



# STOMATOLOŠKI GLASNIK SRBIJE

## SERBIAN DENTAL JOURNAL

Vol. 66 • Number 4 • October-December 2019





# STOMATOLOŠKI GLASNIK SRBIJE

---

# SERBIAN DENTAL JOURNAL

Vol. 66 • Number 4 • October-December 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](http://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

---

<b>REČ UREDNIKA .....</b>	<b>165</b>
 <b>ORIGINAL ARTICLES / ORIGINALNI RADOVI</b>	
Vanja Opačić Galić, Danica Popović, Jovana N. Stašić, Bojan Dželetović, Stefan Manojlović Gloss and surface analysis of various composite materials. .... Analiza sjaja i površine različitih kompozitnih materijala	167
Mirjana Duspara, Maida Mulić, Kristina Duspara Prevalence of biomechanical risks among dentists ..... Prevalenca biomehaničkih rizika kod doktora stomatologije	175
Nikola Živković, Pavle Nikolić, Jovana Kuzmanović-Pfićer, Mirjana Perić, Aleksandra Milić-Lemić An anthropometric study of craniofacial measurements and their correlation with vertical dimension of occlusion among fully dentate population in Serbia ..... Antropometrijska studija kraniofacijalnih dimenzija i njihova korelacija sa vertikalnom dimenzijom okluzije u populaciji Srbije kod pacijenata sa očuvanom denticijom	182
Minja Miličić Lazić, Milica Jakšić, Ana Todorović, Igor Đorđević, Vojkan Lazić Biological complications of the cement-retained implant-supported restorations ..... Biološke komplikacije cementom retiniranih nadoknada na implantatima	189
 <b>CASE REPORT / PRIKAZ IZ PRAKSE</b>	
Dragan Ivanović, Slavoljub Tomić, Lado Davidović, Dajana Nogo-Živanović, Tanja Ivanović Combined orthodontic-surgical approach in the treatment of impacted upper canines ..... Kombinovani ortodontsko-hirurški tretman u terapiji impaktiranih gornjih očnjaka	196
 <b>DA LI STE PAŽLJIVO ČITALI RADOVE? .....</b>	201
<b>UPUTSTVO AUTORIMA ZA PRIPREMU RADA .....</b>	204
<b>INSTRUCTIONS FOR AUTHORS .....</b>	206



,Niko nas nije pitao kad i gde ćemo se roditi,  
i za to nemamo ni zasluge ni krivice,  
a da li ćemo postupati kao ljudi ili neljudi –  
to zavisi isključivo od nas.“

Patrijarh Pavle

**K**ad ideje za urednički komentar naviru kao bujice, jedini problem je izabrati najoriginalniju za našu realnost. U moru „svekolikog“ napretka najteže je ipak ostati razuman, pa je i ova misao našeg patrijarha najbolje tumačenje moralnog, društvenog, ali i individualnog posrnuća u skoro svim segmentima života.

Živimo u vremenu totalne hipokrizije i laži, gde su paranoja i autoritarnost osnovni životni postulati, a primitivizam, mržnja i, svakako, nasilje osnovni modeli ponašanja. U takvoj imitaciji života samo se hipnozom ili simuliranjem može objasniti „normalnost“ i svakodnevica.

Naš društveni ambijent se bazira na apsurdimu i cinizmu, ali i na neznanju i često verbalnoj agresiji na zdrav razum. Antiintelektualizam je ne samo stav već i stanje svesti onih koji nam „oblikuju“ život. A kada su afere, malverzacije, prevare i laži normalan „društveni proizvod“, onda je boljšitak udaljen svetlosnim godinama. Sigurno je, takođe, da su i tetovaže koje iscrtava takva realnost na dušama onih koji žive montipajtonovsku stvarnost teško izbrisive. Kada se na sve ovo nadovežu i institucije u kojima sede i „vredno“ rade mediokriteti i „partijski podobni“ sa sumnjivom školskom spremom i plagiranim doktoratima, put u „bezdan“ je jedina svetla tačka.

Cinjenica je, takođe, da je moralni kodeks „kreatora“ naših života prilično „izvitoperen“ i značajno pomeren iz normalnog koloseka. Biti ponosan na sopstveno neznanje je karakteristika neukih i suprotna je svakoj logici. Tamo gde je kultura izolovana iz svakog društvenog konteksta, tamo gde su nosioci zakona promotori bezakonja, tamo gde sistem manipulacije „validno“ derogira argumente, tamo gde se „uredno“ menjaju uzroci i posledice i gde se jedino „tapšanjem“ valorizuju podvizi „preučenih“ – moralni sunovrat je jedini izlaz na kraju tunela.

Vrhunac društvene hipokrizije je trgovina diplomama i ordenjem, odnosno „krađa“ tuđeg znanja (čitaj plagiranje) uz „sistematski“ pokušaj odbrane laži i neistina neakademskim postupcima.

U talasu primitivizma jedino Univerzitet i sistem visokog obrazovanja uspevaju da se usprotive „kreatorima jednoumlja“ i „sejačima straha“ protiv svake kritične i kreativne ideje. Univerzitet je centralna institucija svakog društva i stub na kome počiva prosperitet i napredak i trebalo bi da počiva na čestitosti, stručnosti i znanju kao osnovnim merilima.

Akademска čestitost bi morala biti najveća vrlina jer podrazumeva pre svega poštjenje, slobodu i hrabrost u tumačenju brojnih izazova sadašnjeg trenutka, ali i visoku profesionalnost i odgovornost u poštovanju elementarnih zakonskih, etičkih i moralnih normi. Borba za istinu je osnovni cilj i jedina destinacija odgovornih i kompetentnih, ali i neiscrpna energija i jedino svetlo u mraku koji natkriljuje našu stvarnost.

Ovaj urednički komentar će završiti citatom i danas aktuelnog Branislava Nušića: „Tamo gde se znanje rasprodaje a titula kupuje – nema boljšitka“ jer je to istovremeno i pitanje i odgovor, ali i tragična komedija naše stvarnosti i aktuelnog trenutka.

Prof. dr Slavoljub Živković



# Gloss and surface analysis of various composite materials

Vanja Opačić Galić<sup>1</sup>, Danica Popović<sup>2</sup>, Jovana N. Stašić<sup>1</sup>, Bojan Dželetović<sup>1</sup>, Stefan Manojlović<sup>3</sup>

<sup>1</sup>University of Belgrade, School of Dental Medicine, Department of Restorative Dentistry and Endodontics, Belgrade, Serbia;

<sup>2</sup>University of Belgrade, School of Dental Medicine, Department of Prostodontics, Belgrade, Serbia;

<sup>3</sup>Dental Clinic "S Dent" Subotica, Serbia

## SUMMARY

**Introduction** To obtain the ideal aesthetics, each restorative material must imitate natural tooth in color, surface texture and be stable over time. Damage or wear of the material causes poor optical properties of the restoration, so it is necessary to repolish, repair or replace it. The aim of this study was to test the gloss and surface changes of the composite materials with filler's particles of different size, before and after material artificial mechanical ageing.

**Material and Methods** Four composite materials were tested, two microhybrid composites (Gradia Direct GC, Herculite XRV, Kerr) and two nanohybrid composites (Filtek Ultimate 3M; TetricEvoceram, Ivoclar). Composites' samples of  $9 \times 9 \times 2$  mm in size were polished in accordance to the standard protocol by Sof-Lex discs (2382 C, SM, F, SF) for 30 seconds. Gloss was measured after polishing and taking photos using optical microscope ( $400\times$ ). In the chewing simulator, ageing of the samples was conducted (100,000 cyclic kicks). After the samples' ageing, surface photos were taken and gloss measured. The obtained results were statistically processed (One-way ANOVA, t-test).

**Results** The best gloss after polishing was shown by Filtek Ultimate ( $54.00 \pm 14.06$ ), the worst by Gradia Direct ( $47.33 \pm 7.92$ ). There was no statistically significant difference ( $p > 0.05$ ) in surface gloss after polishing composite. The smallest defects on the surface of composites were detected in material Gradia Direct ( $21363.7 \mu\text{m}^2$ ) with the average value of the diameter  $137 \mu\text{m}$ .

**Conclusion** The tested nanohybrid and microhybrid composites showed comparable gloss value before and after artificial aging. Mechanical aging caused vivid changes regarding surface defects on all tested composite materials.

**Keywords:** nanohybrid composite; microhybrid composite; gloss

## INTRODUCTION

Many philosophers have spoken of aesthetics and beauty, and most of them agreed with Plato's saying that beauty is in the eye of the viewer and that it is subjective experience of the object of observation. Aristotle's quote that what is beautiful has to be harmonious, could apply on nowadays composite materials which in general comply with aesthetic, functional and biological demands in restorative dentistry. To obtain ideal aesthetics, each restorative material must match natural tooth in color, surface texture and be stable over time [1]. The main reason for replacement of the existing restorations is mostly aesthetics [2].

One of the problems when applying composite restorative materials is the rough surface of restoration. This facilitates staining, plaque accumulation, recurrent decay, inflammation of the gingiva, and brightness reduction of the restoration. The surface roughness of  $\text{Ra } 0.2\mu\text{m}$  ( $\text{Ra} =$  means roughness value) is considered sufficient for plaque accumulation and discoloration [3, 4], while patient can feel roughness of  $0.3 \mu\text{m}$  by the tip of the tongue [5]. O'Neill pointed out that the maximum acceptable threshold for roughness is 200 nm, after which plaque accumulation occurs [6]. Damage or wear of the material

causes poor optical properties of the restoration, so it is necessary to repolish, repair or replace it.

In addition to surface roughness, gloss is another factor that plays an important role in the aesthetics of composites. Gloss is surface ability to reflect light. Human eye can easily tell the difference between the radiance of the restoration and surrounding enamel, even if the colors of these structures are the same [7]. Furthermore, glossy surface of enamel "tolerates" mechanical wear, while glossy surface of the composite, which is initially lower, tends to continue to decrease due to mechanical stresses over time. With increasing surface roughness, the degree of random light reflection increases, which eventually results in the decrease in the surface gloss [8]. Reduction of gloss and smoothness potentially leads to discoloration of the restoration [5, 11].

In the oral environment, many external and internal factors have great impact on restorations. The factors related to the material itself are primarily the structure of the matrix and the characteristics of the restoration particles, which have direct influence on the surface smoothness and susceptibility to exterior discolouration [1, 9].

Reducing the particle size of hybrid composites can enhance aesthetic properties, but with optimum physical properties, microhybrids (0.04 to  $1\mu\text{m}$ ) were the first one

introduced and followed by nanotechnology with particles that are in the range of 0.1-100 nanometers. The use of nanotechnology in new composite formulations is one of the major contributions in dental materials [10, 11]. Nanocomposites are considered to be a combination of good mechanical strength of hybrid composites but with superior optical properties than micro-filled ones [4, 12]. They have high translucency, are well polished and have superior gloss with adequate mechanical properties for high stress restorations [5]. In addition to the particle size, the shape of the particles also has an impact on the resistance to occlusal wear, so Tamura et al. [13] pointed out that spherical particle composites are more resistant to simulated occlusal wear than irregularly shaped particle composites.

Resin and filler particles do not have the same wear resistance due to different degrees of hardness [9]. Thus, composite structure, refining and polishing systems have direct effect on surface (gloss and roughness), and mechanical properties (hardness and resistance to chemical degradation) [1, 14]. It has been shown that more time spent on polishing a composite, the restoration with higher and longer gloss is obtained [3].

Given that degradation of the composite in the oral environment is known, numerous *in vitro* studies have examined the effect of artificial aging on the mechanical and optical properties of these materials. Cycle loading protocols (mechanical artificial aging), immersion in media such as ethanol or water, brush simulation and light aging [2, 15, 16] are most commonly used.

The aim was to investigate gloss and surface changes of different composite materials before and after simulated aging. The null hypothesis was that there was no difference in gloss before and after the mechanical aging of different composite materials.

## MATERIALS AND METHODS

Four types of composite materials were included in this investigation, two microhybrid and two nanohybrid composites (color A2) (Table 1).

For each groups of tested materials, eight samples were prepared (in silicon mold 9x9x2 mm). Each sample was polymerized across glass slide 40 s on both sides, (Wood-pecker Led. H, China). Samples were polished by standard protocol aluminum oxide abrasive Sof-Lex discs (2382 C, SM, F, SF) (3M, ESPE), for 30 s each, using watercooling. After polishing the samples, (IG-331; Horiba) gloss of each sample surface of the composite material was measured by the gloss-meter. Samples were centrally set up with striking beam of 60 degrees. Polished surfaces were observed with optical microscope (x400) (Carl Zeiss Jena NU2) and photographed.

Until placed in chewing simulator, samples were kept in wet environment with constant temperature of 37°C. Samples were poured into acrylate and placed in two chambers of chewing simulator. Cyclic loading with force of 5 kg in vertical direction simulated mechanical aging. For each sample 100,000 cycles were performed. This was equivalent to one year of chewing (CS-4.2 Economyline, SD Mechanotronics, Germany). After the mechanical aging, gloss was measured for every surface. Surface of samples were photographed and saved in digital format.

The obtained results were statistically processed using One-way ANOVA and T- test.

## RESULTS

The results were presented in Figures 1–6 and Table 2.

After being polished with Sof-Lex system, the highest gloss was shown in Filtek Ultimate with values  $54 \pm 14.08$ , Tetric EvoCeram with values  $49.67 \pm 7.03$  and Herculite

**Table 1.** Tested materials  
**Tabela 1.** Testirani materijali

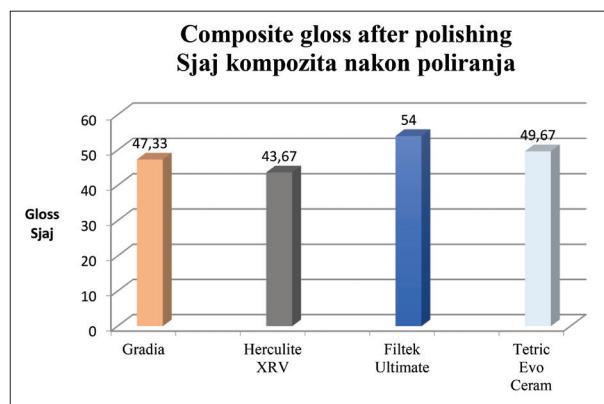
Material Materijal	Type Tip	Fillers Punioci	Matrix Matriks	Manufacturer Proizvodac
Gradia	Microhybrid mikrohibridni	0.85 µm Silica / silika	UDMA, dimethacrylate co-monomers-dimetakrilat ko-monomer	GC Dental, Japan
Herculite XRV	Microhybrid mikrohibridni	0.3–0.6 µm Ba-Al-Silicate / Ba-Al-silikat	Bis-GMA	KerrHawe S. A., Switzerland
Filtek Ultimate	Nanohybrid nanohibridni	0.6–10 µm 4–20 nm silica, zirconia / silikat, cirkonijum	Bis-GMA, UDMA, TEGDMA, bis-EMA	3M ESPE, USA
Tetric EvoCeram	Nanohybrid nanohibridni	40–3000 nm Ba-Al-silicate, iterbiumtrifluorid, silica / Ba-Al-silikat, iterbiumfluorid, silika	UDMA, Bis-GMA	IvoclarVivadent, Liechtenstein

UDMA – urethane dimethacrylate; Bis-GMA – bisphenol glycidyl methacrylate; TEGDMA – triethylene glycol dimethacrylate; Bis-EMA – ethoxylated bisphenol-A dimethacrylate UDMA – uretan-dimetakrilat; Bis-GMA – bisfenol-glicidil metakrilat; TEGDMA – trietilen-glikol dimetakrilat; Bis-EMA – etoksilirani bisfenol-A dimetakrilat

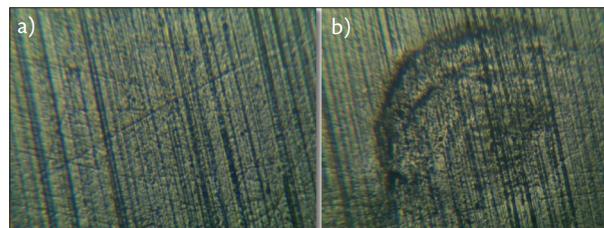
**Table 2.** Composite surface defect sizes (µm) after chewing simulation

**Tabela 2.** Veličina defekata na površini kompozita (µm) posle simulacije žvakanja

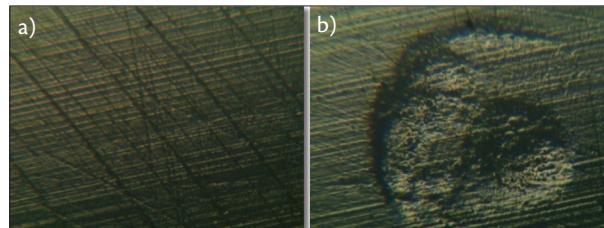
Material Materijal	Area, µm <sup>2</sup> Površina, µm <sup>2</sup>	Max diameter, µm Maksimalni prečnik, µm	Min diameter, µm Minimalni prečnik, µm	Mean diameter, µm Srednji prečnik, µm	Roundness Zaokruženo
Gradia	21363.7	226.4	103.1	137.8	1.91
Herculite XRV	268696,7	630.0	537.3	582.7	1.17
Filtek Universal	187307.0	584.2	300.8	457.2	2.34
Tetric EvoCeram	247833.3	756.3	547.4	642.4	3.61



**Figure 1.** Gloss of composite after polishing  
**Slika 1.** Sjaj kompozitnih materijala posle poliranja



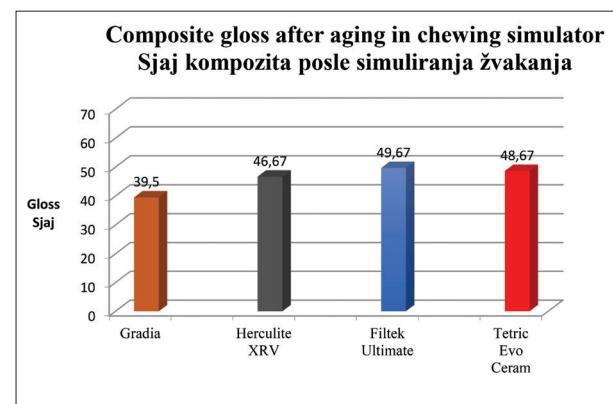
**Figure 3.** Composite filling surface Gradia Direct  
a) after polishing ( $\times 400$ );  
b) after aging; defect size ( $21.364 \mu\text{m}^2$ ) ( $\times 400$ )  
**Slika 3.** Kompozitna površina kompozita Gradia Direct  
a) posle poliranja ( $\times 400$ );  
b) posle starenja; veličina defekta ( $21,364 \mu\text{m}^2$ ) ( $\times 400$ )



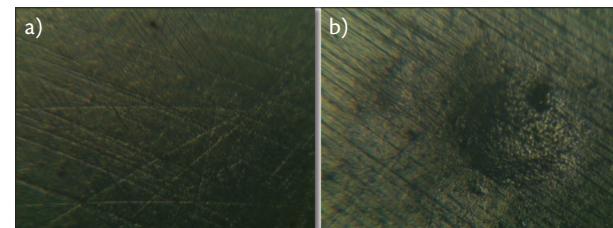
**Figure 5.** Composite filling surface Filtek Ultimate  
a) after polishing ( $\times 400$ );  
b) after aging; defect size ( $187.307 \mu\text{m}^2$ )  
**Slika 5.** Kompozitna površina kompozita Filtek Ultimate  
a) posle poliranja ( $\times 400$ );  
b) posle starenja; veličina defekta ( $187,307 \mu\text{m}^2$ ).

XRV with  $43.67 \pm 12.14$ . The lowest gloss after polishing was recorded in Gradia Direct with values  $47.33 \pm 7.92$  (Figure 1). After polishing there was no statistically significant difference in gloss between micro and nanohybrid composites.

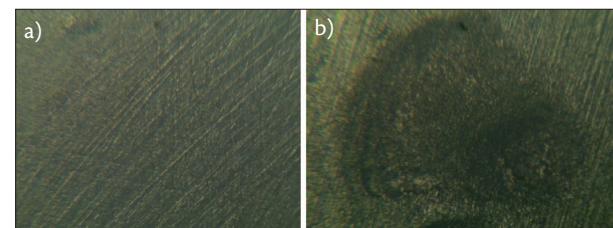
After exposure of the composite materials to simulated mechanical aging (100.000 cycles) in chewing simulator it was observed that the highest gloss was still in Filtek Ultime with average values  $49.67 \pm 11.83$ , then Tetric EvoCeram with  $48.67 \pm 12.14$  and Herculite XRV with  $46.6 \pm 11.71$ . After simulated mechanical aging the lowest values were found in Gradia Direct with average  $39.5 \pm 6.83$  (Figure 2). After simulated mechanical aging there was no statistically significant difference in gloss between microhybrid and nanohybrid composite. There was no statistically significant difference in gloss values before and after aging of all tested materials.



**Figure 2.** Gloss of composite after aging in chewing simulator  
**Slika 2.** Sjaj kompozita posle simuliranja žvakanja



**Figure 4.** Composite filling surface Tetric EvoCeram  
a) after polishing ( $\times 400$ );  
b) after aging; defect size ( $247.883 \mu\text{m}^2$ )  
**Slika 4.** Kompozitna površina kompozita Tetric EvoCeram  
a) posle poliranja ( $\times 400$ );  
b) posle starenja; veličina defekta ( $247,883 \mu\text{m}^2$ )



**Figure 6.** Composite filling surface Herculite XRV  
a) after polishing ( $\times 400$ );  
b) after aging; defect size ( $268.697 \mu\text{m}^2$ ) ( $\times 400$ )  
**Slika 6.** Kompozitna površina kompozita Herculite XRV  
a) posle poliranja ( $\times 400$ );  
b) posle starenja; veličina defekta ( $268,697 \mu\text{m}^2$ ) ( $\times 400$ )

Optical microscope revealed the smallest defects on the composite surface of Gradia Direct, with the average surface area of this defect being  $21,363.7 \mu\text{m}^2$ , followed by Filtek Ultime with  $187,307.0 \mu\text{m}^2$  and Tetric EvoCeram with  $247,883.3 \mu\text{m}^2$ . The largest defect was observed on the surface of Herculite XRV with average value of  $268,696.7 \mu\text{m}^2$  (Table 2, Figures 3–6).

## DISCUSSION

Polishing gives high gloss of restorations that imitate natural dental structures. Gloss plays a key role in the aesthetic experience of restorations. Many authors have found that there is a correlation between surface gloss and surface roughness, and polishing can increase gloss [1, 9, 17]. Endo T. [18] considers that if the surface roughness

is less than  $0.1\mu\text{m}$ , the surface of the composite will be visibly smooth. High gloss even reduces any color difference between the composite and surrounding enamel. The color of the reflected light is dominant over the color of the composite below [5, 19].

Radiance is an optical phenomenon that depends on the amount of light beams reflected from the surface and the degree of diffuse reflection has negative effect on surface gloss. Rodrigues Jr [7] pointed out that light reflection is influenced by the microstructural properties of the material (size, shape and refractive index of the filler particles, viscosity and refractive index of matrix, as well as the homogeneity of the matrix-filler complex). The smaller the filler particles is, smaller is the diffuse reflection [8, 17].

In our study, gloss was measured by a glossmeter with the striking angle of  $60^\circ$  which is close to the angle at which an average height person observes the surface, that also complies with the standard (ISO 28132014) [20]. There is no agreement at what angle gloss should be measured, whether there is better differentiation at an angle of  $20^\circ$  or  $45^\circ$  than  $60^\circ$  [15].

