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ORIGINALNI RAD  
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# PUŠENJE I KONZUMIRANJE ALKOHOLA KAO FAKTORI RIZIKA KOD 112 ONKOLOŠKIH BOLESNIKA SA DIJAGNOZOM BISFOSFONATNE OSTEONEKROZE VILICA

## SMOKING AND ALCOHOL CONSUMPTION AS RISK FACTORS IN 112 ONCOLOGY PATIENTS DIAGNOSED WITH BISPHOSPHONATE-ASSOCIATED OSTEONECROSIS OF THE JAW

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### Sažetak

**Uvod:** Osteonekroza vilica udružena sa bisfosfonatima (OVUB) je komplikacija od velikog medicinskog značaja. Neki od najkontroverznijih aspekata o kojima se najviše diskutovalo jesu faktori rizika, od kojih su neki povezani sa pušenjem i konzumacijom alkohola kod pacijenata kod kojih se osteonekroza pojavila.

**Cilj:** Proceniti koliki je rizik od nastajanja OVUB oboljenja kod onkoloških pacijenata sa rizičnim zdravstvenim navikama.

**Materijal i metode:** Sprovedena je Prospektivna epidemiološka studija, je obuhvatila 112 pacijenata sa dijagnostifikovanom osteonekrozom vilice udružene sa bisfosfonatima, sprovedena je na Klinici za maksilofacijalnu hirurgiju Univerzitetske bolnice “Sveti Georgije” u Plovdivu, u Bugarskoj, u periodu od 2016. i 2017. godinu, na osnovu anamneze, kliničkog pregleda i pregleda bolničke dokumentacije. Za statističku analizu korišćen je SPSS program v.24, sa nivoom značajnosti postavljenim na  $p < 0,05$ .

**Rezultati:** Preko 2/3 pacijenata bili su pušači (40,18%) ili bivši pušači (25,00%), što ih povezuje sa faktorom rizika - pušenjem. U vreme studije, pušači koji su pušili između 1 cigarete i 9 cigareta i između 10 i 19 cigareta dnevno imali su jednak relativni udeo od 44,22%. Više od polovine pacijenata koji su pušili starosti su između 20 i 39 godina, odnosno bili su sa visokom prosečnom starošću. Većina ispitivanih pacijenata konzumirala je alkohol, najčešće jednom nedeljno ili vikendom (28,57%) ili samo povremeno (26,79%), a 24,11% unosilo je alkohol nekoliko puta nedeljno. Skoro 2/3 ispitanika konzumiralo je piće i sa niskim i sa visokim sadržajem alkohola.

**Zaključak:** Najveći broj pacijenata bili su pušači/bivši pušači i povremeni konzumenti alkohola, što ih ukazuje da su pušenje i alkohol potencijalni faktori rizika za razvoj bisfosfonatne osteonekroze vilica.

**Ključne reči:** pušenje, alkohol, rak, bisfosfonati, osteonekroza

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### Abstract

**Background:** Bisphosphonate-associated osteonecrosis of the jaws (BAONJ) is a complication of great medical importance. Some of the most discussed and controversial aspects are the risk factors, some of which are related to patients' smoking and alcohol consumption.

**The Aim:** To study cancer patients with BAONJ and determine their participation in the mentioned above risky health-related habits.

**Material and methods:** A prospective epidemiological study of 112 patients diagnosed with bisphosphonate-associated osteonecrosis of the jaw in 2016 and 2017 was conducted at the Clinic of Maxillofacial surgery of University hospital “St. George”, Plovdiv, Bulgaria, based on anamnesis, clinical examination, and hospital documentation. SPSS Statistics v.24 was used for statistical analysis, at a significance level  $p < 0.05$ .

**Results:** Over 2/3 of the patients were smokers (40.18%) or ex-smokers (25.00%), which linked them with the risk factor of smoking. At the time of the study, patients smoking between 1 and 9 and between 10 and 19 cigarettes a day had equal relative shares of 44.22%. More than half of the patients smoked from the age of 20-39, which we explain by the high average age. The majority of patients studied consumed alcohol, most often once a week or on weekends (28.57%) or only on occasions (26.79%), followed by 24.11% who used alcohol several times per week. Nearly 2/3 drink drinks with both low and high alcohol content.

**Conclusion:** The highest proportion of patients are smokers / ex-smokers and consume alcoholic beverages occasionally, which links them to these risk potential factors.

**Key words:** smoking, alcohol, cancer, bisphosphonates, osteonecrosis

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## Uvod

Bisfosfonatni lekovi koriste se u lečenju osteoporoze i malignih procesa u koštanom tkivu<sup>1</sup>. Kao rezultat njihove upotrebe, formiraju se lezije u koštanom tkivu i na oralnoj sluzokoži, poznate kao osteonekroza vilice udružena sa bisfosfonatom (OVUB) – komplikacija od velikog medicinskog značaja. Epidemiološke i kliničke studije sumiraju diskusije različitih grupa specijalista o definiciji, epidemiologiji i faktorima rizika, mehanizmima pojave, klasifikaciji, kliničkim manifestacijama, pristupima lečenju i prevenciji ovog procesa. Jasno je da je ovo izuzetno složen i multifaktorijski proces, koji zahteva pažljivo praćenje i individualni pristup svakom pacijentu. Verovatno su najsporniji i najkontraverziji aspekti faktori rizika<sup>2-4</sup>, od kojih su neki povezani sa lošim navikama, poput pušenja i konzumiranja alkohola od strane pacijenata, za koje se pretpostavlja da doprinose bržem i agresivnijem razvoju osteonekroze. Pošto se stanje smatra ireverzibilnim, naponi bi trebalo da budu usmereni ka prevenciji, pre i posle početka terapije bisfosfonatima (BP), što uključuje promene povezane sa zdravijim načinom života.

## Materijali i metode

Prospektivna epidemiološka studija, koja je obuhvatila 112 pacijenata sa dijagnostikovanim osteonekrozom vilice udružene sa bisfosfonatima, sprovedena je na Klinici za maksilofacijalnu hirurgiju Univerzitetske bolnice "Sveti Georgije" u Plovdivu, u Bugarskoj, tokom 2016. i 2017. godine, na osnovu anamneze, kliničkog pregleda i uvida u bolničku dokumentaciju. Podaci su unošeni u specijlno napravljen karton za ovu vrstu epidemiološke studije. Za deskriptivnu statistiku, kontinuirane varijabile prikazane su kao srednji i interkvartilni raspon (medijana  $\pm$  IQR), a kategorijalne varijabile kao brojevi i procenti. Varijabile su upoređene pomoću dve proporcije z-testa i Pearsonovog hi-kvadrata. Sve statističke analize izvedene su u SPSS program, verzije 24 (IBM Corporation, New York, NY). Vrednost p manja od 0,05 smatrana je statistički značajnom.

## Introduction

Bisphosphonate drugs are used in the treatment of the osteoporosis and malignant processes in the bone tissue<sup>1</sup>. As a result of their use lesions are formed in bone tissue and oral mucosis, known as bisphosphonate - associated osteonecrosis of the jaws (BAONJ) - a complication of great medical importance. Epidemiological and clinical studies summarize discussions of different groups of specialists on the definition, epidemiology and risk factors, the mechanism of occurrence, classification, clinical manifestations and approaches to treatment and prevention of this process. It is clear that this is an extremely complex and multifactorial process that requires careful monitoring and individual approach to each patient. Arguably of the most discussed and controversial aspects are the risk factors<sup>2-4</sup>, some of which are related to bad habits, such as smoking and alcohol consumption of patients, which are assumed to contribute to more rapid and aggressive development of osteonecrosis. As the condition is considered irreversible, efforts should focus on prevention, both before and after the start of BP therapy, which includes changes associated with a healthier lifestyle.

## Materials and methods

A prospective epidemiological study of 112 patients diagnosed with bisphosphonate-associated osteonecrosis of the jaw in 2016 and 2017 was conducted in the Clinic of maxillofacial surgery of University hospital "St. George", Plovdiv, Bulgaria, based on anamnesis, clinical examination, and hospital documentation. The data is reflected in a specially created for the purpose epidemiological study card. For descriptive statistics, continuous variables were displayed as the median and interquartile range (median  $\pm$  IQR) and categorical variables as counts and percentages. Variables were compared with the use of two proportions z-test and Pearson's chi-square. All statistical analyses were performed with SPSS version 24 (IBM Corporation, New York, NY). A p-value below 0.05 was considered statistically significant.

## Rezultati

Srednja starost pacijenata sa OVUB-om bila je 68 godina (IKR = 16), najmlađi pacijent imao je 38 godina, dok je najstariji imao 85 godina. Nije bilo statistički značajne razlike između relativnih proporcija muškaraca (51,79%,  $n = 58$ ) i žena (48,21%,  $n = 54$ ) ( $p > 0,05$ ). Onkološke bolesti, kao što su rak dojke (40,18%,  $n = 45$ ) i rak prostate (37,71%,  $n = 40$ ) ( $p > 0,05$ ) dominirale su kod pacijenata, a 16,07% ( $n = 18$ ) pacijenata bilo je sa drugim onkološkim oboljenjima, najčešće bubrežnim ćelijskim karcinomom, 6,25% ( $n = 7$ ) multiplim mijelomom i 1,79% ( $n = 2$ ) rakom pluća.

Preko 2/3 pacijenata bili su pušači (40,18%,  $n = 45$ ) ili bivši pušači (25,00%,  $n = 28$ ). U vreme sprovođenja studije, sa jednakim relativnim udelom, 44,22% ( $n = 19$ ) pacijenata pušilo je između 1 cigarete i 9 cigareta i između 10 i 19 cigareta dnevno. Samo su dva pacijenta (4,44%) prestala da puše nakon pojave simptoma / pritužbi. (Slika 1)

Više od polovine pacijenata puši između 20 i 39 godina, što se opravdava visokom srednjom starošću (68 godina). Korisnici nikotina stariji od 40 godina (20,00%,  $n = 9$ ) i oni koji su pušili od 10 do 19 godina (22,22%,  $n = 10$ ) imali su sličan relativni udeo ( $p > 0,05$ ). (Slika 2)

Skoro polovina bivših pušača ( $n = 27$ ) prestala je da puši pre više od 10 godina (25,93,  $n = 7$ ). Otprilike, četvrtina pacijenata prestala je da puši pre 5 do 9 godina (22,22%,  $n = 6$ ), a zatim sledi jednak udeo osoba koje su prestale da puše pre 2 do 4 godine (18,52%,  $n = 5$ ). Nije pronađena statistički značajna razlika između sekcija ( $p > 0,05$ ). (Slika 3)

Većina pacijenata konzumirala je alkohol, najčešće jednom nedeljno ili vikendom (28,57%,  $n = 32$ ) ili samo povremeno (26,79%,  $n = 30$ ) ( $p > 0,05$ ), a 24,11% ( $n = 28$ ) pacijenata konzumiralo je alkoholna pića nekoliko puta nedeljno (Slika 4). Samo 2,68% pacijenata alkohol konzumira svakog dana. Skoro 2/3 pacijenata pije sve vrste alkohola (59,78%,  $n = 55$ ), dok ostali, sa bliskim relativnim udelom, konzumiraju uglavnom pića sa visokim (19,57%,  $n = 18$ ) ili pića sa niskim (20,65%,  $n = 19$ ) sadržajem alkohola ( $p > 0,05$ ).

Utvrđena je statistička veza između vrste raka i pušenja ( $\chi^2 = 19,86$ ,  $p < 0,05$ ) i konzumiranja određene vrste alkohola i raka ( $\chi^2 = 45,66$ ,  $p < 0,05$ ): kod pacijenata sa rakom dojke, bilo je znatno više nepušača od pušača i bivši pušači i oni koji ne konzumiraju alkohol bili su u većem broju od onih koji često i vrlo često konzumiraju alkohol.

## Results

The median age of BAONJ patients was 68 years (IQR = 16), with a minimum of 38 years and a maximum of 85 years. There was no statistically significant difference between the relative proportions of men (51.79%,  $n = 58$ ) and women (48.21%,  $n = 54$ ) ( $p > 0.05$ ). Oncological diseases breast cancer (40.18%,  $n = 45$ ) and prostate cancer (37.71%,  $n = 40$ ) ( $p > 0.05$ ) were predominant in patients, followed by 16.07% ( $n = 18$ ) with other oncological diseases, most commonly renal cell carcinoma, 6.25% ( $n = 7$ ) with multiple myeloma, and 1.79% ( $n = 2$ ) with lung cancer.

Over 2/3 of the patients were smokers (40.18%,  $n = 45$ ) or ex-smokers (25.00%,  $n = 28$ ). At the time of the study, with equal relative shares of 44.22% ( $n = 19$ ) were the onessmoking between 1 and 9 and between 10 and 19 cigarettes per day. Only two patients (4.44%) stopped smoking after the onset of symptoms/complaints (Figure 1).

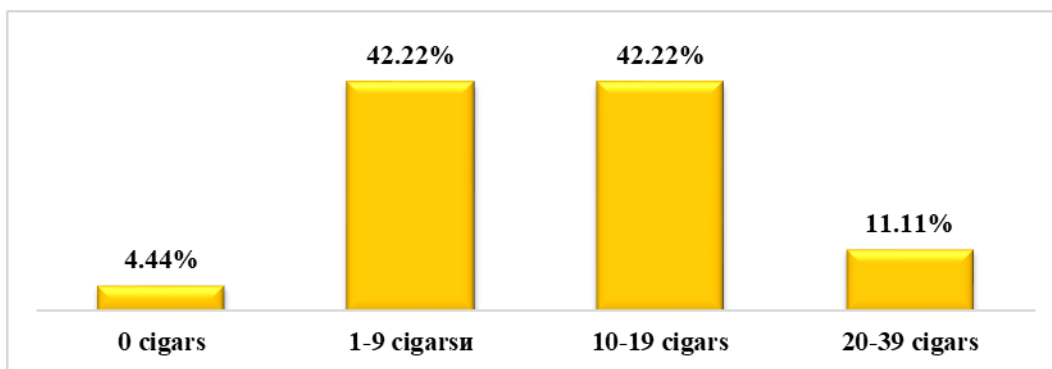
More than half of the patients have been smoking for 20-39 years, which we justify by the high median age (68 years). Nicotine users over 40 years (20.00%,  $n = 9$ ) and those who smoked from 10 to 19 years (22.22%,  $n = 10$ ) had similar relative shares ( $p > 0.05$ ) (Figure 2).

Nearly half of ex-smokers ( $n = 27$ ) quit smoking more than 10 years ago (25.93,  $n = 7$ ). About a quarter quit smoking 5-9 years ago (22.22%,  $n = 6$ ), followed by equal shares of quitters 4 years ago and 2 years ago (18.52%,  $n = 5$ ). No statistically significant difference was found between the sections ( $p > 0.05$ ) (Figure 3).

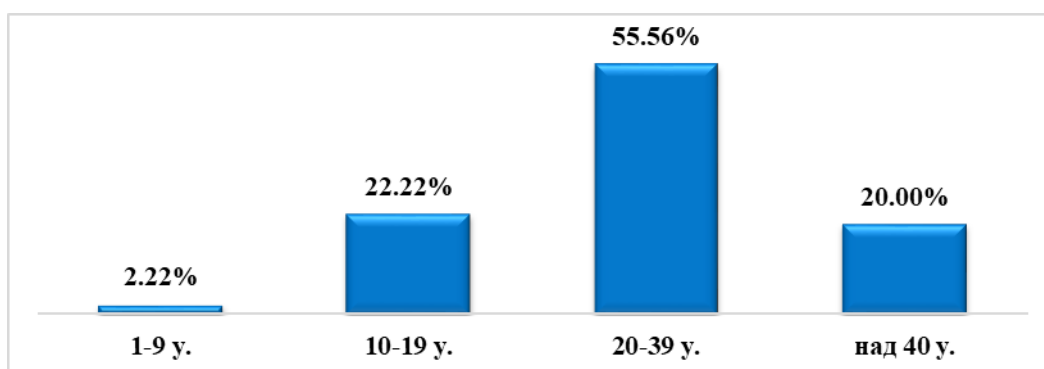
The majority of patients studied consumed alcohol, most often once a week or on weekends (28.57%,  $n = 32$ ) or only on occasions (26.79%,  $n = 30$ ), ( $p > 0.05$ ), followed by those consuming alcoholic substances several times a week (24.11%,  $n = 28$ ) (Figure 4). Only 2.68% drank every day. Nearly 2/3 drank all types of alcohol (59.78%,  $n = 55$ ), while the rest, with close relative shares, consumed mainly drinks with high (19.57%,  $n = 18$ ) or drinks with low (20.65%,  $n = 19$ ) alcohol content ( $p > 0.05$ ).

A statistical linkage was found between the type of cancer and smoking ( $\chi^2 = 19.86$ ,  $p < 0.05$ ) and type of cancer and alcohol consumption ( $\chi^2 = 45.66$ ,  $p < 0.05$ ): in breast cancer patients there were significantly more non-smokers than smokers and ex-smokers and there were significantly more nondrinkers than those who consume alcohol often and very often.

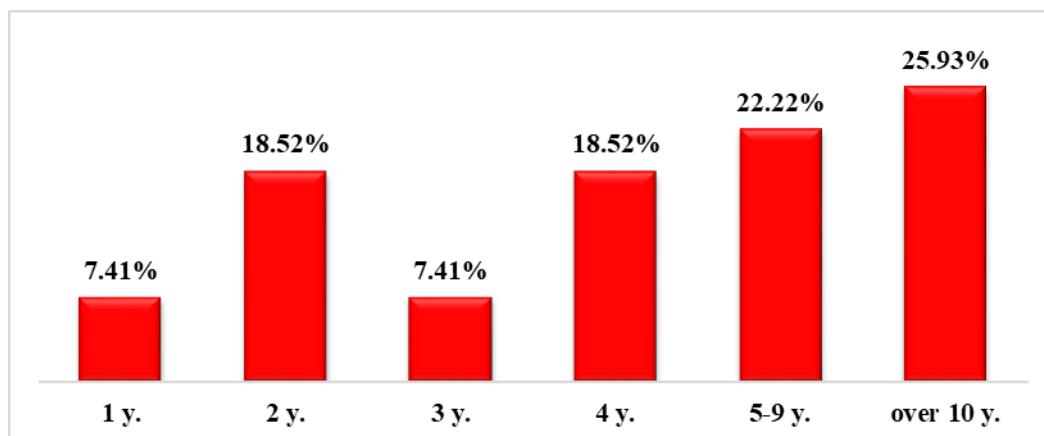




**Slika 1.** Distribucija ispitanih pacijenata prema broju popušenih cigareta u toku 24 sata  
**Figure 1.** Distribution of the studied patients according to the number of cigarettes smoked for 24 hours

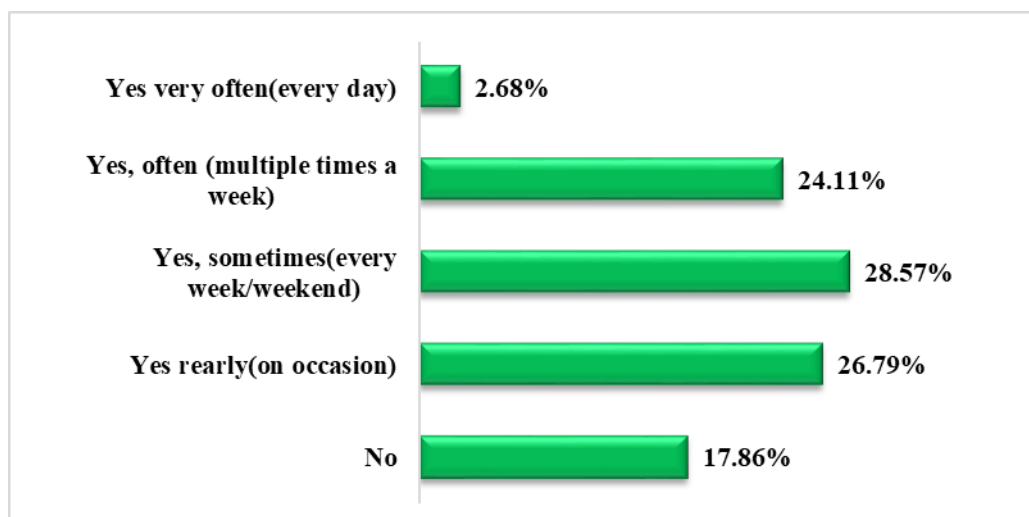


**Slika 2.** Distribucija ispitanih pacijenata u odnosu na vreme trajanja pušenja  
**Figure 2.** Distribution of the studied patients according to the duration of smoking



**Figure 3.** Distribucija bivših pušača po vremenu proteklom od prestanka štetne navike

**Slika 3.** Distribution of ex-smokers according to the statute of limitations for cessation of the harmful habit



**Slika 4.** Distribucija ispitanih pacijenata na osnovu količine konzumiranog alkohola  
**Figure 4.** Distribution of the studied patients according to alcohol consumption

### Diskusija

Upotreba duvana navodi se kao faktor rizika za OVUB-a<sup>2-6</sup>. Upotreba alkohola takođe se navodi, u nekim publikacijama, kao faktor rizika<sup>3,6</sup>. Utvrđeno je da većina pacijenata sa OVUB-om nedeljno konzumira alkohol, najčešće u umerenim količinama, a više od 2/3 pacijenata bili su pušači ili bivši pušači, ali sve slične informacije o broju konzumiranih cigareta dnevno i trajanju pušenja, kao i detalji o konzumiranju alkohola, nisu pronađeni u drugim studijama na tu temu.

Studija slučaja je otkrila da je većina pacijenata sa osteonekrozom vilice okarakterisana kao pušači<sup>7</sup>. U drugoj studiji kontrole slučaja, gojaznost i pušenje bili su povezani u značajnoj meri sa razvojem osteonekroze vilice (OV)<sup>5</sup>. U Italiji je otkriven niži procenat pojave sa 32 pušača (21,2%) i 11 (7,28%) bivših pušača. U studiji o OVUB-u kod žena sa rakom dojke, 6 žena (21%) bilo je izloženo štetnim efektima duvana<sup>8</sup>. Watters i dr. pronašli su vezu između pušenja ( $p = 0,03$ ) i OVUB progresije pomoću  $\chi^2$  testa<sup>9</sup>. Drugi navode to da istovremena upotreba BP i pušenje mogu produžiti trajanje potpune remisije OVUB lezije<sup>10</sup>. Pušenje i dalje može biti zbunjujući faktor, s obzirom na to da pušači imaju goru oralnu higijenu od nepušača. U nedavnoj studiji, samo 2 pacijenta od 146 pacijenata, kod kojih je dijagnostifikovana osteonekroza vilice udružena sa lekovima (OVUL), bili su pušači, možda zbog činjenice da je tokom perioda lečenja zoledronskom kiselinom pacijentima savetovano da prestanu sa pušenjem i konzumacijom alkohola<sup>11</sup>.

### Discussion

Tobacco use is cited as a risk factor for BAONJ<sup>2-6</sup>. Alcohol use is also cited in some publications as a risk<sup>3,6</sup>. We found that the majority of patients with BAONJ most of ten consume alcohol moderately on a weekly basis, and more than 2/3 of patients are smokers or ex-smokers, but any similar information on the number of cigarettes per day and duration of smoking, as well as details on alcohol consumption, were not found in other studies on the topic.

A case-control study also found that most patients with jaw osteonecrosis were smokers<sup>7</sup>. In another case-control study, obesity and smoking were significantly associated with ONJ development<sup>5</sup>. In Italy, they found lower rates, with 32 smoking patients (21.2%) and 11 (7.28%) ex-smokers. In a study of BAONJ in women with breast cancer, 6 (21%) were exposed to the harmful effects of tobacco<sup>8</sup>. Watters et al. found a ratio between smoking ( $p = 0.03$ ) and BAONJ progression by  $\chi^2$  test<sup>9</sup>. Others report that concomitant use of BP and smoking may prolong the duration of complete remission of the BAONJ lesion<sup>10</sup>. Smoking can still be a confusing factor, given that smokers tend to have poorer oral hygiene than non-smokers. In a recent study, only 2 of the 146 patients diagnosed with medication-related osteonecrosis of the jaws (MRONJ) were smokers, maybe due to the fact that during the treatment period with Zoledronic acid patients were advised to quit smoking and alcohol drinking<sup>11</sup>.

U studiji sprovedenoj u Kini, koja je obuhvatila 201 pacijenta sa različitim tipovima osteonekroze vilice, 36,7% pacijenata sa OVUL-om bili su pušači. 30% pacijenata sa OVUL-om imalo je naviku konzumiranja alkohola, ali nisu utvrđene statističke razlike između pacijenata sa OVUL-om i drugih grupa pacijenata<sup>12</sup>.

Što se tiče konzumiranja alkohola, neke studije povezuju alkoholizam i zloupotrebu alkohola sa osteonekrozom, ali dalje informacije nisu dostupne u naučnoj literaturi<sup>13-16</sup>.

Međutim, smernice za prevenciju OVUB-a/OVUL-a i dalje uključuju kontrolu faktora rizika, kao što su pušenje i alkohol<sup>17</sup> i ograničavanje ili prestanak rizičnog ponašanja za oralno zdravlje, poput pušenja i upotrebe droga i alkohola. Kada postoji rizik, ove smernice odmah se preporučuju, zbog rizika od razvoja OVUB-a<sup>18-20</sup>, čak iako za neka istraživanja nisu klinički potkrepljena<sup>21</sup>.

### ***Zaključak***

U ovoj studiji, koja je obuhvatila 112 pacijenata obolelih od raka, kojima je dijagnostifikovan OVUB, najveći procenat pacijenata bili su pušači / bivši pušači, koji povremeno konzumiraju alkoholna pića, što ih povezuje sa ovim potencijalnim faktorima rizika. Takođe, smernice za sprečavanje OVUB-a/OVUL-a i dalje preporučuju ograničavanje ili prestanak rizičnog ponašanja, radi oralnog zdravlja, kao što su pušenje i upotreba droga i alkohola. Uprkos tome, pušenje, a naročito konzumiranje alkohola i dalje su kontroverzni faktori rizika, pa bi trebalo sprovesti detaljnije studije, kako bi se utvrdilo njihovo pravo učešće u razvoju ovog ozbiljnog stanja.

### ***Sukobi interesa***

Nema sukoba interesa za otkrivanje.

### ***Zahvalnice***

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In a study in China with 201 patients with different types of osteonecrosis of the jaw, 36.7% of MRONJ patients were smokers. Thirty percent of MRONJ patients had drinking habits, but no statistical differences between MRONJ and other groups were found<sup>12</sup>.

As for alcohol consumption, some studies link alcoholism and alcohol abuse to osteonecrosis, but no further information is available in the scientific literature<sup>13-16</sup>.

However, the guidelines for prevention of BAONJ/MRONJ continue to involve controlling the risk factors such as smoking and alcohol<sup>17</sup> and limiting or ceasing oral health risk behaviors such as smoking and drug and alcohol use are promptly recommended when at risk for development of BAONJ<sup>18-20</sup> even if for some researchers it is not evidence-based<sup>21</sup>.

### ***Conclusions***

In our study of 112 cancer patients diagnosed with BAONJ, the highest proportion of patients are smokers/ex-smokers and consume alcoholic beverages occasionally, which links them to these potential risk factors. Also, guidelines for prevention of BAONJ/MRONJ continue to recommend limiting or ceasing oral health risk behaviors such as smoking and drug and alcohol use. In spite of that, smoking and especially alcohol consumption are still controversial risk factor, and more in-depth studies should be conducted to determine their true involvement with the development of this serious condition.

### ***Conflicts of Interest***

There are no conflicts of interest to disclose.

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# STATISTIČKA ANALIZA KRITERIJUMA ZA PROCENU EFIKASNOSTI ISPUNA NA STALNIM ZUBIMA KOD DECE

## STATISTICAL ANALYSIS OF CRITERIA FOR EFFICIENCY OF FILLING OF PERMANENT TEETH IN CHILDREN

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### Sažetak

**Uvod:** Efikasnost lečenja karijesa zavisi od mnogih faktora, kao što su stanje zubnih tkiva, stadijum razvoja korena, period denticije, kvalitet preparacije i izolacije i optimalan izbor materijala za restauraciju. Problem izbora materijala za plomiranje zuba aktuelan je pri svakom tretmanu karijesa kod dece sa mešovitim i stalnom denticijom.

**Cilj:** Utvrditi i statistički potkrepiti parametre za odabir restaurativnog materijala za stalne zube kod dece sa različitim fazama razvoja korenazuba.

**Materijali i metode:** Ispitano je 248 dece uzrasta od 7 do 11 godina (122 dečaka i 126 devojčica) i 246 dece uzrasta od 12 do 17 godina (120 dečaka i 126 devojčica) učenika Srednje škole broj 20 u Užgorodu. Ispitivani su materijali za restauraciju "Polofil Supra" (VOCO, Nemačka) i "Dyract eXtra" (Dentsply, SAD). Analizirani su sledeći kriterijumi: pH vrednosti pljuvačke, područje destrukcije okluzalne površine bočnih zuba, stadijum razvoja korena, dubina i topografija lezije, kao i otpornost gleđi na kiselinu. U svrhu statističkog opravdanja odabranih parametara, koji su se pokazali značajnima pri izboru restaurativnih materijala, kao i radi analize međusobnih odnosa proučavanih parametara, određen je Spearmanov koeficijent korelacije ( $r$ ). Koeficijent korelacije smatrao se statistički značajnim kada je  $p < 0,05$ .

**Rezultati:** Za decu uzrasta od 7 do 17 godina, za restauraciju stalnih zuba tokom perioda mešovite i stalne denticije, najbolji materijali za upotrebu bili su: "Polofil Supra" (VOCO, Nemačka) i "Dyract eXtra" (Dentsply, SAD).

**Zaključak:** Za restauraciju stalnih zuba, u bilo kojoj fazi razvoja korena, racionalno je koristiti kompozitni materijal "Dyract eXtra" ( $r = 0,80$ ), a kompozitni materijal "Polofil Supra" uslovima završenog rasta korena, zavisno od pH pljuvačke veći od 6,2, uz visok stepen otpornosti gleđi na kiselinu i područje destrukcije okluzalne površine zuba manje od 0,55 ( $r = 0,72$ ).

**Ključne reči:** dečja stomatologija; karijes; stalni zubi; kompozitni materijali; statistička opravdanost

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### Abstract

**Introduction:** The effectiveness of caries treatment depends on many factors, such as the condition of dental tissues, the stage of root development, the period of dentition, the quality of preparation and isolation, the optimal choice of material for restoration. The problem of choosing the filling material is acute in each treatment of caries in children with mixed and permanent dentition.

**The aim:** To determine and statistically substantiate parameters for choosing restorative material for permanent teeth in children with different stages of root development.

**Materials and methods:** 248 children aged 7 to 11 (122 boys and 126 girls) and 246 children aged 12 to 17 (120 boys and 126 girls), students of Uzhgorod Secondary School №20 were examined. Restoration materials - "Polofil Supra" (VOCO, Germany) and "Dyract eXtra" (Dentsply, USA). The following criteria were investigated: saliva pH, area of destruction of the occlusal surface of masticatory teeth, stage of root development, depth of the lesion and cavity topography, the acid resistance of the enamel. For the purpose of statistical justification of the selected parameters that pointed as significant in the choice of restorative materials, and for the analysis of the interrelations of the parameters studied, the Spearman correlation coefficient ( $r$ ) was determined. The correlation coefficient was considered statistically significant when  $p < 0,05$ .

**Results:** For children aged 7-17 years to restore permanent teeth during the period of mixed and permanent dentition, the best materials in use were: "Polofil Supra" (VOCO, Germany) and "Dyract eXtra" (Dentsply, USA).

**Conclusion:** To restore permanent teeth in any stage of root development, it is rational to use a compomer material "Dyract eXtra" ( $r = 0,80$ ), and a composite material "Polofil Supra" - under the conditions of the formed root, at a pH level of more than 6.2, a high degree acid resistance of the enamel and the area of destruction of the occlusal surface less than 0.55 ( $r = 0,72$ ).

**Key words:** pediatric dentistry, caries, permanent teeth, composite materials, statistical justification

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## Uvod

Veliki broj naučnih i naučno-stručnih istraživanja posvećen je pitanju dijagnoze i izboru metoda restauracije tvrdih zuba kod dece<sup>1-7</sup>. Izbor materijala za restauraciju izgubljenih tvrdih zubnih tkiva kod dece, obično je, osim karakteristika materijala, ograničen i periodom denticije i funkcionalnom grupom, kojoj zubi pripadaju, što dovodi do komplikacija, kao što su defekti i gubitak ispuna i razvoj komplikacija karijesa<sup>8-10</sup>. Međutim, postoji niz faktora, kao što su lokalni oralni faktori (pH vrednosti pljuvačke, higijena, razvoj korena zuba, otpornost gleđina karijes, dubina karijesne lezije, područje destrukcije okluzalne površine bočnih zuba) koji igraju značajnu ulogu u kvalitetu i izdržljivosti ispuna. Stoga, razvoj jasnih kriterijuma za dijagnozu i optimizaciju izbora retsaurativnog materijala zahteva dalje proučavanje<sup>7-10</sup>.

Pružanje kvalifikovane, visokokvalitetne stomatološke nege deci komplikovano je i uslovljeno specifičnostima psihoemocionalnog statusa ovih pacijenata. Deca su, u velikoj većini slučajeva, u strahu, što zahteva jasnu i brzu primenu svih medicinskih manipulacija, upotrebu minimalno invazivnih i, istovremeno, najinformativnijih dijagnostičkih mera i jasnih kriterijuma za izbor restaurativnih materijala<sup>11-14</sup>.

S obzirom na gore navedeno, postoji potreba za razvojem jasnih i objektivnih, statistički značajnih dijagnostičkih kriterijuma, koji će dovesti do poboljšanja kvaliteta stomatoloških usluga namenjenih deci.

Efikasnost lečenja karijesa zavisi od mnogih faktora, kao što su stanje zubnog tkiva, stadijum razvoja korena, period denticije, kvalitet preparacije i izolacije, kao i optimalan izbor materijala za restauraciju<sup>1-5,10</sup>. Problem izbora materijala za plomiranje aktuelan je pri svakom tretmanu karijesa kod dece sa mešovitom i stalnom denticijom<sup>15,16</sup>. Ograničen pristup usnoj duplji, obilno lučenje pljuvačke, različita struktura zubnog tkiva u različitim fazama razvoja korena, uznemirenost deteta tokom stomatološke intervencije i brojni drugi faktori iziskuju kriterijume koje treba da zadovolje materijali za zubne ispune u dečjoj stomatologiji<sup>17-20</sup>.

**Cilj** ovog rada je utvrditi i statistički potkrepiti parametre za odabir materijala za retsauraciju stalnih zuba kod dece sa različitim fazama razvoja korena.

## Introduction

A large number of scientific and scientific-practical researches are devoted to the issue of diagnosis and choice of methods of restoration of hard tissues of teeth in children<sup>1-7</sup>. The choice of material for the restoration of lost hard tissues of teeth in children, usually, in addition to the characteristics of the material, is limited by the period of dentition and group affiliation of the tooth, which leads to complications such as filling defects and their loss, the development of complicated caries<sup>8-10</sup>. However, there are a number of factors such as local oral factors (pH of saliva, hygiene, tooth root development, enamel caries resistance, the depth of carious cavity, the area of destruction of the occlusal surface of the masticatory teeth) which play a significant role in quality and durability. Therefore, the development of clear criteria for diagnosis and optimization of the choosing of restorative material requires further study<sup>7-10</sup>.

The provision of qualified high-quality dental care to the children's contingent is complicated by the peculiarities of the psycho-emotional status of the patient. Children, in the vast majority of cases, are under stress, which requires a clear and rapid implementation of all medical manipulations, requires the use of minimally invasive and, at the same time, the most informative diagnostic measures and clear criteria for choosing restorative material<sup>11-14</sup>.

Considering the above, there is a need to develop clear objective statistically significant diagnostic criteria, which will lead to an improvement in the quality of dental services to the children.

The effectiveness of caries treatment depends on many factors, such as the condition of dental tissues, the stage of root development, the period of dentition, the quality of preparation and isolation, the optimal choice of material for restoration<sup>1-5,10</sup>. The problem of choosing the filling material is acute in each treatment of caries in children with mixed and permanent dentition<sup>15,16</sup>. Limited access to the cavity, abundant salivation, different structure of tooth tissues at different stages of its development, excitement of the child during dental manipulations and a number of other factors causes criteria that should meet filling materials for use in pediatric dentistry<sup>17-20</sup>.

**The aim.** To determine and statistically substantiate the parameters for choosing restorative material for permanent teeth in children with different stages of root development.

## Materijali i metode

Ovaj članak je deo istraživačkog rada Odeljenja za dečju stomatologiju, Nacionalnog univerziteta Užgorod „Sveobuhvatno opravdanje za pružanje stomatološke zaštite deci koja žive na području biogeohemijskog nedostatka fluora i joda“ (Državni registracioni broj 0119U101329). Studija je dobila odobrenje Komisije za bioetiku Medicinskog fakulteta Nacionalnog univerziteta Užgorodu Ukrajini.

Restauraciji defekata krunicnog dela zuba, naklinici, prethodilo je eksperi-mentalno potkrepljivanje kriterijuma za izbor materijala za restauraciju. U tu svrhu, proučavali smo prirodu prijanjanja restaurativnih materijala na tvrda tkiva zuba laboratorijskim studijama, koristeći odabrane materijale i to kompomer "Dyract eXtra" (Densply, SAD) i svetlosnopolimerizujućikompozit "Polofil Supra" (VOCO, Nemačka).

Pregledano je 248 dece uzrasta od 7 do 11 godina (122 dečaka i 126 devojčica) i 246 dece uzrasta od 12 do 17 godina (120 dečaka i 126 devojčica), učenika Srednje škole broj 20 u Užgorodu. Ovo je klinička baza Odeljenja za dečju stomatologiju Stomatološkog fakulteta Nacionalnog univerziteta Užgorod, prema sporazumu između Nacionalnog univerziteta Užgorodi Srednje škole broj 20, Užgorod, o zajedničkim aktivnostima, u oblasti obuke i medicinsko-konsultantskog rada (od 01.03. 2013). Anketa je sprovedena uz informisani pristanak roditelja ili staratelja. Rezultati istraživanja evidentirani su u zdravstvene knjižice stomatoloških pacijenta N 043 / o.

Indeks destrukcije okluzalne površine zuba (IDOST) određen je metodom koju je predložio V. Ju. Milikevich (1984)<sup>10</sup>: celokupno područje okluzalne površine zuba uzima se kao jedinica. Indeks destrukcije izračunava se iz jedinice, odnosno područja cele okluzalne površine. Ako je IDOST jednak 0 – 0,55, odnosno manje od 55% okluzalne površine zuba je destruirano – preporučuje se lečenje ispunom. Ako je IDOST jednak 0,56 – 0,6, odnosno više od 55% okluzalne površine je uništeno, indikovana je upotreba inleja, ako je indeks veći od 0,8 – indikovana je restauracija kolčićem.

Prirodna pH vrednost pljuvačke određena je pomoću test trakica<sup>10,14</sup>. Prethodno je pacijent pljunuo nestimulisano pljuvačku u posebnu čašu. Test traka je stavljena u pljuvačku na 10 sekundi, zatim je boja trake upoređena sa bojamana standardnoj skali i procenjena prema prirodi boje: crvena –pH u rasponu od 5,0 do 5,9; žuta –pH u rasponu od 6,0 do 6,7; zelena –pH u rasponu od 6,8 do 7,8.

## Materials and methods

This article is a fragment of the research work of the Department of Pediatric Dentistry, Uzhhorod National University «Comprehensive justification for providing dental care for children living in the area of biogeochemical deficiency of fluorine and iodine» (State Registration № 0119U101329). The study received a positive approval from the Commission on Bioethics of the Medical Faculty of Uzhhorod National University, Ukraine.

The restoration of defects of the coronal part in the Clinic was preceded by experimental substantiation of the criteria for choosing the restorative material. To this end, we studied the nature of the adhesion of restorative materials to the hard tissues of the teeth through laboratory studies using selected materials, namely the compomer "Dyract eXtra" (Densply, USA) and light-cured composite "Polofil Supra" (VOCO, Germany).

Two hundred forty-eight children aged 7 to 11 (122 boys and 126 girls) and 246 children aged 12 to 17 (120 boys and 126 girls), students of Uzhhorod Secondary School №20 were examined. This is the clinical base of the Department of Pediatric Dentistry of the Faculty of Dentistry of Uzhgorod National University, under the Agreement between Uzhhorod National University and Uzhhorod Secondary School № 20 on joint activities in the field of training and medical and consulting work (of 1.03.2013). The survey was conducted with the informed consent of parents or guardians. The results of the research were recorded in the medical card of the dental patient N 043/o.

The Index of Destruction of the Occlusal Surface of the Teeth (IDOST) was determined by the method proposed by V. Yu. Milikevich (1984)<sup>10</sup>: the entire area of the occlusal surface of the tooth is taken as a unit. The index of destruction is calculated from the unit, that is, the area of the entire occlusal surface. If the IDOST is equal to 0–0.55, that is, less than 55% of the occlusal surface of the tooth is destroyed – treatment with filling is recommended. If the IDOST is equal to 0.56–0.6, i.e., more than 55% of the occlusal surface is destroyed, the use of inlays is indicated, if the index is more than 0.8 – pin restorations is indicated.

The natural pH of saliva was determined using a strip test<sup>10,14</sup>. Previously, the patient spit unstimulated saliva into a special cup. The test strip was placed in the saliva for 10 seconds, then the color of the strip was compared on a standard scale and evaluated by the nature of the color: red –pH in the range of 5.0–5.9; yellow –pH in the range of 6.0–6.7; green –pH in the range of 6.8–7.8.



Da bismo statistički potkrepili jasnoću parametara, koji su važni pri izboru restaurativnog materijala i za analizu odnosa proučavanih parametara, odredili smo Spearmanov koeficijent korelacije ( $r$ ). Koeficijent korelacije smatran je statistički značajnim pri  $p < 0,05$ <sup>16</sup>.

