa, poor nutrition, diseases of the airways, heart and stomach. In older patients hygienic dentures should be given priority over aesthetics, according to authors who have investigated oral health of elderly [30–34].

The aim of the study is to examine oral health behaviour and oral hygiene habits of the elderly population in Podgorica, Montenegro.

MATERIALS AND METHODS

Ethics Committee of the Medical School of the University of Montenegro in Podgorica approved the research and research method was accepted. The research was performed according to the method of analytical cross-sectional study, from October 2018 to April 2019, at the Faculty of Medicine in Podgorica, Dental Program. A doctor of dentistry, a specialist in dental prosthetics who is employed by the Faculty, performed the study. The study included 105 respondents between the ages of 65 and 96 with an average age of 71 (standard deviation 6.35).

The criteria for respondents were as follows:

1. Persons, ages 65 and older, who visited clinic on certain days of the week (Tuesdays and Thursdays), from October 2018 to April 2019.
2. Persons who voluntarily agreed to participate in the research after explaining the purpose of the research, the method of data collection and the anonymity of participation. They all signed informed consent.

Research method

The research method included a questionnaire consisting of 21 closed-ended questions (Table 1). The questionnaire was composed for the purpose of this research by the World Health Organization guidelines [12]. The questions were divided into the three sections:

The first part consisted of 13 questions related to oral health behaviour. The second part had 6 questions and was related to oral hygiene habits. The third part consisted of two questions related to the reasons that motivated patients to apply for oral health services at the Faculty and satisfaction with the service provided.

For statistical analysis methods of descriptive and inferential statistics were used (arithmetic mean and standard deviation). Data were processed with the statistical program IBM STATISTICS 20. The Pearson χ^2 test was used. The significance level was set at 0.05.

RESULTS

Sample structure

By gender, the structure of the sample was: 53 (50.5%) females and 52 (49.5%) males. Compared to age groups: 78 (74.3%) subjects were 65-74 years and 27 (25.7%) sub-

Table 1. Questions included in the questionnaire
Tabela 1. Pitanja koje je sadržao upitnik

| # of question Broj pitanja | Question Pitanje |
|-------------------------------|--|
| P1 | Do you have selected doctor? Da li imate izabranog lekara? |
| P2 | How often do you perform basic laboratory tests (blood and urine tests)? Koliko često radite laboratorijske testove (krvnu sliku i urin)? |
| P3 | Do you have selected dentist? Da li imate izabranog stomatologa? |
| P4 | Where have you been treating your teeth so far? Gde ste dosad išli kod stomatologa? |
| P5 | How do you assess your mouth and teeth health? Kako procenjujete združljje svojih usta i zuba? |
| P6 | How long ago was your last visit to dentist? Koliko je vremena proteklo od vaše poslednje posete stomatologu? |
| P7 | What was the reason for your last visit to the dentist? Koji je bio razlog poslednje posete stomatologu? |
| P8 | What made you lose your natural teeth? Iz kojih razloga ste izgubili svoje prirodne zube? |
| P9 | What is the reason for your irregular visit to the dental examinations? Koji je razlog vašeg neregularnog odlaska stomatologu? |
| P10 | How much in this time you have remaining natural teeth? Koliko imate preostalih svojih prirodnih zuba sada? |
| P11 | Do you use tobacco products? Da li pušite? |
| P12 | Are you a consumer of alcoholic beverages? Da li pijete alkoholna pića? |
| P13 | Did you receive advice from your dentist about the need for regular check-ups at least once a year when receiving your dentures? Da li ste posavetovani da je potrebno da imate regularne preglede kada ste dobili svoje proteze? |
| P14 | How many times during the day do you brush your teeth / dentures? Koliko puta dnevno perete zube/proteze? |
| P15 | What means do you use to clean your teeth (for people who have teeth)? Šta sve koristite za pranje zuba (za ljudi koji imaju svoje zube)? |
| P16 | What means do you use to wash your denture (for people who have dentures)? Šta sve koristite za pranje proteza (za ljudi koji imaju proteze)? |
| P17 | Do you use tablets for cleaning dentures? Da li koristite tablete za pranje proteza? |
| P18 | How much do you wear a denture in 24 hours? Koliko dugo nosite proteze u toku 24 časa? |
| P19 | Where do you keep your denture when it's not in your mouth? Gde čuvate proteze kada vam nisu u ustima? |
| P20 | Why did you choose the School of Medicine to provide dental services? Zašto ste izabrali fakultet za stomatološke usluge? |
| P21 | Are you satisfied with the provided dental services? Da li ste zadovoljni stomatološkim uslugama? |

jects 75 years old (71.0 ± 6.35 ; min 65; max 96). By level of education: the majority of respondents had secondary level of education (42 (41.0%)), higher education had 29 respondents (27.6%). There were 12 (11.4%) college graduates, 18 with elementary school (19.0%) and one with no education (1.0%). Forty-two people (40.0%) were completely edentulous. 43 (41.0%) respondents had less

than 20 teeth. More than 20 teeth had 20 (19.0%) respondents. Most of them had some kind of dentures (mobile prosthetic appliances) - 86 (81.90%).

Oral health behaviour

The results of the study of oral health behaviour of respondents are shown in Table 2.

102 (97.1%) of respondents had selected general physician (GP). Once a year, 49 (46.7%) of respondents performed basic laboratory tests. 42 (40.0%) of tested re-

spondents had selected dentist. In response to question number 4, 43 (41.0%) stated that they had so far treated their teeth exclusively in state dental offices. 7 (6.7%) respondents were treated in private dental offices only while 55 (52.4%) respondents were referred for dental services to both state and private dental offices.

For the reason of losing natural teeth, 62 (59.0%) reported decay and 41 (39.0%) periodontal disease. In oral health self-assessment, 46 (43.8%) of respondents assessed their oral health as poor. When asked about the time elapsed since the last visit to the dentist, 27 (25.7%)

Table 2. Oral health behaviour of the respondents

Tabela 2. Oralne navike ispitanika

| # | Answers Odgovori | % n | Years Godine | | χ^2 P | Gender Pol | | χ^2 P | Education Obrazovanje | | | | χ^2 P |
|-----------|--|--------|-----------------|-----|---------------|---------------|--------|---------------|--------------------------|----------|----------|----------|------------------|
| | | | 65-74 | >75 | | F Ž | M M | | ES OO | HS SO | CE VS | UE UU | |
| | | | n | n | | n | n | | n | n | n | n | |
| P1 | Yes Da | 97.1 | 75 | 27 | | 53 | 49 | | 18 | 42 | 12 | 29 | |
| | No Ne | 2.9 | 3 | 0 | | 0 | 3 | | 2 | 1 | 0 | 0 | |
| P2 | Once a year Jednom godišnje | 46.7 | 35 | 14 | | 26 | 23 | | 5 | 17 | 6 | 21 | 13.304 0.010* |
| | When I have problem Kada imam neki problem | 53.3 | 43 | 13 | | 27 | 29 | | 15 | 26 | 6 | 8 | |
| P3 | Yes Da | 40.0 | 33 | 9 | | 16 | 26 | 4.292 0.038* | 1 | 17 | 7 | 17 | 16.749 0.002* |
| | No Ne | 60.0 | 45 | 18 | | 37 | 26 | | 19 | 26 | 5 | 12 | |
| P4 | In state clinics U državnim klinikama | 41.0 | 31 | 12 | | 19 | 24 | | 6 | 16 | 7 | 13 | |
| | In private clinics U privatnim klinikama | 6.7 | 7 | 0 | | 3 | 4 | | 2 | 2 | 0 | 3 | |
| | In both I jednim i drugim klinikama | 52.4 | 40 | 15 | | 31 | 24 | | 12 | 25 | 5 | 13 | |
| P5 | Bad Loše | 43.8 | 34 | 12 | | 23 | 23 | | 10 | 21 | 4 | 10 | |
| | Good Dobro | 56.2 | 44 | 15 | | 30 | 29 | | 10 | 22 | 8 | 19 | |
| P6 | Less than 1 year Manje od jedne godine | 25.7 | 24 | 3 | | 17 | 10 | | 1 | 9 | 3 | 14 | 47.178 0.001* |
| | From 1 to 2 years Od jedne do dve godine | 21.9 | 17 | 5 | | 8 | 14 | | 2 | 4 | 5 | 11 | |
| | From 2 to 5 years Od dve do pet godina | 24.8 | 19 | 7 | | 9 | 17 | | 4 | 16 | 3 | 3 | |
| | 5 years and over pet godina i više | 27.6 | 17 | 12 | | 18 | 11 | | 13 | 13 | 1 | 1 | |
| P7 | Pain or problem Bol ili neprijatnost | 59.0 | 44 | 18 | | 37 | 25 | | 17 | 29 | 4 | 11 | 22.660 0.031* |
| | Regular control Regularna kontrola | 9.5 | 8 | 2 | | 4 | 6 | | 1 | 1 | 2 | 6 | |
| | Treatment Tretman | 20.0 | 17 | 4 | | 8 | 13 | | 2 | 8 | 5 | 6 | |
| | Consultation /advice Konsultacija/ savet | 11.4 | 9 | 3 | | 4 | 8 | | 0 | 5 | 1 | 6 | |
| P8 | Decay Karijes | 59.0 | 49 | 13 | | 37 | 25 | | 11 | 24 | 9 | 17 | |
| | Periodontal disease Parodontopatija | 39.0 | 27 | 14 | | 15 | 26 | | 7 | 19 | 3 | 12 | |
| | Trauma Povreda | 1.9 | 2 | 0 | | 1 | 1 | | 2 | 0 | 0 | 0 | |

| # | Answers Odgovori | % n | Years Godine | | χ^2 P | Gender Pol | | χ^2 P | Education Obrazovanje | | | | χ^2 P |
|------------|--|------------|-----------------|-----|-----------------|---------------|--------|---------------|--------------------------|----------|----------|----------|------------------|
| | | | 65-74 | >75 | | F Ž | M M | | ES OO | HS SO | CE VS | UE UO | |
| | | | n | n | | n | n | | n | n | n | n | |
| P9 | Fear Strah | 33.3 29 | 6 | | | 24 | 11 | | 5 | 15 | 3 | 12 | |
| | High price Visoka cena | 16.2 12 | 5 | | | 6 | 11 | | 2 | 9 | 4 | 2 | |
| | The absence of a dental office (poor organization) in the place where I live Nedostatak stomatološke ordinacije (loša organizacija) u mestu gde živim | 12.4 6 | 7 | | | 5 | 8 | | 3 | 3 | 1 | 6 | |
| | Neglect oral health due to life problems Zanemarivanje zdravlja usta zbog drugih životnih problema | 21.0 16 | 6 | | | 12 | 10 | | 3 | 10 | 3 | 6 | |
| | Neglecting oral health due to ignorance of its importance Zanemarivanje zdravlja usta zbog ignorisanja značaja zdravlja zuba | 17.1 15 | 3 | | | 6 | 12 | | 7 | 6 | 1 | 3 | |
| P10 | Edentulous Bezubi | 40.0 27 | 15 | | | 28 | 14 | 7.342 0.025* | 9 | 15 | 5 | 12 | |
| | < 20 teeth < 20 zuba | 41.0 35 | 8 | | | 17 | 26 | | 10 | 20 | 4 | 9 | |
| | > 20 teeth > 20 zuba | 19.0 16 | 4 | | | 8 | 12 | | 1 | 8 | 3 | 8 | |
| P11 | Yes Da | 41.0 39 | 4 | | | 22 | 21 | | 9 | 23 | 1 | 9 | 12.369 0.015* |
| | No Ne | 59.0 39 | 23 | | | 31 | 31 | | 11 | 20 | 11 | 20 | |
| P12 | Yes Da | 21.0 18 | 4 | | | 3 | 19 | 15.110 <0.001 | 5 | 11 | 3 | 3 | |
| | No Ne | 79.0 60 | 23 | | | 50 | 33 | | 15 | 32 | 9 | 26 | |
| P13 | Yes Da | 43.8 32 | 7 | | 2.866 0.090* | 16 | 23 | 3.863 0.045* | 3 | 15 | 5 | 16 | 10.737 0.030* |
| | No Ne | 56.2 33 | 17 | | | 31 | 19 | | 14 | 21 | 5 | 9 | |

F – female, M – male, ES – elementary education, HS – high school education, CE – college education, UE – university education, * – there is a statistically significant correlation
 Ž – ženski pol, M – muški pol, OO – osnovno obrazovanje, SO – srednjoškolsko obrazovanje, VS – viša škola, UO – univerzitetsko obrazovanje, * – postoji statistička značajnost

reported last visit less than 1 year ago and 29 (27.6%) more than 5 years ago. As a reason for the last visit to the dentist, 62 (59.0%) of the respondents reported pain or problem related to the mouth, teeth or dental replacement, while only ten (9.5%) went for regular check-up. On the 13th question from the questionnaire, 39 (43.8%) recalled having received advice from physicians about the need for regular check-ups. When asked about the reasons for irregular dental visits, the following were answered: "Fear of dental intervention" - 35 (33.3%); "High cost of dental services" - 17 (16.2%); "Lack (or poor organization) of the dental service in the place where I live" - 13 (12.4%); "Neglect of tooth and mouth health due to other life problems" - 22 (21.0%); "Neglect of teeth and mouth health due to insufficient knowledge of their importance" - 18 (17.1%). 43 (41.0%) respondents reported tobacco use while 22 (21.0%) reported use of alcoholic beverages.

Oral-hygiene habits

Answers to questions related to oral health habits are shown in Table 3.

Three times a day, 41.0% of the subjects brushed their teeth / dentures. The number of subjects who had natural

teeth remaining was 62 (59.05%). When asked what means they used to brush teeth: 64.5% used only toothbrush and toothpaste; 24.2% used dental floss in addition, 11.3% also used mouthwash. High percentage (68.6%) of respondents used toothbrush and toothpaste to clean their dentures. Alternative denture hygiene products (household soaps and dishwashing detergents, baking soda, lemon juice, bleach-sodium hypochlorite, rough brushes, etc.) were used by 31.4% of mobile denture wearers. Some respondents used denture-cleaning tablets. In regards to their denture wearing habits 40.7% said they wore dentures "both day and night", while 59.3% wore dentures only during the day. When dentures were not in the mouth 51.2% of the respondents hold them in a glass with water, while 48.8% kept them in a glass / box without water.

The reasons for visiting the Faculty of Medicine in Podgorica and satisfaction with the provided oral health services

65.7% of respondents reported "recommendation of a family member or a friend" was the reason to visit the Faculty of Medicine, dental division. The expertise of dentists working in the Dentistry Study Program was the

Table 3. Oral-hygiene habits of the respondents**Tabela 2.** Navike ispitanika koje se tiču higijene zuba

| # | Answers Odgovori | % n | Years Godine | | χ^2 p | Gender Pol | | χ^2 p | Education Obrazovanje | | | | χ^2 p |
|----|---|--------|-----------------|-----|---------------|---------------|--------|---------------|--------------------------|----------|----------|----------|----------------|
| | | | 65–74 | >75 | | F Ž | M M | | ES OO | HS SO | CE VS | UE UO | |
| | | | n | n | | n | n | | n | n | n | n | |
| P1 | Three times Tri puta | 41.0 | 32 | 11 | | 29 | 14 | 9.140 0.010* | 6 | 15 | 4 | 18 | 16.405 0.037* |
| | Two times Dva puta | 23.8 | 15 | 10 | | 8 | 17 | | 3 | 11 | 6 | 4 | |
| | One time Jednom | 35.2 | 31 | 6 | | 16 | 21 | | 11 | 17 | 2 | 7 | |
| P2 | Toothbrush and toothpaste Pastu i četkicu | 64.5 | 33 | 7 | | 17 | 23 | | 11 | 21 | 1 | 7 | 27.737 <0.001* |
| | Dental floss Konac | 24.2 | 12 | 3 | | 6 | 9 | | 0 | 2 | 5 | 8 | |
| | Mouthwash Tečnost za ispiranje usta | 11.3 | 5 | 2 | | 2 | 5 | | 0 | 4 | 1 | 2 | |
| P3 | Toothbrush and toothpaste Pastu i četkicu | 68.6 | 46 | 13 | | 29 | 30 | | 9 | 24 | 7 | 18 | |
| | Alternative means Alternativne stvari | 31.4 | 17 | 10 | | 18 | 9 | | 8 | 11 | 2 | 6 | |
| P4 | Yes Da | 50.0 | 33 | 10 | | 25 | 18 | | 4 | 14 | 6 | 19 | 17.540 0.002* |
| | No Ne | 50.0 | 30 | 13 | | 22 | 21 | | 13 | 21 | 3 | 5 | |
| P5 | Both day and night I danju i noću | 40.7 | 25 | 10 | | 25 | 10 | 6.703 0.010* | 11 | 12 | 2 | 10 | |
| | Just by day Samo danju | 59.3 | 38 | 13 | | 22 | 29 | | 6 | 23 | 7 | 14 | |
| P6 | In container with water U posudi s vodom | 51.2 | 30 | 14 | | 27 | 17 | | 13 | 20 | 4 | 6 | 13.464 0.009* |
| | In container without water U posudi bez vode | 48.8 | 33 | 9 | | 20 | 22 | | 4 | 15 | 5 | 18 | |

F – female, M – male, ES – elementary education, HS – high school education, CE – college education, UE – university education, * – there is a statistically significant correlation
 Ž – ženski pol, M – muški pol, OO – osnovno obrazovanje, SO – srednjoškolsko obrazovanje, VS – viša škola, UO – univerzitetsko obrazovanje, * – postoji statistička značajnost

reason for 18.1% of people and good price for services in 16.2%. 92.4% of respondents were satisfied with the oral health treatment they received at this institution (Table 4).

DISCUSSION

One of the key prerequisites for maintaining oral health and maintaining the therapeutic effect of prosthodontic appliances is to attend regular check-ups. Similar results were reported by Popović et al. in Serbia [16] and Škunac et al. in Croatia [17] as well as Mariño et al. in Chile [14] and Zhu et al. [15] in China. Zubiene et al. [18] reported more responsible oral health behaviour of elderly in Lithuania compared to elderly in Montenegro. The level of education in respondents was found to have impact on the regularity of check-ups (Table 2). On the question 13 from the questionnaire, close to half of respondents confirmed receiving advice from physicians about the importance of regular check-ups, at least once a year. However, the fact was that they did not follow given recommendations (Table 2). In the question 9, more than one third stated that they neglected their oral health because of ignorance or their occupation with other life problems (Table 2). As the reason for the last visit to the dentist, the results of our study are in agreement with the results of similar

studies in Serbia [16], Chile [14], China [15] and related to pain/problems with mouth, teeth or dentures. Elderly in Lithuania [18] in 58.3% visited dentist even though they did not have any problems, understanding the importance of regular check-ups. In our study, elderly in Montenegro did not understand the integrity of health and the connection between general and oral health. Popović et al. [30] in 2016 estimated that 67.65% of elderly in the central region of Montenegro needed dental treatment related to making new dentures. The average age of dental appliances at that time was 11 years. Elderly people had more responsible attitude towards general health compared to oral health, and they performed basic laboratory findings (blood and urine tests) once a year. Persons with higher level of education were more responsible toward their oral health (Table 2). 97.1% of respondents had chosen general practitioner, while less than half of them had chosen dentist. Respondents 65 years old and older had trust in public (state) offices and went for dental services exclusively in state clinics and health centers (Table 2). All services in government clinics by 2008 were provided free of charge or with little participation for complete population, at the expense of the Healthcare Fund of Montenegro (FZOCG). At the same time private dental clinics were available as well. After 2008, when the reform of the health care system in Montenegro was implemented, 95% of dental offices

Table 4. Reasons for coming to the Faculty of Medicine in Podgorica and satisfaction with the provided oral health services
Tabela 4. Razlozi dolaska na Medicinski fakultet u Podgorici i zadovoljstvo pruženim stomatološkim uslugama

| # | Answers Odgovori | % n | Years Godine | | χ^2 P 11.422 0.003* | Gender Pol | | χ^2 P | Education Obrazovanje | | | | χ^2 P 3.463 0.063* |
|-----------|-----------------------------|--------|--------------|----|-----------------------------------|------------|--------|---------------|-----------------------|-------------|----------------|----|-------------------------------|
| | | | 65-74 >75 | | | F Ž | M M | | ES OO SO | HS SO VS | CE VS UE UO | | |
| | | | n | n | | n | n | | n | n | n | | |
| P1 | Recommendation Preporuka | 65.7 | 47 | 22 | | 39 | 30 | | 14 | 29 | 7 | 19 | |
| | Good price Dobra cena | 16.2 | 17 | 0 | | 7 | 10 | | 6 | 7 | 0 | 4 | |
| | Dentist expertise Stručnost | 18.1 | 14 | 5 | | 7 | 12 | | 0 | 7 | 5 | 6 | |
| P2 | Yes Da | 92.4 | 72 | 25 | | 47 | 50 | | 16 | 40 | 12 | 28 | 3.463 0.063* |
| | No Ne | 7.6 | 6 | 2 | | 6 | 2 | | 4 | 3 | 0 | 1 | |

F – female, M – male, ES – elementary education, HS – high school education, CE – college education, UE – university education, * – there is a statistically significant correlation
 Ž – ženski pol, M – muški pol, OO – osnovno obrazovanje, SO – srednjoškolsko obrazovanje, VS – viša škola, UO – univerzitetsko obrazovanje, * – postoji statistička značajnost

were transferred from the state to the private sector. Also the concept of “chosen dentist” was introduced. The most vulnerable categories of the population, including the elderly, received coverage in the obligatory form of dental care (e.g. mobile dentures in the form of acrylic dentures) and they could be treated by the dentist of their choice. All other services were charged at the market prices. In our study, respondents did not find satisfactory possibilities offered by the national system of dental care. The number of dental offices on the territory of Montenegro that have a contract with the FZOCG is around 190 (in Podgorica 123). This could be the reason why less than half of the respondents had chosen a dentist, due to the limited number of offices that have contract with FZOCG. Working with elderly is in all aspects very specific, and it is necessary to have properly trained personnel. According to the data of the Dental Chamber of Montenegro, there are currently eight specialists in prosthodontics in the country, and only one works at the Dental Polyclinic of the Clinical Center, as the most important dental institution of public health. Out of the existing number of specialists, five of them are part-time engaged in practical training at the Faculty. “A recommendation of a family member or friend” was decision for more than half of the respondents coming to the faculty clinic and high percentage of them expressed satisfaction with the service provided. Prevention of oral diseases is considered to be the most important segment of dentistry, and this was the reason why our research was initiated. It targets the elderly as their numbers are expected to increase in the future. Question 5 informed us that respondents did not know enough about the importance of preserving natural teeth. Although most of them were edentulous and with less than 20 remaining natural teeth, more than half of the respondents rated their oral health as good. Probably this is due to 81.9% of denture holders being satisfied with their existing dentures. It is necessary to emphasize the importance of work on the health literacy of the population [34]. Developing communication skills therapists need to build confidence and good cooperation between patients and dentists, which has a significant impact on the success of treatment and

maintaining results in time. Mandatory check-ups with “selected dentist” must also be considered as part of the proper selection of information obtained from social networks. Using the information available on the Internet to gain knowledge about oral diseases, diagnostic and therapeutic options can be very useful, but only in conjunction with the information provided by the dentist as the only professional and qualified person to provide it.