Many studies engaged in the problem of the impact of the manual skills and length of the practitioner's clinical practice [5, 7, 14]. In this study, two dentists polished the samples: one with years of experience and the other one with three years of experience. Given that within the composite groups there was no statistically significant difference, it is obvious that different practitioner skills did not affect the result. Zimmerli and Rodrigues Jr. have also found no correlation between clinical experience and polishing efficiency [7, 14]. Jung et al. [21], even pointed out that the greatest surface roughness was observed in long-term practitioners, while the student and physicians with five-year internship were similar.

There are different systems for polishing composites and almost every material manufacturer recommends their own systems, which differ in material (aluminum oxide, carbide components, diamond abrasives, silicon dioxide, zirconium oxide), abrasiveness and shape (discs, cups, cones, tapes) [22]. Polishing protocols can be multiple-step or one-step systems [4]. For the finishing and polishing systems to be effective, abrasive particles must be relatively harder than the filler particles, otherwise polishing would only remove the soft matrix while the filler particles would come through the surface [22]. However, the type and shape of the particles that make the base of the polishing agents differ from each other, and it is therefore difficult to compare polishing agents [8]. The authors pointed out that satisfactory surface and gloss roughness levels are obtained if the polishing particles are less than  $13\mu\text{m}$  (1200-grit according to ISO 8486-1) [17].

The material samples in this study were polished with Sof-Lex disks, as flexible aluminum oxide disks are the most commonly used systems and leave the least rough surfaces [23]. In line with our results, Pala [1] and Rodriguez Jr. [7] pointed out that "multiple-step" systems give better gloss than "one-step" systems. The efficiency of these disks is due to even removal of both organic matrix and filler particles. Despite their smooth surface, their application

is limited in the posterior region. Some authors don't like the metal center, as well as great flexibility that can leave uneven surfaces if the pressure force is higher [7].

The third factor that has an effect on polishing is the composite material itself (hardness, the shape, size, particle orientation, the degree of matrix conversion, the stability of the silanes etc. [3, 7, 9, 12, 18, 24]. Despite all these factors, polishing and surface roughness are the function of the size of the filler particles [7, 19]. Antonson et al. [5] and Tursi et al. [25] confirmed that composites with smaller particles showed higher gloss and less surface roughness. Suzuki found that polished surface of the Tetric EvoCeram nanohybrid was very smooth, with an equally abraded surface without any discontinuity between the prepolymerized fillers and surrounding matrix [11]. Although Filtek Ultimate nanohybrid showed the highest gloss as well as Tetric EvoCeram, there was no significant difference in the appearance of polished surface and surface gloss between them.

Can Say et al. [24] reported in their study that microhybrid composites had less surface roughness than nanohybrids, which can be explained by an uneven abrasion of the matrix and filler particles. It is considered that nano-size particles (20–40 nm) tend to fill the space between larger particles, thus protecting soft matrix from abrasion. The homogeneity of the material, that is, the uniform processing during polishing, ultimately gives greater gloss [1]. Lai et al. [15] based on 1990 standards, found out that good gloss is between 70 and 80 GU (gloss units), and excellent above 80 GU. Ivoclar Vivadent, however, finds that the observer cannot differentiate between 70 and 90 GU. According to the American Dental Association (ADA) in 2010, gloss of 40–60 GU is, as per most experts, desirable and acceptable gloss [1, 3]. The results of our study showed that the average gloss of the composites was between 47.33 and 54 GU, which can be considered as well polished, glossy surfaces.

Number of authors [1, 3, 13, 19] also pointed out the significant influence of filler particle shape on surface roughness, suggesting that irregular particles give rougher surface. They also argued that spherical particles such as Filtek (3M ESPE) can also be a factor for better light reflection with irregularly shaped particles of other composites. Aesthetic properties are also enhanced when filler particles have the same refractive index as resin [15]. Composites with glass particles have been observed to have rougher surface than those with particles that are a combination of silica and zirconia, whether microhybrid or nanohybrid [5]. Although Tetric EvoCeram showed greater roughness, or less gloss than Filtek Ultimate, this was not statistically significant. Endo et al. [18] also stated that glass particles in composites influence their increased porosity and more frequent discoloration.

In addition to filler particles resin can also affect surface properties of the material. Composites with hydrophobic matrix are less stained (UDMA versus BisGMA) [9, 10, 23], while those with UDMA based matrix have rougher surface compared to those based on Bis-GMA, due to the difference in the degree of polymerization, rigidity of the molecules etc. [4, 24]. The results of our

study are in agreement with previous findings, as Gradia (UDMA matrix) showed the lowest gloss after polishing with Sof-Lex discs.

After simulating aging of the composite samples, the smallest surface defects were demonstrated by Gradia Direct, a microhybrid composite, which confirmed their optimal mechanical and physical properties. However, it is important to note that in this paper there was no statistically significant difference between micro- and nanohybrid composites.

Finally, it is important to note that in our study, a simulation of accelerated aging of materials under laboratory conditions was performed. The presence of water, temperature changes, pH levels, as well as the abrasive nature of food or tooth brushing are all factors that influence the properties of composite restorations and their surfaces. Also, the samples were flat, for the sake of uniformity of the experiment, but clinically, the composite restorations have irregular geometric structures with concave and convex surfaces.

## CONCLUSION

With the limitations of this study, it can be concluded that investigated nanohybrid and microhybrid composites showed comparable gloss values before and after artificial aging. The null hypothesis was accepted. Filtek Ultimate showed the highest gloss before and after aging, while Gradia Direct had the lowest. The one-year chewing simulation caused the least surface defects with Gradia Direct, while the largest defects were observed with Herculite XRV composite materials.

## REFERENCES

- Pala K, Tekce N, Tuncer S, Serim ME, Demirci M. Evaluation of the surface hardness, roughness, gloss and color of composites after different finishing/polishing treatments and thermocycling using a multitechnique approach. *Dent Mater J.* 2016; 35(2):278–89.
- Rocha RS, Oliveira AC, Canepele TMC, Bresciani E. Effect of Artificial Aging Protocols on Surface Gloss of Resin Composites. *Int J Dent.* 2017; 2017:3483171.
- Kamonkantikul K, Arksornnukit M, Takahashi H, Kanehira M, Finger JW. Polishing and toothbrushing alters the surface roughness and gloss of composite resins. *Dent Mater J.* 2014; 33(5):599–606.
- Kumari CM, Bhat KM, Bansal R. Evaluation of surface roughness of different restorative composites after polishing using atomic microscopy. *J Conserv Dent.* 2016; 19(1):56–62.
- Antonson SA, Yazici AR, Kilinc E, Antonson DE, Hardigan PC. Comparison of different finishing/polishing systems on surface roughness and gloss of resin composites. *J Dent.* 2011; 39(1):E9–E17.
- O'Neill C, Kreplak L, Rueggeberg, Labrie D, Shimokawa CAK, Price RB. Effect of tooth brushing on gloss retention and surface roughness of five bulk-fill resin composites. *J Esthet Restor Dent.* 2018; 30(1):59–69.
- Rodrigues-Junior SA, Chemin P, Piaia PP, Ferracane JL. Surface Roughness and Gloss of Actual Composites as Polished with Different Polishing Systems. *Oper Dent* 2015; 40(4):418–29.
- Takanashi E, Kishikawa R, Ikeda M, Inai N, Otsuki M, Foxton RM, Tagami J. Influence of abrasive particle size on surface properties of flowable composites. *Dent Mater J.* 2008; 27(6):780–6.
- Sirin Karaarslan E, Bulbul M, Yildiz E, Seçilmis A, Sari F, Usumez A. Effects of different polishing methods on color stability of resin composites after accelerated aging. *Dent Mater J.* 2013; 32(1):58–67.
- Ozera EH, Pascon FM, Correr AB, Puppin-Rontani RM, Castilho AR, Correr-Sobrinho L, et al. Color Stability and Gloss of Esthetic Restorative Materials after Chemical Challenges. *Braz Dent J.* 2019; 30(1):52–7.
- Suzuki T, Kyoizumi H, Finger WJ, Kanehira M, Endo T, Utterodt A, et al. Resistance of nanofill and nanohybrid resin composites to toothbrush abrasion with calcium carbonate slurry. *Dent Mater J.* 2009; 28(6):708–16.
- Egilmez F, Ergun G, Cekic-Nagas I, Vallittu PK, Lassila LVJ. Short and long term effects of additional post curing and polishing systems on the color change of dental nano-composites. *Dent Mater J.* 2013; 32(1):107–14.
- Tamura Y, Kakuta K, Ogura H. Wear and mechanical properties of composite resins consisting of different filler particles. *Odontology.* 2013; 101(2):156–69.
- Zimmerli B, Lussi A, Flury S. Operator Variability Using Different Polishing Methods and Surface Geometry of a Nanohybrid Composite. *Oper Dent.* 2011; 36(1):52–9.
- Lai G, Zhao L, Wang J, Kunzelmann KH. Surface properties and color stability of dental flowable composites influenced by simulated toothbrushing. *Dent Mater J.* 2018; 37(5):717–24.
- DeLong R, Douglas WH. An Artificial Oral Environment for Testing Dental Materials. *IEEE Trans Biomed Eng.* 1991; 38(4):339–45.
- Hosoya Y, Shiraishi T, Odatsu T, Nagafugi J, Kotaku M, Miyazaki M, et al. Effects of polishing on surface roughness, gloss and color of resin composites. *J Oral Sci.* 2011; 53(3):283–91.
- Endo T, Finger WJ, Kanehira M, Utterodt A, Komatsu M. Surface texture and roughness of polishednanofill and nanohybrid resin composites. *Dent Mater J.* 2010; 29(2):213–23.
- IJain V, Platt JA, Moor K, Spohr AM, Borges GA. Color stability, gloss and surface roughness of indirect composite resins. *J Oral Sci* 2013; 55(1):9–15.
- Barakah HM, Taher NM. Effect of polishing systems on stain susceptibility and surface roughness of nanocomposite resin material. *J Prosthet Dent.* 2014; 112(3):625–31.
- EN ISO 2813. Paints and vanishes-Determination of gloss value at 20 degrees, 60 degrees and 85 degrees. 2014
- Jung M, Otte A, Klimek J. Is surface roughness of resin composites affected by operator's performance. *Amer J Dent.* 2008; 21(1):3–6.
- Barakah HM, Taher NM. Effect of polishing systems on stain susceptibility and surface roughness of nanocomposite resin material. *J Prosthet Dent.* 2014; 112(3):625–31.
- Gönülol N, Yilmaz F. The effects of finising and polishing techniques on surface roughness and color stability of nanocomposites. *J Dent.* 2012; 40(2):64–70.
- Can Say E, Yurdagüven H, Yaman BC, Ozer F. Surface roughness and morphology of resin composites polished with two-step polishing systems. *Dent Mater J.* 2014; 33(3):332–4.
- Turssi CP, Ferracane JL, Vogel K. Filler features and their effects on wear and degrae of conversion of particulate dental resin composites. *Biomaterials.* 2005; 26(24):4932–7.

# Analiza sjaja i površine različitih kompozitnih materijala

Vanja Opačić Galić<sup>1</sup>, Danica Popović<sup>2</sup>, Jovana N. Stašić<sup>1</sup>, Bojan Dželetović<sup>1</sup>, Stefan Manojlović<sup>3</sup>

<sup>1</sup>Univerzitet u Beogradu, Stomatološki fakultet, Klinika za bolesti zuba, Beograd, Srbija;

<sup>2</sup>Univerzitet u Beogradu, Klinika za protetiku, Stomatološki fakultet, Beograd, Srbija;

<sup>3</sup>Stomatološka ordinacija „S Dent“ Subotica, Beograd

## KRATAK SADRŽAJ

**Uvod** Da bi se dobila idealna estetika, svaki restaurativni materijal mora oponašati prirodni zub po boji i teksturi površine i mora biti stabilan u vremenu. Oštećenje ili habanje materijala uzrokuje loša optička svojstva ispuna, pa ga je neophodno prepolirati, reparirati ili zameniti. Cilj rada je bio da se ispitaju sjaj i površinske promene kompozita sa različitom veličinom čestica punilaca, pre i posle artifijalnog mehaničkog starenja.

**Materijal i metode** Testirana su četiri kompozita, dva mikrohibridna (Gradia Direct GC; Herculite XRV, Kerr) i dva nanohibridna (Filtek Ultimate 3M; Tetric Evoceram, Ivoclar). Uzorci kompozita ( $9 \times 9 \times 2$  mm) polirani su po standardnom protokolu diskovima Sof-Lex 30 sek. Posle poliranja izmeren je sjaj, a uzorci su posmatrani pod optičkim mikroskopom ( $\times 400$ ). U simulatoru žvakanja uzorci su izloženi artifijalnom starenju sa 100.000 cikličnih udaraca. Posle mehaničkog starenja ponovo je izmeren sjaj, a površine su fotografisane i sačuvane u digitalnom formatu. Dobijeni rezultati su statistički obrađeni (One-way ANOVA, t-test).

**Rezultati** Najveći sjaj posle poliranja pokazao je Filtek Ultimate ( $54,00 \pm 14,06$ ), a najmanji Gradia Direct ( $47,33 \pm 7,92$ ). Nije bilo statistički značajne razlike sjaja između testiranih materijala posle poliranja ( $p > 0,05$ ). Najmanji defekti na površini kompozita uočeni su kod materijala Gradia Direct ( $21.364 \mu\text{m}$ ), sa srednjom vrednošću prečnika  $137 \mu\text{m}$ .

**Zaključak** Ispitivani nanohibridni i mikrohibridni kompoziti su pokazali komparabilne vrednosti sjaja pre i posle artifijalnog starenja. Mehaničko starenje je izazvalo vidljive promene u vidu površinskih defekata na svim ispitivanim kompozitima.

**Ključne reči:** nanohibridni kompoziti; mikrohibridni kompoziti; sjaj

## UVOD

Mnogi filozofi govorili su o estetici i lepoti, i većina njih se složila sa Platonovom izrekom da je lepota u oku posmatrača i da predstavlja subjektivan doživljaj predmeta posmatranja. Mišljenje Aristotela da je lepo samo ono što je skladno moglo bi se primeniti na današnje kompozitne materijale, koji uglavnom zadovoljavaju estetske, funkcionalne i biološke zahteve u restaurativnoj stomatologiji.

Da bi se ostvarila idealna estetika, svaki restaurativni materijal mora odgovarati prirodnom zubu po boji i teksturi površine i mora biti stabilan u vremenu [1]. Glavni razlog za zamenu restauracija na Zubima je uglavnom estetske prirode [2].

Jedan od problema pri primeni kompozitnih restaurativnih materijala je hrapava površina ispuna. Ovo utiče na prebojavanje, akumulaciju plaka, sekundarni karijes, zapaljenje gingive i smanjenje sjaja restauracije. Hrapavost površine čija je Ra vrednost  $0,2 \mu\text{m}$  ( $\text{Ra} = \text{mean roughness value}$ ) smatra se dovoljnom za akumulaciju plaka i prebojavanje [3, 4], a hrapavost od  $0,3 \mu\text{m}$  ( $\text{Ra}$ ) pacijent može osetiti vrhom jezika [5]. O'Neill čak ističe da je maksimalno prihvatljiv prag za hrapavost  $200 \text{ nm}$  ( $\text{Ra}$ ), posle čega dolazi do akumulacije plaka [6]. Oštećenje ili habanje materijala uzrokuje loša optička svojstva ispuna, pa ga je neophodno prepolirati, reparirati ili zameniti.

Osim hrapavosti, sjaj površine je drugi faktor koji ima važnu ulogu u estetici kompozita. Sjaj je svojstvo površine da reflekтуje svetlost. Ljudsko oko lako uočava razliku između sjaja ispuna i okolne gleđi, iako su boje ovih struktura iste [7]. Takođe, sjajna površina gleđi „podnosi“ mehaničko habanje, dok sjajna površina kompozita, koja je inicijalno niža, ima tendenciju da i dalje opada zbog mehaničkih opterećenja tokom vremena. Sa povećanjem hrapavosti površine povećava se stepen nasumične refleksije svetlosti, što na kraju rezultira smanjenjem sjaja površine [8]. Smanjenje sjaja i glatkoće može dovesti do diskoloracije ispuna [1, 5].

U oralnom okruženju na ispun deluju brojni spoljašnji i unutrašnji faktori. Faktori vezani za sam materijal su pre svega struktura matriksa i karakteristike čestica punilaca, koje imaju direktni uticaj na glatkoću površine i prijemčivost za spoljašnja prebojavanja [9, 1].

Potreba za usavršavanjem kompozitnih materijala doveo je do razvijanja hibridnih kompozita. Redukovanjem veličine čestica hibridnih kompozita radi povećanja estetskih osobina, ali sa optimalnim fizičkim osobinama, prvo nastaju mikrohibridni (0,04 do  $1 \mu\text{m}$ ), a zatim, uvođenjem nanotehnologije, nanohibridni kompozitni materijali, čije su čestice u opsegu od 0,1 do 100 nanometara. Upotreba nanotehnologije u novim formulacijama kompozita je jedan od najvećih doprinosa dentalnim materijalima [10, 11]. Za nanokompozite se smatra da su kombinacija dobre mehaničke snage hibridnih kompozita, a da imaju superiornije optičke karakteristike od mikropunjениh [12, 4]. Oni imaju visoku translucenciju, dobro se poliraju, imaju superioran sjaj uz odgovarajuća mehanička svojstva za restauracije pod visokim stresom [5]. Osim veličine čestica, na otpornost na okluzalno „habanje“ utiče i oblik čestica, pa Tamura i sar. [13] ističu da su kompoziti sa sferičnim česticama otporniji na simulirana okluzalna trošenja od kompozita sa česticama iregularnog oblika. Smola i čestice punioca se ne abradiraju na isti način, zato što su različitog stepena tvrdoće [9]. Stoga, sastav kompozita i sistemi za finiranje i poliranje imaju direktni uticaj na svojstva površine (sjaj i hrapavost) i na mehanička svojstva (tvrdost i otpornost na hemijsku degradaciju) [1, 14]. Dokazano je da duže vreme poliranja kompozita rezultira ispunom sa višim i dugotrajnijim sjajem [3].

S obzirom na to da dolazi do degradacije kompozita u oralnoj sredini, brojne studije *in vitro* su ispitivale uticaj artifijalnog starenja na mehanička i optička svojstva ovih materijala. Najčešće se koriste protokoli cikličnog opterećenja (mehaničko artifijalno starenje), potapanje u medije kako što su etanol ili voda, simulacija četkanja i svetlosno starenje [15, 16, 2].

Cilj rada je bio da se ispitaju sjaj i površinske promene kod različitih kompozitnih materijala, pre i posle artifijalnog starenja. Postavljena je nulta hipoteza da ne postoji razlika u sjaju pre i posle mehaničkog starenja različitih kompozitnih materijala.

## MATERIJAL I METODOLOGIJA

U ovo istraživanje su uključene četiri vrste komercijalnih kompozitnih materijala, dva mikrohibridna i dva nanohibridna kompozita (boja A2) (Tabela 1).

Za svaku grupu testiranih materijala napravljen je po osam uzoraka (u silikonskom kalupu  $9 \times 9 \times 2$  mm). Svaki uzorak je polimerizovan preko staklenih pločica 40 sek. sa obe strane (Woodpecker Led. H, China). Uzorci su ispolirani po standarnom protokolu aluminijum-oksid abrazivnim diskovima Sof-Lex (2382 C, SM, F, SF) (3M, ESPE), 30 sek. svaki, uz vodeno hlađenje. Posle poliranja uzoraka, meračem sjaja (IG-331; Horiba) izmeren je sjaj površine za svaki uzorak testiranih kompozitnih materijala. Uzorci su centralno postavljeni, sa upadnim zrakom od 60 stepeni. Ispolirane površine su posmatrane pod optičkim mikroskopom ( $\times 400$ ) (Carl Zeiss Jena NU2) i fotografisane.

Do postavljanja u simulator žvakanja, uzorci su čuvani u vlažnoj sredini na konstantnoj temperaturi od 37 stepeni. Uliniani su u akrilat i postavljeni u dve komorice simulatora žvakanja. Mehaničko starenje je izvođeno cikličnim opterećenjem silom od 5 kg u vertikalnom smeru. Izvedeno je 100.000 cikličnih udaraca za svaki uzorak, što predstavlja ekvivalent jednogodišnjem žvakanju (CS-4.2 Economyline, SD Mechanotronics, Germany). Posle mehaničkog starenja uzoraka izmeren je sjaj za sve površine, i uzorci, odnosno površine su ponovo fotografisane i sačuvane u digitalnom formatu.

Svi dobijeni rezultati su statistički obrađeni jednosmernom analizom varijance (One-way, ANOVA) i t-test-om.

## REZULTATI

Rezultati ovih istraživanja predstavljeni su na grafikonima 1 i 2, u Tabeli 2 i na slikama 1–4.

Posle poliranja sistemom Sof-Lex, najveći sjaj pokazao je Filtek Ultimate sa vrednostima ( $SV \pm SD$ ) od  $54 \pm 14,08$ , zatim sledi Tetric EvoCeram sa vrednostima sjaja od  $49,67 \pm 7,03$ , potom Herculite XRV sa  $43,67 \pm 12,14$ , a najmanji sjaj posle poliranja pokazala je Gradia Direct sa vrednostima od  $47,33 \pm 7,92$  (Grafikon 1). Nije bilo statistički značajne razlike sjaja između mikrohibridnih i nanohibridnih kompozita posle poliranja.

Nakon što je svaki kompozitni materijal bio izložen simuliranom mehaničkom starenju (100.000 cikličnih udara) u simulatoru žvakanja, uočeno je da je i dalje najveći sjaj zadržao Filtek Ultimate sa prosečnom ocenom  $49,67 \pm 11,83$ , zatim sledi Tetric EvoCeram sa  $48,67 \pm 12,14$  i Herculite XRV sa  $46,67 \pm 11,71$ , a najmanji sjaj i posle starenja imala je Gradia Direct sa prosekom od  $39,5 \pm 6,83$  (Grafikon 2). Pokazalo se da i posle simuliranog mehaničkog starenja mikrohibridni u odnosu na nanohibridne kompozite nisu pokazali statistički značajnu razliku u pogledu sjaja površine.

Promene u vrednostima izmerenog sjaja re i posle starenja materijala nisu ukazale na statistički značajnu razliku.

Optičkim mikroskopom uočeni su najmanji defekti na površini kompozita kod materijala Gradia Direct; prosečna površina ovog defekta iznosila je  $21363,7 \mu\text{m}^2$ , zatim slede Filtek Ultimate sa  $187307,0 \mu\text{m}^2$ , Tetric EvoCeram sa  $247883,3 \mu\text{m}^2$ , a najveći defekt je uočen na površini Herculite XRV, čija je srednja vrednost iznosila  $268696,7 \mu\text{m}^2$  (Tabela 2, slike 1–4).

## DISKUSIJA

Poliranjem se dobija visok sjaj restauracija koje imitiraju prirodne zubne strukture. Sjaj ima važnu ulogu u estetskom doživljaju estetskih restauracija. Mnogi autori su utvrdili da postoji korelacija između sjaja površine i hrapavosti površine, kao i da se sjaj konstantno povećava poliranjem [17, 1, 9]. Endo T. [18] smatra da ako je hrapavost površine manja od  $0,1 \mu\text{m}$ , površina kompozita će biti vidljivo glatka. Visok sjaj čak i smanjuje eventualnu razliku u boji kompozita i okolne gleđi. Boja odbijene svetlosti je dominantna u odnosu na boju kompozita ispod [19, 5].

Sjaj je optički fenomen koji zavisi od količine svetlosnih zraka koji se reflektuju od površine, a stepen difuzne refleksije negativno utiče na sjaj. Rodrigues Jr. [7] ističe da na refleksiju svetlosti utiču mikrostruktura svojstva materijala, pre svega veličina, oblik i indeks refrakcije čestica punilaca, viskoznost i indeks refrakcije matriksa, kao i homogenost kompleksa matriks-punilac. Što su manje čestice punilaca, manja je difuzna refleksija [17, 8].