Vrednost koeficijenta korelacije karakteriše zavisnosti vrednosti prema linearnom funkcionalu, što odgovara vrednosti  $r \pm 1$  koeficijenta korelacije. Ako je  $r_{xy} > 0$ , korelacija je pozitivna. To znači da sa rastom jedne od vrednosti, druga takođe, u proseku, raste. U slučaju kada je  $r_{xy} < 0$ , korelacija je negativna, odnosno, sa povećanjem jedne od vrednosti, druga opada, u proseku.

U nedostatku statističkog odnosa između vrednosti, koeficijent korelacije je nula. Nivo p-kriterijuma (statistička značajnost) zavisi i od vrednosti koeficijenta korelacije i od veličine eksperimentalne grupe, za koju je koeficijent korelacije određen<sup>13,16</sup>.

Predloženi skup studija omogućio je da se na osnovu morfološke analize utvrdi glavni kriterijumi, koje treba uzeti u obzir u fazi odabira materijala za restauraciju zuba.

U skladu sa utvrđenim ciljevima studije, ponekad je izvršena dodatna podela glavnih grupa na podgrupe. Izračunavanje prognostičkih koeficijenata za svaki znak izvedeno je matematičkom obradom dobijenih vrednosti prema Baiesovoj formuli:

$PC = 10 \lg P1/P2$ ;

PC – prognostički koeficijent;

P1 i P2 – verovatnoća prisustva znaka u svakoj grupi;

$P1 = S1/n1$ ,  $P2 = S2/n2$ , gde je S1, S2 – učestalost znaka u svakoj grupi;

n1, n2 – broj pacijenata koji su proučavani u svakoj grupi;

$10 \lg P1/P2$  – logaritam verodostojnosti, koji je zbog pogodnosti povećan 10 puta.

## Rezultati

Za decu uzrasta od 7 do 17 godina, upotrebljeni su najbolji materijali za restauraciju stalnih zuba u mešovitoj i stalnoj dentaciji: Polofil Supra (VOCO, Nemačka) i Dyract eXtra (Dentsply, SAD).

Za određivanje parametara, po kojima ovi materijali najbolje funkcionišu, izabrani su kriterijumi ocenjivanja, koji pokazuju direktnu korelaciju sa efikasnošću prijanjanja proučavanih materijala. Slika, takođe, prikazuje proporciju pozitivnih rezultata stomatološkog tretmana, upotrebom proučavanih materijala. Stoga, analizirano je 8 kriterijuma prikladnosti upotrebe istraživanog materijala, opisanih u prethodnom pododeljku.

In order to perform statistical substantiation of clarified parameters, which are important in choosing therestorative material and for the analysis of the relationships of the parameters that were studied, we determined the correlation coefficient ( $r$ ) of Spearman. The correlation coefficient was considered statistically significant at  $p < 0.05$ <sup>16</sup>.

The correlation value of the coefficient characterizes the degree of proximity of the dependence between the values to the linear functional, which corresponds to the value of  $r \pm 1$  correlation coefficient. If  $r_{xy} > 0$ , the correlation is positive. This means that with the growth of one of the values, the second—also, on average, increases. In the case when  $r_{xy} < 0$ —the correlation is negative, i.e. with increasing one of the values, the second—decreases on average.

In the absence of a statistical relationship between the values, the correlation coefficient is zero. The level of the p-criterion (statistical significance) depends on both the value of the correlation coefficient and the size of the experimental group for which the correlation coefficient is determined<sup>13,16</sup>.

The proposed set of studies made it possible, on the basis on morphological analysis, to determine the main criteria that should be considered at the stage of selection of restorative material.

In accordance with the established objectives of the study, additional division of the main groups into subgroups was sometimes carried out. Calculation of prognostic coefficients for each sign was carried out by mathematical processing of the obtained values according to Bayes formula:

$PC = 10 \lg P1/P2$ ,

PC—prognostic coefficient;

P1 and P2—probability of presence of a sign in each group;

$P1 = S1/n1$ ,  $P2 = S2/n2$ , where S1, S2—the frequency of the sign in each group;

n1, n2—the number of patients studied in each group.

$10 \lg P1/P2$ —the logarithm of plausibility, which for convenience increased 10 times.

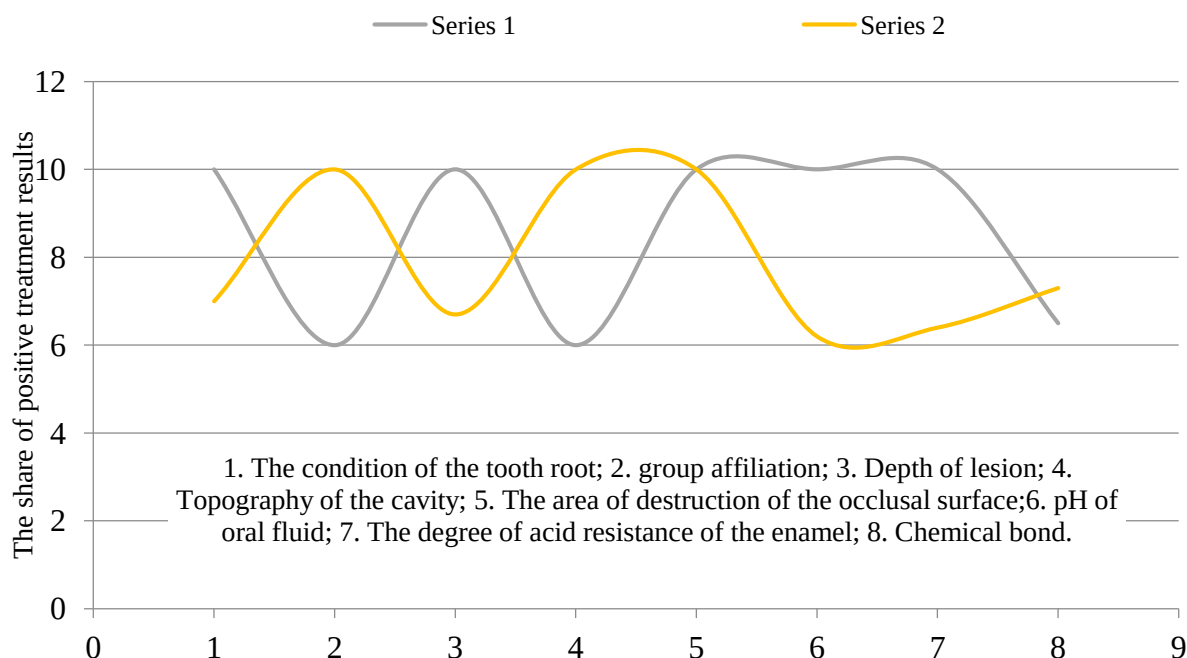
## Results

For children aged 7–17 years, the best materials used to restore permanent teeth during alternating and permanent dentition were: Polofil Supra (VOCO, Germany) and Dyract eXtra (Dentsply, USA).



Maksimalna vrednost na slici–10 pokazuje da se materijal sa ovim parametrom uvek može koristiti; 0 – materijal se uopšte ne može koristiti. Niz „prosečna vrednost“ pokazuje podobnost materijala za upotrebu, prema svim prosečno proučenim kriterijumima (Slika 1).

To determine the parameters at which these materials work best, evaluation criteria were selected that show a direct correlation with the adhesion efficiency of the studied reducing materials.

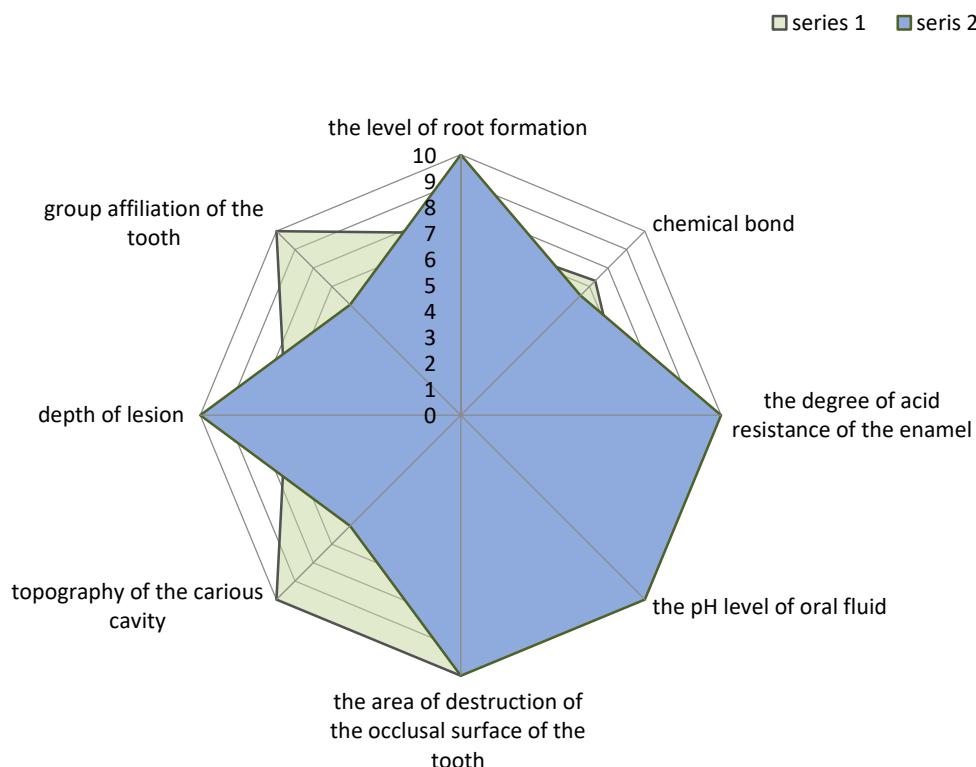


**Slika 1.** Indikatori upotrebe materijala za ispune kod dece sa različitim kriterijumima  
**Figure 1.** Indicators of the use of filling materials in children with different criteria

Rezultati složenih kliničkih i morfoloških studija, u kojima su ispitivana svojstva restaurativnih materijala i njihova naknadna statistička potkrepljenja, pokazuju da je kompozitni materijal „Dyract eXtra“ (Densply, SAD) visoko efikasan za upotrebu u slučajevima restauracije karijesnih lezija stalnih zuba u frontaloj i žvačnoj regiji zuba grupe (10 bodova), u stadijumu formiranog i neoformljenog korena (10 bodova), za lečenje karijes medije i dubokog karijesa (10 bodova), sa IDOST vrednostima  $<0,55$  (10 bodova). PH nivo pljuvačke i stepen otpornosti glede na kiselinu nisu odlučujući kriterijumi pri izboru ovog materijala (10 bodova). Adhezivna svojstva optimalna su za gleđ i dentin (10 bodova). Ne preporučuje se upotreba kompozitnog materijala „Dyract eXtra“ (Densply, SAD) unutar cementa (3 poena) i sa vrednošću IDOST  $> 0,55$  (0 poena) (Slika 2).

The Figure 1 also shows the proportion of positive results of dental treatment using the studied materials. Thus, 8 criteria of suitability of use of the researched material described in the previous subsection are analyzed. The maximal value in the table–10 shows that the material can always be used with this parameter, 0–the material cannot be used at all. The string “average value” shows the suitability of the material for use on all the criteria studied on average (Figure 1).

The results of complex clinical and morphological studies of the properties of restorative materials and their subsequent statistical substantiation show that the compomer material "DyractExtra" (Densply, USA) is highly effective for use in cases of restoration of carious cavities of permanent teeth, both frontal and masticatory groups (10 points), at the stage of formed and unformed root (10 points), for the treatment of moderate and deep caries (10 points), with IDOST values  $<0.55$  (10 points).



**Slika 2.** Gradacijska skala pokazatelja optimalne upotrebe materijala za restauraciju stalnih zuba

**Figure 2.** Gradation scale of indicators of optimal use of filling materials for restoration of permanent teeth

Kao rezultat sveobuhvatne kliničke i morfološke studije svojstava kompozitnog materijala „Polofil Supra“ (VOCO, Nemačka) i naknadne statističke analize, utvrđeni su sledeći parametri: upotreba za restauraciju karijesnih lezija stalnih zuba žvačne i frontalne grupe (10 bodova), sa razvijenim korenima zuba (9,8 bodova), za lečenje superficijalnog karijesa (10 bodova), karijes medije (10 bodova) i dubokog karijesa (6 bodova), uzimajući u obzir područje destrukcije okluzalne površine zuba <0,55 (10 poena), kada je pH pljuvačke veća od 6,2 (6,2 poena), sa visokim (10 poena) i srednjim (7,4 poena) stepenom otpornosti gleđi na kiseline.

Kompomerni materijal „Dyract eXtra“ (Dentsply, SAD) optimalan je za restauraciju stalnih zuba, bez obzira na stanje razvoja korena, dubinu karijesnog procesa, kada je vrednost indeksa destrukcije okluzalne površine zuba manji od 0,55, pri bilo kom

The pH level of the saliva and the degree of acid resistance of the enamel are not determining criteria when choosing this material (10 points). Adhesive properties are optimal for enamel and dentin (10 points). It is not recommended to use the compomer material "DyracteXtra" (Dentsply, USA) within the cement (3 points) and with the value of IDOST>0.55 (0 points) (Figure 2).

As a result of a comprehensive clinical and morphological study of the properties of the composite material "Polofil Supra" (VOCO, Germany) and subsequent statistical analysis, the following parameters were established: the use in the restoration of carious cavities of permanent teeth of the masticatory and frontal group (10 points), with developed roots (9, 8 points), for the treatment of superficial (10 points), medium (10 points) and deep (6 points) caries, taking into account the area of destruction of the occlusal surface of the tooth <0.55 (10 points), when the pH of the saliva is more than 6.2 (6.2 points), with

nivou pH pljuvačke i stepenu otpornosti gleda na kiselinu, sa Spearmanovim koeficijentom korelacije ( $r = 0,80$ ).

Kompozitni materijal „Polofil Supra“ (VOCO, Nemačka) je materijal izbora u lečenju stalnih zuba, u restauraciji karijesnih lezija bilo koje grupe zuba, kod zuba sa završenim razvojem korena, za lečenje površinskog i sekundarnog karijesa, u estetski značajnim područjima i za restauraciju sa intenzivnim mehaničkim opterećenjem, pri pH vrednosti pljuvačke 6,2, visokom i srednjem stepenu otpornosti gleda na kiseline, sa Spearmanovim koeficijentom korelacije ( $r = 0,72$ ).

## Diskusija

Budući da lečenje karijesa stalnih zuba kod dece sa različitim stepenom razvijenosti ovog oboljenja podrazumeva hirurško uklanjanje zahvaćenih tvrdih zubnih tkiva i restauraciju anatomskog i funkcionalnog integriteta zuba, optimalan izbor materijala za restauraciju značajan je faktor u efikasnosti lečenja ovog oboljenja i određuje njegovu trajnost.

Raznolikost restaurativnih materijala dostupnih na stomatološkom tržištu zahteva jasne kriterijume odabira za svaki pojedinačni slučaj. Obično su glavne indikacijske karakteristike materijala period denticije i grupa kojoj zub pripada, što dovodi do komplikacija, kao što su defekti i gubitak ispunai razvoj komplikacija karijesa.

Statistička istraživanja pokazala su toda sledeći faktori igraju važnu ulogu u kvalitetu i trajnosti restauracije tvrdog tkiva stalnih zuba: period denticije i, shodno tome, stepen razvoja korena i grupa kojoj zub pripada, kao i lokalizacija i dubina karijesnih lezija. Lokalni oralni faktori, kao što su higijena, pH pljuvačke i otpornost zubne gleđi na kiselinu, imaju značajan uticaj.

Izbor materijala za plombiranje zavisi od karakteristika samog materijala, poput hemijske ili adhezivne veze sa tkivima zuba, što je u korelaciji sa dubinom oštećenja zuba, čvrstoćom i modulom elastičnosti materijala, koji određuju izbor, u zavisnosti od pripadnosti zuba određenoj grupi i topografske lokacije lezija. Kriterijum destrukcije okluzalnih površina bočnih zuba takođe je važan.

Koristeći statističku skalu gradacije napred navedenih parametara, istaknute su korelacione zavisnosti, sa različitim kriterijumima korelacije i istaknut je Spearmanov koeficijent korelacije, kao najznačajniji.

high (10 points) and medium (7.4 points) degrees of acid resistance of enamel.

Compomer material "DyractExtra" (Dentsply, USA) is optimal for the restoration of permanent teeth, regardless of the state of root development, the depth of the carious process, when the value of the index of destruction of the occlusal surface of the tooth is less than 0.55, at any pH level and the degree of acid resistance of the enamel with the Spearman correlation coefficient ( $r = 0.80$ ).

Composite material "Polofil Supra" (VOCO, Germany) serves as a material of choice in the treatment of permanent teeth, in the restoration of carious cavities of any group, in the state of the developed root, for the treatment of superficial and secondary caries, in aesthetically significant areas and for restoration, carrying an intense mechanical load, at the pH value of saliva at 6.2, high and medium degrees of acid resistance of enamel with a Spearman correlation coefficient ( $r = 0.72$ ).

## Discussion

Because the treatment of permanent teeth caries in children with varying degrees of caries is surgical removal of the affected hard tissues and restoration of the anatomical and functional integrity of the tooth, the optimal choice of material for restoration is a significant factor in treatment effectiveness and determines its durability. The variety of restorative materials available on the dental market requires clear selection criteria for each case. Usually, the main indications are the characteristics of the material, the period of dentition and the group affiliation of the tooth, which leads to complications such as filling defects and their loss, the development of complicated caries.

Statistical studies have shown that the following factors play an important role in the quality and durability of hard tissue restoration of permanent teeth: the period of dentition and, accordingly, the degree of root development and group affiliation of the tooth, localization of carious lesions and its depth. Local oral factors such as hygiene, saliva pH and acid resistance of tooth enamel have a significant effect.

The choice of filling material depends on the characteristics of the material itself, such as chemical or adhesive bond with the tissues of the tooth, which correlates with the depth of tooth damage; the strength of the material and elasticity module, which

Za stomatologe za decu, propisane sujasne indikacije za upotrebu različitih vrsta restaurativnih materijala za lečenje karijesa stalnih zuba kod dece i adolescenata, u zavisnosti od perioda razvoja zuba, stanja razvoja korena, pripadnosti zuba određenoj funkcionalnoj grupi, dubine i topografije karijesnog procesa, pH pljuvačke, stepena otpornosti gleđi na kiselinu i područje destrukcija okluzalne površine zuba.

Kompozitni materijal "Polofil Supra" (VOCO, Nemačka) treba koristiti u lečenju karijesa svih grupa stalnih zuba, u fazi formiranog korena, pri bilo kojoj dubini karijesnog procesa, bez obzira na klinički tok karijesa, pri pH vrednosti pljuvačke  $> 6,2$ , za obnavljanje lezija u estetski značajnim područjima i područjima koja nose intenzivno mehaničko naprezanje.

Kompomerni materijal „Dyract eXtra“ (Densply, SAD) može se preporučiti za restauraciju žvačnih zuba u lečenju karijesa, bilo koje dubine, sa nezavršenim rastom korenom zuba, bez obzira na stepen otpornosti gleđi na kiselinu i prirodu karijesnog procesa.

### **Zaključak**

Utvrđeno je prisutvo korelacija između stepena funkcionalne zrelosti zubnog tkiva, perioda denticije, stanja razvoja korena, prirode karijesnog procesa, dubine i topografije karijesne lezija, indeksa destrukcije okluzalne površine zuba, pH nivoa pljuvačke i stepena otpornosti zubne gleđina kiseline.

Za restauraciju stalnih zuba, bez obzira na stepen razvoja korena zuba, na topografiju karijesne lezije i njene dubine, pH nivoa pljuvačke, stepen otpornosti gleđi na kiseline, pri vrednosti IDOST  $< 0,55$ , racionalno je koristiti kompomerni materijal „Dyract eXtra“ ( $r = 0,80$ ), i kompozitni materijal „Polofil Supra“ u uslovima razvijenog korena zuba, pri pH vrednosti većoj od  $6,2$ , uz visok stepen otpornosti gleđi na kiselinu i područje destrukcije okluzalne površinemanje od  $0,55$  ( $r = 0,72$ ).

determines the choice depending on the group affiliation of the tooth and the topography of the cavity location. The criterion of destruction of the occlusal surface of the masticatory teeth is important.

Using the statistical-gradation scale of the above parameters, correlation dependencies with different correlation criteria were highlighted and the most significant Spearman was distinguished.

For pediatric dentists, clear indications for the use of different types of restorative materials in the treatment of caries of permanent teeth in children and adolescents, depending on the period of dentition, the state of root development, group affiliation of teeth, depth and topography of carious process, pH of saliva, the degree of acid resistance of the enamel and the area of destruction of the occlusal surface of the tooth.

Composite material "Polofil Supra" (VOCO, Germany) should be used in the treatment of caries of all groups of permanent teeth, at the stage of the formed root, at any depth of carious process, regardless of the clinical course of caries, pH value  $> 6.2$ , to restore cavities in aesthetically significant areas and areas that carry intense mechanical stress.

Compomer material "Dyract eXtra" (Densply, USA) can be recommended for the restoration of masticatory teeth in the treatment of caries of any depth, with unformed tooth root, regardless of the degree of acid resistance of the enamel and the nature of the carious process.

### **Conclusion**

The presence of correlations between the degree of functional maturity of dental tissues, the period of dentition, the state of root development, the nature of the carious process, the depth and topography of the carious cavity, the index of destruction of the occlusal surface of the tooth, the pH level of saliva and the degree of the acid resistance of tooth enamel have been established.

To restore permanent teeth in any condition of root development, regardless of the topography of the carious cavity, its depth, pH level of saliva, the degree of acid resistance of the enamel, at the value of IDOST  $< 0.55$  rational to use compomer material "Dyract eXtra" ( $r = 0,80$ ), and composite material "Polofil Supra" - under the conditions of the root development, at a pH level greater than  $6.2$ , a high degree of acid resistance of the enamel and the area of destruction of the occlusal surface is less than  $0.55$  ( $r = 0.72$ ).

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# PROCENA RIZIKA ZA NASTANAK ORTODONTSKIH NEPRAVILNOSTI KOD DECE U PRIGRADSKIM NASELJIMA

## RISK ASSESSMENT OF ORTHODONTIC ANOMALIES IN CHILDREN IN SUBURBAN AREAS

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### Sažetak

**Uvod:** Ortodontske nepravilnosti su veoma učestale kako u svetu, tako i kod nas. Etiologija ortodontskih anomalija je multifaktorijska, složena i uslovljena brojnim genetskim i negenetskim faktorima: endogenim i egzogenim. Sprečavanje nastanka ortodontskih nepravilnosti je moguće ukoliko imamo uvid u najčešće etiološke faktore.

**Cilj:** Proceniti učestalost pojedinih etioloških faktora i proceniti ukupan rizik za nastanak ortodontskih anomalija kod dece u prigradskoj sredini.

**Materijali i metode:** Istraživanje je izvršeno na 115 dece, učenika prvog razreda osnovne škole (28.68% od svih učenika 1. razreda), prosečne starosti od 6.8 godina, iz 4 naselja iz okoline Novog Sada: Kisač, Kač, Veternik, Futog. Istraživanje je sprovedeno u vidu anonimnih anketa na zaokruživanje za roditelje uz prethodno objašnjenje postavljenih pitanja. Pitanjima su bili obuhvaćeni etiološki faktori za nastanak ortodontskih nepravilnosti (oboljenja u trudnoći, tok porođaja, dojenje, dohranjivanje i hranjenje, vrsta cucle, položaj boce pri ishrani, loše navike, položaj pri spavanju, položaj ruku pri spavanju u odnosu na vilicu, visina uzglavlja, disanje na usta, ortodontske nepravilnosti kod roditelja).

**Rezultati:** Ukazuju na sledeće etiološke faktore kao najčešće: dohranjivanje i hranjenje cuclom (u 41.74% slučajeva), dojenje od 0 do 6 meseci (40.87% ispitanih) i disanje na usta (u 24.35% dece). U ispitivanju ukupnog rizika za nastanak ortodontskih nepravilnosti nizak rizik je bio ustanovljen u 95.65% slučajeva, srednji rizik u 4.35% (u Kisaču 9.38%, u Kaču 2.94%, u Veterniku 4.35%, u Futogu 0% dece), dok ispitanika sa visokim rizikom nije bilo.

**Zaključak:** Preventivne mere treba usmeriti na edukaciju majki o potrebi i prednostima prirodnog načina ishrane dojenjem i da za dohranjivanje i hranjenje koriste kašičicu.

**Cljučne reči:** ortodontske nepravilnosti, dohranjivanje deteta, dojenje, disanje na usta

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### Abstract

**Introduction:** Orthodontic anomalies are very common both in the world and in our country. The etiology of orthodontic anomalies is multifactorial, complex and conditioned by numerous genetic and non-genetic factors: endogenous and exogenous. Prevention of orthodontic anomalies is possible if we have an insight into the most common etiological factors.

**Goal:** To assess the frequency of individual etiological factors and assess the overall risk of orthodontic anomalies in children in suburban environments.

**Materials and methods:** The research was conducted on 115 children, first grade elementary school pupils (28.68% of all 1st grade students), average age of 6.8 years, from 4 settlements around Novi Sad: Kisač, Kač, Veternik, and Futog. The research was conducted in the form of anonymous rounding surveys for parents with a preliminary explanation of the questions asked. The questions included etiological factors for the occurrence of orthodontic anomalies (diseases in pregnancy, childbirth, breastfeeding, supplementation and feeding, type of pacifier, position of the bottle when eating, bad habits, position when sleeping, position of arms when sleeping in relation to the jaw, pillow height, mouth breathing, orthodontic anomalies in parents).

**Results:** Results indicate the following etiological factors as the most common: supplementary feeding and bottle feeding (in 41.74% of cases), breastfeeding from 0 to 6 months (40.87% of respondents) and mouth breathing (in 24.35% of children). In the examination of the total risk for orthodontic anomalies, low-risk was found in 95.65% of cases, medium-risk in 4.35% (in Kisač 9.38%, in Kač 2.94%, in Veternik 4.35%, in Futog 0% of children), while there were no high-risk respondents.

**Conclusion:** Preventive measures should be aimed at educating mothers about the need and benefits of a natural way of breastfeeding and of using a spoon for supplementation and feeding.

**Key words:** orthodontic anomalies, breastfeeding, supplementation, mouth breathing

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za stomatologiju Niš. Sva prava zadržana.

## Uvod

Ortodontske nepravilnosti predstavljaju stanje bilo kojeg odstupanja od normalne ili idealne okluzije. Edward H. Angle 1890. godine daje prvu jasnu i jedinstvenu definiciju normalne prirodne okluzije. Anglov postulat bio je da su gornji prvi molari ključevi okluzije i da odnos gornjih i donjih prvih molara mora biti takav da meziobukalna kvržica gornjeg prvog molara okludira sa bukalnom fisurom donjeg prvog molara. Ako su zubi poređani po lagano zakrivljenoj liniji okluzije uz prethodno spomenut odnos molara, rezultat je normalna okluzija<sup>1</sup>.

Ortodontske nepravilnosti su veoma učestale, preko 70% kako u svetu, tako i kod nas. Takvo stanje zahteva primenu intenzivnih preventivnih mera od strane stomatologa, kao i edukacionih programa u obdaništima i obrazovnim ustanovama, jer malokluzije dovode do narušavanja izgleda lica, poremećaja u funkciji žvakanja, povećanog rizika od trauma zuba i smanjenja kvaliteta života<sup>1,2</sup>.

Preventivne mere u ortodontiji obuhvataju jednostavne zahvate i preporuke koji eliminišu ili smanjuju delovanje faktora koji dovode do nastanka ortodontskih anomalija, čime se obezbeđuju povoljni uslove za normalan rast i razvoj orofacijalne regije. Preventivne mere podrazumevaju: promociju faktora koji pozitivno utiču na oralno zdravlje, preporuke higijensko-dijetetskog režima trudnica i prevenciju u doba odojčeta, mešovite i stalne denticije. Ove mere se ne mogu sprovoditi samo u ordinaciji, već se moraju koristiti sva moguća sredstva da informacija stigne do krajnjeg korisnika<sup>3</sup>.

Preventivne mere treba usmeriti na edukaciju majki o potrebi i prednostima prirodnog načina ishrane dojenjem. S ortodontskog stanovišta, sisanje je podstrek za normalni razvoj lica i vilica jer se razvija 60 puta veća snaga mišića nego kod veštačke ishrane na flašicu. Kada majka nema dovoljno mleka, pa dete treba da se dohranjuje, preporučuje se da se to čini na kašičicu a ne na flašicu, da se izbegne opasnost od odbijanja dojenja, jer ono zahteva veći radni napor. Po prestanku dojenja najprirodnije je preći na ishranu pomoću čaše i kašičice<sup>4</sup>.

Etiologija ortodontskih anomalija je vekovima predmet interesovanja ortodonata i svih koji su se bavili razvojem orofacijalnih struktura. U manjku bazičnih genetskih znanja, mislilo se da su na razvoj različitih anomalija uticali isključivo lokalno dejstvujući faktori - upražnjavanje loših navika.

## Introduction

Orthodontic anomalies represent a condition of any deviation from normal or ideal occlusion. Edward H. Angle in 1890 gives the first clear and unique definition of normal natural occlusion. Angle's postulate was that the upper first molars are the keys to occlusion, and that the ratio of the upper and lower first molars has to be such that the mesiobuccal cusp of the upper first molar occludes with the buccal groove of the lower first molar. If the teeth are arranged along a slightly curved line of occlusion with the previously mentioned molar ratio, the result is normal occlusion<sup>1</sup>.

Orthodontic anomalies are very common; it is over 70% both in the world and in our country. Such a condition requires the application of intensive preventive measures by dentists, as well as educational programs in kindergartens and educational institutions, since malocclusions lead to impaired facial appearance, masticatory disorders, increased risk of dental trauma and reduced quality of life<sup>1,2</sup>.

Preventive measures in orthodontics include simple procedures and recommendations that eliminate or reduce the effects of factors leading to the occurrence of orthodontic anomalies, thus providing favourable conditions for normal growth and development of the orofacial region. Preventive measures include: promotion of factors that positively affect oral health, recommendations of hygienic dietary regime of pregnant women and prevention in infancy, mixed and permanent dentition. These measures cannot be implemented only at the clinic; all possible means have to be used to get the information to the end user<sup>3</sup>.

Preventive measures should be aimed at educating mothers about the need and benefits of a natural breastfeeding. From an orthodontic point of view, sucking is an incentive for normal facial and jaw development because it develops 60 times more muscle strength than bottle-feeding. When the mother does not have enough milk, and the child needs to be supplemented, it is recommended to do it with a spoon and not on a bottle, to avoid the danger of refusing breastfeeding, since it requires more work. After stopping breastfeeding, it is most natural to switch to a feeding with a glass and a spoon<sup>4</sup>.

The etiology of orthodontic anomalies has been the subject of interest of orthodontists and all those who have dealt with the development of orofacial structures for centuries.



Međutim, razvojem genetike sve više se akcenat stavlja na nasleđe kao odlučujući etiološki činilac za nastanak ortodontskih anomalija. Poznavanje uloge genetike je od suštinskog značaja za ortodonte koji pomažu da se razume zašto pacijent ima drugačiju okluziju, jer je ona manifestacija uticaja genetskih faktora i faktora spoljasnje sredine, i njihove međusobne interakcije na razvoj orofacijalnog kompleksa<sup>5</sup>.

Najveći korak ka rasvetljavanju prave etiologije ortodontskih anomalija načinjen je prepoznavanjem da je ona multifaktorijska i složena<sup>6</sup>. Same ortodontske nepravilnosti mogu biti nasledne i nenasledne. U slučaju ovih drugih deluju endogeni i egzogeni negenetski faktori. Najčešće ne možemo uticati na nasleđe, te je eliminisanje egzogenih činilaca je najočiglednije rešenje.

Različita rasprostranjenost ortodontskih anomalija u svetu i u regionu upravo svedoči o njihovoj složenoj etiologiji: u izolovanim populacijama prevalencija malokluzija je veća (zbog veće zastupljenosti homozigota i recesivnih gena), ali i u modernom industrijalizovanom svetu je incidencija malokluzija značajno porasla u poslednjih 150 godina usled promenjenog načina života i prisustva loših navika<sup>7</sup>.

Veliki broj autora istraživanjima u različitim delovima sveta dobija podatke o prisustvu ortodontskih nepravilnosti koji se kreću u širokom rasponu i ukazuju na izraženu rasprostranjenost ovih anomalija<sup>7,8,9,10,11</sup>. Najčešće dobijeni rezultati u toku ranije sprovedenih istraživanja u domaćoj i stranoj literaturi variraju od 29,42 do 81%<sup>12</sup>.

Najveći procenat prisustva ortodontskih anomalija nalaze Lauc – 93,3% i Ciuffolo i sar. - 93%, kod dece uzrasta 7-14 i 11-14 godine, respektivno. Prema istraživanju Thilander-a i sar. kod 4724 deteta uzrasta 5-17 godina 88% ispitanih ima prisutne ortodontske anomalije. Carvalho i sar. nalaze ortodontske nepravilnosti kod 44,3% dece sa mlečnom denticijom. U našoj zemlji Đurić nalazi 72,3% dece uzrasta 3-7 godina sa različitim oblicima ortodontskih anomalija, u regionu Milinkovic nalazi 52,67% ortodontskih anomalija u uzrastu dece od osam godina<sup>13</sup>.

Istraživanja sprovedena sa ciljem da se proceni potreba za ortodontskim lečenjem, ukazuju na manji, ali još uvek zabrinjavajući procenat<sup>14-16</sup>. U istraživanjima dobijeni rezultati kreću se od 35,3% (A. Liepa i sar., 505 dece uzrasta 12-13 god.) do 74% slučajeva u kojima je potrebna ortodontska terapija (Abu Alhaija i sar., 1002 dece uzrasta 12-14 god.), a dobiju se i podaci o potrebi lečenja u 51,7%<sup>17</sup>.

In the absence of basic genetic knowledge, it was thought that the development of various anomalies was influenced exclusively by locally acting factors - the exercise of bad habits. However, with the development of genetics, more and more emphasis is placed on inheritance as a decisive etiological factor for the development of orthodontic anomalies. Knowledge of the role of genetics is essential for orthodontists who help understand why the patient has a different occlusion, since it is a manifestation of the influence of genetic and environmental factors and their mutual interactions on the development of the orofacial complex<sup>5</sup>.

The largest step towards elucidating the true etiology of orthodontic anomalies was made by recognizing that it is multifactorial and complex<sup>6</sup>. Orthodontic anomalies themselves can be hereditary or non-hereditary. In the case of the latter, endogenous and exogenous non-genetic factors are in action. Usually, we cannot influence the heritage, so eliminating exogenous factors is the most obvious solution.

The different prevalence of orthodontic anomalies in the world and in the region testifies to their complex etiology: in isolated populations the prevalence of malocclusion is higher (due to the higher presence of homozygotes and recessive genes); however, in the modern industrialized world as well, the incidence of malocclusion has increased significantly in the last 150 years due to a changed lifestyle and the presence of bad habits<sup>7</sup>.

A large number of authors have obtained data on the presence of orthodontic anomalies in various parts of the world, which range widely and indicate a pronounced prevalence of these anomalies<sup>7,8,9,10,11</sup>. The most frequently obtained results during previously conducted research in domestic and foreign literature vary from 29,42 to 81%<sup>12</sup>.

The highest percentage of the presence of orthodontic anomalies is found by Lauc - 93.3% and Ciuffolo et al. - 93%, in children 7-14 and 11-14 years old, respectively. According to a study by Thilander et al., of 4,724 children 5-17 years old, 88% of respondents have orthodontic anomalies. Carvalho et al. found orthodontic anomalies in 44.3% of children with deciduous dentition. In our country, Đurić finds 72.3% of children 3-7 years old with various forms of orthodontic anomalies, while Milinkovic in the region finds 52.67% of orthodontic anomalies in children who are eight years old<sup>13</sup>.



ispitanih (Tausche i sar., 1975 dece uzrasta 6-8 god.). Al Nimri i Richardson nalaze da je svakom trećem detetu (33% od 2002 dece) potreban intercektivni ortodontski tretman<sup>17</sup>.

Ovakvi rezultati ukazuju da postoje veliki propusti na nivou preventivnog i ranog ortodontskog delovanja prevashodno na mladu populaciju. Počev od rođenja, kroz mlečnu, mešovitu i stalnu denticiju, sagledavanjem genetskih predispozicija, insistiranjem na pravilnom vršenju orofacijalnih funkcija i intercektivnim korigovanjem početnih razvojnih odstupanja, ortopedija vilica ima mogućnosti da usmerava rast i razvoj kraniofacijalnog kompleksa, znači, može u velikoj meri da osujeći nastanak teških skeletnih nepravilnosti, sagitalnog, transferalnog i vertikalnog pravca, koje se u doba adolescencije moraju lečiti komplikovanim i skupim ortodontskohirurškim zahvatima<sup>18</sup>.

Učestalost ortodontskih nepravilnosti je danas nekoliko puta češća nego pre 1000 godina, što se smatra posledicom "civilizacijskog napretka" u kvalitetu života<sup>19</sup>.

Iz gore iznetog vidi se da su ortodontske nepravilnosti veoma učestale, te je neophodno ispitivanje njihovih etioloških činilaca. Preventivne mere možemo usmeriti najefikasnije na egzogene etiološke faktore, od kojih su najprisutniji nepravilna ishrana deteta, loše navike (disanje na usta, sisanje prsta ili različitih predmeta, tiskanje jezika, infantilno gutanje) i prevremeni gubitak zuba usled karijesa. Đurić i Milićević u istraživanjima na 167 roditelja dece od 4 do 6 godina starosti u Novom Sadu, dobiju podatke o navici sisanja u 56,89% dece, kratkom periodu dojenja kod 47,14% ispitanih, navici spavanja sa otvorenim ustima u 22,16% slučajeva, prisustvu karijesa kod 72,26% dece (kep 667 od ukupno 3007 pregledanih zuba, %k 82,28%)<sup>20</sup>.

Novije istraživanje Knosel-a i saradnika iz 2016. godine pokazalo je da su malokluzije u sagitalnoj ravni i duboki zagrižaj (overjet) u kombinaciji sa teskobom u maksilarnoj regiji povezane s oralnim disanjem. U vertikalnoj ravni otvoreni zagrižaj i smanjena dubina zagrižaja (overbite) takođe su se pojavljivali češće nego u normalnoj populaciji. Osim toga u transversalnoj ravni u bočnom segmentu ukršten zagrižaj isto tako pokazuje veću incidenciju pri disanju na usta<sup>21</sup>.

Preventivno delovanje u cilju smanjenja učestalosti ortodontskih anomalija je moguće ako imamo uvid u najčešće etiološke faktore u određenoj populaciji. Zbog toga smo postavili sledeći cilj.

- proceniti učestalost pojedinih etioloških faktora, kao i procenu ukupnog rizika za nastanak ortodontskih anomalija kod dece u prigradskoj sredini.

Research conducted to assess the need for orthodontic treatment indicates a lower but still worrying percentage<sup>14-16</sup>. The results obtained in the research range from 35.3% (A. Liepa et al., 505 children 12-13 years old) to 74% of cases in which orthodontic therapy is required (Abu Alhaia et al., 1002 children 12-14 years old), and data on the need for treatment are obtained in 51.7% of respondents (Tausche et al., 1975 children 6-8 years old). Al Nimri and Richardson find that every third child (33% of 2002 children) needs interceptive orthodontic treatment<sup>17</sup>.

These results indicate that there are major gaps in the level of preventive and early orthodontic action, primarily on the young population. Starting from birth, through milk, mixed and permanent dentition, by considering genetic predispositions, insisting on the proper performance of orofacial functions and interceptive correction of initial developmental deviations, jaw orthopedics has the ability to direct the growth and development of the craniofacial complex, so it can greatly thwart severe skeletal anomalies in the sagittal, transverse and vertical direction, which in adolescence have to be treated with complicated and expensive orthodontic surgery<sup>18</sup>.

The frequency of orthodontic anomalies is several times more common today than 1000 years ago, which is considered a consequence of "civilizational progress" in the quality of life<sup>19</sup>.

From the above-mentioned, it can be observed that orthodontic anomalies are very common, and it is necessary to examine their etiological factors. Preventive measures can be focused most effectively on exogenous etiological factors, the most common of which are improper nutrition of the child, bad habits (mouth breathing, sucking fingers or various objects, pressing the tongue, infantile swallowing) and premature tooth loss due to caries. Đurić and Milićević in their research on 167 parents of children aged 4 to 6 in Novi Sad, obtained data on the habit of sucking in 56.89% of children, short breastfeeding in 47.14% of respondents, sleeping habits with open mouth in 22.16% of cases, the presence of caries in 72.26% of children (app. 667 out of 3007 examined teeth, % k 82.28%)<sup>20</sup>.

A recent study by Knosel et al. from 2016 showed that sagittal plane malocclusions and overjet combined with crowding in the maxillary region were associated with oral respiration. In the vertical plane, open bite and reduced bite depth (overbite) also occurred more frequently than in the normal population. In addition, in the transverse plane in the lateral segment, the cross-bite also shows a higher incidence in mouth breathing<sup>21</sup>.

## Materijali i metode

Istraživanje je izvršeno na 115 deteta (učenika prvog razreda osnovne škole, prosečne starosti od 6,8 godina) iz 4 naselja iz okoline Novog Sada, i to tridesetdva deteta iz Kisača, tridesetčetvoro iz Kaća, dvadesettroje iz Veternika i dvadesetšestoro iz Futoga, što čini ukupno 28,68% od svih učenika prvog razreda.

Istraživanje je sprovedeno u vidu anonimnih anketa na zaokruživanje za roditelje, uz prethodno objašnjenje u anketi postavljenih 12 pitanja. Pitanjima su bili obuhvaćeni etiološki faktori odgovorni za nastanak ortodontskih nepravilnosti:

- Oboljenja u trudnoći
- Tok porođaja
- Dojenje
- Dohranjivanje i hranjenje
- Vrsta cucle
- Položaj boce pri ishrani
- Loše navike
- Položaj pri spavanju
- Položaj ruku pri spavanju u odnosu na vilicu
- Visina uzglavlja
- Disanje na usta
- Ortodontske nepravilnosti kod roditelja

Roditelji su davali odgovore zaokruživanjem jednog od ponuđenih odgovora. Svaki odgovor je nosio određen broj bodova, koji su na kraju sabirani. Stepenn rizika za nastanak ortodontskih nepravilnosti zatim je procenjivan na osnovu sledećeg kriterijuma (maksimalni broj bodova bio je 18):

Preventive action in order to reduce the frequency of orthodontic anomalies is possible if we have an insight into the most common etiological factors in a particular population. That is the reason to set the following goal:

- to assess the frequency of individual etiological factors, as well as the assessment of the overall risk of orthodontic anomalies in children in the suburban environment.