In order to promote and implement the WHO recommendation [32], that persons under the age of 65 should preserve at least 20 natural teeth, it is necessary to work on the development of oral-hygiene habits and promote them as a basic condition for maintaining oral and dental health, improving general health and quality of life [28, 33]. Respondents older than 65 brushed their teeth / dentures 3 times a day, significantly more women than men, which is consistent with the results of Aoun et al. [26] in Lebanon (31.15% women; 22.54% men). Older people in Saudi Arabia [27] had greater commitment to maintaining oral hygiene than elderly in our study. Of the oral hygiene products according to the study by Olusile et al. [21], 39.9% of population older than 60 years of age in Nigeria used hygiene aids, which is in agreement with the results of our study. In contrast, elderly in Iran [19] and Western Cameroon [20] use them less frequently. Research by Asgari et al. [19] indicated that oral hygiene develops with age, and maximum is reached between the ages of 25-34 and then gradually decreases.

When it comes to maintaining denture hygiene, the results of our study are consistent with those of Evren et al. [22] done in Turkey. It is unquestionable that the patient should be provided with detailed instructions regarding the care of the denture and need for check-ups after denture delivery. Mok et al. [24] emphasized the importance of written guides for maintaining denture hygiene because they believe that older patients cannot remember all the instructions for various reasons such as stress, confusion or reduced memory. Mild impairments of cognitive power occur in 36.1% of hospitalized elderly patients and about 23% in those 65 years and older. Even without damaging cognitive power, most people remember less than 1/4 of

what they hear. Therefore, they recommend that patients in addition to the verbal instructions should be demonstrated brushing techniques and given instructions in the form of a brochure on denture maintenance and need for regular check-ups. Marchini et al. [25] investigated the link between the lack of oral health guidance and denture cleaning and the presence of prosthetic stomatitis. They concluded that mechanical cleaning was the predominant method of maintaining denture hygiene and lack of oral health information was related to inflammatory state of oral cavity. Strajnić et al. [3] concluded that improper denture hygiene is health and aesthetic problem for the persons who use them. They recommended a combination of mechanical and chemical denture cleaning and use of tablets to clean dentures. Instructions must also be given on the proper use of dentures. Numerous studies [25, 26, 27] have focused on the impact of dentures on oral mucosa, microflora and nutritional status. The prevailing opinion is that alveolar mucosa should not be under constant pressure of the denture base, and that it is better to keep the denture (while not in the mouth) dry than in contact with water [31].

Studies like the current one have social significance, because the possession of the data collected this way contributes to the real design needs for material resources and human capacities for the provision of more efficient and higher quality dental care in general. The significance of this research is that it is the first study of oral hygiene habits and oral health behaviour in elderly, conducted in Montenegro. The use of questionnaires with the same or similar question as in this survey (as part of taking the medical history) can be very useful to make oral health profile of the patient and create a picture of the patient's habits and health understanding. These findings are important for making optimal treatment plan before beginning oral rehabilitation and making dentures. Future research should put the emphasis on older people living in the southern and northern region of the country. It is also necessary to include persons who are placed in homes for elderly stay.

The results can be considered representative of old people who live not only in Podgorica but also in the central region of the country. Looking for specialist services patients from other cities in the central part of the country (Danilovgrad, Cetinje and Niksic) typically come to Podgorica, that has about 300,000 inhabitants, and that is almost half of the entire population of Montenegro.

CONCLUSION

Oral-health behaviour and oral-hygiene habits of the elderly in Podgorica are not satisfactory. As the elderly mostly need prosthodontics treatment, this part of dental care must be better organized in the state health system, and the Faculty can make a significant contribution to it.

Acknowledgment to the Dental Chamber of Montenegro for providing data from their jurisdiction and records.

REFERENCES

1. UN report Ageing in the 21st Century: a celebration and a challenge. (2012). 111-18; [Online]. ISBN 978-0-89714-981-5 Available from: <https://www.researchgate.net/publication/314205132> [08. 7.2019]
2. Crna Gora / Montenegro Zavod za Statastiku/ Statistical Office / Saopštenje / Realease Broj / No: 83 Podgorica. (2011). [Online]. Available from: <https://www.monstat.org/userfiles/file/popis2011/saopstenje/saopstenje.pdf> [08.07.2019.]
3. Strajnić IJ, Đokić M, Vučinić P. Contemporary methods and mobile denture cleansers and theirs significance for older population. *Med Pregl.* 2011; LXIV (9-10):497-502. DOI: 10.2298/MPNS1110497S]
4. World Health Organization. Oral health Fact sheet N°318 April 2012 [Internet]. WHO. Available from: <http://www.who.int/media-centre/factsheets/fs318/en/>
5. Jandial S, Kotwal B, Kotwal V, Mahajan N, Kharyal S, Tomar V. Prevalence of complete and partial edentulism in the patients visiting district hospital of Kathua, Jammu, Jammu and Kashmir. *Int J Sci Stud.* 2017; 5(7):71-4. [DOI: 10.17354/ijss/2017/498]
6. World Health Organization. Strategies for oral disease prevention and health promotion [Internet]. WHO. Available from: http://www.who.int/oral_health/strategies/cont/en/index.html [018.07.2019.]
7. Naghibi Sistani MM, Yazdani R, Virtanen J, Pakdaman A, Murtomaa H. Determinants of oral health: does oral health literacy matter? *ISRN Dent.* 2013; 2013:249591. [DOI: 10.1155/2013/249591] [PMID: 23577262]
8. Chinn D. Critical health literacy: a review and critical analysis. *Soc Sci Med.* 2011; 73(1):60-7. [DOI: 10.1016/j.socscimed.2011.04.004] [PMID: 21640456]
9. Nutbeam D. Defining and measuring health literacy: what can we learn from literacy studies? *Int J Public Health.* 2009; 54(5):303-5. [DOI: 10.1007/s00038-009-0050-x] [PMID: 19641847]
10. Lee JY, Divaris K, Baker AD, Rozier RG, Lee S-YD, Vann WF Jr. Oral health literacy levels among a low-income WIC population. *J Public Health Dent.* 2011 Spring; 71(2):152–60. [PMID: 21774139]
11. Baskaradoss JK. Relationship between oral health literacy and oral health status. *BMC Oral Health.* 2018; 18:172. [DOI: 10.1186/s12903-018-0640-1]
12. Vodanović M. Prevention of oral diseases Acta Med Croatica. 2013; 67(3):251-4. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/25007435> [PMID: 25007435]
13. WHO. Oral Health Surveys -Basic Methods. 5th Edition, WHO Library Cataloguing-in-Publication Data, World Health Organization 2013, ISBN 978 92 4 154864 9 (NLM classification: WU 30).
14. Mariño R, Giacaman RA. Patterns of use of oral health care services and barriers to dental care among ambulatory older Chilean. *BMC Oral Health.* 2017; 17:38. [DOI: 10.1186/s12903-016-0329-2] [PMID: 28068973]
15. Zhu L, Petersen PE, Wang HY, Bian JY, Zhang BX. Oral health knowledge, attitudes and behaviour of adults in China. *Int Dent J.* 2005; 55(4):231-41. [DOI: 10.1111/j.1875-595X.2005.tb00321x] [PMID: 16167612]
16. Popović Ž. Socijalno-medicinski pristup definisanju modela monitoringa pacijenata sa zubnim nadoknadama. Doctoral dissertation. Beograd: Univerzitet u Beogradu, Stomatološki fakultet, 2015.
17. Ograjsek Škunca D, Klaić B, Čatović A, Tomek Roksandić S, Jorgić Srdjak K. Oralno higijenske navike u populaciji starije životne dobi u gradu Zagrebu: 7. Hrvatskog međunarodnog Quintessence kongresa: Zbornik radova. Zagreb, Hrvatska: Quintessence (2012):225-26.
18. Zubiene J, Milciuviene S, Klumbiene J. Evaluation of dental care and the prevalence of tooth decay among middle-aged and elderly population of Kaunas city. *Baltic Dent Maxillofac J.* 2009; 1:42-7. [PMID: 19773627]
19. Asgari F, Majidi A, Koohpayehzadeh J, Etemad K, Rafe A. Oral hygiene status in a general population of Iran, 2011: a key life-style marker in relation to common risk factors of non-com-

- municable diseases, *Int J Health Policy Manag.* 2015; 4(6):343–52. [DOI: 10.15171/ijhpm.2015.18]
20. Michele Lolita Y, Ashu Michael A, Hubert N, Florence D, Jacques B. Oral Health Status of the Elderly at Tonga, West Region, Cameroon. *Int J Dent.* 2015; 2015:820416. [DOI: 10.1155/2015/820416] [PMID: 26633972]
 21. Olusile AO, Adeniyi A, Orebanjo O. Self-rated oral health status, oral health service utilization, and oral hygiene practices among adult Nigerians. *BMC Oral Health.* 2014; 14:140. Available from: <http://www.biomedcentral.com/1472-6831/14/140>. [14. 7. 2019.] [DOI: 10.1016/j.archger.2010.12.016] [PMID: 21269712]
 22. Evren BA, Uludamar A, Iseri D, Ozkan YF. The association between socioeconomic status, oral hygiene practice, denture stomatitis and oral status in elderly people living different residential homes. *Arch Gerontol Geriatr.* 2011; 53(3):252-7. [DOI: 10.1016/j.archger.2010.12.016] [PMID: 21269712]
 23. Kandelman D, Petersen PE, Ueda H. Oral health, general health, and quality of life in older people. *Spec Care Dentist.* 2008; 28(6):224-36. [DOI: 10.1111/j.1754-4505.2008.00045.x] [PMID: 19068063]
 24. Mok J, Emami E, Kobayashi T, Feine JS. An oral hygiene brochure for your implant overdenture patients. *J Dent (Shiraz).* 2015; 16(1):68-72. [PMID: 26106638]
 25. Marchini L, Tomashiro E, Nascimento DF, Cunha VP. Self-reported denture hygiene of a sample of edentulous attendees at a University dental clinic and the relationship to the condition of the oral tissues. *Gerodontology.* 2004; 21(4):226-8. [PMID: 15603282]
 26. Aoun G, Gerges E. Assessment of hygiene habits in acrylic denture wearers: a cross-sectional study. *Mater Sociomed.* 2017; 29(3):216-8. [DOI: 10.5455/msm.2017.29.216-218]
 27. Aljoharah A, Al-Sinaidi. Periodontal health and oral hygiene practice of elderly Saudis living at Riyadh Nursing Home. *King Saud Univer J Dent Sci.* 2012; 3(1):1-5. [DOI: 10.1016/j.ksuds.2011.10.005]
 28. Erić J, Stančić I, Tihaček Šojić L, Jelenković Popovac A, Tsakos G. Validity and reliability of the Oral Impacts on Daily Performance (OIDP) scale in the elderly population of Bosnia and Herzegovina. *Gerodontology.* 2012; 29(2):1-8. [DOI: 10.1111/j.1741-2358.2011.00584.x] [PMID: 22103883]
 29. Sonkesariya S, Jain D, Shakya P, Agrawal R, Prasad SVS. Prevalece of dentulism, partial edentulism and complete edentulism in rural and urban population of Malwa region of India: A population-based study. *Int J Prostodont Restor Dent.* 2014; 4(4):112-9. [PMID: 26668484]
 30. Popović Z, Đuričković Đ, Ljaljević A, Matijević S, Obradović-Đuričić K. Assessment of reliability and validity of Montenegrin version of the oral health impact profile for use among the elderly in Montenegro. *Srp Arh Celok Lek.* 2019; DOI: <https://doi.org/10.2298/SARH180528049P> ISSN Online 2406-0895
 31. Tihaček Šojić Lj, Stančić I. Stomatološka gerontoprotetika. Kragujevac: Koraci 2009.
 32. Association of State and Territorial Dental Directors (ASTDD) Best Practices Committee. (2017). Best practice approach: oral health in the older adult population (age 65 and older) [monograph on the Internet]. Reno, NV: Association of State and Territorial Dental Directors; Mar 2017. 29 p. Available from: <http://www.astdd.org>. [30. 7. 2019]
 33. Paraguassu EC, Cardens AM. Systematic review of current medical literature on the impact of oral health on quality of life. *Int J Adv Eng Res Sci (IJAERS).* 2019; (6):115-23. [DOI: 10.22161/ijaers.6.3.14]
 34. Santos P, Sá L, Couto L, Hespanhol A. Health literacy as a key for effective preventive medicine. *Cogent Social Sciences.* 2017; 3:1407522. [DOI: 10.1080/23311886.2017.1407522]

Received: 16.04.2019 • Accepted: 31.07.2019

Oralnozdravstveno ponašanje i oralnohigijenske navike starih osoba u Podgorici, Crna Gora

Zorica Popović, Mirjana Đuričković

Univerzitet Crne Gore, Medicinski fakultet u Podgorici, Studijski program stomatologije, Podgorica, Crna Gora

KRATAK SADRŽAJ

Uvod U budućnosti se očekuje povećan broj starih osoba korisnika stomatoloških usluga. Cilj istraživanja je da ispita oralnozdravstveno ponašanje i oralnohigijenske navike starih osoba u Podgorici, Crna Gora.

Materijal i metode U istraživanju je korišćen upitnik zatvorenog tipa sa 21 pitanjem, koji je pripremljen u skladu sa preporukama Svetske zdravstvene organizacije. Korišćene su standardne statističke metode, χ^2 test, $p = 0,05$.

Rezultati Prosečna starost ispitanika je $71 \pm 6,35$ godina. Bezub je 40% osoba; mobilne zubne nadoknade ima 81,90% osoba; poslednja poseta stomatologu bila je pre manje od godinu dana kod 25,7%, a pre više od pet godina kod 27,6% ispitanika; osobe sa visokim obrazovanjem redovnije dolaze na stomatološke pregledne ($\chi^2 = 47,178$; $p < 0,001$); razlog posete bio je bol ili problem sa ustima, zubima ili zubnim nadoknadama kod 59% ispitanika; strah od stomatološke intervencije kao razlog nedolazaka kod stomatologa navelo je 33,3% ispitanika, dok 16,2% njih krivi visoku cenu usluga. Što se tiče loših navika ispitanika, 41% njih su korisnici duvanskih proizvoda, a 21% koristi alkoholne napitke; izabranog stomatologa ima manje od polovine osoba (40%); zube i/ili zubne proteze pere tri puta dnevno 41% ispitanika; pomoćna sredstva za oralnu higijenu koristi 35,6% ispitanika; tablete za čišćenje proteza koristi 50% njih.

Zaključak Oralnozdravstveno ponašanje i oralnohigijenske navike starih osoba u Podgorici nisu na zadovoljavajućem nivou. S obzirom na to da stari najviše imaju potrebu za protetskom terapijom, mora se raditi na unapređenju stomatoprotetske zaštite u državnom zdravstvenom sistemu.

Ključne reči: stare osobe; oralno zdravlje; oralnozdravstveno ponašanje; higijenske navike

UVOD

Demografski pokazatelji ukazuju na činjenicu da Evropa ubrzano stari. Do 2060. godine prosečan građanin Evropske unije (EU) imaće 47,2 godine, a osoba starijih od 65 godina biće skoro 30% u EU (16% u 2010. godini) [1]. Podaci Zavoda za statistiku Crne Gore (Monstat) takođe ukazuju na višedecenijski trend starenja stanovništva [2]. Procenat starijih od 65 godina porastao je sa 10% (1953. godine) na 18,3% (2011). Danas je petina stanovnika Crne Gore starija od 65 godina. U budućnosti ćemo imati znatno veći broj starih osoba koji su korisnici stomatoloških usluga, što direktno utiče na zdravstvene troškove i postaje ključni problem javnog zdravstva, čak i u razvijenijim zemljama [3].

Oko 30% ljudi na svetu u dobi od 65 do 74 godine nema više svoje prirodne zube [4]. *Jandial S.* i saradnici [5] komentarišući rezultate do kojih su došli u svojim istraživanjima iznose da je sa povećanjem starosti prisutan veći trend prema delimičnoj bezubosti, nakon čega sledi potpuna bezubost pacijenata, već kod starijih od 45 godina. Upozoravaju na uticaj bezubosti na stomatognati sistem, na opšte blagostanje, kvalitet života i naglašavaju značaj pravovremene zamene nedostajućih zuba. Među osnovnim smernicama Svetske zdravstvene organizacije (SZO) za poboljšanje oralnog zdravlja [6] u tačkama tri i četiri govori se: o potrebi da države razvijaju oralnozdravstvene sisteme u skladu sa potrebama korisnika i njihovim finansijskim mogućnostima; o neophodnosti integrisanja oralnog zdravlja u nacionalne zdravstvene programe uz naglašenu potrebu da se radi na zdravstvenoj pismenosti stanovništva. Ključ uspeha je u preventivni i u stvaranju pojedinca koji je zdravstveno osvešćen. Preventivni programi ne daju uvek očekivane rezultate zbog neodgovarajućeg nivoa zdravstvene pismenosti stanovništva [7]. Zdravstvena pismenost je sposobnost čitanja, razumevanja i pravilnog korišćenja informacija, uputstava i smernica vezanih za vlastito zdravlje [8]. Njena definicija govori o tri stepenice u njenom razvoju (funkcionalna, interaktivna i kritička) [9] i njen

nivo nije nužno proporcionalan stepenu formalnog obrazovanja, jer pojedinac može imati visok nivo formalnog obrazovanja, ali nedovoljnu svest o važnosti svoga zdravlja [10].

Oralna zdravstvena pismenost uključuje: poznavanje i sprovođenje oralnohigijenskih mera; prepoznavanje rizičnih činilaca koji utiču na oralno zdravlje; svesnost o povezanosti opštег i oralnog zdravlja te njihovog uticaja na kvalitet života; takođe, izgradnju i održavanje različitih tradicionalnih i savremenih komunikacionih modela saradnje između pacijenata i stomatologa u svrhu podizanja stepena oralne zdravstvene pismenosti [11, 12]. Rezultati brojnih istraživanja ukazuju na značaj odgovornog ponašanja pojedinca prema sopstvenom oralnom zdravlju [13, 14, 15]. Status oralnog zdravlja starih osoba (zastupljenost bezubosti), oralnohigijenske navike i ponašanje u vezi sa oralnim zdravljem istraživali su autori u regionu [16, 17], u Evropi [18] i na drugim kontinentima [19–29].

Stare osobe većinom su nosioci zubnih nadoknada. *Kandelman D., Petersen P.* i saradnici [23] naglašavaju da je briga o protezama i sluzokožnom tkivu kao o ležištu proteza važna kako za oralno tako i za opšte zdravlje. Nečiste proteze prouzrokuju ili doprinose pojavi patoloških promena na oralnoj sluzokoži, lošoj ishrani, obolenjima disajnih puteva, srca i želuca. Pacijentima s protezama koji su u poodmaklim godinama čišćenje proteza mora biti prioritet i mnogo više od estetike, mišljenja su autora koji su istraživali oralno zdravlje starih osoba [30–34]. Cilj istraživanja je da ispita oralnozdravstveno ponašanje i oralnohigijenske navike starih osoba u Podgorici, Crna Gora.

METODOLOGIJA

Pre realizacije istraživanja odradene su obavezne mere koje prethode ovakvim istraživanjima, kao što je dobijanje saglasnosti Etičkog komiteta Medicinskog fakulteta Univerziteta Crne Gore u Podgorici i urađen je plan istraživanja.

Istraživanje je rađeno po metodi analitičke studije preseka, u periodu od oktobra 2018. do aprila 2019. godine, na Medicinskom fakultetu u Podgorici, Studijskom programu stomatologije. Osoba koja je obavila istraživanje je doktorka stomatologije, specijalista stomatološke protetike, koja je radno angažovna na pomenutom fakultetu.

Istraživanjem je obuhvaćeno 105 osoba starosti između 65 i 96 godina sa prosečnom starošću od 71 godine (stand. devij. 6,35).