U ovom istraživanju sjaj je meren meračem sjaja sa upadnim uglom od  $60^\circ$ , što je najbliže ugлу pod kojim osoba prosečne visine posmatra površinu, a što se slaže i sa standardom (ISO 2813-2014) [20]. Ne postoji usaglašenost pod kojimuglom treba meriti sjaj, da li je bolja diferencijacija pod uglom od  $20^\circ$  ili  $45^\circ$  u odnosu na  $60^\circ$  [15].

Mnoge studije su se bavile problemom uticaja manuelne spretnosti i dužine kliničke prakse izvođača [14, 7, 5]. U ovom istraživanju uzorke su polirala dva izvođača sa višegodišnjim i trogodišnjim iskustvom. S obzirom na to da unutar grupe kompozita nije utvrđena statistički značajna razlika, može se zaključiti da njihovo iskustvo ili različit pritisak primenjen pri poliranju nije uticao na rezultat. Zimmerli i Rodrigues Jr. takođe nisu pronašli korelaciju između kliničkog iskustva i efikasnosti poliranja [14, 7]. Jung i sar. [21] čak ističu da su najveću hrapavost površine uočili kod dugogodišnjih praktičara, dok su studenti i lekari sa petogodišnjim stažom bili izjednačeni.

Postoje različiti sistemi za poliranje kompozita i gotovo svaki proizvođač materijala preporučuje i svoje odgovarajuće sisteme, koji se razlikuju po materijalu (aluminijum-oksid, karbidne komponente, dijamantski abrazivi, silicon-dioksid, cirkonijum-oksid), abrazivnosti u obliku (diskovi, kupe, konusi, trake) [22]. Protokoli za poliranje mogu biti sistemi *multiple-step* ili *one-step* [4]. Da bi sistemi za finiranje i poliranje bili efikasni, abrazivne čestice moraju biti relativno tvrde od čestica filera, jer bi u suprotnom prilikom poliranja došlo do uklanjanja samo mekanog matriksa, dok bi čestice punilaca prominirale iz površine [22]. Ipak, vrsta i oblik čestica koje čine bazu sredstava za poliranje međusobno se razlikuju, pa je zato veoma teško upoređivati sredstva za poliranje [8]. Autori ističu da se zadovoljavajući nivo hrapavosti površine i sjaja dobija ako su čestice za poliranje manje od  $13 \mu\text{m}$  (1200 grita po ISO 8486-1) [17].

Uzorci materijala u ovom istraživanju su polirani diskovima Sof-Lex, jer su fleksibilni aluminijum-oksidni diskovi najčešće korišćeni sistemi i ostavljaju najmanje hrapave površine [23]. U skladu sa našim rezultatima, Pala [1] i Rodriguez Jr. [7] ističu da sistemi *multiple-step* daju bolji sjaj od sistema *one-step*. Efikasnost ovih diskova je posledica ravnomernog uklanjanja i organskog matriksa i čestica punioca. Uprkos glatkoj površini, njihova primena je ograničena u bočnoj regiji. Neki autori im zameraju i metalni centar, kao i veliku fleksibilnost, koja može ostavljati neujednačene površine ako je sila pritiska veća [7].

Treći faktor koji ima uticaja na poliranje je sam kompozitni materijal, odnosno njegova tvrdoća, oblik, veličina, orientacija čestica, stepen konverzije matriksa, stabilnost silana i sl. [12, 9, 7, 24, 3, 18]. Uprkos svim ovim faktorima, poliranje i hrapavost površine su u funkciji veličine čestica punilaca [24, 7]. Tursi i sar. [25] istakli su da kompoziti sa manjim česticama pokazuju veći sjaj i manju hrapavost površine, što potvrđuje i Antonson sa saradnicima [5]. Suzuki [11] nalazi da je polirana površina nanohibridnog kompozita Tetric EvoCeram veoma glatka, sa jednakom abradiranim površinom bez ikakvog diskontinuiteta između prepolimerizovanih punilaca i okolnog matriksa. Iako je nanohibridni Filtek Ultimate pokazao najveći sjaj, a potom i Tetric EvoCeram, razlika nije bila značajna ni u izgledu ispolirane površine, ni u sjaju.

Can Say i sar. [24] čak ističu da su u njihovim istraživanjima mikrohibridni kompoziti imali manju hrapavost površine u odnosu na nanohibridne, što objašnjavaju neravnomernom abrazijom matriksa i čestica punioca. Smatra se da čestice nanoveličine [20–40 nm] imaju tendenciju da popunjavaju prostor između većih čestica, čime štite mehanički matriks od abrazije. Homogenost materijala, odnosno ravnomerno obrađivanje prilikom poliranja daje na kraju veći sjaj [1]. Lai i sar. [15] na osnovu standarda iz 1990. God. ističu da je dobar sjaj između 70 i 80 GU, a izvrstan iznad 80 GU. Ivoclar Vivadent pak ističe da posmatrač ne razlikuje sjaj između 70 i 90 GU. Prema Američkoj dentalnoj asocijaciji (ADA) iz 2010. godine, sjaj od 40 do 60 GU (gloss units) po mišljenju većine eksperata je željen i prihvatljiv sjaj [3, 1]. Rezultati ove studije su pokazali da je prosečan sjaj kompozita bio između 47,33 i 54 GU, što se može smatrati dobro ispoliranim i sjajnim površinama.

Brojni autori [19, 3, 1, 13], takođe, ističu značajan uticaj oblika čestica punilaca na hrapavost površine, sugerujući da čestice iregularnog oblika daju hrapaviju površinu. Takođe, ističu da sferične čestice kakve su u Filteku (3M ESPE) takođe mogu biti faktor za bolju refleksiju svetlosti u odnosu na kompozite sa

česticama iregularnog oblika kod drugih kompozita. Do una-prednja estetskih svojstava dolazi i kad čestice punioca imaju isti refraktivni indeks kao i smola [15]. Uočeno je da kompoziti sa česticama stakla imaju hrapaviju površinu od onih sa kombinacijom silike i cirkonije, bez obzira na to da li su mikrohibridni ili nanohibridni [5]. Iako je Tetric EvoCeram pokazao veću hrapavost, odnosno manji sjaj od Filtek Ultimate, to nije imalo statistički značaj. Endo i sar. [18] takođe ističu da čestice stakla u kompozitima utiču na njihovu povećanu poroznost i češću diskoloraciju.

Osim čestica punilaca, i smola može da utiče na svojstva površine materijala. Kompoziti sa hidrofobnim matriksom manje se prebojavaju (UDMA u odnosu na BisGMA) [9, 23, 10], dok oni sa matriksom na bazi UDMA imaju hrapaviju površinu u poređenju sa onima na bazi Bis-GMA, zbog razlike u stepenu polimerizacije, krutosti molekula i sl. [24, 4]. Rezultati ovog istraživanja su u saglasnosti sa prethodnim zaključcima, jer je Gradia (matriks UDMA) pokazala najmanji sjaj posle poliranja diskovima Sof-Lex.

Posle simulacije starenja kompozitnih uzoraka, najmanji defekt površine pokazala je Gradia Direct, mikrohibridni kompozit, koji je potvrdio njihova optimalna mehanička i fizička svojstva. Ipak, važno je istaći da u ovom radu nije bilo statistički značajne razlike, između mikrohibridnih i nanohibridnih kompozita.

Na kraju, bitno je istaći da je u ovoj studiji izvedena simulacija ubrzanog starenja materijala u laboratorijskim uslovima. Prisustvo vode, temperaturne promene, nivo pH vrednosti, kao i abrazivna priroda hrane ili četkanje zuba su svakako faktori koji utiču na svojstva kompozitnih restauracija, odnosno na njihove površine. Takođe, uzorci su bili ravnii, radi uniformnosti eksperimenta, ali klinički, kompozitne restauracije su iregularne geometrijske strukture sa konkavnim i konveksnim površinama.

## ZAKLJUČAK

Uz ograničenja ove studije može se zaključiti da su ispitivani nanohibridni i mikrohibridni kompoziti pokazali komparabilne vrednosti sjaja pre i posle arteficijalnog starenja. Nulta hipoteza je potvrđena. Najveći sjaj pre i posle starenja pokazao je Filtek Ultimate, a najmanji Gradia Direct. Simulacija jednogodišnjeg žvakanja izazvala je najmanje defekte površine kod kompozita Gradia Direct, dok su najveći defekti uočeni kod kompozitnih materijala Herculite XRV.

# Prevalence of biomechanical risks among dentists

Mirjana Duspara<sup>1</sup>, Maida Mulić<sup>2</sup>, Kristina Duspara<sup>3</sup>

<sup>1</sup>Public Health Teaching Institution Health Center "Dr Mustafa Šehović" Tuzla, Bosnia and Herzegovina;

<sup>2</sup>University of Tuzla, Faculty of Medicine, Department of Social Medicine, Tuzla, Bosnia and Herzegovina;

<sup>3</sup>Public Health Institution „Gradske apotekе“ (City Pharmacies), Tuzla, Bosnia and Herzegovina

## SUMMARY

**Introduction** Dental staff are often affected by musculoskeletal system disorders, including changes in ligaments, muscles and nerves of hand, wrist, elbow, upper arm, shoulder, neck and back. Ergonomic prevention programs include redesigning work environment and education of healthcare workers on work-related hazards and their preventive measures. The aim of the paper was to determine pain prevalence in neck and shoulder joints due to professional risk factors among dentists.

**Material and Methods** In the research, dentists were surveyed anonymously using "The questionnaire on problems related to neck and shoulder joints". In cooperation between Public Health Teaching Institution Health Center "Dr Mustafa Šehović" Tuzla, Department of Dentistry with Institute of Public Health of Tuzla Canton, 150 questionnaires were distributed to Public Health Centers Tuzla Canton and private practices. There were 112 fully completed and analyzed questionnaires.

**Results** The rate of pain prevalence in neck and shoulder joints was very high, more precisely among 101 respondents (90.1%). The highest number of the respondents practiced self-medication- 88 (78.5%), while 64 respondents (58%) sought professional help. There was statistically significant number of respondents (92 dentists-82 %) that used analgesics/antirheumatics several times per year (two to three times).

**Conclusion** Pain prevalence was high. The research indicated a serious, widespread issue that can only be solved if carried out thoroughly and continuously.

**Key words:** pain, posture, ergonomics, neck, spine, physical therapy

## INTRODUCTION

Deterioration in health status due to working postures among dentists is most frequently reflected in changes in the neck and lumbar region of the spine extending to the shoulders, arms and legs. Risk factors also include S-shaped curvature of the neck and moving head forward for a better view of the working surface. Given that these two postures are parallel and simultaneous, intense pressure and strain of the cervical spine occur [1].

Diseases affecting working populations are defined as diseases without causal relationship with work, but they can be exacerbated by professional health risks [2]. In comparison to other health professions, dentistry is considered one of the most dangerous professions due to stress, chronic fatigue and occupational burnout syndrome [3, 4]. The World Health Organization (WHO) defines occupational diseases as a combination of disease and exposure, and their connection, dividing occupational diseases according to hazards of the workplace into: diseases caused by chemical, physical and biological hazards [5, 6].

Biological hazards (biohazards) are substances that pose a threat to the health of dental staff, and they include viruses, bacteria, fungi and prions [7, 8]. Biomechanical hazards in dentistry include incorrect body working

posture, repetitive movements, forces imposing stress on the body with a potential to cause diseases affecting the musculoskeletal or neurological systems [9, 10]. The statio-dynamic causes of professional risks in dentistry are vibrations, and physical hazards include radiation (ionizing and non-ionizing), noise, artificial light and polymerization light [11].

Chemical hazards in dentistry include drugs, remedies, dental materials and dental personal protective equipment such as gloves, disinfectants etc. [12]. Psychological hazards can be the cause of many psychological difficulties such as depression and anxiety, but can also cause some somatic disorders such as cardiovascular diseases, hypertension and neurological disorders [13].

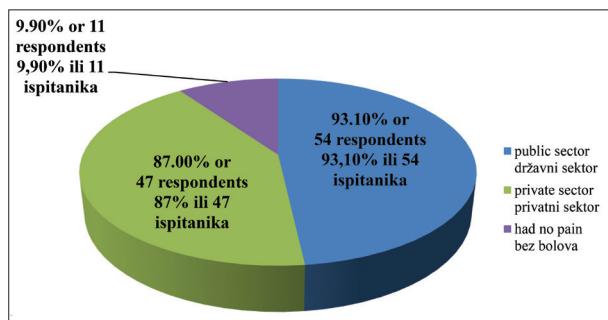
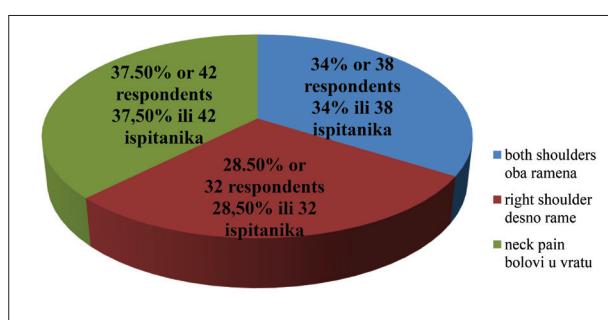
The aim of the paper is to determine pain prevalence in neck and shoulder joints due to professional risk factors among dentists.

## MATERIAL AND METHODS

The questions from "The questionnaire on problems related to neck and shoulder joints" were grouped into the three basic groups: the first part contained general, demographic and individual data for each respondent: age, gender, years of practicing, occupation, workplace;

**Table 1.** Distribution of respondents according to the treatment**Tabela 1.** Raspodela ispitanika po načinu tretiranja bolova

Self-medicated Samomedikacija	Professional medical help Stručna medicinska pomoć	Analgesic / antirheumatics – how often? Analgetici-antireumatici/koliko često	Physical therapy Fizikalna terapija	Spa treatment Spa centar
88 respondents/ ispitanika (78.5%) (9% > private sector/ privatni sektor)	64 respondents/ ispitanika (58%) (10% > private sector/ privatni sektor)	92 respondents/ ispitanika (82%) (2–3 times a year/ puta godišnje)	43 respondents/ ispitanika (38.3%) (24.1% > public sector/ državni sektor)	30 respondents/ ispitanika (26.7%) (5.6% > private sec- tor/privatni sektor)

**Figure 1.** Comparison of pain prevalence in public and private sector**Slika 1.** Učestalost bolova kod stomatologa u državnom i privatnom sektoru**Figure 2.** Distribution of respondents according to the pain localization**Slika 2.** Raspodela ispitanika prema lokalizaciji bolova

the second group of questions was related to the presence of pain, localization, extension, period of occurrence and absence from work; the third group of questions included data on ways to relieve pain using antirheumatics / analgesics, physical therapy, spa therapy and the degree of disability. In the total sample of 112 respondents (public sector 58 respondents, private sector 54 respondents), the data analysis according to gender showed that 53 respondents (47.3%) belong to male gender and 59 respondents (52.7%) to female gender. In the public sector there was higher representation of female gender by 14 (24.2%), while in the private sector there was a higher representation of male gender by 8 (14.8%).

Most respondents in the public sector, a total of 30 (51.70%), were in the 25-39 age group, 17 respondents (29.31%) were in the 40-49 age group and 11 respondents (18.99%) belonged to the 50-65 age group. The 25-39 and 50-65 age groups of the private sector contained the same number of the respondents, 21 respondents (38.8%), while in the 40-49 age group there were 12 respondents (22.4%).

**Table 2.** Pain prevalence according to age, years of work, season and sick leave duration**Tabela 2.** Raspodela ispitanika po godinama života, godinama rada, dobu godine i vremena odsustva sa posla

Season Godišnje doba	Autumn / winter – higher presence of pain
Age Godine starosti	30 to 39 years –higher presence 30–39 – učestalije
Years of practicing Godine rada	Up to ten years – higher presence Do 10 godine – učestalije
Sick leave duration Dužina bolovanja	From four to six weeks 4/6 nedelja

**Table 3.** Distribution of respondents according to the treatment (physical therapy, spa treatment) and gender**Tabela 3.** Raspodela ispitanika po načinu tretiranja bolova (fizikalna terapija, spa prema polu)

Treatment of musculoskeletal disorder Način lečenja muskuloskeletnih bolova	74.5% of respondents/ ispitanika
Gender, physical therapy, analgesics / antirheumatics Pol, fizikalna terapija, analgetici /antireumatici	20 % > women/žena
Using physical therapy on a one-year basis Fizikalna terapija godinu dana	48.2% of respondents/ ispitanika
Spa treatment Spa centar	29.6% (5% > private sector/privatni sektor)
Surgery Hirurški tretman	5% of respondents/ ispitanika

Microsoft Office Excel 2007 (Microsoft) was used in statistical data processing and collected data were presented in table and graph form.

## RESULTS

The obtained results are shown in Figures 1, 2 and Tables 1-3.

In the total sample of private and public sector, 90.1% of respondents had pain in neck and shoulder joints and only 9.9% of the respondents did not feel any pain. The pain prevalence in the public sector (93.1%) was higher than in the private sector (87%).

The largest number of respondents reported pain in the neck, 42 of them (37.5%), 38 (34%) respondents felt pain in both shoulders and 32 respondents (28.5%) reported pain in one shoulder, usually right shoulder.

The results showed that respondents most frequently self-medicated, 88 of them (78.5%), 9% more than in private practices, while 64 respondents (58%) sought professional help, 10% more than in private practices. The statistically significant result is that 92 respondents (82%) used

analgesics / antirheumatics several times a year (two to three times). Furthermore, 43 respondents (38.3%) used physical therapy and 30 respondents (26.7%) used spa treatment.

The respondents from public sector used physical therapy more, 29 of them (50%), while the respondents from the private sector used spa treatment slightly more. The analysis indicated that pain in the shoulder and neck region of the spine occurred more frequently in autumn and winter compared to spring and summer.

A significant finding was that pain was more frequent among younger dentist aged 30 to 39 years and with up to 10 years of practicing. Sick leave duration was from four to six weeks.

There was a correlation between the occurrence of musculoskeletal problems, age and years of practicing of the respondents due to the fact that 20% more female respondents had problems, as well as younger respondents with up to 10 years of practicing, while 5% of respondents received recommendation for surgery. Although they underwent a treatment (physical therapy, analgesics, antirheumatics), 74.5% of the respondents continued performing work activities.

## DISCUSSION

The results obtained in our study confirmed that dental staff is at high risk of occupational and work-related diseases. This study was the first one to publish data on musculoskeletal health status of dentists in the Federation of Bosnia and Herzegovina (F/BH). In Tuzla Canton, a total of 112 respondents were surveyed, 58 respondents from the public sector (22 males and 36 females) and 54 respondents from the private sector (31 males and 23 females). Most respondents from the study belonged to the 25-39 age group (51 respondents), 29 respondents were in the 40-49 age group and in the 50-65 age group there are 32 respondents. The study showed undesirable results; out of 112 respondents in Tuzla Canton, a total of 90.10% had a musculoskeletal disorder.

Kierklo et al. obtained similar results assessing the prevalence of musculoskeletal problems among dentists in Poland. In the previously mentioned study, the sample consisted of 220 dentists and they found that 92% of them experienced some musculoskeletal disorders, especially in the neck (47%) and lower back (35%) [14]. The study by Sustova et al. in the Czech Republic involved 581 dentists, with a response rate of 72.6%. 96.9% of the surveyed dentists reported having musculoskeletal problems. A statistically significant correlation with the occurrence of musculoskeletal problems of medium and major intensity was determined with gender, age, running a private practice, past injuries of musculoskeletal systems and the perception of work as psychologically demanding [15].

The study conducted in Tuzla Canton indicated correlation between the occurrence of musculoskeletal problems, gender, age and years of practicing. Data analysis showed that pain in the shoulder and neck region of the spine occurred more frequently in autumn and winter

compared to spring and summer. Dentists in Tuzla Canton had high prevalence of musculoskeletal problems, occurring early, from age 30-39 years. It was significant that pain prevalence was higher in the public sector than in the private sector in Tuzla Canton by 6.1%.

A group of Swedish scientists conducted a study on the correlation between work characteristics and upper extremity musculoskeletal disorders among female dentists. The results of the questionnaire completed by 945 women (dentists and nurses) showed that 81% of respondents reported an upper extremity musculoskeletal disorder. Also, female dentists reported the highest levels of physical load and fatigue [16]. The study in Tuzla Canton showed that female dentists and younger respondents (up to ten years of practicing) had more frequent musculoskeletal problems and more often used physical therapy by 20% than male respondents. The economic crisis has resulted in various changes and rationalizations in providing dental care. The study by Jonker et al. showed that rationalization often results in an increased risk of developing musculoskeletal disorders related to work [17].

Yi et al. recruited 271 dental staff in order to determine how early musculoskeletal disorders occur in dental professionals. Depending on dental specialty, musculoskeletal disorders in the neck region were reported by 47.5% - 69.8% of the surveyed postgraduates; shoulder region 50.8% - 65.1%, lower back region 27.1% - 51.2%; upper back region by 25.6% - 46.5%, elbow region 5.1% - 18.6%, hip region 3.4% - 16.3% and ankle region 5.1% - 11.6% [18]. The study in Tuzla Canton showed that most respondents experienced neck pain, 42 of them (37.5%), 38 respondents (34%) experienced pain in both shoulders, and one shoulder (usually the right one) a total of 32 respondents (28.5%).

As confirmed in the study by Kazancioglu et al. the occurrence of musculoskeletal disorders is highly correlated with the body posture during work and improper loading of the foot [19]. Thanathornwong et al. used a Bayesian network and developed a system for predicting and preventing musculoskeletal disorders related to work [20].

In a two-year study by Nemes et al. 390 dentists from the western part of Romania who were diagnosed with a musculoskeletal disorder were monitored to assess the efficiency of rehabilitation. Dentists who underwent physical therapy experienced improvements of functional parameters and increased work productivity [21].

In comparison to the previous studies, the results of our study showed that in the total sample 37% of respondents used physical therapy (public sector 49% and private sector 25%). Most respondents performed self-medication, 78.5%, 9% more than in private practices. Furthermore, 58% of respondents sought professional help, 10% more than in private practice. The statistically significant result was that 82% of the respondents used analgesics / antirheumatics several times a year (two to three times). It was interesting that 74.5% of respondents continued performing work activities although they underwent some treatment (physical therapy, analgesics, antirheumatics), while only 5% of respondents received recommendation for surgery.

The most frequent musculoskeletal disorders that can occur in dental staff are carpal tunnel syndrome, compression of the median nerve, lateral epicondylitis, radial tunnel syndrome, cubital tunnel syndrome, painful shoulder syndrome, subacromial impingement syndrome, adhesive capsulitis and trapezius myalgia [22].

Puriene et al. showed that in 2017 87.2% of dentists reported at least one symptom of musculoskeletal disorder in the past 12 months. The study in Tuzla Canton showed that over one-year period 53% of the respondents experienced problems in the musculoskeletal system [23].

The study in Greece showed the pain prevalence in the lower back region of 46% and Australia 53.7%, while 25% dentists reported chronic pain. Dentists who spend the majority of their work time sitting are at higher risk of lower back pain. However, older dentists more often suffer from neck pain [24]. Ergonomic improvements, health promotion and organizational interventions are necessary in order to reduce the risk of musculoskeletal disorders [24, 25].

## CONCLUSION

The research in Tuzla Canton demonstrated that 90.1% of the surveyed respondents had musculoskeletal health problem. Young dentists from the age of 39, in the first ten years of practice, experienced problems with neck and shoulder joints, as part of the commitment of young dentists at the beginning of their carrier and the occurrence of occupational burnout syndrome. The aim of our research was to point out to serious, widespread problem that is relatively easy to solve if properly detected and if carried out thoroughly and continuously by the implementation of ergonomic prevention measures and programs. Exercises for stretching and strengthening the spine are important for its long and optimal function. A healthy spine protects body from metabolic diseases and enables dentists to focus on their profession and skills.