## Materials and Methods

The research was conducted on 115 children (first grade elementary school pupils, average age of 6.8 years) from 4 settlements around Novi Sad, namely thirty-two children from Kisač, thirty-four from Kač, twenty-three from Veternik and twenty-six from Futog, which makes a total of 28.68 % of all first grade pupils.

The research was conducted in the form of anonymous rounding surveys for parents with a preliminary explanation of 12 questions asked in the survey. The questions covered the etiological factors responsible for the occurrence of orthodontic anomalies:

- Diseases in pregnancy
- The course of labour
- Breastfeeding
- Supplementary feeding and feeding
- Type of pacifier
- Bottle position when feeding
- Bad habits
- Sleeping position
- Position of the arms when sleeping in relation to the jaw
- Pillow height
- Mouth breathing
- Orthodontic anomalies in parents

Parents gave answers by circling one of the offered answers. Each answer carried a certain number of points, which were eventually added up. The risk level for the occurrence of orthodontic anomalies was then assessed on the basis of the following criteria (maximum number of points was 18):

| Broj bodova/Number of points | Stepen rizika/Risk level |
|------------------------------|--------------------------|
| 0-6                          | nizak/low                |
| 7-12                         | srednji/medium           |
| 13-18                        | visok/high               |

Po prikupljenim anketama izvršena je statistička obrada podataka.  
According to the collected surveys, statistical data processing was performed.

**Rezultati**

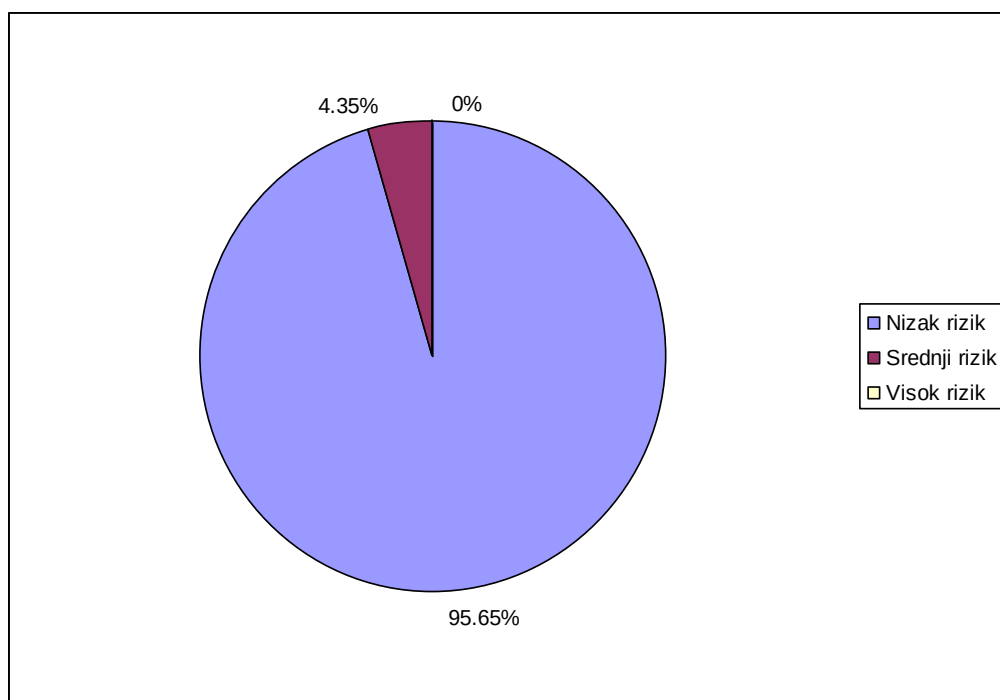
Rezultati istraživanja prikazani su u Tabelama 1 i 2 i na Grafikonima 1, 2 i 3

**Results**

The results of the research are shown in Tables 1 and 2 and in Graphs 1, 2 and 3

**Tabela 1:** Rezultati ankete**Table 1:** Survey results

| PITANJA/QUESTIONS                                                                                           | ODGOVORI/RESPONSES                         | BROJ/NUMBER | %     |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------|-------------|-------|
| Oboljenja u trudnoći/<br>Diseases in pregnancy                                                              | ne/no                                      | 108         | 93.91 |
|                                                                                                             | da/yes                                     | 7           | 6.09  |
|                                                                                                             | rubeola/rubella                            | 0           | 0     |
| Porodaj/<br>Childbirth                                                                                      | lak/carski rez/easy /<br>caesarean section | 102         | 88.7  |
|                                                                                                             | težak/difficult                            | 12          | 10.43 |
|                                                                                                             | forcepsom/forceps                          | 1           | 0.87  |
| Dojenje/<br>Breastfeeding                                                                                   | 7-9 meseci/months                          | 68          | 59.13 |
|                                                                                                             | 3-6 meseci/months                          | 38          | 33.04 |
|                                                                                                             | manje od 2 meseca/less<br>than 2 months    | 9           | 7.83  |
| Dohranjivanje i<br>hranjenje/<br>Supplementation and<br>feeding                                             | kašičicom/with spoon                       | 67          | 58.26 |
|                                                                                                             | cuclo/With pacifier                        | 48          | 41.74 |
| Vrsta cucle/<br>Type of pacifier                                                                            | anatomska/anatomical                       | 101         | 87.83 |
|                                                                                                             | ostalo/other                               | 14          | 12.17 |
| Položaj boce pri ishrani/<br>The position of the bottle<br>during feeding                                   | pravilan/regular                           | 109         | 94.78 |
|                                                                                                             | nepravilan/irregular                       | 6           | 5.22  |
| Loše navike/<br>Bad habits                                                                                  | nema/no                                    | 103         | 89.57 |
|                                                                                                             | ima/yes                                    | 12          | 10.43 |
| Položaj pri spavanju/<br>Sleeping position                                                                  | pravilan/regular                           | 110         | 95.65 |
|                                                                                                             | nepravilan/irregular                       | 5           | 4.35  |
| Položaj ruku pri spavanju<br>u odnosu na vilicu/Position<br>of arms when sleeping in<br>relation to the jaw | pravilan/regular                           | 109         | 94.78 |
|                                                                                                             | nepravilan/irregular                       | 6           | 5.22  |
| Visina uzglavlja/<br>Pillow height                                                                          | pravilna/regular                           | 110         | 95.65 |
|                                                                                                             | nepravilna/irregular                       | 5           | 4.35  |
| Disanje na usta/<br>Mouth breathing                                                                         | ne/no                                      | 87          | 75.65 |
|                                                                                                             | da/yes                                     | 28          | 24.35 |
| Ortodontske<br>nepravilnosti<br>kod roditelja/Orthodontic<br>anomalies in parents                           | Nema/no                                    | 101         | 87.83 |
|                                                                                                             | Ima/yes                                    | 14          | 12.17 |

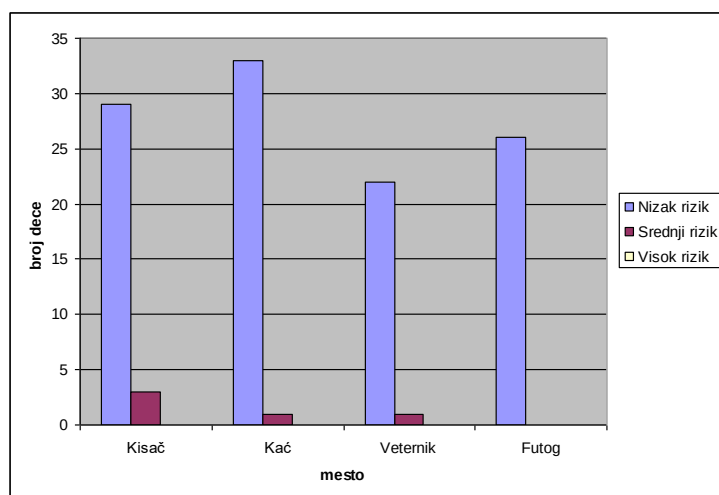


**Grafikon 1:** Ukupan rizik za nastanak ortodontskih nepravilnosti

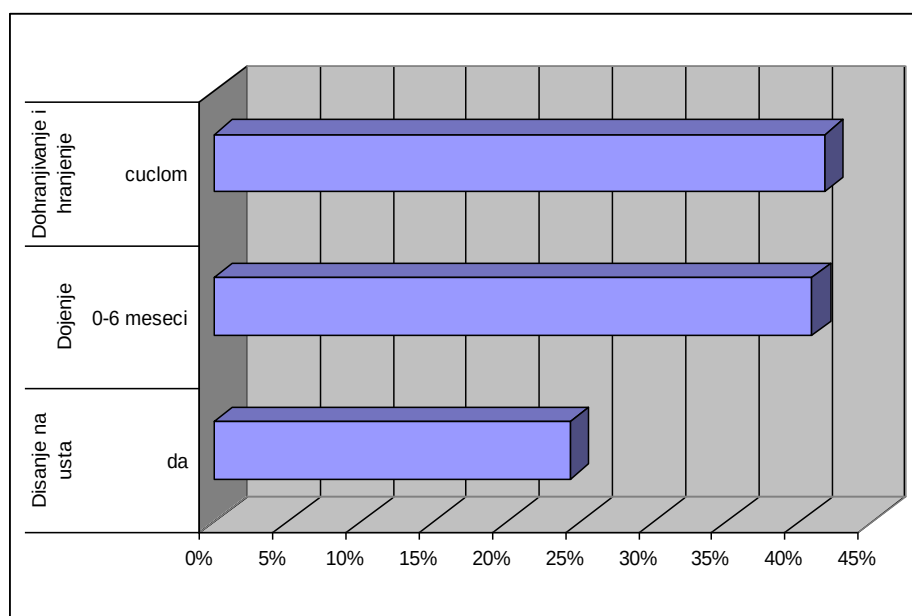
**Graph 1:** Total risk of orthodontic anomalies

**Tabela 2 :** Stepen rizika za nastanak ortodontskih anomalija po naseljima  
**Table 2:** Risk level for the occurrence of orthodontic anomalies per settlements

|              | Nizak rizik/<br>Low-risk | Srednji rizik/Medium-risk | Visok rizik/High-risk |
|--------------|--------------------------|---------------------------|-----------------------|
| Kisač        | 29<br>(90.62%)           | 3<br>(9.38%)              | 0                     |
| Kač          | 33<br>(97.06%)           | 1<br>(2.94%)              | 0                     |
| Veternik     | 22<br>(95.65%)           | 1<br>(4.35%)              | 0                     |
| Futog        | 26<br>(100%)             | 0                         | 0                     |
| Ukupno/Total | 110<br>(95.65%)          | 5<br>(4.35%)              | 0                     |



**Grafikon 2 :** Stepen rizika za nastanak ortodontskih anomalija po naseljima  
**Graph 2:** Risk level for the occurrence of orthodontic anomalies per settlements



**Grafikon 3:** Najčešći etiološki faktori za pojavu ortodontskih anomalija  
**Graph 3:** The most common etiological factors for the occurrence of orthodontic anomalies

## Diskusija

Na osnovu našeg istraživanja najčešći etiološki faktori za nastanak ortodontskih anomalija su (grafikon 3): hranjenje i dohranjivanje cuclo (flašicom) umesto kašičice (41,74% ispitanih) i dojenje kraće od 7 meseci (u 40,87% slučajeva). U relativno velikom procentu je prisutno i disanje na usta (24,35%).

Aktivnost obraza i jezika kod novorođenčeta pomaže u razvoju okluzije i u rastu vilica.

## Discussion

Based on our research, the most common etiological factors for the occurrence of orthodontic anomalies are (Chart 3): feeding and supplementation with a pacifier (bottle) instead of a spoon (41.74% of respondents) and breastfeeding for less than 7 months (in 40.87% of cases). A relatively large percentage of mouth breathing is also present (24.35%).

The activity of the cheeks and tongue in the new-born helps in the development of occlusion and in the growth of the jaws.

Poboljšanje okluzije u velikoj mjeri zavisi od naponskih sila koje nastaju tokom različitih orofacijalnih funkcija. Stoga početna faza postnatalnog života igra izuzetno važnu ulogu. Čini se da je malokluzija povezana sa neravnotežom funkcionalnih snaga oralne i facijalne muskulature<sup>22</sup>.

Poznato je da neefikasno dojenje utiče na obrascu rasta kod pojedinaca, uzrokujući malokluzije i deformitete govora, estetska odstupanja i poremećaj funkcije<sup>23</sup>.

Korišćenje flašice sa cuclom za ishranu deteta može da prouzrokuje ortodontske nepravilnosti kao i skraćivanje potrebe za dojenjem<sup>24</sup> i to ima reperkusije ne samo na razvoj orofacijalnih struktura već i celog tela<sup>25</sup>. Rano uvođenje flašice za hranjenje negativno utiče na mišićnu aktivnost i razvoj alveolarnih grebenova i tvrdog nepca, a to dovodi do posledične pojave ukrštenog zagrižaja u postkaninom sektoru<sup>26</sup>.

Hranjenje na flašicu ograničava potencijalnu upotrebu perioralnih mišića i na taj način deluje kao primarni agens u etiologiji malokluzije<sup>27</sup>. Proces sisanja se razlikuje kod dece koja se doje i one koja se hrane iz flašice. Dece koja su dojena pokazuju veću aktivnost mišića lica od dece koja su hranjena na flašicu, čime se promoviše adekvatniji kraniofacijalni rast i razvoj kostiju vilice. Kretanje usana i jezika tokom dojenja primorava dete da usisava majčino mleko putem ceđenja, dok je kod dece koja se hrane na flašicu pokret za dobijanje mleka pasivniji, stoga postoji veći potencijal za razvoj malokluzije. Format brachicefalnog mandibularnog luka lakše se postiže kada se dete doji, što zauzvrat omogućava odgovarajuće nicanje zuba. Još jedan aspekt anatomije u korist dojenja je da se majčina bradavica prilagođava unutrašnjem obliku usne duplje, omogućavajući savršeno oralno zaptivanje, što zauzvrat dovodi do zadovoljavajućeg razvoja nazalnog disanja. Dobro je poznato da deca koja dišu na nos imaju manje šanse da razviju držanje otvorenih usta, što zauzvrat može dovesti do prevelike vertikalne dimenzije lica<sup>28</sup>. Ovakvi efekti prvenstveno nastaju ukoliko cucla nije anatomska, tj. ne imitira oblik mamile. Anatomski cucla je kratka, čvrsta i spljoštena, a otvor treba da bude prilagođen konzistenciji hrane. Uprkos visokom procentu korišćenja cucle, zadovoljavajući je podatak da su anatomsku vrstu cucle upotrebili kod 87,83% dece i položaj boce pri ishrani bio pravilan kod 94,78% ispitanih - boca je u pravilnom položaju ukoliko je postavljena skoro horizontalno, tako da dete koristi muskulaturu slično sisanju prilikom dojenja.

Improvement of occlusion largely depends on the stress forces generated during different orofacial functions. Therefore, the initial phase of postnatal life plays an extremely important role. Malocclusion appears to be associated with an imbalance in the functional strength of the oral and facial muscles<sup>22</sup>.

Inefficient breastfeeding is known to affect growth patterns in individuals, causing malocclusions and speech deformities, aesthetic deviations, and dysfunction<sup>23</sup>.

The use of a bottle with a pacifier for feeding a child can cause orthodontic anomalies as well as shorten the need for breastfeeding<sup>24</sup> and this has repercussions not only on the development of orofacial structures but also the whole body<sup>25</sup>. Early introduction of the feeding bottle negatively affects the muscle activity and development of the alveolar ridges and the hard palate, and this leads to the consequent appearance of cross-bite in the post-canine sector<sup>26</sup>.

Bottle feeding limits the potential use of perioral muscles and thus acts as a primary agent in the etiology of malocclusion<sup>27</sup>. The process of sucking differs between breastfed babies and bottle-fed babies. Breastfed infants show more facial muscle activity than bottle-fed infants, thus promoting more adequate craniofacial growth and jaw bone development. The movement of the lips and tongue during breastfeeding forces the child to suck the mother's milk by squeezing, while in bottle-fed infants, the movement for obtaining milk is more passive; therefore there is a greater potential for the development of malocclusion. The format of the brachycephalic mandibular arch is easier to achieve when the child is breastfed, which in turn enables the proper teething. Another aspect of anatomy in favour of breastfeeding is that the mother's nipple adapts to the internal shape of the oral cavity, allowing perfect oral sealing, which in turn leads to the satisfactory development of nasal breathing. It is well known that children who breathe through their noses are less likely to develop an open mouth, which in turn can lead to an excessive vertical dimension of the face<sup>28</sup>. Such effects primarily occur if the pacifier is not anatomical, i.e. does not imitate the form of the decoy. The anatomical pacifier is short, firm and flattened, and the opening should be adjusted to the consistency of the food. Despite the high percentage of pacifier use, it is satisfactory that 87.83% of children used the anatomical type of pacifier and the position of the bottle while feeding was correct.

Međutim, često korišćenje cucle može dovesti do pojave "baby bottle" ili "nursing" karijesa, koji izaziva prerani gubitak mlečnih zuba i sekundarnu teskobu<sup>20</sup>.

Dojenje je prirodni put ka nastanku efektivne veze između majke i deteta. Majčino mleko predstavlja najadekvatniju hranu za odojče<sup>29</sup>, a sam akt sisanja ima nezamenljivo mesto u razvoju stomatognatnog sistema. Duže dojenje povezano je sa smanjenom incidencijom malokluzija i ima preventivni efekat na razvoj ukrštenog zagrižaja u postkaninom sektoru i distookluzije<sup>20</sup>. Takođe se uočavaju i opšte zdravstvene prednosti dojenja, pospešivanje rasta i razvoja bebe, imunološka zaštita deteta, sazrevanje želudačne mikroflore, zaštita od upale srednjeg uha za razliku od upotrebe cucle, prevencija gastrointestinalnih poremećaja<sup>30</sup>, zaštita od dijabetesa tipa 2 i dugotrajne gojaznosti<sup>31</sup>, smanjuje rizik od raka dojke i jajnika kod majki<sup>32</sup>.

Đurić i Milićević u istraživanjima u Novom Sadu nalaze period dojenja kraći od 7 meseci u 42,02% slučajeva<sup>20</sup>. Slični rezultati su dobijeni i u našem istraživanju (40,87%), znači da je ovaj problem podjednako prisutan u urbanoj i ruralnoj sredini. Kao moguće rešenje, Ball predlaže spavanje zajedno ("bed-sharing") sa odojčecom, što po njenim rezultatima u istraživanju na 253 majke, predstavlja stimulaciju za duže dojenje<sup>33</sup>.

Disanje kroz nos je prva vitalna refleksna funkcija novorođenčeta. Disanje na usta predstavlja nefiziološku radnju, koja nastaje kao posledica različitih oboljenja, najčešće respiratornih infekcija u periodu odojčeta, ili kao loša navika. Zajedno sa nenutritivnim sisanjem, disanje na usta predstavlja najznačajniji etiološki faktor rizika za nastanak malokluzije, jer ometaju normalan kraniofacijalni razvoj. Bebe imaju urođen, biološki nagon za sisanje, koji se može zadovoljiti nutritivnim sisanjem, uključujući dojenje i dojenje na flašicu, ili preko nenutritivnog sisanja predmeta kao što su varalice ili igračke koje mogu zadovoljiti psihološke potrebe.

Dok je sisanje normalno ponašanje kod odojčadi i male dece, produženo trajanje takvog ponašanja može imati posledice na razvoj orofacijalnih struktura i razvoj pravilne okluzije<sup>34</sup>. Takođe, uzrok može biti i nepravilan položaj deteta pri spavanju, kada dolazi do prinudnog otvaranja usta<sup>35</sup>.

Prema našim istraživanjima, ovaj poslednji etiološki faktor prisutan je samo kod 4-5% svih ispitanih, dok disanje na usta kod svakog četvrtog deteta.

in 94.78% of respondents - the bottle is in the correct position if placed almost horizontally, so the child uses muscles similar to sucking when breastfeeding. However, a frequent use of a pacifier can lead to "baby bottle" or "nursing" caries, which causes premature loss of baby's teeth and secondary crowding<sup>20</sup>.

Breastfeeding is a natural way to create an effective bond between mother and child. Breast milk is the most adequate food for an infant<sup>29</sup>, and the very act of sucking has an irreplaceable role in the development of the stomatognathic system. Prolonged breastfeeding is associated with a reduced incidence of malocclusions and has a preventive effect on the development of cross-bite in the post-canine sector and dystocclusion<sup>20</sup>. There are also general health benefits of breastfeeding, promoting growth and development of the baby, immune protection of the child, maturation of gastric microflora, protection against otitis media as opposed to pacifier use, prevention of gastrointestinal disorders<sup>30</sup>, protection against type 2 diabetes and long-term obesity<sup>31</sup>, as well as lowering the risk of breast and ovarian cancer in mothers<sup>32</sup>.

Đurić and Milićević in their research in Novi Sad found a breastfeeding period shorter than 7 months in 42.02% of cases<sup>20</sup>. Similar results were obtained in our study (40.87%), which means that this problem is equally present in urban and rural areas. As a possible solution, Ball suggests "bed-sharing" with the baby, which according to her results in a study of 253 mothers, is an incentive for longer breastfeeding<sup>33</sup>.

Breathing through the nose is the first vital reflex function of a new-born. Mouth breathing is a non-physiological action which occurs as a consequence of various diseases, most often respiratory infections in infancy, or as a bad habit. Together with non-nutritive sucking, mouth breathing is the most important etiological risk factor for malocclusion, as they interfere with normal craniofacial development. Babies have an innate, biological urge to suck, which can be satisfied by nutritional sucking, including breastfeeding and bottle-feeding, or through non-nutritive sucking of items such as decoys or toys that can meet psychological needs.

While sucking is normal behaviour in infants and young children, prolonged duration of such behaviour may have consequences for the development of orofacial structures and the development of proper occlusion<sup>34</sup>.

Likewise, the cause can be an incorrect position of the child during sleep, when there is a forced opening of the mouth<sup>35</sup>.

To bi značilo da kod velikog broja dece postoji loša navika disanja na usta kao posledica trenutnih ili ranijih infekcija disajnih puteva. Rezultati istraživanja Đurića i Milićevića novosadske dece bi potvrdili ovu pretpostavku: 20% dece je imalo oboljenje nazofarinksa jednom u 2 meseca u prvoj godini života i 38,18% jednom u 6 meseci u istom periodu života, a navika spavanja sa otvorenim ustima prisutna je u 22,16% slučajeva<sup>20</sup>.

Disanje kroz usta dovodi do uskosti maksilarnih lukova i nastanka visokog nepca, otvorenog zagrižaja napred, bočno ukrštenog zagrižaja, povećanja incizalnog razmaka i devijacije. Rezultati istraživanja su pokazali da su mandibula i maksila rotirane unazad i nadole, a da je okluzalna ravan strma. Pored toga, disanje na usta predstavlja tendenciju labijalne inklinacije gornjih sekutića. Stenoza disajnih puteva bila je česta kod dece koja dišu na usta<sup>36</sup>. Potrebna je bliska saradnja između različitih stručnjaka (pedijatar, alergolog, ORL specijalista, ortodont, logoped) za promovisanje rane dijagnoze i lečenja ovih nepravilnosti<sup>37</sup>. Kuroishi RC je čak prijavio nisko akademsko postignuće i lošije fonološko radno pamćenje kod dece sa disanjem na usta, u poređenju sa učesnicima sa nazalnim disanjem<sup>38</sup>. Zbog toga zdravstveni radnici treba da obrate posebnu pažnju na decu sa disanjem na usta i razmotre upotrebu vestibularnog štita.

Na povezanost respiratornih oboljenja, disanja na usta i ortodontskih nepravilnosti ukazuje nalaz De Freitas-a i sar.: na uzorku od 101 dete sa alergičnim rinitisem nalazi veću visinu nepca za 1,73 mm u odnosu na kontrolnu grupu<sup>39</sup>. Löfstrand-Tideström i sar. takođe dobiju nalaze o užoj gornjoj vilici, većoj visini nepca, kraćem donjem zubnom luku i lateralnom ukrštenom zagrižaju kod dece sa opstrukcijom disajnih puteva u odnosu na kontrolnu grupu<sup>40</sup>. Interesantno je primetiti da od 644 deteta, koja su bila uključena u ovo ispitivanje u Švedskoj, samo 48 (7,45%) je imalo bilo kakav poremećaj disanja, što je signifikantno manje u odnosu na naše rezultate, te ukazuje na potrebu preventivnog delovanja u smislu pravovremenog i potpunog lečenja oboljenja disajnih puteva u ranom uzrastu u našoj populaciji.

Ohrabrujući su podaci o relativno maloj učestalosti oboljenja tokom trudnoće (7 slučajeva – 6,09%) i malom broju komplikovanih porođaja: 13 slučajeva naspram 102 porođaja, koji su bili laki ili izvođeni carskim rezom.

According to our research, this last etiological factor is present in only 4-5% of all subjects, while mouth breathing is recorded in every fourth child. This would mean that a large number of children have a bad habit of breathing through their mouths as a result of current or previous respiratory infections. The results of Đurić and Milićević's research on children from Novi Sad confirms this assumption: 20% of children had nasopharyngeal disease once in 2 months in the first year of life and 38.18% once in 6 months in the same period of life, and the habit of sleeping with open mouth is present with 22.16 % of cases<sup>20</sup>.

Breathing through the mouth leads to the narrowing of the maxillary arches and the formation of a high palate, overbite, lateral cross-bite, increased incisal spacing and deviation. The results of the study show that the mandible and maxilla were rotated back and down, and that the occlusal plane was steep. In addition, mouth breathing is a tendency of the labial inclination of the upper incisors. Respiratory stenosis was common in children who breathed through the mouth<sup>36</sup>. Close cooperation between different specialists (pediatrician, allergist, ENT specialist, orthodontist, speech therapist) is needed to promote early diagnosis and treatment of these anomalies<sup>37</sup>. Kuroishi RC even reported low academic achievement and poorer phonological working memory in children with mouth breathing, compared with participants with nasal breathing<sup>38</sup>. Therefore, healthcare professionals should pay special attention to children with mouth breathing and consider using a vestibular shield.

The connection between respiratory diseases, mouth breathing and orthodontic anomalies is indicated by the findings of De Freitas et al.: in a sample of 101 children with allergic rhinitis, he found a higher palate height by 1.73 mm compared to the control group<sup>39</sup>. Löfstrand-Tideström et al. also obtained findings of a narrower upper jaw, higher palate height, shorter lower dental arch, and lateral cross-bite in children with airway obstruction compared to the control group<sup>40</sup>.

It is interesting to note that of the 644 children included in this study in Sweden, only 48 (7.45%) had some respiratory disorder, which is significantly less than our results, indicating the need for preventive action in terms of timely and complete treatment of respiratory diseases at an early age in our population.



Od komplikovanih, u jednom slučaju su korišćena porođajna klešta-forceps, čija upotreba često dovodi do teških maternalnih i fetalnih negativnih posledica. Al-Kadri i sar.<sup>41</sup>, nalaze da od 92 porođaja izvođenih pomoću forcepsa, 26 nisu bila uspešna. Porođajna klešta su bila korišćena u 2,3% od svih porođaja. U našem istraživanju ovaj procenat iznosi 0,87%.

Ortodontske nepravilnosti kod roditelja su prisutne u 12,17% slučajeva. Nasleđe je glavni etiološki faktor u određenom broju ortodontskih anomalija. Marković u istraživanjima o malokluziji II klase 2. odeljenje, upoređuje 2812 ljudi iz opšte populacije, gde su malokluzije prisutne u 8,21%, sa 442 člana jedne porodične populacije, u kojoj 46,61% članova ima malokluzije. U istoj studiji takođe nalazi statistički značajnu razliku konkordantnosti kod jednojajnih i dvojajnih blizanaca za malokluziju II klase 2. Odeljenje<sup>42</sup>. Stoga kod izvesnog broja dece, zbog genetski determinisanih predispozicija za nastanak određenih ortodontskih nepravilnosti, preventivno delovanje u smislu uklanjanja egzogenih faktora neće bitnije uticati na pojavu anomalija.

Interesantno je primetiti veliku razliku u prisustvu loših navika između dece u ruralnoj i urbanoj sredini. Prema našim istraživanjima, sve loše navike prisutne su u 10,43% dece, a Đurić i Milićević dobiju podatak da je navika sisanja prsta ili varalice bila ili je još uvek prisutna kod 56,89% dece iz Novog Sada<sup>20</sup>. Objašnjenje za ovu pojavu bi se moglo naći u različitom načinu življenja. "Seoska" deca su bliža prirodi i aktivnostima na otvorenom, koji zahtevaju puno energije i stoga ređe pribegavaju upražnjavanju loših navika od "gradske" dece, koja većinu vremena provedu u stanu, dosađuju se i loše navike postaju prinudna alternativa za zabavu.

The data on the relatively low incidence of the disease during pregnancy (7 cases-6.09%) and the small number of complicated births are encouraging: 13 cases versus 102 births which were easy or performed by caesarean section. Of the complicated ones, in one case, labour forceps were used, the use of which often leads to severe maternal and fetal negative consequences. Al-Kadri et al.<sup>41</sup> found that of the 92 births performed using forceps, 26 were unsuccessful. Birth forceps were used in 2.3% of all births. In our study, this percentage is 0.87%.

Orthodontic anomalies in parents are present in 12.17% of cases. Heredity is a major etiological factor in a number of orthodontic anomalies. In the research on class II division 2 malocclusion, Markovic compares 2,812 people from the general population, where malocclusions are present in 8.21%, with 442 members of one family population, in which 46.61% of members have malocclusions. In the same study, he also found a statistically significant difference in concordance in monozygotic and dizygotic twins for class II division 2 malocclusion<sup>42</sup>. Therefore, in a number of children, due to genetically determined predispositions for the development of certain orthodontic anomalies, preventive action in terms of removing exogenous factors will not significantly affect the occurrence of anomalies.

It is interesting to note the large difference in the presence of bad habits between children in rural and urban areas. According to our research, all bad habits are present in 10.43% of children, and Đurić and Milićević obtained the data that the habit of sucking a finger or a pacifier was or is still present in 56.89% of children from Novi Sad<sup>20</sup>. The explanation for this phenomenon could be found in a different way of life. "Rural" children are closer to nature and outdoor activities, which require a lot of energy and therefore less often resort to bad habits than "urban" children, who spend most of their time in the apartment, get bored and bad habits become a forced alternative for fun.

## Zaključak

Na osnovu dobijenih rezultata mogu se izvesti sledeći zaključci:

- U 95,65% ispitanika utvrđen je nizak rizik za nastanak ortodontskih anomalija, kod 4,35% srednji rizik, dok osobe sa visokim rizikom nisu nađene
- Loše navike su prisutne u manjem procentu kod dece u prigradskoj sredini u odnosu na gradsku decu;
- Najčešći etiološki faktori za nastanak ortodontskih nepravilnosti kod dece u prigradskim naseljima jesu;
  - korišćenje cucle (flašice) za hranjenje i dohranjivanje umesto kašičice (kod 41,74% dece);
  - kratak period dojenja - manje od 7 meseci (u 40,87% slučajeva);
  - disanje na usta (24,35% ispitanih).

Upravljanje oralnim zdravljem, u cilju uspostavljanja zdrave denticije i ublažavanja ili izbegavanja malokluzije od nicanja prvog mlečnog zuba do dobijanja stalnih zuba, od velikog je značaja u pedijatrijskoj populaciji. Zbog toga preventivne mere treba usmeriti na edukaciju majki o potrebi i prednostima prirodnog načina ishrane dojenjem i da za dohranjivanje i hranjenje koriste kašičicu. Postoji potreba za informisanjem roditelja o značaju pravovremenog i potpunog lečenja infekcija disajnih puteva.

Odgovarajuće planiranje oralnog zdravlja može smanjiti pojavu težih malokluzija koji mogu dovesti do komplikovanih ortodontskih tretmana u stalnoj denticiji. Stoga, i znanju o etiologiji i upravljanju problemima malokluzije treba dati veći naglasak u budućim istraživanjima<sup>43</sup>.

## Conclusion

Based on the obtained results, the following conclusions can be made:

- In 95.65% of respondents, a low risk for the development of orthodontic anomalies was found, in 4.35% a medium risk, while persons with a high risk were not found;
- Bad habits are present in a smaller percentage of children in suburban areas compared to children in the cities;
- The most common etiological factors for the occurrence of orthodontic anomalies in children in suburban areas are:
  - using a pacifier (bottle) for feeding and supplementary feeding instead of a spoon (in 41.74% of children);
  - short breastfeeding period - less than 7 months (in 40.87% of cases);
  - mouth breathing (24.35% of respondents)

Oral health management, in order to establish healthy dentition and alleviate or avoid malocclusion from the eruption of the first deciduous tooth to the acquisition of permanent teeth, is of great importance in the paediatric population. Therefore, preventive measures should be aimed at educating mothers about the need and benefits of a natural way of breastfeeding and at using a spoon for supplementation and feeding. There is a need to inform parents about the importance of timely and complete treatment of respiratory infections.

Proper oral health planning can reduce the occurrence of more severe malocclusions that can lead to more complicated orthodontic treatments in permanent dentition. Therefore, the knowledge of the etiology and management of malocclusion problems should be given more emphasis in the future research<sup>43</sup>.

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# RENDGENKONTRASTNOST JEDNOKOMPONENTNIH KALCIJUM SILIKATNIH ENDODONTSKIH PASTA RADIOPACITY OF PREMIXED CALCIUM SILICATE- BASED ENDODONTIC SEALERS

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## Sažetak

**Uvod:** Jednokomponentne kalcijum-silikatne endodontske paste su injektibilni materijali, spremni za upotrebu bez prethodne pripreme, sa dobrim biološkim osobinama koji stvaraju povoljne uslove za reparaciju i očuvanje periapikalnih tkiva.

**Cilj** našeg rada bio je da ispitamo rendgenkontrastnost jednokomponentnih kalcijum silikatnih endodontskih pasta: TotalFill BC Sealer, EndoSequence BC Sealer, Ceraseal, Bio-C Sealer i da ih uporedimo sa pastom na bazi epoksi smola, AH Plus.

**Materijal i metode:** Po tri uzorka (2 mm debljine i 5 mm u prečniku) svake paste su radiografsana sa referentnim aluminijumskim etalonom koristeći CCD (charge-coupled device) digitalni senzor (Trophy Radiology, Cedex, France). Za određivanje rendgenkontrastnosti pravljen je grafikon logaritamske zavisnosti debljine aluminijuma od radiografske gustine sa kalibracionom krivom. Rendgenkontrastnost je očitavana sa grafika i predstavljena u milimetrima debljine aluminijuma po milimetru debljine materijala (mmAl). Jednofaktorska analiza varijanse sa Tukey post hoc testom je korišćena za statističku analizu i nivo značajnosti je bio postavljen na 0,05.

**Rezultati:** Rendgenkontrastnost EndoSequence BC Sealer i Bio-C Sealer bila je značajno manja od rendgenkontrastnosti Ceraseal i AH Plus paste. Razlike među vrednostima za EndoSequence BC Sealer i Bio-C Sealer kao i među vrednostima za Ceraseal i AH Plus nisu bile značajne. TotalFill BC Sealer pasta nije bila značajno različita od ostalih pasta.

**Zaključak:** Jednokomponentne kalcijum silikatne endodontske paste ispitivane u našem istraživanju imale su rendgenkontrastnost veću od 9 mm, po rastućim vrednostima od Bio-C Sealer, EndoSequence BC Sealer, TotalFill BC Sealer do Ceraseal.

**Cljučne reči:** rendgenkontrastnost, kalcijum-silikati, endodontska pasta

## Abstract

**Background:** Premixed calcium silicate-based sealers are ready-to-use, injectable materials with advantageous biological properties that create environment favorable for periapical tissues repair and health.

**The aim** of our study was to examine the radiopacities of premixed calcium silicate-based sealers: TotalFill BC Sealer, EndoSequence BC Sealer, Ceraseal, Bio-C Sealer and to compare them with epoxy-based sealer, AH Plus.

**Material and methods:** Three specimens (2 mm thick and 5 mm in diameter) of each sealer were radiographed using charge-coupled device-based digital sensor (Trophy Radiology, Cedex, France) along with an aluminum stepwedge reference. For radiopacity determination, a graph of the logarithm of aluminum thickness versus radiographic density was plotted and a calibration curve was generated. Radiopacities were assessed from the graph and presented as millimeters of aluminum per millimeter of material (mmAl). ANOVA with a post hoc Tukey test was used for statistical analysis and significance was set at 0.05.

**Results:** Radiopacity values of EndoSequence BC Sealer and Bio-C Sealer were significantly lower than radiopacities of Ceraseal and AH Plus. Differences in values between EndoSequence BC Sealer and Bio-C Sealer as well as between Ceraseal and AH Plus were nonsignificant. TotalFill BC Sealer was nonsignificantly different from all other sealers.

**Conclusion:** Premixed calcium silicate-based endodontic sealers evaluated in our study had radiopacity values higher than 9 mmAl, in ascending order, from Bio-C Sealer, EndoSequence BC Sealer, TotalFill BC Sealer to Ceraseal.

**Key words:** radiopacity calcium silicate, endodontic sealer

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za stomatologiju Niš. Sva prava zadržana.

## Uvod

Jedan od glavnih ciljeva endodontske terapije je trodimenzionalno, hermetično punjenje kanalnog sistema koristeći gutaperka poene i endodontsku pastu kao sredstvo za ostvarivanje veze sa dentinom kanala korena. Kanalne paste dolaze u direktni kontakt sa okolnim periapikalnim tkivima i trebalo bi da imaju odgovarajuća biološka svojstva. Biokompatibilni endodontski materijal trebalo bi da stvori sredinu povoljnu za reparaciju i očuvanje periapikalnih tkiva<sup>1</sup>. Kalcijum-silikatni materijali imaju poželjna bioaktivna svojstva jer stimulišu biološke signale i interakciju sa susednim tkivima<sup>2</sup>. To može biti korisno za reparaciju/regeneraciju potencijalno oštećenog periodontalnog ligamenta, cementa ili tkiva alveolarne kosti. Naime, dokazano je da kalcijum-silikatni materijali mogu da pokrenu regeneraciju i da ne ometaju zarastanje periapikalnih tkiva čak i kada se prebace, nenamerno, preko otvora na vrhu korena<sup>3</sup>.

Kalcijum-silikatne paste su trenutno dostupne kao dvokomponentni i jedno-komponentni materijali spremni za upotrebu bez prethodne pripreme. Kod dvokomponentnih pasta reakcija vezivanja/hidratacije se pokreće posle mešanja komponenti, pre unošenja u kanal korena. Sa druge strane, jedno-komponentne paste vodu neophodnu za hidrataciju i vezivanje dobijaju apsorpcijom vlage zaostale u kanalu, dentinskim tubulima ili iz tkiva oko korena<sup>4</sup>. Jednokomponentne paste se isporučuju kao unapred pripremljeni, injektabilni materijali u špricima sa kanalnim kanilama. To omogućava lakšu i efikasniju aplikaciju i potencijalno može imati kliničke prednosti zbog olakšavanja rada stomatologa. Lakša aplikacija može biti naročito korisna u kompleksnim endodontskim slučajevima kao što su perforacije korena, apikotomije ili široki otvori na vrhu korena. Sa druge strane, injektabilni materijal se može lako prebaciti i trebalo bi paziti da se pastom, pri injektiranju, ne ispuni potpuno kanalni prostor.

Pored povoljnih bioloških osobina, materijali za punjenje kanala korena bi trebalo da obezbede dugotrajno zaptivanje i odgovarajuće fizičko-hemijske osobine, kao što su, rastvorljivost, vreme vezivanja, tečljivost i sorpcija. Važna osobina endodontskih pasta je rendgenkontrastnost koja im omogućava jasno razlikovanje od susednih anatomskih struktura kao što su kost i zubi<sup>5</sup>.

## Introduction

One of the main goals of endodontic treatment is hermetic three-dimensional obturation of root canal system that requires gutta-percha cones and endodontic sealer as a binding agent to the root dentin. Root canal sealers come into direct contact with the surrounding periapical tissues and should have suitable biological behavior. Biocompatible endodontic material should create environment favorable for periapical tissues repair and health<sup>1</sup>. Calcium silicate-based materials have favorable bioactive properties to provide biological signals and interact with adjacent tissues<sup>2</sup>. This could be beneficial for the reparation/regeneration of potentially damaged periodontal ligament, cementum or alveolar bone tissues. Namely, it was proposed that calcium silicate-based materials could induce tissue regeneration and that they do not act as a hindrance for periapical healing even when extruded, unintentionally, beyond the apical foramen<sup>3</sup>.

Calcium silicate-based sealers are currently available as two-component and premixed ready-to-use materials. In two-component sealers setting, reaction/hydration is initiated after components mixing, before their insertion into the root canal. On the other hand, premixed sealers obtain the water necessary for hydration and setting by absorption of the residual moisture present in the root canal, dentinal tubules or periradicular area<sup>4</sup>. Premixed sealers are supplied as ready-to-use, injectable materials in syringes with intracanal tips. This offers easier delivery approach, efficient application and potential clinical advantage due to dentist-friendly manipulation. Easier material application may be additionally favorable in complex endodontic situations like root perforations, apicoectomy or wide apices. Conversely, injectable material may be susceptible to extrusion and care should be taken to try not to fill the whole canal space with the sealer.