Metoda uključivanja ispitanika u istraživanje je bila zasnovana na sledećim karakteristikama:

1. Uključene su osobe starosti od 65 i više godina koje su se javile određenim danima (utorkom i četvrtkom), u periodu od oktobra 2018. do aprila 2019.

2. Uključene su osobe koje su dobровoljno pristale da učestvuju u istraživanju nakon što su im objašnjeni svrha istraživanja, način distribucije dobijenih podataka i anonimnost učešća. O dobrovoljnosti su se izjasnili potpisivanjem informisanog pristanka.

Instrumenti istraživanja

Instrument istraživanja je upitnik koji se sastoji od 21 pitanja zatvorenenog tipa. Upitnik je sačinjen za potrebe ovog istraživanja, a u njegovom kreiranju korišćene su preporuke Svetske zdravstvene organizacije [12]. Pitanja su podeljena u tri celine:

Prvi deo, koji sačinjava 13 pitanja, odnosi se na ponašanje ispitanika u vezi sa oralnim zdravljem. Drugi deo uputnika sastoji se od šest pitanja i odnosi se na oralnohigijenske navike. Treći deo čine dva pitanja koja se odnose na razloge koji motivišu pacijente da se obrate za oralnozdravstvene usluge na Fakultetu i zadovoljstvo pruženom uslugom. Pitanja uvrštena u upitnik prikazana su u Tabeli 1.

U statističkoj obradi podataka korišćene su metode deskriptivne i inferencijalne statistike. Od deskriptivnih metoda upotrebljene su aritmetička sredina i standardna devijacija. Podaci su obrađivani statističkim programom IBM STATISTICS 20. Korišćen je Pearson χ^2 test. Nivo značajnosti je 0,05.

REZULTATI

Struktura ispitanika

Prema polu struktura je: 53 (50,5%) ženskog i 52 (49,5%) muškog pola. U odnosu na godine starosti: 78 (74,3%) ispitanika je starosti 65–74 godine i 27 (25,7%) ispitanika je starosti 75 godina i više ($71 \pm 6,35$; min. 65; max. 96). Prema stepenu obrazovanja: najviše ispitanika ima srednji stepen obrazovanja, i to 42 ispitanika (41%). Sledi ispitanici sa visokim obrazovanjem, njih 29 (27,6%). Osoba sa završenom višom školom ima 12 (11,4%), sa osnovnom školom 18 (19%) i jedna osoba je bez obrazovanja (1%). Bezube su 42 (40%) osobe. Manje od 20 zuba imaju 43 (41%) osobe. Više od 20 zuba ima 20 (19%) osoba. Ispitanici su većinom nosioci mobilnih zubnih nadoknada, i to njih 86 (81,90%).

Oralnozdravstveno ponašanje

Rezultati istraživanja oralnozdravstvenog ponašanja ispitanika prikazani su u Tabeli 2.

Izabranog lekara opšte prakse ima 102 (97,1%) ispitanika. Jedanput godišnje rade osnovne laboratorijske pretrage 49 (46,7%). Izabranog stomatologa imaju 42 (40%) osobe. U odgovoru na pitanje broj 4, 43 (41%) osobe su se izjasnile da su svoje zube do tada isključivo lečile u državnim ordinacijama, u privatnim ordinacijama svega 7 (6,7%) osoba, dok se za stomatološke usluge obraćalo „i državnim i privatnim ordinacijama“ 55 (52,4%) ispitanika.

Za gubitak prirodnih zuba 62 (59%) ispitanika su okrivila karijes, a 41 (39%) ispitanik parodontopatiju. Pri samoproceni oralnog zdravlja 46 (43,8%) osoba ocenjuje svoje oralno zdravlje kao loše. Na pitanje o vremenu proteklom od poslednje posete stomatologu 27 (25,7%) ispitanika to je učinilo pre manje od jedne godine, a 29 (27,6%) njih pre više od pet godina. Kao razlog poslednje posete stomatologu 62 (59%) ispitanika je navelo „bol ili problem vezan za usta, zube ili zubnu nadoknadu“, dok je svega deset (9,5%) njih došlo na kontrolu. Na 13. pitanje iz upitnika, 39 (43,8%) ispitanika se seća da je dobilo savet od lekara o potrebi redovnih kontrola. Na pitanje o razlozima neredovnog dolaska na stomatološke pregledne odgovori su sledeći: „strah od stomatološke intervencije“ – 35 (33,3%) ispitanika; „visoka cena stomatoloških usluga“ – 17 (16,2%) ispitanika; „nepostojanje (ili loša organizacija) stomatološke službe u mestu gde sam živeo/la“ – 13 (12,4%) ispitanika; „zanemarivanje zdravlja zuba i usta zbog drugih životnih problema“ – 22 (21%) ispitanika; „zanemarivanje zdravlja zuba i usta zbog nedovoljnog znanja o njihovom značaju“ – 18 (17,1%) ispitanika.

Kada je korišćenje duvanskih proizvoda u pitanju, 43 (41%) osobe su korisnici. Da su korisnici alkoholnih napitaka izjasnilo se njih 22 (21%).

Oralnohigijenske navike

Odgovori na pitanja koja se odnose na oralnozdravstvene navike prikazani su u Tabeli 3.

Tri puta u toku dana zube / zubnu protezu pere 41% ispitanika. Osoba koje imaju preostale prirodne zube je 62 (59,05%). Na pitanje koja sredstva koriste za njihovo pranje: 64,5% ispitanika koristi samo četkicu i pastu; 24,2% ispitanika osim četkice i paste koristi i dentalni konac; 11,3% ispitanika upotrebljava osim četkice i paste još i tečnosti za ispiranje usta. Osobe koje imaju zubne proteze u visokom procentu (68,6%) koriste četkicu i pastu za zube za pranje proteze. Alternativna sredstva za higijenu proteza (sapuni i deterdženti za pranje sudova koji se koriste u domaćinstvu, soda bikarbona, limunov sok, izbeljivač natrijum-hipohlorit, grube četkice i sl.) koristi 31,4% nosilaca mobilnih zubnih proteza. Po pitanju korišćenja tableta za čišćenje proteza ispitanici su podeljeni. Navike nošenja zubne nadoknade tokom 24 h ispitanici su izrazili tako što se 40,7% njih izjasnilo da ih nosi „i danju i noću“, dok 59,3% ispitanika nosi zubne proteze samo danju. Kada proteze nisu u ustima, 51,2% osoba ih drži u čaši sa vodom, dok ih 48,8% osoba čuva u čaši/kutiji za protezu bez vode.

Razlozi dolaska na Medicinski fakultet u Podgorici i zadovoljstvo pruženim oralnozdravstvenim uslugama

Ispitanici su se na dva pitanja iz trećeg dela upitnika izjasnili da je „preporuka člana porodice ili prijatelja“ bila razlog da se za stomatološku uslugu obrate na Medicinski fakultet (65,7%

osoba). Stručnost stomatologa koji rade na Studijskom programu stomatologije je bila razlog kod 18,1% osoba i povoljna cena usluga kod 16,2% ispitanika. Oralnozdravstvenim tretmanom koji su dobili u pomenutoj ustanovi bilo je zadovoljno 92,4% pacijenata (Tabela 4).

DISKUSIJA

Jedan od ključnih preduslova za očuvanje oralnog zdravlja i održavanje terapijskog dejstva zubne nadoknade jeste dolazak na redovne kontrolne preglede. Rezultate slične kao kod crnogorskih ispitanika pokazala su istraživanja Popovića Ž. i saradnika [16] u Srbiji i Ograjšek Škunca i saradnika [17] u Hrvatskoj. Mariño R. i autori [14] u studiji rađenoj u Čileu pokazuju rezultate najsličnije onima kod starih u Crnoj Gori. Ponašanje starih u Kini istraživali su Zhu L., Petersen P. i saradnici [15] i rezultati su takođe saglasni. Zubiene J. i saradnici [18] ukazuju na odgovornije oralnozdravstveno ponašanje starih u Litvaniji u odnosu na stare u Crnoj Gori. Ustanovljeno je da stepen obrazovanja ima uticaj na redovnost posećenosti, što govori o uticaju formalnog obrazovanja na zdravstveno ponašanje (Tabela 2). Na 13. pitanje iz upitnika blizu polovine se izjasnilo da se seća da je dobilo savet od lekara o neophodnosti dolazaka na kontrolne pregledе najmanje jednom godišnje. Kada ovaj podatak stavimo u korelaciju sa podatkom da mali broj ispitanika to zaista i čini, možemo zaključiti da stare osobe ne primenjuju uputstva lekara. Značajno više muškaraca u odnosu na žene se izjasnilo da je dobilo ovakav savet od stomatologa, a takođe i osobe 65–74 godine u odnosu na starije od 75 godina (Tabela 2). Evidentno je da su ispitanici svesni da je potrebno redovnije dolaziti na stomatološke pregledе, što se vidi i po odgovoru na pitanje broj 9, gde više od jedne trećine navodi da je zanemarilo svoje oralno zdravje zbog neznanja o njegovom značaju ili zbog okupiranosti drugim životnim problemima (Tabela 2).

Kao razlog poslednje posete stomatologu rezultati u ovoj studiji saglasni su sa rezultatima istraživanja kod starih osoba u Srbiji [16], u Čileu [14] i u Kini [15], gde dominira bol/problem sa ustima, zubima ili zubnim nadoknadama kao razlog posete. Stari u Litvaniji [18] u 58,3% posetili su stomatologa iako nisu imali zdravstvenih problema, čime pokazuju da shvataju značaj redovnih kontrola.

Može se reći da stare osobe u Crnoj Gori ne shvataju celovitost zdravlja i povezanost opštег sa oralnim zdravljem. U svetu rečenog treba sagledati podatak iz istraživanja Popovića Z. i saradnika [30] iz 2016. godine, kada je procenjeno da kod 67,65% starih osoba u središnjem regionu Crne Gore postoji potreba za brzim tretmanom, što se uglavnom odnosi na neophodnost izrade novih zubnih nadoknada. Prosečna starost zubnih nadoknada tada je iznosila 11 godina. Stare osobe imaju odgovorniji odnos prema opštem zdravljу u odnosu na oralno zdravje, što se jasno vidi iz podatka da se blizu polovine njih jednom godišnje podvrgava kontroli osnovnih laboratorijskih nalaza (analiza krvi i urina). U ovome značajno prednjače osobe sa visokim stepenom obrazovanja u odnosu na ostale (Tabela 2). U prilog ovoj tvrdnji ide i podatak da je 97,1% ispitanika izabralo svog lekara opšte prakse, dok je svog stomatologa izabralo manje od polovine ispitanika. Da je decenijama unazad građeno poverenje u državni sistem stomatološke zaštite pokazuje podatak da su osobe koje danas imaju 65 i više godina u prethod-

nim decenijama u visokom procentu ostvarivale stomatološke usluge isključivo u državnim ordinacijama nasuprot osobama koje su to činile isključivo u privatnim ordinacijama (Tabela 2). Stare osobe stekle su oralnozdravstvene navike u vreme kada je zdravstveni sistem u Crnoj Gori bio sistemski uređen drugačije nego danas. Sve usluge u državnim ambulantama do 2008. godine pružane su bez novčane nadoknade ili uz neznatnu participaciju celokupnom stanovništvu o trošku Fonda za zdravstvenu zaštitu Crne Gore (FZOCG). Istovremeno su postojale i privatne zubne ordinacije. Nakon 2008. godine, kada je sprovedena reforma zdravstvenog sistema u Crnoj Gori, 95% stomatoloških ordinacija prevedeno je iz državnog u privatni sektor. Uveden je pojam „izabrani stomatolog“. Najranjivije kategorije stanovništva, među kojima i stare osobe, obuhvaćene su obaveznim vidom stomatološke zaštite i omogućeno im je da se leče kod stomatologa koga same izaberu. Od stomatoprotetskih radova se ne naplaćuje izrada akrilatnih mobilnih zubnih proteza, dok se izrada svih ostalih zubnih nadoknada naplaćuje po tržišnim cenama. Danas crnogorski ispitanici ne prepoznavaju u dovoljnoj meri mogućnosti koje im pruža državni sistem dentalne zaštite. Broj ordinacija na teritoriji Crne Gore koje imaju ugovor sa FZOCG, čiji doktori stomatologije stoje na raspolaganju da postanu „izabrani“, ima oko 190 (u Podgorici 123). Razlog zbog kojeg je manje od polovine izabralo stomatologa možemo tražiti i u činjenici da iako zakonski postoji mogućnost registrovanja specijalizovanih ambulanti za stomatološku protetiku (što za stare osobe ima najveći značaj), do sada ne postoji takva specijalizovana ordinacija (koja ima ugovor sa FZOCG). Rad sa stariim osobama je u svim aspektima veoma specifičan, te je potrebno osposobiti kadar za formiranje gerontostomatoloških timova. Prema podacima Stomatološke komore Crne Gore, trenutno na evidenciji strukovne organizacije stomatologa u državi postoji osam specijalista stomatološke protetike, a samo jedan radi u Stomatološkoj poliklinici Kliničkog centra, kao najznačajnijoj stomatološkoj ustanovi državnog zdravstva. Od postojećeg broja pet specijalista je honorarno angažovano u realizaciji praktične nastave na Fakultetu. Pokazalo se da je „preporuka člana porodice ili prijatelja“ bila odlučujuća kod više od polovine ispitanika i ohrabuje podatak da je u visokom procentu izraženo zadovoljstvo pruženom uslugom. Rad na prevenciji oralnih oboljenja se smatra najvažnijim segmentom rada i upravo u tom cilju je i pokrenuto ovo istraživanje. Usmereno je na stare osobe jer se očekuje da će se u budućnosti povećavati njihov broj.

Da ne znaju dovoljno o značaju očuvanja prirodne denticije može se zaključiti i po odgovorima na pitanje broj 5. Iako su većinom bezubi i sa manje od 20 preostalih prirodnih zuba, više od polovine ispitanika svoje oralno zdravje ocenjuje kao dobro. Razlog za ovakav odgovor može se naći u podatku da su 81,9% ispitanika nosioci mobilnih zubnih nadoknada i da je moguće da su kroz odgovor „dobro“ izrazili zadovoljstvo postojećim nadoknadama.

Potrebno je neprestano naglašavati značaj rada na zdravstvenom opismenjavanju stanovništva [34]. Razvijanje komunikacijskih veština terapeuta treba da doprinese stvaranju poverenja i dobre saradnje između pacijenta i stomatologa, što ima značajan uticaj na uspeh terapije i održavanje terapijskih rezultata u vremenu nakon predaje/cementiranja zubne nadoknade. Istiniranje na obaveznoj kontroli kod „izbranog stomatologa“ mora se posmatrati i u sklopu pravilnog selektovanja informacija dobijenih sa društvenih mreža. Korišćenje informacija do-

stupnih na internetu za sticanje saznanja o oralnim oboljenjima, dijagnostičkim i terapijskim mogućnostima može biti veoma korisno, ali samo i jedino u sadejstvu sa informacijama koje se dobijaju od doktora stomatologije kao jedinog stručnog i kvalifikovanog lica za pružanje informacija.

U cilju promovisanja i ostvarivanja preporuke SZO [32] da osobe do 65 godina života treba da sačuvaju najmanje 20 prirodnih zuba, neophodno je raditi na razvijanju oralnohigijenskih navika i promovisati ih kao osnovni uslov očuvanja zdravlja usta i zuba, unapređenja opštег zdravlja i kvaliteta života [28, 33]. Svoje zube / Zubne proteze peru tri puta u toku dana značajno više žene (u odnosu na muškarce), što je saglasno sa rezultatima koje imaju *Aoun G.* i saradnici [26] u Libanu (31,15% žena; 22,54% muškaraca). Veću posvećenost održavanju oralne higijene pokazuju stari u Saudijskoj Arabiji [27] u odnosu na stare osobe u ovom istraživanju. *Olusile A.* O i saradnici [21] u studiji rađenoj u Nigeriji ukazuju da od sredstava za oralnu higijenu osobe starije od 60 godina koriste pomoćna sredstva za higijenu u 39,9% slučajeva, što je saglasno sa rezultatima u ovoj studiji. Nasuprot tome, stare osobe u Iranu (*Asgari F.* i saradnici [19]) i u zapadnom Kamerunu (*Lolita Y. M* [20]) znatno ređe ih koriste. *Asgari F.* i saradnici [19] u svom istraživanju ukazuju da se oralna higijena razvija sa godinama, da se maksimum postiže u dobi između 25–34 godine, a zatim postepeno opada.

Kad je u pitanju održavanje higijene zubne proteze, rezultati u ovoj studiji u skladu su sa rezultatima istraživanja koje su prikazali *Evren B. A.* i saradnici [22] u Turskoj. Nesumnjivo je da pacijent pri predaji proteze treba pružiti detaljna uputstva o nezi iste i o neophodnosti kontrolnih pregleda. *Mok J.* i saradnici [24] naglašavaju značaj pisanih brošura za održavanje higijene proteza jer smatraju da stariji pacijenti ne mogu da zapamte sve instrukcije iz različitih razloga, kao što su stres, zbunjenost ili njihova smanjena memorija. Blaga oštećenja saznajnih moći pojavljuju se kod 36,1% hospitalizovanih starijih pacijenata i kod oko 23% onih od 65 godina i starijih. Čak i bez oštećenja saznajnih moći većina ljudi zapamtiti manje od 1/4 onog što čuju. Stoga preporučuju da se pacijentima pored verbalnih instrukcija demonstriraju tehnike pranja i uruči uputstvo u obliku brošure o održavanju proteze i o potrebi redovnih kontrola. *Marchini* i saradnici [25] istraživali su vezu između nedostatka uputstava koja se tiču oralnog zdravlja i čišćenja proteze i prisustva proteznog stomatita. Zaključuju da je mehaničko čišćenje preovlađujući metod održavanja higijene proteza i da je nedostatak informacija o brizi za oralno zdravlje bio statistički povezan s inflamatornim stanjem oralne duplje. *Strajnčić J.* i

saradnici [3] zaključuju da nečiste proteze predstavljaju zdravstveni i estetski problem za osobe koje ih koriste. Preporučuju kombinaciju mehaničkog i hemijskog čišćenja proteza i korišćenje tableta za čišćenje proteza. Takođe se moraju dati uputstva o pravilnom korišćenju proteza. Brojna istraživanja [25, 26, 27] posvećena su uticaju proteze na oralnu sluzokožu i mikrofloru i na nutricioni status. Preovladava mišljenje da sluzokoža tegumenta ne sme da bude pod stalnim pritiskom protezne baze, kao i da je protezu bolje držati (dok nije u ustima) na suvom nego u kontaktu sa vodom [31].

Istraživanja ovog tipa imaju društveni značaj, jer posedovanje podataka prikupljenih na ovaj način doprinosi realnom projektovanju potrebe za materijalnim sredstvima i kadrovskim kapacitetima za obezbeđenje efikasnije i kvalitetnije stomatološke zaštite u celini. Značaj ovog istraživanja je i u tome što je prvo istraživanje oralnohigijenskih navika i oralnozdravstvenog ponašanja kod starih osoba rađeno u Crnoj Gori. Korišćenje u svakodnevnoj praksi upitnika sa istim ili sličnim pitanjima kao što su u ovom upitniku (u sklopu uzimanja anamnestičkih podataka) može biti veoma korisno za pravljenje oralnozdravstvenog profila pacijenta i stvaranje slike o pacijentovim nавикама i shvatanju zdravlja. Ova saznanja su važna za donošenje optimalnog plana terapije pre početka sanacije oboljenja usne duplje i izrade zubne nadoknade. U budućim istraživanjima treba staviti akcenat na stare osobe koje žive u južnom i severnom regionu države. Takođe je potrebno obuhvatiti osobe koje su smeštene u domovima za boravak starih lica.

Dobijeni rezultati mogu se smatrati reprezentativnim za stare osobe koje žive ne samo u Podgorici već i u središnjem regionu države. U potrazi za specijalističkom uslugom pacijenti iz drugih gradova središnjeg dela države (Danilovgrad, Cetinje i Nikšić) dolaze u Podgoricu, u kojoj živi oko 300.000 stanovnika, što je skoro polovina cele Crne Gore.

ZAKLJUČAK

Oralnozdravstveno ponašanje i oralnohigijenske navike starih osoba u Podgorici nisu na zadovoljavajućem nivou. S obzirom na to da stari najviše imaju potrebu za protetskom terapijom, mora se raditi na unapređenju stomatoprotetske zaštite u državnom zdravstvenom sistemu, čemu značajno može da doprinese Fakultet.

Zahvalnost Stomatološkoj komori Crne Gore na pružanju podataka iz svoje nadležnosti i evidencije.

Micoleakage assessment of a resin based sealant after acid etching and Er: YAG laser treatment – an *in vitro* study

Liburn Kurtiši¹, Mira Jankulovska², Meri Pavlevska², Elizabeta Gorgievska², Ana Sotirovska Ivkova², Sonja Apostolska², Vasilka Rendžova², Vesna Ambarkova², Marija Jankulovska³

¹Dental office "Dr. Liburn", Tetovo, North Macedonia;

²University Dental Clinic St. Panteleimon, Faculty of Dentistry, Skoplje, North Macedonia;

³Dental office "Ardent", Skoplje, North Macedonia

SUMMARY

Introduction Marginal adaptation of sealants is important element in prevention of dental caries. The failure of marginal adaptation leads to marginal leakage, passage of bacteria, fluids, molecules or ions between enamel and sealant, creating possibility for development of dental caries below the sealant. The aim of this study was to assess and compare micoleakage of resin based sealant after acid etching and Er: YAG laser treatment of enamel.