## REFERENCES

- Vodanović M. Occupational diseases and diseases related to work in dental medicine. 1st ed. Zagreb: Naklada Slap; 2015.
- European Commission 2013. Report on the current situation in relation to occupational diseases' systems in EU Member States and EFTA/ EEA countries, in particular relative to Commission Recommendation 2003/670/EC concerning the European Schedule of Occupational Diseases and gathering of data on relevant related aspects. Available from: <http://www.osha.europa.eu>
- Ayatollahi J, Ayatollahi F, Ardekani AM, Bahrololoomi R, Ayatollahi J, Ayatollahi A, et al. Occupational hazards to dental staff. *Dent Res J (Isfahan)*. 2012; 9(1):2–7.
- Bramson JB, Smith S, Romagnoli G. Evaluating dental office ergonomic. Risk factors and hazards. *J Am Dent Assoc*. 1998; 129(2):174–83.
- Gupta A, Ankola AV, Hebbal M. Optimizing human factors in dentistry. *Dent Res J (Isfahan)*. 2013; 10(2):254–9.
- Shaghaghi S, Pardis S, Mansoori Z. Knowledge, attitude and practice of dentists towards prophylaxis after exposure to blood and body fluids. *Int J Occup Environ Med*. 2014; 5(3):146–54.
- Sacchetto MS, Barros SS, Araripe Tde A, Silva AM, Faustino SK, da Silva JM. Hepatitis B: knowledge, vaccine situation and seroconversion of dentistry students of a public university. *Hepat Mon*. 2013; 13(10):e13670.
- Burgess-Limerick B. Biomechanical Hazards. The Core Body of Knowledge for Generalist OHS Professionals. Tullamarine: Health and Safety Professionals Alliance; 2012. Available from: <http://ohsbok.org.au>
- Ritzline PD, Mulvany RD. Ergonomics and posture and pain--oh my! *Cranio*. Cranio. 2012; 30(2):82–3.
- Messano GA, Petti S. General dental practitioners and hearing impairment. *J Dent*. 2012; 40(10):821–8.
- Santarsiero A, Fuselli S, Piermattei A, Morlino R, De Blasio G, De Felice M, et al. Investigation of indoor air volatile organic compounds concentration levels in dental settings and some related methodological issues. *Ann Ist Super Sanita*. 2009; 45(1):87–98.
- Boran A, Shawaheen M, Khader Y, Amarin Z, Hill Rice V. Work-related stress among health professionals in northern Jordan. *Occup Med (Lond)*. 2012; 62(2):145–7.
- Khanna R, Khanna R. Is medicine turning into unhappy profession? *Indian J Occup Environ Med*. 2013; 17(1):2–6.
- Kierklo A, Kobus A, Jaworska M, Botulinski B. Work-related musculoskeletal disorders among dentists - a questionnaire survey. *Ann Agric Environ Med*. 2011; 18(1):79–84.
- Sustova Z, Hodacova L, Kapitan M. The prevalence of musculoskeletal disorders among dentists in the Czech Republic. *Acta Medica (Hradec Kralove)*. 2013; 56(4):150–6.
- Lindfors P, Berntsson L, Lundberg U. Factor structure of Ryff's psychological well-being scales in Swedish female and male white-collar workers. *Personality and Individual Differences*. 2006; 40(6):1213–22.
- Jonker D, Rolander B, Balogh I, Sandsjo L, Ekberg K, Winkel J. Rationalisation in public dental care--impact on clinical work tasks and mechanical exposure for dentists--a prospective study. *Ergonomics*. 2013; 56(2):303–13.
- Yi J, Hu X, Yan B, Zheng W, Li Y, Zhao Z. High and specialty-related musculoskeletal disorders afflict dental professionals even since early training years. *J Appl Oral Sci*. 2013; 21(4):376–82.
- Kazancioglu HO, Bereket MC, Ezirganli S, Ozsevik S, Sener I. Musculoskeletal complaints among oral and maxillofacial surgeons and dentists: a questionnaire study. *Acta Odontol Scand*. 2013; 71(3–4):469–74.
- Thanathornwong B, Suebnukarn S, Songpaisan Y, Ouivirach K. A system for predicting and preventing work-related musculoskeletal disorders among dentists. *Comput Methods Comput Methods Biomed Engin*. 2014; 17(2):177–85.
- Nemes D, Amarai E, Tanase D, Popa D, Catan L, Andrei D. Physical therapy vs. medical treatment of musculoskeletal disorders in dentistry--a randomised prospective study. *Ann Agric Environ Med*. 2013; 20(2):301–6.
- Murtomaa H. Conceptions of dentists and dental nurses about ergonomics. *Ergonomics*. 1983; 26(9):879–86.
- Puriene A, Janulyte V, Musteikyte M, Bendinskaite R. General health of dentists. Literature review. *Stomatologija*. 2007; 9(1):10–20.
- Gupta A, Ankola AV, Hebbal M. Dental ergonomics to combat musculoskeletal disorders: a review. *Int J Occup Saf Ergon*. 2013; 19(4):561–71.
- Custodio RA, Silva CE, Brandao JG. Ergonomics work analysis applied to dentistry-a Brazilian case study. *Work*. 2012; 41 Suppl 1:690–7.

# Prevalenca biomehaničkih rizika kod doktora stomatologije

Mirjana Duspara<sup>1</sup>, Maida Mulić<sup>2</sup>, Kristina Duspara<sup>3</sup>

<sup>1</sup>Javna zdravstveno-nastavna ustanova Dom zdravlja „Dr Mustafa Šehović“, Tuzla, Bosna i Hercegovina;

<sup>2</sup>Univerzitet u Tuzli, Medicinski fakultet, Katedra za socijalnu medicinu, Tuzla, Bosna i Hercegovina;

<sup>3</sup>Javna zdravstvena ustanova „Gradske apoteke“, Tuzla, Bosna i Hercegovina

## KRATAK SADRŽAJ

**Uvod** Stomatološko osoblje je često pogodeno poremećajima mišićno-koštanog sistema, što podrazumeva promene na tetivama, mišićima i živcima šake, ručnog zgloba, laka, nadlaktice, ramena, vrata i leđa. Ergonomski preventivni programi uključuju redizajniranje radnog okruženja i edukaciju zdravstvenih radnika o opasnostima na radu i njihovom rešavanju.

Cilj ovog rada je da se utvrdi prevalenca bola vratnog i ramenog pojasa kao posledica profesionalnog rizika kod doktora stomatologije.

**Metode** Istraživanje je sprovedeno anonimnim anketiranjem doktora stomatologije pomoću „Upitnika o poteškoćama sa vratnim i ramenim pojasom“. U saradnji JZNU Dom zdravlja „Dr Mustafa Šehović“, Tuzla, Službe Stomatologije sa ZZJZ TK distribuirano je 150 anketnih upitnika u JU domove zdravlja TK i ordinacije privatne prakse, a bilo je 112 uredno ispunjenih i analiziranih upitnika.

**Rezultati** Stopa prevalence bola vratnog i ramenog pojasa je veoma visoka, tačnije kod 101 ispitanika (procenzualno: 90,10%). Ispitanici su se najviše lečili samostalno i to njih 88 (78,5%), a stručnu pomoć su tražila 64 ispitanika (58%). Statistički je značajan rezultat da 92 ispitanika (82%) koriste analgetike/antireumatike više puta godišnje (i to dva do tri puta).

**Zaključak** Prevalenca bola bila je visoka. Istraživanje je ukazalo na ozbiljan, sveprisutan i u osnovi lako rešiv problem ukoliko se dovoljno uključi u njegovu svakodnevnu realizaciju.

**Ključne reči:** bol; položaj tela; ergonomija; vrat; kičma; fizikalna terapija

## UVOD

Narušavanje zdravstvenog stanja zbog radnog položaja kod doktora stomatologije najčešće se uočava na promenama vratnog i slabinskog dela kičme koji se širi prema ramenima, rukama i nogama. Rizični faktori su i izvijanje vrata u obliku slova S, te naginjanje glave napred zbog boljeg pregleda radnog polja. Kako se ta dva položaja obično odvijaju paralelno i istovremeno, dolazi do izrazitog pritiska i naprezanja cervicalne kičme [1].

Bolesti koje pogađaju radno stanovništvo definisane su kao bolesti bez uzročno-posledične veze s radom, ali mogu biti pogoršane profesionalnim zdravstvenim rizicima [2]. Poređenjem s drugim zdravstvenim zanimanjima, stomatologija se smatra jednim od najopasnijih zanimanja zbog stresa, hroničnog umora i sindroma izgaranja na poslu [3, 4]. Svetska zdravstvena organizacija (WHO) definiše profesionalne bolesti kao kombinaciju bolesti i ekspozicije te njihovu povezanost, i deli profesionalne bolesti prema štetnostima radnog mesta na: bolesti uzrokovanе hemijskim, fizikalnim i biološkim štetnostima [5, 6].

Biološke opasnosti (biohazardi) su stvari koje prete zdravlju stomatološkog osoblja, a uključuju virusе, bakterije, gljivice i prione [7, 8]. Biomehaničke opasnosti u stomatologiji su nepravilan položaj tela tokom rada, ponavljajuće kretnje, prenaprezanje tela, s mogućom opasnošću da uzrokuju bolesti koje pogađaju mišićno-koštani ili neurološki sistem [9, 10]. Statodinamički uzroci profesionalnih rizika u stomatologiji su vibracije, a fizikalne opasnosti uključuju zračenje (jonizirajuće i nejonizirajuće), buku, veštačku rasvetu, polimerizacijsko svetlo i drugo [11].

Hemijskim opasnostima u stomatologiji smatraju se lekovi, preparati, stomatološki materijali te oprema za ličnu zaštitu kao što su rukavice, dezinficijensi i drugo [12]. Psihološke opasnosti mogu biti izvor mnogobrojnih psiholoških tegoba, poput depresije i anksioznosti, ali i izvor somatskih poremećaja poput kardiovaskularnih bolesti, povišenog krvnog pritiska i neuroloških poteškoća [13].

Cilj rada je odrediti prevalencu bola vratnog i ramenog pojasa kao profesionalnog rizika kod doktora stomatologije.

## METODE I TOK RADA

Pitanja iz upitnika „Upitnik o poteškoćama sa vratnim i ramenim pojasom“ grupisana su u tri osnovne grupe: prvi deo sadrži opšte, demografske i individualne podatke za svakog ispitanika: starost, pol, radni staž, zanimanje, radno mesto; druga grupa pitanja odnosila se na prisustvo bola, lokalizaciju, širenje, period javljanja i odsustvo sa posla, a treća grupa pitanja obuhvatala je podatke o načinu rešavanja bola u osnovi korišćenjem antireumatika/analgetika, fizikalnom tretmanu, banjskom lečenju i stupnju invaliditeta. U ukupnom uzorku od 112 anketiranih ispitanika (javnog sektora 58, privatnog sektora 54 ispitanika) analiza podataka po polu je pokazala da 53 (47,3%) ispitanika pripadaju muškom polu, a 59 (52,7%) ženskom polu. U javnom sektoru veća je zastupljenost ženskog pola za 14 (24,2%), dok je u privatnom sektoru veća zastupljenost muškog pola za osam (14,8%).

Najviše ispitanika javnog sektora, ukupno 30 (51,70%), u starosnoj je grupi od 25 do 39 godina, 17 (29,31%) ispitanika pripada starosnoj grupi od 40 do 49 godina, dok starosnoj grupi od 50 do 65 godina pripada ukupno 11 (18,99%) ispitanika. Starosne grupe privatnog sektora od 25 do 39 godina i od 50 do 65 godina imale su isti broj ispitanika i to 21 (38,8%), dok starosnoj grupi od 40 do 49 godina pripada 12 (22,4%) ispitanika.

Pri statističkoj obradi korišten je računarski program Microsoft Office Excell 2007, a prikupljeni podaci su prikazani u tabelarnoj i grafičkoj formi.

## REZULTATI

Dobijeni rezultati su prikazani slikama 1 i 2 i tabelama 1, 2 i 3.

U ukupnom uzorku privatnog i javnog sektora 90,10% ispitanika su imali bolove u vratnom i ramenom pojasu, a samo 9,90% ispitanika bol nije osetilo. Zastupljenost bola u javnom sektoru je veća, i to ukupno 93,10%, a u privatnom sektoru 87%.

Najveći broj ispitanika je imao bol u vratu, ukupno 42 (37,5%); bol u oba ramena osetilo je 38 (34%) ispitanika, a u jednom ramenu, i to češće u desnom, 32 (28,5%) ispitanika.

Rezultati pokazuju da su se ispitanici najviše lečili samostalno – 88 (78,5%), za 9% više u privatnoj praksi, a stručnu pomoć su tražila 64 ispitanika (58%), 10% više u privatnoj praksi. Statistički je značajan rezultat da 92 (82%) ispitanika koriste analgetike/antireumatike više puta godišnje (dva do tri puta). Fizikalni tretman koristila su 43 (38,3%) ispitanika, a banjsko lečenje je koristilo 30 ispitanika (26,7%). Ispitanici iz javnog sektora koriste više fizikalni tretman i to njih 29 (50%), dok ispitanici iz privatnog sektora malo više koriste banjsko lečenje.

Analiza podataka pokazuje da se bolovi u ramenom i vratnom delu kičme češće pojavljuju u jesen i zimu u odnosu na proleće i leto. Značajan podatak je da se bolovi više pojavljuju kod mlađih zaposlenih starosti od 30 do 39 god. i do 10 godina radnog staža. Dužina bolovanja je bila od četiri do šest sedmica.

Pостоји веза између појаве мишићно-коштаног проблема, старости и година стаža испитаника јер је 20% више испитаника јенског пола имало проблеме, као и млади испитаници до 10 година радног стаža, док је 5% испитаника добило препорuku за оперативни захват. Иако су били подвргнути терапији (физична терапија, аналгетици, антиреуматичи), 74,5% испитаника су обављали радну делатност.

## DISKUSIJA

Rezultati добијени овим истраживањем потврђују доказе да је стоматолошко осoblje у великој опасности од развоја професионалних болести и болести vezanih uz rad. Ово је прво истраживање које objavljuje податке о мишићно-коштаном здравственом статусу доктора стоматологије Федерације Босне и Херцеговине. Анетирено је 112 испитаника у Тузланској котону (TK), 58 испитаника јавног сектора (муških 22, a ženskih 36) i 54 испитаника privatnog sektora (muških 31 i ženskih 23). Najviše испитаника ovog istraživanja pripada starosnoj grupi od 25 do 39 godina (51 испитаник), starosnoj grupi od 40 do 49 godina (29 испитаника), dok starosnoj grupi od 50 do 65 godina pripadaju 32 испитаника. Истраживање је указало на лоше резултате – од 112 испитаника у Тузланској котону (TK), укупно 90,10% је имало мишићно-коштани poremećaj.

Slične rezultate su имали Kierklo i saradnici испитујући заступљеност мишићно-коштаних проблема међу poljskim stomatologima. Prethodno spomenuto istraživanje podrazumevalo je узорак од 220 stomatologa i уstanovljeno је да је 92% njih имало неки мишићно-коштани poremećaj, posebno u vratu (47%) i donjem delu leđa (35%) [14]. Истраживање Šustova i njenih saradnika у Republici Češkoj обухватило је 581 stomatologa, a stopa odgovora била је 72,6%; njih 96,9% изјавило је да има пoteškoće s мишићно-коштаним sistemom. Utvrđена је statistički značajna korelacija između појаве мишићно-коштаних poteškoća srednjeg i jakog intenziteta; te pola, starosti, vođenja privatne ordinacije, povreda мишићно-коштаног sistema u prošlosti, kao i doživljaja posla kao psihološki zahtevnoga [15].

Istраживање спроведено у TK pokazalo је да постоји korelacija između појаве мишићно-коштаних problema, pola, starosti

i godina staža. Analiza podataka je pokazala да se bolovi u ramenom i vratnom delu kičme češće pojavljuju u jesen i zimu u odnosu na proleće i leto. Stomatolozi u TK imaju visoku učestalost mišićno-koštanih problema koji se pojavljuju rano, od 30. do 39. god. života. Značajna je činjenica o većoj zastrupljenosti bola u javnom sektoru, за 6,1% nego u privatnom sektoru u TK.

Grupa švedskih naučnika je sprovela studiju o povezanosti radnih karakteristika i mišićno-koštanih poremećaja gornjih ekstremiteta kod žena stomatologa. Rezultati upitnika koji je ispunilo 945 žena (stomatološkinje i medicinske sestre) pokazuju da je 81% испитанica пријавило mišićno-koštani poremećaj u gornjim ekstremitetima. Takođe је dokazano da najveći nivo opterećenja i umora пријављују stomatološkinje [16]. Истраживање у TK је показало да жене (stomatološkinje) и млађи испитаници (до 10 godina radnog staža) имају чеšće mišićno-koštane probleme i da чеšće користе fizikalnu terapiju – за 20% u odnosu na muške испитанике.

Ekonomске krize u zemlji rezultirale су mnogobrojnim promenama i racionalizacijama u pružanju stomatološke zaštite. Истраживање Jonkera i saradnika pokazalo је да racionalizacija често završava povećanim rizikom od razvoja mišićno-koštanih tegoba povezanih s radom [17].

Yi i saradnici су angažovali 271 diplomiranog studenta stomatologije kako bi установили koliko se rano pojavljuju mišićno-koštani poremećaji kod stomatološkog osoblja. Zavisno od stomatološke specijalnosti, mišićno-koštane tegobe u području vrata pojavljuju se kod 47,5% do 69,8% испитаних; u području ramena kod 50,8% do 65,1%; u donjem delu leđa kod 27,1% do 51,2%; u gornjem delu leđa od 25,6% do 46,5%; u laktu od 5,1 do 18,6%; u području kukova od 3,4 do 16,3%; te gležnja od 5,1 do 11,6% испитаних [18]. Rezultati istraživanja u TK pokazali су да najveći broj испитаника има бол у vratu, i to njih 42 (37,5%), бол у oba ramena osetilo je 38 (34%) испитаника, а u jednom ramenu (najčešće desnom) ukupno 32 (28,5%) испитаника.

Kao što је u svom istraživanju potvrdio Kazancioglu sa sar., појава мишићно-коштаних tegoba u tesnoj je vezi s položajem tela pri radu i nepravilnim opterećenjem stopala [19]. Thanathornwong i saradnici koristili су se Bajezijanovom mrežom i razvili sistem za predviđanje i prevenciju mišićno-koštanih tegoba povezanih s radom [20].

Nemes i saradnici су u dvogodišnjem istraživanju pratili 390 stomatologa iz zapadnih delova Rumunije којима је dijagnostikovan neki od mišićno-koštanih poremećaja, kako bi se pokazala učinkovitost rehabilitacije. Stomatolozima који су odlazili na fizikalnu terapiju poboljšали су se funkcionalni pokazatelji, te им је porasla radna produktivnost [21].

Poređenjem sa prethodnim, rezultati ovog istraživanja су pokazali да је u ukupnom uzorku fizikalni tretman koristilo 37% испитаника (јавни сектор 49%, privatни сектор 25%). Najviše испитаника су se lečili samostalno, 78,5% njih, i to за 9% više u privatnoj praksi. Stručnu pomoć je tražilo 58% испитаника, за 10% više u privatnoj praksi. Statistički je značajan rezultat da 82% испитаника користи analgetike/antireumatike više puta godišnje (dva do tri puta). Interesantno је да је то 74,5% испитаника обављали radnu delatnost iako су били под терapijom (физична, аналгетички, антиреуматичи), а само 5% испитаника су добили препорuku за operativni zahvat.

Najučestaliji mišićno-koštani poremećaji који се могу појавити као posledica bavljenja stomatološком profesijom су

sindrom karpalnog kanala, kompresija nervusa medijanusa, lateralni epikondilitis, sindrom radijalnog tunela, sindrom kuibitalnog tunela, sindrom bolnog ramena, sindrom subakromi-jalnog sraza, adhensivni kapsulitis, mialgija m. trapeziusa [22]

Puriene i saradnici dokazali su da je 2007. godine 87,2% stomatologa prijavilo barem jedan simptom mišićno-koštanog poremećaja u prethodnih 12 meseci [23]. Istraživanje u TK pokazalo je da se na jednogodišnjem nivou problemi mišićno-koštanog sistema javljaju kod 53% ispitanika.

Studija u Grčkoj je pokazala prevalenciju bola u donjem delu leđa kod stomatologa od 46%, a studija u Australiji od 53,7%, a 25% stomatologa je tu bol prijavilo kao hroničnu. Stomatolozi koji veći deo radnog vremena provode u sedećoj poziciji imaju veći rizik za nastanak bola u donjem delu leđa. Stariji stomatolozi češće pate od bolova u vratu [24]. Ergonomска poboljšanja, promocija zdravlja te intervencije u organizaciji posla potrebne su kako bi se smanjio rizik od mišićno-koštanih tegoba [24, 25].

## ZAKLJUČAK

Istraživanje u TK je dokazalo da 90,10% anketiranih ispitanika ima mišićno-koštanu zdravstveni problem. Mlađi stomatolozi već do 39 godina starosti, dakle u prvih 10 godina radnog staža, imaju probleme sa vratnim i ramenim pojasom, što potvrđuje angažovanost mlađih stomatologa na početku karijere i nastanak tzv. sindroma izgaranja na poslu.

Ovim istraživanjem želimo ukazati na ozbiljan, sveprisutan i u osnovi lako rešiv problem ukoliko se dovoljno uključimo u njegovu svakodnevnu realizaciju, a to je obavezna primena ergonomskih preventivnih mera i programa.

Pranje zuba smatramo preduslovom zdravlja usne šupljine; tako bi trebalo da i vežbe za razgibavanje i jačanje kičme smatramo preduslovom za njeno dugo i optimalno funkcionisanje. Zdrav stub organizma štiti organizam od svih metaboličkih oboljenja te omogućava stomatologu da se koncentriše na svoju stručnu pomoć pacijentu.

# An anthropometric study of craniofacial measurements and their correlation with vertical dimension of occlusion among fully dentate population in Serbia

Nikola Živković, Pavle Nikolić, Jovana Kuzmanović-Pfićer, Mirjana Perić, Aleksandra Milić-Lemić  
University of Belgrade, School of Dental Medicine, Belgrade, Serbia

## SUMMARY

**Introduction** In clinical conditions vertical dimension of occlusion (VDO) is defined as a distance between the two points, one above and the other one under the mouth, while teeth are intercuspidated. As a result of teeth loss, attrition, abrasion or unsuccessful dental interventions the VDO changes. Decrease of VDO not only changes the esthetic appearance of the lower third of the face, but also affects the function of the orofacial system. The objective of the study was to find correlation of VDO and craniofacial measurements among fully dentate subjects.

**Material and methods** The study was performed at the Clinic of Prosthodontics of University of Belgrade from October 2018 until March 2019. The participants included both genders age range between 22 and 24 years, class I occlusion and intact dentition. Twelve craniofacial lines were measured with specially constructed divider. Gathered results were analyzed in SPSS 22 computer software. Mean values and standard deviation were used for data description.

**Results** The results showed statistically significant correlation in values of some parameters in both genders. The proportion of the face was noticed among all participants, and possibility of analyzing face by thirds. Also the correlation was noticed between the lower facial height and the height of right ear as well as bi-pupillary distance where with increasing distance of bi-pupillary line, the value of the lower facial height was also increased. Statistical significance in values of both genders was noticed in middle facial height ( $p = 0.006$ ), lower facial height/ vertical dimension of occlusion ( $p = 0.004$ ), width of nose ( $p = 0.01$ ), Frankfurt plane ( $p = 0.008$ ), height of the right ear ( $p = 0.000$ ).