Beside advantageous biological properties, root filling materials should have a long-lasting sealing ability and adequate physicochemical properties, such as solubility, setting time, flow or water sorption. Important characteristic of endodontic sealer is radiopacity that allows it to be distinguished from adjacent anatomic structures such as bone and tooth<sup>5</sup>. Adequate sealer radiopacity enhances the evaluation of the root fillings quality and diagnostic procedures in endodontics<sup>6</sup>. Radiopacity could be helpful in revealing of possible empty spaces or voids in the obturation as well as in inappropriate contours or overtreatment.

Odgovarajuća rendgenkontrastnost doprinosi boljoj proceni kvaliteta kanalnog punjenja i kvalitetnijim dijagnostičkim procedurama u endodonciji<sup>6</sup>. Rendgenkontrastnost olakšava uočavanje praznih prostora ili pukotina kao i neodgovarajućih oblika ili prebacivanja punjenja. Sa druge strane, postoji i zabrinutost da previše kontrastna pasta može zamaskirati nesavršenosti u samom punjenju<sup>7</sup>.

Minimalni zahtevi za rendgenkontrastnost endodontske paste, utvrđeni od strane Međunarodne organizacije za standardizaciju (ISO), su nivo kontrastnosti ne manji od vrednosti koju ima 3 mm aluminijuma, pri debljini od 1mm<sup>8</sup>. Prema ISO standardima rendgenkontrastnost se mora utvrđivati korišćenjem konvencionalnih dental filmova i njihove hemijske obrade rastvorima razvijaa/fiksira, ispiranjem i sušenjem. Rendgenkontrastnost se procenjuje pomoću optičkog denzitometra kojim se meri količina svetla propuštenog kroz rendgen film, a koja se potom prevodi u odgovarajuću debljinu aluminijuma poređenjem sa aluminijumskim etalonom radiografisanim zajedno sa ispitivanim uzorkom<sup>8</sup>. Međutim, usvajanje digitalnih metoda radiografisanja u kliničkoj praksi, pokrenulo je upotrebu takvih radiografskih sistema i u istraživanjima rendgenkontrastnosti<sup>9-11</sup>. Digitalne metode mogu ukinuti potrebu za hemijskim razvijanjem filmova i merenjima denzitometrom, dajući konzistentnije rezultate uz vremenski manje zahtevne postupke<sup>12</sup>. Prednost ovih metoda je i mogućnost merenja na dobijenim slikama pri velikom uveličanju, direktno na ekranu, čime je moguće odabrati zonu reprezentativnu za merenje<sup>9</sup>. Sagledavajući činjenicu da digitalni radiografski sistemi koriste različite tehnologije digitalnih senzora pokazano je da izbor sistema radiografisanja može uticati na merenja rendgenkontrastnosti<sup>11,13</sup>. Slično tome, pretpostavlja se da razlike u eksperimentalnim metodologijama korišćenim u studijama koje su ispitivale rendgenkontrastnost endodontskih pasta mogu biti uzrok razlika među njihovim rezultatima<sup>14,15</sup>.

Kako se nove jednokomponentne kalcijum-silikatne paste pojavljuju u kliničkoj praksi, postaje sve značajnije uporediti ih sa materijalima koji su trenutno u širokoj upotrebi kako bi se kliničarima omogućio izbor materijala zasnovan na dokazima.

**Cilj** ove studije bio je da ispitamo rendgenkontrastnost jednokomponentnih kalcijum silikatnih endodontskih pasta: *TotalFill BC Sealer*, *EndoSequence BC Sealer*, *Ceraseal*, *Bio-C Sealer* i da ih uporedimo sa zlatnim standardom u endodontskoj praksi, *AH Plus* pastom.

On the other hand, worry has been expressed that a too opaque sealer may mask imperfections in filling material<sup>7</sup>.

The minimal requirement for the radiopacity of endodontic sealer established by International Organization for Standardization (ISO) is a radiopacity value equivalent to not less than 3 mm Al, at a thickness of 1 mm<sup>8</sup>. According to the ISO standards, radiopacity must be determined using conventional dental films and their chemical processing by developing/fixation solutions, rinsing, and drying. The radiopacity must be evaluated with the aid of an optical densitometer measuring the amount of light transmitted through the film image that is then translated into equivalent thickness of aluminum by comparing it with an aluminum stepwedge standard radiographed alongside the test specimens<sup>8</sup>. However, as digital imaging systems have been adopted in clinical practice, this has motivated the use of these radiographic systems in radiopacity research<sup>9-11</sup>. Digital methods could eliminate the need for chemical processing of radiographic film and optical densitometer measuring, thus providing more consistent results and less time-consuming procedure<sup>12</sup>. Further advantage of these methods is that the image can be measured at great magnification directly on the screen enabling selection of a representative measurement area<sup>9</sup>. Considering that digital radiography systems use different technologies of digital sensors, it was shown that the choice of imaging system may affect radiopacity measurements<sup>11,13</sup>. In a similar way, it was proposed that the differences in experimental methodology used in the studies examining radiopacity of endodontic sealers could be the reason for discrepancies in the obtained results<sup>14,15</sup>.

As new premixed calcium silicate-based sealers emerge for clinical application, it becomes more important to compare them with the currently widely used materials in order to enable evidence-based selection by clinicians.

**The aim** of present study was to examine the radiopacity of premixed calcium silicate-based sealers: *TotalFill BC Sealer*, *EndoSequence BC Sealer*, *Ceraseal*, *Bio-C Sealer* and to compare them with gold standard in endodontic practice *AH Plus* sealer.

## Materijalii metode

U istraživanju smo ispitivali sledeće materijale: *TotalFill BCSealer*, *EndoSequence BC Sealer*, *Ceraseal*, *Bio-C Sealer* i *AH Plus* (Tabela 1). Paste su zamešane po uputstvu proizvođača i postavljene u 2 mm duboke i 5 mm široke kalupe. Posle kompletnog vezivanja, u inkubatoru pri 95% vlažnosti i temperaturi od 37°C, debljina uzoraka je merena digitalnim meračem. Ukoliko je bilo potrebno, a kako bi imali debljinu od  $2 \pm 0.1$  mm, uzorci su bili tanjeni vodenim šmirglanjem. Pripremljena su po tri uzorka svake paste.

Svi uzorci su bili radiografisani sa aluminijumskim stepeničastim etalonom (99,6 % čistoće, 1-10 mm debljine, 1 mm svaki stepenik) koristeći CCD (charge-coupled device) digitalni senzor (Trophy Radiology, Cedex, France), Radiovisiography (RVG-4). Korišćen je rendgen aparat (Trophy Radiology) sa naponom cevi od 70 kVp, strujom 7 mA, vremenom ekspozicije 0.07 s i rastojanjem od cevi do uzorka od 30 cm. Svaki uzorak materijala i svaki stepenik aluminijumskog etalona očitavan je tri puta i radiografska gustina uzoraka izražena srednjim vrednostima tona sivo-bele skale koristeći program Adobe Photoshop CS4 (Adobe Systems, San Jose, Kalifornija). Pažljivo su izbegavani delovi uzoraka koji su sadržavali mehuriće vazduha ili druge nepravilnosti. Za određivanje rendgenkontrastnosti nacrtan je grafikon logaritamske zavisnosti debljine aluminijuma od radiografske gustine sa kalibracionom krivom. Radiografska gustina svakog uzorka na snimku je korišćena za očitavanje rendgenkontrastnosti sa grafika. Rendgenkontrastnost je predstavljena u milimetrima debljine aluminijuma po milimetru debljine materijala (mmAl).

Kolmogorov–Smirnov test korišćen je za proveru normalnosti raspodele podataka, a jednofaktorska analiza varijanse (ANOVA) sa *Tukey post hoc* testom za poređenja među grupama. Nivo statističke značajnosti je bio postavljen na 0,05. Podatke smo analizirali SPSS 16.0 for Windows (SPSS Inc., Chiago, IL, USA) statističkim programom.

## Materials and methods

Materials evaluated in the study were: *TotalFill BCSealer*, *EndoSequence BC Sealer*, *Ceraseal*, *Bio-C Sealer* and *AH Plus* (Table 1). Sealers were mixed, according to the manufacturers' instructions and placed in 2 mm thick and 5 mm wide molds. After complete setting, in an incubator at 95% humidity and 37°C temperature, the thickness of specimens was measured using a digital caliper. Specimens were ground wet if it was necessary to ensure a thickness of  $2 \pm 0.1$  mm. Three specimens of each sealer were prepared.

All specimens of each sealer were radiographed with an aluminum stepwedge (99.6 % pure, 1-10 mm thickness, 1 mm each step) using charge-coupled device-based digital sensor (Trophy Radiology, Cedex, France), Radiovisiography (RVG-4). X-ray machine (Trophy Radiology) was used, with a tube voltage at 70 kVp, current 7 mA, exposure time 0.07 s and focus-to-target distance of 30 cm. Each sealer specimen and step of the aluminum stepwedge was read three times and radiographic densities were expressed as an average greyscale values using the Adobe Photoshop CS4 software (Adobe Systems, San Jose, CA). Care was taken to avoid regions containing air bubbles or other imperfections. For radiopacity determination, a graph of the logarithm of aluminum thickness versus radiographic density was plotted and a calibration curve was generated. Radiographic density of each specimen on the image was used to assess the radiopacity from the graph. Radiopacities were presented as millimeters of aluminum per millimeter of material (mmAl).

Kolmogorov–Smirnov test was used to check normality of data distribution and analysis of variance (ANOVA) with a Tukey post hoc test for between groups' comparisons. Statistical significance was set at 0.05. We evaluated data using SPSS 16.0 for Windows (SPSS Inc., Chiago, IL, USA) statistical program.



**Tabela 1:** Paste, proizvođači i sastavi ispitivnih endodontskih materijala  
**Table 1:** Sealers, producers and composition of the tested endodontic materials

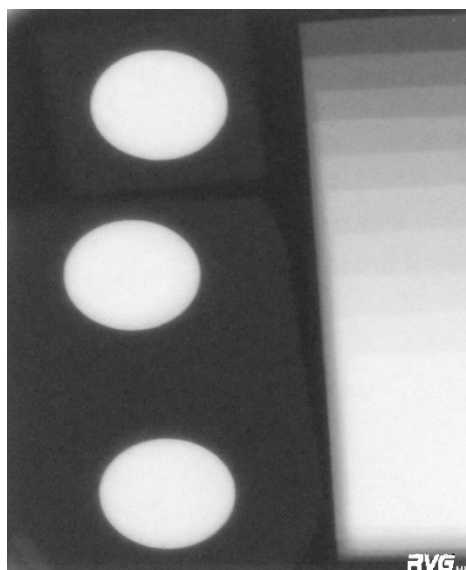
| Pasta<br>Sealer           | Proizvođač<br>Producer                                                | Sastav<br>Composition                                                                                                                                                                                                                                                               |
|---------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TotalFill BCSealer        | FKG Dentaire SA, La<br>Chaux-de-Fonds,<br>Switzerland                 | Zirconium oxide, calcium silicates, calcium phosphate<br>monobasic, calcium hydroxide, filler and thickening<br>agents                                                                                                                                                              |
| EndoSequence BC<br>Sealer | Brasseler USA<br>Savannah, Georgia, USA                               | Zirconium oxide, calcium silicates, calcium phosphate<br>monobasic, calcium hydroxide, filler and thickening<br>agents                                                                                                                                                              |
| Ceraseal                  | Meta Biomed Co.,<br>Cheongju-si,<br>Chungcheongbuk-do,<br>South Korea | Calcium silicates, zirconium oxide, thickening agent                                                                                                                                                                                                                                |
| Bio-C Sealer              | Angelus, Londrina, PR,<br>Brazil                                      | Calcium silicates, calcium aluminate, calcium oxide,<br>zirconium oxide, iron oxide, silicon dioxide,<br>dispersing agent                                                                                                                                                           |
| AH Plus                   | Dentsply,<br>DeTrey GmbH,<br>Konstanz,<br>Germany                     | <b>Paste A:</b> Bisphenol epoxy resin–A, Bisphenol epoxy resin–F, calcium<br>tungstate, zirconium oxide, silica, iron<br>oxide pigments.<br><b>Paste B:</b> Dibenzyl diamine, aminodiamantana, tricyclodecane–diamine,<br>calcium tungstate, zirconium oxide, silica, silicone oil. |

## Rezultati

Na Slici 1 prikazan je digitalni radiogram Bio-C Sealer paste i aluminijumski etalon. Srednje vrednosti i standardne devijacije rendgenkontrastnosti ispitivanih jedno-komponentnih kalcijum-silikatnih pasta predstavljene u milimetrima aluminijuma (mmAl) prikazani su na grafiku 1. EndoSequence BC Sealer ( $9.21 \pm 0.51$ ) i Bio-C Sealer ( $9.08 \pm 0.01$ ) imali su slične vrednosti rendgenkontrastnosti koje su bile značajno niže od rendgenkontrastnosti AH Plus ( $10.48 \pm 0.54$ ) i Ceraseal ( $10.41 \pm 0.33$ ) paste. AH Plus pasta je pokazala najveću rendgenkontrastnost ali razlika nije bila značajna u odnosu na Ceraseal i TotalFill BC Sealer ( $9.63 \pm 0.32$ ) paste. Razlike između TotalFill BC Sealer i svih ostalih pastanisu bile značajne.

## Results

Figure 1 shows a digital radiographic image of Bio-C Sealer and aluminium stepwedge. Graph 1 shows the mean and standard deviations of the radiopacity values of investigated premixed calcium silicate-based sealers in millimetres of aluminum (mmAl). EndoSequence BCSealer ( $9.21 \pm 0.51$ ) and Bio-C Sealer ( $9.08 \pm 0.01$ ) had close radiopacity values that were significantly lower than radiopacities of AH Plus ( $10.48 \pm 0.54$ ) and Ceraseal ( $10.41 \pm 0.33$ ). AH Plus had the highest radiopacity but the difference was nonsignificant in comparison to Ceraseal and TotalFill BCSealer ( $9.63 \pm 0.32$ ). Differences between TotalFill BCSealer and all other sealers were statistically nonsignificant.



**Slika 1:** Digitalni radiogram Bio-C paste i aluminijumskog etalona  
**Figure 1:** Digital radiographic image of Bio-C Sealer and aluminum stepwedge

## Diskusija

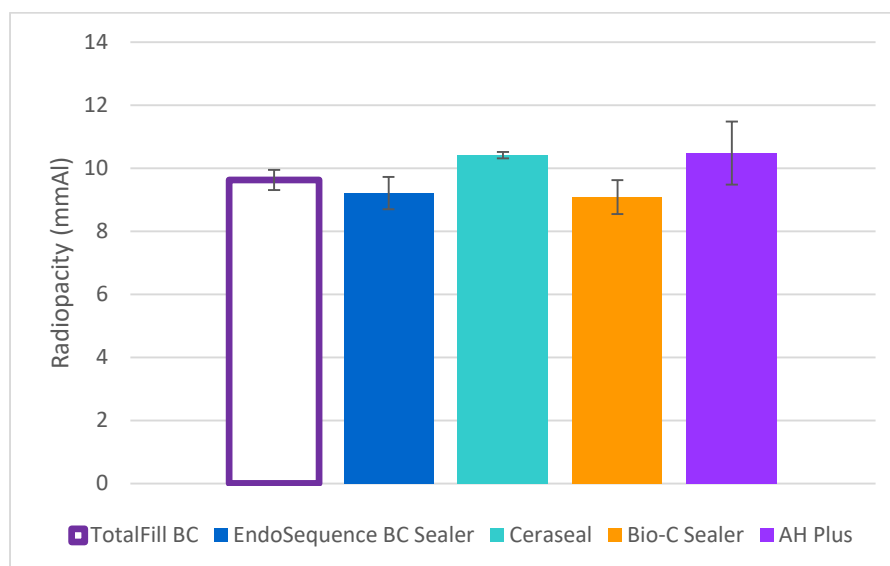
Kako bi postigle optimalnu rendgenkontrastnost, endodontskim pastama je potrebno dodati rendgenkontrastna sredstva. Nivo rendgenkontrastnosti materijala prevashodno zavisi od molekularne strukture i količine rendgenkontrastnih sredstava u njihovom sastavu<sup>16</sup>. Analizom sastava ispitivanih pasta videli smo da je glavno rendgenkontrastno sredstvo u svim materijalima cirkonijum oksid (Tabela 1).

Cirkonijum oksid se koristi u oblastima stomatologije i ortopedije kao biomaterijal i rendgenkontrastno sredstvo<sup>17</sup>. Kao rendgenkontrastno sredstvo korišćen je takođe i u endodontskim materijalima kao što je Portland cement<sup>18</sup>. Pored rendgenkontrastnosti on može uticati na i druge osobine paste kao što su vreme vezivanja, sorpcija, rastvorljivost ili kompresivna čvrstoća<sup>17</sup>. Takođe, cirkonijum oksid ne utiče na mehanizme hidratacije kalcijum-silikata<sup>19</sup> ali može poboljšati in vitro biokompatibilnost materijala<sup>20</sup>. Cutajar i sar. su pokazali da je dodatak cirkonijum oksida redukovao poroznost materijala, a da sama poroznost može uticati na rendgenkontrastnost paste<sup>17</sup>. Naime, autori su objasnili da prazni prostori u materijalu (poroznost) mogu smanjiti broj atoma koji mogu reagovati sa X zracima<sup>17</sup>. Dodatno, Marciano i sar. su pretpostavili da povećanje količine rendgenkontrastnih sredstava u kalcijum-silikatnim pastama može smanjiti poroznost usled relativno manje količine kalcijum-silikatne komponente što rezultira manjim brojem pora<sup>21</sup>.

## Discussion

Endodontic sealers require an addition of radiopacifying agents in order to optimize their radiographic visualization. Radiopacity level of the material primarily depends on molecular structure and quantity of the radiopacifiers in its composition<sup>16</sup>. Analyzing the composition of the examined sealers, we saw that the main radiopacifying agent in all materials was zirconium oxide (Table 1).

Zirconium oxide is used in dental and orthopedic fields as a biomaterial and radiopacifier<sup>17</sup>. As a radiopacifying agent, it was used also in endodontic materials such as Portland cement<sup>18</sup>. Besides radiopacity, it could influence other sealers properties such as setting time, sorption, solubility or compressive strength<sup>17</sup>. Also, zirconium oxide does not affect the hydration mechanisms of the calcium silicate<sup>19</sup> but can improve in vitro biocompatibility of the material<sup>20</sup>. Cutajar et al. showed that the addition of zirconium oxide reduced the porosity of the material and that porosity, for itself, can affect radiopacity of the sealer<sup>17</sup>. Namely, authors explained that voids in the material (porosity) could reduce the number of atoms available for interaction with the X-rays<sup>17</sup>. In addition, Marciano et al. proposed that the increased amount of radiopacifier in calcium silicate-based sealer would reduce the porosity due to relatively less presence of the calcium silicate component, which results in fewer pores<sup>21</sup>.



**Grafik 1:** Rendgenkontrastnost jednokomponentnih kalcijum-silikatnih endodontskih pasta (u ekvivalentnim milimetrima aluminijuma)

**Graph 1:** Radiopacity of premixed calcium silicate-based endodontic sealers (in millimetres of aluminium equivalent).

Još uvek su retki podaci nezavisnih istraživanja fizičko-hemijskih osobina jednokomponentnih kalcijum-silikatnih pasta, kao grupe endodontskih pasta koja se poslednja pojavila, a naročito nekih od novijih formulacija. Uzimajući u obzir rendgenkontrastnost, većina podataka dostupnih u naučnoj literaturi odnosi se na EndoSequence BC Sealer sa vrednostima između 3,8 i 10,8 mmAl (16,4). Naši rezultati koji se odnose na ovu pastu (9,21 mmAl) bili su na nivou viših vrednosti opisanih u literaturi. To može biti objašnjeno razlikama među radiografskim tehnikama korišćenim u ranijim studijama. U istraživanjima u kojima su dobijene više vrednosti rendgenkontrastnosti korišćeni su, kao i u našem istraživanju, digitalni radiografski sistemi, dok su u istraživanjima u kojima su dobijene niže vrednosti za EndoSequence BC Sealer korišćeni konvencionalni filmovi za radiografisanje<sup>22,4</sup>. Pretpostavlja se da ova razlika verovatno može biti posledica sastava materijala i veće osetljivosti digitalnih senzora na fotone visokih energija<sup>10,13</sup>. To znači da se hemijski elementi koji filtriraju više fotona visokih energija, u poređenju sa aluminijumskim etalomom, mogu činiti više rendgenkontrastnim na snimku načinjenom digitalnim senzorom nego rendgen filmom<sup>10,13</sup>. U tom smislu, Baksi i sar. pokazali su da se rendgenkontrastnost endodontskih pasta razlikovala oko 7%-20% na snimcima dobijenim konvencionalnim filmovima u odnosu na one dobijene digitalnim sistemima baziranim na fosfornim pločama<sup>23</sup>.

Data from an independent investigation of physico-chemical properties of premixed calcium silicate-based endodontic sealers, as the most recently introduced group of endodontic sealers, and especially some of the new formulations, are still limited. Considering radiopacity, majority of the data in scientific literature refers to EndoSequence BC Sealer with reported values between 3.8 and 10.8 mmAl (16,4). Our results for this sealer (9.21 mmAl) were consistent with higher values from the range reported in the literature. This could be explained by the differences related to radiographic technologies used in previous studies. Studies that reported higher radiopacity values, as ours, used digital radiographic imaging systems, while studies that presented lower values for EndoSequence BC Sealer used conventional x-ray film for radiographic imaging<sup>22,4</sup>. It was suggested that this difference possibly could be a consequence of the material's composition and greater sensitivity of the digital sensors to high-energy photons<sup>10,13</sup>. This means that elements that filter out more high-energy photons, in comparison with aluminum reference, could appear more radiopaque on the sensor than on radiographic film<sup>10,13</sup>. In this regard, Baksi et al. showed that radiopacity of endodontic sealers were by 7%–20% different when comparing images obtained using conventional dental x-ray film and images obtained using a digital system based on storage phosphor plate technology<sup>23</sup>.

Oni su sugerisali da, pored osetljivosti senzora, uočene razlike takođe mogu biti posledica činjenice da digitalni sistemi imaju konverziju podataka analogno-u-digitalno i ograničenu mogućnost predstavljanja nijansi sive (od 0 do 255) za razliku od konvencionalnih radiograma koji se sastoje od zrna srebra i koji mogu predstaviti skoro neograničen broj nivoa ozračenosti<sup>23</sup>. Slično tome, Akcay i sar. su poredeći konvencionalni i dva digitalna sistema radiografisanja (fosforne ploče i CCD-senzor) pokazali da je pet endodontskih pasta imalo veću rendgenkontrastnost na digitalnim slikama<sup>11</sup>. Ovi autori su takođe zapazili da na očitavanja rendgenkontrastnosti pri digitalizaciji filmova utiču i osobine skenera i da bi i oni trebalo da imaju svoju referentnu skalu sive boje<sup>11</sup>.

Rezultati koje smo dobili za TotalFill BC Sealer pastu nisu bili značajno različiti od vrednosti za EndoSequence BC Sealer. Ovo je verovatno uzrokovano činjenicom da su sastavi ovih pasta bazirani na istom patentu<sup>14</sup>. Ceraseal je nedavno razvijena pasta i postoji samo jedna studija o njenim fizičko-hemijskim osobinama. U toj studiji autori su pokazali da je rendgenkontrastnost Ceraseal paste ekvivalentna debljini od 5,94 mm aluminijumskog etalona<sup>3</sup>. Značajna razlika u odnosu na vrednosti koje smo mi dobili, 10,41 mmAl, može se pripisati razlikama u ekspozicionim parametrima ili razlikama u osetljivosti korišćenih digitalnih senzora<sup>13</sup>. Naime, u pomenutoj studiji autori su koristili napon cevi od 60 kV, struju od 2 mA, vreme ekspozicije od 0,08 s i rastojanje cevi od objekta od 10 cm za razliku od parametara koje smo mi koristili: 70 kV, 7 mA, 0,07 s i 30 cm. Slično prethodnoj, *Bio-C Sealer* pasta je relativno nov materijal na tržištu tako da ima malo podataka u literaturi koji se odnose na njenu rendgenkontrastnost. Samo jedna skorašnja studija je ispitivala rendgenkontrastnost koristeći digitalni sistem i pokazala malo niže vrednosti od naših, 7,11 mmAl, ali koristeći drugačije parametre ekspozicije<sup>22</sup>.

Nivoi rendgenkontrastnosti svih ispitivanih jednokomponentnih kalcijum-silikatnih pasta bili su relativno visoki, najmanje tri puta viši od onih zahtevanih standardom. To verovatno može da doprinese boljoj proceni endodontskih punjenja u slučaju prebacivanja preko vrha korena, posebno imajući u vidu da su ove paste injektabilne i da lako mogu biti prebačene periapikalno.

They suggested that, beside sensors sensitivity, the observed difference also may be a consequence of the fact that digital systems have analogue-to-digital data conversion and a limited number of available grey shades (from 0 to 255) in contrast to conventional radiographic image which consists of silver grains that could display almost continuous radiation intensities<sup>24</sup>. Likewise, Akcay et al., using a conventional and two digital-radiography systems (storage phosphor plate and charge-coupled device sensor), showed that five different endodontic sealers had higher radiopacities on digital images<sup>11</sup>. These authors also noted that read-out of radiopacity-measurements with film digitalization depends on characteristics of the scanner and they proposed that they should have their own grey scale references<sup>11</sup>.

Our results for TotalFill BC Sealer were not significantly different from the values observed for EndoSequence BC Sealer. This is probably due to the fact that the compositions of these two sealers are based on the same patent<sup>14</sup>. Ceraseal is a recently developed sealer and there is just one research report about its physicochemical properties. In this study, the authors reported that radiopacity of Ceraseal was equivalent to 5.94 mm thick aluminium step wedge<sup>3</sup>. Quite a difference from the value obtained in our study, 10.41 mmAl, could be related to different exposure parameters or sensitivity of the digital sensor used<sup>13</sup>. Namely, in the mentioned study, the authors used a tube voltage at 60 kV, 2 mA current, 0.08 s exposure time and focus-to-target distance of 10 cm unlike parameters used in our study: 70 kV, 7 mA, 0.07 s and 30 cm, respectively. Likewise, Bio-C Sealer is a relatively new material on the market and there are limited data in the literature concerning its radiopacity levels. Only one current study evaluated its radiopacity using digital imaging system, but different exposure parameters showed the results slightly lower than ours, 7.11 mmAl<sup>22</sup>.

Radiopacity values of all examined premixed calcium silicate-based sealers were relatively high, three times higher than the value required by standards, at least. This possibly could facilitate the better evaluation of endodontic filling in case of the extrusion over the root apex, especially having in mind that these sealers are injectable materials and could easily be extruded periapically.

## ***Zaključak***

Ispitivane jednokomponentne kalcijum-silikatne endodontske paste imale su rendgenkontrastnost preko 9 mmAl, od Bio-C Sealer, EndoSequence BC Sealer, TotalFill BC Sealer do Ceraseal, po rastućim vrednostima. Pasta na bazi epoksi smola, AH Plus, kao kontrolni materijal, imala je najveću rendgenkontrastnost ali mislimo da uočene razlike, u odnosu na druge paste, verovatno klinički nisu dovoljno značajne da bi uticale na odabir paste u svakodnevnoj praksi, prema nivou rendgenkontrastnosti.

## ***Zahvalnica***

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## ***Conclusion***

Premixed calcium silicate-based endodontic sealers evaluated in our study had radiopacity values higher than 9 mmAl, in ascending order, from Bio-C Sealer, EndoSequence BC Sealer, TotalFill BC Sealer to Ceraseal. Epoxy-based sealer, AH Plus, as a control material, had the highest radiopacity but we think that the differences observed are probably not clinically significant and relevant to influence the choice of sealer in everyday practice, based on radiopacity level.

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# UTICAJ NAČINA PRIPREME NA MEHANIČKE KARAKTERISTIKE GIPSA

## INFLUENCE OF PREPARATION METHOD ON MECHANICAL CHARACTERISTICS OF PLASTER

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### Sažetak

**Uvod:** Gips se u stomatologiji široko koristi za izradu radnih modela, kao vezivo u vatrostalnim masama i kao pomoćni materijal u laboratorijskim fazama izrade proteza. Zbog njegove krutosti, postoji stalna potreba za poboljšanjem mehaničkih svojstava. S tim u vezi, u istraživanju smo pošli od pretpostavke da se povećanjem udela praha, prilikom pripreme, gipsa poboljšavaju njegove mehaničke karakteristike.

**Cilj** ovog istraživanja je utvrđivanje značaja promene odnosa praha i tečnosti na mehaničke karakteristike gipsa (pritisnu čvrstoću).

**Materijal i metode:** U istraživanju su korišćene tri vrste gipsa: tip 2, 3 i 4. Za svaki tip gipsa pravljena su po tri uzorka sa različitim odnosom praha i količine vode (n=9). Nakon 24h, uzorci su analizirani na Mašinskom fakultetu u Nišu, na univerzalnoj mašini za testiranje.

**Rezultati:** Najmanje vrednosti pritiska čvrstoće pokazao je gips tipa 2, a veće vrednosti tip 3 i 4, bez obzira na srazmeru praha gipsa i vode. Sa porastom udela praha, povećavala se pritisna čvrstoća uzoraka.

**Zaključak:** U cilju poboljšanja pritiska čvrstoće, može se povećati udeo praha u tečnoj fazi u toku pripreme materijala bez vidljivih promena u njegovoj strukturi.

**Cljučne reči:** gips, pritisna čvrstoća

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### Abstract

**Introduction:** Plaster is widely used in dentistry for the production of master casts, as a binder in investment materials and as an auxiliary material in the laboratory stages of denture production. Due to its brittleness, there is a constant need to improve its mechanical properties. In this regard, in the research we started from the assumption that increasing the proportion of powder during the preparation of plaster improves its mechanical properties.

**The aim** of this research was to determine the significance of the change in the ratio of powder and liquid to the mechanical characteristics of plaster (compressive strength).

**Material and methods:** Three types of plaster were used in the research: type 2, 3 and 4. For each type of plaster, three samples were made with different ratio of powder and amount of water (n = 9). After 24 hours, the samples were analyzed at the Faculty of Mechanical Engineering in Niš, on a universal testing machine.

**Results:** Plaster type 2 showed the lowest values of compressive strength, and higher values of types 3 and 4, regardless of the ratio of plaster powder and water. As the powder content increased, the compressive strength of the samples increased.

**Conclusion:** In order to improve the compressive strength, the proportion of powder in the liquid phase can be increased during the preparation of the material without visible changes in its structure.

**Key words:** plaster, compressive strength

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za stomatologiju Niš. Sva prava zadržana.

## Uvod

Gips se u stomatologiji koristi za izradu radnih modela, kao vezivo u vatrostalnim masama i kao pomoćni materijal u laboratorijskim fazama izrade proteza (kalupi za polimerizaciju veštačkih smola, fiksiranje modela u artikulatu). U savremenoj stomatološkoj praksi, gips se više ne koristi kao otisni materijal<sup>1</sup>. Pre bi se moglo reći da njegova primena, u svrhu otiskivanja bezubih ili krezubih vilica, ima istorijski značaj<sup>2</sup>.

U svakodnevnoj praksi, uobičajeno je da se gipsom naziva veći broj supstanci koje se razlikuju po hemijskom sastavu, što je, naravno, neprihvatljivo sa aspekta hemijskog sastava ovog materijala. Precizniji nazivi za materijale na bazi gipsa su<sup>3</sup>:

- gips (prirodni mineral, kao i očvršli proizvod nastao dodavanjem vode prahu) po hemijskom sastavu je kalcijum-sulfat dihidrat;
- poluhidrat ( $\alpha$  i  $\beta$ ) nastaje delimičnom dehidracijom gipsa i u hemijskom smislu predstavlja kalcijum-sulfat poluhidrat;
- dentalni gipsevi (alabaster gips, tvrdi gips, poboljšani tvrdi gips itd.) predstavljaju preparate  $\alpha$  -poluhidrata i  $\beta$ -poluhidrata sa dodacima drugih supstanci;

Podela dentalnih gipseva prema ISO 6873:1998 standardu<sup>4</sup>:

- tip 1– Dental plaster (gips za otiske);
- tip 2– Dental plaster (gips za modele, alabaster, beli gips);
- tip 3– Dental stone ( gips za modele, tvrdi gips);
- tip 4– Dental stone (gips za modele, gips velike tvrdoće i čvrstoće i male ekspanzije);
- tip 5– Dental stone ( gips za modele, gips velike tvrdoće i čvrstoće i velike ekspanzije);

**Dentalni gips-tip 1:** Koristi se za izradu radnih modela, kao i vezivo u vatrostalnim masama i kao pomoćni materijal u laboratorijskim fazama izrade proteza.

**Dentalni gips-tip 2:** Koristi se za izlivanje modela za analizu i izradu individualnih kašika, kivetiranje poteza, fiksiranje modela u artikulatu, izradu radnih modela u ortodontici, izlivanje postolja radnih modela i izradu raznih držača i fiksatora.

**Dentalni gips-tip 3:** Njegova tipična primena je u izradi radnog modela za parcijalne i totalne akrilatne proteze, okluzalne trećine modela antagonista, radnog modela za parcijalne skeletirane proteze i radnog modela za fiksne nadoknade.

## Introduction

Plaster is widely used in dentistry for the production of master casts, as a binder in investment materials and as an auxiliary material in the laboratory stages of denture production (molds for polymerization of synthetic resins, fixing the model in the articulator). In modern dental practice, plaster is no longer used as an impression material<sup>1</sup>. Rather it could be said that its application for the purpose of imprinting edentulous or partial edentate jaws has historical significance<sup>2</sup>.

In everyday practice, it is common to designate as plaster a large number of substances that differ in chemical composition, which is, of course, unacceptable from the aspect of the chemical composition of this material. More precise names for plaster - based materials are<sup>3</sup>:

- plaster (natural mineral, as well as hardened product formed by adding water to powder) by chemical composition is calcium sulfate dehydrate
- hemihydrate ( $\alpha$  and  $\beta$ ) is formed by partial dehydration of plaster and in the chemical sense is calcium sulfate hemihydrate
- dental plasters (alabaster plaster, hard plaster, improved hard plaster, etc.) are preparations of  $\alpha$  and  $\beta$ -hemihydrate with the addition of other substances.

Division of dental plasters according to ISO 6873: 1998 standard<sup>4</sup>:

- Type 1. Dental plaster
- Type 2. Dental plaster (plaster for models, alabaster, white plaster)
- Type 3. Dental stone (plaster for models, hard plaster)
- Type 4. Dental stone (plaster for models, plaster of high hardness and strength and small expansion)
- Type 5. Dental stone (plaster for models, plaster of high hardness and strength and large expansion)

Dental plaster - type 1. It is used for the production of working models, as well as a binder in investment materials and as an auxiliary material in the laboratory stages of prosthesis production.

Dental plaster - type 2. It is used for pouring models for analysis and making custom trays, denture flasking, fixing models in articulators, making working models in orthodontics, pouring stands of working models and making various holders and fixators.



**Dentalni gips-tip 4:** Koristi se za izlivanje najfinijih i najpreciznijih modela za izradu fiksnih nadoknada.

**Dentalni gips-tip 5:** Primenjuje se u fiksnoj protetici za izradu patrljaka radnih modela, gde se nadoknada lije od neplemenitih legura.

**Sintetički gipsevi:** Iako ovi gipsevi nisu sistematizovani po ISO standardima, njihova primena u stomatologiji je u porastu. Oni su višestruko skuplji od prirodnih gipseva, a njihove fizičke karakteristike često prevazilaze i najkvalitetnije prirodne gipseve.

Da bi se iskoristio maksimalni potencijal svake od navedenih vrsta gipsa, neophodno je odrediti pravilan odnos praha i tečnosti pri njihovoj primeni. Sa druge strane, svedoci smotoga da se u svakodnevnoj praksi pripremi gipsa pristupa rutinski, te da se materijal retko sprema prema uputstvu proizvođača. S tim u vezi, u istraživanju smo pošli od pretpostavke da se povećanjem udela praha prilikom pripreme gipsa poboljšavaju njegove mehaničke karakteristike.

**Cilj** ovog istraživanja je utvrđivanje značaja promene odnosa praha i tečnosti na mehaničke karakteristike gipsa (pritisnu čvrstoću gipsa).

### ***Materijali i metode***

U okviru ovog istraživanja korišćena su tri različita tipa gipsa, sa jasno definisanim fabričkim svojstvima:

- Alabaster Polident – pomoćni gips u tehnici – tip 2:

**Karakteristike:** Smesa kalcijumovog sulfata sa dodacima; bele boje; bez mirisa.

**Odnos mešanja:** voda (ml)/gips (g) – 60/100; ekspanzija: 0,16%.

**Vreme stvrdnjavanja:** 10 – 14 min; radno vreme: 5 – 6 min.

- Polidur Blue Polident – tip 3:

**Karakteristike:** Smesa kalcijum-sulfata sa dodacima; bez mirisa; plave boje.

**Odnos mešanja:** voda (ml)/gips (g) – 30/100; ekspanzija 0,18%.

**Vreme stvrdnjavanja:** 7 – 12 min.

- Vet Metal Polistone Polident – tip 4:

**Karakteristike:** Super tvrdi sintetički dentalni gips; smesa kalcijum-sulfata sa dodacima; bež boje, bez mirisa.

**Odnos mešanja:** voda (ml)/gips (g) – 22/100; ekspanzija: 0,10%.

**Vreme stvrdnjavanja:** 13 – 15 min.

Uzorci gipsa (Slika 1) pravljani su u metalnom kalupu, čije su dimenzije bile 3 cm x 3 cm x 5 cm. Dobijeni su uzorci oblika kvadra, ravnih i međusobno paralelnih površina, koji su šmirglom ispolirani.

Dental plaster - type 3. Its typical application is in the production of a working model for partial and total acrylic dentures, occlusal thirds of the antagonist model, a working model for partial skeletal dentures and a working model for fixed restorations.

Dental plaster-type 4. It is used for casting the finest and most precise models for making fixed restorations.

Dental plaster -type 5. It is used in fixed prosthetics for making stumps of working models, where the compensation is made of base alloys.

Synthetic plaster. Although these plasters are not systematized according to ISO standards, their application in dentistry is on the rise. They are more expensive than natural plasters, and their physical characteristics often exceed even the highest quality natural plasters.

In order to use the maximum potential of each of the mentioned types of plasters, it is necessary to determine the correct ratio of powder and liquid during their application. On the other hand, we are witnesses that in everyday practice the plaster preparation is approached routinely, and that the material is rarely prepared according to the manufacturer's instructions. In this regard, in the research we started from the assumption that increasing the proportion of powder during the plaster preparation improves its mechanical properties.

**The aim** of this research was to determine the significance of the change in the ratio of powder and liquid to the mechanical characteristics of plaster (compressive strength of plaster).

### ***Materials and methods***

Within this research, three different types of plaster with clearly defined factory properties were used:

- Alabaster Polident - Auxiliary plaster in technique - Type 2.

**Characteristics:** Mixture of calcium sulfate with additives. White. Odorless.

**Mixing ratio:** water (ml)/plaster (g) - 60/100.

**Expansion:** 0.16%.

**Curing time:** 10-14 min. **Working time:** 5-6 min.

- Polidur Blue Polident - Type 3

**Characteristics:** Mixture of calcium sulfate with additives. Odorless. Blue.

**Mixing ratio:** water (ml)/plaster (g) – 30/100.

**Expansion** 0.18%.

**Curing time:** 7-12 min.

- Vet Metal Polistone Polident - Type 4

Za svaki tip gipsa pravljena su po tri uzorka sa različitim odnosom praha i količine vode ( $n=9$ ), prikazanim u tabelama 1 do 3. Količina vode merena je špricom. Masa gipsa merena je na digitalnoj vagi. Mešanje gipsa obavlja se tako što se prah dodaje u vodu i meša ručno, pomoću gumene šolje i špatule.

Nakon 24h, uzorci su analizirani na Mašinskom fakultetu u Nišu, na univerzalnoj mašini za testiranje.

Pri ispitivanju pritiskivanjem pod dejstvom aksijalnih sila nastaje smanjenje visine uzorka, do loma (Slika 2).

Characteristics: Super hard synthetic dental plaster. A mixture of calcium sulfate with additives. Beige, odorless. Mixing ratio: water (ml)/plaster (g) - 22/100. Expansion: 0.10%. Curing time: 13-15 min.

● Plaster samples (Figure 1) were made in a metal mold whose dimensions were 3x3x5cm. Samples of square shape with flat and parallel surfaces were obtained, which were polished with sandpaper.

For each type of plaster, three samples were made with different ratio of powder and amount of water ( $n=9$ ), shown in Tables 1 to 3. The amount of water was measured with a syringe. The mass of plaster was measured on a digital scale. The plaster is mixed by adding the powder into the water and mixing it by hand, using a rubber cup and a spatula.



**Slika 1.** Uzorci gipsa

**Fig. 1.** Plaster samples /

**Tabela 1.** Odnos praha i tečnosti u uzorcima Alabaster Polident gipsa (tip 2)

**Table 1.** Powder/liquid ratio in Alabaster Polident plaster samples (type 2)

| Uzorak/Sample | Masa gipsa/Plaster mass | Količina vode/Water amount |
|---------------|-------------------------|----------------------------|
| 1             | 50g                     | 30ml                       |
| 2             | 60g                     | 30ml                       |
| 3             | 70g                     | 30ml                       |

**Tabela 2.** Odnos praha i tečnosti u uzorcima Polidur Blue Polident (tip 3)

**Table 2.** Powder/liquid ratio in Polidur Blue Polident samples (type 3)

| Uzorak/Sample | Masa gipsa/Plaster mass | Količina vode/Water amount |
|---------------|-------------------------|----------------------------|
| 1             | 90g                     | 30ml                       |
| 2             | 100g                    | 30ml                       |
| 3             | 110g                    | 30ml                       |

**Tabela 3.** Odnos praha i tečnosti u uzorcima Vet Metal Polistone Polident (tip 4)

**Table 3.** Powder/liquid ratio in Vet Metal Polistone Polident samples (type 4)

| Uzorak/Sample | Masa gipsa/Plaster mass | Količina vode/Water amount |
|---------------|-------------------------|----------------------------|
| 1             | 90g                     | 25ml                       |
| 2             | 100g                    | 25ml                       |
| 3             | 110g                    | 25ml                       |

Pritisna čvrstoća određuje se samo kod krutih materijala i predstavlja odnos maksimalne pritisne sile ( $F_{pm}$ ), pri kojoj nastaje lom uzorka i prvobitne površine poprečnog preseka epruvete ( $A_0$ ), što se određuje sledećom formulom:

$$\sigma_{pm} = F_{pm} / A_0$$

After 24 hours, the samples were analyzed at the Faculty of Mechanical Engineering in Niš, using a universal testing machine.