Materials and Methods An *in vitro* study included 30 premolars and molars extracted for orthodontic purpose, without any structural anomalies, and divided in the two groups of 15 samples. Group I included teeth with fissures sealed using resin based sealant (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein) after enamel etching with 37% phosphoric acid. Group II consisted of teeth where fissures were sealed with resin based sealant (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein) after enamel etching with Er: YAG laser (Fotona Light Walker Laser).

Results In the group I, 10 (66.67%) samples demonstrated level 0 micoleakage, 2 (13.33%) samples demonstrated level 1 micoleakage and 3 (20%) samples demonstrated level 3 micoleakage. In the second group, 10 (66.67%) samples demonstrated level 0 micoleakage, 1 (6.67%) demonstrated level 1 micoleakage, 2 (13.33%) samples demonstrated level 2 micoleakage and 2 (13.33%) samples showed level 3 micoleakage. Descriptive statistics for micoleakage resulted with mean score=0.73 for the first and second group. There was no statistically significant difference in chosen technique for etching occlusal enamel (37% phosphoric acid or Er: YAG Laser radiation) $p>0.05$ ($p=0.98$), when placing fissure sealants.

Conclusion The use of Er: YAG Laser radiation for pits and fissures treatment, demonstrated excellent results and could replace the procedure of etching pits and fissures with phosphoric acid, with the same effect and without the negative impact of the phosphoric acid.

Keywords: prevention; micoleakage; pit and fissure sealant

INTRODUCTION

From prevention perspective, anatomic grooves or pits and fissures on occlusal surfaces of permanent molars trap food debris and promote the presence of bacterial biofilm, thereby increasing the risk of developing carious lesions. Effectively penetrating and sealing these surfaces with dental material – for example, pit-and-fissure sealants—can prevent lesions and is part of comprehensive caries management approach [1]. The most appropriate and cost-effective treatment for the prevention of occlusal caries in children at high risk is the application of pit-and-fissure sealants [2, 3]. Retention rates vary according to the proper isolation of the working field, viscosity of the sealant material, preparation of enamel surfaces, and use of an adhesive system [4].

The use of phosphoric acid is well-accepted, standard method for roughening enamel surfaces. Unfortunately, conditions are not always optimal and organic remnants as well as fissure morphology and aprismatic enamel

structure can reduce etching performance and thus compromise adhesion [5]. The use of erbium: yttrium-aluminum-garnet (Er: YAG) laser irradiation for dental applications has become increasingly widespread since FDA approval in 1997, and its use for pretreatment and surface conditioning in pit-and-fissure sealing has since been under discussion [6–9].

The laser irradiation of hard dental tissue modifies the calcium/phosphorus ratio, reduces the carbonate/phosphate ratio, and leads to the formation of more stable and less acid-soluble compounds, thus reducing susceptibility to acid attacks and caries [10, 11]. It has also been shown that it has an anti-bacterial effect by trapping free ions and forming remineralisation micro spaces [10, 12].

On the other hand several studies are attributing some level of negative impact of the conventional enamel etching due to demineralization process that occurs after acid etching. It is possible that enamel becomes more vulnerable to dental caries, especially if demineralized surface remains uncovered from the material used as dental seal-

ant. Numerous studies have been done in order to find alternative procedures for enamel preparation such as Er: Yag Laser radiation. Operating principle of Er: Yag Laser is "mechanical" with micro-explosions of instant evaporation of the tissue water.

Retention and good adaption of the sealants with the occlusal surface of the enamel is essential for their success.

Therefore, the aim of our study was to assess and compare microleakage of resin based sealant after acid etching and Er: YAG laser treatment of enamel.

MATERIALS AND METHODS

An *in vitro* study that included 30 extracted premolars and molars free of any caries, structural anomalies, without restorations and with orthodontic indication for extraction were distributed equally in the two groups (15 in each). After the extraction the samples were stored in saline solution.

The two groups tested were:

Group-I: Fissures sealed with composite based fissure sealant (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein) after enamel etching with 37% phosphoric acid.

Group-II: Fissures sealed with composite based fissure sealant (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein) after enamel treatment with Er: YAG laser (Fotona Light Walker Laser).

For microleakage assessment, samples were cleaned with periodontal curettes and pumice, washed, rinsed with 3% hydrogen peroxide and dried with oil free air syringe.

According to the manufacturer instructions, the samples from the first group were etched with 37% phosphoric acid gel during 30 seconds, rinsed with water, dried with oil free air syringe and sealed with resin based sealant Helioseal-F. The sealant was photopolymerized for 20 seconds with halogen lamp Bonart art-L2 with wavelength around 400 nm.

The occlusal surface of the samples from the second group was treated with laser irradiation of Fotona Light-Walker Laser (Erbium: YAG laser) with 6W intensity, energy of 300 mJ per pulse and frequency of 20 Hz. After the irradiation the samples were dried with oil free air syringe and sealed accordingly to the manufacturer instructions as the samples of the first group.

The root apices were sealed with red wax. All the samples were then covered with two layers of nail varnish, except for the 1 mm window around the sealant margins, and immersed in 2% methylene blue solution for 24 h.

After the dye exposure, the teeth were thoroughly washed under running tap water for 5 minutes to remove the superficial dye and then nail varnish was removed with the scalpel. Longitudinal sections were prepared with a diamond disk, in bucco-lingual direction. Approximately 1.5 mm thick sections were made to assess the degree of dye penetration in the occlusal cavity walls separately under a binocular microscope at 40X magnification and photographed

with digital camera. Marginal dye penetration was assessed and determined 4 levels of marginal leakage (0-No penetration, 1-Penetration up to one half the sealant's length, 2-Penetration greater than one half, not including the underlying fissure, 3- Penetration into the underlying fissure) as per Overbo R.C and Raddal M [13].

Microleakage data for each groups were compared using the Kruskal-Wallis test ($p=0.05$). Significant differences were evaluated using the Mann-Whitney U test (Z).

RESULTS

In the first group that contained samples sealed with Helioseal-F after etching enamel with 37% phosphoric acid, 10 (66.67%) samples demonstrated level-0 microleakage, 2 (13.33%) samples demonstrated level-1 microleakage and 3 (20%) samples demonstrated level-3 microleakage. Second group that contained samples, sealed with Helioseal-F, after enamel treatment with Er: YAG laser radiation showed following results: 10 (66.67%) samples showed level-0 microleakage, 1 (6.67%) sample showed level-1 microleakage, 2 (13.33%) samples demonstrated level-2 microleakage and 2 (13.33%) samples demonstrated level-3 microleakage (Table 1).

Table 1. Microleakage of the fissure and pitt sealant after etching enamel with 37% phosphoric acid and Er:YAG laser treatment.

Tabela 1. Mikrocurenje zaličavača fisura nakon nagrizanja gledi sa 37% fosfornom kiselinom i tretmana gledi laserom Er: YAG

| | N broj | Microleakage score (%) Mikrocurenje (%) | | | |
|---|-----------|--|--------|--------|--------|
| | | 0 | 1 | 2 | 3 |
| Group 1 Etched with 37% phosphoric acid Grupa 1, tretirana 37% fosfornom kiselinom | 15 | 10 | 2 | 0 | 3 |
| | | 66.67% | 13.33% | 0.00% | 20.00% |
| Group 2 Treated with Er: YAG laser radiation Grupa 2, tretirana laserom Er: YAG | 15 | 10 | 1 | 2 | 2 |
| | | 66.67% | 6.67% | 13.33% | 13.33% |

$p > 0,05$ ($p = 0,98$) indicates that there was no statistically significant difference in microleakage between the samples from the first group (sealed with resin based sealant / etched with 37% phosphoric acid gel) and samples from the second group (sealed with resin based sealant / treated with Er: YAG laser radiation) (Figures 1-6).

DISCUSSION

International paediatric dentistry guidelines recommend sealing the primary and permanent molars in children and adolescents to prevent the onset of cavities and minimize the progression of noncavitated occlusal carious lesions [14, 15]. Pretreatment of enamel with various concentrations of phosphoric acid is traditional method that has certain disadvantages; therefore, other methods

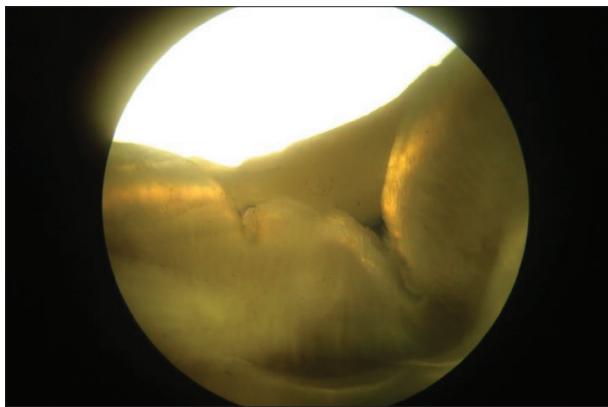


Figure 1. Level 3 microleakage
Slika 1. Treći nivo mikrocurenja

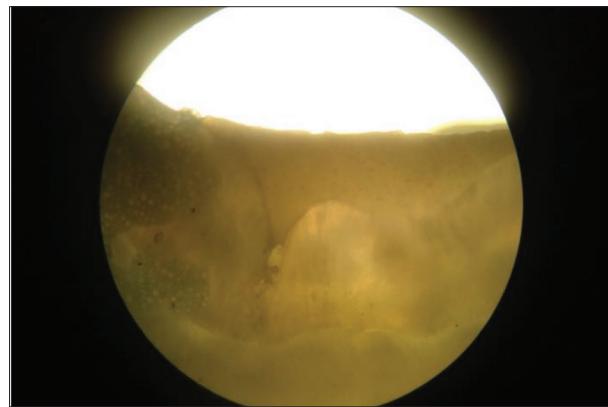


Figure 2. Level 0 microleakage
Slika 2. Nulta vrednost mikrocurenja

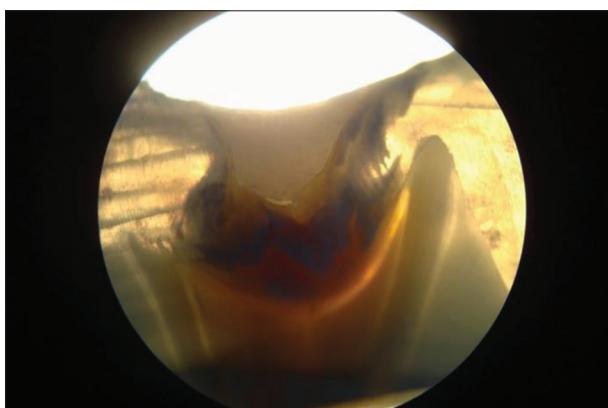


Figure 3. Level 0 microleakage
Slika 3. Nulta vrednost mikrocurenja

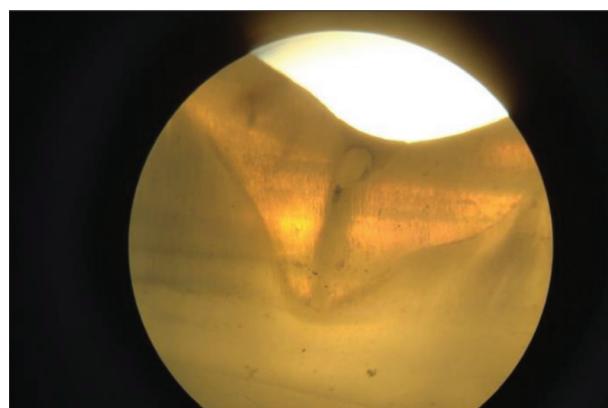


Figure 4. Level 0 microleakage
Slika 4. Nulta vrednost mikrocurenja

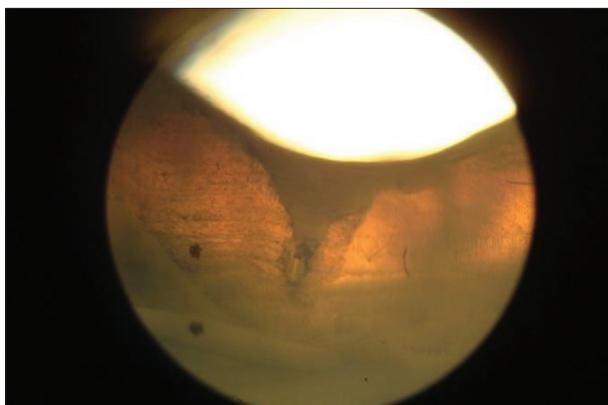


Figure 5. Level 3 microleakage
Slika 5. Treći nivo mikrocurenja

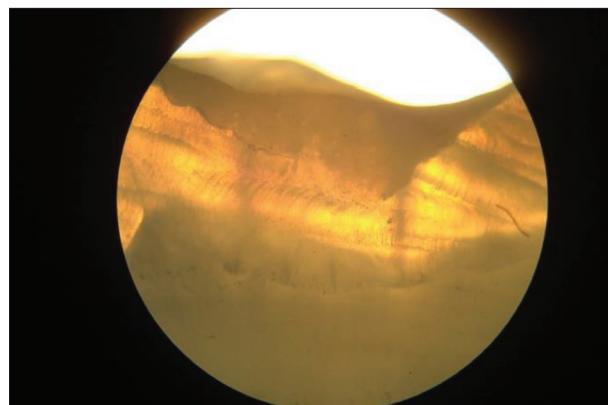


Figure 6. Level 0 microleakage
Slika 6. Nulta vrednost mikrocurenja

such as laser etching of enamel surfaces have gained popularity [9, 16].

Sealant efficiency depends on the ability to achieve strong bond with enamel on occlusal surface. This bond is greatly responsible for the level of microleakage in the interface enamel-sealant. The main reasons for sealant loss are microleakage, sealant depth penetration and placement technical skills.

Operating principle of Er: Yag Laser is “mechanical” with micro-explosions of instant evaporation of the tissue water. Occlusal enamel surface absorbs the laser energy promoting surface modifications, resulting in greater treatment achievement.

Current research has indicated that the application of laser ablation as an adjunct to traditional phosphoric acid etching may improve adhesion, adaptation, retention, and resistance to microleakage of resin-based sealants [17, 18]. Recent clinical and *in vitro* studies support the use of laser ablation prior to acid etching [17–20], although these findings are not unanimously confirmed [5, 21, 22].

Baygin et al. [6] (Er,Cr:YSGG laser 2W, 20 Hz) and Shahabi et al. [9] (Er:YAG laser 100 mJ, 10 Hz) reported that laser etching may be an alternative to conventional acid etching, but laser etching did not eliminate the need for acid etching prior to placement of fissure

sealants. Hossain et al. reported that stereomicroscopic observation revealed laser completely cleaning debris in pits and fissures, reaching the narrowest, deepest parts of the fissures [23]. Authors concluded that the laser removal of debris accumulated in fissures could improve sealant retention. Our findings are in alignment with the findings of Hossain et al. [23] that the laser could improve sealant retention, and also partially in alignment with Baygin et al. [6] and Shahabi et al. [9] where they suggested that laser etching may constitute an alternative to conventional acid etching.

Several findings concerning the use of lasers for enamel etching are contradictory. Some researchers stated that laser irradiation was not capable of etching enamel. Martinez-Insua et al. found weaker adhesion forces in a Er: YAG laser-etched enamel surface than an acid-etched enamel surface [24]. This was related to sub-surface cracks observed in SEM images. Tarcin et al. found that microtensile bond strength was significantly lower in the acid-etched group than the Er, Cr: YSGG and Nd: YAG laser-etched enamel group for both bonding agents used [25]. Borsatto et al. and Lupi-Pegurier et al. both verified that Er: YAG laser irradiation did not eliminate need to etch enamel surface with acid before applying the sealant [26, 27].

CONCLUSION

Er: YAG laser irradiation of pits and fissures could provide strong enamel-sealant adhesion and prevent microleakage and it may be recommended as an alternative method for etching pits and fissures when fissure sealants are applied.

REFERENCES

- Anusavice KJ, Shen C, Rawls HR. Phillips' Science of Dental Materials. St. Louis, Mo.: Elsevier/Saunders; 2013.
- Azarpazhooh A, Main PA. Pit and fissure sealants in the prevention of dental caries in children and adolescents: A systematic review. *J Can Dent Assoc.* 2008; 74:171-7. [PMID: 18353204]
- Erdemir U, Sancaklı HS, Yaman BC, Ozel S, Yucel T, Yıldız E. Clinical comparison of a flowable composite and fissure sealant: A 24-month split-mouth, randomized, and controlled study. *J Dent.* 2014; 42:149-57. [DOI: 10.1016/j.jdent.2013.11.015] [PMID: 24296163]
- Yazici AR, Karaman E, Baseren M, Tuncer D, Yazici E, Unluer S. Clinical evaluation of a nanofilled fissure sealant placed with different adhesive systems: 24-month results. *Oper Dent.* 2009; 34:642-7. [DOI: 10.2341/08-097-C] [PMID: 19953772]
- Ciucchi P, Neuhaus KW, Emerich M, Peutzfeldt A, Lussi A. Evaluation of different types of enamel conditioning before application of a fissure sealant. *Lasers Med Sci.* 2015; 30:1-9. [DOI: 10.1007/s10103-013-1333-2] [PMID: 23636296]
- Baygin O, Korkmaz FM, Tüzüner T, Tanrıverdi M. The effect of different enamel surface treatments on the microleakage of fissure sealants. *Lasers Med Sci.* 2012; 27:153-60. [DOI: 10.1007/s10103-011-0918-x] [PMID: 21476043]
- dos Reis Derceli J, Faraoni-Romano JJ, Azevedo DT, Wang L, Baglion C, Palma-Dibb RG. Effect of pretreatment with an Er:YAG laser and fluoride on the prevention of dental enamel erosion. *Lasers Med Sci.* 2015; 30:857-62. [DOI: 10.1007/s10103-013-1463-6] [PMID: 24149579]
- Lepri TP, Souza-Gabriel AE, Atoui JA, Palma-Dibb RG, Pecora JD, Milori Corona SA. Shear bond strength of a sealant to contaminated-enamel surface: Influence of erbium:yttrium-aluminum-garnet laser pretreatment. *J Esthet Restor Dent.* 2008; 20:386-94. [DOI: 10.1111/j.1708-8240.2008.00214.x] [PMID: 19120785]
- Shahabi S, Bagheri HG, Ramazani K. Tensile bond strength of sealants following Er:YAG laser etching compared to acid etching in permanent teeth. *Lasers Med Sci.* 2012; 27:371-5. [DOI: 10.1007/s10103-010-0869-7] [PMID: 21336680]
- Castellan CS, Luiz AC, Bezinelli LM, Lopes RM, Mendes FM, De P Eduardo C, et al. *In vitro* evaluation of enamel demineralization after Er:YAG and Nd:YAG laser irradiation on primary teeth. *Photomed Laser Surg.* 2007; 25:85-90. [DOI: 10.1089/pho.2006.2043] [PMID: 17508842]
- Corrêa-Afonso AM, Ciccone-Nogueira JC, Pecora JD, Palma-Dibb RG. *In vitro* assessment of laser efficiency for caries prevention in pits and fissures. *Microsc Res Tech.* 2012; 75:245-52. [DOI: 10.1002/jemt.21050] [PMID: 21809416]
- Borsatto MC, Giuntini Jde L, Contente MM, Gomes-Silva JM, Torres CP, Galo R. Self-etch bonding agent beneath sealant: Bond strength for laser-irradiated enamel. *Eur J Dent.* 2013; 7:289-95. [DOI: 10.4103/1305-7456.115412] [PMID: 24926208]
- Overbo RC, Raadal M. Microleakage in fissures sealed with resin or glass ionomer cement. *Scand J Dent Res.* 1990; 98:66-9. [PMID: 2183346]
- Welbury R, Raadal M, Lygidakis NA. EAPD guidelines for the use of pit and fissure sealants. *Eur J Paediatr Dent.* 2004; 5(3):179-84. [PMID: 15471528]
- Wright JT, Crall JJ, Fontana M, Gillette EJ, Nový BB, Dhar V, et al. Evidence-based clinical practice guideline for the use of pit-and-fissure sealants: a report of the American Dental Association and the American Academy of Pediatric Dentistry. *JADA.* 2016; 47:672-82. [DOI: 10.1016/j.adaj.2016.06.001] [PMID: 27470525]
- Pires PT, Ferreira JC, Oliveira SA, Azevedo AF, Dias WR, Melo PR. Shear bond strength and SEM morphology evaluation of different dental adhesives to enamel prepared with Er: YAG laser. *Contemp Clin Dent.* 2013; 4:20-6. [DOI: 10.4103/0976-237X.111588] [PMID: 23853447]
- Khogli AE, Cauwels R, Vercruyse C, Verbeeck R, Martens L. Microleakage and penetration of a hydrophilic sealant and a conventional resin-based sealant as a function of preparation techniques: a laboratory study. *Int J Paediatr Dent.* 2013; 23:13-22. [DOI: 10.1111/j.1365-263X.2011.01218.x] [PMID: 22276649]
- Güçlü ZA, Dönmez N, Tüzüner T, Odabaş ME, Hurt AP, Coleman NJ. The impact of Er:YAG laser enamel conditioning on the microleakage of a new hydrophilic sealant—UltraSeal XT® hydro™. *Lasers Med Sci.* 2016; 31:705-11. [DOI: 10.1007/s10103-016-1878-y] [PMID: 26964797]
- Güçlü ZA, Dönmez N, Hurt AP, Coleman NJ. Characterisation and microleakage of a new hydrophilic fissure sealant—UltraSeal XT® hydro™. *J Appl Oral Sci.* 2016; 24:344-51. [DOI: 10.1590/1678-775720160010] [PMID: 27556205]
- Durmus B, Giray F, Peker S, Kargul B. Clinical evaluation of a fissure sealant placed by acid etching or Er:YAG laser combined with acid etching. *Oral Health Prev Dent.* 2017; 15:157-62. [DOI: 10.3290/j.ohpda37927] [PMID: 28322359]
- Borsatto MC, Corona SAM, Palma-Dibb RG, Ramos RP, Pecora JD. Microleakage of a resin sealant after acid-etching, Er:YAG laser irradiation and air-abrasion of pits and fissures. *J Clin Laser Med Surg.* 2001; 19:83-7. [DOI: 10.1089/104454701750285403] [PMID: 11443794]
- Sungurtekin-Ekci E, Oztas N. Microtensile bond strength of a resin-based fissure sealant to Er, Cr:YSGG laser-etched primary enamel. *Odontology.* 2016; 104:163-9. [DOI: 10.1007/s10266-015-0203-8] [PMID: 25847685]
- Hossain M, Yamada Y, Masuda-Murakami Y, Nakamura Y. Removal of organic debris with Er:YAG laser irradiation and microleakage of fissures sealants in vitro. *Lasers Med Sci.* 2012; 27:895-902. [DOI: 10.1007/s10103-011-0994-y] [PMID: 21968762]