**Conclusion** Obtained results showed correlation between VDO and craniofacial dimension among young adults with intact dentition.

**Keywords:** vertical dimension of occlusion, craniofacial analysis, and anthropometric measurements

## INTRODUCTION

Vertical dimension of occlusion (VDO) is defined as lower facial height, measured between two points on the face when the maxillary and mandibular teeth are intercuspidated [1]. It is changeable throughout life due to the both physiological and pathological factors. During the process of mastication as a consequence of masticatory forces the amount of enamel tissue is gradually thinning and it is the outcome of attrition [2]. Even though there is compensatory mechanism of producing new layers of cementum, it is not sufficient and vertical dimension of occlusion will undoubtedly be decreasing throughout the lifetime [2]. Therefore, the VDO needs to be restored especially if extensive prosthodontic procedures are needed.

Most commonly used techniques for determining VDO are physiological (based on the physiological rest position), phonetic and cephalometric [1, 2]. None of these techniques has been proven to be sufficiently reliable and accurate; therefore they should be used combined [1–6]. Some authors recommended that VDO may be determined using the external appearance of the face,

with reference to nasolabial folds, harmony between lower third and other facial thirds and consistency with patients' age [2]. Willis showed that the distance between the outer corner of the eye to the labial commissure was equal to the distance from the base of the nose to the chin, and proposed the Willis clipper for this type of measurements [2, 7].

The most commonly used method is physiological rest position, but many authors have stated that it depends on numerous factors, such as head posture, emotional state, time of the day, presence or absence of the teeth, and parafunctional activities [1, 2]. However, determination of the new VDO in restorative procedures is complex and demanding procedure and has to be with patient's esthetic, biomechanical, and functional requests. In clinical conditions it is essential to properly determine VDO for the procedures of making dentures, full-mouth reconstructions and implant-supported restorations [2].

The objective of the study was to find correlation between VDO and craniofacial measurements among fully dentate subjects. The Null hypothesis was that there is significant correlation between VDO and some facial measurements.

## MATERIAL AND METHODS

The cross-sectional study was performed at the Clinic for Prosthodontics, School of Dental Medicine University of Belgrade during the period from October 2018 until February of 2019. Analysis was performed among young adults, who met the inclusion criteria (45.71% were male and 54.29% female participants). The inclusion criteria were the following: young adult patients (19–25 years), who did not have in dental history orthodontic or surgical interventions, had intact dentition, Angle class I occlusion, no extensive lesions of non-carious lesions (extensive abrasions, erosions and abfractions of teeth), with no visible facial asymmetry, and no mio-facial pain or signs of temporomandibular dysfunctions.

Twelve craniofacial measurements were performed including VDO with a specially constructed divider. Patients were instructed to sit upright and look straight with head parallel to the floor. Craniofacial measurements that were analyzed included upper height of the face (UHF), middle height of the face (MHP), lower height of the face (LHP), facial height (FH), distance between zygions (Zyg-Zyg), inter-pupillary distance (ID), interocular distance (IO), length of the right eye, distance between gonions (Go-Go), width of the lips (LW), width of the nose (NW), Frankfurt plane (FRA) and the height of the right ear (EH) (Picture1).

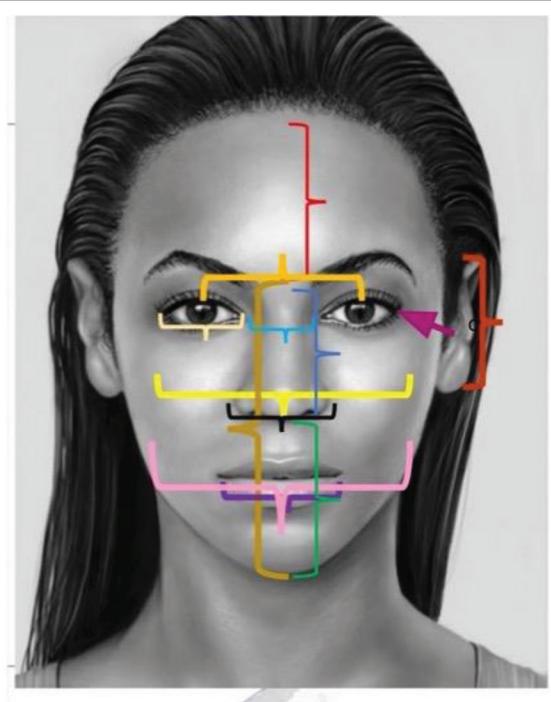
VDO was determined by measuring the distance between two points, one was marked on the tip of the nose and one on the tip of the chin. Taking into account that its accuracy was pivotal, measured values were recorded twice by two therapists.

1. UFH (upper facial height) - distance measured from the hairy part of head to the radix area of the nose.

2. MFH (middle facial height) - distance measured from radix of the nose to the base of the nose.
3. LFH (VDO) - distance measured from the most prominent point on the nose to the most prominent point on the chin.
4. Zyg-Zyg - distance measured from the most prominent areas on zygomatic bone on the left and right side.
5. Inter-pupillary distance - distance measured between two pupils while patients were looking straight with occlusal plane parallel to the floor.
6. Inner distance between two eyes (IO) - distance measured between two inner angles of the eyes, while looking straight
7. Width of the right eye - distance measured between outer and inner angle of the right eye
8. Go-Go (distance between gonions) - distance measured between the two most prominent points on the lower third of mandible ramus on the right and left side
9. Width of the lips - distance measured from the right to the left angle of the mouth
10. Width of the nose - distance measured between right and left wings of nose
11. Frankfurt plane - distance measured between tragus and outer angle of the right eye
12. Height of the right rear - distance measured from the base to the tip of the right ear

Obtained results were statistically analyzed in SPSS 22 computer software. Mean values and standard deviations were used in order to describe data. T-test and Man-Whitney test were used in order to compare tested groups. Spearman correlation was applied in order to get correlation between used parameters.

- ❖ **UPPER FACIAL HEIGHT UFH**
- ❖ **GORNJA VISINA LICA GVL**
- ❖ **MIDDLE FACIAL HEIGHT MFH**
- ❖ **SREDNJA VISINA LICA SVL**
- ❖ **LOWER FACIAL HEIGHT MFH**
- ❖ **DONJA VISINA LICA SVL**
- ❖ **ZYG-ZIG DISTANCE**
- ❖ **RASTOJANJE ZYG-ZYG**
- ❖ **INERPUPILLARY DISTANCE**
- ❖ **RASTOJANJE IZMEDU PUPILA**
- ❖ **INNER DISTANCE BETWEEN EYES**
- ❖ **RASTOJANJE IZMEĐU DVA OKA**
- ❖ **WIDTH OF THE RIGHT EYE**
- ❖ **ŠIRINA DESNOG OKA**
- ❖ **GONION-GONION DISTANCE**
- ❖ **RASTOJANJE IZMEĐU DVE GONION TAČKE**
- ❖ **MOUTH WIDTH**
- ❖ **ŠIRINA USANA**
- ❖ **NOSE WIDTH**
- ❖ **ŠIRINA NOSA**
- ❖ **FRANFORT HORIZONTAL LINE**
- ❖ **FRANKFURTSKA HORIZONTALNA LINIJA**
- ❖ **HEIGHT OF THE RIGHT EAR**
- ❖ **VISINA DESNOG UVA**



**Figure 1.** Craniofacial lines on the face of the patients that were used in research  
**Slika 1.** Kraniofacijalne linije na licu pacijenta koje su korišćene u istraživanju

## RESULTS

Obtained results are presented in Table 1. The results showed facial harmony of facial thirds among tested participants of both genders. Although facial proportions were slightly higher among male participants the harmony of the face was noticed among all participants. Statistical significance between genders was noticed for the following craniofacial parameters MHP ( $p = 0.006$ ), VDO ( $p = 0.004$ ), width of the nose ( $p = 0.01$ ), Frankfurt plane ( $p = 0.008$ ) and height of the ear ( $p = 0.000$ ).

**Table 1.** Craniofacial parameters for all participants of both genders  
**Tabela 1.** Kraniofajjalni parametri za ispitane oba pola

Parameter Parametar	Male Muški pol	Female Ženski pol	p
UFH GVL	$6.35 \pm 0.79$ (5.50–8.00)	$6.35 \pm 0.79$ (4.80–7.70)	
MFH SVL	$6.38 \pm 0.54$ (5.70–7.90)	$5.93 \pm 0.34$ (5.40–6.60)	0.006
LFH (VDO) DVL (VDO)	$6.69 \pm 0.82$ (5.40–8.10)	$5.94 \pm 0.62$ (4.80–7.30)	0.004
FH VL	$12.16 \pm 1.01$ (10.50–14.40)	$11.29 \pm 0.92$ (10.10–13.10)	0.012
Zg-Zg Zg-Zg	$12.34 \pm 1.25$ (9.60–14.50)	$11.68 \pm 1.15$ (10.00–14.00)	0.112
IPD MPR	$6.14 \pm 0.52$ (4.90–7.00)	$5.47 \pm 0.65$ (4.00–6.50)	0.002
IOD MOR	$3.28 \pm 0.24$ (2.90–3.70)	$2.99 \pm 0.25$ (2.60–3.50)	0.001
Width of the right eye Širina desnog oka	$3.44 \pm 0.29$ (2.90–3.90)	$0.24 \pm 0.24$ (3.00–3.80)	0.275
Go-Go Go-Go	$12.42 \pm 1.21$ (11.00–16.30)	$11.43 \pm 0.96$ (10.00–13.80)	
Width of the nose Širina nosa	$3.57 \pm 0.37$ (3.00–4.40)	$3.31 \pm 0.55$ (2.50–5.30)	
Width of the mouth Širina usta	$5.30 \pm 0.70$ (3.80–6.70)	$4.91 \pm 0.40$ (3.90–5.40)	
FHL FHL	$3.80 \pm 0.42$ (7.10–8.80)	$3.04 \pm 0.45$ (6.80–8.50)	0.008
Height of the right ear Visina desnog uva	$6.83 \pm 0.44$ (6.00–8.00)	$6.07 \pm 0.30$ (5.60–6.50)	0.000

Mild correlation among genders was noticed between VDO and inter-pupillary distance ( $p = 0.04$ ), as well as between VDO and height of the right ear between both genders ( $p = 0.004$ ). The dimensions of the right ear had positive correlation among female participants. Also, positive correlation between VDO and inner distance between two eyes ( $p = 0.04$ ), as well as lower facial height and width of the lips ( $p = 0.06$ ) was demonstrated. In addition, correlation was demonstrated between upper and middle facial height of the face, due to the fact that if value of one parameter increases, the other one increases as well.

Furthermore, the Pearson Correlation coefficient demonstrated statistically significant correlation between VDO and inter-pupillary line ( $p = 0.44$ ). Positive coefficient means that increasing the value of one parameter will undoubtedly lead to increase of another.

Also, positive correlation was demonstrated between VDO and height of the ear ( $p = 0.004$ ) and VDO and width of the nose ( $p = 0.031$ ). VDO and width of the lips

did not correlate significantly according to Pearson correlation coefficient with value 0.325.

## DISCUSSION

Obtained results in our study showed positive correlation between VDO and craniofacial dimensions among young adults with intact dentition. Positive correlation between VDO and height of the right ear was observed in both genders, as well as between VDO and inter-pupillary distance. Our results are in concordance with the results of Budai et al. [8].

Selected method was proven to be convenient, reproducible, non-invasive, easily operated and inexpensive. On the other side, in comparison to some computer methods it is less precise in locating and measuring particular craniofacial dimensions.

The study of Majeed et al. came to similar conclusion. They also demonstrated strong positive correlation between exocanthion-right labial commissure and mesial wall of the right external auditory canal-orbitale with VDO in both genders [4].

Taking into account that our investigation was performed among young adults, whose VDO was not diminished, obtained results should not be implemented in edentulous patients, whose VDO has changed and needs reestablishing. Therefore, it should be underlined that VDO represents the critical point of prosthodontics therapy. Determination of maxillomandibular relationship is essential stage during prosthodontics treatment that usually appears to be obstacle of the majority of dental practitioners in clinical practice.

Although positive correlation between the VDO and ear height is documented in this study, further investigation is needed in order to establish how these parameters change in relation to each other.

Many researchers point out the importance of determining relations between craniofacial dimensions and VDO, in order to be introduced in daily clinical practice, especially since concept of VDO is frequent topic of discussion in dental literature [9, 10, 11].

Some authors use ear-eye distance to predict chin-nose distance [12, 13] but contrary to them the results of this study could not establish correlation between these two parameters.

Inadequately determined VDO will significantly affect not only the esthetic but also the function of the oro-facial system [7, 12]. This methodology has shown to be reproducible, inexpensive, non-invasive, and may be used in numerous investigations regardless of gender or ethnicity [3, 14].

One limitation of our study was that it was performed on one ethnic group, (European Caucasian) in Serbian population, and the results may be applicable only on them. Moreover, computer analysis could be more accurate and reliable in comparison to other techniques [3, 5, 8, 10, 11]. However, the exposure to the radiation should also be considered, if radiography is used.

## CONCLUSION

Obtained results demonstrated correlation between craniofacial dimensions and VDO among fully dented individuals of both genders. Finding reliable dimensions on the face can be of great importance for practitioners during procedures related to adjustment and reestablishment of VDO.

## REFERENCES

1. Veeraiyan DN, Ramalingam K, Bhat V. Textbook of prosthodontics. New Delhi: Jaypee Brothers Medical Publishers; 2003. p. 123–39.
2. Calamita M, Coachman C, Sesma N, Kois J. Occlusal vertical dimension: treatment planning decisions and management considerations. *Int J Esthet Dent.* 2019;14(2):166–81.
3. Strajnić Lj, Stanišić-Sinobad D, Marković D, Stojanović Lj. Cephalometric indicators of the vertical dimension of occlusion. *Coll Antropol.* 2008; 32(2):535–41.
4. Majeed MI, Haralur SB, Khan MF, Al Ahmari MA, Al Shahrani NF, Shaik S. An Anthropometric Study of Cranio-Facial Measurements and Their Correlation with Vertical Dimension of Occlusion among Saudi Arabian Subpopulations. *Open Access Maced J Med Sci.* 2018; 6(4):680–6.
5. Tavano KT, Seraidarian PI, de Oliveira DD, Jansen WC. Determination of vertical dimension of occlusion in dentate patients by cephalometric analysis-pilot study. *Gerodontology.* 2012;29(2):e297–305.
6. Sakar O, Sülün T, Kurt H, Gençel B. Reliability and comparison of two facial measurements to detect changes of occlusal vertical dimension in complete denture wearers. *Gerodontology.* 2011; 28(3):205–8.
7. Willis FM. Features of the Face Involved in Full Denture Prosthesis. *Dental Cosmos.* 1935; 77(9):851–4.
8. Budai M, Farkas LG, Tompson B, Katic M, Forrest CR. Relation between anthropometric and cephalometric measurements and proportions of the face of healthy young white adult men and women. *J Craniofac Surg.* 2003; 14(2):154–61.
9. Ladda R, Kassat VO, Bhandari AJ. A new technique to determine vertical dimension of occlusion from anthropometric measurements of fingers. *Ind J Dent Res.* 2013; 24(3):316–20.
10. Strajnic LJ, Sinobad DS. Application of cephalometric analysis for determination of vertical dimension of occlusion. A review. *Med Pregl.* 2012; 65(5–6):217–22.
11. Tavano KT, Seraidarian PI, De Oliveira DD, Jansen WC. Determination of vertical dimension of occlusion in dentate patients by cephalometric analysis – a pilot study. *Gerodontology.* 2012; 29(2):297–305.
12. Nagpal A, Parkash R, Bhargava A, Chittaranian B. Reliability of different facial measurements for determination of vertical dimension of occlusion in edentulous using accepted facial dimensions recorded from dentulous subjects. *J Indian Prosthodont Soc.* 2014; 14(3):233–42.
13. Delić Z, Šimunović-Šoškić M, Perinić-Gržić R, Vukovojac S, Rajić Z, Kuna T, et al. Evaluation of craniometric methods for determination of vertical dimension of occlusion. *Coll Antropol.* 2000; 24(Suppl 1):31–5.
14. Helal MA, Hassan AH. Evaluation of lower facial heights as related to different anthropometric measurements in dentate and completely edentulous subjects. *Quintessence Int.* 2016; 47(1):51–60.

---

Received: 13.08.2019 • Accepted: 02.12.2019

# Antropometrijska studija kraniofacijalnih dimenzija i njihova korelacija sa vertikalnom dimenzijom okluzije u populaciji Srbije kod pacijenata sa očuvanom denticijom

Nikola Živković, Pavle Nikolić, Jovana Kuzmanović Pfićer, Mirjana Perić, Aleksandra Milić Lemić

Univerzitet u Beogradu, Stomatološki fakultet, Beograd, Srbija

## KRATAK SADRŽAJ

**Uvod** U kliničkim uslovima vertikalna dimenzija okluzije (VDO) definiše se kao rastojanje gde je jedna tačka lokalizovana iznad, a druga ispod nivoa usana, kada su zubi u maksimalnoj interkuspidaciji. Kao posledica gubitka zuba usled atricije, abrazije, odnosno neuspješnih stomatoloških intervencija VDO se menja i ne utiče samo na estetski izgled donje trećine lica već i na funkciju mastikatornog aparata.

Cilj ovog rada bio je da se utvrdi povezanost vrednosti VDO i kraniometrijskih dimenzija kod pacijenata sa intaktnom denticijom.

**Materijal i metode** Ispitivanje je sprovedeno na Klinici za Stomatološku protetiku Univerziteta u Beogradu i trajalo je od oktobra 2018. do marta 2019. godine. Ispitanici su bili muškog i ženskog pola, prosečne starosti između 22 i 24 godine, I skeletne klase i intaktne denticije.

Dvanaest kraniometrijskih linija je izmereno korišćenjem specijalno izrađenog šestara. Priključeni rezultati su analizirani u kompjuterском programu SPSS 22. Prosek i standardna devijacija su korišćeni za deskripciju podataka, a Spirmanova korelacija za utvrđivanje povezanosti između parametara.

**Rezultati** Rezultati su pokazali statistički značajnu povezanost kraniometrijskih linija kod osoba oba pola. Uočena je skladnost lica ispitanika, i mogućnost analize lica po trećinama. Pokazana je korelacija srednje jačine između donje trećine lica i veličine uveta. Takođe je zapažena korelacija donje trećine lica i bipupilarne linije jer je uočeno da se pri povećanju rastojanja bipupilarne linije povećavala i vrednost donje trećine lica. Statistička značajnost u rezultatima među polovima je uočena kada su u pitanju srednja visina lica ( $p = 0,006$ ), donja visina lica/vertikalna, dimenzije okluzije ( $p = 0,004$ ), širine nosa ( $p = 0,01$ ), Frankfurtske horizontale ( $p = 0,008$ ), visine desnog uveta ( $p = 0,000$ ).

**Zaključak** Dobijeni rezultati su pokazali da postoji korelacija VDO i kraniometrijskih dimenzija među pacijentima mlađe životne dobi sa intaktnom denticijom.

**Ključne reči:** vertiklana dimezija okluzije; kraniometrijska analiza; antropometrijske mere

## UVOD

Vertikalna dimenzija okluzije (VDO) definiše se kao donja visina lica, koja se meri između dve tačke kada su maksilarni i mandibularni zubi u interkuspidaciji [1]. Ona je promjenjiva tokom života zbog sinergističnog delovanja fizioloških i patoloških faktora. Tokom procesa mastikacije kao posledica mastikatornih sila količina gleđi se postepeno smanjuje i to oslikava fiziološki proces atricije zuba [2]. S druge strane, ukoliko se javе patološke lezije zuba kao što su abrazija, erozija i abfrakcija, VDO će se bez sumnje smanjiti, iako tokom života dolazi do kompenzatornog mehanizma stvaranja slojeva cementa zuba [2]. VDO zahteva ponovno uspostavljanje kod obimnih protetskih intervencija.

Među najčešćim tehnikama određivanja VDO su fiziološka (bazirana na fiziološkom položaju mirovanja), fonetska i kefalometrijska [1, 2]. Kako se nijedna od navedenih tehnika nije pokazala dovoljno pouzdanom i preciznom, ne bi ih trebalo koristiti pojedinačno [1–6].

Tarner i Foks su preporučili da se VDO određuje u odnosu na spoljašnji izgled lica, uzimajući u obzir nazolabijalne brazde, skladnost donje trećine sa ostalim trećinama lica i godine pacijenta [2].

Vilis je pokazao da je rastojanje između spoljašnjeg ugla oka do labijalne komisure jednak rastojanju merenom od baze nosa do brade, i unapredio Vilisov merač za ovu vrstu merenja [2]. Najčešće korišćen metod je položaj fiziološkog mirovanja, iako su mnogi autori potvrdili da on zavisi od brojnih faktora – položaja glave, emocionalnog stanja pacijenta, doba dana,

prisutnosti ili odsustva zuba, odnosno dnevnih i noćnih parafunkcija [1, 2].

VDO treba da zadovolji pacijentove estetske, biomehaničke i funkcionalne potrebe. U kliničkim uslovima pri izradi proteza, potpunoj implantatno-podržanoj rehabilitaciji neophodno je pravilno i ponovno uspostavljanje VDO i obezbeđivanje potpore gornjoj usni promenom položaja frontalnih zuba u gornjoj vilici [2].

Cilj ovog istraživanja je bio da se utvrdi povezanost vrednosti VDO i kraniometrijskih dimenzija kod pacijenata sa intaktnom denticijom.

Nulta hipoteza je bila da postoji značajna korelacija između VDO i pojedinih kraniometrijskih linija.

## MATERIJAL I METODE

Studija preseka je sprovedena na Klinici za stomatološku protetiku Univerziteta u Beogradu u periodu od oktobra 2018. do februara 2019. godine. Analize su urađene kod pacijenata mlađe životne dobi u rasponu od 22 do 24 godine, koji su zadovoljavali uslove studije. Ispitanici muškog pola obuhvatili su 45,71%, a ženskog 54,29% testiranih osoba.

U istraživanje su uključeni pacijenti životne dobi 19–25 godina koji prethodno nisu bili povrgnuti ortodontskoj ili hirurškoj terapiji na vilicama, koji su imali intaktnu denticiju i I skeletnu klasu, bez uočenih lezija nekarijesne etiologije (obimne abrazije, erozije i abfrakcije zuba), pacijenti bez vidljivih asimetrija lica (povreda, malformacija, otoka) i pacijenti

bez miofajalnih bolova i bez znakova temporomandibularnih disfunkcija.

Tokom merenja je korišćeno dvanaest kraniometrijskih linija, uključujući i VDO. Merenje je realizovano specijalno konstruisanim šestarom. Pacijentima je bilo objašnjeno da sede uspravno, sa pogledom usmerenim napred i paralelno sa podom. Analizirane su sledeće kraniometrijske linije: gornja visina lica (GVS), srednja visina lica (SVS), donja visina lica (DVS), visina lica (VL), rastojanje između zigoma (Zyg-Zyg), interpupilarno rastojanje (IR), unutrašnje rastojanje očiju (URS), širina desnog oka, rastojanje između goniona (Go-Go), širina usta, širina nosa, Frankfurtska horizontala i visina desnog uha (Slika 1).

VDO je određena merenjem rastojanja između dve tačke, jedne obeležene na najprominetnijem delu nosa, a druge na vrhu brade. Imajući u vidu njenu verodostojnost, vrednosti su merene dva puta, a merenje su realizovala dva istraživača.