When tested by pressing under the action of axial forces, there is a decrease in the height of the sample, up to fracture (Figure 2). The compressive strength is determined only for brittle materials and represents the ratio of the maximum compressive force ( $F_{pm}$ ) at which the sample breaks and the original cross-sectional area of the specimen ( $A_0$ ), which is determined by the following formula:

$$\sigma_{pm} = F_{pm} / A_0$$



**Slika 2.** Testiranje uzoraka

**Fig. 2.** Testing samples

## Rezultati

Dobijene vrednosti pritisne čvrstoće gipsa date su u tabeli 4.

Različite vrednosti pritisne čvrstoće dobijene su u zavisnosti od tipa testiranog gipsa, ali i udelnog odnosa praha i tečnosti.

Najveću pritisnu čvrstoću pokazao je žuti gips, manje vrednosti plavi, dok je lom pod pritiskom kod belog gipsa bio najlakše moguć. Sa porastom mase dodatog praha gipsa u istu količinu vode, poboljšana su mehanička svojstva uzoraka, odnosno poboljšana je pritisna čvrstoća.

## Results

The obtained values of plaster compressive strength are given in Table 4.

Different values of compressive strength were obtained depending on the tested plaster type, but also the specific ratio of powder and liquid.

The highest compressive strength was shown by yellow plaster, lower values by blue, while the fracture under pressure in white plaster was the easiest possible. With the increase of the mass of added plaster powder in the same amount of water, the mechanical properties of the samples, i.e., the compressive strength, improved.

**Tabela 4.** Pritisna čvrstoća gipsa  
**Table 4.** Plaster compressive strength

| Broj/Uzorak<br>Number/Sample | Pritisna čvrstoća / Compressive strength, Rm (MPa ) |                               |                                      |
|------------------------------|-----------------------------------------------------|-------------------------------|--------------------------------------|
|                              | Alabaster Polident<br>X±SD                          | Polidur Blue Polident<br>X±SD | Vet Metal Polistone Polident<br>X±SD |
| 1 (n=3)                      | 14.1±0.6                                            | 36.7±2.4                      | 56.3±4.5                             |
| 2(n=3)                       | 18.2±2.0                                            | 41.4±3.3                      | 62.3±4.9                             |
| 3(n=3)                       | 27.5±2.7                                            | 51.7±2.9                      | 77.0±4.8                             |

X-median, arithmetic mean, SD-standard deviation  
 X-mediana, aritmetička sredina, SD-standardna devijacija

## Diskusija

Mehanička svojstva materijala čine skup svojstava koje definišu njihovo ponašanje kada su izloženi dejstvu spoljašnjih sila i određuju mogućnost ili nemogućnost njihove primene u izradi neke konstrukcije. Mehanička svojstva koja se najčešće ispituju jesu čvrstoća, elastičnost, žilavost i tvrdoća<sup>5</sup>.

Istraživanje je imalo za cilj da utvrdi kako odnos praha gipsa i vode utiče na pritisnu čvrstoću materijala. Testiranje je izvršeno na tri različita tipa gipsa, sa jasno definisanim indikacionim područjem u stomatologiji. Sam postupak vezivanja odvija se po hemijskoj reakciji, koja je univerzalna za sve stomatološke gipseve<sup>6</sup>.

Mešanjem praha dentalnog gipsa sa vodom, poluhidrat ponovo prelazi u dihidrat i oslobađa se toplota, nakon čega dolazi do reakcije vezivanja, koja prolazi kroz tri faze:

- faza 1 – poluhidrat i dihidrat, pomešani sa vodom, delimično se rastvaraju;
- faza 2 – kada dođe do povećanja koncentracije jona u vodi, dihidrat se kristališe, a polihidrat se i dalje rastvara, što je posledica veće rastvorljivosti poluhidrata od dihidrata;
- faza 3 – dolazi do kristalizacije. Dihidrat se kristališe, a poluhidrat se rastvara. Rezultat je tvrda masa kalcijum-sulfata dihidrata;

Srazmerno veća količina praha dovodi do jače kristalizacije dihidrata i jačeg otvrdnjavanja gipsa. Rezultati istraživanja pokazali su to da dodavanje veće količine praha u istu količinu vode stvara uzorke otpornije na lom.

Mehanička postojanost gipsanih modela kao modela, za studije u atrikulatoru ili paralelometru i kao radnih modela za izradu svih vrsta zubnih nadoknada, od izuzetnog je značaja. Može se reći da je gips

## Discussion

Mechanical properties of materials are a set of properties that define their behavior when exposed to external forces and determine the possibility or impossibility of their application in the manufacture of some structures. The mechanical properties that are most often tested are strength, elasticity, toughness, hardness<sup>5</sup>.

The research aimed to determine how the ratio of plaster powder to water affects the compressive strength of the material. Testing was performed on three different types of plaster with a clearly defined indication area in dentistry. The bonding process itself takes place according to a chemical reaction that is universal for all dental plasters<sup>6</sup>.

By mixing the powder of dental plaster with water, the hemihydrate turns into dihydrate again and the heat is released. This is followed by a binding reaction that goes through three phases:

- Phase 1 - hemihydrate and dihydrate, mixed with water, are partially dissolved.
- Phase 2 - when the concentration of ions in water increases, the dihydrate crystallizes and the polyhydrate continues to dissolve. This is due to the higher solubility of hemihydrate than dihydrate.
- Phase 3 - Crystallization occurs. The dihydrate crystallizes and the hemihydrate dissolves. The result is a solid mass of calcium sulfate dihydrate.

A relatively larger amount of powder leads to stronger crystallization of dihydrate and stronger hardening of plaster. The results of the research showed that adding a larger amount of powder to the same amount of water creates samples more resistant to breakage.

The mechanical stability of plaster models as a model for studies in the articulator or parallelometer and as working models for the production of all types of dental restorations is of great importance.

osnovni pomoćni stomatološki materijal, te da se, uprkos stalnom istraživanju i uvođenju novih vrsta optisnih materijala, njegova upotreba, u cilju njihove reprodukcije u pozitivu, nije promenila. Novi materijal za radne modele (ukoliko zamemarimo CAD/CAM tehnologiju) i ne postoji. Stoga je svako istraživanje u polju unapređenja kvaliteta gipsa veoma važno<sup>7</sup>. Gips treba da bude mehanički postojan, kako bi izdržao sve proceduralne faze izrade stomatoloških nadoknada. Ako uzmemo u obzir toda je gips krt materijal, postoji mogućnost oštećenja radnog modela u toku rada. Rezultati istraživanja pokazali su toda dodatak veće količine praha može poboljšati čvrstoću dobijenog modela, odnosno smanjiti rizik od preloma prilikom izrade stomatoloških nadoknada. Pri tome, sam izgled uzoraka nije se promenio, što znači da se ovaj model pripreme materijala može promeniti u praksi, bez bojazni da se kompromituje sam postupak izrade stomatoloških nadoknada.

Rezultati su, takođe, pokazali i razliku u ispitivanom mehaničkom svojstvu čvrstoće u odnosu na tip testiranog dentalnog gipsa. Kao što je i očekivano, najmanju čvrstoću pokazao je alabaster, odnosno beli gips, bez obzira na srazmeru praha i vode. Veće vrednosti prikazane su kod plavog, a najveće kod gipsa za specijalne radne modele. Potvrđivanjem rezultata, koje su dobili i drugi autori u svojim istraživanjima, stomatološke gipseve možemo klinički egzaktno klasifikovati, upotrebljavajući one koji odgovaraju jasnoj indikaciji, a sa druge strane, kontrolišući njihova mehanička svojstva pravilnim odabirom odnosa praha i tečnosti.

Literaturni podaci pokazali su težnju istraživača da poboljšaju mehanička svojstva stomatoloških gipseva. Mehanička čvrstoća gipsa može se poboljšati i dodatkom silikatnih nanočestica, što potvrđuje činjenica da porastom čvrste faze dobijamo materijal bolje čvrstoće<sup>8</sup>. Abdullah je predložio smanjenje površinske hrapavosti gipsa, kao i povećanje kompresivne čvrstoće i dimenzionalne stabilnosti radnih modela potapanjem u hipohloričnu kiselinu<sup>9</sup>. Yap i sar. dokazali suda sušenje uzoraka gipsa u mikrotalasnoj peći povoljno utiče na njegove karakteristike i sprečava deformaciju<sup>10</sup>. Silva i sar. predložili su isušivanje gipsanih modela u mikrotalasnoj peći ili na sobnoj temperaturi, kao efikasan metod za poboljšanje kompresivne čvrstoće<sup>11</sup>.

It can be said that plaster is the basic auxiliary dental material, and that, despite constant research and the introduction of new types of impression materials, its use in order to reproduce them in a positive has not changed. There is no new material for working models (if we ignore CAD CAM technology). Therefore, any research in the field of plaster quality improvement is very important<sup>7</sup>. Plaster should be mechanically durable to withstand all procedural stages of making dental restorations. If we take into account that plaster is a brittle material, there is a possibility of damaging the working model during work. The results of the research showed that the addition of a larger amount of powder can improve the strength of the obtained model, i.e., reduce the risk of fractures when making dental restorations. At the same time, the appearance of the samples did not change, which means that this model of material preparation can be applied in practice without fear of compromising the process of making dental restorations.

The results also showed a difference in the examined mechanical property in relation to the type of tested dental plaster. As expected, alabaster, i.e., white plaster, showed the lowest strength, regardless of the ratio of powder and water. Higher values are shown for blue, and the highest for plaster for special working models. By confirming the results obtained by other authors in their research, we can classify dental plasters clinically exactly, using those that correspond to a clear indication, and on the other hand controlling their mechanical properties by correctly choosing the ratio of powder and liquid.

The literature data have shown the tendency of researchers to improve the mechanical properties of dental plasters. The mechanical strength of plaster can also be improved by the addition of silicate nanoparticles, which confirms that with the increase of the solid phase, we obtain a material of better strength<sup>8</sup>. Abdullah proposed a reduction in the surface roughness of plaster, as well as an increase in compressive strength and dimensional stability of working models by immersion in hypochlorous acid<sup>9</sup>. Yap et al. have proved that drying plaster samples in a microwave oven has a favorable effect on its characteristics and prevents deformation<sup>10</sup>. Silva et al. have proposed drying plaster models in a microwave oven or at room temperature as an effective method for improving compressive strength<sup>11</sup>.

## Zaključak

Gips je jedan od osnovnih pomoćnih materijala u stomatologiji, ali je zbog svoje krutosti podložan oštećenjima. U cilju poboljšanja pritisne čvrstoće, može se povećati udeo praha u tečnoj fazi u toku pripreme materijala bez vidljivih promena u njegovoj strukturi. Najmanje vrednosti pritisne čvrstoće pokazao je gips tipa 2, a veće vrednosti tip 3 i 4, bez obzira na srazmeru praha gipsa i vode.

## Conclusion

Plaster is one of the basic auxiliary materials in dentistry, but it is susceptible to damage due to its brittleness. In order to improve the compressive strength, the proportion of powder in the liquid phase can be increased during the preparation of the material without visible changes in its structure. Plaster type 2 showed the lowest values of compressive strength, and higher values of type 3 and 4, regardless of the ratio of plaster powder and water.

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PRIKAZ SLUČAJA  
CASE REPORT  
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## BELOOKI BLOWOUT PRELOM BEZ SUBKONJUKTIVALNOG KRVARENJA – 10 DANA ODLOŽENA HIRURŠKA INTERVENCIJA I NJEN ISHOD: PRIKAZ SLUČAJA

### WHITE-EYED BLOWOUT FRACTURE: A 10 DAYS DELAYED SURGICAL INTERVENTION AND OUTCOMES: A CASE REPORT

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#### Sažetak

**Osnov problema:** Povreda kraniomaksilofacijalne regije u pedijatrijskoj populaciji je retka povreda, sa stopom incidencije od 15%, a najčešće se javlja prelom dna orbite. Belooki blowout prelomi mogu biti neinficirani ili inficirani, sa traumom koja je načešća u etiologiji ovog oboljenja.

**Metode rada:** Prikazan je petnaestogodišnji pacijent sa dijagnozom belooki blowout prelom, koji je lekaru prijavljen deset dana nakon povrede. Prelom je hirurški saniran oslobađanjem zarobljenog donjeg pravog mišića očne jabučice i postavljanjem titanijumske mreže na orbitalni pod, sa postoperativnim periodom praćenja od 6 meseci.

**Rezultati:** U ovom prikazu slučaja, iako su pokreti oka bili evidentni, bez ikakvih ograničenja, autori nisu uspjeli pacijentu da omoguće čitav spektar pokreta oka, zbog odložene hirurške intervencije.

**Zaključak:** Uklještenje donjeg pravog mišića očne jabučice najčešći je entitet koji se sreće u slučajevima belookog blowout preloma, zbog njegove neposredne blizine sa podom orbite. Rana dijagnoza i brza hirurška intervencija doveli bi do najboljeg pozitivnog ishoda u lečenju belookog blowout preloma.

**Ključne reči:** trauma u dečjem uzrastu, diplopija, belooki blowout prelom, čisti prelom orbitalnog poda, odložena intervencija

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#### Abstract

**The basis of the problem:** Craniomaxillofacial trauma in pediatric group is less common with an incidence rate of 15% and the most commonly involved site is the fracture of orbital floor. Blow out fractures can either be pure or impure with trauma being the most predominant etiology.

**Method:** Our case report present a 15 year old patient with a diagnosis of white eye blowout fracture reported ten days post trauma. The case was surgically dealt by releasing the entrapped inferior rectus muscle and placement of titanium mesh in the orbital floor with a postoperative follow up period of 6 months.

**Results:** In the present report, although the eye movements were evident without any restriction, the authors were unable to achieve a full range of eye movements due to delayed surgical intervention.

**Conclusion:** Inferior rectus muscle entrapment is the most common entity encountered in cases of white eye blow out fractures, due to its close proximity with the orbital floor and lack of periodontal fat. Early diagnosis and immediate surgical intervention would bring about a best positive outcome in the management of white eye blow out fractures.

**Key words:** pediatric trauma, diplopia, white eye blowout, pure orbital floor fracture, delayed intervention

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## Uvod

Prelomi lica u pedijatrijskoj populaciji ređi su u odnosu na prelome u populaciji odraslih, a uzroci preloma lica kod dece i adolescenata razlikuju se u odnosu na uzroke preloma kod odraslih pacijenata. Prelomi poda orbite česti su u pedijatrijskoj grupi pacijenata i mogu biti neinficirane ili inficirane *blowout* povrede, koje mogu biti povezane sa prelomima zigomaksilarnog kompleksa. Termin "belooki *blowout*" prelom prvi je uveo Džordan 1998<sup>1</sup>. Belooki *blowout* prelomi obično se povezuju sa čistim prelomima poda orbite kod dece i adolescenata i nastaju zbog veće elastičnosti kostiju lica. Belooki *blowout* prelomi obično se manifestuju diplopijom, ograničenim pokretima očne jabučice pri pogledu nagore, te zahtevaju brzu dijagnozu i blagovremenu hiruršku intervenciju<sup>2</sup>. Ovaj prikaz slučaja imao je za cilj da predstavi funkcionalni ishod u lečenju belookog *blowout* preloma u dečjem uzrastu.

## Prikaz slučaja

U ovom radu, prikazan je slučaj petnaestogodišnjeg pacijenta, koji se 10 dana nakon povrede javio na odeljenje Oralne i maksilofacijalne hirurgije, zbog nemogućnosti gledanja na levo oko, pri pogledu nagore. Anamnestički je dobijen podatak o tome da je pacijent pao u toaletu, pri čemu je došlo do povrede levog oka izazvane tupom silom. Kliničkim pregledom evidentirani su ograničeni pokreti nagore povređenog oka, praćeni diplopijom i subkonjunktivnim krvarenjem (Slika 1). Kompjuterska tomografija prikazuje uklještenje donjeg pravog mišića očne jabučice i diskontinuitet u infraorbitalnom obodu (Slika 2). Slučaj je privremeno dijagnostikovao kao belooki *blowout* prelom. Hirurška intervencija uključila je oslobađanje zarobljenog mišića, nakon čega je usledilo postavljanje titanijumske mreže u pod orbite. Autori su dobili pisani informisani pristanak pacijenata za objavljivanje slika (slike priložene u ovom prikazu slučaja pripadaju autorima: dr Karthik Kattur Premkumar i dr Balamurugan Rajendran) i druge kliničke informacije, koje će biti objavljene u časopisu, uz podrazumevanu obavezu autora da imena i inicijali neće biti objavljeni i njihovo zalaganje da se prikrije identitet pacijenta, ali da se njegova anonimnost ne može garantovati.

## Introduction

Facial fractures in pediatric groups are less common when compared to adults and the facial fracture patterns of children and adolescence vary in contrast to adults. Orbital floor fractures are common in pediatric group, which can be either pure or impure blowout fractures associated with zygomaticomaxillary complex fractures. The term white eye blowout fracture was first coined by Jordan in 1998<sup>1</sup>. White eye blowout fractures are commonly associated with pure blow fractures of the orbital floor in children and adolescence due to greater elasticity nature of the facial bones. Trap door blowout fractures usually present with a clinical sign of diplopia, restriction of upward gaze movements which require prompt diagnosis and timely surgical intervention<sup>2</sup>. The current case report aimed to evaluate the functional outcome in the management of pediatric white eye blowout fracture.

## Case report

The current case report article describes a 15 year old patient who presented to the Department of Oral and Maxillofacial Surgery ten days post trauma with a complaint of inability to view in his left eye in the upward direction. History revealed a fall in his restroom with a blunt trauma to the left eye. On clinical examination, restriction of eye movement in the upward gaze with diplopia was evident along with subconjunctival hemorrhage (Figure 1). Computed tomography depicted an inferior rectus muscle entrapment and discontinuity in the infraorbital rim (Figure 2). The case was provisionally diagnosed as white eye blowout fracture. Surgical intervention included release of the entrapped muscle followed by the placement of titanium mesh in the orbital floor. The authors certify that they have obtained written informed patient consent for images (the images enclosed in the current case report refers to authors: Dr. Karthik Kattur Premkumar and Dr. Balamurugan Rajendran) and other clinical information to be reported/publish in the journal with an understanding that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.





**Slika 1:** Preoperativna slika pokazuje ograničene pokrete leve očne jabučice pri pogledu nagore

**Figure 1:** Preoperative image showing restriction of left eye movement in the upward gaze



**Slika 2:** Kompjuterska tomografija (koronalni i sagitalni presek) pokazuje white-eyed belooku blowout povredu

**Figure 2:** Computed tomography (coronal and sagittal section) showing white-eyed blow out fracture

### ***Hirurška procedura***

Opšta anestezija sprovedena je nazalnom endotrahealnom intubacijom. Urađeno je standardno bojenje i drapiranje, kako bi se obezbedila sterilna hirurška procedura. Urađen je test forsirane dukcije, koji je ukazivao na ograničene pokrete oka pri pogledu nagore. Za zaštitu rožnjače stavljeni su tarsorafijski šavovi i napravljene su oznake za subtarzalni pristup. Lokalna anestezija infiltrirana je duž označenih polja. Nakon presecanja kože, izvršeno je presecanje potkožnog tkiva. Identifikovan je i izložen kružni mišić oka. Submuskularna ravan izabrana je kako bi se izbeglo oštećenje septuma. Supraperiostalna disekcija izvedena je preko infraorbitalnog oboda. Dalja disekcija nastavljena je subperiostavno 3 mm inferiorno, u odnosu na ivicu, kako bi se otkrili koštani deo i pod orbite.

### ***Surgical procedure***

Under naso-endotracheal intubation general anesthesia was administered. Standard painting and draping was done to ensure a sterile surgical procedure. Forced duction test was performed which indicated a restriction of eye movement in superior gaze. Tarsorrhaphy sutures were placed for corneal protection and markings were made for sub-tarsal approach. Local anesthesia was infiltrated along the markings. Skin was incised followed by subcutaneous dissection. The orbicularis oculi muscle was identified and exposed. Submuscular plane was chosen to avoid damage to the septum. Supraperiosteal dissection was carried over the infraorbital rim. Further dissection was continued subperiosteally 3mm inferior to the rim to expose the bony part and orbital floor. On exploring the floor, muscle entrapment was evident.

Pregledom poda orbite, uklještenje mišića bilo je jasno uočljivo. Zatim je napravljen koštani prozor, adhezije su pažljivo oslobođene pružanjem naižmeničnih pokreta, gde su segmenti preloma bili pritisnuti, kako bi se oslobodio zarobljeni donji pravi mišić oka (Slika 3). Postavljena je titanijumska mreža srednje veličine na pod orbite i vijakom 1,5 mm × 6 mm pričvršćena je za infraorbitalni obod (Slika 4). Nakon fiksacije, urađen je test forsirane dukcije i nisu primećena ograničenja u pokretima oka. Finalno zatvaranje urađeno je u slojevima. Kružni mišić oka zašiven je upotrebom 4-0 vikrila. Zatvaranje sloja kože urađeno je korišćenjem 5-0 prolona. Kasnije je postavljena *frost* sutura, kako bi se izbegli ektropija i ožiljak kože, tako što je slobodni kraj šava zalepljen za čelo.

Later a bony window was created, the adhesions were meticulously freed by providing alternating movements where the fracture segments were depressed to release the entrapped inferior rectus muscle (Figure 3). A medium sized titanium mesh was placed in the orbital floor and secured onto the infraorbital rim using 1.5×6mm screws (Figure 4). After fixation, forced duction test was carried out and no restrictions in the eye movements were noticed. Final closure was done in layers. Orbicularis oculi muscle was sutured using 4-0 vicryl. Skin layer closure was done using 5-0 prolene. Later, frost suture was placed to avoid ectropion and skin scarring by taping the free end of the suture to the forehead.



**Slika 3:** Klinički slika prikazuje oslobađanje zarobljenog donjeg pravog mišića oka

**Figure 3:** Clinical image showing the release of entrapped inferior rectus muscle



**Slika 4:** Klinička slika koja prikazuje rekonstrukciju poda orbite titanijumskom mrežom

**Figure 4:** Clinical image showing reconstruction of the orbital floor with titanium mesh



**Slika 5:** Postoperativna slika, koja prikazuje kretanje očiju pri pogledu nagore bez ograničenja

**Figure 5:** Postoperative image showing eye movement in the superior gaze without restriction

### **Postoperativni ishod**

Pacijent je praćen nakon operacije u periodu od 6 meseci (Slika 5). Neposrednog postoperativnog dana nije bilo komplikacija. Diplopija je bila prisutna mesec dana, nakon čega se povukla i bili su vidljivi pokreti oka pri pogledu nagore, bez ograničenja. Međutim, kompletan niz pokreta oka u pogledu nagore nije bio značajan, jer nam se pacijent javio deset dana nakon povrede.

### **Diskusija**

Termin *white eye blowout* prelom, kao takav, uveden je zbog termina koji opisuje nedostatak krvarenja u subkonjunktivalnom regionu<sup>1</sup>. *White eye blowout* prelomi najčešće se povezuju sa čistim *blowout* prelomima, koji pretežno pogađaju decu i adolescente uzrasta od 5 do 16 godina. Anatomski, debljina medijalnog orbitalnog zida kreće se od 0,2 mm do 0,4 mm, a dno orbite iznosi 0,5 mm<sup>3</sup>. Pod orbite skloniji je prelomima, zbog gubitka efekta podupirača i prisustva inferiorne orbitalne fisure<sup>3</sup>. Za sada, predložene su tri teorije za definisanje *blowout* preloma, a to su hidraulička teorija, teorija savijanja i vođena koštana teorija<sup>4,5</sup>. Hidrauličke teorije i teorije savijanja najšire su prihvaćene, što čini osnovu mehanizama preloma u okviru *blowout* preloma<sup>6</sup>.

Klinički, reakcije mekog tkiva, kao što su hematoma i periorbitalna ekchimoza nevidljive su, jer je uticaj sile mali i nema pojave enoftalmusa, zbog toga što je sadržaj orbite zarobljen unutar frakture<sup>7</sup>.

### **Postoperative outcome**

After surgery the patient was reviewed for a period of 6 months (Figure 5). No complications were elicited on the immediate postoperative day. Diplopia was present for a period of 1 month after which it got resolved and the eye movement in superior gaze was evident without any restriction. However, a full range of eye movements in the upward gaze was not significant as the patient reported to us with ten days post trauma.

### **Discussion**

The term *white-eye blowout* fracture was described due to the lack of hemorrhage in the subconjunctival region<sup>1</sup>. *White eye* or *trap door blowout* fractures are most commonly associated with pure *blowout* fractures predominantly affecting children and adolescents of 5-16 years of age. Anatomically, the thickness of the medial orbital wall ranges from 0.2mm to 0.4mm and the floor of orbit measures 0.5mm<sup>3</sup>. The orbital floor is more prone to fracture because of the loss of buttressing effect and due to the presence of inferior orbital fissure<sup>3</sup>. Three theories have been currently proposed to define the *blowout* fractures, namely hydraulic theory, buckling theory and bone conduction theory<sup>4,5</sup>. Hydraulic and buckling theories are most widely accepted which form a basis for fracture mechanism in *trap door blowout* fractures<sup>6</sup>.

Clinically, the soft tissue responses such as hematoma and periorbital ecchymosis are unseen as the impact of force is low and the occurrence of enophthalmos is absent as the contents of the orbit are entrapped within the fracture<sup>7</sup>.

Pozitivna klinička slika uključuje laceraciju ili abraziju, periorbitalno oticanje, ograničenje pokreta očnih jabučica pri pogledu nagore, praćeno binokularnom diplopijom, okulokardijalni refleks i pozitivan test prinudne dukcije. Iako okulokardijalni refleks ostaje klasičan nalaz, on je takođe bio indikacija za operaciju, jer duže trajanje refleksa može dovesti do bradikardije i srčanog bloka<sup>8,9</sup>. Radiografski, belooki *blowout* prelom dokazan je postojanjem uklještenja mekog tkiva (donji pravi mišić oka) i preloma donjeg orbitalnog oboda. Neinstein i saradnici<sup>7</sup> su putem morfološke procene zasnovane na CT opisali to da je donji pravi mišić oka češće zahvaćen, zbog bliske aproksimacije mišića na dnu orbite i istovremenog nedostatka periorbitalne masne podrške.

Vreme operacije igra važnu ulogu, a trenutna literatura prihvata činjenicu da se zbrinjavanje belookih *blowout* preloma mora izvesti u roku od 24 sata do 48 sati. Yang i saradnici<sup>10</sup> primetili su to da nije bilo razlika u stopi uspešnosti operacije kada je obavljena u roku od 24 h od nastanka povrede, između 24 h i 72 h i posle 72 h od nastanka povrede. Balaraman i saradnici<sup>2</sup> izvestili su o tome da odloženo hirurško lečenje dovodi do trajnog ograničavanja pokreta očiju pri pogledu nagore, što na kraju izaziva diplopiju, dok rana hirurška mera vraća normalnu funkciju mišića i sprečava pojavu ishemije ekstraokularnih mišića. U ovom prikazu slučaja, predstavljeno je odloženo hirurško lečenje, budući da se klinička manifestacija bolesti javila 10 dana nakon povrede orbite. Test forsirane dukcije bio je negativan nakon operacije. Egbert i saradnici<sup>11</sup> i Bansagi i saradnici<sup>12</sup> izvestili su o tome da oporavak poda orbite nakon povrede traje oko 10 do 14 dana kod odraslih, dok je kod dece trajanje oporavka kraće, zbog direktnog oštećenja mišića.

Postoperativno, diplopija je bila najčešća komplikacija, koja se javljala kod pacijenata sa > 50% perzistentnih belookih *blowout* preloma. Vreme oporavka od postoperativne diplopije može da se kreće od 25 dana do 18 meseci, sa dužim trajanjem kod dece mlađe od 9 godina<sup>10,13</sup>. U ovom prikazu slučaja, iako su pokreti oka pri pogledu nagore bili evidentni, bez ikakvih ograničenja, autori nisu uspeli pacijentu da omoguće čitav spektar pokreta oka, zbog odložene intervencije izazvane činjenicom da roditelji pacijenta nisu bili svesni značaja brze terapije. U buduću, treba se odlučiti za pravovremeni hirurški zahvat, kako bi se sprečili ovakvi nepovoljni ishodi.

The positive clinical presentation includes laceration or abrasion, periorbital swelling, restriction of eye movements in superior gaze with binocular diplopia, oculocardiac reflex and positive forced duction test. Though oculocardiac reflex remains a classical finding, it is also an indicator for surgery as the long term persistence of reflex may lead to bradycardia and heart block<sup>8,9</sup>. Radiographically, white eye blow fracture evidenced with soft tissue (inferior rectus muscle) entrapment and fracture of the inferior orbital rim. Neinstein et al.<sup>7</sup> through CT-based morphological assessment describes that the inferior rectus muscle is more commonly involved because of the close approximation of the muscle to orbital floor and concomitant lack of periorbital fat support.

Timing of surgery plays a major role and the current literature accepts the fact that white-eyed blowout must be intervened within 24–48 hours. Yang et al.<sup>10</sup> observed that there was no differences in the success rate of the surgery when it was performed within 24 h, between 24 and 72 h and after 72 h. Balaraman et al.<sup>2</sup> reported that delayed surgical treatment lead to permanent restriction of eye movements in the upward gaze eventually causing diplopia whereas, early surgical measure restores the normal function of the muscle and prevents the occurrence of ischemia to the extraocular muscles. In the present case report, a delayed surgical treatment was initiated as the clinical presentation of the patient was 10 days after the trauma to the orbit. Intraoperatively, the forced duction test was found to be negative after the surgery. Egbert et al.<sup>11</sup> and Bansagi et al.<sup>12</sup> reported that the repair of orbital floor took around 10-14 days in adults whereas the duration of repair is shorter in children because of the direct muscle damage.

Postoperatively, diplopia was the most common complication encountered in patients with >50% of persisting white eye blowout fractures. The recovery time for the postoperative diplopia may range from 25 days to 18 months with a longer duration encountered in children <9 years of age<sup>10,13</sup>. In the present report, although the eye movements in the superior gaze were evident without any restriction, the authors were unable to achieve a full range of eye movements due to delayed intervention caused by the unawareness of the patient's parent. Henceforth, timely surgical procedure should be opted in order to prevent such unfavorable outcomes.

## **Zaključak**

Slučajevi belookih *blowout* preloma kod dece zahtevaju posebnu pažnju. U slučaju belookog *blowout* preloma, klinički i radiografski prikaz mogu biti suptilni. Rana dijagnoza (u roku od 7 dana) i hitna hirurška intervencija doneli bi najbolji pozitivan ishod.

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## **Conclusion**

In cases of pediatric orbital bone fractures, special attention is required. In the event of white-eye blowout fractures the clinical and the radiographic presentation may be subtle. Early diagnosis (within 7 days) and immediate surgical intervention would bring about a best positive outcome.

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**Author contributions:** KKP designed the study, conducted research, provided required materials, collected and organized the necessary data. KKP and BR analyzed and interpreted the data. BR drafted the initial and final manuscript. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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PRIKAZ SLUČAJA  
 CASE REPORT  
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## PARRY-ROMBERGOV SINDROM I DEFORMITET “PRESEK SABLJOM” – PRIKAZ SLUČAJA

### PARRY ROMBERG SYNDROME WITH EN COUP DE SABRE: A REPORT OF A RARE CASE

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#### Sažetak

**Osnov problema:** Parry-Rombergov sindrom (PRS) je redak razvojni poremećaj, koji se manifestuje sporom i progresivnom atrofijom lica, često jednostranom i zato se naziva i progresivna hemifacijalna atrofija. Opseg atrofije može varirati, uključujući površinski sloj kože i atrofiju, koja zahvata dublja tkiva do kosti. Kliničke karakteristike PRS-a uključuju kraniofacijalne, neurološke, oftalmološke i dermatološke manifestacije, koje rezultiraju različitim funkcionalnim i psihološkim problemima. PRS i linearna skleroderma pripadaju istoj vrsti bolesti. Može postojati jasna granica između normalne i abnormalne kože, koja se može uvideti kod PRS-a, pod nazivom „presek sabljom“. PRS se najčešće javlja kod žena i uključuje levu stranu lica.

**Metod rada:** Opisujemo slučaj PRS-a kod mlade devojkice sa deformitetom „presek sabljom“ na desnoj strani lica.

**Rezultati:** Mikrohiruska rekonstrukcija lica zahvaćene strane je zlatni standard među metodama za korekciju asimetrije lica. U prikazanom slučaju, pacijentkinja se trenutno nalazi na dugogodišnjem praćenju, a estetski hirurški tretman planira se kada atrofija bude u stabilnoj fazi.

**Zaključak:** Povezivanje PRS-a sa Linearnom sklerodermijom može predstavljati poteškoću u dijagnozi ovog sindroma. Pažljivo evidentiranje istorije bolesti i klinički pregled pacijenta uz odgovarajuće ispitivanje mogu pomoći u postavljanju tačne dijagnoze.

**Ključne reči:** kompjuterska tomografija konusnih zraka, hemifacijalna atrofija, maksilofacijalne abnormalnosti, retke bolesti.

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#### Abstract

**The basis of the problem:** Parry Romberg syndrome (PRS) is a rare developmental disorder manifesting as a slow and progressive atrophy of the face which is often unilateral, hence also termed as progressive hemifacial atrophy. The extent of the atrophy may vary, involving the superficial skin extending up to the underlying bone. The clinical features of PRS include craniofacial, neurologic, ophthalmic and dermatological manifestations, which result in various functional and psychological problems. PRS and linear scleroderma belong to the same disease spectrum. There can be demarcating line between the normal and abnormal skin seen in PRS, termed as “en coup de sabre”. PRS is most commonly seen in females and involves the left side of the face.

**Method:** We hereby report a case of PRS in a young girl presenting with en coup de sabre appearance on the right side of face.

**Results:** Microsurgical facial reconstruction of the affected side is known to be the gold standard method for correction of the facial symmetry. In our case, the patient is currently kept under long term follow up and cosmetic surgical treatment will be planned once the atrophy attains stability.

**Conclusion:** The association of PRS with linear scleroderma may present difficulty in its diagnosis. Hence, careful recording of the history and clinical examination with appropriate investigations can aid in establishing the correct diagnosis.

**Key words:** cone-beam computed tomography, hemifacial atrophy, maxillofacial abnormalities, rare diseases.

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 All rights reserved / © 2021. Medicinski fakultet Niš. Klinika  
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## Uvod

Parry-Rombergov sindrom (PRS) je redak razvojni poremećaj, koji pogađa kraniofacijalnu regiju. Hillier Parry 1815. godine i Moritz Heinrich Romberg 1846. godine prvi su opisali ovaj entitet<sup>1</sup>. PRS karakteriše sporo napredujuća atrofija lica, koja je često jednostrana, pa se naziva i progresivna hemifacijalna atrofija. Poremećaj sporo napreduje od detinjstva do adolescencije, posle koje se može stabilizovati. Maksilofacijalne manifestacije su najistaknutije, zajedno sa neurološkim i oftalmološkim promenama<sup>2,3</sup>. Atrofija se u početku može pojaviti na površini kože, ali kasnije može zahvatiti potkožno tkivo, masno tkivo, fascije, mišiće, hrskavicu i kosti. Zlezdane strukture, takođe, mogu biti uključene<sup>4</sup>. Cilj ovog članka je da opiše slučaj Parry-Rombergovog sindroma.

## Prikaz slučaja

Šesnaestogodišnja devojčica žalila se od detinjstva na asimetriju na desnoj strani lica. Njena bolest počela je kada je imala 9 godina i polako je napredovala do stadijuma predstavljenog u ovom radu. Takođe, javio se gubitak kose na desnoj strani poglavine. Nisu zabeleženi drugi neurološki i oftalmološki simptomi. Nije bilo istorije traume, niti porodične istorije vezane za ovo oboljenje. Prilikom kliničkog pregleda, primećena je asimetrija desne strane lica, sa odstupanjem usana, hiperpigmentacijom i hipoplazijom lica i nosa (Slika 1). Uočen je linearni ožiljak, koji ukazuje na deformitet „presek sabljom“, koji se proteže od desnog frontalnog područja do desne bočne hrskavice nosa (Slika 2). Duž zahvaćene strane, zapaža se suvo vlasite sa izraženom alopecijom (Slika 3). Intraoralnim pregledom, ustanovljena je stalna denticija, koja obuhvata zube u prvoj klasi, sa obe strane. Pacijentkinja je upućena na neurološke i oftalmološke analize, kako bi se isključile abnormalnosti. Urađena je kompjuterska tomografija konusnih zraka (CBCT), zbog procene uznapredovalosti oboljenja (Slika 4) i uočena je abnormalnost nosnog septuma sa nerazvijenom desnom nosnom šupljinom, hipoplastičnim desnim etmoidnim i frontalnim sinusom (Slika 5). Desni maksilarni sinus i desni kondil bili su hipoplastični, u poređenju sa levom stranom (Slika 6). Tako je, na osnovu kliničkih i radiografskih karakteristika, postavljena dijagnoza PRS-a sa deformitetom „presek sabljom“, koji zahvata desnu stranu lica.

## Introduction

Parry Romberg syndrome (PRS) is an uncommon developmental disorder affecting the craniofacial region. Hillier Parry in 1815 and Moritz Heinrich Romberg in 1846 were the first to describe this entity<sup>1</sup>. PRS is characterized by slowly progressing facial atrophy which is often unilateral, hence it is also termed as progressive hemifacial atrophy. The disorder has a slow progression from childhood upto adolescence after which it may attain stability. The maxillofacial manifestations are most prominent along with neurological and ophthalmic changes<sup>2,3</sup>. Atrophy may present initially in the superficial skin but later can involve the subcutaneous tissue, fat, fascia, muscle, cartilage and bone. The underlying glandular structures may also be involved<sup>4</sup>. The objective of this article is to report a case of Parry Romberg syndrome.

## Case report

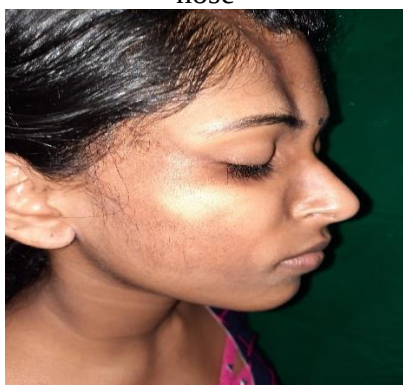
A 16 year old girl presented with the complaint of asymmetry on the right side of her face since childhood. Her illness started when she was 9 years old and it has progressed slowly to the present state. She had also developed hair loss on the right frontal region of the head. There was no other neurological and ophthalmic symptoms. There was no history of trauma and no relevant family history. On physical examination, facial asymmetry with deviation of lips, hyperpigmentation and hypoplasia of the face and nose was noted on the right side (Figure 1). A linear scar suggestive of “en coup de sabre” was seen extending from the right frontal region to the right lateral cartilage of the nasal cavity (Figure 2). Dry scalp with marked alopecia was noted along the affected side (Figure 3). Intraoral examination revealed permanent dentition with no significant findings and Class 1 molar relation was observed on both the sides. The patient was referred for neurological and ophthalmological evaluation, which ruled out abnormalities. Cone beam computed tomography (CBCT) was taken to evaluate the bony involvement (Figure 4), presence of deviated nasal septum with underdeveloped right nasal cavity, hypoplastic right ethmoidal and frontal sinus (Figure 5). The right maxillary sinus and right condyle were hypoplastic when compared to the left side (Figure 6). Thus, on correlation of the clinical and radiographic features, a diagnosis of PRS with en coup de sabre involving the right side of the face was made.





**Slika 1:** Klinička slika prikazuje asimetriju lica sa hiperpigmentacijom na desnoj strani, zajedno sa promenama na usnama i nosu.