24. Martínez-Insua A, Da Silva Dominguez L, Rivera FG, Santana-Peníñ UA. Differences in bonding to acid-etched or Er: YAG-laser-treated enamel and dentin surfaces. *J Prosthet Dent.* 2000; 84:280-8. [DOI: 10.1067/mpr.2000.108600] [PMID: 11005900]
25. Tarcin B, Gunday M, Ovecoglu HS, Türkmen C, Oveçoglu ML, Ok-süz M, et al. Tensile bond strength of dentin adhesives on acid- and laser-etched dentin surfaces. *Quintessence Int.* 2009; 40:865-74. [PMID: 19898719]
26. Borsatto MC, Corona SA, Ramos RP, Liporaci JL, Pecora JD, Palma-Dibb RG, et al. Microleakage at sealant/enamel interface of primary teeth: effect of Er: YAG laser ablation of pits and fissures. *J Dent Child (Chic).* 2004; 71:143-7. [PMID: 15587098]
27. Lupi-Pégurier L, Bertrand MF, Genovese O, Rocca JP, Muller-Bolla M. Microleakage of resin-based sealants after Er: YAG laser conditioning. *Lasers Med Sci.* 2007; 22:183-8. [DOI: 10.1007/s10103-006-0437-3] [PMID: 17256104]

Received: 05.03.2019 • Accepted: 07.08.2019

Procena mikropustljivosti zalivača na bazi smole nakon nagrizanja kiselinom i tretmana laserom Er: YAG – *in vitro* studija

Liburn Kurtiši¹, Mira Jankulovska², Meri Pavlevska², Elizabeta Gorgjevska², Ana Sotirovska Ivković², Sonja Apostolska², Vasilka Rendžova², Vesna Ambarkova², Marija Jankulovska³

¹Stomatološka ordinacija „Dr. Liburn”, Tetovo, Severna Makedonija;

²Univerzitetska stomatološka klinika „Sv. Pantelejmon”, Stomatološki fakultet, Skoplje, Severna Makedonija;

³Stomatološka ordinacija „Ardent”, Skoplje, Severna Makedonija

KRATAK SADRŽAJ

Uvod Marginalno zaptivanje zalivača je izuzetno važan element u prevenciji zubnog karijesa. Neuspeh marginalnog zaptivanja dovodi do marginalne mikropustljivosti, odnosno prodora bakterija, tečnosti, molekula ili jona između gledi i zalivača, što stvara mogućnost za razvoj zubnog karijesa.

Cilj ove studije je bio da se proceni i uporedi mikropustljivost zalivača na bazi smole nakon nagrizanja kiselinom i laserskog tretmana Er: YAG laserom.

Materijali i metode U istraživanje je bilo uključeno 30 premolara i molara ekstrahovanih iz ortodontskih razloga, bez ikakvih strukturnih anomalija, podeljenih u dve grupe – od po 15 zuba za svaku grupu. Grupa I: fisure zalive zalivačem na bazi smole (Helioseal-F, Ivoclar Vivadent AG, Lihtenštajn), gde je nagrizanje sprovedeno 37% ortofosfornom kiselinom. Grupa II: fisure zalive zalivačem na bazi smole (Helioseal-F, Ivoclar Vivadent AG, Lihtenštajn) nakon tretmana laserom Er: YAG (laser Fotona Lightwalker).

Rezultati Prva grupa je sadržala uzorke zalive Helioseal-F, nagrižene 37% ortofosfornom kiselinom. Deset (66,67%) uzorka je pokazalo mikropustljivost ocene 0, dva (13,33%) uzorka mikropustljivost ocene 1, a tri (20,00%) uzorka mikropustljivost ocene 3. Druga grupa je sadržala uzorke zalive Helioseal-F, nakon primene laserskog zračenja Er: YAG. Deset (66,67%) uzorka je pokazalo mikropustljivost ocene 0, jedan (6,67%) uzorak mikropustljivost ocene 1, dva (13,33%) uzorka mikropustljivost ocene 2 i dva (13,33%) uzorka mikropustljivost ocene 3.

Deskriptivna statistika mikropustljivosti rezultirala je srednjim rezultatom 0,73 za prvu i drugu grupu. Rezultati studije pokazuju da nema razlike u tehnički koju smo odabrali za nagrizanje okluzalne gledi (37% ortofosforna kiselina ili lasersko zračenje Er: YAG): $p > 0,05$ ($p = 0,98$). Razlika nije statistički značajna između ove dve grupe.

Zaključak Upotreba laserskog zračenja Er: YAG za tretiranje jamica i fisura pokazala je odlične rezultate i mogla bi da zameni postupak nagrizanja jama i fisura ortofosfornom kiselinom, sa istim efektom i bez negativnog uticaja ortofosforne kiseline.

Ključne reči: prevencija; mikropustljivost; zalivač jama i fisura

UVOD

Iz perspektive primarne prevencije, anatomske brazde ili jamice na okluzalnim površinama stalnih molara zadržavaju ostatke hrane i promovišu prisustvo bakterijskog biofilma, povećavajući tako rizik od nastanka karijesa. Efikasno prodiranje i zaptivanje ovih površina zubnim materijalom – na primer, zalivačima jamica i fisura – može se sprečiti pojava karijesne lezije, što predstavlja deo sveobuhvatnog pristupa lečenju karijesa [1]. Najbolji i najisplativiji tretman za prevenciju okluzalnog karijesa kod dece sa visokim rizikom je primena zalivača fisura [2, 3]. Stope opstajanja variraju u zavisnosti od pravilne izolacije radnog polja, viskoznosti materijala za zalianje, pripreme površine gledi i upotrebe adhezivnog sistema [4].

Upotreba ortofosforne kiseline je dobro prihvaćena, standarna metoda za grubo obrađivanje površine gledi. Nažalost, uslovi nisu uvek optimalni i organski ostaci, kao i morfologija fisura i aprizmatična struktura gledi, mogu smanjiti performanse nagrizanja i tako ugroziti adheziju [5]. Upotreba laserskog zračenja erbijum: aluminijum-granat (Er: YAG) u stomatološkoj praksi postala je sve učestalija od odobravanja FDA, 1997. godine, a njegova primena u pripremi i kondicioniranju površine gledi u zalianju jamica i fisura od tada se ispituje i proverava [6–9].

Lasersko zračenje tvrdog zubnog tkiva menja odnos kalcijum : fosfor, smanjuje odnos karbonat : fosfat i dovodi do stvaranja stabilnijih jedinjenja, manje rastvorljivih u kiselini, smanjujući tako podložnost dejstvu kiseline i karijesu [10, 11]. Smatra

se da ima i antibakterijski efekat zarobljavanjem slobodnih jona i formiranjem remineralizacionih mikroprostora [12, 10].

Razlog zbog kojeg nekoliko studija pripisuje određeni nivo negativnog uticaja konvencionalnog nagrizanja gledi kiselinom je proces demineralizacije koji se dešava nakon kiselinskog nagrizanja, pri čemu gled postaje prijemljivija na zubi karijes, naročito kada demineralizovana površina ostane nezaštićena materijalom koji se koristi kao zubi zaptivač. Za prevazilaženje ovog problema sprovedene su brojne studije u potrazi za alternativnim postupcima za pripremu gledi kao što je lasersko zračenje Er: YAG. Princip rada laserskog zračenja Er: YAG je „mehanički“ sa mikroeksplozijama trenutnog isparavanja tkivne vode. Zadržavanje i dobra adaptacija zalivača sa površinom gledi su faktori od suštinskog značaja za njihov uspeh. To je bio glavni razlog za ispitivanje karakteristika mikropukotina primenom zaptivača Heliosotineal-F na bazi smole, nakon različite pripreme okluzalne površine.

Ova studija se bavi ispitivanjem i upoređivanjem marginalnog curenja zalivača na bazi smole nakon kiselinskog nagrizanja i laserskog tretmana Er: YAG laserom.

MATERIJALI I METODE

Za realizaciju našeg istraživanja korišćeno je 30 intaktnih premolara i molara – bez karijesa, strukturnih anomalija i bez restauracija ekstrahovanih iz ortodontskih razloga – podeljenih u

dve grupe (15 u svakoj). Nakon ekstrakcije uzorci su bili čuvani u fiziološkom rastvoru.

Distribucija grupa:

Prva grupa: fisure zalive kompozitnim zaličem (Helioseal-F, Ivoclar Vivadent AG, Lihtenštajn), prethodno nagrižene sa 37% ortofosfornom kiselinom.

Druga grupa: fisure zalive kompozitnim zaličem (Helioseal-F, Ivoclar Vivadent AG, Lihtenštajn), prethodno tretirane laserom Er: YAG (laser Fotona Lightwalker).

Za procenu mikropukotina, uzorci su prethodno očišćeni parodontalnim kiretama, podvrgnuti pranju, potapanju u 3% hidrogen peroksidu i sušenju vazdušnim mlazom iz pustera.

1. Prema uputstvu proizvođača, uzorci iz prve grupe su nagrizani sa 37% gelom ortofosorne kiseline u trajanju od

30 sekundi, isprani vodom, posušeni vazdušnim mlazom iz pustera i zalive Gerioseal-F na bazi smole. Zalič je fotopolimerizovan tokom 20 sekundi halogenom lampom Bonart art-L2 talasne dužine oko 400 nm.

2. Okluzalna površina uzoraka iz druge grupe tretirana je laserskim zračenjem laserom Fotona Lightwalker (laser Erbium: YAG) intenziteta 6 V, energije od 300 mJ po impulsu i frekvencije 20 Hz. Nakon tretmana uzorci su osušeni vazdušnim mlazom i zalive prema uputstvima proizvođača kao uzorci iz prve grupe.

Vrhovi korenova su bili zapečaćeni roze voskom. Svi uzorci su zatim prekriveni sa dva sloja laka za nokte, osim površine od 1 mm oko ivice zaliča, i uronjeni u 2% rastvor metilensko plavo tokom 24 sata.

Nakon izlaganja boji, zubi su temeljno očišćeni pod tekućom vodom iz slavine u trajanju od pet minuta da bi se uklonila površinska boja, a zatim je lak za nokte uklonjen skalpelom. Dijamantskim diskom su pripremljeni uzdužni preseci u bukvalingvalnom pravcu. Preseci su bili približno 1,5 mm debljine kako bi se procenio stepen prodiranja boje ispod okluzalne površine. Korišćen je biokularni mikroskop sa uvećanjem 40× i fotografije su napravljene digitalnim fotoaparatom. Određen je stepen marginalnog prodora boje u četiri nivoa kao što su to uradili autori Overbo R. C. i Raddal M. [13]:

MARGINALNA PROPUSTLJIVOST

0 – Nema prodora

1 – Prodiranje do polovine dužine zaliča

2 – Prodiranje veća od jedne polovine, ne uključujući fisuru

3 – Prodiranje u fisuru

Podaci mikropustljivosti za svaku grupu su poređeni korišćenjem Kraskal–Volisovog testa ($p = 0,05$). Značajne razlike procenjene su korišćenjem Man–Vitnijevog U testa (Z).

REZULTATI

Prva grupa je sadržala uzorke zalive Helioseal-F, nagrižene 37% ortofosfornom kiselinom. Deset (66,67%) uzoraka je pokazalo mikropustljivost ocene 0, dva (13,33%) uzorka mikropustljivost ocene 1, a tri (20,00%) uzorka mikropustljivost ocene 3. Druga grupa je sadržala uzorke zalive Helioseal-F, gde je okluzalna površina prethodno pripremljena primenom laserskog zračenja Er: YAG laserom. Deset (66,67%) uzoraka je pokazalo mikropustljivost ocene 0, jedan (6,67%)

uzorak je pokazao mikropustljivost ocene 1, dva (13,33%) uzorka mikropustljivost ocene 2 i 2 (13,33%) uzorka mikropustljivost ocene 3 (Tabela 1).

Vrednost $p > 0,05$ ($p = 0,98$) ukazuje da ne postoji statistički značajna razlika u mikropustljivosti između uzoraka iz prve grupe (zalive zaličem na bazi smole / nagrizanjem sa 37% gelom ortofosorne kiseline) i uzorcima iz druge grupe (zalive zaličem na bazi smole / tretiranim laserskim zračenjem Er: YAG).

Fotografije opisuju nivo mikropustljivosti na nekoliko preseka zuba koji su napravljeni tokom naše studije.

Fotografije 1, 2 i 3 napravljene su od uzoraka iz grupe 1, koji su zalive Helioseal-F i nagriženi 37% ortofosfornom kiselinom.

Slike 4, 5 and 6 su napravljene iz uzoraka iz druge grupe, gde je postavljen zalič Helioseal-F, a površine prethodno pripremljene nagrizanjem kiselinom ili tretiranjem laserskim zračenjem Er: YAG.

DISKUSIJA

Međunarodna preporuka stomatologa i dečjih stomatologa je zalianje mlečnih i stalnih molara kod dece i adolescenata kako bi se sprečio nastanak karijesa i minimiziralo napredovanje nekavitizovanih okluzalnih karijesnih lezija [14, 15]. Priprema gleđi raznim koncentracijama ortofosorne kiseline je uobičajena metoda koja ima određene nedostatke; stoga su i druge metode, poput laserske pripreme površine gleđi, stekle popularnost [9, 16].

Efikasnost zaliča zavisi od njegove sposobnosti da postigne snažnu vezu sa gleđi na okluzalnoj površini. Ova veza je u velikoj meri odgovorna za nivo mikropustljivosti u delu gleđ–zalič. Glavni razlozi gubitka zaliča odnose se na osovinu mikrootpornosti, dubine prodiranja i postavljanja zaliča.

Princip rada lasera Er: YAG je „mehanički“ sa mikroeksplozijama trenutnog isparavanja tkivne vode. Okluzalna površina gleđi apsorbuje lasersku energiju, koja dovodi do modifikacije površine, što poboljšava terapijski efekat.

Trenutno istraživanje je pokazalo da primena laserske ablacijske kao dodatak tradicionalnom nagrizanju ortofosfornom kiselinom može poboljšati prijanjanje, prilagođavanje, zadržavanje i otpornost na mikropustljivost zaliča na bazi smole [17, 18].

Nedavna klinička i *in vitro* istraživanja podržavaju upotrebu laserske ablacije pre nagrizanja gleđi kiselinom [17–20], mada ovi nalazi nisu jednoglasno potvrđeni [5, 21, 22].

Baigin i saradnici [6] (laser Er, Cr: ISGG, 2 V, 20 Hz) i Shahabi i saradnici [9] (laser Er: YAG, 100 mJ, 10 Hz) objavili su da lasersko nagrizanje može predstavljati alternativu konvencionalnom nagrizanju kiselinom, ali da nije eliminisalo potrebu za kiselinskim nagrizanjem pre stavljanja zaliča. Hossain M. i saradnici [23] saopštili su da stereomikroskopsko istraživanje pokazuju da laser potpuno uklanja ostatke nečistoća u jamama i fisurama, imajući prednost da dosegne do najužih, najdubljih delova pukotina. Autori su zaključili da lasersko uklanjanje plaka akumuliranog u fisurama može poboljšati zadržavanje zaliča.

Naši nalazi se podudaraju sa nalazima koje su objavili Hossain M. i saradnici [23], koji smatraju da laser može poboljšati trajnost zaliča, a takođe su delimično uskladjujući sa nalazima koje su objavili Baigin i saradnici [6] i Shahabi i saradnici [9]

u rečenici u kojoj sugerišu da lasersko nagrivanje može predstavljati alternativu konvencionalnom nagrivanju kiselinom.

Nekoliko nalaza koji se tiču upotrebe lasera za nagrivanje gledi su kontradiktorni. Neki istraživači su izjavili da lasersko zračenje nije sposobno da nagrize gled. *Martinez-Insua A.* i saradnici [24] zaključili su da su adhezivne sile slabije nakon primene lasera Er: YAG na gled u odnosu na površinu gledi na koju je aplikovana kiselina. Ovo se odnosilo na pukotine koje su uočene na SEM slikama. *Tarcin B.* i saradnici [25] otkrili su da je čvrstoća veze značajno niža u grupi sa kiselinskim nagrivanjem od grupa Er, Cr: ISGG i Nd: YAG za oba korišćena sredstva za vezivanje. *Borsatto MC* i saradnici [26] i *Lupi-Pegurier L.* i

saradnici [27] potvrdili su da lasersko zračenje Er: YAG nije eliminisalo potrebu da se površina gledi nagriza kiselinom pre nanošenja zalivača.

ZAKLJUČAK

Naša otkrića, koja se tiču marginalne mikropustljivosti zaličića na bazi smole, ukazuju da lasersko zračenje Er: YAG jamica i fisura može pružiti snažnu vezu gledi i zalivača, što može sprečiti mikrocurenje i može se preporučiti kao alternativna metoda za pripremu jamica i fisura pre aplikovanja zalivača.

Dental anthropological status of the human population found in the Roman site of Viminacium necropolis “Kod Koraba”

Ilija Mikić¹, Bogdan Lisul², Đurica Grga²

¹Archaeological Institute of SASA, Belgrade, Serbia;

²University of Belgrade, School of Dental Medicine, Clinic of Restorative Dentistry and Endodontics, Belgrade, Serbia

SUMMARY

Introduction The “Kod Koraba” site is located in the territory of antique Viminacium. Archaeological excavations were carried out from 2005 to 2008. On this occasion, a necropolis with a total of 77 graves was explored, which according to archaeological contributions can be dated to the period from 2nd to 4th century AD (Roman period).

The aim of this study was to provide, on the basis of the results of dental anthropological analysis of osteological material from the necropolis “Kod Koraba”, data of the dental status and pathological changes of the oral cavity and teeth in human population that inhabited this area of antique Viminacium from 2nd to 4th century AD.

Material and method During the archaeological excavations from 2005 to 2008, a total of 77 graves were explored. Of this number, due to lower degree of preservation, the dental status of 45 individuals was analyzed. Of these, 36 belonged to adult individuals and nine were children. Functional methodology used in previous studies of human populations of the prehistoric period was applied in order to compare obtained results with similar ones as well as with the status of the oral cavity and teeth of the current population.

Results The obtained results supplemented the picture of dental health status of ancient populations in Viminacium. They indicated high degree of abrasion and dental plaque, the presence of caries within the expected limits for the studied period, as well as the presence of other dental pathologies such as periodontal disease and periapical processes present in the current human population.

Conclusion Anatomo-morphological status of the teeth and the jaw of the human population from ancient Viminacium are similar with the characteristics of modern man. Pathological changes of the oro-facial system of modern man were present in the studied human population of Roman period, with different values of their distribution.

Keywords: archaeological; ancient humans; dental status; Viminacium

INTRODUCTION

The archaeological site Viminacium is topographically located on the territory of the present-day Republic of Serbia at the junction of the river Mlava in the Danube, in the immediate vicinity of the village Stari Kostolac (Figure 1). Throughout its history, Viminacium has become the largest urban settlement and one of the most important military points of the Roman province of Upper Moesia [1]. At the end of 1st century, it housed the Flavius IV and Claudius VII legions, which began its economic rise [1]. There are large number of necropolises in the vicinity of Viminacium: from late prehistoric with bi-ritual burial, to several Roman also with bi-ritual burial, as well as several necropolises with inhumation from different periods of the Middle Ages. It is complex site with a long history of research.

The first territorial identification of Viminacium was made by A. F. Marsigli during the 18th century. At the time, he wrote a capital three-volume opus of great importance for the study of Serbia, and his data on the appearance of Viminacium from the end of the 17th century are valuable. Among the later explorers who visited the site, one

should mention F. Kanitz, who passed through the area in the mid-19th century and J. Šafarik. The first archaeological research started by M. Valtrović in 1881, and M. Vasić continued the work of his predecessor in 1902 and 1903. The two doyens of Serbian archaeology made a great contribution to the knowledge of the topography of Viminacium [2].

Large-scale excavations done in the 1970's were organized by the Archaeological Institute, the Republic Institute for the Protection of Cultural Monuments, the National Museum in Belgrade and the Museum in Pozarevac. The head of the excavation was Ljubica Zotović, who was also the director of this major multidisciplinary project from 1977 to 1997. During this period, necropolises extending south and west of the city of Viminacium were explored. Since 2000, when Miomir Korać took over the management of the project, necropolises extending east of the military camp have also been investigated.