1. GVL (gornja trećina lica) – rastojanje mereno od kosmatog dela glave do korena nosa
2. SVL (srednja trećina lica) – rastojanje mereno od korena nosa do baze nosa
3. DVL(VDO) – rastojanje mereno od najprominentnije tačke na nosu do najprominentnije tačke na bradi
4. ZYG-ZYG – rastojanje mereno od najispupčenijeg mesta na zigomatičnoj kosti sa desne i leve strane
5. BIP linija – rastojanje mereno između dve papile, merene dok pacijent gleda pravo sa okluzalnom linijom, koja je paralelna sa podom
6. URO (unutrašnje rastojanje očiju) – rastojanje mereno između dva unutrašnja ugla očiju, dok pacijent gleda pravo
7. Širina desnog oka – rastojanje između spoljašnjeg i unutrašnjeg ugla desnog oka
8. Go-Go (gonion-gonion) – rastojanje mereno između najprominentnije tačke u donjoj trećini ramusa sa desne i leve strane
9. Širina usta – rastojanje mereno od desnog do levog ugla usne
10. Širina nosa – rastojanje mereno između desnog i levog nosnog krilca
11. Frankfurtska horizontala – rastojanje mereno između tragusa i spoljašnjeg ugla desnog oka
12. Visina uveta – rastojanje mereno od baze do vrha desnog uveta

Dobijeni rezultati su statistički obrađeni u kompjuterском programu SPSS22. Prosek i standardna devijacija su korišćeni radi deskripcije podataka. T-test i Men-Vitnijev test su korišćeni radi poređenja ispitivanih grupa. Spirmanova korelacija je korišćena za utvrđivanje povezanosti između korišćenih parametara.

## REZULTATI

Dobijeni rezultati su prikazani u Tabeli 1.

Rezultati su pokazali skladnost dimenzija facijalnih trećina kod testiranih osoba oba pola. Iako su facijalne proporcije bile nešto veće među muškim ispitanicima, skladnost trećina lica uočena je kod svih ispitnika. Statistička značajnost između

polova je uočena kod SVS ( $p = 0,006$ ), DVS ( $p = 0,004$ ), širine nosa ( $p = 0,01$ ), Frankfurtske horizontalale ( $p = 0,008$ ) i visine uha ( $p = 0,000$ ). Umerena korelacija između polova je uočena između DVS i bipupilarnog rastojanja ( $p = 0,04$ ), kao i između VDO i visine desnog uha kod oba pola ( $p = 0,004$ ). Veličina desnog uha je imala pozitivnu korelaciju među ispitanicima ženskog pola. S druge strane, pokazana je pozitivna korelacija između VDO i URO ( $p = 0,04$ ), kao i donje trećine lica i širine usana ( $p = 0,06$ ). Pokazana je korelacija gornje i srednje visine lica, jer se sa povećanjem jednog parametra povećavao i drugi.

Korišćenjem Pirsonove korelacijske uočena je statistički značajna povezanost između VDO i bipupilarne linije ( $p = 0,44$ ), pozitivnog smera, što znači da se povećanjem vrednosti jednog parametra povećava vrednost drugog. Takođe, Pirsonova korelacija je pokazala pozitivnu umerenu povezanost VDO i visine desnog uha kod ispitnika oba pola ( $p = 0,004$ ). Između VDO i širina nosa je isto tako uočena pozitivna korelacija ( $p = 0,031$ ). Ipak, VDO i širina usta nisu bili u pozitivnoj korelaciji ( $p = 0,325$ ).

## DISKUSIJA

Dobijeni rezultati ovog istraživanja su pokazali da kod mladih osoba sa intaktnom denticijom postoji korelacija između VDO i kraniofacijalnih dimenzija. Uočena je pozitivna korelacija između VDO i visine desnog uha kod oba pola, kao i između VDO i bipupilarne linije. Dobijene vrednosti SVL su saglasne sa rezultatima do kojih su došli *Budai* i saradnici [8].

Odarvana metodologija se pokazala prikladnom jer je ponovljiva, neinvazivna, laka za upotrebu i jeftina. S druge strane, u odnosu na neke kompjuterske metode može biti nepreciznija u lociranju određenih tačaka, ali i merenju odabranih kraniofacijalnih linija u ovom istraživanju.

Slične rezultate, kao u ovom istraživanju dobili su *Majeed* i saradnici [4]. Oni su pokazali jaku pozitivnu korelaciju između *ehokantion* leve labijalne komisure i medijalnog zida desnog spoljašnjeg ušnog kanala i VDO kod oba pola. S druge strane, visina ušne školjke je imala pozitivnu korelaciju kod ženskih ispitnika.

Nalazi ovih istraživanja su potvrdili korelaciju između rastojanja nosa i uha sa VDO, pa se nulta hipoteza može prihvatiti jer postoji korelacija između VDO i pojedinih kraniometrijskih linija [4].

Imajući u vidu da je istraživanje sprovedeno među mladim pacijentima, gde VDO nije bila smanjena, dobijeni rezultati se ne bi mogli koristiti kod bezzubih pacijenata, čija je VDO ugrožena i zahteva ponovno uspostavljanje [2]. Zato je neophodno naglasiti da VDO predstavlja kritičnu tačku protetske terapije, a određivanje međuviličnih odnosa važnu fazu i često izazov brojnih stomatologa u kliničkoj praksi [2, 4].

Iako je uočena pozitivna korelacija između vrednosti VDO i visine desnog uha, neophodna su dalja istraživanja i praćenja svakog pojedinačnog slučaja kako bi se registrovalo kako odabrani parametri i njihove dimenzije utiču jedni na druge.

Pojedini istraživači smatraju da je neophodno ustanoviti povezanost između kraniofacijalnih linija i VDO, kako bi se ovakva metoda uvela u svakodnevnu stomatološku praksu, jer je koncept VDO česta tema diskusije u literaturi [9, 10, 11]. Pojedini istraživači su u analizama koristili rastojanje između

dva oka u cilju koreliranja rastojanja između brade i nosa [12, 13]. U ovim istraživanjima ova povezanost nije uočena.

Neadekvatno uspostavljanje visine donje trećine lica značajno ugrožava kako estetiku tako i funkciju stomatognatnog sistema [7, 12]. Korišćena metodologija je ponovljiva, jeftina i neinvazivana za upotrebu, i može da se koristi u brojnim istraživanjima nezavisno od pola i nacionalnosti [3, 14]. Dodatno ograničenje ovog istraživanja je u tome što je spovedeno samo na jednoj etničkoj grupi (Evropskim belcima) u srpskoj populaciji, pa je teško ove rezultate koristiti za neka druga poređenja.

Primena kompjuterske analize, po mišljenju brojnih autora, ukazala je na daleko preciznije i pouzdanije nalaze u poređenju

sa drugim korišćenim metodama [3, 5, 8, 10, 11]. Izlaganje zračenju pacijenata korišćenjem telerendgenskih snimaka kod kefalometrijskih metoda može biti problem, ali bi se zbog izuzetne preciznosti moglo razmotriti.

## ZAKLJUČAK

Dobijeni rezultati su pokazali da postoji korelacija između kraniometrijskih dimenzija i VDO kod osoba oba pola sa intaktnom denticijom. Pronalaženje pouzdane dimenzije na licu može biti od koristi praktičarima, tokom obimnih intervencija koje su skopčane sa promenom i ponovnim uspostavljanjem VDO.

# Biological complications of the cement-retained implant-supported restorations

Minja Miličić Lazić<sup>1</sup>, Milica Jakšić<sup>2</sup>, Ana Todorović<sup>1</sup>, Igor Đorđević<sup>1</sup>, Vojkan Lazić<sup>1</sup>

<sup>1</sup>University of Belgrade, School of Dental Medicine, Clinic of Prosthodontics, Belgrade, Serbia;

<sup>2</sup>University of Belgrade, School of Dental Medicine, Department of Biology and Human Genetics, Belgrade, Serbia

## SUMMARY

Dental cements have been established in practice since 1878, and technological advances in the field of implant prosthetics have directly influenced the development of materials in this area. Although the retention type of implant-supported restorations can be dual, it is nowadays known that the overall rate of technical complications is higher for cement-retained restorations by 2% over screw-retained restorations. Biological complications, including peri-implant mucositis, periimplantitis, bone loss around implants, soft-tissue recession and fistula suppuration, are also more frequent with cement-retained restorations. The most common of these, periimplantitis is often related to factors depending on a clinician.

**Keywords:** cement-retained implant crown; cement volume; dental cement; luting cement application; periimplantitis

## INTRODUCTION

Prosthetic components of implant restorations represent transmucosal part of the implant and replace the missing crown of the tooth. An important decision in implant prosthetics is the choice of retention of definitive prosthetic restoration on implant abutment. The crown may be retained by screw or cement. The main advantage of screw retention is retrievability in the case of complications, and the possibility to return it to function after repair of the problem. The disadvantages of this type of retention are: technically demanding procedure, more expensive, inability to compensate extreme divergence of the implant and abutment axis, and requirement that the screw hole should be on the occlusal surface of posterior teeth and lingual surface of anterior teeth [1, 2].

On the other hand, cementation of permanent implant crown is widespread primarily because due to the simple process of fixing dental restorations on implants and the fact that cement materials have been present in dental practice for over a hundred years.

Wismeijer and Wittneben indicated that high rate of clinical success in working with cement-retained crowns correlates with proper adherence to indications (single crowns or small bridges, situations where the interarch space is higher than 7mm, when a screw-retained crown would decrease the aesthetics and in case of narrow-diameter implant crowns on which the screw opening would compromise the occlusal contact pattern) [3, 4]. Data from the literature indicate that the occurrence of biological complications, such as periimplantitis with the presence of fistula, resulting from residual cement, is 2.2% higher in cement-retained crowns compared to screw re-

tention [5]. Some authors suggest the benefits of cement retention [6-8]. Primarily, a more passive fit of casting (given the fact that cement can fill micro irregularities and act as a sort of "shock absorber"). On the other hand, the ideal fit of prosthetic components of screw-retained reconstructions must exist because this ensures that the fastening screw doesn't loose or, even worse, breaks due to cyclic fatigue [9-11]. Additional advantages of cement retention are enhanced aesthetics, improved load direction, simplicity of processing and cost-effectiveness [12].

The frequency of biological complications in cement-retained restorations requires the analysis of the specificity of implants restorations in comparison to the restorations of natural teeth. At the same time, these specifics provide the answer to the question of more common complications caused by excessive cement in fixed implant prosthetics. Similarities in the anatomy of the supporting tissues of implants and teeth relate primarily to the free gingival margin, which forms keratinized epithelium that fills the area to the bottom of the gingival sulcus. The differences are related to the tissue that is apically from the bottom of the gingival sulcus. The junctional epithelium of the natural tooth is less permeable and has greater ability to regenerate unlike the junctional epithelium surrounding the implant. The fiber bundles around the natural tooth are oriented in multiple directions, while the fiber bundle surrounding the implant have horizontal-circular orientation [13]. Such structure of peri-implant tissues allows easier penetration of both microorganisms and various environmental agents [13].

The aim of this paper was to show, through literature analysis, direct connection between the occurrence of biological complications and parameters related to the

choice of cement (type, quantity and cementing technique). A literature search was performed in MEDLINE. Forty-one original scientific papers were analyzed. The fact that clinical practice has faced with higher incidence of biological complications with cement-retained crowns led to enriched electronic base related to periimplantitis and cement dependent factors in the past decade.

### **Cement as a risk factor for the occurrence of biological complications**

The analyzed papers showed multifactorial influence of cement on the development of complications. Periimplantitis occurs as a result of biological interaction of the body with the cement material [14–17]. For easier evaluation of the results, the etiology of the problem is explained through three parameters: type and quantity of cement, as well as cementing technique.

#### *Type of cement*

Basic physical features that directly indicate the retention strength of prosthetic crown to implant abutment are compressive and tensile strength, expressed in mega-Pascal (MPa). The well-known strength values divide cements into provisional, semi-permanent and permanent [18]. The main advantage of the temporary cements is easier removal of the crown in the case of technical complications (usually fracture of porcelain veneer) [18]. However, when selecting the type of temporary cement, clinicians are facing the challenge of which cement to prioritize?

Lee JH et al. [19] found that acrylic-urethane polymer based temporary cement for implant luting cement cause a significantly higher inflammatory response in peri-implant soft tissue in comparison to conventional zinc oxide eugenol cements. Methacrylate resins represent better substrate for biofilm formation, showing greater number of oral pathogenic bacteria in the residual material of the peri-implant sulcus. In addition, the research of Korsch et al. [20, 21] demonstrated an intensive antimicrobial effect of zinc oxide and eugenol, with a dominant inhibitory effect on bacterial growth and development. Zinc oxide based cements are soluble in tissue fluids, unlike cements based on acrylic-urethane polymer (MMA), so that all extra material can be resorbed over time [22].

Limitations of the use of temporary cements are related to bridge constructions on implants. Low values of compressive strength of luting materials may cause the structure to become unfastened by loosening connection on one of the anchoring implant while the retention strength remains non changed on the other abutment. That is how Implant Bridge becomes a lever that tends to rotate around the fulcrum. In this case, it is an implant on which the crown is firmly cemented. Problems may arise if this condition lasts longer period. The compression forces, which are converted around the implant acting as a fulcrum can cause traumatic bone loss [23].

On the other hand, permanent cements have found wide application in implant prosthetics. Numerous papers indicate a detrimental effect of residual cement in

peri-implant tissue [24–27]. The effect of residual cement on the soft tissues around the implant may vary. It is reflected in the inflammatory response of the body around the foreign substrate as well as the fact that residual material is good substrate for bacterial colonization [24–27].

Titanium alloys belong to the group of biocompatible materials due to their passivation potential, ie. ability to form an oxide layer on the metal surface [28]. Decomposition of the oxide layer can occur under the influence of various environmental agents. The authors especially mentioned glass ionomer and polycarboxylate cements [28, 29, 30]. Fluoride ions released from these cements tend to destabilize the oxide layer. Decomposition of the protective oxide layer increases the corrosion potential of the metal. The local corrosion effect depends on the concentration of fluoride ions and the length of time they are released from cement [31]. Resin-reinforced glass ionomer cements releases fluoride at a higher concentration than conventional glass ionomer cements. The consequence of degradation of titanium oxide and the occurrence of corrosion is most often an aesthetic problem in the form of soft tissue discoloration [31].

#### *Quantity of luting agent*

The amount of implant luting cement film required to provide good retention is defined by the space between the axial abutment walls and the interior of the implant crown. When there is a corresponding size of prosthetic components, crowns, and abutments, the average values of this space are 25–40 microns [32]. One of the advantages of cement retention over screw retention is the ability of cement to fill the micro-gap between the superstructure and the crown. However, in this case, the exposed cement can be good substrate for bacterial colonization, and the inaccurate alignment of the crown edge to the marginal edge of the superstructure creates an anaerobic environment ideal for microorganism growth [32].

Any variations in the amount of cement required to provide adequate retention force may result in early or late complications. Excessive amount of prosthetic fixation material can lead to: inaccurate attachment of the crown due to abundant cement, supraocclusal crown position, or extrusion of excess material into the peri-implant tissue. On the contrary, insufficient cement leads to reduced retention [33].

#### *Prevention of biological complications through cementing techniques*

Cementing technique represents the clinical application of the material during the process of fixation of the crown on an abutment. A clinician should perform the procedure that will ensure optimal quantity of material inside the crown and prevent excessive extrusion. Due to the fact that cements belong to the group of low viscous fluids, Wadhwani [34] gives recommendations for working with cement materials through an experimental presentation. The specificity of cement as a fluid is that being different from water, it has different flow pressure. The viscosity-

ty coefficient of the material decreases with increasing pressure. It is important to be aware of this characteristic when working with materials. Also, the speed at which the crown is seated affects the cement flow. It is best not to seat the crown too rapidly and in vibrating manner, thus allowing the cement to penetrate perpendicularly at the length of the axial wall crowns and abutments in occlusal direction, filling in a uniform space between the prosthetic components [34].

One of the main indicators of clinical success in implant prosthetics is certainly the cementing process itself. In recent years, much attention has been paid to cementing techniques. Researchers [35–39] have made suggestions for various practical methods to achieve the most favorable amount of cement. One possibility of quantitative verification of the luting material necessary for fixing the crown to the superstructure is the method of using laboratory abutment described by Dumbrigue et al. [36]. The process is based on the controlled application of the material with a brush to the retaining walls towards the shoulder area immediately before cementing. Upon insertion of the material into the crown, the laboratory abutment is extraordinarily applied. The cement flows along the axial walls to the occlusal space and extends beyond the crown so that the excess remains on the laboratory abutment itself, and exactly enough material required for cementing is left behind in the crown margin.

An identical procedure can be performed if a copy of the abutment is made of vinylpolysiloxane material [37]. The interior of the crown is isolated with polytetrafluoroethylene tape. Then an elastic impression material is applied to the crown. While the material is still not set, a rigid post is placed in the impression material, which is intended to serve as a future abutment replica carrier. After the material is hardened, the following procedure is identical to that used in the application of fabricate laboratory abutment. To reduce the excess of material into the peri-implant tissue, some authors suggest to use a separating agent in the form of a polytetrafluoroethylene tape or to apply a layer of petroleum jelly on the transmucosal surface of the abutment before cementation and remove of the same after the procedure is finished [38].

Finally, clinical success is also influenced by the design of the abutment itself. The potential for the occurrence of biological complications in cement-retained crowns is greater if subgingival localization of the crown edge is more apically positioned [39, 40]. When the marginal edge of the abutment shoulder is positioned deeper than 2 mm below the free gingival margin, the conditions for controlling extruded material in the soft tissues and removing the excess are more difficult. It is recommended to use customized instead of fabric-designed abutment [41].

In conclusion, ideal cement could be characterized as luting material for fixing the prosthetic components strong enough to ensure balance between good retention of the crown and convenient retrievability if needed.

## REFERENCES:

- Gómez-Polo M, Ortega R, Gómez-Polo C, Celemín A, Del Rio Highsmith J. Factors Affecting the Decision to Use Cemented or Screw-Retained Fixed Implant-Supported Prostheses: A Critical Review. *Int J Prosthodont*. 2018; 31(1):43–54.
- Sherif S, Susarla HK, Kapos T, Munoz D, Chang BM, Wright RF. A systematic review of screw versus cement-retained implant-supported fixed restorations. *J Prosthodont*. 2014; 23(1):1–9.
- Wismeijer D, Brägger U, Evans C, Kapos T, Kelly JR, Millen C, et al. Consensus statements and recommended clinical procedures regarding restorative materials and techniques for implant dentistry. *Int J Oral Maxillofac Implants*. 2014; 29 Suppl:137–40.
- Wittneben JG, Joda T, Weber HP, Brägger U. Screw retained vs. cement retained implant-supported fixed dental prosthesis. *Periodontol 2000*. 2017; 73(1):141–51.
- Wittneben JG, Millen C, Brägger U. Clinical Performance of Screw-Versus Cement-Retained Fixed Implant-Supported Reconstructions: A Systematic Review. *Int J Oral Maxillofac Implants*. 2014; 29(Suppl):84–98.
- Michalakis K, Hirayama H, Garefis P. Cement retained versus screw-retained implant restorations: A critical review. *Int J Oral Maxillofac Implants*. 2003; 18(5):719–28.
- Lee A, Okayasu K, Wang HL. Screw- Versus Cement-Retained Implant Restorations: Current Concepts. *Implant Dent*. 2010; 19(1):8–15.
- Longoni S, Sartori M, Maroni I, Baldoni M. Intraoral luting: modified prosthetic design to achieve passivity, precision of fit, and esthetics for a cement-retained, implant-supported metalresin-fixed complete denture. *J Prosthodont*. 2010; 19(2):166–70.
- Bashutski JD, Wang HL. Common implant esthetic complications. *Implant Dent*. 2007; 16(4):340–8.
- Tosches NA, Brägger U, Lang NP. Marginal fit of cemented and screw-retained crowns incorporated on the Straumann (ITI) Dental Implant System: an in vitro study. *Clin Oral Implants Res*. 2009; 20(1):79–86.
- Keith SE, Miller BH, Woody RD, Higginbottom FL. Marginal discrepancy of screw-retained and cemented metal-ceramic crowns on implants abutments. *Int J Oral Maxillofac Implants*. 1999; 14(3):369–78.
- Hebel KS, Gajjar RC. Cement-retained versus screw-retained implant restorations: achieving optimal occlusion and esthetics in implant dentistry. *J Prosthet Dent*. 1997; 77(1):28–35.
- Michael N, Takei H, Klokkevold P, Carranza FA. Carranza's Clinical Periodontology, 10th ed, Elsevier Health Sciences, 2006.
- Burbano M, Wilson TG Jr, Valderrama P, Blansett J, Wadhwanji CP, Choudhary PK, et al. Characterization of Cement Particles Found in Peri-implantitis-Affected Human Biopsy Specimens. *Int J Oral Maxillofac Implants*. 2015; 30(5):1168–73.
- Staubli N, Walter C, Schmidt JC, Weiger R, Zitzmann NU. Excess cement and the risk of periimplant disease - a systematic review. *Clin Oral Implants Res*. 2017; 28(10):1278–90.
- Kotsakis GA, Zhang L, Gaillard P, Raedel M, Walter MH, Konstantinidis IK. Investigation of the Association Between Cement Retention and Prevalent Peri-Implant Diseases: A Cross-Sectional Study. *J Periodontol*. 2016; 87(3):212–20.
- Garzon H, Camilo A, Camilo T, Johana C, Javier C, Jefferson C, et al. Relationship Between Dental Cement Materials of Implant-Supported Crowns with Periimplantitis Development in Humans: A Systematic Review of Literature. *J Long Term Eff Med Implants*. 2018; 28(3):223–32.
- Wolfart S. *Implant Prosthodontics: A Patient-Oriented Strategy*. 1st ed. St. Louis, 2016.
- Lee JH, Yang SE, Lee J, Lee SY. Influence of Luting Materials and Methods and the Restoration Surface on the Amount of Cement Remnants in Implant Restorations. *J Oral Implantol*. 2019; 45(4):301–7.
- Korsch M, Walther W. Peri-Implantitis Associated with Type of Cement: A Retrospective Analysis of Different Types of Cement and Their Clinical Correlation to the Peri-Implant Tissue. *Clin Implant Dent Relat Res*. 2015; 17 Suppl 2:e434–43.