**Figure 1:** Clinical picture showing facial asymmetry with hyperpigmentation on the right side along with deviation of lips and nose



**Slika 2:** Bočni prikaz desne strane lica pokazuje defekt u frontalnoj regiji, koji se proteže do bočnog dela nosne šupljine

**Figure 2:** Right lateral view of the face showing a defect in the frontal region extending to the lateral part of nasal cavity



**Slika 3:** Klinička slika, koja pokazuje izraženu alopeciju

**Figure 3:** Clinical picture showing marked alopecia



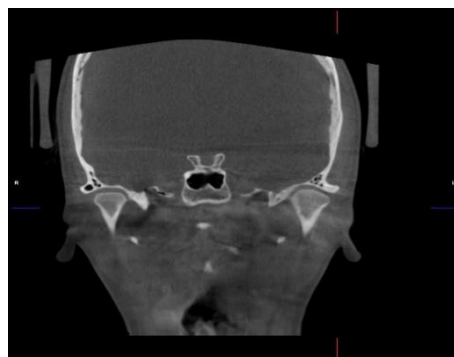
**Slika 4:** 3D rekonstrukcija, koja pokazuje defekt na čeonj kosti

**Figure 4:** 3D Reconstruction demonstrating the defect in the frontal bone



**Slika 5:** Koronalna CBCT slika, koja prikazuje odstupanje nosnog septuma i nerazvijenu desnu nosnu šupljinu, hipoplastičnu desnu stranu maksilarnih i etmoidalnih sinusa, sa delimičnim zamućenjem

**Figure 5:** Coronal CBCT image showing deviated nasal septum and underdeveloped right nasal cavity, hypoplastic right maxillary and ethmoidal sinuses with partial opacification



**Slika 6:** Koronalna CBCT slika, koja prikazuje hipoplaziju desnog kondila

**Figure 6:** Coronal CBCT image showing hypoplasia of the right condy

## Diskusija

Parry-Rombergov sindrom je redak degenerativni poremećaj, koji dovodi do različitih funkcionalnih i psiholoških problema kod obolelih osoba, zbog asimetrije lica<sup>5</sup>. Poremećaj se može pripisati različitim etiološkim faktorima, uključujući nasledne faktore, viruse, traume, poremećaje simpatičkog nervnog sistema, endokrine poremećaje, autoimune uzroke itd.<sup>3</sup> Stone J. je prijavio stopu prevalencije od 1 na 700.000 među opštom populacijom. Prema literaturnim podacima, približan vremenski razmak od početka poremećaja do dijagnoze je oko 10 godina, jer većina obolelih pacijenata i dalje nije svesna svoga stanja u blažem obliku<sup>6</sup>. Bolest je prisutna većinom kod žena, a leva strana lica najčešće je pogođena<sup>7</sup>. Međutim, u slučaju naše pacijentkinje desna strana lica bila je zahvaćena defektom duž srednje linije, a zahvaćena koža bila je suva i hiperpigmentisana. U prikazanom slučaju, primećena je linija koja razgraničava normalnu kožu od abnormalne kože, koja je označena kao "presek sabljom", slična linearnoj sklerodermiji. PRS i linearna skleroderma pripadaju istoj grupaciji bolesti i oko 28% – 42% slučajeva PRS-a koegzistira sa lokalizovanim sklerodermom<sup>8</sup>. Segna i saradnici<sup>9</sup> prijavili su niz slučajeva pacijenata sa PRS-om i linearnom sklerodermijom lica sa različitim prevalencijom, slično kao u slučaju naše pacijentkinje. Defekti kose, poput fokalne alopecije, takođe su primećeni u slučaju naše pacijentkinje. Uobičajene maksilofacijalne manifestacije uključuju promene u predelu nosa i usana na zahvaćenoj strani, što je primećeno i u slučaju naše pacijentkinje, ali druge maksilofacijalne karakteristike, kao što su atrofija jezika, nerazvijene obe vilice, tvrdo i meko nepce, odloženo nicanje zuba i to sa kratkim korenima nisu detektovani u slučaju pacijentkinje predstavljene u ovom radu<sup>10</sup>. Mogu se javiti i retinalni vaskulitis i gubitak periorbitalnog masnog tkiva, koji rezultira enoftalmosom, a česte su i oftalmološke manifestacije. Oboleli pojedinci mogu, takođe, imati paresteziju lica, neuralgiju trigeminusa i epilepsiju, koji nisu primećeni u slučaju naše pacijentkinje<sup>5</sup>. Farmakološko lečenje PRS-a sa coup de sabre deformitetom uključuje steroide, D penicilamin, metotreksat, topikalne analoge vitamina D3, psoralen sa UVA, ali je stopa uspeha različita od slučaja do slučaja<sup>6</sup>.

## Discussion

Parry Romberg syndrome is a rare degenerative disorder leading to various functional and psychological problems in the affected individuals due to facial asymmetry<sup>5</sup>. The disorder may be attributed to various etiologies including hereditary, viral, trauma, sympathetic malfunctions, endocrine disturbances, autoimmune causes, etc.<sup>3</sup> Stone J reported a prevalence rate of 1 per 700,000 among the general population. According to the literature evidences, the approximate time gap between the onset of the disorder to diagnosis is about 10 years, as most of the affected patients remain unaware of the condition in the milder form<sup>6</sup>. The disease has a female predilection with left side of the face being most frequently affected<sup>7</sup>. However, in our case, the right side of the face was affected with a defect along the midline and the affected skin was dry and hyperpigmented. A line demarcating the normal with abnormal skin, called "en coup de sabre" which is similar to linear scleroderma was seen in our case. PRS and linear scleroderma belong to the same disease spectrum and about 28–42% of PRS cases coexist with localized scleroderma<sup>8</sup>. Segna et al.<sup>9</sup> have reported a series of cases with PRS and linear facial scleroderma with varied involvement, similar to our case. Hair defects such as focal baldness was also seen in our case. Common maxillofacial manifestations include deviation of nose and mouth to the affected side as observed in our case, but other maxillofacial features like atrophy of the tongue, underdeveloped jaws, hard and soft palate, delayed tooth eruption and teeth with short roots were not present in our case<sup>10</sup>. Retinal vasculitis and loss of periorbital fat resulting in enophthalmos are the common ophthalmological manifestations. The affected individuals can also present with facial paresthesia, trigeminal neuralgia and contralateral epilepsy, which were not seen in the present case<sup>5</sup>. The Pharmacological management of PRS with coup de sabre include steroids, D-penicillamine, methotrexate, topical Vitamin D3 analogues, psoralen with UVA have been reported in the literature but the success rate varies on a case-to-case basis<sup>6</sup>. Patient education, motivation and surgical correction of the atrophy need to be considered for a successful treatment outcome. Microsurgical facial reconstruction of the affected side is known to be the gold

Obrazovanje pacijenata, motivaciju i hiruršku korekciju atrofije treba uzeti u obzir, kada je reč o uspešnom ishodu lečenja. Poznato je to da je mikrohrurška rekonstrukcija lica zahvaćene strane zlatni standard među metodama za korekciju asimetrije lica<sup>10</sup>. Kozmetičke hirurške opcije uključuju mikrovaskulature slobodne režnjeve, aloplastične graft materijale za transplantaciju, autolognu transplantaciju masti itd.<sup>11</sup> Poznato je to da titanijumski implantati za rekonstrukciju defekta daju dobre rezultate<sup>12</sup>. U prikazanom slučaju, pacijentkinja se trenutno nalazi na dugogodišnjem praćenju, a estetski hirurški tretman planira se kada atrofija bude u stabilnoj fazi.

### ***Zaključak***

PRS je redak, samoograničavajući poremećaj sa različitom uključenosti i težinom simptoma. Povezivanje PRS-a sa linearnom sklerodermijom može napraviti poteškoće u njegovoj dijagnozi. Zbog toga je potreban pažljiv fizički i sistematski pregled za postavljanje ispravne dijagnoze i formiranja sveobuhvatnog plana lečenja.

### ***Sukobi interesa***

Nema

standard method for correction of the facial symmetry<sup>10</sup>. Cosmetic Surgical options include Microvascular free flaps, Alloplastic graft materials, autologous fat transplantation, etc<sup>11</sup>. Custom made titanium implants for reconstruction of the defect are known to give good outcomes<sup>12</sup>. In our case, the patient is currently kept under long term follow up and cosmetic surgical treatment will be planned once the atrophy attains stability.

### ***Conclusion***

PRS is a rare, self-limiting disorder with varied involvement and severity. The association of PRS with linear scleroderma may present difficulty in its diagnosis. Therefore, a careful physical and systemic examination is required for establishing a proper diagnosis and formulating a comprehensive treatment plan.

### ***Conflicts of interest***

Nil

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PRIKAZ SLUČAJA  
 CASE REPORT  
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# TRAUMATSKA INTRUZIJA MLEČNOG ZUBA-PRIKAZ SLUČAJA

## TRAUMATIC INTRUSION OF PRIMARY TOOTH: A CASE REPORT

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### Sažetak

**Uvod:** Prednji zubi su od velikog značaja za žvakanje, govor i izgled. Stoga, svaka traumatska povreda zuba ima psihološki nepoželjne efekte na decu i njihove roditelje. Ova studija prikazala je slučaj traumatske povrede zuba izazvane padom sa stolice i upućivanje pacijenta na hitnu pomoć, kao i mere preduzete za rekonstrukciju zuba i poboljšanje stanja pacijenta.

**Prikaz slučaja:** Roditelji su doveli trogodišnju devojčicu na Kliniku zadržanju i preventivnu stomatologiju Univerzitetske stomatološke klinike Centar "Sveti Panteleimon", Skoplje, sa povredama lica i oralnih struktura, nastalih usled pada deteta sa stolice. Ekstraoralnim pregledom utvrđena je razderotina na submentalnoj površini kože i povreda gornje usne. Dete je pregledano i ustanovljeno je da je levi, centralni, mlečni sekutić maksile komprimiran u alveoli. Okolno meko tkivo je povređeno. Intraoralno, prednji segment maksile pokazao je povredu izazvanu traumom tupe sile male brzine, uključujući nekoliko laceracija tkiva gingive. Pacijentov gornji, levi, centralni sekutić bio je utisnut u čašicu.

**Zaključak:** Prognoza mnogih slučajeva povreda zuba zavisi od vremena proteklog od nastanka povrede. Utisnuće zuba može imati posledice i treba uzeti u obzir mogućnost da je zub potpuno utisnut. Upotreba radiografskog snimka od velikog je značaja za ispravnu dijagnozu utisnuća mlečnih zuba.

**Ključne reči:** utisnuti zubi; mlečni sekutić; povreda

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### Abstract

**Introduction:** Anterior teeth are of utmost importance with regard to chewing, speaking, and beauty. Therefore, any traumatic dental injury has psychologically undesirable effects on children and their parents. The present study reported a case of a traumatic dental injury induced by falling off a chair and referral to an emergency department as well as measures taken for dental reconstruction and patient's improvement.

**Case Report:** Parents with a 3-year-old girl came to the Clinic for Pediatric and Preventive Dentistry at University Dental Clinic Center "St. Panteleimon", Skopje with injuries to her face and oral structures resulting from a fall from a chair. The extraoral examination revealed a laceration on the submental skin surface and an injury to the upper lip. The child was examined and it was found that the maxillary left primary central incisor was compressed in the alveoli. The surrounding soft tissue was injured. Intraorally, the anterior segment of the maxilla showed injury consistent with low-velocity blunt-force trauma, including several lacerations of the gingival tissues. The patient's maxillary left central incisor was intruded from the socket.

**Conclusion:** The prognosis of many cases of dental injuries is time-dependent. The intrusion of a tooth can have ramifications and the possibility that it has been fully intruded should be considered. The use of a radiograph is of great importance for the correct diagnosis of deciduous tooth intrusion.

**Keywords:** intruded teeth, primary incisor, trauma.

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## Uvod

Utisnuće i avulzija zuba najteže su povrede zuba. Povrede oralnih tvrdih i mekih tkiva najčešće se javljaju kod dece. Među svim povredama lica, povrede zuba su kod dece daleko najčešće. Čak 18% svih povreda kod dece do 6 godina starosti javlja se u oralnoj regiji<sup>1</sup>. Povrede u mlečnoj denticiji česte su i javljaju se sa znatno većom godišnjom incidencijom, u odnosu na povrede zuba u stalnoj denticiji<sup>2,3,4</sup>. Traumatska dislokacija zuba uobičajena je povreda kod dece i adolescenata. Iako je ponekad teško dijagnostikovati, utisnuće zuba, aspiracija i gutanje mogu dovesti do ozbiljnih komplikacija.

Utisnuće i izbijanje zuba najteže supovrede koje utiču na razvoj klica zuba kod dece, od novorođenčeta do 2 godine starosti<sup>5,6</sup> što odgovara vremenu kalcifikacije incizalne i srednje trećine gleđnog matriksa<sup>7,8</sup>. Traumatsko pomeranje korenova mlečnih zuba može uticati na razvoj klica stalnih zuba promenom sekrecijske faze amelogeneze, rezultirajući defektom poznatim kao kružna hipoplazija gleđi. Rizik od razvojnih smetnji na stalnom zubu, nakon povrede njegovog mlečnog prethodnika, proizlazi iz bliske veze između vrha mlečnog zuba i njegovog stalnog sledbenika u razvoju<sup>9,10</sup>.

Utisnuće zuba definiše se kao pomak zuba dublje u alveolarnu kost. Ova povreda uzrokovana je silom u aksijalnom smeru, koja dovodi do pomeranja zuba unutar njegove čašice<sup>10,11</sup>. Utisnuće mlečnog zuba može rezultirati raznim patološkim promenama na stalnim zubima, uključujući hipoplaziju, dilaceraciju kruna, angulaciju i dilaceraciju korena, delomično ili potpuno zaustavljanje stvaranje korena, sekvstraciju klice stalnog zuba i poremećaje u nicanju. Od ovih, hipoplazija (uključujući promenu boje gleđi i/ili defekte gleđi) je najčešća posledica.

Deca predškolskog uzrasta sklonija supadu ikao rezultat togai zbog nedostatka neuromišićne koordinacije, suočavaju se sa povredama i traumama<sup>12</sup>. Većinupovreda u mlečnoj denticiji čini utisnuće zuba, kao luksaciona povreda uzrokovana udarcem u predeo lica<sup>13</sup>. Gondim i dr.<sup>14</sup> pratili su u svojoj studiji 16 pacijenata sa utisnućem mlečnih zuba. Otkrili su toda je 56,25% pacijenata, koji su patili od karijesa bili muškarci, a u 91% slučajeva gornji centralni sekutići bili su najugroženiji zubi. Autori su zaključili da su prednji zubi, a najviše maksilarni centralni sekutići, pogođeni zbog njihove anatomske lokacije, jer su direktno izloženi bilo kakvoj fizičkoj traumi.

## Introduction

Intrusion and avulsion are the most severe injuries. Trauma to the oral hard and soft tissues is commonly seen in children. Among all facial injuries, dental injuries are the most common in children. As much as 18% of all injuries in children up to 6 years of age are seen in the oral region<sup>1</sup>. Injuries to the primary dentition are common, occurring with a significantly higher annual incidence than in the permanent dentition<sup>2,3,4</sup>. Traumatic tooth displacement is a common injury affecting children and adolescents. Although sometimes challenging to diagnose, tooth intrusion, aspiration, and ingestion may lead to serious complications.

Intrusion and avulsion are the most severe injuries that affect the developing tooth germ in children 0-2 years of age<sup>5,6</sup>, which corresponds to the time of calcification of the incisal and middle thirds of the enamel matrix<sup>7,8</sup>. The traumatic displacement of primary teeth roots may affect the development of permanent tooth germs by altering the secretory phase of ameloblasts, resulting in a defect known as circular enamel hypoplasia. The risk of developmental disturbances in a permanent tooth following intrusive injury of its primary predecessor stems from the close relationship between the apex of the primary tooth and the developing permanent successor<sup>9,10</sup>.

Tooth intrusion is defined as the displacement of a tooth farther into the alveolar bone. An intrusive injury is caused by a force in an axial direction that results in displacement of the tooth within its socket<sup>10,11</sup>. Primary tooth intrusion may result in a variety of pathologic alterations to permanent teeth, including hypoplasia, crown dilaceration, root angulation or dilaceration, partial or complete arrest of root formation, sequestration of the permanent tooth germ, and disturbances in eruption. Of these, hypoplasia (including enamel discoloration and/or enamel defects) is the most common sequela.

Preschool children, are much more vulnerable to fall; as a result, they face injuries and traumas due to lack of their neuromuscular coordination<sup>12</sup>. Most of the injuries in deciduous dentition are an intrusive luxation caused by face impact<sup>13</sup>. Gondim et al.<sup>14</sup> in their study followed 16 patients with primary tooth intrusion. They found that 56.25% of patients suffering from tooth decay were men and in 91%, the upper central incisors were the most affected teeth.



Kada dođe do pomeranja zuba, najgora prognoza povezana je sa utisnutim dislociranim zubima. Moguće komplikacije kod utisnuća zuba su nekroza pulpe, obliteracija pulpe, resorpcija korena, ankiloza i gubitak marginalne potpore. Za utisnute zube sa zatvorenim vrhovima, učestalost pulpne nekroze je 100%, dok je kod utisnutih zuba sa otvorenim vrhovima učestalost pulpne nekroze 63%<sup>15</sup>. Eksterna resorpcija korena prijavljena je kao komplikacija utisnuća zuba u 58% slučajeva zuba sa nezavršenim rastom korena i u 70% slučajeva zuba sa potpunim formiranjem korena<sup>16</sup>.

Andreasen i Vestergaard-Pedersen<sup>17</sup> prijavili su učestalost ankiloze nakon teškog utisnuća zuba u 24% slučajeva, a takođe su otkrili to da je do marginalnog gubitka kosti došlo u čak 31% slučajeva utisnuća. Potencijalno najozbiljnije komplikacije mogu nastati kada se zub pomakne u drugi deo tela ili kada zub otvori komunikaciju iz usne šupljine u anatomske prostor.

Ova studija opisuje slučaj koji uključuje traumatsko utisnuće zuba kod deteta.

### **Prikaz slučaja**

Roditelji su doveli trogodišnju devojčicu na Kliniku za dečju i preventivnu stomatologiju Univerzitetske stomatološke Klinike "Sveti Pantelejmon", Skoplje, sa povredama lica i oralnih struktura, nastalih usled pada sa stolice. Ekstraoralni pregled otkrio je razderotinu kože submentalne regije i povredu gornje usne. Dete je pregledano i utvrđeno je da je gornji, levi, mlečni, centralni sekutić utisnut u alveolu. Okolno meko tkivo je povređeno. Devojčica i njeni roditelji bili su vidno uznemireni, zbog čega nismo uspeali da napravimo početni rendgen snimak.

Intraoralno, prednji segment premaxile pokazao je povredu izazvanu traumom tupe sile male brzine, uključujući nekoliko laceracija tkiva gingive. Pacijentkinjin maksilarni, levi, centralni, mlečni sekutić u potpunosti je upao u alveolu. Nedostajala je slika pri prvom pregledu.

Roditeljima je trebalo dati neke preporuke, poput održavanja unosa tečnosti kod deteta i savete o mekoj ishrani u trajanju od nekoliko dana nakon povrede. Traumatizovano područje očišćeno je brisanjem povređenih zuba i mekih tkiva upotrebom fiziološkog rastvora.

Za sledeći dan zakazan je pregled. Nakon mesec dana, roditelji su poslali sliku ponovnog nicanja zuba (Slika 1). Nakon tri meseca, maksilarni levi centralni sekutić bio je prisutan (Slika 2).

The authors have concluded that the front teeth, and most of the maxillary central incisors, are affected by their anatomical location, where they are directly exposed to any kind of physical trauma.

When tooth displacement occurs, the poorest prognosis is associated with intrusively displaced teeth. Possible complications of intrusive tooth are pulp necrosis, pulp obliteration, root resorption, ankylosis, and loss of marginal support. For intruded teeth with closed apices, the incidence of pulpal necrosis is 100%, whereas in intruded teeth with open apices, the incidence of pulpal necrosis is 63%<sup>15</sup>. External root resorption has been reported as a complication of intrusive injuries in 58% of teeth with immature root formation and in 70% of teeth with complete root formation<sup>16</sup>.

Andreasen and Vestergaard-Pedersen<sup>17</sup> reported a 24% incidence of ankylosis following severe intrusion and also found that marginal bone loss occurred in as many as 31% of cases of intrusive luxation. The potentially most serious complications can occur when a tooth is displaced into another part of the body or when the tooth opens a communication from the oral cavity into an anatomical space.

This study describes a case involving traumatic tooth intrusion in a child.

### **Case report**

Parents with a 3-year-old girl came to the Clinic for Pediatric and Preventive Dentistry at University Dental Clinic Center "St. Panteleimon", Skopje with injuries to her face and oral structures resulting from a fall from a chair. The extraoral examination revealed a laceration on the submental skin surface and an injury to the upper lip. The child was examined and the upper left primary central incisor was found to be compressed in the alveoli. The surrounding soft tissue was injured. The child and her parents were visibly upset and we were not able to do an X-ray.

Intraorally, the anterior segment of the premaxilla showed injury consistent with a low-velocity blunt-force trauma, including several lacerations of the gingival tissues. The patient's maxillary left central primary incisor was totally intruded from the socket. An image was missing from the first examination.

Some recommendations should be given to parents, such as maintaining fluid intake in the child and a soft diet for a few days after the injury. The traumatized area can be cleaned by wiping the injured teeth and soft tissues with a swab dipped in physiological solution.

Zub je skoro dostigao svoju veličinu u nicanju, nakon šest meseci (Slika 3). Roditelji su dovodili dete na redovne preglede, ali su sami pravili snimke zuba svog deteta, jer devojčica nije dozvolila da se slika u ordinaciji.

Praćenje utisnuća mlečnih zuba veoma je važno. Učestalost i obim poseta zavise od vrste i težine povrede. Pregledi bi otkrili sve komplikacije u vezi sa zahvaćenim zubom, što bi, zauzvrat, moglo prouzrokovati trajno oštećenje zuba u razvoju. Potrebne su redovne kontrole nakon povrede, koje bi trebalo sprovesti najpre 7 dana nakon povrede, zatim svake 2 nedelje tokom prvog meseca, potom svakog meseca prvih 5 meseci, a nakon toga svakih 6 meseci. Potreban je kompletan pregled, kako bi se utvrdilo prisustvo bilo kakvih neuobičajenih simptoma, kao što su spontani bol, malaksalost, groznica, znaci apscesa, fistule i otoka gingive i okolnih mekih tkiva.



**Slika 1:** Utisnuće maksilarnog, mlečnog, levog, centralnog sekutića mesec dana nakon povrede (Fotografija iz arhive autora rada – Efka Zabokova Bilbilova)

**Figure 1:** Intrusive injured maxillary primary left central incisor one month later (Photo from the archive of the author of the paper – Efka Zabokova Bilbilova)

A check-up was scheduled for the next day. After a month the parents sent a picture of a re-erupted tooth (Figure 1). After three months the maxillary left central incisor was present (Figure 2).

The tooth almost reached its size in eruption after six months (Figure 3). The parents took the child to regular check-ups, but they made images of their child teeth themselves because the girl would not allow the doctor to make images of her teeth in the office.

Monitoring intrusive injuries to primary teeth is very important. The frequency of visits depends on the type and severity of the injury. Examinations would reveal any complications related to the seized tooth, which in turn could cause permanent damage to the developing tooth. Regular post-injury check-ups are required, which should be 7 days later. Then every 2 weeks during the first month, then every month for the first 5 months, and then every 6 months. A complete examination is needed to determine the presence of any unusual symptoms, such as spontaneous pain, malaise, fever, signs of an abscess such as fistula and swelling of the gingiva and surrounding soft tissues.



**Slika 2:** Utisnuće povređenog zuba tri meseca kasnije (Fotografija iz arhive autora rada – Efka Zabokova Bilbilova)

**Figure 2:** Intrusive injury three months later (Photo from the archive of the author of the paper – Efka Zabokova Bilbilova)





**Slika 3:** Ponovna erupcija maksilarnog, mlečnog, levog, centralnog sekutića šest meseci kasnije  
(Fotografija iz arhive autora rada – Efka Zabokova Bilbilova)

**Figure 3:** Re-eruption of the maxillary primary left central incisor after six months (Photo from the archive of the author of the paper – Efka Zabokova Bilbilova)

### **Diskusija**

Traumatska povreda zuba je povreda koja ima uticaja na zube, druga tvrda i meka tkiva unutar i oko usta i usne šupljine. Obično je iznenadna i često zahteva hitnu pomoć. Povrede tipa utisnuća predstavljaju veliki rizik za oštećenje razvoja stalnog zuba u alveolarnoj kosti. Prema tome, mogućnosti lečenja zavise od odnosa između korena mlečnog zuba i krune stalnog zuba u razvoju. Rendgen je neophodan, kako bi se utvrdio ovaj odnos. Ako nema dokaza o mogućem uticaju na razvoja stalnog zuba, mlečni zub se može ostaviti da spontano ponovo izbije. Međutim, zub treba izvaditi, ako nije ponovo izbio u roku od šest meseci.

Ako ima izgleda da je utisnuti zub ugrozio zub u razvoju, treba ga odmah pažljivo izvaditi, kako bi se izbeglo dalje oštećenje.

Kod bilo koje vrste dislokacije zuba, dugotrajno kliničko i radiografsko posmatranje od suštinskog je značaja za praćenje vitalnosti ovih zuba i kako bi se osiguralo toda ne dođe do prolongirane infekcije korena, koja može oštetiti nastanak trajnog utisnuća zuba. Prati ga kompresija parodontalnog ligamenta, poremećaj neurovaskularnog snabdevanja pulpe, kontuzija cementa i prelom alveolarne čašice. Kod težih povreda, zub može biti zarobljen u kost. Klinički nalazi otkrivaju zub koji može izgledati skraćeno ili čak zub koji nedostaje. Kod mlečnih zuba, vrh zuba obično se pomera labijalno prema koštanoj lameli ili kroz labijalnu koštanu lamelu. Kod stalnih zuba, zub je pomaknut u alveolarnu kost. Nema pokretljivosti zuba, niti osetljivosti na dodir.

### **Discussion**

A traumatic dental injury is an impact injury to the teeth, other hard and soft tissues within and around the vicinity of the mouth and oral cavity. It is usually sudden and often requires emergency care. Intrusion injuries present a high risk of damage to the development of permanent tooth in the alveolar bone. Therefore, the treatment options depend on the relationship between the root of the primary tooth and the crown of the developing permanent tooth. X-rays are necessary to determine this relationship. If there is no evidence of a compromise to the developing permanent tooth, the primary tooth may be left to spontaneously re-erupt. However, the tooth should be extracted if it has not re-erupted within six months.

If the intruded tooth appears to have compromised the developing tooth, it should be carefully extracted immediately, to avoid any further damage.

With any type of displacement, a long-term clinical and radiographic follow-up is essential to monitor the vitality of these teeth and to ensure that there is no delayed infection of the root which can damage the developing permanent tooth intrusion. It is accompanied by compression of the periodontal ligament, disruption of the neurovascular supply to the pulp, contusion of the cementum and crushing fracture of the alveolar socket. In severe injuries the tooth may be locked into the bone. Clinical findings reveal a tooth that may appear shortened or even missing.

Radiografski nalazi otkrivaju da je zub apikalno pomaknut i gubitak kontinuiteta periodontalnog prostora. Određivanje položaja mlečnog zuba u odnosu na stalni zub u razvoju može se odrediti lateralnom radiografijom. Alternativno, ako se vrh pomeri labijalno, apikalni vrh može se videti radiografski, a zub izgleda kraće od kontralateralnog. Ako je vrh korena zuba pomeran palatinalno, prema stalnom zubu u razvoju, apikalni vrh ne se može videti radiografski i zub izgleda izduženo.

Kod mlečnih zuba, moguće je spontano nicanjeutisnutog zuba, osim ako radiografski snimci ukažu na utisnuće u stalni zub u razvoju. U prikazanom slučaju izmerena je količina zuba izloženog izvan gingivalnog ruba. Ako je došlo do ponovne erupcije, drugo merenje vrši se četiri nedelje kasnije. Ovo se ponavlja sve dok zub potpuno ne izbije (čak i sa kontralateralnim zubom). Ako zub ne pokazuje dokaze o ponovnom nicanju, nakon perioda od četiri sedmice, preporučuje se vađenje zuba, kako bi se izbegli ankiloza i moguća povreda stalnog zuba u razvoju.

### ***Zaključak***

Utisnuće zuba može imati posledice i treba uzeti u obzir mogućnost da je zub potpuno utisnut. Za dijagnostikovanje utisnuća zuba upotreba radiograma može biti od pomoći.

In primary teeth, the tooth apex is usually displaced labially toward or through the labial bone plate. In permanent teeth the displacement is into the alveolar bone. There is no tooth mobility or tenderness to touch. Radiographic findings reveal the tooth is displaced apically and the periodontal ligament space is not continuous. Determination of the position of the primary tooth in relationship to the developing permanent tooth may be determined by a lateral radiograph. Alternatively, if the apex is displaced labially, the apical tip can be seen radiographically with the tooth appearing shorter than contralateral. If the apex is displaced palatally towards the developing permanent tooth, the apical tip cannot be seen radiographically and the tooth appears elongated.

***Primaryteeth:*** Allow the intruded tooth to spontaneously erupt unless radiographs indicate intrusion into the developing tooth. In the presented case the amount of tooth exposed beyond the gingival margin was measured. If any re-eruption has occurred, another measurement is taken four weeks later. This is repeated until the tooth is fully re-erupted (even with the contralateral tooth). If the tooth exhibits no evidence of re-eruption after a four-week period, extraction of the tooth is recommended to avoid ankylosis and possible injury to the developing permanent tooth.

### ***Conclusion***

The intrusion of a tooth can have ramifications and the possibility that it has been fully intruded should be considered. For diagnosing intruded teeth, the use of radiographs can be helpful.

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PRIKAZ SLUČAJA

CASE REPORT

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## RETKA PREZENTACIJA CEMENTO-OSIFICIRAJUĆEG FIBROMA U MAKSILI: PRIKAZ SLUČAJA

### A RARE PRESENTATION OF CEMENTO-OSSIFYING FIBROMA IN THE MAXILLA: A CASE REPORT

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#### Sažetak

**Osnova problema:** Cemento-osificirajući fibrom je benigna fibro-koštana lezija vilice. Manifestuje se kao spororastući otok, koji može da se povećava progresivno, ukoliko se ne interveniše hirurški. Kada je reč o cimento-osificirajućem fibromu, u upotrebi su različita terminologija i različiti dijagnostički kriterijum za predlaganje strateškog plana njegovog lečenja.

**Metode rada:** Ovaj članak opisuje retku pojavu cimento-osificirajućeg fibroma u gornjoj vilici kod četrdesetčetvorogodišnje pacijentkinje. Klinički prisutna lezija je bila bezbolna i spororastuća. Kompjuterska tomografija otkrila je hipodenzno polje u desnoj posteriornoj regiji maksile veličine 19,07 mm x 27,11 mm. Lezija je hirurški resecirana, u opštoj anesteziji i patohistološki je utvrđeno da se radi o cimento-osificirajućem fibromu.

**Rezultati:** Na vreme se mora obezbediti totalna enukleacija/resekcija koštane lezije kako bi se sprečilo ponovno pojavljivanje ove lezije, i postigla dobra prognoza, što je u opisanom prikazu slučaja i učinjeno. U slučaju ovog pacijenta, koji je praćen 24 meseca, nije prijavljen nijedan recidiv.

**Zaključak:** Iako postoje brojne kontroverze, kada je reč o upotrebi terminologije, multicentrični pristup nalaže da se uspostavi klinička, radiografska i histološka povezanost, kako bi se odredila perspektiva lečenja ovih lezija.

#### Abstract

**The basis of the problem:** Cemento-ossifying fibroma is a benign fibro-osseous lesion of the jaw. It presents as a slow growing swelling which progressively enlarges if not surgically intervened. Cemento-ossifying fibroma revolves around the use of different terminologies and diagnostic criteria in proposing a strategic treatment plan.

**Method:** The current article describes a rare occurrence of cement-ossifying fibroma affecting maxilla in a 44 year old female patient. Clinically, the lesion was painless and slow growing in nature. Computed tomography revealed a hypodense area in the right posterior maxilla measuring 19.07mm X 27.11mm. The lesion was surgically resected under general anesthesia and it was histopathologically confirmed to be cemento-ossifying fibroma.

**Results:** Total enucleation/ resection of the osseous lesion must be timely ensured to prevent recurrence and also to achieve good prognosis which was done in the described case report. No recurrence was reported in the present case which had a follow up for 24 months.

**Conclusion:** Although numerous controversies exist in the use of terminologies, a multi centric approach mandates to correlate clinically, radiographically and histologically to determine the treatment perspective.

**Ključne reči:** osobe ženskog pola; maksila; spori rast; bezbolnost

**Keywords:** female individuals; maxilla; slow growing; painless

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za stomatologiju Niš. Sva prava zadržana.

## Uvod

Cemento-osificirajući fibrom je koštana neoplazma odontogenog porekla, koju je Svetska zdravstvena organizacija (SZO)<sup>1</sup> klasifikovala kao neoplazmu fibro-koštanog tipa. Zastupljenija je kod žena u odnosu na muškarce. Cemento-osificirajući fibrom klinički se manifestuje kao spororastuća masa u donjoj vilici. Veličina lezije nadalje se povećava, kada se uočava u predelima maksile i paranasalnog sinusa<sup>2</sup>.

Radiografski, cemento-osificirajući fibrom pokazuje jasno definisane granice, sa oblastima mešovityh radiolucenitnih i rentgenkontrastnih područja, uslovljenih različitim stepenom kalcifikacije. Lezije nezrelog tipa manifestuju se kao radiolucenitna područja, dok su zrele lezije označene kao radiopakna polja<sup>3</sup>. Patohistologija otkriva fibrozu stromu vezivnog tkiva sa masom sličnom osteoidu i cementu<sup>4</sup>. Lečenje cemento-osificirajući fibroma povezano je sa spektrom kontroverzi, koje uključuju određivanje dijagnoze i, sa time u vezi, planom terapije. Pristup cemento-osificirajući fibromu uključuje hiruršku resekciju koštane lezije i kiretažu koštanog ležišta<sup>5</sup>.

## Prikaz slučaja

U ovom prikazu slučaja predstavljamo pacijentkinju staru 44 godine, koja je u poslednjih 6 meseci imala otok na desnoj strani lica. Anamnestički je utvrđeno to da je pre 10 meseci bila podvrgnuta ekstrakciji maksilarnih desnih kutnjaka, zbog parodontopatije. Otok je u početku bio male veličine i postepeno se, tokom vremena, povećavao. Pacijentkinja nije osećala bol, ali je mogla da oseti neku neprijatnost tokom žvakanja. Ekstraoralno, na desnoj strani lica bio je očigledan difuzni otok. Intraoralno, uočen je otok u desnoj maksilarnoj alveoli, u predelu molara (Slika 1). Otok je bio nepravilnog oblika, širio se medijalno do dubine vestibuluma, bočno je dopirao do nepca i pozadi do tubera maksile. Površina otoka bila je glatka. Otok je bio bledoružičaste boje. Prilikom palpacije, otok je bio čvrste konzistencije i nije bio osetljiv na dodir.

Aksijalna kompjuterizovana tomografija otkrila je hipodenzno polje u desnoj maksilarnoj alveoli veličine 19,07 mm x 12,11 mm (Slika 2), koja se proteže medijalno od bukalnog korteksa, ne naslanjajući se na maksilarni sinus, bočno do nepca i posteriorno doseže do gornje vilice. Uočeni su bikortikalna ekspanzija kosti i pomeranje zuba.

## Introduction

Cemento-ossifying fibroma is a bony neoplasm of odontogenic origin which was classified as fibro osseous type by the World Health Organisation (WHO)<sup>1</sup>. It is more prevalent among females than males. Cemento-ossifying fibroma clinically presents as a slow growing mass in the mandible. This size of the lesion further increases when it is seen in the regions of maxilla and paranasal sinus<sup>2</sup>.

Radiographically, cemento-ossifying fibroma shows well-defined borders with areas of mixed radiolucent and radiopaque areas based on the varying degree of calcifications. Immature type of lesions appears as radiolucent areas and mature lesions signify radiopaque areas<sup>3</sup>. Histopathology reveals a fibrous connective tissue stroma with osteoid and cementumlike mass<sup>4</sup>. The management of cemento-ossifying fibroma is surrounded by spectrum of controversies which involves determining the diagnosis and its associated treatment design. Approach to cemento-ossifying fibroma includes surgical resection of the bony lesion and curettage of the bony bed<sup>5</sup>.

## Case report

The present case report depicts a 44 year old female patient who presented with a swelling on the right side of her face for the past 6 months. History revealed that she underwent extraction of her maxillary right molars due to periodontitis 10 months back. The swelling was initially small in size which gradually increased over a period of time. The patient had no pain but she could experience some discomfort while mastication. Extraorally, a diffused swelling was evident on her right side of the face. Intraorally, the swelling was seen in the right maxillary alveolus in the region of molars (Figure 1). The swelling was irregular in shape extending medially till the depth of vestibule, laterally reaching the palate and posteriorly lying close to the maxillary tuberosity. The surface of the swelling was smooth. It was pale pink in colour. On palpation, the swelling was hard in consistency and non-tender.

Axial computed tomography revealed hypodense areas in the right maxillary alveolus measuring 19.07mmX12.11mm(Figure2) that extended medially to buccal cortex not abutting the maxillary sinus, laterally to the palate and posteriorly reaching to the maxillary tuberosity.

Na osnovu gorepomenute kliničke i radiografske interpretacije, slučaj je dijagnostikovao kao cementno-koštana displazija. Planirana je hirurška resekcija koštane lezije, nakon čega bi usledila kiretaža osnovnog koštanog ležišta.

Autori potvrđuju da su dobili pismeni informisani pristanak pacijenata za fotografisanje (slike priložene u ovom prikazu slučaja pripadaju autorima: dr Santhosh Rajan Packiaraj, dr Balamurugan Rajendran i dr Sahana Pushpa Thaneraj) i dobijanje drugih kliničkih informacija, koje će biti objavljene u časopisu, uz obavezu autora da neće objaviti ime i inicijale pacijenta i da će nastojati da se prikrije identitet pacijenta, ali da se njegova anonimnost ne može garantovati.

### ***Hirurška procedura***

Pod nazo-endotrahealnom intubacijom, sprovedena je opšta anestezija. Izvršeno je standardno bojenje i drapiranje. Intraoralno su dati povidon jod i fiziološki rastvor. Rezovi središnjeg grebena, zajedno sa buko lateralnim oslobađajućim rezom postavljeni su da odražavaju režanj pune debljine, kako bi se otkrilo hirurško mesto. Izvršena je ostetomija i koštana lezija je uklonjena u celosti, uz obilnu irigaciju fiziološkim rastvorom (Slika 3). Koštano ležište je kiretirano, nakon čega je urađena periferna ostektomija. Koštane ivice su doterane, a režnjevi su osveženi, kako bi se ponovo približili korišćenjem 4-0 vikrilnih šavova. Na patohistološko ispitivanje poslata su dva uzorka tvrdog tkiva dimenzija 2,5 cm x 1,5 cm i 1 cm x 0,5 cm. Presek obojen hematoksinom i eozinom pokazao je ostrva koštanog tkiva sa masama sličnim cementu, prekrivenim fibroznom stromom vezivnog tkiva, što ukazuje na cemento-osificirajući fibrom (Slika 4).

### ***Postoperativni ishod***

Nakon operacije, pacijent je pregledan nakon 10 dana, a zatim praćen u 6., 12. i 24. mesecu. Desetog dana praćenja, pacijent je imao minimalan bol i nije bilo znakova otoka i infekcije. Mesto operacije je bilo je zdravo, bez dehiscencije tkiva. Nisu primećeni recidivi lezije u 6., 12. i 24. mesecu praćenja.

Bicortical expansion of bone and displacement of teeth were evident. Based on the above clinical and radiographic interpretation, the case was diagnosed as cemento-osseous dysplasia. A surgical resection of the osseous lesion was planned which was then followed by curettage of the underlying osseous bed.

The authors certify that they have obtained written informed patient consent for images (the images enclosed in the current case report refers to authors: Dr. Santhosh Rajan Packiaraj, Dr. Balamurugan Rajendran, Dr. Sahana Pushpa Thaneraj) and other clinical information to be reported/published in the journal with an understanding that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

### ***Surgical procedure***

Under naso-endotracheal intubation, general anesthesia was administered. Standard painting and draping was performed. Povidone iodine and saline wash was given intraorally. Midcrestal incisions along with lateral buccal releasing incision were placed to reflect the full thickness flap in order to expose the surgical site. The osteotomy cuts were placed and the osseous lesion was removed in toto under copious saline irrigation (Figure 3). The underlying bone bed was curetted, following which a peripheral ostectomy was performed. The bony margins were trimmed and the flaps were freshened to approximate it using 4-0 vicryl sutures. Two hard tissue specimens measuring 2.5cm X 1.5cm and 1cm X 0.5cm were sent for histopathological examination. The hematoxylin and eosin stained section showed islands of bony tissue with cementum like masses covered by a fibrous connective tissue stroma suggestive of cemento-ossifying fibroma (Figure 4).

### ***Postoperative outcome***

Post-surgery, the patient was reviewed after 10 days and thereafter at 6-, 12- and 24 month follow-up. On the 10th day of follow up the patient had minimal pain and there was no sign of swelling and infection. The surgical site was healthy with no tissue dehiscence. No evidence of recurrence was observed at 6-, 12- and 24- month follow up.