Over the total of 14,000 graves of cremated and inhumed deceased have been investigated over several decades, placing Viminacium in the first place, in front of the Intercisa site in Hungary. With the exception of a few Iron

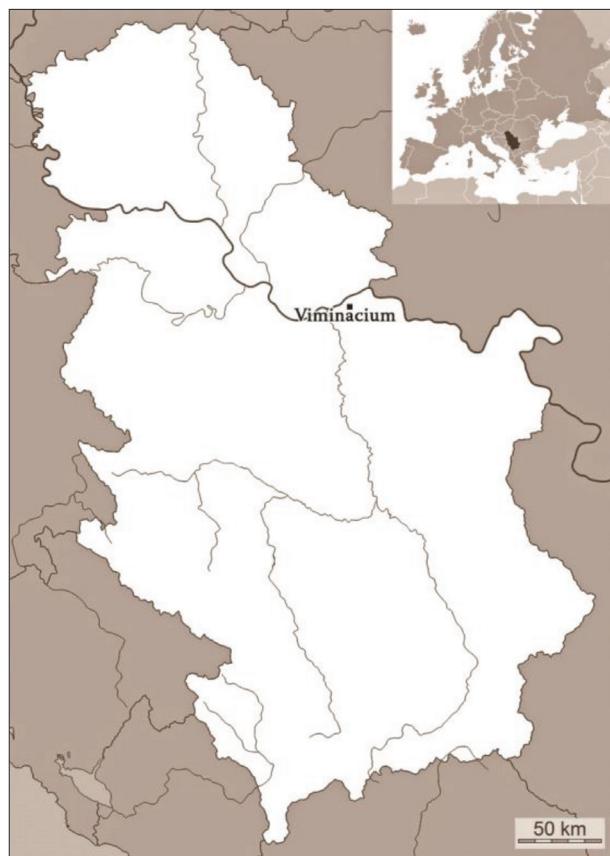


Figure 1. Location of Viminacium according to the contemporary geographical map of Serbia

Slika 1. Lokacija Viminacijuma na sadašnjoj mapi Srbije

Age graves, the oldest necropolises belong to the Celtic population, with the largest number of burials taking place during Roman domination from 1st to 5th century AD. The continuity of life in the territory of ancient Viminacium persisted during the period of Great migration of peoples as well as during Middle Ages.

Archaeological excavations of the "Kod Koraba" site in the area of the ancient site of Viminacium were carried out from 2005 to 2008. On this occasion, a necropolis with a total of 77 graves was explored, which according to archaeological contributions can be dated to the period from 2nd to 4th century AD (Roman period).

The aim of this study was to provide, on the basis of the results of dental anthropological analysis of osteological material from the necropolis "Kod Koraba", data on dental status and pathological changes of the oral cavity and teeth of the human population that inhabited the area of ancient Viminacium from 2nd to 4th century AD.

MATERIAL AND METHOD

Data analysis was performed with the methodology used in the research of human population teeth and jaws from the Lepenski Vir culture [3, 4, 5]. The methodology used is functional and obtained results can be compared with each other, as well as with the status of the oral cavity and teeth of the current population. All collected data were entered into the four individual tables. The table for basic

information data included: skeleton number, individual's age and gender (data taken from previously published anthropological analysis). In the Table for jaws preservation assessment, number 1 stands for complete preservation, 0.5 for partial and 0 for the absence of examined jaw segment. Tables for lower and upper jaw generate a wide range of data (7 columns and 16 rows). First column shows data on dentition type. Second column generates information on teeth status and consists of 6 types of data: 1 – present tooth, 2 – tooth lost during lifetime, 3 – tooth lost after death, 4 – present tooth root, 5 – tooth root lost after death, 6 – tooth germ. Third column shows data on tooth surfaces affected with tooth decay numerically defined on a 1–5 scale, (1 – occlusal and incisal, 2 – mesial, 3 – distal, 4 – vestibular, 5 – oral). Fourth column consists of data assessing tooth decay depth and it is numerated 1–4, (1 – superficial, 2 – medium and deep, 3 – dental cavity trepanation, 4 – radix). Data on teeth abrasion were summarized up in the fifth table and expressed on a 0–4 scale (0 – tooth without abrasion, 1 – enamel abrasion, 2 – dentin abrasion, 3 – abrasion with dental cavity trepanation, 4 – radix). Sixth column shows data on the amount of tooth tartar on a 0–3 scale, (0 – without tartar, 1 – 1/3 of tooth covered by tartar, 2 – 2/3 of tooth covered by tartar, 3 – tooth completely covered by tartar). Seventh column generates data on existing macroscopically visible periapical lesions (0 – not present, 1 – ≤5 mm in diameter, 2 – > 5 mm in diameter) [3–9].

Usual number of teeth (16 per jaw) defined the number of rows in each of the two tables. All eventual findings on exceeded number of teeth were stated as anomalies in the space for additional comments. The data collected were statistically processed and presented in summary tables for adults and children.

RESULTS AND DISCUSSION

Individual data collected were generated in summary tables, for adults (Tables 1–3, Figure 2) and children (Table 4, Figure 3). It was found that in the group of 36 adults (Table 1), it was possible to determine the status of 900 teeth. Assuming that the expected number of teeth for this age group could be 1152 (36 X 32), given that it is an anthropological skeletal material almost two millennia old, it can be said that it was a representative sample (78%). Of these, 720, or 80% were well preserved and suitable for further analysis. Seven teeth (2%) were reliably found to be lost during life, possibly due to present pathology in the form of extensive decay, advanced abrasion or more pronounced trauma. The presence of only root of the tooth was noted in 8 cases (0.9%). In one case, one root (0.9%) of the double-rooted tooth (lower molar) was lost after death. The presence of 32 (3.5%) permanent teeth germs was detected in adults, during the third molar emergence period.

The presence of caries lesions in adults, the number of affected surfaces, the depth of penetration into the hard dental tissues and the relationship with the pulp chamber are shown in Table 2. Of the 720 teeth analyzed, the presence of decay was found in 28 (3.9%), which is in accord-

Table 1. Number and status of evaluated teeth in adults of both genders

Tabela 1. Broj i status ispitanih zuba odraslih osoba oba pola

| Status Status | Number Broj | % |
|-----------------------------|----------------|------|
| 1 | 720 | 80 |
| 2 | 17 | 2 |
| 3 | 122 | 13.5 |
| 4 | 8 | 0.9 |
| 5 | 1 | 0.1 |
| 6 | 32 | 3.5 |
| Total number Ukupan broj | 900 | 100% |

Table 2. Distribution of decay on affected surfaces and depth in adults of both genders

Tabela 2. Rasprostranjenost karijesa i zahvaćene površine, kao i dubina kod odraslih oba pola

| Degree Stepen | Number of teeth by surface decay Broj zuba po površini karijesa | Percentage of teeth by surface decay Procenat zuba po povr- šini karijesa (%) | Number of teeth by depth of decay Broj zuba po dubini karijesa | Percentage of teeth by depth of decay Procenat zuba po du- bini karijesa (%) |
|------------------|---|--|--|---|
| 1 | 7 | 25 | 9 | 32 |
| 2 | 7 | 25 | 12 | 43 |
| 3 | 3 | 11 | 7 | 25 |
| 4 | 11 | 39 | 0 | 0 |
| Total Ukupno | 28 | 100% | 28 | 100% |

Table 3. Distribution of teeth abrasion and dental deposits in adults of both genders

Tabela 3. Rasprostranjenost abrazije i zubnog kamenca na zubima kod odraslih oba pola

| Degree Stepen | Number of teeth with abrasion Broj zuba sa abrazijom | Percentage of teeth with abrasion (%) Procenat zuba sa abra- zijom (%) | Number of teeth with calculus Broj zuba sa kamencem | Percentage of teeth with calculus (%) Procenat zuba sa kamencem (%) |
|------------------|--|---|---|---|
| 1 | 179 | 39 | 197 | 87 |
| 2 | 272 | 59 | 22 | 10 |
| 3 | 9 | 2 | 8 | 3 |
| Total Ukupno | 460 | 100% | 227 | 100 % |

ance with research by Radović in 2008 [8]. The distribution of the detected decay in relation to the affected areas had the following values: caries of the occlusal or incisal surface (due to pronounced abrasion) was noted in 7 cases (25%). The same number 7 (25%) was found on the mesial surface. Three cases (11%) of caries were observed on the distal surface. Most caries lesions 11 (39%) were present on the vestibular surface of the cervical third of the teeth. Of the 28 caries lesions present, 9 (32%) belonged to superficial decay, 12 (43%) to medium and deep decay, and in 7 (25%) cases, decay was going through the roof or wall of the pulp chamber. Results are in accordance with similar research [4, 8–11].

Abrasions was the most common pathological change in the studied teeth (Figure 4). Of the 720 teeth observed, 460

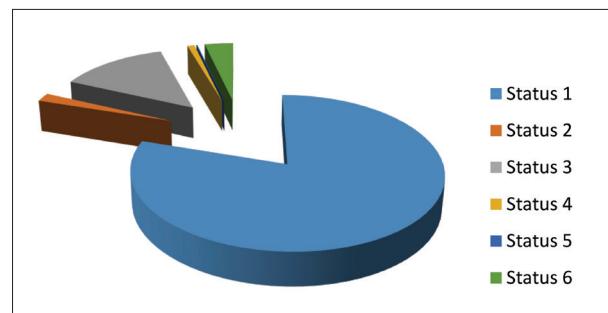


Figure 2. Graphical representation of the status of teeth in adults of both genders.

Slika 2. Grafički prikaz istatusa ispitanih zuba odraslih osoba oba pola.

Table 4. Dental status of childhood individuals from the site Viminacium "Kod Koraba".

Tabela 4. Status dečijih zuba iskopanih na nalazištu Viminacijum „Kod Koraba”.

| Skeleton number Broj skeleta | Permanent teeth status Status stalnih zuba | | | | Deciduous teeth status Status mlečnih zuba | | | Total Ukupno |
|------------------------------------|--|---|---|----|--|---|---|-----------------|
| | 1 | 2 | 3 | 6 | 1 | 2 | 3 | |
| 1 | 0 | 0 | 0 | 3 | 16 | 0 | 0 | 18 |
| 2 | 0 | 0 | 4 | 5 | 6 | 0 | 0 | 15 |
| 3 | 0 | 0 | 0 | 7 | 12 | 0 | 0 | 19 |
| 4 | 0 | 0 | 0 | 3 | 5 | 0 | 4 | 12 |
| 5 | 20 | 0 | 0 | 2 | 0 | 0 | 0 | 22 |
| 6 | 5 | 0 | 4 | 2 | 0 | 0 | 0 | 11 |
| 7 | 5 | 0 | 0 | 0 | 2 | 0 | 0 | 7 |
| 8 | 22 | 0 | 1 | 1 | 0 | 0 | 0 | 24 |
| 9 | 5 | 0 | 0 | 6 | 2 | 0 | 0 | 13 |
| Total Ukupno | 57 | 0 | 9 | 29 | 43 | 0 | 4 | 142 |

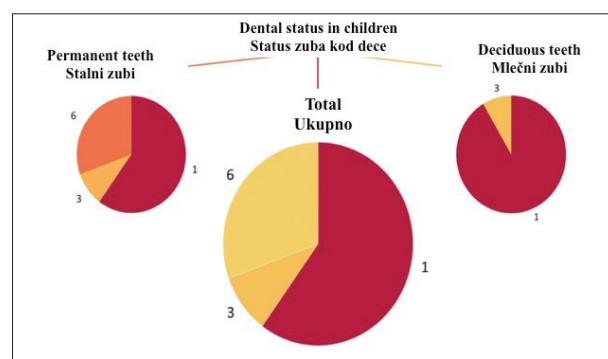


Figure 3. Graphical representation of the tooth status in childhood population from the necropolis "Kod Koraba".

Slika 3. Grafički prikaz statusa zuba dece na nalazištu „Kod Koraba“

(64%) reported loss of hard dental substance due to this pathology. First-degree abrasion was observed in 179 teeth (39%), while more than half of abraded teeth 272 (59%) presented with second-degree of abrasion. In 9 teeth (2%), grade 3 abrasion was observed. Even though the abrasion is professional term commonly used to define examined pathological change, more adequate and precise term is abfraction, since it is not possible to determine, whether the change is due to direct contacts of dental surfaces of



Figure 4. Grade II abrasion and grade I deposits on the teeth of an adult

Slika 4. Abrazija drugog stepena i kamenac prvog stepena na zubima odrasle osobe



Figure 6. Impacted upper canine of an adult

Slika 6. Impaktirani očnjak kod odrasle osobe



Figure 5. Erosions in the neck of the inferior premolars of an adult

Slika 5. Erozija zuba u predelu vrata kod donjih prekutnjaka odrasle osobe

teeth or contact of teeth with external factors (food, mechanical admixtures in drinking water, powder fragments from the immediate environment...) [3, 5, 6, 7].

Calcified dental plaque - calculus was the second most widespread pathological occurrence on the teeth of skeletal remains in Viminacium. The calculus was present to varying degrees on 227 teeth (32%). Most of these teeth (197) (87%) were covered with grade 1 deposits, ie. only in the region of the gingival third of the crown. Second-degree deposits were observed in 22 cases (10%) and third degree in only 8 teeth (3%).

Periapical processes were determined by direct inspection due to the bone loss in the projection of a bone defect. Six of these cases were observed, representing less than one percent (0.7%) of teeth with pathological changes that could have been the etiological factor (cause) of this occurrence. Namely, when calculating this percentage, it was necessary to include teeth from position 1 and position 3 (teeth lost after death) but also positions 4 and 5 (present

roots and roots lost after death) (Table 1) [10, 11]. In two cases, erosion of vestibular surfaces in the neck of the lower permanent premolars was noted (Figure 5). Due to the massive loss of palatal surface of the right maxilla, an impacted permanent canine was observed (Figure 6).

Individual results of the analysis of dental status in nine children skeletons are presented in Table 4. In one third of the study population, only deciduous dentition was present. The other two-thirds had mixed or permanent dentition. In total 57 permanent and 43 deciduous teeth were present. 29 permanent teeth germs were observed. It was found that 9 permanent and 4 deciduous teeth were lost post mortem. In the lower jaw of one individual, two molars showed decay on the vestibular side of the tooth neck (class V per Black) and the second degree of decay in terms of depth.

Abrasions were observed in all seven children. No abrasion was visible on the permanent teeth. All seven abraded teeth were in deciduous dentition. Lower prevalence of the analysed phenomena (16%) compared to the values obtained in adults is expected, due to different diet and the length of their chewing exposures. The first degree of abrasion was noticed in three teeth and the remaining four teeth had second degree of abrasion.

CONCLUSION

Based on the obtained results, it can be concluded that anatomical-morphological status of teeth and jaws of the human population in the area of antique Viminacium are similar with characteristics of modern humans. Pathological changes of the oro-facial system present in modern humans were also present in the studied human population of the Roman period, with different values of their distribution.

The most dominant pathological phenomenon was tooth abrasion. In permanent dentition, it was present in almost two thirds (64%) of the teeth analysed. In children, permanent teeth were present in low percentage (1.75%), while abrasion was more pronounced on deciduous teeth and present in 14% of all deciduous teeth.

Calcified dental plaque, according to the results of this study, was the most common pathological phenomenon immediately after abrasion, and it was present in one third of the teeth of human population from the necropolis "Kod Koraba". In children, calcified plaque deposits were not registered. Decay was detected in 28 teeth with an incidence of 3.9%, which is consistent with the results of similar studies. The presence of macroscopically visible periapical changes with an incidence of less than 1% was detected. Two cases of enamel erosion in the cervical area of the vestibular surface of the lower permanent premolars and one macroscopically visible impaction of the upper right canine were noted.

REFERENCES

1. Popović V. Uvod u topografiju Vimanicijuma. Starinar XVIII/1967, Beograd; 1968:29-49.
2. Zотовић Љ, Јордовић Ћ. Viminacium – некропола више гробалја, Beograd; 1990:1-34.
3. Грга Đ. Абразија зуба као обележје humane популације културе Лепенског вира. Балканика. 1997; XXVIII:79-94.
4. Грга Đ. Најстарији tragovi karijesa na tlu današnje Jugoslavije. Stom Glas Srb. 1997; 37.
5. Грга Đ. Tooth abrasion among the prehistoric population of the Iron Gate culture. Balkan J Stomatol. 1998; 2:92-7.
6. Hilson S. Dental Anthropology. Cambridge: University Press; 1996.
7. Brothwell DR. Dental Anthropology. Oxford: Pergamon Press; 1963.
8. Radović M. Dentalni profil stanovnika antičkog Viminacijskog kopavanja-2003-2006, Arheologija i prirodne nauke 3, Beograd; 2008. p. 45-74.
9. Ђурић Срејић М. Увод у антропологију дrevnih populacija. Beograd: Завод за уџбенике и наставна средства; 1995. p. 261-85.
10. Lovrinčević A, Mikić Ž. Atlas osteopatoloških promena na istorijskim populacijama Jugoslavije. Sarajevo: Svijetlost; 1989. p. 25-53.
11. Грга Đ, Микић I, Лисул B, Злопаша T, Дželetović B. Status zuba i vilica humane populacije sa lokaliteta Gomolava. Stom Glas Srb. 2017; 64(1):24-31.

Received: 23.04.2019 • Accepted: 21.08.2019

Dentalnoantropološki status humane populacije antičkog lokaliteta Viminacijum – nekropol „Kod Koraba“

Ilija Mikić¹, Bogdan Lisul², Đurica Grga²

¹Arheološki institut SANU, Beograd, Srbija;

²Univerzitet u Beogradu, Stomatološki fakultet, Klinika za bolesti zuba, Beograd, Srbija

KRATAK SADRŽAJ

Lokalitet „Kod Koraba“ se nalazi na prostoru antičkog Viminacijuma. Arheološka iskopavanja su sprovedena u periodu od 2005. do 2008. godine. Tom prilikom je istražena nekropola sa ukupno 77 grobova koji se prema arheološkim prilozima mogu datovati u period od II do IV veka nove ere (rimski period).

Cilj ovog rada je bio da se na osnovu rezultata dentalnoantropološke analize osteološkog materijala iz nekropole „Kod Koraba“ upotpune saznanja o dentalnom statusu i patološkim promenama usta i zuba humane populacije koja je nastanjivala prostor antičkog Viminacijuma u periodu od II do IV veka nove ere.

Materijal i metod Prilikom arheoloških iskopavanja od 2005. do 2008. godine ukupno je istraženo 77 grobova, od kojih je, usled lošijeg stepena očuvanosti, mogao biti analiziran dentalni status 45 individua. Od tog broja je 36 pripadalo odraslim individuama, a devetoro dečjem uzrastu. Primenjena je metodologija koja je korišćena u prethodnim istraživanjima humanih populacija praistorijskog perioda. Izabrana metodologija je funkcionalna jer se dobijeni rezultati mogu međusobno porebiti, kao i sa statusom usta i zuba sadašnje populacije.

Rezultati Dobijeni rezultati su upotpunili sliku o Zubnozdravstvenom statusu antičkih populacija na Viminacijumu, ukazali na visok stepen abrazije i zubnih naslaga, zastupljenost karijesa u očekivanim granicama za ispitivani period, kao prisustvo i druge dentalne patologije, parodontopatija, periapikalnih procesa, prisutnih i u sadašnjoj humanoj populaciji.

Zaključak Na osnovu dobijenih rezultata može se zaključiti da se anatomo-morfološki status zuba i vilica humane populacije sa prostora antičkog Viminacijuma podudaraju sa karakteristikama savremenog čoveka.

Patološke promene orofacialnog sistema savremenog čoveka su prisutne i u ispitivanoj humanoj populaciji rimskega perioda, sa različitim vrednostima njihove distribucije.

Ključne reči: arheološki; antički ljudi; status zuba; Viminacijum

UVOD

Arheološki lokalitet Viminacijum je topografski lociran na teritoriji današnje Republike Srbije kod ušća reke Mlave u Dunav u neposrednoj blizini sela Stari Kostolac (Slika 1). Viminacijum je tokom svoje istorije postao najveće gradsko naselje i jedan od najznačajnijih vojnih punktova rimske provincije Gornja Mezija [1]. Krajem I veka u njemu su bile stacionirane IV Flavijeva i VII Klaudijeva legija, čime počinje njegov ekonomski uspon. Period od II do IV veka smatra se najprosperitetnijim u istoriji ovog lokaliteta [1]. U okolini Viminacijuma se nalazi veliki broj nekropola: počev od kasnopristorijske sa biritualnim sahranjivanjem, preko više rimskih, takođe sa biritualnim sahranjivanjem, kao i nekoliko nekropola sa inhumacijom iz različitih perioda srednjeg veka. Radi se o kompleksnom nalazištu koje ima dug istorijat istraživanja.

Pruv teritorijalnu identifikaciju Viminacijuma je izvršio A. F. Marsilji tokom 18. veka. On u to vreme piše kapitalno tretomno delo, koje je od velikog značaja za proučavanje Srbije i dragoceni su njegovi podaci o izgledu Viminacijuma s kraja 17. veka. Među kasnijim istraživačima koji obilaze lokalitet treba spomenuti F. Kanica, koji ovim prostorima prolazi sredinom 19. veka, i J. Šafarika. Prva arheološka istraživanja je započeo M. Valtrović 1881. godine, a M. Vasić je nastavio rad svog prethodnika 1902. i 1903. godine. Pomenuta dva doajena srpske arheologije su dala veliki doprinos poznavanju topografije Viminacijuma [2].