21. Korsch M, Robra BP, Walther W. Predictors of excess cement and tissue response to fixed implant-supported dentures after cementation. *Clin Implant Dent Relat Res.* 2015; 17 Suppl 1:e45–53.
22. Flanagan D. Zinc phosphate as a definitive cement for implant-supported crowns and fixed dentures. *Clin Cosmet Investig Dent.* 2017; 9:93–7.
23. Frisch E, Ratka-Krüger P, Weigl P, Woelber J. Minimizing excess cement in implant-supported fixed restorations using an extraoral replica technique: a prospective 1-year study. *Int J Oral Maxillofac Implants.* 2015; 30(6):1355–61.
24. Quaranta A, Lim ZW, Tang J, Perrotti V, Leichter J. The Impact of Residual Subgingival Cement on Biological Complications Around Dental Implants: A Systematic Review. *Implant Dent.* 2017; 26(3):465–74.
25. Linkevicius T, Puisys A, Vindasiute E, Linkeviciene L, Apse P. Does residual cement around implant-supported restorations cause peri-implant disease? A retrospective case analysis. *Clin Oral Implants Res.* 2013; 24(11):1179–84.
26. Ivanovski S, Lee R. Comparison of peri-implant and periodontal marginal soft tissues in health and disease. *Periodontol 2000.* 2018; 76(1):116–30.
27. Renvert S, Polyzois I. Risk indicators for peri-implant mucositis: a systematic literature review. *J Clin Periodontol.* 2015; 42 Suppl 16:S172–86.
28. Huang HH. Effects of fluoride concentration and elastic tensile strain on the corrosion resistance of commercially pure titanium. *Biomaterials.* 2002; 23(1):59–63.
29. Noguti J, de Oliveira F, Peres RC, Renno AC, Ribeiro DA. The role of fluoride on the process of titanium corrosion in oral cavity. *Biometals.* 2012; 25(5):859–62.
30. Wadhwani CP, Piñeyro AF. Implant cementation: clinical problems and solutions. *Dent Today.* 2012; 31(1):56–62.
31. Horasawa N, Marek M. Effect of fluoride from glass ionomer on discoloration and corrosion of titanium. *Acta Biomater.* 2010; 6(2):662–6.
32. Nawafleh NA, Mack F, Evans J, Mackay J, Hatamleh M. Accuracy and Reliability of Methods to Measure Marginal Adaptation of Crowns and FDPs: A Literature Review. *J Prosthodont.* 2013; 22(5):419–28.
33. Wadhwani C, Hess T, Piñeyro A, Opler R, Chung KH. Cement application techniques in luting implant-supported crowns: a quantitative and qualitative survey. *Int J Oral Maxillofac Implants.* 2012; 27(4):859–64.
34. C.P.K. Wadhwani (ed.), *Cementation in Dental Implantology: An Evidence-Based Guide,* 15 © Springer-Verlag Berlin Heidelberg 2015.
35. Liang T, Hu X, Zhu L, Pan X, Zhou Y, Liu J. Comparative in vitro study of cementing techniques for implant-supported restorations. *J Prosthet Dent.* 2016; 116(1):59–66.
36. Dumbrigue HB, Abanomi AA, Cheng LL. Techniques to minimize excess luting agent in cement-retained implant restorations. *J Prosthet Dent.* 2002; 87(1):112–4.
37. Rayyan MM, Makarem HA. A modified technique for preventing excess cement around implant supported restoration margins. *J Prosthet Dent.* 2016; 116(6):840–2.
38. Hess TA. A technique to eliminate subgingival cement adhesion to implant abutments by using polytetrafluoroethylene tape. *J Prosthet Dent.* 2014; 112(2):365–8.
39. Sancho-Puchades M, Crameri D, Özcan M, Sailer I, Jung RE, Hämerle CHF, et al. The influence of the emergence profile on the amount of undetected cement excess after delivery of cement-retained implant reconstructions. *Clin Oral Implants Res.* 2017; 28(12):1515–22.
40. Agar JR, Cameron SM, Hughbanks JC, Parker MH. Cement removal from restorations luted to titanium abutments with simulated subgingival margins. *J Prosthet Dent.* 1997; 78(1):43–7.
41. Long L, Alqarni H, Masri R. Influence of implant abutment fabrication method on clinical outcomes: a systematic review. *Eur J Oral Implantol.* 2017; 10 Suppl 1:67–77.

---

Received: 02.09.2019 • Accepted: 02.12.2019

# Biološke komplikacije cementom retiniranih nadoknada na implantatima

Minja Miličić Lazić<sup>1</sup>, Milica Jakšić<sup>2</sup>, Ana Todorović<sup>1</sup>, Igor Đorđević<sup>1</sup>, Vojkan Lazić<sup>1</sup>

<sup>1</sup>Univerzitet u Beogradu, Stomatološki fakultet, Klinika za stomatološku protetiku, Beograd, Srbija;

<sup>2</sup>Univerzitet u Beogradu, Stomatološki fakultet, Odeljenje za humanu genetiku, Beograd, Srbija

## KRATAK SADRŽAJ

Materijali za fiksiranje zubnih protetskih nadoknada utemeljeni su u stomatološkoj praksi od 1878. godine, a tehnološki napredak na polju implant-protetike direktno je uticao i na razvoj materijala u ovoj oblasti.

Iako mehanizam vezivanja fiksnih nadoknada može biti dvojak, danas se zna da je ukupna stopa tehničkih komplikacija veća kod cementno retiniranih nadoknada za 2% u odnosu na retenciju šrafom. Biološke komplikacije u koje se ubrajam periimplantatni mukozitis, periimplantitis, gubitak kosti oko implantata, recesija mekih tkiva i pojava fistule, takođe su učestalije kod cementno retiniranih zubnih nadoknada. Najzastupljenija među njima, periimplantitis, često se dovodi u vezu sa „lekar-zavisnim“ parametrima.

**Ključne reči:** cementi; implant-protetika; biološke komplikacije

## UVOD

Protetske komponente predstavljaju transmukozni deo implantata i nadoknađuju nedostajući krunični deo zuba. Važna odluka u implant-protetici je izbor tipa retencije definitivne zubne nadoknade na abatmentima. Kruna može biti retinirana zavrtnjem ili cementom. Osnovna prednost retencije šrafom jeste mogućnost da kliničar ukloni nadoknadu u slučaju pojave komplikacije, i da naknadno istu vrati u funkciju po saniranju problema. Nedostaci ovakvog vida retencije su: tehnički zahtevan postupak, skuplja izrada nadoknade, nemogućnost kompenzacije izrazite divergencije ose implantata i ose abatmenta, i zahtev da otvor za zavrtanj mora biti u nivou okluzalne površine bočnih zuba i oralne površine prednjih zuba [1, 2].

S druge strane, postupak cementiranja je široko rasprostranjen, pre svega zbog jednostavnog postupka fiksiranja zubnih nadoknada na implantatima i činjenice da su cementi u stomatološkoj protetici prisutni preko sto godina.

Wismeijer i Wittneben su istakli da klinički uspeh u radu sa cementno retiniranim nadoknadama korelira sa poštovanjem indikacija za njihovu izradu (pojedinačne krune ili mostovi malog raspona, situacije kada je vertikalna dimenzija interokluzalnog prostora veća od 7 mm, situacije kada bi nadoknada retinirana šrafom ugrozila estetiku, i u slučaju kruna na implantatima uskog promera, na kojima bi otvor šrafa kompromitovao okluzalnu kontaktну šemu) [3, 4].

Podaci iz literature navode da je pojava bioloških komplikacija u vidu periimplantitisa, sa prisustvom fistule, nastalog kao posledica rezidualnog cementa, veća za 2,2% kod cementno retiniranih nadoknada u odnosu na retenciju šrafom [5]. Pojedini autori ipak sugerisu na prednosti retencije cementom [6, 7, 8]. To je, pre svega, pasivniji odnos komponenata (s obzirom na činjenicu da cement ima mogućnost da popuni mikrone slaganja i na neki način deluje kao amortizer). S druge strane, idealno naleganje protetskih komponenata kod šrafom retiniranih nadoknada mora da postoji, jer to obezbeđuje da se šraf ne olabavi ili, još nepoželjnije, polomi usled cikličnog zamora [9, 10, 11]. Dodatne prednosti cementne retencije jesu poboljšan smer opterećenja, estetika, jednostavnost izrade i ekonomičnost [12]. Pojava bioloških komplikacija kod cementno retiniranih

nadoknada zahteva analizu specifičnosti vezanih za nadoknade na implantatima u odnosu na nadoknade na prirodnim zubima. Ujedno, ove specifičnosti jesu odgovor na pitanje zbog čega su komplikacije izazvane potisnutim cementom češće u fiksnoj-implantat protetici. Sličnosti u anatomsкоj građi potpornih tkiva implantata i zuba odnose se prevashodno na predeo slobodne gingive, a čini je keratinizovani epitel koji popunjava prostor do dna gingivalnog sulkusa. Različitosti su u vezi sa tkivom koje je apikalno od dna gingivalnog sulkusa. Pripojni epitel prirodnog zuba je manje permeabilan i ima veću sposobnost regeneracije za razliku od pripojnog epitela koji okružuje implantat. Fibrozna vlakna oko prirodnog zuba su orijentisana u multiplim pravcima, dok su fibrozna vlakna koja okružuju implantat horizonlano-cirkularne orientacije [13]. Ovakva građa periimplantatnih tkiva pogoduje lakšoj penetraciji kako mikroorganizama, tako i različitim agenasa spoljašnje sredine [13].

Cilj ovog rada je da se kroz prikupljenu literaturu prikaže direktna veza između pojave bioloških komplikacija i parametara vezanih za izbor cementa (vrsta, količina i tehnika cementiranja).

Prilikom pretraživanja literature korišćena je bibliografska baza MEDLINE. Dobijen je materijal od 41 originalnog naučnog rada. Činjenica da je klinička praksa suočena sa većom incidencom bioloških komplikacija kod cementom retiniranih nadoknada na implantatima uslovila je da su se poslednjih godina obogatile elektronske baze pojmovima periimplantitis i cement-zavisni faktori.

## CEMENT KAO FAKTOR NASTANKA BIOLOŠKIH KOMPLIKACIJA

Analizirani radovi pokazali su multifaktorijski uticaj cementa na razvoj komplikacija. Periimplantitis nastaje kao rezultat biološke interakcije organizma sa materijalom za fiksiranje nadoknada na implantatima [14–17]. Radi lakše evaluacije rezultata, etiologija nastanka problema objašnjena je kroz tri parametra – vrstu i količinu cementa, kao i samu tehniku cementiranja.

## Vrsta cementsa

Osnovne fizičke osobine koje direktno diktiraju jačinu retencije zubne nadoknade za abatment jestu kompresivna i zatezna čvrstoća, izražene u megapaskalima. Dobro poznate vrednosti čvrstoće omogućile su podelu cemenata na privremene, uslovno trajne i trajne [18]. Autori u radu [18] kao glavnu prednost privremenih cemenata naveli su lakše uklanjanje krune u slučaju pojave tehničkih komplikacija (najčešće frakturne keramike) radi sprovođenja reparature i ponovnog vraćanja krune u funkciju. Međutim, prilikom odabira tipa privremenog cementa kliničari su suočeni sa izazovom kom cementu dati prednost [19, 20, 21].

*Jae-Hyun Lee* i sar. [19] ustanovili su da privremeni cementi na bazi uretan metakrilata-MMA izazivaju znatno veći inflamatori odgovor u periimplatnom mekom tkivu za razliku od konvencionalnih cink-oksida eugenol cemenata. Metakrilatne smole predstavljaju bolju podlogu za formiranje biofilma, pokazujući veći broj oralnih patogenih bakterija u zaostalom materijalu periimplatnog sulkusa. U prilog ovome govori i istraživanje *Korsch* i sar. [20, 21], koji su dokazali izrazito antimikrobrovo dejstvo cink-oksida i eugenola, sa dominantnim inhibišućim efektom na rast i razvoj bakterija. Cementi na bazi cink-oksida su rastvorljivi u prisustvu tkivnih tečnosti, za razliku od cemenata na bazi elastomernih smola (MMA), tako da vremenom dolazi do resorpcije viška potisnutnog materijala [22].

Ograničenja upotrebe privremenih cemenata su u vezi sa manjim višečlanim konstrukcijama na implantatima. Male vrednosti kompresivne čvrstoće ovih materijala mogu uslovit rascementiranje konstrukcije zbog popuštanja veze na jednom od nosača, dok na drugom veza retencije ostaje zadovoljavajuća. Tada most na implantatima postaje poluga koja teži da se rotira oko tačke oslonca. U ovom slučaju to je implantat na kom je kruna čvrsto vezana cementom. Problemi nastaju ako pomenuta situacija potraje duži period. Tada sile kompresije, koje se konvertuju oko implantata koji se ponaša kao tačka oslonca, dovode do gubitka kosti uzrokovanog traumom [23].

S druge strane, cementi za trajno fiksiranje zubi nadoknada našli su široku primenu u implant-protetici. Mnogobrojni radovi ukazuju na štetan efekat rezidualnog cementa u periimplatnom tkivu [24–27]. Dejstvo zaostalog cementa na meka tkiva oko implantata je dvojako. Ogleda se u inflamatornoj reakciji organizma oko stranog tela, kao i činjenici da je zaostali materijal dobra podloga za bakterijsku kolonizaciju [24–27].

Legure titana pripadaju grupi biokompatibilnih materijala zahvaljujući sposobnosti pasivizacije, tj. stvaranja oksida na površini metala [28]. Razgradnja oksidnog sloja može nastati pod uticajem različitih agenasa spoljašnje sredine. Autori posebnu pažnju posvećuju glas-jonomernim i polikarboksilatnim cementima [28, 29, 30]. Joni fluorida koji se oslobođaju iz ovih cemenata pokazuju tendenciju ka destabilizaciji oksidnog sloja. Razgradnjom zaštitnog sloja oksida povećava se korozioni potencijal metala. Lokalni efekat korozije zavisi od koncentracije jona fluora i dužine vremena za koje se oslobođaju iz cementa [31]. Smolom ojačani glas-jonomerni cementi otpuštaju fluor u većoj koncentraciji od konvencionalnih glas-jonomernih cemenata. Posledica degradacije titanijum-oksida i pojave korozije je najčešće estetski problem u vidu diskolokacije mekih tkiva [31].

## KOLIČINA CEMENTA

Količina cementnog filma neophodnog da obezbedi zadovoljavajuću retenciju definisana je prostorom između aksijalnih zidova abatmenta i unutrašnjosti zubne krunice. Kada postoji kongurentnost protetskih komponenata, krune i abatmenta, prosečne vrednosti ovog prostora su između 25 i 40 mikrona [32]. Kao jedna od prednosti cementne retencije u odnosu na retenciju zavrtnjem navodi se sposobnost cementa da popuni mikroneslaganja između suprastrukture i krunice. Međutim, u tom slučaju eksponirani cement može predstavljati dobru podlogu za bakterijsku kolonizaciju, a neprecizno naleganje ruba krune na marginalnu ivicu suprastrukture stvara anaerobnu sredinu idealnu za rast mikroorganizama [32].

Skavo odstupanje u količini cementa neophodnog da obezbedi zadovoljavajuću silu retencije može imati za posledicu rane ili kasne komplikacije. Prekomerna količina materijala za fiksiranje protetske nadoknade može dovesti do nepreciznog naleganja krune usled zarobljenog cementa u prostoru između okluzalne površine abatmenta i unutrašnjosti krune, supraokluzalnu poziciju krune ili ekstruziju viška materijala u periimplantatno tkivo. Nasuprot tome, nedovoljna količina cementa vodi ka smanjenoj retenciji [33].

## PREVENCIJA NASTANKA BIOLOŠKIH KOMPLIKACIJA KROZ TEHNIKU CEMENTIRANJA

Tehnika cementiranja predstavlja način kliničke aplikacije materijala u toku fiksiranja nadoknade na suprastrukturu. Terapeut bi trebalo da sproveđe procedure koje će osigurati optimalnu količinu materijala unutar krune, a sprečiti prekomernu ekstruziju viška. Imajući u vidu činjenicu da cementi pripadaju grupi niskoviskoznih tečnosti, *Wadhwan* [34] je kroz eksperimentalni prikaz dao preporuke za rad sa cementnim materijalima. Specifičnost cementa kao fluida je to što za razliku od vode ne pokazuje tečenje pod pritiskom koje pokazuje voda. Koeficijent viskoznosti materijala se smanjuje sa povećanjem pritiska. Ova osobina je važna za razumevanje u toku rada sa materijalom. Takođe, brzina kojom se kruna postavlja na suprastrukturu utiče na tečenje cementa. Najbolje je ne prebrzo i vibrirajućim pokretima aplikovati krunu na suprastrukturu, jer se na taj način stvara mogućnost da cement teče perpendikularno duž aksijalnih zidova krune i suprastrukture u okluzalnom pravcu popunjavajući ravnometerno prostor između protetskih komponenata [34].

Jedan od glavnih pokazatelja kliničkog uspeha u implant-protetici svakako je sam postupak cementiranja. Poslednjih godina velika pažnja usmerena je na tehnike cementiranja. Istraživači [35–39] su dali predloge za različite praktične metode kojima se može postići najpovoljnija količina cementa. Jedna mogućnost kvantitativne verifikacije cementnog materijala neophodnog za fiksiranje krune na suprastrukturu jeste metoda korišćenja laboratorijskog abatmenta koju su opisali *Dumbrigue* i sar. [36]. Postupak se zasniva na kontrolisanom nanošenju materijala četkicom na zidove nadoknade prema vratnom delu neposredno pre cementiranja. Po unošenju materijala u krunu, ekstraoralno se u nadoknadu unosi laboratorijski abatment. Cement se potiskuje uz aksijalne zidove do okluzalnog prostora i iznosi van krune tako da višak ostaje na samom laboratorijskom

abatmentu, a u čauri krune zaostaje tačno dovoljna količina materijala neophodna za cementiranje.

Identična procedura može se izvesti ako se kopija abatmenta napravi od materijala vinilpolisiloksan [37]. Unutrašnjost nadoknade se izoluje politetrafluoroetilenskom trakom. Zatim se u krunu aplikuje elastični otisni materijal. Dok je materijal još u nevezanom stanju, postavlja se kočić u otisnu masu, koji ima za cilj da posluži kao budući nosač replike abatmenta. Po vezivanju materijala, dalji postupak je identičan kao kod primene fabričkog laboratorijskog abatmenta. Da bi se smanjilo prekomerno potiskivanje viška materijala u periimplantatno tkivo, pojedini autori predlažu korišćenje separirajućeg agensa u formi politetrafluoroetilenske trake ili nanošenje sloja vazelina na transmukoznu površinu abatmenta neposredno pre cementiranja i njegovo uklanjanje posle vezivanja cementa [38].

Konačno, na uspeh u radu utiče i dizajn samog abatmenta. Mogućnost nastanka bioloških komplikacija kod cementno retiniranih nadoknada je utoliko veća ukoliko je subgingivalna lokalizacija ruba krune apikalnije pozicionirana [39, 40]. Kada je marginalna ivica ramena abatmenta postavljena dublje od 2 mm u odnosu na slobodnu ivicu gingive, uslovi za kontrolu potisnutog materijala u meka tkiva i uklanjanje viška su otežani. Preporuka je koristiti individualizovani umesto fabrički dizajniranog abatmenta [41].

U sklopu analize svega navedenog, idealni cement mogao bi da se okarakteriše kao sredstvo za fiksiranje nadoknada na implantatima sa ciljem da obezbedi ravnotežu između dobre retencije nadoknade i istovremeno stvori uslove za eventualno lakše uklanjanje u slučaju pojave komplikacija.

# Combined orthodontic-surgical approach in the treatment of impacted upper canines

Dragan Ivanović<sup>1</sup>, Slavoljub Tomić<sup>2</sup>, Lado Davidović<sup>3</sup>, Dajana Nogo-Živanović<sup>3</sup>, Tanja Ivanović<sup>1</sup>

<sup>1</sup>University of East Sarajevo, Faculty of Medicine, Department of Pediatric and Preventive Dentistry and Orthodontics, Foča, Bosnia and Herzegovina;

<sup>2</sup>University of East Sarajevo, Faculty of Medicine, Department of Oral Surgery, Foča, Bosnia and Herzegovina;

<sup>3</sup>University of East Sarajevo, Faculty of Medicine, Department of Dental Pathology, Foča, Bosnia and Herzegovina

## SUMMARY

Impacted tooth is the tooth that failed to reach occlusal level, with a growth of 2/3 of the root completed. Etiological factors of the impacted teeth are various, but the main reason is the lack of space for their eruption. The most common impacted teeth are lower wisdom teeth, then upper wisdom teeth, upper canines and lower premolars. A seventeen-year-old patient referred by a general dentist came to the clinic for an orthodontic examination. The existence of upper primary canines on both sides was revealed by clinical examination. After orthopantomography analysis, the impacted upper canines were diagnosed. The treatment plan was the extraction of primary teeth, surgical exposure of impacted teeth and orthodontic treatment using fixed orthodontic appliance. The orthodontic treatment of impacted teeth achieved excellent results. The success depends on adequate planning and teamwork of orthodontist and oral surgeon.

**Keywords:** impacted tooth; canines; orthodontic treatment; surgical treatment

## INTRODUCTION

Impacted teeth are very common and well-known orthodontic anomaly. A small number of patients seek treatment because the impaction is most commonly asymptomatic. In most cases, it is accidentally detected on the X-ray when a patient goes to the dentist for other reasons [1]. Impacted teeth are found in 1-5% of orthodontic patients [2]. The most common causes of impaction are the lack of space for eruption, ectopic position of the tooth embryo, an extended bone retention barrier or premature loss of deciduous teeth, the presence of alveolar clefts, ankylosis, neoplasia, dental or alveolar trauma, dilatation of the tooth root, the presence of an obstacle that appears in the way for growing dentition.

There are two proposed theories related to the impaction of the maxillary canines: genetical theory and theory of direction [1]. According to the first one, the impaction of the canines is associated with other anomalies: enamel hypoplasia, aplasia of premolars, hypodontia or atypical lateral incisor. According to the theory of direction, the canine emerges along the distal surface of the lateral incisor, which serves as a guide. If the root of the lateral incisor is absent or improperly placed, the canine cannot properly emerge. The maxillary canine is the second most commonly impacted tooth. The most common impacted teeth are wisdom teeth, the lower and upper ones, followed by the upper canines and premolars [3]. The prevalence of the impacted canines in upper and lower jaw ranges from 0.008 to 8.8%, while the prevalence of impacted upper ca-

nines is from 0.8 to 2.8% [4]. The impaction of the teeth is more common in females than males [5]. 8% of patients with the impaction have both sides impacted [6]. The prevalence of upper canines impaction is 10 to 20 times higher than the impaction of lower canines. The impacted canine can be positioned buccally, lingually or along the edge of the alveolar ridge. Most of the impactions have palatal direction, 85% [7]. Diagnosis of the canines impaction can be established if permanent canines are absent in patients older than 14-15 years [8]. The tooth impaction must be confirmed by an orthopantomography analysis, and in some cases a 3D image of the jaw is required, in order to obtain more details on the position of the impacted tooth and its relationship with adjacent teeth [9].

The case presented in this study received treatment of surgical exposure of impacted canine with subsequent orthodontic treatment.

## CASE REPORT

A patient (17) came in for an orthodontic examination, referred by a general practitioner. The existence of deciduous canines on both sides was revealed by the clinical examination (Figure 1 and 2). After orthopantomography analysis, bilateral impaction of upper canines was diagnosed (Figure 3). The patient was in good general health, had no prior orthodontic treatment or tooth extraction. She also denied the existence of pain in the area of the orofacial region.



**Figure 1.** Clinical presentation of the patient at the first visit to orthodontist

**Slika 1.** Klinički prikaz pacijenta u prvoj poseti kod ortodonta



**Figure 2.** Clinical presentation of the patient at the first visit to the orthodontist

**Slika 2.** Klinički prikaz pacijenta u prvoj poseti kod ortodonta



**Figure 3.** Orthopantomography

**Slika 3.** Ortopantomogram



**Figure 4.** Elevated flap and tooth crowns visible

**Slika 4.** Podignut režanj i eksponirana krunica zuba



**Figure 5.** Orthodontic treatment and bringing teeth to dental arch

**Slika 5.** Ortodontska terapija i dovođenje zuba u niz



**Figure 6.** Canines brought into dental arch

**Slika 6.** Zubi dovedeni u zubni niz

After the orthodontic examination has been completed, the patient was referred to an oral surgeon's examination. After a thorough orthopantomography analysis and 3D analysis, final diagnosis and treatment planning was established, including combined orthodontic-surgical treatment of the impacted teeth.

A fixed orthodontic appliance was set up for the patient, after oral-surgical intervention that was performed in local anesthesia. Primary canines were extracted and after removal of the bone and exposure of the teeth crowns, the traction pins for pulling impacted canines were placed (Figure 4). The wounds were washed with a physiological solution and individual stitches were placed that were finally removed 7 days later. Two days before the intervention, the patient was prescribed antibiotics (Dovicin 100 mg, 7 days) and Chymoral Forte for 5 days for faster resorption of edema and hematoma. Painkillers were used as needed.

The orthodontic treatment was based on gradual pull of the impacted teeth and their bringing to the arch (Figures 5, 6). The final treatment was to be completed after the emergence of canines, when a stable occlusion was fully achieved.