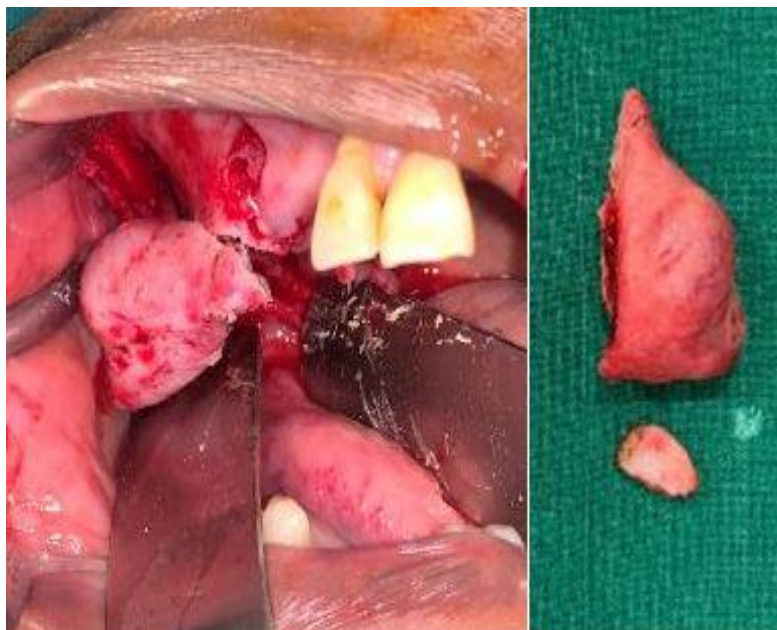
**Slika 1:** Klinička slika pokazuje leziju u desnoj alveoli gornje vilice koja se proteže medijalno do bukalnog korteksa, lateralno do nepca, a posterijorno dostiže do tubera maksile

**Figure 1:** Clinical image showing lesion in the right maxillary alveolus extending medially to the buccal cortex, laterally to the palate and posteriorly reaching to the maxillary tuberosity



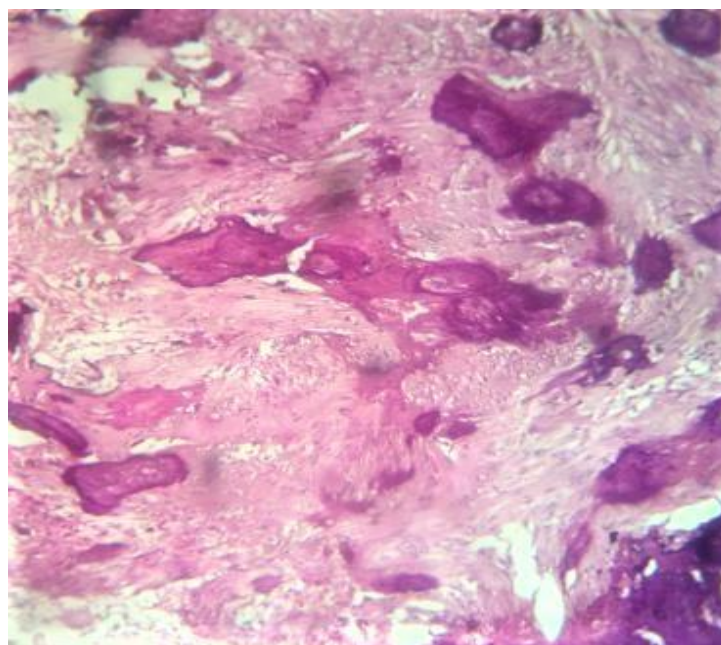
**Slika 2:** Slika aksijalne kompjuterizovane tomografije pokazuje hipodenzna polja u desnoj alveoli gornje vilice veličine oko 19.07mm X 12.11mm

**Figure 2:** Axial computed tomography image showing hypodense areas in the right maxillary alveolus measuring about 19.07mm X 12.11mm



**Slika 3:** Lezija u gornjoj desnoj alveoli je hirurški osteotomizovana i potpuno resektovana iz koštanog ležišta. Dobijena su dva tvrdotkivna uzorka: jedan veliki dimenzija 2,5 cm X 1,5 cm i drugi mali tvrdotkivni uzorak dimenzija 1 cm X 0,5 cm

**Figure 3:** The lesion in the maxillary right alveolus was surgically osteotomized and resected completely from the underlying osseous bed. Two hard tissue specimens were obtained: one large hard tissue measured 2.5cm X 1.5cm and other small hard tissue measured 1cm X 0.5cm



**Slika 4:** Presek obojen hematoksilinom i eozinom koji pokazuje kalcifikovanu masu sličnu cementu okruženu fibroznom vezivno-tkivnom stromom

**Figure 4:** Hematoxylin and eosin stained section showing cementum like calcified mass surrounded by fibrous connective tissue stroma



## Diskusija

Cemento-osificirajući fibrom, u mandibuli, prvi je opisao Menzel 1872. godine. Kasnije, SZO 1971. godine počinje da smatra cemento-osificirajući fibrom lezijom koja formira cement. SZO je 2005. godine redefinisala termin „cemento-osificirajući fibrom“ kao „osificirajući fibrom“. Cemento-osificirajući fibrom manifestuje se u dve različite varijante: centralna varijanta je neoplastični oblik i razvija se iz parodonticijuma, dok je periferna varijanta neneoplastični oblik, koji nastaje iz mekih tkiva vilice<sup>3</sup>.

Cemento-osificirajući fibrom počinje kao spororastuća lezija, koja se pretežno javlja kod osoba starosti 30 do 50 godina života. Lezija se češće javlja kod žena i odnos učestalost lezija kod muškaraca u odnosu na žene kreće se od 2 : 17 do 5 : 1111. Generalno, kod osoba kod kojih se javlja, cemento-osificirajući fibrom je u ranim fazama pojave asimptomatski. U uznapredovalim stadijumima, lezija se postepeno povećava, što rezultira ekspanzijom kortikalne kosti, pomeranjem zuba i deformacijom lica<sup>5</sup>. Kod dece, lezija se naziva juvenilni cemento-osificirajući fibrom, koji je agresivan i visoko vaskularan. Etiologija je nepoznata, ali trauma, odnosno vađenje zuba mogu biti predisponirajući reaktivni uzroci, koji mogu dovesti do cemento-osificirajućeg fibroma. Razlog za takav uzrok je to što nakon vađenja zuba neki deo parodontalnog ligamenta ostaje vezan za alveolarnu kost, koja nakon stimulacije taloži cement.

Radiografske šablone cemento-osificirajućeg fibroma opisali su Eversole i sar.<sup>6</sup>. U početnim fazama, lezija se karakteriše kao unilokularna ili multilokularna radiolucencija. Kako lezija sazreva, evidentna je mešovita oblast žarišta sa dobrodefinisanom radiolucencijom i raštrkanim rentgenkontrastnih poljima. Sklerotični obod radiolucenčnih područja nastaje perifernom kondenzacijom kosti, koja proširuje korteks, bez ikakve perforacije, dovodeći do resorpcije zuba i divergencije korena<sup>5</sup>. Ponekad je moguća i ujednačena ekspanzija kortikalne kosti, koja pokazuje karakterističan centrifugalni obrazac, značajan kriterijum za dijagnozu cemento-osificirajućeg fibroma.

Waldron i sar.<sup>7</sup> izvestili su o tome da je 26% slučajeva pokazalo radiolucenčne oblasti, 63% slučajeva pokazalo je mešovite radiolucenčne i rentgenkontrastnih oblasti, dok je 12% slučajeva imalo homogenu formu. Suprotno tome, Titinchiet i sar.<sup>8</sup> pokazali su radiopakna područja u 49,2% slučajeva,

## Discussion

Cemento-ossifying fibroma was at first described by Menzel in 1872 in mandible. Later WHO in 1971 considered cemento-ossifying fibroma as cementum forming lesion. In 2005, WHO redefined the terminology of “cemento-ossifying fibroma” as “ossifying fibroma”. Cemento-ossifying fibroma presents itself in two different variants: the central variant is a neoplastic form and develops from the periodontium while the peripheral variant is a non-neoplastic form which arises from the soft tissues of the jaws<sup>3</sup>.

Cemento-ossifying fibroma initiates as a slow growing lesion which predominantly affects individuals between 30 and 50 years old. The lesion has female predilection and the male to female ratio ranges from 2:17 to 5:1111. Generally, the individuals are asymptomatic in the early stages of the occurrence of cemento-ossifying fibroma. In advanced stages, the lesion gradually enlarges resulting in expansion of cortical bone, displacement of teeth and facial disfigurement<sup>5</sup>. In children, the lesion is termed as juvenile cemento-ossifying fibroma which is aggressive and is highly vascular. The etiology is unknown however trauma/tooth extractions could be a predisposing reactive cause that can lead to cemento ossifying fibroma. The reason for such cause is that, after a dental extraction some portion of the periodontal ligament remains attached to the alveolar bone which upon stimulation deposits cementum.

The radiographic patterns of cemento-ossifying fibroma were described by Eversole et al<sup>6</sup>. During initial stages, the lesion presents as unilocular or multilocular radiolucency. As the lesion matures, a mixed area of foci is evident with well-defined radiolucency and scattered radio-opacities. The sclerotic rimming of radiolucent areas are formed by the peripheral condensation of the bone which expands the cortex without any perforation causing resorption of tooth and root divergence<sup>5</sup>. At times, uniform expansion of the cortical bone is also possible showing a characteristic centrifugal pattern, a significant criteria for diagnosing cemento-ossifying fibroma.

Waldron et al<sup>7</sup>, reported that 26% of cases showed radiolucent areas, 63% of cases showed mixed radiolucent and radiopaque areas and 12% cases had homogenous form. On the contrary, Titinchiet et al<sup>8</sup>, demonstrated radiopaque areas in 49.2% of cases, mixed form in 34.9% of cases and only 15.9% cases had radiolucent areas.

mešovitu formu u 34,9% slučajeva i samo 15,9% slučajeva imalo je radiolucetna područja.

Na osnovu obrasca perifernog oboda, Barberi i sar.<sup>9</sup>, opisali su je kao dobrodefinisanu leziju, bez sklerotičnih granica u 40% slučajeva, dobrodefinisanu leziju sa sklerotskim obodom u 45% slučajeva i 15% slučajeva pokazalo je loše definisane granice.

Postoje razlike u dijagnozi i proceni cemento-osificirajućeg fibroma, jer ga je teško histološki razlikovati od osteoida i cementa<sup>2</sup>. Cemento-osificirajući fibrom manifestuje se kao fibrovaskularna stroma vezivnog tkiva sa kalcifikacijama. Preseci bojeni hematoxilinom i eozinom pokazuju fragmente bazofilnih kalcifikacija, koji ukazuju na nezreli cement, što sugerise na centralni cemento-osificirajući fibrom, dok je presek hematoxilina i eozina, koji pokazuje kalcifikovane fragmente sa eozinofilnim osteoidom značajan za centralni osificirajući fibrom. Kako bi se prevazišle ove razlike, Endo i sar.<sup>10</sup> analizirali su upotrebu keratin-sulfata i hondroitin-4-sulfata na tri različite lezije i to cemento-osificirajući fibrom, osificirajući fibrom i fibrozne displazije, kroz imunohistohemijsku procenu. Njihove studije ističu da je keratin-sulfat pokazao imunu reaktivnost za cemento-osificirajući fibrom, dok je hondroitin-4-sulfat značajan za osificirajući fibrom i fibrozne displazije.

Preporučeni tretman cemento-osificirajućeg fibroma je enukleacija, kada je lezija mala, dok bi kod velikih ekspanzivnih lezija poželjna bila hirurška resekcija lezije, praćena rekonstrukcijom kosti<sup>4</sup>. U ovom slučaju, zbog velikog obima, autori su izvršili hiruršku resekciju prisutne lezije. Čak iako veličina i obim lezije mogu da variraju, mora se obezbediti potpuna hirurška enukleacija lezije, praćena kiretažom osnovnog koštanog ležišta. Prognoza cemento-osificirajućeg fibroma je dobra ali je utvrđenai visoka stopa recidiva u maksili, u poređenju sa stopom recidiva u mandibuli. U slučaju ovog pacijenta, koji je praćen 24 meseca, nije prijavljen nijedan recidiv. Bala i sar.<sup>1</sup> prijavili su prosečni recidiv od 10,1% tokom perioda praćenja od 25 meseci. Liu i sar.<sup>11</sup> primetili su recidiv od 27,2% za 7 godina, a Eversole i sar.<sup>6</sup> prijavili su recidiva od 28% za period praćenja od 38 meseci.

Based on the peripheral rimming pattern, Barberiet al<sup>9</sup>, described as well-defined lesion without sclerotic borders in 40% of cases, well-defined lesion with sclerotic rim in 45% of cases and 15% of cases showed ill-defined borders.

Differences in the diagnosis exist in evaluating cemento-ossifying fibroma as it is difficult to distinguish osteoid and cementum histologically<sup>2</sup>. Cemento-ossifying fibroma presentsas fibrovascular connective tissue stroma with calcifications. Hematoxylin and eosin section showing fragments of basophilic calcifications indicating immature cementumis suggestive of central cemento-ossifying fibroma while, hematoxylin and eosin section showing calcified fragments with eosinophilic osteoid is significant of central ossifying fibroma. In order to overcome these differences,Endo et al<sup>10</sup>assessed the use of keratin sulphate and chondroitin-4-sulphate on three different lesions namely cemento-ossifying fibroma, ossifying fibroma and fibrous dysplasia through immuno-histochemical evaluation.Its studies report that keratin sulphate showed immune reactivity for cemento-ossifying fibroma while chondroitin-4-sulphate was significant for ossifying fibroma and fibrous dysplasia.

The recommended treatment for cemento-ossifying fibroma is enucleationwhen the lesion is small and surgical resection followed by reconstruction of bone can be preferred at large expansile lesions<sup>4</sup>. In the present case, the authors have performed surgical resection since the extent of the lesion was large. Even if the size and the extent of the lesion may vary, a complete surgical enucleationfollowed by curettage of the underlying osseous bed must be ensured. The prognosis of the cemento-ossifying fibroma is fair and the rate of recurrence is found to be high in maxilla when compared to mandible. No recurrence was reported in the present case which had a follow up for 24 months. WhereasBala et al<sup>1</sup>,reported average recurrence of 10.1% for a follow up period of 25 months,Liu et al<sup>11</sup>observed recurrence of 27.2% in 7 years and Eversole et al<sup>6</sup>reported 28% recurrence in 38 months.

## ***Zaključak***

Cemento-osificirajući fibrom u maksili retka je zastupljen, u poređenju sa njegovom prevalencijom u mandibuli. Iako postoje brojne kontroverze, kada je reč o upotrebi terminologije, multicentrični pristup nalaže da se uspostavi klinička, radiografska i histološka povezanost, kako bi se odredila perspektiva lečenja. Na vreme se mora obezbediti totalna enukleacija/resekcija koštane lezije kako bi se sprečilo ponovno pojavljivanje ove lezije, i postigla dobra prognoza.

### ***Sukob interesa:***

Autori izjavljuju da nemaju sukob interesa.

## ***Conclusion***

Cemento-ossifying fibroma in maxilla is a rare presentation when compared to its prevalence in mandible. Although numerous controversies exist in the use of terminologies, a multi centric approach mandates to correlate clinically, radiographically and histologically to determine the treatment perspective. Total enucleation/ resection of the osseous lesion must be timely ensured to prevent recurrence and also to achieve good prognosis.

### ***Conflict of interest:***

The authors declare that they have no conflict of interest

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# REGENERATIVNA PARODONTALNA TERAPIJA – I DEO

## REGENERATIVE PERIODONTAL THERAPY – I PART

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### Sažetak

**Uvod:** Pod konceptom regenerativne terapije parodontalnih tkiva, treba imati u vidu dva pristupa: prvi je koncept pasivne regeneracije, koji obuhvata upotrebu koštanih zamenika i vođenu regeneraciju parodontalnih tkiva primenom biomembrana, a drugi je koncept aktivne regeneracije, koji podrazumeva primenu faktora rasta. Pasivna regeneracija primenom koštanog matriksa (koštanih zamenika) ima za cilj stabilizaciju i popunjavanje defekta, sprečavanje urastanja epitelnog tkiva, kao i čuvanje prostora za stvaranje novog tkiva. Pod ovim konceptom podrazumeva se primena autogenih transplantata, ksenograftova, alograftova, kao i aloplastičnih materijala. Nosioći aktivne regeneracije, faktori rasta (growth factors - GF) su prirodni biološki medijatori koji regulišu ćelijske procese ključne za regeneraciju tkiva.

**Cilj:** Prikazati savremene pristupe terapiji obolelog parodonticijuma koji su usmereni na regeneraciju i kompletnu rekonstrukciju parodontalnih tkiva.

**Zaključak:** U budućnosti, parodontalni regenerativni postupak progenitorskim ćelijama parodontalnog ligamenta trebalo bi da podstakne repopulaciju površina koje su bile zahvaćene parodontopatijom.

**Ključne reči:** parodontalna hirurģija, tkivna regeneracija

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### Abstract

**Introduction:** Under the concept of regenerative periodontal therapy, there are two approaches: the first is the passive regeneration concept that includes bone substitutes and guided periodontal regeneration by using of biomembranes and the second concept of active regeneration that implies the use of growth factors. The aim of the passive regeneration, by using of bone matrix (bone substituents) has been stabilization and bone defects management, preventing epithelial tissue growth, as well as saving space for the new tissue regeneration. This concept implies the use of autogenous transplantats, xenografts, allografts, as well as alloplastic materials. The carriers for active tissue regeneration, growth factors – GF are biological mediators that regulate cellular processes and that is crucial for the tissue regeneration.

**Aim:** Presentation of modern approaches to periodontal therapy that are focused on the attachment regeneration and complete reconstruction of periodontal tissue.

**Conclusion:** In the future, periodontal regenerative therapy with periodontal ligament progenitor cells should encourage repopulation of the areas that have been affected by periodontal disease.

**Key words:** periodontal surgery, tissue regeneration

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za stomatologiju Niš. Sva prava zadržana.

## Uvod

Oboljenja potpornog aparata zuba karakterišu se destrukcijom i gubitkom potpornih tkiva (gingive, cementa, alveolarne kosti i periodontalnih vlakana). Koncept regenerativne terapije parodontopatije baziran je na ideji kompletne regeneracije izgubljenih tkiva. "Prava" regeneracija parodontijuma podrazumeva stvaranje novog cementa, nove gingive, alveolarne kosti i novog periodontalnog ligamenta na delu korena zuba, nakon hirurške intervencije<sup>1</sup>.

Osnovni cilj parodontalne hirurgije je da obezbedi pristup za pravilno čišćenje površine korena zuba, ali, i pored toga, većina hirurških procedura rezultira redukcijom dubine parodontalnog džepa. Tradicionalno, eliminacija dubokih parodontalnih džepova postiže se gingivektomijom ili apikalnim pomeranjem mekotkivnog režnja, koje se izvodi udruženo sa oblikovanjem alveolarne kosti. U poslednje vreme, češće se koriste regenerativni tretmani, u cilju restauracije izgubljenog potpornog aparata zuba<sup>2</sup>. Veoma je bitno da parodontalna terapija da zadovoljavajuće rezultate, zbog toga što postoji dokazana veza između parodontalnih oboljenja i sistemskog zdravlja<sup>3</sup>.

## Indikacije

Parodontalni tretman, bez obzira da li se radi o hirurškom ili nehirurškom, dovodi do recesije gingive nakon oporavka<sup>4</sup>. Kod uznapredovalih slučajeva, ovo može dovesti do lošeg estetskog rezultata kod frontalnih zuba, naročito kod slučajeva gde hirurška procedura uključuje oblikovanje alveolarne kosti sa odstranjivanjem koštanih defekata. U slučajevima kod kojih nema oblikovanja alveolarne kosti u toku hirurškog tretmana, može doći do stvaranja rezidualnih parodontalnih džepova, koji su nedostupni za odgovarajuće održavanje oralne higijene. Ovi problemi mogu se izbeći ili redukovati pomoću regenerativnih hirurških procedura, kojima se obnavljaju izgubljeni potporni aparat zuba i koštani defekti. Indikacije za regenerativnu parodontalnu hirurgiju najčešće su bazirane na esteticima, iako je pored toga važna činjenica da funkcija i dugoročna prognoza tretiranih zuba mogu biti poboljšane.

Lokalizovana gingivalna recesija može predstavljati estetski problem pacijentima i često je povezana sa hipersenzitivnim dentinom.

## Introduction

Diseases of the tooth-supporting apparatus are characterized by destruction and loss of periodontal supporting tissues (gingiva, cement, alveolar bone and periodontal ligament). The concept of regenerative periodontal therapy is based on the idea of complete regeneration of periodontal tissues. "True" periodontal regeneration implies making of the new cementum, gingiva, alveolar bone and periodontal ligament on the part of tooth radix after surgical procedure<sup>1</sup>.

The main goal of periodontal surgery is to achieve the space for regular cleaning of the tooth radix area, but the most common surgical procedures resulted only with reduction in depth of periodontal pocket. Traditionally, elimination of deep periodontal pockets is achieved by gingivectomy or apical movement of the soft tissue flap, which was performed in conjunction with alveolar bone remodeling. Recently, regenerative treatments have been used more often in order to restore the loss of the tooth-supporting apparatus<sup>2</sup>. It is very important that periodontal therapy can provide satisfactory results because there has been found a proven link between periodontal disease and systemic health<sup>3</sup>.

## Indications

Periodontal treatment, whether surgical or non-surgical leads to gingival recession after recovery<sup>4</sup>. Advanced cases may lead to poor esthetical results in the front teeth, especially in patients where surgical procedure includes alveolar bone remodeling with the elimination of osseous defects. In cases without alveolar bone remodeling through surgical treatment could lead to formation of residual periodontal pockets, which were unavailable for proper oral hygiene. These problems could be avoided or reduced by regenerative surgical procedures that result in restoration of tooth-supporting apparatus and bone defects. The indications for regenerative periodontal surgery are most often based on aesthetics, although of importance is the fact that function and long-term prognosis of treated teeth could be improved.

Localized gingival recession may be an esthetic issue for patients and usually connected with the hypersensitive dentin. Situation like this is usually indication for regenerative periodontal surgery in order to achieve tooth root coverage.

Ovakva situacija indikacija je za primenu regenerativne parodontalne hirurgije, kako bi se održala prekrivenost korena zuba. Na taj način, poboljšava se estetika i smanjuje hipersenzitivnost korena zuba. Uspešno prekrivanje korena zuba podrazumeva regeneraciju potpornog aparata na izloženoj površini korena, uključujući cement sa umetnutim kolagenim vlaknima i alveolarnu kost, kao i estetski prihvatljivu restauraciju anatomije mukogingivalnog kompleksa.

Još jedna indikacija za regenerativnu parodontalnu terapiju je zahvaćenost furkacija zuba. Predeo furkacije često je nepristupačan za adekvatnu obradu, što praktično dovodi do toga da adekvatno čišćenje, nakon resektivne hirurgije, nije moguće izvesti. Dugoročna prognoza za lečenje takvih zuba značajno je poboljšana uz pomoć regenerativne parodontalne terapije<sup>5</sup>.

### ***Regenerativne hiruške procedure***

Regenerativna parodontalna terapija obuhvata specijalne procedure, osmišljene tako da restauriraju one delove potpornog aparata zuba koji je izgubljen tokom parodontopatije. Regeneracija je definisana kao reprodukcija ili rekonstrukcija izgubljenih ili oštećenih delova zuba i tkiva, na takav način da se kompletno restauriraju arhitektura i funkcija izgubljenog ili oštećenog tkiva<sup>6</sup>. Ovo znači da će se pripojni epitel zuba potpuno regenerisati kada se formira novi cement sa umetnutim kolagenim vlaknima na površini korena, dok regeneracija potpornog aparata zuba podrazumeva i obnavljanje alveolarne kosti. Procedure koje imaju za cilj restauraciju izgubljenog potpornog aparata zuba opisane su kao "reatachment" ili "novi attachment" procedure.

Parodontalna regeneracija podrazumeva sledeće hirurške procedure: biomodifikaciju površine korena zuba, kombinovanu sa koronarno pomeranim režnjem, primenu koštanih graftova / koštanih implanata ili upotrebu organskih/sintetskih biomembrana (vođena regeneracija primenom biomembrana). Iako postoji dokazana klinička uspešnost sa značajnim porastom nivoa alveolarne kosti, histološki je prisutan fibrozni sadržaj duž površine korena zuba, umesto depozita novog cementa<sup>7</sup>. Uspešna regeneracija procenjuje se na osnovu sondiranja, rendgenografskih analiza, direktnim merenjem nove kosti i histoškim metodama<sup>8-11</sup>.

Hiruške procedure, čija se primena zasniva na činjenici da sposobnost regeneracije imaju samo ćelije periodoncijuma, dok tu osobinu ne poseduju ćelije epitela i vezivnog tkiva gingive.

This improves the aesthetics and reduces the hypersensitivity of the tooth root. Successful technique of the tooth root coverage involves the regeneration of the supporting apparatus on the exposed root surface including cement with inserted collagen fibers and alveolar bone, as well as an aesthetically acceptable restoration of the anatomy of the mucogingival complex.

One more indication for regenerative periodontal therapy is involvement of the tooth furcation. The furcation area is often inaccessible for adequate treatment, and it practically leads to the fact that adequate cleaning after resective surgery could not be done. The long-term prognosis for the treatment of such teeth has been significantly improved by regenerative periodontal techniques<sup>5</sup>.

### ***Regenerative surgical procedures***

Regenerative periodontal therapy includes special procedures designed to restore those parts of the tooth-supporting apparatus that was lost during periodontal disease. Regeneration is defined as the reproduction or reconstruction of lost or damaged parts in such a way that the architecture and function of the lost or damaged tissues have been completely restored<sup>6</sup>. This means that the attached epithelium to the tooth will be completely regenerated, when a new cementum has been formed with inserted collagen fibers on the root surface, while the regeneration of the tooth-supporting apparatus implies and the alveolar bones regeneration. A procedure aimed at restoring lost the tooth-supporting apparatus has been described as a "reattachment" or "new attachment" procedure.

Periodontal regeneration includes the following surgical procedures: biomodification of the tooth root surface combined with coronary displaced flap, using of bone grafts / bone implants or using of organic / synthetic biomembranes (guided regeneration using biomembranes). Although there is a proven clinical success rate with a significant increase in alveolar bone levels, histologically, there was fibrous content along the root surface of the tooth instead of the new cement deposits<sup>7</sup>. The successful regeneration was assessed on the basis of sounding, radiographic analysis, direct measurement of new bone levels and by histological methods<sup>8-11</sup>.

Surgical procedures, which were based on the fact that only periodontal cells have the ability to regenerate, while epithelial cells and connective tissue of the gingiva do not have that property.



Zbog toga se primenom terapije mora stvoriti barijera, koja sprečava urastanje ćelija epitela i krzna i omogućava repopulaciju parodontalnog džepa ćelijama periodoncijuma i ćelijama kosti, koje poseduju sposobnost regeneracije. U pokušaju da se stvori barijera, čiji je cilj sprečavanje prodora ćelija epitela i vezivnog tkiva u gingive i omogućiti naseljavanje ćelija periodoncijuma, koriste se dve metode<sup>8</sup>:

I metoda: čiji je cilj postizanje novog pripoja bez korišćenja transplantata, koja se odvija u tri faze:

1. Faza: uklanjanje pripojnog epitela i epitela parodontalnog džepa, koje se vrši ili kiretažom ili hirurškom procedurom. Nepotpuno uklanjanje patološki izmenjenih tkiva parodontalnog džepa sprečava pozitivan ishod svih terapijskih procedura;

2. Faza: onemogućavanje prodora vezivnog tkiva i epitela implantacijom određenih barijera (membrana), koje se klasifikuju kao resorptivne i neresorptivne. Neresorptivne membrane prave se od teflona, "Milipor filtera" politetrafluoretilena, silikonske gume, titanijuma i mnogih drugih materijala i uklanjaju se nakon 3 nedelje do 6 nedelja od trenutka hirurške intervencije, dok su resorptivne membrane napravljene od polilaktične kiseline, kolagena, smrznute dure mater, polikarbolaktana itd. Pored njih, aplikuju se i koštani i sintetički transplantati, koji treba da stimulišu stvaranje nove kosti;

3. Faza: obrada i priprema korena zuba za stvaranje novog epitelnog pripoja vrši se kiretažom (uklanjanjem pripojnog epitela i epitela parodontalnog džepa) i nekim medikamentima (kondicioniranje površine korena zuba). Cilj je da se iz parodontalnog džepa odstrane ostaci periodontalnih vlakana, mikroorganizmi i njihovi produkti, dok se sa korena zuba odstranjuje oštećeni cement. Za demineralizaciju cementa i dentina na korenu, koristi se limunska kiselina, kao i premazivanje korena zuba tetraciklinima, koji treba da olakšaju pripoj vezivnih vlakana za dentin. Može se umesto stavljanja membrane, površina korena premazati emdogainom (faktor rasta gleđi), koji sprečava apikalnu proliferaciju epitela.

II metoda: rekonstruktivne mere korišćene za postizanje novog pripoja, upotrebom kalema (transplantata). Ovi zahvati vrše se u relativno malom operativnom polju – mikrohirurški zahvati, koji se obavljaju pod lupom ili sistemom lupa, koje se nose kao naočare. Nekada se intervencije vrše i pod posebno konstruisanim mikroskopom, za šta je neophodno korišćenje gracilnih instrumenata. Mikrohirurške zahvate pacijenti prihvataju lakše, zato što je prisutan manji postoperativni bol<sup>8</sup>.

Therefore, the surgical therapy has to create a barrier, that prevents the ingrowth of epithelial and corium cells and enables repopulation of the periodontal pocket with periodontal and bone cells, that have the ability to regenerate themselves. In the attempt to create a barrier that plays a role in preventing penetration of the epithelial cells and connective tissue of the gingiva and allows the repopulation of periodontal cells, these two methods were used<sup>8</sup>:

I method: the aim has been to achieve a new attachment without the using of the grafts, it has evolved through three phases:

Phase 1. Removal of the epithelial attachment and periodontal pocket epithelium performed by either curettage or surgical procedure. Incomplete removal of pathologically altered periodontal pocket tissues prevents the positive outcome of all therapeutic procedures.

Phase 2. Preventing of the connective tissue and epithelium penetration by implanting certain barriers (membranes) that are classified as resorptive and non-resorptive. Non-resorptive membranes were made from Teflon, "Millipore filter" polytetrafluoroethylene, silicone rubber, titanium and many other materials and have been removed after 3-6 weeks of surgery. While resorbable membranes were made from polylactic acid, collagen, frozen dura mater, polycarbolactan, etc. In addition, bone and synthetic transplants were applied, that should stimulate the formation of the new bone.

Phase 3. Processing and preparation of the tooth root for the creation of a new epithelial attachment have been performed by curettage (removal of the adnexal epithelium and periodontal pocket epithelium) and some medications (conditioning of the tooth root surface). The goal is to remove the remains of periodontal fibers, microorganisms and their products from the periodontal pocket, while the damaged cement has been removed from the root of the tooth. For demineralization of cementum and dentin of the tooth root, citric acid is used, as well as coating the tooth root with tetracyclines, which should facilitate the attachment of connective fibers to the dentin. Instead of applying a membrane, the tooth root surface can be coated with "Emdogain" (enamel growth factor), which prevents apical proliferation of the epithelium.

II method: reconstructive measure used in realization of new attachment by grafts (transplants). These procedures have been performed in a relatively small operative field - microsurgical procedures, performed under the magnifying glass or under the system of

### **Postupci transplantiranja**

U kliničkim studijama i eksperimentima na životinjama, rezanje operacija kombinuje se sa ubacivanjem koštanih transplantata ili materijala za implantaciju u kiretirani koštani defekt, sa ciljem da se stimuliše parodontalna regeneracija<sup>12,13</sup>.

Različiti materijali za transplantate i implantate mogu se klasifikovati u četiri kategorije:

1. Autogeni transplantati uzeti su sa jednog mesta, a implantiraju se na drugo mesto kod iste osobe. To su: (a) kortikalna kost ili (b) spongiozna kost i koštana srž, bilo da su uzeti sa intraoralnog ili ekstraoralnog donorskog mesta;

2. Alotransplantati implantiraju se genetski različitim članovima iste vrste. To su: (a) zamrznuta spongiozna kost i koštana srž i (b) suvozamrznuta kost;

3. Ksenotransplantati ili heterotransplantati uzeti su od donora, koji pripadaju drugoj vrsti;

4. Aloplastični materijali su sintetički ili neorganski materijali, koji se koriste kao zamena za koštane transplantate.

Razlog korišćenja koštanih transplantata ili aloplastičnih materijala je pretpostavka da utiču na rast alveolarne kosti i stvaranje novog pripojnog epitela, zbog toga što:

1. Sadrže ćelije koje utiču na formiranje alveolarne kosti (osteogeneza);

2. Služe kao matrica za koštanu formaciju (osteokondukcija);

3. Matriks koštanih graftova sadrži supstance koje indukuju formaciju kosti (osteoindukcija)<sup>9,14</sup>. Ovakva kompletna regeneracija pripojnog epitela pomoću transplantata indukuje sposobnost koštanih ćelija da stvaraju novi cement sa kolagenim vlaknima na površini korena, koji je prethodno izmenjen parodontopatijom<sup>15</sup>.

### **Autogeni transplantati**

Autogeni transplantati mogu zadržati ćelijsku sposobnost da poboljšaju stvaranje kosti preko osteogeneze i/ili osteokondukcije. Oni se postepeno zamenjuju novom kosti. Osim toga, potencijalni problemi koji mogu nastati zbog histokompatibilnosti i potencijalnog prenošenja bolesti ovim putem su eliminisani. Autogeni transplantati mogu se uzeti sa intraoralnih i ekstraoralnih donorskih mesta.

magnifying glasses worn like glasses. Sometimes interventions were performed under a specially constructed microscope, and the use of these graceful instruments was necessary. Patients accepted microsurgical procedures more easily, because they were associated with reduced postoperative pain<sup>8</sup>.

### **Transplant procedures**

In clinical studies and animal experiments, flap surgery has been combined with the insertion of bone grafts or implant materials into a cured bone defect in order to stimulate periodontal regeneration<sup>12,13</sup>.

Different materials for transplants and implants could be classified into four categories:

1. Autogenous transplants were taken from one part of the body and implanted in another part of the same person body. These were: (a) cortical bone or (b) spongy bone and bone marrow, whether taken from an intraoral or extraoral donor site.

2. Allografts have been implanted in the genetically different members of the same species. These were: (a) frozen spongy bone and bone marrow and (b) dry-frozen bone.

3. Xenografts or heterografts have been taken from the donor which belongs to another species.

4. Alloplastic materials are synthetic or inorganic materials that were used as the substitute for bone grafts.

The reason why a bone graft or alloplastic material was used is the assumption that both affect the growth of alveolar bones and the formation of a new adherent epithelium, because they consist of:

1. The cells that affect the formation of alveolar bone (osteogenesis), or

2. They are used as a matrix for bone formation (osteoconduction), or

3. The matrix of bone grafts, which contains substances that induce bone formation (osteoinduction)<sup>9,14</sup>. This complete regeneration of the adherent epithelium by using grafts have been induced by the ability of bone cells to create the new cementum with collagen fibers on the root surface, which was previously altered by periodontal disease<sup>15</sup>.

### **Autogenous transplants**

Autogenous transplants may retain the cellular ability to improve bone formation through osteogenesis and / or osteoconduction. The transplants are gradually replaced by the new bone over time. In addition, potential problems due to histocompatibility and potential disease transmission in this way was eliminated.

### ***Intraoralni autogeni transplantati***

Intraoralni autogeni transplantati uzimaju se sa bezubih predela vilica, ekstrakcionih rana, tubera maksile ili retromolarnog predela mandibule, koji se često koriste u parodontalnoj regenerativnoj hirurgiji<sup>16</sup>.

Spongiozna kost češće je u upotrebi kao materijal za transplantate, ali je i kortikalna kost u upotrebi, kada su u pitanju mali delovi<sup>17</sup>. Mešanje materijala sa krvlju, pre nego da se aplikuje u defekt<sup>18,19</sup>, predstavlja napredak u regenerativnoj terapiji parodontalnih infrakoštanih defekata. Rezultati studija<sup>20-23</sup> prikazuju to da, kod infrakoštanih defekata, primena intraoralnog koštanog transplantata može dati bolje rezultate parodontalne regeneracije.

### ***Ekstraoralni autogeni transplantati***

Schallhorn<sup>24,25</sup> je uveo korišćenje autogenih transplantata od koštane srži sa kuka (srž uzeta sa criste iliacae za tretman infrakoštanih defekata i furkacija). Međutim, zbog invazivnog postupka više se ne koriste transplantati srži ilijačne kosti.

### ***Alogeni transplantati***

Upotreba alotransplantata uključuje izvestan rizik, s obzirom na antigenost, mada se oni prethodno zamrznju i izlože zračenju ili hemikalijama, kako bi se sprečile reakcije na strano telo. Dostupne vrste alotransplantata su: zamznuta spongiozna ilijačna kost i srž, mineralizovani transplantati suvo smrznute kosti (FDBA – freeze dried bone graft) i dekalificirani suvo smrznuti koštani transplantat (DFDBA – decalcified freeze-dried bone allograft).

### ***Ksenotransplantati***

Kod ksenotransplantata primenjuju se nove metode, koje omogućuju odstranjivanje svih organskih sastojaka iz goveđe kosti, ostavljajući koštani matriks u nepromenjenom neorganskom obliku (npr. "Bio-Oss", Geistlich AG, Wolhusen Switzerland; Endobone, Merck Biomaterialen, Darmstadt, Germany; Laddec®, Ost Development, Clermont-Ferrand, France; Bon-Apatite®, Bio-Interfaces Inc., San Diego, US). Ipak, postoje razlike u metodama prečišćavanja transplantata i manipulacije transplantatom, što je dovelo do komercijalno dostupnih proizvoda sa različitim hemijskim osobinama. Ovi materijali dostupni su u različitim veličinama čestica ili kao blokovi.

Autogenous transplants could be taken from intraoral and extraoral donor sites.

### ***Intraoral autogenous transplants***

Intraoral autogenous transplants have been taken from the edentulous areas of the jaws, from the extraction wounds, the maxillary tubers, or the retromolar area of the mandible has been often used in periodontal regenerative surgery<sup>16</sup>.

The spongy bone has been more commonly used as a graft material, but cortical bone has been also used when small parts were involved<sup>17</sup>. Mixing the material with blood, before applied for the defect<sup>18,19</sup>, represents an advance for the regenerative therapy of periodontal infraosseous defects. The results of these studies<sup>20-23</sup> showed that in the case of infraosseous defects, using of an intraoral bone graft could provide better periodontal regeneration outcomes.

### ***Extraoral autogenous transplants***

The using of autogenous bone marrow transplants from the hip (marrow was taken from criste iliacae for the treatment of infraosseous defects and furcations) has been initiated by Schallhorn<sup>24,25</sup>. However, due to the invasive procedure, iliac bone marrow transplants were no longer available in practice.

### ***Allogeneic transplants***

The using of allografts has been associated with some risk regarding antigenicity measurement, although these have been pre-frozen and exposed to radiation or chemicals in order to prevent foreign body reactions. Available types of allografts are: frozen spongy iliac bone and marrow, mineralized freeze dried bone graft (FDBA) and decalcified dry frozen bone graft (DFDBA).

### ***Xenotransplants***

In xenotransplants, the new methods that have been applied, allow the removal of all organic constituents from bovine bone by leaving the bone matrix in unchanged inorganic form (e.g. Bio-Oss®, Geistlich AG, Wolhusen Switzerland; Endobone®, Merck Biomaterial, Darmstadt, Germany; Laddec®, Ost Development, Clermont-Ferrand, France; Bon-Apatite®, Bio-Interfaces Inc., San Diego, US). However, there are different methods of purification and manipulation of the graft, which led to commercially available

### ***Aloplastični materijali***

Aloplastični materijali su sintetski, neorganski, biokompatibilni i/ili bioreaktivni zamenci kosti, koji imaju osteokonduktivne osobine. Postoje četiri vrste aloplastičnih materijala koje se koriste u regenerativnoj parodontalnoj hirurgiji: hidroksiapatit (HA), beta trikalcijum-fosfat ( $\beta$ -TCF), polimeri i bioaktivna stakla (biostakla).

### ***Hidroksiapatit (HA)***

Hidroksiapatit (HA) upotrebljava se u parodontalnoj hirurgiji u dva oblika – u obliku čestica neresorptivne keramike (npr. Periograf<sup>®</sup>, Miter Inc., Warsaw, IN, US; Calcitite<sup>®</sup>, Calcitek Inc., San Diego, US) i u obliku resorptivnih čestica (npr. OsteoGraf/LD<sup>®</sup>, CeraMed Dental, Lakewood, CO, US).

### ***Betatrikalcijum-fosfat ( $\beta$ -TCF)***

Beta trikalcijum-fosfat ( $\beta$ -TCP) je aloplastični materijal. To je sintetski, neorganski, biokompatibilni i/ili bioaktivni koštani zamjenik, koji poseduje osteokonduktivni potencijal. Ovaj materijal karakteriše se izuzetno brзом resorptivnošću, da je regeneracija parodontalnih tkiva bila nekompletna, u smislu formiranja novog acelularnog cementa i alveolarne kosti. Inak, smatra se da ovaj materijal primarno deluje kao nosač za čuvanje prostora parodontalnih defekata<sup>26</sup>.

### ***Polimeri***

Postoje dva polimerna materijala, koja se koriste kao zamena za kost u lečenju parodontalnih defekata: neresorptivni kopolimer od poli-metilmetakrilata (PMMA) i poli-hidroksietilmetakrilat (PHEMA) prekriven kalcijum-hidroksidom, koji se naziva HTR (hard tissue replacement).

### ***Bioaktivna stakla (biostakla)***

Biostakla se sastoje od SiO<sub>2</sub>, Na<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>, tako da se resorbuju ili se ne resorbuju, u zavisnosti od odnosa njihovih sastojaka.

Kada se biostakla izlože tkivnim tečnostima, onda se na njihovoj površini stvori dvostruki sloj silicijumskog gela i kalcijum-fosfata<sup>27</sup>. Komercijalno dostupna biostakla u obliku čestica, teoretski resorptivna, koriste se za parodontalno lečenje (PerioGlass<sup>®</sup>, US Biomaterials Corp., Alachua, FL, US; BioGran<sup>®</sup>, Orthovita, Malvern, PA, US).

products with different chemical properties. These materials are available in different particle sizes or as blocks.

### ***Alloplastic materials***

Alloplastic materials are synthetic, inorganic, biocompatible and / or bioreactive bone substitutes that have properties of osteoconductive biomaterials. There are four types of alloplastic materials that are used in regenerative periodontal surgery: hydroxyapatite (HA), beta-tricalcium phosphate ( $\beta$ -TCF), polymers, and bioactive glasses (bioglass).

### ***Hydroxyapatite (HA)***

HA is used in periodontal surgery in two forms, in the form of non-resorptive ceramic particles (e.g. Periograf<sup>®</sup>, Miter Inc., Warsaw, IN, US; Calcitite<sup>®</sup>, Calcitek Inc., San Diego, US) and in the form of resorptive particles (e.g. OsteoGraf / LD<sup>®</sup>, CeraMed Dental, Lakewood, CO, US).

### ***Beta-tricalcium phosphate ( $\beta$ -TCF)***

Beta-tricalcium phosphate ( $\beta$ -TCP) is an alloplastic material. It is a synthetic, inorganic, biocompatible and / or bioactive bone substitute that has osteoconductive potential. This material is characterized by extremely fast resorption, so the regeneration of periodontal tissues was incomplete regarding the formation of new acellular cementum and alveolar bone. However, this material acts primarily as the carrier in preserving periodontal defect space<sup>26</sup>.

### ***Polymers***

There are two polymeric materials as a replacement for bone in the treatment of periodontal defects: a non-resorptive copolymer, made of polymethyl methacrylate (PMMA) and polyhydroxyethyl methacrylate (PHEMA), coated with calcium hydroxide, called HTR (hard tissue replacement).

### ***Bioactive glasses (bioglass)***

Bioglasses are made of SiO<sub>2</sub>, Na<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>, so they are in a resorptive or a non-resorptive form, depending on the ratio of their components.

When bioglass are exposed to tissue fluids, then a double layer of silica gel and calcium phosphate is formed on their surface<sup>27</sup>. Commercially available bioglass in the form of particles, theoretically resorptive, is used for periodontal treatment (PerioGlass<sup>®</sup>, US Biomaterials Corp., Alachua, FL, US; BioGran<sup>®</sup>, Orthovita, Malvern, PA, US).