Iskopavanja većeg obima su usledila tek sedamdesetih godina prošlog veka u organizaciji Arheološkog instituta, Republičkog zavoda za zaštitu spomenika kulture, Narodnog muzeja u Beogradu i Muzeja u Požarevcu. Rukovodilac iskopavanja je bila Ljubica Zotović, koja je bila i direktor ovog velikog multidis-

ciplinarnog projekta od 1977. do 1997. godine. U tom periodu se istražuju nekropole koje su se prostirale južno i zapadno od grada Viminacijuma. Od 2000. godine, kada rukovođenje projektom preuzima Miomir Korać, istražuju se i nekropole koje se prostiru istočno od vojnog logora.

Ukupno je tokom više decenija istraženo preko 14 000 grobova spaljenih i inhumiranih pokojnika, što Viminacijum stavlja na prvo mesto, ispred nalazišta Intercisa u Mađarskoj. Izuzev nekoliko grobova iz gvozdenog doba, najstarije nekropole pripadaju keltskom stanovništvu, a najveći broj sahrana je obavljen u periodu rimske dominacije od I do V veka nove ere. Kontinuitet života se na teritoriji antičkog Viminacijuma nastavlja tokom perioda velike seobe naroda, kao i tokom srednjeg veka.

Arheološka iskopavanja lokacije „Kod Koraba“ na prostoru antičkog lokaliteta Viminacijum su sprovedena u periodu od 2005. do 2008. godine. Tom prilikom je istražena nekropola sa ukupno 77 grobova koji se prema arheološkim prilozima mogu datovati u period od 2. do 4. veka nove ere (rimski period).

Cilj ovog rada je bio da se na osnovu rezultata dentalnoantropološke analize osteološkog materijala iz nekropole „Kod Koraba“ upotpune saznanja o dentalnom statusu i patološkim promenama usta i zuba humane populacije koja je nastanjivala prostor antičkog Viminacijuma u periodu od 2. do 4. veka nove ere.

MATERIJAL I METODE

Istraživanja su obuhvatila 77 skeletnih ostataka, različitog pola i starosti, otkrivenih na lokalitetu „Kod Koraba“. Potiču iz rimskog perioda i njihova apsolutna starost je datovana na period od 2. do 4. veka nove ere. Od ukupnog broja pronađenih huma-

nih skeletnih ostataka 77 osoba, usled različitog stepena devastiраности, dentalno-antropološku analizu je bilo moguće sprovesti na 45 potpuno ili delimično očuvanih skeleta. Svi skeleti potiču iz jedne nekropole. Od tog broja 36 skeleta je pripadalo odraslim individuama različite individualne starosti i pola, a devet skeleta je pripadalo dečjem uzrastu. Očuvanost skeleta je bila različita i kretala se od kompletно sačuvanih lobanja i vilica do fragmentovanih delova vilica sa delimično sačuvanim zubima.

Podaci su analizirani metodologijom koja je prvi put primeđnjivana u istraživanjima zuba i vilica humane populacije kulture Lepenskog Vira [3, 4, 5]. Izabrana metodologija je funkcionalna jer se dobijeni rezultati mogu međusobno porebiti, kao i sa statusom usta i zuba sadašnje populacije. Svi prikupljeni podaci se unoše u četiri pojedinačne tabele. U tabeli za osnovne podatke generisani su: broj skeleta, individualna starost i pol individue (podaci preuzeti iz prethodno obavljenih antropoloških analiza). U tabeli za procenu očuvanosti vilica brojem 1 označavano je kompletno prisustvo ispitivanog dela vilice, sa 0,5 delimično, a 0 je označavala odsustvo tog dela. Tabele za donju i gornju vilicu generišu veliki broj podataka (sedam kolona i 16 redova). Prva kolona sadrži podatke o vrsti denticije. Druga kolona generiše podatke o statusu zuba i ona sadrži šest vrsta podataka: 1 – prisutan Zub, 2 – izgubljen tokom života, 3 – izgubljen posle smrti, 4 – prisutan koren zuba, 5 – koren zuba izgubljen posle smrti, 6 – zametak zuba. U treću su unošeni podaci o površinama zuba zahvaćenih karijesom i definisani su numerički od 1 do 5 u skladu sa brojem površina zuba (1 – okluzalno i incizalno, 2 – mezijalno, 3 – distalno, 4 – vestibularno, 5 – oralno). Četvrta kolona sadrži ocenu dubine karijesa i kreće se od 1 do 4 (1 – superficialis, 2 – medija i profunda, 3 – trepanacija kavuma dentis, 4 – radiks). Podaci o abraziji zuba su unošeni u petu kolonu i stepenovani od 0 do 4 (0 – Zub bez abrazije, 1 – abrazija gleđi, 2 – abrazija dentina, 3 – abrazija sa trepanacijom kavuma dentis i 4 – radiks). Šesta kolona sadrži podatke o prisustvu čvrstih zubnih naslaga kroz četiri stepena (0 – bez naslaga 1 – prekrivena 1/3 zuba, 2 – prekrivene 2/3 i 3 – prekriven ceo Zub). Osma kolona generiše podatke o prisustvu makroskopski vidljivih periapikalnih lezija (0 – nema, 1 – do 5 mm u prečniku, 2 – preko 5 mm u prečniku) [3–9].

Uobičajen broj zuba (16) definisao je i broj redova u svakoj od ove dve tabele. Svi eventualni nalazi o prekobrojnim zubima unošeni su kao konstantovane anomalije, u prostor za posebne napomene.

Prikupljeni podaci su statistički obrađeni i prikazani u sumarnim tabelama za odrasle osobe i dečji uzrast.

REZULTATI I DISKUSIJA

Prikupljeni pojedinačni podaci su generisani u sumarne tabele, za odrasle osobe (Tabele 1, 2, 3, Slika 2) i za dečji uzrast (Tabela 4, Slika 3). Ustanovljeno je da je u grupi od 36 odraslih osoba (Tabela 1) bilo moguće utvrditi status za 900 zuba. Uz pretpostavku da bi očekivani broj zuba za ovu starosnu grupu mogao iznositi 1152 (36×32), s obzirom na to da se radi o antropološkom skeletnom materijalu starom gotovo dva milenijuma, može se reći da se radi o reprezentativnom uzorku (78%). Od tog broja 720, odnosno 80% je bilo dobro očuvano i pogodno za dalju analizu. Za sedam zuba (2%) pouzdano je ustanovljeno da su izgubljeni tokom života, moguće zbog prisutne patologije u

vidu obimnog karijesnog procesa, poodmakle abrazije ili izraženije traume. Prisustvo samo korena zuba konstatovano je u osam slučajeva (0,9%). U jednom slučaju je jedan koren (0,9%) dvokorenog zuba (donji molar) izgubljen posle smrti osobe. Otkriveno je prisustvo 32 (3,5%) zametka stalnih zuba kod osoba starosne dobi *adultus*, odnosno perioda nicanja trećeg kutnjaka.

Prisustvo karijesa na zubima odraslih osoba, broj zahvaćenih površina, dubina prodora u čvrsta zubna tkiva i odnos sa komorom pulpe prikazani su u Tabeli 2. Od analiziranih 720 zuba prisustvo karijesa je ustanovljeno na 28 (3,9%) zuba, što je u skladu sa istraživanjima Radović M. iz 2008. godine. Distribucija otkrivenih karijesa u odnosu na zahvaćene površine imala je sledeće vrednosti: karijes okluzalne ili incizalne površine (zbog izražene abrazije) konstatovan je u sedam slučajeva (25%). Isti broj – 7 (25%) ustanovljen je i za mezijalnu površinu. Na distalnoj površini su uočena tri slučaja (11%) karijesa. Najviše karijesa – 11 (39%) bilo je prisutno na vestibularnoj površini cervicalne trećine zuba. Od 28 prisutnih karijesa, devet (32%) njih je pripadalo kategoriji površnih (superficialis), 12 (43%) kategoriji srednje dubokih i dubokih (media), a u sedam (25%) slučajeva je karijes trepanirao krov ili zid komore pulpe. Rezultati su se kretali u granicama vrednosti sličnih istraživanja [4, 8–11].

Abrazija je najčešća patološka promena na zubima ispitivane humane populacije (Slika 4). Od 720 opserviranih zuba, na 460 (64%) konstatovan je gubitak tvrde zubne supstance usled ove patologije. Abrazija prvog stepena uočena je na 179 zuba (39%), dok je destrukcijom drugog stepena bilo zahvaćeno više od polovine abradiranih zuba – 272 (59%). Na devet zuba (2%) mogla se uočiti abrazija trećeg stepena. Abrazija je stručni termin koji se obično koristi za definisanje ispitivane patološke promene. Adekvatniji i precizniji termin je abfrakcije jer se ne može, posebno na antropološkom materijalu velike absolutne starosti, sa sigurnošću utvrditi da li je promena nastala međusobnim uticajem direktnih kontakata zubnih površina ili spoljnim faktorima (hranom, mehaničkim primesama u vodi za piće, praškastim fragmentima iz neposredne okoline...) [3, 5, 6, 7].

Čvrste zubne naslage (kamenac) su druga najrasprostranjenvija patološka pojava na zubima ispitivanih skeletnih ostataka sa Viminacijuma. Kamenac je u različitom stepenu bio prisutan na 227 zuba (32%). Najveći deo tih zuba – 197 (87%) bio je prekriven naslagama 1. stepena, tj. samo u predelu gingivne trećine krunice. Naslage drugog stepena su uočene u 22 slučaju (10%), a trećeg na svega osam zuba (3%).

Periapikalni procesi su konstatovani direktnom inspekcijom usled gubitka kosti u projekciji koštanog defekta. Uočeno je šest takvih slučajeva, što predstavlja manje od jednog procenta (0,7%) zuba sa patološkim promenama koje su mogle biti etiološki faktori (uzrok) ove pojave. Naime, prilikom izračunavanja ovog procenta neophodno je bilo da se u statusu (vidi Tabelu 1) uključe zubi iz pozicije 1 i pozicije 3 (zubi izgubljeni posle smrti), kao i iz pozicije 4 i 5 (prisutni koreni i koreni izgubljeni posle smrti) [10, 11].

U dva slučaja je konstatovana erozija vestibularnih površina u predelu vrata donjih stalnih premolara (Slika 5).

Usled masivne devastacije palatalne površine desne maksile uočen je impaktiran starni očnjak (Slika 6).

Pojedinačni rezultati analize statusa zuba devet dečjih skeleta individualne starosti *infans I i II* predstavljeni su u Tabeli 4. Kod jedne trećine ispitivane populacije je bila prisutna isključivo mlečna denticija *infans I*. Druge dve trećine su imale

mešovitu ili stalnu denticiju. Na nivou kompletne grupe konstatovano je prisustvo 57 stalnih i 43 mlečna zuba. Uočeno je 29 zametaka stalnih zuba. Utvrđeno je da su devet stalnih i četiri mlečna zuba izgubljeni posle smrti osobe. U donjoj vilici jedne osobe otkrivena su na dva mlečna druga molara karijesi na vestibularnoj strani u predelu vrata zuba (V klasa po Bleku), i dubinom prodora drugog stepena.

Abrazija je uočena u svega sedam slučajeva od ukupnog broja prisutnih zuba dečjeg uzrasta. Na stalnim zubima još uvek nisu bili vidljivi tragovi abrazije. Svih sedam abradiranih zuba pripadalo je mlečnoj denticiji. Znatno niži stepen rasprostranjenosti analizirane pojave (16%) u odnosu na dobijene vrednosti kod odraslih je očekivan, najverovatnije potiče od drugačijeg načina ishrane i dužine njihove izloženosti pri funkciji žvakanja. Prvim stepenom abrazije su bila zahvaćena tri zuba, a drugim preostala četiri.

ZAKLJUČAK

Na osnovu dobijenih rezultata može se zaključiti da se anatomo-morfološki status zuba i vilica humane populacije sa prostora

antičkog Viminacijuma podudara sa karakteristikama savremenog čoveka.

Patološke promene orofacijalnog sistema savremenog čoveka su prisutne i u ispitivanoj humanoj populaciji rimskog perioda, sa različitim vrednostima njihove distribucije.

Dominantna patološka pojava je abrazija zuba. U stalnoj denticiji je prisutna u skoro dve trećine (64%) analiziranih zuba. U dečjem uzrastu na stalnim zubima se retko javlja, ispod dva procenta (1,75%), dok je na mlečnim zubima izraženija i bila je prisutna na 14% svih mlečnih zuba.

Čvrste Zubne naslage – kamenac, prema rezultatima ovog istraživanja, patološka su promena koja je odmah posle abrazije najzastupljenija patološka pojавa, prisutna na trećini zuba odraslih osoba humane populacije iz nekropole „Kod Koraba“. U dečjem uzrastu čvrste naslage nisu registrovane.

Karijes je otkriven na 28 zuba sa incidencom od 3,9%, što je u skladu sa rezultatima sličnih istraživanja.

Ustanovljeno je prisustvo makroskopskih vidljivih periapikalnih promena sa incidencom manjom od 1%

Konstatovana su dva slučaja erozije gleđi u cervikalnom delu vestibularne strane donjih stalnih premolara i jedna makroskopska vidljiva impakcija gornjeg desnog očnjaka.

Ewing sarcoma with initial presentation in mandible – a case report

Srđan Milanović¹, Nikola Milošević¹, Marko Dožić¹, Dušan Ristić¹, Goran Stojković², Nebojša Milić¹

¹Institute for Oncology and Radiology of Serbia, Belgrade, Serbia;

²Clinical Center of Serbia, Clinic for Otorhinolaryngology and Maxillofacial Surgery, Belgrade, Serbia

SUMMARY

Ewing sarcoma is a tumor that rarely occurs after the age of twenty. This tumor is even more rare in the region of head and neck, either as a primary site or a place of dissemination of the disease. Treatment is multidisciplinary and includes administration of chemotherapy, surgery and/or radiotherapy. This case report refers to the 29-year-old female patient who was referred to maxillofacial surgeon for tooth pain and swelling of the left side of mandible that was not solved after the antibiotic treatment. After a biopsy was performed, Ewing's sarcoma of the mandible was diagnosed, and primary localization in the pelvis was confirmed before starting the treatment. One year after chemotherapy and radiation treatment completion, there was no sign of disease. This case shows that all doctors specialized in oral and / or maxillofacial surgery, as well as medical doctors and dentists in primary health care, have important role in early diagnosis of these rare diseases, and thus contribute to better treatment outcomes, even in advanced cases.

Keywords: Ewing sarcoma; mandible; chemotherapy; radiotherapy

INTRODUCTION

Ewing sarcoma is a rare disease. Incidence of sarcomas in adults are less than 1% of all solid tumors, and only about 10% of them are localized in bones [1]. Ewing sarcoma (ES) in population of children and young adults is on the second place of bone tumor by frequency. Ewing sarcoma group of tumors includes Ewing sarcoma in bone, extraosseus Ewing sarcoma and Askin tumor (PNET). ES is usually diagnosed in the second decade, while in the first decade appears in about 20–30% of these tumors. Occurrence after 30 years of age is rare [2].

Ewing sarcoma may occur in any bone, however, most often appears in long and flat bones, in the first place with localization in pelvis, femur, chest bones, tibia, fibula and humerus. Its manifestation in the head bones is not common, either as a primary site, or as a site of dissemination of the disease, with a prevalence of 2% [3], and the most commonly affected is mandible [4].

These tumors are primarily manifested as pain and swelling, but as lesions grow there is dysfunction of the affected region. At the time of diagnosis, about 25% of patients have metastasis, but only about 10% of patients present with isolated bone metastases [3]. Patients with localized disease have better prognosis with survival rate of about 60 - 70%, while patients with metastasis at initial diagnosis have significantly worse prognosis with a survival rate of less than 25% [3].

The treatment is multimodal and includes chemotherapy, surgery and radiotherapy, with an active cooperation of members of a multidisciplinary oncological team [3, 5].

CASE REPORT

A female patient 29 years old visited a dentist in January 2017, due to pain and swelling of the left side of mandible, in good general health, with no other symptoms. She was administered wide-spectrum antibiotic, but no improvement has been achieved. The patient was then referred to maxillofacial surgeon at the Clinical Center of Serbia.

Initial CT exam of the head and neck showed osteolysis of the left ramus, irregularly shaped (Figure 1). Biopsy was performed at the beginning of February 2017. After receiving histopathological findings, patient was presented on the specialist tumor board for sarcoma and admitted to the Institute for Oncology and Radiology of Serbia for additional diagnosis and starting chemotherapy.

Additional examinations (CT neck, chest, abdomen and pelvis, MR pelvis, SCI skeleton, X-ray) revealed the presence of osteolytic tumor mass in the right iliac bone with extension to the right sacroiliac joint and infiltration of the sacrum cortex, as well as minor extraskeletal propagation and infiltration of gluteus maximus muscle, with total dimensions of 2×9 cm. There were also other osteolytic lesions found in the sacrum (4×2, 7×2 cm) with lateral reaching to the left sacroiliac joint and one more lesion in the left iliac bone, above acetabulum (1.5×1.5 cm).

The treatment started with VIDE (vincristine, ifosfamide, doxorubicin, etoposide) regimen chemotherapy. After six cycles of chemotherapy, the control CT examinations showed regression of the disease (Figure 2) and the control PET CT (September 2017) showed the absence of increased metabolism of the radiopharmaceutical (complete



Figure 1. Tumor of mandibular ramus – Initial CT of the head and neck
Slika 1. Tumor ramusa mandibule – Inicijalni CT glave i vrata

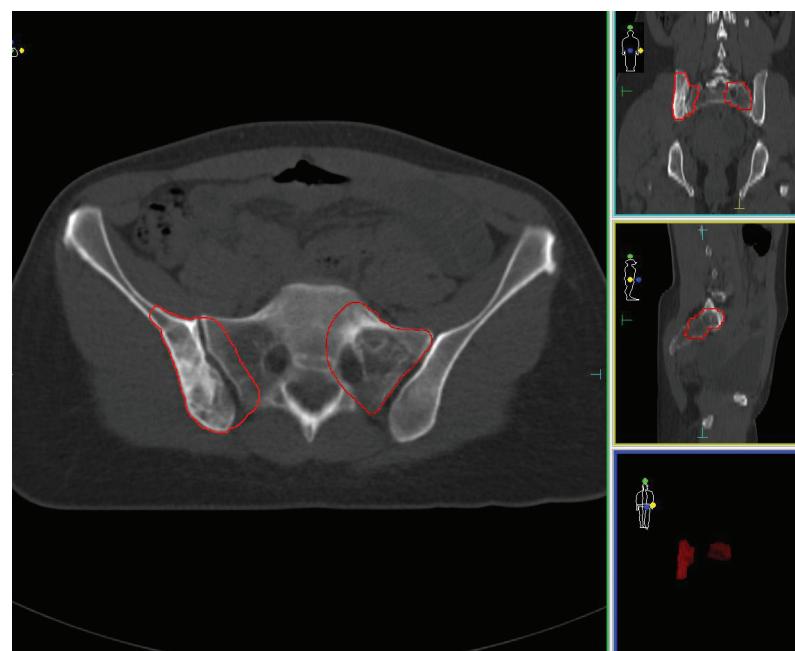


Figure 2. The primary localization of tumor in pelvis, CT after CT VIDE
Slika 2. Primarna lokalizacija tumora u karlici, CT nakon HT VIDE

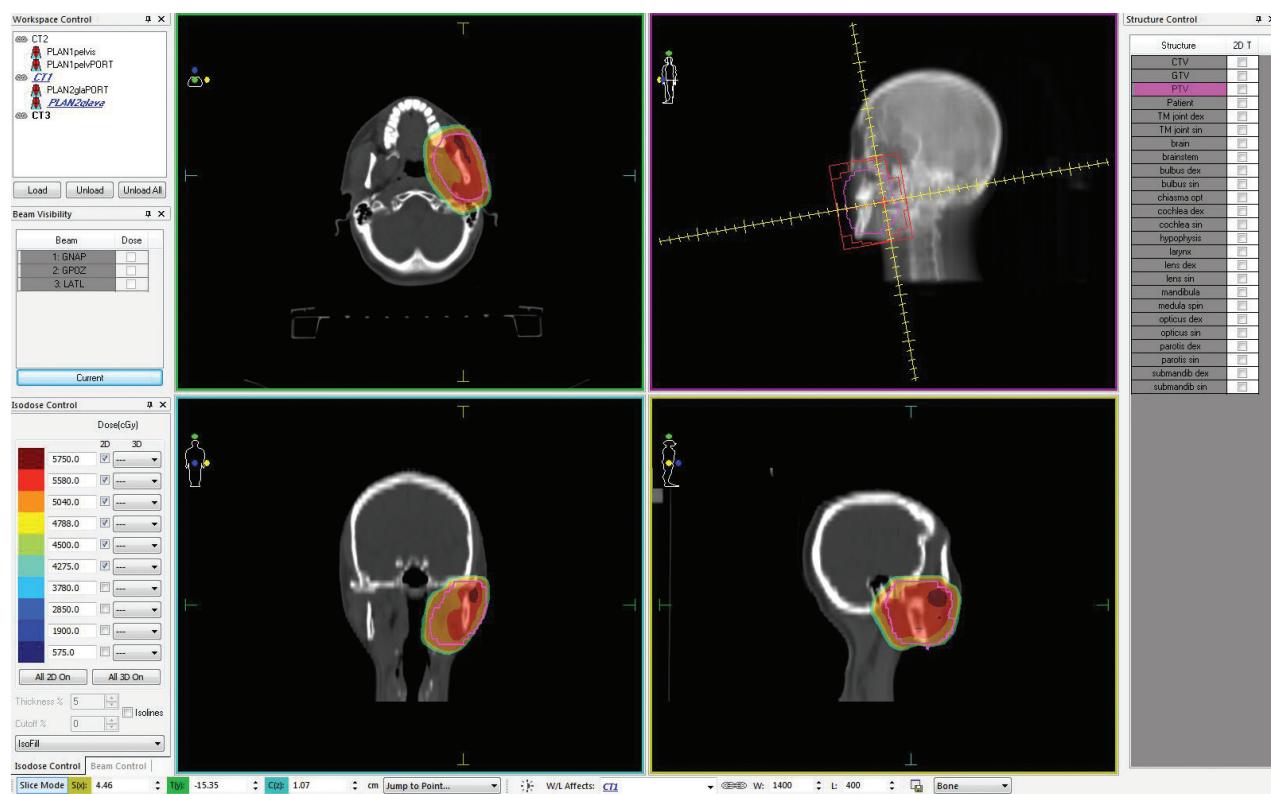


Figure 3. The treated volume and dose distribution in mandible localization
Slika 3. Tretirani volumen i dozna distribucija lokalizacije u mandibuli

response, CR). The patient was then presented to the tumor board and radiotherapy of initially affected locations as well as continuing of chemotherapy with VAI (vincristine, actinomycin, ifosfamide) was prescribed.