## DISCUSSION

There are various methods of treating impacted teeth: a surgical exposure and orthodontic traction, auto transplantation, surgical removal of the impacted teeth and prosthetic implantation [10]. The final choice of treatment depends on several factors, primarily on the existence of sufficient space for impacted tooth, its localization, degree of impaction, and degree of root development. In addition, general health condition of patient, teeth condition and

oral hygiene have a significant role as well as the function and occlusion [11]. In our case, the orthodontic-surgical treatment of the impacted upper canines was recommended, with best long-term prognosis [10].

During the treatment, general principles of orthodontic treatment were followed. The first phase of orthodontic treatment involved the leveling of dental arch and it lasted 6 months. The second phase was the preparation of the space for the impacted tooth and its exposure. This phase lasted for 12 months. The third stage was the completion of orthodontic therapy, when the impacted tooth was placed in a line. This phase lasted for another 6 months.

Diagnosis and localization of the impacted tooth is the most important stage in the treatment. Apart from the orthopantomography image, 3D images are needed to determine correct localization of the impacted tooth and its relationship with neighboring structures, and especially relationship with the incisors' roots. The resorption of the incisors' roots is a common complication of the treatment of impacted canines. To avoid complications, proper diagnostics and a mild continuous orthodontic force are necessary.

Some authors predicted possibility of a canine impaction on the basis of calculating its angulation on the orthopantomography image. The angle between the longitudinal axes of the canine in relation to the central line can be traced from the moment of formation of 1/3 root up to 6 months after the completion of the root formation. If the teeth angle is bigger than 31 degrees in relation to the median line, its eruption potential is small even after deciduous teeth extraction [12].

Exactly 91% of ectopic canines will come to the right occlusion if the crown of the canine was distally positioned in relation to the centerline of the lateral incisive during the removal of primary canine. If the crown is more mesial in relation to the central line of the lateral incisive root, spontaneous eruption occurs in only 64% of cases [12].

An increasing number of young patients have impacted teeth (not just wisdom teeth). There is a tendency for successful correction of the existing orthodontic anomaly, which is rather complex long-term process. Team work (pedodontist and orthodontist), regular checkups with good patient's cooperation ultimately provide excellent results in the treatment of such orthodontic malforma-

tions [11]. The principle of treating impacted teeth is a multidisciplinary; it involves collaboration between orthodontist, oral and maxillofacial surgeon, pedodontist and sometimes endodontist [13]. A general practitioner who refers a patient for an orthodontist's examination due to suspected impaction plays a very important role in the final treatment.

## REFERENCES

1. Urbanowicz-Kaczor K, Zadurska M, Czochrowska E. Impacted Teeth: An Interdisciplinary Perspective. *Adv Clin Exp Med.* 2016; 25(3):575–85.
2. Manilla EA, Katagiri KM. Orthodontic- surgical treatment of an impacted central incisor. Case report. *Revista Mexicana De Orto-doncia.* 2017; 5(3):190–5.
3. Spuntarelli M, Cecchetti F, Arcuri L, Testi L, Melone P, Bigelli E, et al. Combined orthodontic-surgical approach in the treatment of impacted maxillary canines: three clinical cases. *Oral Implantol (Rome).* 2015; 8(2):63–7.
4. Pavlović J, Tabaković SZ, Simić S, Vujačić A, Vukićević V. Orthodontic-surgical treatment of four impacted canines in an adult patient: A case report. *Vojnosanit Pregl.* 2016; 73(7):682–5.
5. Halicioglu K, Corekci B, Celal I. Incidence of impacted teeth and transmigrated canines- a radiographic study in Turkish dental patients. *Clin Dent Res.* 2012; 36(3):42–50.
6. Sukh R, Singh PG, Tandon P. Interdisciplinary approach for the management of bilaterally impacted maxillary canines. *Contemp Clin Dent.* 2014; 5(4):539–44.
7. Nagaraj K, Upadhyay M, Yadav S. Impacted maxillary central incisor, canine and second molar with 2 supernumerary teeth and an odontoma. *Am J Orthod Dentofacial Orthop.* 2009; 135(3):390–9.
8. Crescini A, Nieri M, Buti J, Baccetti T, Pini Prato GP. Pre-treatment radiographic features for the periodontal prognosis of treated impacted canines. *J Clin Periodontol.* 2007; 34(7):581–7.
9. Datana S, Londhe SM, Kumar P, Mathur V. Orthodontic Guidance of an Impacted Maxillary Canine – A review. *Journal of Oral Health & Community Dentistry.* 2014; 8(2):101–3.
10. Sumitra. Orthodontic-surgical treatment of bilateral maxillary canine impaction. *Contemp Clin Dent.* 2012; 3(3):363–6.
11. Simić I, Domazet T, Lečić J, Ješić J. Combined surgical and orthodontic treatment of impacted second lower premolar – Case report. *Serbian Dental Journal.* 2017; 64(3):131–5.
12. Goel A, Loomba A, Goel P, Sharma N. Interdisciplinary approach to palatally impacted canine. *Natl J Maxillofac Surg.* 2010; 1(1):53–7.
13. Topkara A, Sari Z. Impacted teeth in a Turkish orthodontic patients population: prevalence, distribution and relationship with dental arch characteristics. *Eur J Pediatric Dent.* 2012; 13(4):311–6.

---

Received: 22.08.2019 • Accepted: 21.11.2019

# Kombinovani ortodontsko-hirurški tretman u terapiji impaktiranih gornjih očnjaka

Dragan Ivanović<sup>1</sup>, Slavoljub Tomić<sup>2</sup>, Lado Davidović<sup>3</sup>, Dajana Nogo-Živanović<sup>3</sup>, Tanja Ivanović<sup>1</sup>

<sup>1</sup>Univerzitet u Istočnom Sarajevu, Medicinski fakultet, Odeljenje za dečju i preventivnu stomatologiju, Foča, Bosna i Hercegovina;

<sup>2</sup>Univerzitet u Istočnom Sarajevu, Medicinski fakultet, Odeljenje za oralnu hirurgiju, Foča, Bosna i Hercegovina;

<sup>3</sup>Univerzitet u Istočnom Sarajevu, Medicinski fakultet, Odeljenje za dentalnu patologiju, Foča, Bosna i Hercegovina

## KRATAK SADRŽAJ

Impaktirani zub je onaj koji nije uspeo da dosegne okluzalnu ravan, sa završenim rastom 2/3 korena. Etiološki faktori impakcije zuba su različiti, ali kao glavni razlog se smatra nedostatak prostora za njegovo nicanje. Najčešći impaktirani zubi su donji umnjaci, zatim gornji umnjaci, gornji očnjaci, pa donji premolari. Pacijentkinja starosti 17 godina javila se na pregled kod ortodonta, upućena od strane stomatologa opšte prakse. Kliničkim pregledom uočeno je postojanje mlečnih očnjaka, obostrano. Posle analize ortopantomografskog snimka dijagnostikovani su impaktirani očnjaci u gornjoj vilici, obostrano. Plan terapije je bio vađenje mlečnih očnjaka, postavka fiksne ortodontskog aparata i hirurško izvlačenje impaktiranih očnjaka. Ortodontski tretman impaktiranih zuba daje odlične terapijske rezultate. Uspešnost terapije zavisi od adekvatnog planiranja i timskog rada ortodonta i oralnog hirurga.

**Ključne reči:** impaktirani zub; očnjak; ortodontski tretman

## UVOD

Impakcija zuba je veoma česta i dobro poznata anomalija. Mali broj pacijenata traži tretman, jer je impakcija najčešće asimptomatska. U većini slučajeva, slučajno se otkriva na RTG snimku, kada se pacijent javi stomatologu iz nekog drugog razloga, npr. teskobe zuba [1]. Impaktirani zubi se nalaze kod 1–5% ortodontskih pacijenata [2]. Najčešći uzroci impakcije zuba su nedostatak prostora za erupciju, ektopičan položaj zametka zuba, produžena koštana retenciona barijera ili prevremeni gubitak mlečnih zuba, prisutnost alveolarnog rascepa, ankiroza, neoplazija, Zubna ili alveolarna trauma, dilatacija korena zuba, prisustvo prepreke koja se našla na putu nicanja zuba. Postoje dve teorije u vezi sa impakcijom maksilarnih očnjaka: genetska teorija i teorija usmeravanja [1]. Prema genetskoj teoriji, impakcija očnjaka je familijarna i povezana je sa drugim anomalijama: gleđna hipoplazija, aplazija drugih premolara, hipodoncija ili atipičan lateralni sekutić. Prema teoriji usmeravanja, očnjak niče duž distalne površine lateralnog sekutića, koji služi kao vodič. Ako je koren lateralnog sekutića odsutan ili nepravilno postavljen, očnjak ne može pravilno da iznikne. Maksilarni očnjak je drugi po učestalosti impaktirani zub. Najčešći impaktirani zubi su umnjaci, donji pa gornji, slede gornji očnjaci, pa premolari [3]. Prevalenca impakcije očnjaka u gornjoj i donjoj vilici je rangirana od 0,008 do 8,8%, prevalenca impakcije gornjih očnjaka je rangirana od 0,8 do 2,8% [4]. Impakcija zuba je češća kod žena nego kod muškaraca [5]. Osam posto pacijenata sa impakcijom ima bilateralnu impakciju [6]. Prevalenca impakcije gornjih očnjaka je 10 do 20 puta viša u odnosu na impakciju donjih očnjaka. Impaktirani očnjak može da bude pozicioniran bukolabijalno, oralno ili duž ivice alveolarnog grebena. Većina impakcija očnjaka su palatalne (85%) [7]. Dijagnoza impakcije očnjaka može se postaviti ako su stalni očnjaci odsutni u zubnom nizu kod pacijenata starijih od 14–15 godina [8]. Impakcija zuba mora da bude potvrđena ortopan snimkom, a u nekim slučajevima neophodan je i 3D snimak vilice, kako bi se dobilo više detalja o položaju impaktiranog zuba i njegovom odnosu sa susednim zubima [9].

U ovom slučaju terapija je podrazumevala hirurško oslobođanje impaktiranih očnjaka uz kasniji ortodontski tretman.

## PRIKAZ BOLESNIKA

Pacijentkinja starosti 17 godina javila se na pregled kod ortodonta, poslata od strane stomatologa opšte prakse. Kliničkim pregledom utvrđeno je prisustvo mlečnih očnjaka, obostrano (slike 1 i 2). Posle analize ortopantomografskog snimka dijagnostikovana je impakcija gornjih očnjaka, obostrano (Slika 3). Pacijentkinja je zdrava i u stomatološkoj anamnezi negira ranije ortodontske terapije kao i ekstrakcije zuba. Takođe, negira postojanje bola u području orofacialne regije.

Posle završenog pregleda kod ortodonta, pacijentkinja je poslata na pregled kod oralnog hirurga. Posle detaljne analize ortopantomografskog i 3D snimka napravljen je plan terapije koji je podrazumevao kombinovani ortodontsko-hirurški tretman impaktiranih zuba.

Pacijentkinji je postavljen fiksni ortodontski aparat, posle čega je obavljena oralno-hirurška intervencija u lokalnoj anesteziji. Ekstrahovani su mlečni očnjaci, i posle skidanja režnja i oslobađanja krunica zuba stavljeni su pinovi za izvlačenje impaktiranih očnjaka (Slika 4). Rane su isprane fiziološkim rastvorom i ušivene pojedinačnim šavovima, koji su otklonjeni posle sedam dana. Dva dana pre intervencije pacijentkinji su propisani antibiotici (Dovicin 100 mg, sedam dana), za bržu resorpciju edema i hematomu propisan je Chymoral Forte pet dana i analgetici, koje je koristila po potrebi.

Orthodontski tretman se zasnivao na postepenoj vući impaktiranih zuba i njihovom dovođenju u zubni luk (slike 5 i 6). Konačni završetak terapije će biti posle nicanja umnjaka, kada će se potpuno postići stabilna okluzija.

## DISKUSIJA

Postoje različite metode lečenja impaktiranih zuba: hirurško otvaranje i ortodontsko izvlačenje, autotransplantacija, hirurško uklanjanje impaktiranog zuba i protetsko-implantska nadoknada [10]. Koji način terapije će biti izabran zavisi od više faktora, prvenstveno od postojanja dovoljno prostora za nicanje impaktiranog zuba, njegove lokalizacije, stepena dubine impak-

cije, stepena razvijenja korena zuba. Osim njih značajnu ulogu ima i opšte zdravstveno stanje pacijenta, stanje zuba i oralna higijena, kao i funkcija i okluzija zuba [11]. U našem slučaju dijagnostikovan je ortodontsko-hirurški tretman impaktiranih gornjih očnjaka, što daje najbolje dugoročne rezultate [10].

U ovom slučaju praćeni su opšti principi ortodontske terapije. Prva faza ortodontske terapije je podrazumevala nivelicaciju zubnog luka i trajala je šest meseci. Druga faza je predstavljala pripremu prostora za smeštaj impaktiranog zuba i njegovu vuču i trajala je 12 meseci. Treća faza je završetak ortodontske terapije, kada je Zub smešten u niz. Ova faza je trajala šest meseci.

Dijagnostika i lokalizacija impaktiranog zuba je najvažnija faza u terapiji. Sem ortopantomografskog snimka, 3D snimci su potrebni zbog određivanja pravilne lokalizacije impaktiranog zuba i njegovog odnosa sa susednim strukturama, a naročito odnosa sa korenom sekutića. Resorpcija korenova sekutića je česta komplikacija terapije impaktiranih očnjaka. Da bi se izbegle komplikacije, neophodna je pravilna dijagnostika i blaga kontinuirana ortodontska sila.

Neki autori [12] predviđali su mogućnosti za impakciju očnjaka na temelju izračunavanja njegove angulacije na ortopantomografskom snimku. Ugao između uzdužne ose očnjaka

u odnosu na središnju liniju može da bude praćen od momenta formiranja 1/3 korena pa do šest meseci od završetka formiranja korena. Ako je angulacija zuba veća od  $31^{\circ}$  u odnosu na medijalnu liniju, njegove mogućnosti za erupcijom su male čak i posle mlečne ekstrakcije. Tačno 91% ektopično postavljenih očnjaka će doći u pravilnu okluziju ako je krunica očnjaka bila distalno postavljena u odnosu na središnju liniju lateralnog inciziva u vreme uklanjanja mlečnog očnjaka. Ako je krunica mezijalnije u odnosu na središnju liniju korena lateralnog inciziva, spontana erupcija se javlja samo u 64% slučajeva [12].

Sve veći broj mladih pacijenata ima problem impaktiranih zuba (ne samo umnjaka) i teži se uspešnoj korekciji postojeće ortodontske anomalije, što predstavlja prilično složen i dugotrajan proces. Timski rad (pedodont i ortodont) i redovni kontrolni pregledi uz dobru saradnju pacijenta na kraju daju odlične rezultate u lečenju ovakvih ortodontskih malformacija [11]. Princip lečenja impaktiranih zuba je multidisciplinarnan, uz saradnju ortodonta sa oralnim i maksilofacijalnim hirurgom, dečjim stomatologom, a nekada i endodontom [13]. Veoma važnu ulogu ima i stomatolog opšte prakse, koji posle urađenog pregleda i sumnje na impakciju šalje pacijenta na pregled kod ortodonta.

## Da li ste pažljivo čitali radove?

1. Impakcija zuba je:
  - a) česta anomalija
  - b) retka anomalija
  - c) veoma retka anomalija
  
2. Stomatološko osoblje je obuhvaćeno poremećajima koštano-mišićnog sistema:
  - a) često
  - b) retko
  - c) izuzetno retko
  
3. Materijali za fiksiranje zubnih nadoknada su utemeljeni:
  - a) 1870. godine
  - b) 1878. godine
  - c) 1888. godine
  
4. Vertikalna dimenzija lica se menja kao posledica gubitka zuba?
  - a) Da
  - b) Ne
  - c) Samo ponekad
  
5. Estetski zahtevi su glavni razlog za zamenu restauracija?
  - a) Da
  - b) Ne
  - c) Zavisi od stomatologa
  
6. Antropometrijska studija je pokazala:
  - a) skladnost lica i mogućnost analize po trećinama
  - b) skladnost lica i nemogućnost analize po trećinama
  - c) neusklađenost lica i mogućnost analize po trećinama
  
7. Poremećaji mišićno-koštanog sistema uključuju:
  - a) mišiće noge
  - b) mišiće ručnog zgloba
  - c) mišiće stomaka
  
8. Komplikacije kod cementno retiniranih nadoknada su:
  - a) češće
  - b) ređe
  - c) izuzetno retke
  
9. Vertikalna dimenzija lica utiče na:
  - a) estetiku lica
  - b) funkciju mastikatornog aparata
  - c) estetiku i funkciju
  
10. Hrapava površina kompozitnog ispuna utiče na:
  - a) akumulaciju plaka
  - b) pojavu mikropukotine
  - c) pojavu resorpcija
  
11. Impakcija zuba je najčešće:
  - a) asimptomatska
  - b) simptomatska
  - c) zavisi od impaktiranog zuba
  
12. Komplikacije kod cementno retiniranih nadoknada su češće:
  - a) za 1%
  - b) za 2%
  - c) za 3%
  
13. Preventivni programi kod doktora stomatologije uključuju:
  - a) edukaciju zdravstvenih radnika
  - b) lečenje zdravstvenih radnika
  - c) terapiju poremećaja
  
14. Antropometrijska studija kraniofacijalnih dimenzija lica je realizovana kod:
  - a) ispitanika muškog pola
  - b) ispitanika ženskog pola
  - c) ispitanika i muškog i ženskog pola
  
15. Hrapavost površine ispuna od 0,2 nm je:
  - a) dovoljna za akumulaciju plaka
  - b) nedovoljna za akumulaciju plaka
  - c) dovoljna da pacijent oseti jezikom
  
16. Impaktirani zubi se kod ortodontskih pacijenata javljaju:
  - a) u 1–5% slučajeva
  - b) u 1–3% slučajeva
  - c) u 0,5–1% slučajeva

17. Prevalenca rizika kod doktora stomatologije je sprovedena:
- anonomnom anketom
  - pregledom lekara
  - rendgengrafskim pregledom lekara
18. Biološke komplikacije su učestalije kod:
- cementom retiniranih nadoknada
  - šrafom retiniranih nadoknada
  - podjednako su zastupljene
19. Prosečna starost ispitanika u antropometrijskoj studiji je iznosila:
- između 18 i 20 godina
  - između 20 i 22 godine
  - između 22 i 24 godine
20. Hrapavost ispuna od 0,3 nm se:
- može osetiti vrhom jezika
  - ne može se osetiti vrhom jezika
  - ne mora polariti
21. Ektopičan položaj zametka zuba je:
- jedan od najčešćih uzroka komplikacije
  - jedan od najredjih uzroka komplikacije
  - izuzetno redak uzrok komplikacije
22. Periimplantni mukozitis je biološka komplikacija kod:
- cementom retiniranih nadoknada
  - šrafom retiniranih nadoknada
  - i kod jednih i kod drugih
23. Antropometrijska studija je realizovana kod ispitanika:
1. skeletne klase
  2. skeletne klase
  3. skeletne klase
24. Maksimalno prihvatljiv prag za hrapavost je:
- 100 nm
  - 200 nm
  - 300 nm
25. Impakciju maksilarnih očnjaka objašnjava:
- genetska teorija
  - teorija evaluacije
  - kvantna teorija
26. Prevalenca rizika kod doktora stomatologije je:
- visoka
  - niska
  - izuzetno niska
27. Antropometrijska merenja su pokazala da:
- postoji korelacija VDO i kraniometrijskih dimenzija
  - ne postoji korelacija VDO i kraniometrijskih dimenzija
  - VDO nije u korelaciji sa kraniometrijskim dimenzijsama
28. Sa povećanjem hrapavosti površine ispuna:
- smanjuje se stepen refleksije svetlosti
  - povećava se stepen refleksije svetlosti
  - povećava se kvalitet ispuna
29. Impakcija gornjih očnjaka je povezana sa:
- hipoplazijom dentina
  - hipoplazijom gleđi
  - hipoplazijom cementa
30. Analgetike je koristilo:
- 70% doktora stomatologije
  - 75% doktora stomatologije
  - 82% doktora stomatologije
31. Postupak cementiranja zubnih nadoknada je:
- široko rasprostranjen
  - neadekvatno korišćen
  - neadekvatno zapostavljen
32. Smanjenje sloja kompozitnog ispuna:
- vodi ka diskoloraciji ispuna
  - dovodi do smanjenja akumulacije plaka
  - dovodi do povećanja glatkoće ispuna
33. Maksilarni očnjak je:
- prvi po učestalosti impakcije
  - drugi po učestalosti impakcije
  - treći po učestalosti impakcije
34. Stručnu pomoć je primilo:
- 40% ispitanika
  - 58% ispitanika
  - 63% ispitanika
35. Termoimplantni mukozitis se dovodi u vezu sa „lekar zavisnim“ parametrima:
- često
  - retko
  - izuzetno retko
36. Antropometrijska studija je obuhvatila ispitanike:
- sa intaktnom denticijom
  - krezube pacijente
  - bezube pacijente
37. Na glatkoću površine direktno utiču:
- čestice punioca
  - organske čestice
  - silan
38. Impakcija zuba je češća kod:
- žena
  - muškaraca
  - žena i muškaraca
39. Pojava fistule je češća kod:
- cementom retiniranih nadoknada
  - šrafom retiniranih nadoknada
  - i kod jednih i kod drugih

40. Prednosti retencije šrafom kod zubnih nadoknada su:
- a) lako uklanjanje nadoknade
  - b) teško vraćanje nadoknade
  - c) skupa izrada nadoknade
41. U antropometrijskoj analizi je mereno:
- a) 10 kraniometrijskih linija
  - b) 12 kraniometrijskih linija
  - c) 15 kraniometrijskih linija
42. Čestice nanohibridnih kompozita su:
- a) od 0,1 do 100 nm
  - b) od 0,1 do 0,04 nm
  - c) od 0,1 do 100 mm
43. Prevalenca impakcije gornjih očnjaka je:
- a) od 0,8 do 1%
  - b) od 0,8 do 2%
  - c) od 0,8 do 2,8%
44. Prevalenca rizika kod doktora stomatologije je sprovedena:
- a) u Banjaluci
  - b) u Sarajevu
  - c) u Tuzli
45. Najzastupljenija biološka komplikacija kod cementom retiniranih nadoknada je:
- a) periimplantitis
46. Rezultati antropometrijske analize su pokazali:
- a) značajnu povezanost kraniometrijskih linija
  - b) povezanost bez značajnih razlika
  - c) odsustvo povezanosti korišćenih linija
47. Nanokompoziti imaju:
- a) dobru translucenciju
  - b) lošu translucenciju
  - c) neadekvatnu translucenciju
48. Najčešće impaktirani zubi su:
- a) umnjaci
  - b) očnjaci
  - c) sekutići
49. Prevalenca rizika kod doktora stomatologije je obuhvatala:
- a) 150 anketiranih
  - b) 167 anketiranih
  - c) 175 anketiranih
50. Bol vratnog i ramenog pojasa kod doktora stomatologije je obuhvatio:
- a) 90,1% ispitanika
  - b) 95,1% ispitanika
  - c) 97,1% ispitanika

**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 rasporedene 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](http://www.nlm.nih.gov/bsd/uniform_requirements.html).

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

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

**Slanje rukopisa** Rukopis rada i svi prilozi uz rad mogu se dostaviti imejlom ([stomglas@bvcom.net](mailto: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](mailto: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](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](mailto: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](mailto:stomglas@bvcom.net)

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

CIP - Каталогизација у публикацији  
Народна библиотека Србије, Београд

616.31

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

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

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