Radiation therapy was planned as 3D conformal technique (3DCRT) with standard regime of fractionation 1.8

Gy / day with total dose TD 55.8 Gy in 31 fractions in the region of mandible (Figure 3) and TD 50.4 Gy in 28 fractions of the pelvic region. Radiotherapy was conducted in February 2018 with good subjective tolerance, but with development of radiomucositis grade 1 and radiomucositis grade 2 in the left buccal area, that eventually healed

after increased local care. The administration of chemotherapy VAI (eight cycles) was completed in May 2018. Control PET CT scan in July 2018 confirmed complete response, and the tumor board indicated regular checkups.

At the last control checkup in May 2019, there were no signs of recurrence, the patient had no symptoms, and no toxicity was demonstrated one year after completion of combined treatment and more than two years from diagnosis.

DISCUSSION

Ewing's sarcoma is a rare tumor that is most common in the population under the age of 15 years, while rarely occurs in population over 30 years old and younger than 5 years. The appearance of the disease in the region of head and neck is especially rare and it includes about 2% of all cases of Ewing's sarcoma [2, 3].

In our case report, the first manifestation of the disease was tooth pain and swelling of the left side of mandible. Such initial presentation of the disease was likely the reason for postponing early diagnoses, which may have negative influence on the course of the disease and treatment [4].

Taking into account that in our case patient was in good general health, with no signs and symptoms that would indicate the existence of tumors in pelvis, timely referring to maxillofacial surgery has contributed to rapid initiation of diagnosis and treatment.

Despite the fact that Ewing's sarcoma in maxillofacial, and head and neck region is rare, this case indicates that all medical doctors and dentists in primary health care and doctors who specialise in oral and / or maxillofacial surgery, have very important role in early diagnosis of these rare diseases, and thus can contribute to better treatment outcomes, even in advanced cases.

REFERENCES

- Burningham Z, Hashibe M, Spector L, Schiffman JD. The epidemiology of sarcoma. *Clin Sarcoma Res.* 2012; 2(1):14. [DOI: 10.1186/2045-3329-2-14] [PMID: 23036164]
- Bellan DG, Filho RJ, Garcia JG, de Toledo Petrilli M, Maia Viola DC, Schoedl MF, et al. Ewing's sarcoma: epidemiology and prognosis for patients treated at the pediatric oncology institute, IOP-GRAACC-UNIFESP. *Rev Bras Ortop.* 2015; 47(4):446-50. [DOI: 10.1016/S2255-4971(15)30126-9] [PMID: 27047848]
- Bernstein M, Kovar H, Paulussen M, Randall RL, Schuck A, Teot LA, et al. Ewing's sarcoma family of tumors: current management. *Oncologist.* 2006; 11(5):503-19. [DOI: 10.1634/theoncologist.11-5-503] [PMID: 16720851]
- Margaix-Muñoz M, Bagán J, Poveda-Roda R. Ewing sarcoma of the oral cavity. A review. *J Clin Exp Dent.* 2017; 9(2):e294-e301. [DOI: 10.4317/jced.53575] [PMID: 28210452]
- Halperin EC, Perez CA, Brady LW. Perez and Brady's principles and practice of radiation oncology. 6th ed. Lippincott Williams & Wilkins; 2013.

Received: 26.03.2019 • Accepted: 06.08.2019

Juingov (Ewing) sarkom sa inicijalnom prezentacijom u mandibuli – prikaz slučaja

Srđan Milanović¹, Nikola Milošević¹, Marko Dožić¹, Dušan Ristić¹, Goran Stojković², Nebojša Miletić¹

¹Institut za onkologiju i radiologiju Srbije, Beograd, Srbija;

²Klinički centar Srbije, Klinika za otorinolaringologiju i maksilofacialnu hirurgiju, Beograd, Srbija

KRATAK SADRŽAJ

Juingov (Ewing) sarkom je tumor koji se retko javlja posle dvadesete godine života. Pojavljivanje ovog tumora u regiji glave i vrata je još rede, bilo kao primarno mesto ili kao mesto diseminacije bolesti. Lečenje je multidisciplinarno i uključuje primenu hemoterapije, hirurgiju i/ili radioterapiju. Prikaz slučaja se odnosi na pacijentkinju staru 29 godina koja je upućena maksilofacialnom hirurgu zbog bola zuba i otoka leve strane donje vilice, koji nije prolazio posle primene antibiotika. Nakon biopsije je dijagnostikovan Juingov sarkom u mandibuli, a pre otpočinjanja lečenja je potvrđena primarna lokalizacija u karlici. Posle godinu dana od kompletirane hemoterapije i radioterapije nema znakova bolesti. Ovaj slučaj ukazuje da svi lekari koji su specijalizovani za oralnu i/ili maksilofacialnu hirurgiju, kao i doktori medicine i stomatologije, u primarnoj zdravstvenoj zaštiti mogu imati izuzetno važnu ulogu u što ranijoj dijagnozi ove retke bolesti, a samim tim doprineti boljim rezultatima lečenja, čak i kod uznapredovalih slučajeva.

Ključne reči: Juingov (Ewing) sarkom; mandibula; hemoterapija; radioterapija

UVOD

Juingov sarkom (JS) retko je oboljenje.

Kod odraslih sarkomi broje manje od 1% slučajeva svih solidnih tumora, a od toga je samo oko 10% tumora lokalizovano u kostima [1]. JS je u populaciji dece i mladih odraslih na drugom mestu po učestalosti koštanih tumora. U grupi JS, osim koštanog JS, postoje još ekstraosealni JS i Askinov tumor. JS se najčešće dijagnostikuje u drugoj deceniji, dok se u prvoj deceniji javlja oko 20–30 % slučajeva ovih tumora. Pojavljivanje posle 30. godine je retko [2].

JS se može javiti u bilo kojoj kosti; međutim, najčešće se javlja u dugim i pljosnatim kostima, na prvom mestu sa lokalizacijom u kostima karlice, femuru, kostima grudnog koša, potkolenicama i humerusu. Pojavljivanje u kostima glave nije uobičajeno, bilo kao primarno mesto ili kao mesto diseminacije bolesti, sa učestalošću oko 2% [3], i tada je najčešće zahvaćena mandibula [4].

Ovi tumori se najpre manifestuju pojavom bola i otoka, a sa rastom promene dolazi i do poremećaja funkcije zahvaćene regije. U trenutku dijagnoze je oko 25% pacijenata sa prisutnim metastazama, a samo kod oko 10% pacijenata se javljaju izolovane metastaze u kostima [3]. Pacijenti sa lokalizovanom bolesću imaju bolju prognozu, sa stopom preživljavanja oko 60–70 %, dok pacijenti sa inicijalno prisutnim metastazama imaju znatno lošiju prognozu, sa stopom preživljavanja manjom od 25% [3].

Lečenje je multimodalno, zasnovano na hemoterapiji (HT), hirurgiji i radioterapiji, u aktivnoj saradnji članova multidisciplinarnog onkološkog tima [3, 5].

PRIKAZ SLUČAJA

Pacijentkinja stara 29 godina javila se svom stomatologu u januaru 2017. godine zbog bola i otoka leve strane donje vilice. Bila je dobrog opšteg zdravlja, bez drugih tegoba. Tada je ordiniran antibiotik širokog spektra, na čiju primenu nije došlo do promene kliničke slike. Pacijentkinja je zatim upućena maksilofacialnom hirurgu u Klinički centar Srbije.

Inicijalni CT glave i vrata je pokazao osteolizu levog ramusa mandibule, nepravilnih kontura (Slika 1), te je početkom februara 2017. učinjena biopsija tumora. Po dobijenom histopatološkom nalazu pacijentkinja je prikazana konzilijumu za sarkome i primljena u Institut za onkologiju i radiologiju Srbije radi dodatne dijagnostike i otpočinjanja lečenja primenom hemoterapije. Na učinjenim pregledima (CT vrata, grudnog koša, abdomena i karlice, MR karlice, SCI skeleta, RTG) pokazano je prisustvo osteolitične tumorske mase tela desne ilijačne kosti sa zahvatanjem desnog sakroliličnog zgloba i infiltracijom korteks krila sakruma, kao i manjom ekstraosealnom propagacijom i infiltracijom *m. gluteus maximus*, dimenzija 2 × 9 cm. Takođe je u sakrumu bila prisutna druga osteolitična lezija 4 × 2,7 × 2 cm, koja lateralno dopire do levog sakroliličnog zgloba, i još jedna promena 15 × 15 mm supraacetabularno u levoj ilijačnojести.

Lečenje je otpočeto primenom HT po protokolu VIDE (vin-kristin, ifosfamid, doksorubicin, etopozid). Nakon šest ciklusa HT, kontrolni CT pregledi su pokazali regresiju bolesti (Slika 2), a kontrolni PET CT (septembar 2017) ukazao je na odsustvo pojačanog metabolizma radiofarmaka, odnosno kompletan odgovor (CR), te je pacijentkinja prikazana konzilijumu kada je indikovana radioterapija inicijalno zahvaćenih lokalizacija, kao i primena HT po šemi VAI (vinkristin, aktinomicin, ifosfamid).

Zračna terapija je planirana 3D konformalnom tehnikom, standardnim režimom frakcionisanja 1,8 Gy/dnevno sa TD 55,8 Gy u 31 frakciji na predeo mandibule (Slika 3) i TD 50,4 Gy u 28 frakciji na predeo pelvisa. Radioterapija je sprovedena februara 2018. godine uz dobru subjektivnu toleranciju, uz razvoj radiomukozitisa gr 1 i radiomukozitisa gr 2 levo bukalno, koji su sanirani uz pojačanu lokalnu negu.

Primena HT po šemi VAI (osam ciklusa) kompletirana je maja 2018. godine, a kontrolni PET CT od jula 2018. je potvrdio kompletan odgovor, te je konzilijum indikovao redovne kontrole.

Na poslednjoj kontroli u ranom toku praćenja, koja je bila maja 2019. godine, nema znakova recidiva, pacijentkinja je bez novih tegoba i bez ispoljene toksičnosti godinu dana nakon sprovedenog kombinovanog lečenja i više od dve godine od postavljanja dijagnoze.

DISKUSIJA

JS je redak tumor koji se najčešće javlja u populaciji starosti do 15 godina, dok se kod starijih od 30 godina i mlađih od pet godina retko dijagnostikuje. Pojavljivanje ove bolesti u regiji glave i vrata je posebno retko jer se JS u kostima glave nalazi samo u oko 2% od svih slučajeva JS [2, 3].

U našem prikazu slučaja je prva manifestacija bolesti bila bol zuba i otok leve strane donje vilice. Takva inicijalna prezentacija bolesti lako može dovesti do odlaganja pravovremene dijagnoze, što može imati loš uticaj na lečenje i tok bolesti ovih agresivnih tumora [4].

Imajući u vidu da je u našem slučaju pacijentkinja bila dobrog opšteg zdravlja, klinički bez simptoma i znakova koji bi upućivali na postojanje tumora u karlici, pravovremeno upućivanje maksilofacijalnom hirurgu doprinelo je brzom postavljanju dijagnoze i otpočinjanju lečenja.

Uprkos tome što se JS u maksilofacijalnoj i regiji glave i vrata retko javlja, ovaj slučaj ukazuje da svi doktori medicine i stomatologije u primarnoj zdravstvenoj zaštiti, kao i lekari koji su specijalizovani za oralnu i/ili maksilofacijalnu hirurgiju, imaju izuzetno važnu ulogu u što ranije dijagnozi ove retke bolesti, a samim tim mogu doprineti boljim rezultatima lečenja, čak i kod uznapredovalih slučajeva.

Da li ste pažljivo čitali radove?

1. Juingov (Ewing) sarkom se javlja posle 20. godine života:
 - a) retko
 - b) često
 - c) nikad
2. Dentalno antropološki status humane populacije je izolovan na:
 - a) antičkom lokalitetu
 - b) rimskom lokalitetu
 - c) vizantijskom lokalitetu
3. Antimikrobna aktivnost materijala na bazi kalcijum-aluminata je proveravana:
 - a) testom difuzije u agaru
 - b) mestom difuzije u agaru
 - c) direktnim kontaktnim sredstvom
4. Oralnozdravstveno ponašanje starih osoba je istraživano u:
 - a) Srbiji
 - b) Crnoj Gori
 - c) Makedoniji
5. Pacijentkinja sa Juingovim (Edwing) sarkomom je imala:
 - a) 22 godine
 - b) 29 godina
 - c) 39 godina
6. Nekropole sa Viminacijuma potiču iz perioda:
 - a) 2–4. veka n. e.
 - b) 5–7. veka n. e.
 - c) 2–4. veka p. n. e.
7. Novosintetski materijal na bazi kalcijum-aluminata je upoređivan sa:
 - a) novosintetskim materijalom na bazi kalcijum-silikata
 - b) MTA
 - c) BIO DENTINOM
8. Oralnohigijenske navike u Podgorici su istraživane:
 - a) kod dece
 - b) kod adolescenata
 - c) kod starih osoba
9. Juingov (Ewing) sarkom se javlja u regiji glave i vrata:
 - a) često
 - b) retko
 - c) izuzetno retko
10. Dentalni status vilica sa Viminacijuma je analiziran kod:
 - a) 30 individua
 - b) 45 individua
 - c) 70 individua
11. Kao test-mikroorganizmi korišćeni su standardni slojevi:
 - a) *E. faecalis*
 - b) *S. mutrus*
 - c) *Lactobacillus*
12. Kod testiranih osoba u Podgorici korišćen je upitnik sa:
 - a) 15 pitanja
 - b) 21 pitanjem
 - c) 30 pitanja
13. Lečenje Juingovog (Ewing) sarkoma uključuje hemoterapiju?
 - a) Da
 - b) Ne
 - c) Ponekad
14. Zubnozdravstveni status antičkih populacija na Viminacijumu je ukazao na:
 - a) visok stepen abrazije
 - b) nizak stepen abrazije
 - c) zube bez abrazije
15. Najbolji antibakterijski efekat novosintetskog materijala je pokazan prema:
 - a) *E. faecalis*
 - b) *S. aureus*
 - c) *C. albicans*
16. Prosečna starost ispitanika u Podgorici iznosila je:
 - a) 65 godina
 - b) 71 godinu
 - c) 75 godina

17. Terapija Juingovog (Ewing) sarkoma je:
- hirurška
 - radioterapija
 - multidisciplinarna
18. Anatomofoloski status zuba i vilica sa prostora Viminacijuma se:
- podudara sa karakteristikama savremenog čoveka
 - ne podudara sa karakteristikama savremenog čoveka
 - potpuno je različit od statusa savremenog čoveka
19. Zona inhibicije na agaru za novosintetisani materijal ACBO-MCCA je iznosila:
- 5,7 mm
 - 6,2 mm
 - 4,8 mm
20. Bezubih pacijenata kod ispitanika u Podgorici je bilo:
- 20%
 - 40%
 - 70%
21. Juingov (Ewing) sarkom je otkriven u:
- maksi
 - mandibuli
 - obe vilice
22. Izolovane metastaze kod Juingovog (Ewing) sarkoma se javljaju:
- kod 5% pacijenata
 - kod 10% pacijenata
 - kod 15% pacijenata
23. Prva teritorijalna identifikacija Viminacijuma je izvršena:
- tokom 10. veka
 - tokom 15. veka
 - tokom 18. veka
24. Mikroskopski vidljive PA promene su na Viminacijumu otkrivene:
- kod manje od 1% slučajeva
 - kod 1% slučajeva
 - kod 2% slučajeva
25. Prečnik zone inhibicije rasta testiranih mikroorganizama je meren na:
- 3 polja u agaru
 - 6 polja u agaru
 - 9 polja u agaru
26. Novosintetski materijal ACBO-MCCA je ispoljio antibakterijski efekat prema testiranim mikroorganizmima koji je:
- komparabilan sa MTA
 - nekomparabilan sa MTA
 - bolji od MTA
27. Primarna lokalizacija Juingovog (Ewing) sarkoma je bila u:
- karlici
 - butnoj kosti
 - nadlaktici
28. Karijes zuba na lokalitetu Viminacijuma je otkriven na:
- 18 zuba
 - 28 zuba
 - 38 zuba
29. Materijal na bazi kalcijum-aluminata je imao antibakterijski efekat prema *E. faecalis*?
- Da
 - Ne
 - Samo u nekoliko slučajeva
30. Strah od stomatološke intervencije kod ispitanika u Podgorici navelo je njih:
- 33%
 - 43%
 - 53%
31. Oralni i maksilofacialni hirurzi mogu doprineti efikasnoj dijagnozi?
- Da
 - Ne
 - Skoro nikad
32. Arheološki lokalitet Viminacijuma se nalazi:
- na području Makedonije
 - na području Bosne i Hercegovine
 - na području Srbije
33. Erozija gledi na lokalitetu Viminacijuma je registrovana kod:
- jednog slučaja
 - dva slučaja
 - pet slučajeva
34. Visoka cena stomatoloških intervencija kao razlog nedolaska stomatologu zabeležena je kod:
- 10% pacijenata
 - 16% pacijenata
 - 26% pacijenata
35. Arheološka iskopavanja na Viminacijumu su sprovedena:
- 2005–2008. godine
 - 2003–2005. godine
 - 2003–2008. godine
36. Iskopavanja većeg obima na području Viminacijuma su realizovana:
- pedesetih godina prošlog veka
 - šezdesetih godina prošlog veka
 - sedamdesetih godina prošlog veka

37. Zona inhibicije na agaru za novosintetisani materijal ACBO-MCCA prema *C. albicans* je iznosila:
- a) 3,8 mm
 - b) 4,8 mm
 - c) 6,8 mm
38. Juingov (Ewing) sarkom je u populaciji dece i mladih:
- a) na prvom mestu
 - b) na drugom mestu
 - c) na trećem mestu
39. Na Viminaciju je istražena nekropola sa:
- a) 50 grobova
 - b) 77 grobova
 - c) 89 grobova
40. Najstarije nekropole u Viminaciju pripadaju:
- a) keltskom stanovništvu
 - b) gvozdenom dobu
 - c) srpskom stanovništvu
41. Među ispitanicima u Podgorici alkohol konzumira njih:
- a) 21%
 - b) 41%
 - c) 51%
42. Juingov (Ewing) sarkom se najčešće dijagnostikuje:
- a) u prvoj deceniji
 - b) u drugoj deceniji
 - c) u trećoj deceniji
43. Na području Viminacija je istraženo:
- a) preko 4 000 grobova
 - b) preko 14 000 grobova
 - c) preko 40 000 grobova
44. Kod ispitanika u Podgorici duvan konzumira njih:
- a) 21%
 - b) 41%
 - c) 51%
45. Kod Juingovog (Ewing) sarkoma sa metastazama je oko:
- a) 10% pacijenata
 - b) 20% pacijenata
 - c) 25% pacijenata
46. Dominantna patološka pojava na Viminaciju je bila:
- a) abrazija zuba
 - b) karijes zuba
 - c) pojava zubnog kamenca
47. Pojava Juingovog (Ewing) sarkoma posle 30 godina je:
- a) retka
 - b) česta
 - c) izuzetno česta
48. Među ispitanicima u Podgorici tablete za čišćenje proteza koristi njih:
- a) 40%
 - b) 50%
 - c) 6%
49. Pojava Juingovog (Ewing) sarkoma u kostima glave je zastupljena:
- a) oko 1%
 - b) oko 2%
 - c) oko 3%
50. Pomoćna sredstva za oralnu higijenu među ispitanicima u Podgorici koristi njih:
- a) 25%
 - b) 35%
 - c) 45%

Odgovore slati na email adresu Uredništva časopisa „Stomatološki glasnik Srbije“ ili na adresu Stomatološke komore Srbije (Uzun Mirkova 3/3). 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 radove, prikaze iz prakse, pregledne radove, saopštenja, istoriografske radove, prikaze knjiga, komentare i pisma uredništvu, društvenu hroniku.

Svi rukopisi se podvrgavaju recenziji. Radove 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 radove 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 margine 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 margine, 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 okviru 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 radova publikovanih u časopisima s recenzijom.

Tekst rukopisa Koristiti kratke i jasne rečenice, bez stranih reči i neadekvatnih pojmovima 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 pojavljinjanju 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 biohemiskih 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 čelijama.

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 biomedičkim 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 njegovo 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 preplatnici 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 urednik
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