### ***Biomodifikacija površine korena***

Ispituju se promene koje se javljaju na površini korena zuba, koji je zahvaćen parodontopatijom. Uklanjanje bakterijskih naslaga, kamenca i endoksina iz cementa smatra se osnovnim preduslovom za stvaranje novog vezivnog aparata<sup>28</sup>. Međutim, Stahl i sar.<sup>29</sup> upozorili su na to da bi demineralizacija površine korena, koja ima za posledicu izlaganje kolagena dentina, olakšala taloženje cementa podsticanjem mezenhimskih ćelija iz okolnog tkiva da se diferenciraju u cementoblaste. Biološka koncepcija postavljena je tako da se izlaganjem kolagenih vlakana dentalnog matriksa može omogućiti adhezija krvnog koaguluma za površinu korena zuba, a isto tako i migracija fibroblasta.

### ***Faktori regulacije rasta parodontalne regeneracije***

Faktor rasta opšti je pojam za označavanje grupe polipeptidnih hormona, koji stimulišu veliki broj različitih reakcija, kao što je proliferacija, hemotaksa, diferencijacija i produkcija ekstracelularnih matriksnih proteina<sup>30</sup>. Proliferacija i migracija ćelija periodoncijuma i sinteza ekstracelularnog matriksa, kao i diferencijacija cementoblasta i osteoblasta, preduslov su za regeneraciju parodonta. Samim tim, razumljivo je to što faktori rasta mogu predstavljati potencijalnu pomoć u pokušaju da se stimuliše regeneracija parodonta.

Faktori rasta (growth factors – GF) su prirodni biološki medijatori, koji regulišu ćelijske procese krucijalne za regeneraciju tkiva. Faktori rasta od značaja za parodontalnu regeneraciju su: trombocitni faktor rasta – PDGF, transformišući faktor rasta, faktor rasta – EGF, osteogeni protein 1 – BMP-7, koštani morfogenetski protein – BMP-2, BMP-3 i angiogenetski faktori rasta TGFβ1 i TGFβ2, faktor rasta sličan insulinu – IGF i fibroblastni faktor rasta – FGF.

Trombocitni faktor rasta (PDGF) jedan je od glavnih humanih faktora rasta. Iako prvo primećen u alfa granulama trombocita, otkriveno je da ga sintetišu i ostale ćelije, kao što su makrofagi i ćelije endotelijuma<sup>31</sup>. Brojne studije, kako u medicini, tako i u stomatologiji, potvrdile su njegov pozitivni efekat na zarastanje rana. Smatra se da je on jedan od prvih faktora prisutnih u rani, koji započinje proces zarastanja okolnih tkiva<sup>32</sup>. Zabeleženo je da PDGF vrši mobilizaciju ćelija iz okolnog matriksa, kao i da utiče na hemotaksu i proliferaciju ćelija parodontalnog ligamenta i alveolarne kosti.

### ***Root surface biomodification***

The changes on the surface of the tooth root affected by periodontal disease are investigated as well. Removal of bacterial deposits, tartar and endoxins from the cement is considered as a basic prerequisite for the formation of a new attachment apparatus<sup>28</sup>. However Stahl et al.<sup>29</sup> warned that demineralization of the root surface had as a consequence the exposure of dentin collagen, and that would facilitate cement deposition by encouraging mesenchymal cells from the surrounding tissue to stimulate its differentiation into cementoblasts. The biological concept was that if the collagen fibers of dental matrix were exposed, the adhesion to surface of tooth root of the blood coagulum could be enabled, as well as the fibroblasts migration.

### ***The growth regulating factors of periodontal regeneration***

The growth factor is a general term for a group of polypeptide hormones, and they stimulate a large number of different reactions such as proliferation, chemotaxis, differentiation and production of extracellular matrix proteins<sup>30</sup>. Therefore, it is understandable that growth factors could potentially mean help in trying to stimulate periodontal regeneration.

Growth factors (GF) are natural biological mediators which regulate cellular processes that are crucial for tissue regeneration. The important growth factors for periodontal regeneration are: platelet growth factor-PDGF, transforming growth factor-growth factor-EGF, osteogenic protein 1-BMP-7, bone morphogenetic protein-BMP-2, BMP-3 and angiogenic growth factors TGFβ1 and TGFβ2, insulin-like growth factor-IGF, fibroblast growth factor-FGF.

Platelet-derived growth factor (PDGF) is one of the main human growth factors. Although, it was first described as the part of platelet alpha granules, it was found to be synthesized in other cells, such as macrophages and endothelial cells<sup>31</sup>. Numerous studies, both in medicine and dentistry, have confirmed its positive effect on wound healing. It is considered to be one of the first factors presented in the wounds, and could initiate the healing process of the surrounding tissues<sup>32</sup>. It was noticed that PDGF has mobilized cells from the surrounding matrix, as well as it had influence on chemotaxis and proliferation of periodontal ligament and alveolar bone cells.

On takođe pospešuje regeneraciju alveolarne kosti, periodontalnog ligamenta i cementa, kao i delova potpornog aparata, koji su najkomplikovaniji za regeneraciju.

U jednoj od prvih studija na ovu temu, pokazano je to da aplikacija 0,15 mg/ml PDGF-a i 0,15 mg/ml IGF-a rezultira značajnim poboljšanjem ispunjenosti defekta novom kosti, u odnosu na konvencionalnu hiruršku terapiju<sup>33</sup>.

### ***Zaključak***

Može se zaključiti da postoje dokazi o tome da parodontalni ligament sadrži progenitorske ćelije, koje služe za obnavljanje izgubljenog epitelnog pripoja. U budućnosti, parodontalni regenerativni postupak ćelijama periodoncijuma trebalo bi da podstakne repopulaciju površina, koje su bile zahvaćene parodontopatijom.

Postavljanje koštanih transplantata u infrakoštane parodontalne defekte može dovesti do boljih kliničkih rezultata, od onih koji se postižu klasičnom rezanj operacijom, ali globalno gledano, koštani transplantati ili koštani zamenici primarno se smatraju materijalima izbora, koji služe za punjenje koštanih defekata.

Do sada je utvrđeno da potpuna regeneracija parodoncijuma nije moguća, uprkos primeni poznatih terapijskih procedura. U praksi, zadovoljavamo se sprečavanjem daljeg napredovanja patološkog procesa. Dobrim terapijskim rezultatom može se smatrati postizanje manjeg ili većeg stepena regeneracije parodoncijuma i stvaranje zdravih uslova, koji mogu omogućiti dobru funkciju potpornog zubnog aparata u dužem vremenskom periodu.

### ***Izjava o sukobu interesa***

Autori izjavljuju da nema sukoba interesa.

It also promotes the regeneration of alveolar bone, periodontal ligament and cementum, as well as the parts of the supporting apparatus which are the most challenging for regeneration.

One of the first studies about this topic showed that the application of 0.15 mg/ml PDGF and 0.15 mg/ml IGF resulted in a significant improvement of the new bone-defect-filling, compared to the conventional surgical therapy<sup>33</sup>.

### ***Conclusion***

It could be concluded that there were evidences of periodontal ligament progenitor cells that served to restore the epithelial attachment loss. In the future, periodontal regenerative treatment with periodontal cells should encourage repopulation of the areas that have been affected by periodontal disease.

The placement of bone grafts in the infraosseous periodontal defects may lead to the better clinical outcomes for patients than classical flap surgery, but globally, bone grafts or bone substitutes were primarily considered as material choice for filling the bone defects.

So far, it has been noticed that complete periodontal regeneration has not been possible despite application of known therapeutic procedures. In practice, we are satisfied with the goal of preventing further progression of the pathological process. A successful therapeutic outcome can be considered as the achievement of therapeutic goals described like a greater or lesser percent of periodontal regeneration and the creation of health condition that can enable a good function of the supporting dental apparatus in a long period of time.

### ***Conflicts of Interest statement***

The authors declare no conflicts of interest.

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## SAVREMENI POGLED NA MEHANIZME EPITELIJALNE DIFERENCIJACIJE ORALNE MUKOZE U NORMALNIM I PATOLOŠKIM PROCESIMA

### MODERN VIEW ON MECHANISMS OF EPITHELIUM DIFFERENTIATION OF THE ORAL MUCOSA IN NORMAL AND PATHOLOGICAL PROCESSES

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#### Sažetak

**Uvod:** U svakodnevnoj kliničkoj praksi pacijenti koji traže stomatološku negu u slučaju oboljenja oralne sluzokože su jedna od najtežih kategorija pacijenata zbog komplikacija u dijagnostici i lečenju.

**Materijali i metode:** Pregled i analiza naučne i medicinske literature zasnovana na bazama podataka Scopus, Web of Science, MedLine, PubMed, NCBI, čija starost ne prelazi 5 godina, uključujući pregledne radove i rezultate kliničkih ispitivanja.

**Rezultati:** Promene na oralnoj sluznokoži mogu biti jako specifične. Kliničari mogu postaviti ispravnu dijagnozu i izgledom odrediti proceduru lečenja. Međutim, u većini slučajeva dijagnoza bolesti sa ovom anatomskom lokacijom je komplikovana, jer je klinička slika nespecifična i često su pridodati lokalni i opšti nepovoljni faktori. Za postavljanje tačne dijagnoze neophodan je detaljan klinički pregled i dodatne metode istraživanja. Dijagnoza bolesti oralne sluzokože zasniva se na pažljivoj proceni kliničkih i laboratorijskih podataka.

**Zaključak:** Uzimajući u obzir rasprostranjenost oboljenja oralne sluzokože, posebno je interesantno pitanje toka procesa diferencijacije epitela različitih anatomskih zona i mehanizama restrukturiranja ćelijskog sastava u patološkim procesima, koji objektivizuju dijagnozu, predviđaju tok bolesti i patogenetski potkrepljeni tretman.

**Ključne reči:** usna duplja, epitelne ćelije, upalni proces, parodontalna tkiva

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#### Abstract

**Background:** In everyday clinical practice, patients who seek dental care in case of oral mucosa diseases are one of the most difficult categories of patients due to difficulties in diagnosis and treatment.

**Materials and methods:** The review and analysis of scientific and medical literature based on the Scopus, Web of Science, MedLine, PubMed, NCBI databases, the study of which does not exceed 5 years, including literature reviews and the results of clinical trials.

**Results:** Changes in the oral mucosa can be clearly specific. Clinicians can make the correct diagnosis and determine the tactics of treatment by appearance. However, in most cases the diagnosis of diseases with this anatomical location is complicated, because the clinical picture is nonspecific and often burdened with additional local and general adverse factors. A detailed clinical examination and additional research methods are required to establish the correct diagnosis. Diagnosis of oral mucosa diseases is based on a careful assessment of clinical and laboratory data.

**Conclusions:** Taking into account the prevalence of diseases of the oral mucosa, of particular interest is the question of the course of the process of differentiation of the epithelium of various anatomical zones in the norm and the mechanisms of restructuring of the cellular composition in pathological processes, with the aim of objectifying the diagnosis, predicting the course of the disease and pathogenetically substantiated treatment.

**Key words:** oral cavity, epithelial cells, inflammatory process, periodontal tissues

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## Uvod

Epitel pokriva 80% površine oralne sluzokože, čija je površina, kod odrasle osobe, oko 172 cm<sup>2</sup>. Strukturu epitela karakteriše jasna pripadnost jednoj regiji. Prema morfo-funkcionalnim karakteristikama, istraživači razlikuju sledeće tipove oralne sluzokože: mastikatornu, pokrovnu i specijalizovanu<sup>1</sup>.

Mastikatorna mukoza, koja se nalazi na tvrdom nepcu i desnama, uglavnom je uključena u mehaničku obradu hrane. Sastoji se od pločasto-slojevitog nekeratinizovanog epitela, bazalne membrane i submukozne baze, pokretne i elastične. Sluzokoža specijalizovanog tipa pokriva dorzalnu površinu jezika, prekrivenu pločasto-slojevitim nekeratinizovanim i, na nekim mestima, keratinizovanim epitelom i bazalnom membranom, koju karakteriše prisustvo papila i specijalizovanih kvržica čula ukusa, koja je pričvršćena za mišićno tkivo, umereno pokretna i otporna na mehanički pritisak<sup>2,3</sup>.

**Cilj rada** bila je analiza literaturnih podataka, koji se bave proučavanjem savremenih pogleda na problem imunološkog statusa oralne sluzokože.

## Materijali i metode

Pregled i analiza naučne i medicinske literature na osnovu baza podataka Scopus, Web of Science, MedLine, PubMed, NCBI, čija starost prelazi 5 godina, uključujući pregledne radove i rezultate kliničkih ispitivanja.

## Rezultati i diskusija

Barijerna svojstva epitela oralne sluzokože pojačana su ćelijskom proizvodnjom brojnih peptida - katjonskim proteinima, kalprotektinom, b-efensinom i lingvalnim antimikrobnim peptidom, sa širokim spektrom antimikrobne aktivnosti<sup>4,5</sup>. Održavanje integriteta epitela i svojstava barijere obezbeđeno je kombinacijom tri međusobno uravnotežena procesa sa sinhronim tokom. To su: regeneracija: kontinuirano stvaranje ćelija u bazalnom sloju, usled podele slabo diferenciranih prekursora; diferencijacija - promena morfo-funkcionalnih karakteristika ćelija istovremeno sa njihovim pomeranjem u gornjim slojevima; deskvamacija - uklanjanje oštećenih ćelija (deskvamirane ljuske) sa površine epitela, koje na svojoj površini sadrže mikroorganizme.

## Introduction

The epithelium covers 80% of the oral mucosa surface, the area of which in an adult is about 172 cm<sup>2</sup>. The structure of the epithelium is characterized by a clear regionality. According to morphofunctional features, researchers distinguish the following types of mucosa: masticatory, lining and specialized<sup>1</sup>.

The masticatory mucosa, located on the hard palate and gums, is involved mainly in the mechanical processing of food. It is represented by a stratified squamous keratinized epithelium and basement membrane, which is closely attached to the bone, less mobile, has high strength and low permeability. The lining mucosa covers the cheeks, lips, the floor of the mouth, the oral surface of the soft palate and the ventral surface of the tongue. It is represented by a stratified squamous non-keratinized epithelium, basement membrane and submucosal base, mobile and elastic. The mucous membrane of the specialized type covers the dorsal surface of the tongue, covered with stratified non-keratinized and in some areas - keratinized epithelium and basement membrane, characterized by the presence of special papillae and taste buds, adjacent to muscle tissue, moderately mobile and resistant to mechanical pressure<sup>2,3</sup>.

**The aim.** Analysis of literary sources with the study of modern views on the problem of the immune status of the oral mucosa.

## Materials and methods

The review and analysis of scientific and medical literature based on the Scopus, Web of Science, MedLine, PubMed, NCBI databases, the study of which does not exceed 5 years, including literature reviews and the results of clinical trials<sup>4</sup>.

## Results and discussion

The barrier properties of the oral mucosa epithelium are enhanced by its cells production of a number of peptides - cationic proteins, calprotectin, b-efensin and lingual antimicrobial peptide with a wide range of antimicrobial activity<sup>5,6</sup>. Maintaining the integrity of epithelium and barrier properties is provided by the combination of three mutually balanced processes with a synchronous course.

Ćelijski sastav skvamoznog pločasto-slojevitog epitela usne duplje je stereotipno epitelno tkivo i sadrži sve tipične elemente – bazalni, parabazalni (srednji) i orožao (površinski) sloj. Dakle, reč je o postepenoj diferencijaciji epitelocita u epitelnom sloju, usled čega nastaju orožale skvame, koje se potom deskvamiraju<sup>6</sup>.

Proteinski enzimi sadržani u citoplazmi bazalnih ćelija okruženi su vodenim medijumom, dok su u zrnastim epitelocitima uronjeni u hidrofobnu supstancu – keratohialin. Prema nekim istraživačima<sup>7</sup>, takav medijum inicira intramolekularno preuređivanje polipeptidnih lanaca filamenata.

Procesi keratinizacije pločasto-slojevitog epitela odvijaju se kroz sledeće faze: 1) formiranje tonofibrila; 2) formiranje tonofilamentnih elemenata; 3) stvaranje tonofibrilarno-keratohialinskih kompleksa; 4) formiranje orožalih skvama i njihova deskvacacija<sup>8</sup>.

Prva faza keratinizacije javlja se u bazalnom i parabazalnom sloju. U citoplazmi epitelocita ovih slojeva nastaju tonofibrili prečnika 3 nm – 5 nm, koji su strukturno povezani sa ribozomima. Kontakt bazalnih epitelocita sa membranom obezbeđen je poludezmomalnim kontaktima; ćelije bazalnog i parabazalnog sloja povezane su pojedinačnim dezmozomima.

U drugoj fazi keratinizacije, u citoplazmi ćelija spinoznog sloja nastaju snopovi tonofibrila-tonofilamenata prečnika 7 nm – 8 nm. Poslednji formira dve konture u citoplazmi: jednu direktno oko jedra, a drugu na njenoj periferiji u blizini dezmozoma. Ova ultrastrukturalna distribucija tonofilamentnih struktura u spinoznim ćelijama omogućava funkciju amortizacije<sup>9</sup>. Ćelije spinoznog sloja u kontaktu su jedna sa drugom kroz brojne dezmozome.

U trećoj fazi keratinizacije, u citoplazmi zrnastih epitelocita, nastaju keratinozomi ili Odlanderove granule, prečnika 100 nm – 400 nm. Keratinozomi su okruženi membranom i sadrže lamele sa keratohialinskim masama. Prema Bikovu<sup>1</sup>, oni su poseban oblik lizozoma. Mase keratohialina, koje se oslobađaju keratinozom, zajedno sa snopovima tonofibrila, formiraju složene komplekse kerato-tonofilamenta. Tako je sinteza keratohialina u ćelijama zrnastog sloja praćena uništavanjem njihovog tonofibrilarnog matriksa.

U četvrtoj fazi keratinizacije formiraju se rožaste skvame, koje se naknadno deskvamiraju. Tako se ostvaruje zaštitna funkcija pločasto-slojevitog epitela. U stratum corneumu, na ultrastrukturnom nivou, postoje skvame sa paralelnom orijentacijom tonofibrilarnih struktura (A tip) i sa njihovim

These are: regeneration – the continuous formation of cells in the basal layer due to the division of poorly differentiated precursors; differentiation – change of morphofunctional characteristics of cells simultaneously with their displacement in the upper layers; desquamation – removal of damaged cells (desquamated scales) from the epithelium surface which contain microorganisms on its surface.

The cellular composition of the stratified squamous oral mucosa epithelium is stereotyped epithelial tissue and contains all the typical elements – basal, parabasal (intermediate) and corneal (superficial). Thus, it is a gradual differentiation of epitheliocytes in epithelial layer, as a result of which horny scales are formed and subsequently desquamated<sup>7</sup>.

Protein enzymes contained in the cytoplasm of basal cells are surrounded by an aqueous medium, while in granular epitheliocytes they are immersed in a hydrophobic substance – keratohyalin. According to some researchers<sup>8</sup>, such a medium initiates the intramolecular rearrangement of filaments polypeptide chains.

Keratinization processes in the stratified squamous epithelium occur in stages: 1) the formation of tonofibrils; 2) formation of tonofilament elements; 3) formation of tonofibrillary-keratohyalin complexes; 4) the formation of horny scales and their desquamation<sup>9</sup>.

The first stage of keratinization occurs in the basal and parabasal layers. In the cytoplasm of epitheliocytes of these layers, tonofibrils with a diameter of 3–5 nm are formed, which are structurally connected with ribosomes. Contact of basal epitheliocytes with the membrane is provided by semi-desmosomal contacts, cells of basal and parabasal layers are connected by single desmosomes.

At the second stage of keratinization, bundles of tonofibrils – tonofilaments with a diameter of 7–8 nm are formed in the cytoplasm of the thorny layer cells. The last forms two contours in the cytoplasm: one directly around the nucleus, and the other on its periphery near the desmosomes. This ultrastructural distribution of tonofilament structures in thorny cells provides an amortization function<sup>10</sup>. The cells of the thorny layer are in contact with each other through numerous desmosomes. At the third stage of keratinization, keratinosomes or Odlander granules with a diameter of 100–400 nm are formed in the cytoplasm of granular epitheliocytes. Keratinosomes are surrounded by a membrane and contain lamellae with keratogialin masses. According to V.L.

okomitim ili tangencijalnim rasporedom (B tip). Međutim, u nekim rožnatim skvama, piknotična jezgra, pa čak i pojedinačne mitohondrije, delimično su očuvane. Takve ljuske nazivaju se T-ćelije, a njihovo prisustvo ukazuje na nepotpun proces ortokeratoze<sup>10,11</sup>.

Studija Bryja<sup>12</sup> pokazuje da procese keratinizacije, koji se javljaju u pločasto-slojevitom epitelu oralne sluzokože, karakterišu brojne osobine, koje su povezane sa funkcijom anatomskeg područja.

Ovo potvrđuje studija Choija<sup>13</sup> i ukazuje na to da je težina stratum corneuma, koju formiraju skvame, različita. U stratum corneumu gingive nalazi se veliki broj skvama, dok na obraznoj sluzokoži nisu tako izražene. Istovremeno, primećuje se umeren razvoj tonofilamentnih struktura u citoplazmi ćelija spinoznog sloja. Takve karakteristike višeslojne keratinizacije epitela obrazne sluzokože ukazuju na procese nepotpune keratinizacije u njemu.

Regulaciju procesa diferencijacije i proliferacije, kao i homeostaze epitelocita obezbeđuju ćelije intraepitelnog sistema makrofaga; naime to su Langerhansove ćelije i dendritične ćelije.

Eksperimentalno je dokazan funkcionalni odnos između Langerhansovih ćelija i keratinocita. Pored toga, izneta je teorija<sup>14</sup> o epidermalnoj proliferativnoj jedinici. Prema njoj, Langerhansova ćelija je centar diferona ili zasebna epidermalna proliferativna jedinica. Uz pomoć citoplazmatskih procesa, one dolaze u kontakt sa epitelocitima bazalnog i parabazalnog sloja unutar svog diferona, izazivajući njihov vertikalni anizomorfizam i regulišući procese proliferacije i specijalizacije. Zbog sinteze supstanci sličnih cejlonu, Langerhansove ćelije inhibiraju proliferativnu aktivnost bazalnih epitelocita. Svaki diferon ili svaka epidermalna proliferativna jedinica uključuje oko 20 ćelija, od kojih se polovina nalazi na nivou bazalnog i parabazalnog sloja. Diferon ima oblik vertikalnog stuba, čiji se gornji deo sastoji od rožnatih ljuski, a donji se oslanja na bazalnu membranu. Rožnate ljuske formiraju površinski sloj diferona. U ovom slučaju, tri skale tipa A povezuju se sa tri skale tipa B i zajedno sa T-ćelijama, na površini epitela, formiraju heksagonalne konture svake proliferativne jedinice.

Langerhansove ćelije pripadaju sistemu intraepitelnih makrofaga. Specifičnosti njihove ultrastrukturne organizacije, razvijeni citoplazmatski kompleksi, kao i prisustvo posebnih granula i lizozoma u citoplazmi, ukazuju na visoku funkcionalnu aktivnost ovih ćelija.

Bykov<sup>1</sup>, they are a special form of lysosomes.

Keratogialin masses, which are released with keratinosis, together with bundles of tonofibrils form complex kerato-tonofilament complexes. Thus, the synthesis of keratohyalin in the cells of the granular layer is accompanied by the destruction of their tonofibrillary matrix.

In the fourth stage of keratinization, horny scales are formed, which are subsequently desquamated. Thus the protective function of a stratified squamous epithelium is realized. In the stratum corneum at the ultrastructural level there are scales with parallel orientation of tonofibrillar structures (A-type) and with their perpendicular or tangential arrangement (B-type). However, in some horny scales pyknotic nuclei and even single mitochondria are partially preserved. Such scales are called T-cells, their presence indicates an incomplete process of orthokeratosis<sup>11</sup>.

The work of A. Bryja<sup>12</sup> shows that the keratinization processes that occur in the stratified squamous epithelium of the oral mucosa are characterized by a number of regional features that are associated with the function of the anatomical area.

This position is confirmed by the work of J. Choi<sup>13</sup> and indicates that the severity of the stratum corneum, which is formed by scales, is different. In the stratum corneum of the gums is determined by a large number of scales, while a similar layer of cheeks is almost not expressed. At the same time moderate development of tonofilament structures in a cytoplasm of cells of a prickly layer is observed. Such features of multilayered squamous epithelium keratinization of cheek indicate the processes of incomplete keratinization in it.

Regulation of differentiation and proliferation processes, as well as epitheliocyte homeostasis are provided by cells of the intraepithelial macrophage system, namely Langerhans cells and dendritic cells.

The functional relationship of Langerhans cells with keratinocytes has been experimentally proven. In addition, a theory<sup>14</sup> of the epidermal proliferative unit has been put forward. According to it, the Langerhans cell is the center of diferon, or a separate epidermal proliferative unit. With the help of cytoplasmic processes, they contact the epitheliocytes of the basal and parabasal layers within their diferon, causing their vertical anisomorphism and regulating the processes of proliferation and specialization. Due to the synthesis of keylon-like substances, Langerhans cells inhibit the proliferative activity of basal epitheliocytes.

Nedavna istraživanja<sup>15,16</sup> pokazala su to da su metabolički procesi u epitelnim tkivima oralne sluzokože hormonski zavisni. Receptori za brojne hormone, uključujući estradiol, koji se uglavnom nalazi u ćelijskim jezgrima parabazalnog i bazalnog sloja, otkriveni su u epitelocitima gingivalne mukoze.

U slučaju hormonskog prilagođavanja tokom menstrualnog ciklusa, razvijaju se morfo-funkcionalne promene u epitelu oralne sluzokože.

Razvoj ovih dinamičkih procesa može inicirati pojavu parodontopatije, u slučaju hormonske neravnoteže. Najčešće su ovi oblici atipični i agresivni<sup>17</sup>.

Bae<sup>18</sup> prikazuje to da se tok procesa diferencijacije sluzokože usne duplje i usta odražava na biološku starost pojedinca – stepen starosnih promena bioloških sposobnosti organizma u svakoj fazi ontogeneze. U pozadini preranog starenja tela, stanje njegovih organa i sistema, kao i rizici od pojave i toka parodontalnog tkiva i bolesti sluzokože usne duplje značajno se razlikuju od onih kod fiziološkog starenja; prognoza se pogoršava, vreme oporavka kasni, uobičajeni načini lečenja su neefikasni, što dovodi do smanjenja kvaliteta života<sup>19</sup>.

Prema statističkim podacima, procenat patoloških procesa na oralnoj sluzokoži kod poseta terapeutu varira od 0,5% do 0,9% svih primarnih poseta, u zavisnosti od starosti pacijenata.

Međutim, u svakodnevnoj kliničkoj praksi, pacijenti sa bolestima oralne sluzokože, koji zahtevaju stomatološku negu, jedan su od najtežih izazova u stomatološkoj praksi, zbog poteškoća u dijagnostici i lečenju. Zato je potraga za citološkim markerima, indikatorima stanja pojedinačne oralne sluzokože perspektiva, ne samo za poboljšanje kvaliteta dijagnoze i terapije zuba, već i za utvrđivanje opšteg stanja zdravlja pacijenata. Klinički je dokazano to da je sluzokoža najtačniji pokazatelj procene patoloških procesa u digestivnom traktu, imunološkog stanja organizma, opšteg nivoa aktivnosti i proliferacije ćelijskih sistema<sup>20-22</sup>.

U mladosti, bolesti sluzokože usne duplje razvijaju se zbog smanjene salivacije i lokalne otpornosti tkiva, poremećaja procesa diferencijacije i keratinizacije u epitelnim ćelijama, kao i usled promene u mikrobiocenozi sluzokože.

U vezi sa prethodno navedenim, tokom lečenja bolesti oralne sluzokože, jako je važno uključiti skup dijagnostičkih i profilaktičkih mera, koje karakteriše minimalna invazivnost i dostupnost na prijemu, koje bi ubrzale obnavljanje sluzokože i mikrocirkulaciju<sup>23</sup>,

Each diferon, or epidermal proliferative unit, includes about 20 cells, half of which are located at the level of the basal and parabasal layers. Diferon has the shape of a vertical column, the upper part of which consists of horny scales, and the lower rests on the basement membrane. Horny scales form the surface layer of diferon. In this case, three A-type scales connect with three B-type scales and together with T-cells on the surface of the epithelium form the hexagonal contours of the proliferative unit.

Langerhans cells belong to the system of intraepithelial macrophages. The peculiarities of their ultrastructural organization, namely the developed cyto-plasmic complexes, as well as the presence of specific granules and lysosomes in the cytoplasm, indicate high functional activity of these cells.

Recent studies<sup>15,16</sup> have shown that metabolic processes in the epithelial tissues of the oral mucosa are hormone-dependent. Receptors to a number of hormones, including estradiol, which are mainly found in the cell nuclei of the parabasal and basal layers, have been detected in the epitheliocytes of the gingival mucosa.

In the case of hormonal adjustment during the menstrual cycle, morphofunctional changes develop in the epithelium of the oral mucosa.

The development of these dynamic states can initiate the occurrence of periodontal disease in the case of hormonal imbalance. Most commonly these forms are atypical and aggressive<sup>17</sup>.

The work of C.-Y. Bae<sup>18</sup>, show that the course of the differentiation process of the mucous membrane of the oral cavity and mouth reflects the biological age of the individual – the degree of age-related changes in the biological capabilities of the organism at each stage of ontogenesis. At the background of premature body aging, the condition of its organs and systems, as well as risks of occurrence and course of periodontal tissues and oral mucosa diseases are significantly different from those of physiological aging, the prognosis deteriorates, recovery time is delayed, common treatment regimens are ineffective, resulting in reduced quality of life<sup>19</sup>.

According to statistics, the percentage of pathological processes of the oral mucosa in the structure of visits to the therapeutic department varies from 0.5 to 0.9% of all primary visits depending on age.

However, in everyday clinical practice, patients who seek dental care with diseases of the oral mucosa are one of the most difficult problems in dentistry due to difficulties in diagnosis and treatment.

imajući u vidu istovremeno minimalne nuspojave u organizmu, u celini, i pružajući mogućnost dinamičkog praćenja istih.

Poslednjih godina, zahvaljujući praktičnoj implementaciji programa prevencije stomatoloških oboljenja<sup>24</sup>, postoji tendencija njihovog smanjenja među decom, što otvara perspektivu poboljšanja zdravlja zuba u ovoj starosnoj grupi. Međutim, program prevencije, zapravo, ne odnosi se na odraslu generaciju i u bliskoj budućnosti nema razloga očekivati smanjenje incidencije među pacijentima starosti od 25 do 35 godina, kao i među još starijim pacijentima. Staviše, zbog starenja stanovništva, među starima se očekuju posebni i najteži problemi stomatološke zaštite.

U lekarskoj praksi, pokazalo se<sup>25,26</sup> da promene u oralnoj sluzokoži mogu imati specifičan karakter, kada se samo na osnovu izgleda mogu dijagnostikovati i može se odrediti taktika lečenja. Međutim, u većini slučajeva, dijagnoza bolesti koje se javljaju na sluzokoži je komplikovana, jer je klinička slika nespecifična i često sa udruženim nepovoljnim lokalnim (loša higijena, trauma, sekundarna infekcija) i opštim (hipovitaminoza, somatska patologija) faktorima. Za postavljanje tačne dijagnoze, neophodan je detaljan klinički pregled i potrebne su dodatne metode istraživanja.

Dijagnostika većine oboljenja oralne sluzokože zasniva se na pažljivoj proceni kliničkih i laboratorijskih podataka. Efikasnost lečenja zavisi od tačne dijagnoze. Epitel oralne sluzokože tradicionalni je predmet citoloških studija, koji omogućava otkrivanje razvoja prekanceroznih i tumorskih procesa, poremećaja ćelijske diferencijacije i infektivnih lezija. Ovo ukazuje na to da citološka analiza zahvaćenih područja oralne sluzokože daje dragocene informacije o morfo-funkcionalnom stanju sluzokože u različitim lezijama<sup>27</sup>.

Takve citološke metode istraživanja, kao što su printovi i ponovni printovi, prilično su pouzdane i imaju nekoliko prednosti u odnosu na biopsiju. One su minimalno invazivne, olakšavaju pribavljanje materijala, omogućuju postavljanje preliminarne dijagnoze procesa za 20 do 30 minuta, mogu se ponovo koristiti za praćenje dinamike procesa i procenu efikasnosti lečenja<sup>25</sup>.

Tok diferencijacije epitela oralne sluzokože procenjuje se njenim citološkim pregledom. Prema citološkoj klasifikaciji, u epitelu oralne sluzokože nalaze se bazalne, parabazalne, srednje i površinske ćelije, a rožaste skvame nađene su u područjima koja su podvrgnuta keratinizaciji. U ćelijskom sastavu epitela sluzokože preovlađuju intermedijarne ćelije.

That is why the search for cytological markers-indicators of the individual oral mucosa state is perspective not only to improve the quality of diagnosis and correction of dental status, but also to determine the general health of patients. It is clinically proven that the mucous membrane is the most accurate indicator of the pathological processes assessment of the digestive tract, the immune status of the organism, the general level of activity and proliferation of cellular systems<sup>20-22</sup>.

At young age, diseases of the oral mucosa develop at the background of reduced salivation and local tissue resistance, violation of the differentiation and keratinization processes in epithelial cells, as well as changes in the microbiocenosis of the mucous membrane.

In connection with the foregoing, during the treatment of oral mucosa diseases it becomes important to include in a set of diagnostic and prophylactic measures, which are characterized by minimally invasiveness and availability at the dental reception and would accelerate the renovation of the mucous barrier and microcirculation<sup>23</sup> having at the same time the minimum side effect on an organism as a whole and providing the possibility of dynamic monitoring.

In recent years, thanks to the practical implementation of a dental disease prevention program<sup>24</sup>, there has been a tendency to reduce them among children, which opens the perspective of improving dental health in this age group. However, the prevention program does not actually cover the adult generation and in the near future there is no reason to expect a decrease in the incidence among patients aged 25-35 years and older. Moreover, due to the trend of aging population, special and the most difficult problems of dental care are expected among the elderly.

The clinician's work shows<sup>25,26</sup> that changes in the oral mucosa can have clearly specific character, when the treatment tactics can be diagnosed and determined just by the appearance. However, in most cases, the diagnostics of diseases that occur on the mucosa is complicated because the clinical picture is nonspecific and often burdened by additional adverse local (poor hygiene, trauma, secondary infection) and general (hypovitaminosis, somatic pathology) factors. A detailed clinical examination and additional research methods are required to establish a correct diagnosis.

Izgled površinskih ćelija odgovara maksimalnom nivou sazrevanja nekernizovanog epitela, a izgled rožastih skvama odgovara keratinizovanom epitelu. Sadržaj poslednjeg sloja epitela naglo se uvećava u slučaju hiperkeratoze. Poslednjih godina, razvijene su metode za procenu parametara, koji se odnose na epitelocite oralne sluzokože, korišćenjem sistema za automatsku analizu slike<sup>29</sup>.

Promena prirode epitelne diferencijacije, koja je karakteristična za određeno područje oralne sluzokože, ukazuje na lokalne ili sistemske poremećaje. Prisustvo ćelijske atipije sa velikom verovatnoćom ukazuje na razvoj prekanceroznih i tumorskih promena oralne sluzokože i u 96% slučajeva omogućava pouzdano dijagnostikovanje ovih bolesti citološkim metodama. Promene u diferencijaciji epitela oralne sluzokože mogu takođe biti rezultat metaboličkih i hormonskih poremećaja, dejstva mehaničkih faktora i hemijskih supstanci<sup>30,31</sup>.

Kod inflamatornih procesa, različite geneze u printovima sa sluzokože usne duplje, otkrivaju se manje diferencirane ćelije, sve do bazalne ćelije (I faza). U hiperkeratozi, naprotiv, ima više ćelija VI stadijuma<sup>32</sup>.

U slučaju lichen planusa, citološki metod pregleda, po pravilu, otkriva veliki broj limfocita u zahvaćenom području, od kojih su mnogi aktivirani makrofagi, dok su plazma ćelije ređe.

Analizirajući literaturne podatke, vidimo da se citološka slika ćelijskih elemenata u patološkim procesima oralne sluzokože karakteriše određenim osobinama. Citogrami iz fokusa lezije, koji odražavaju dinamiku promena oralne sluzokože tokom njene epitelizacije, takođe su jedan od objektivnih testova za procenu opšteg stanja organizma<sup>30</sup>.

Prilično često, radovi različitih autora predstavljaju kvantitativne podatke o korelaciji tipova ćelija u citološkim preparatima oralne sluzokože. Do ovakvih odstupanja došlo je čak i u slučajevima u kojima su autori koristili istu klasifikaciju epitelnih ćelija i proučavali slična područja oralne sluzokože. Glavni razlozi za takve razlike su različite metode fiksacije brisa i subjektivne procene citograma, kao i polne i starosne razlike, koje prethodnici nisu uzeli u obzir.

U tu svrhu, predloženi su različiti indeksi: nuklearno-piknotički (procenat ćelija sa piknotičnim jedrom), keratinizacija (procenat nenuklearnih ćelija) i eozinofilni (procenat ćelija sa eozinofilno-oksifilnom citoplazmom među površinskim ćelijama).

Diagnostics of most oral mucosa diseases is based on a careful assessment of clinical and laboratory data. The effectiveness of treatment depends on the correct diagnosis. The epithelium of the oral mucosa is a traditional object of cytological studies, which allows to reveal the development of precancerous and tumor processes, disorders of cell differentiation, infectious lesions. This indicates that the cytological analysis of imprints from the affected areas of the oral mucosa provides valuable information about the morphofunctional state of the mucosa in various lesions<sup>27</sup>.

Such cytological research methods as prints and re-prints are quite reliable and have several advantages over biopsy. They are minimally invasive, make it easy to obtain material, make it possible to establish a preliminary diagnosis of the process in 20-30 minutes, can be reused to monitor the dynamics of the process and evaluate the effectiveness of treatment<sup>25</sup>.

The course of differentiation of the oral mucosa epithelium is assessed by its cytological examination. According to the cytological classification, basal, parabasal, intermediate and superficial cells are selected in the oral mucosa epithelium, and horny scales in the areas that undergo keratinization. In the cellular composition of the mucosal epithelium, intermediate cells predominate. The appearance of surface cells corresponds to the maximum level of non-keratinized epithelium maturation, and the appearance of horny scales corresponds to the keratinized epithelium. The content of the last increases sharply in a case of hyperkeratosis. In recent years, methods to estimate the parameters of oral mucosa epitheliocytes using automatic image analysis systems have been developed<sup>29</sup>.

A change in the nature of epithelial differentiation, which is normally characteristic of a certain area of the oral mucosa, indicates local or systemic disorders. The presence of cellular atypia sign with a high probability indicates the development of precancerous and tumor changes of the oral mucosa and in 96% of cases allows reliably diagnose these diseases by cytological methods. Changes in the differentiation of the oral mucosa epithelium may also be the result of metabolic and hormonal disorders, the action of mechanical factors and chemical substances<sup>30,31</sup>. At inflammatory processes of various genesis in imprints from a mucous membrane of an oral cavity less differentiated cells, up to basal (I stage) are revealed. In hyperkeratosis, on the contrary, there are more cells of VI stage<sup>32</sup>.

Zbog praktične primene i dobijanja najpotpunijih i najobjektivnijih citoloških karakteristika printova oralne sluzokože, preporučuje se korišćenje indeksa ćelijske diferencijacije, koji uzima u obzir ćelije u različitim fazama diferencijacije i citomorfometrijska metoda, koja se zasniva na naprebojavanju epitelnih ćelija različitih vrsta na citogramu. Citopatologija pokazuje: povećanu citoplazmatsku bazofiliju, distrofične i nekrobiotičke promene, "phaging". Na osnovu relativnih nekrobiotičkih indikatora broja izmenjenih ćelija, autori su predložili dva indeksa: indeks uništenja, koji odražava aktivnost procesa i upalno-destruktivni indeks, koji je u korelaciji sa intenzitetom i prirodom zapaljenjskog procesa.

Poslednjih godina, brojne studije<sup>5,7,28,29,34</sup> pokazale su to da u etiologiji i patogenezi niza patoloških procesa oralne sluzokože značajnu ulogu ima mikrobiološki uticaj, posebno predstavnici saprofitnih i oportunističkih mikroflora. Najučestalije bolesti zuba nemaju specifičan etiološki patogen i razvijaju se kao posledica oportunističke proliferacije mikroflora u uslovima naglog smanjenja prirodnih zaštitnih faktora i adaptivnih reakcija organizma.

Naše kliničke studije pokazale su to<sup>6,8,34,35</sup> da je u današnje vreme značajan problem pravovremena dijagnostika dermatoza sa autoimunom komponentom, poput lichen planusa i akantolitičkog pemfigusa. Teškoće prilikom postavljanja dijagnoze nastaju zbog nedostatka jasnih kvantitativnih podataka o procentualnoj korelaciji epitelnih ćelija jedne regije, uzimajući u obzir starost i pol pacijenata, kao i stabilne citološke parametre ovih bolesti u pretkliničkoj fazi. Izolovana lezija oralne sluzokože čini 30% do 35% ukupnog broja slučajeva. Erozivno-ulcerativni i hiperkeratotični oblici lichen planusa su opcionalne prekancerozne lezije sa verovatnoćom transformacije u tumor od 7%.

In the case of lichen planus, the cytological method of examination, as a rule, reveals a large number of lymphocytes in the affected area, many activated macrophages, plasma cells are less common.

Analyzing the literature data, we see that the cytological picture of cellular elements in pathological processes of the oral mucosa is characterized by certain features. Cytochrome from the focus of the lesion, reflecting the dynamics of changes in the oral mucosa during its epithelialization, is also one of the objective tests to assess the general condition of the organism<sup>30</sup>.

Quite often works of various authors present quantitative data concerning the correlation of cell types in cytological preparations of the oral mucosa differ significantly. Such discrepancies occurred even in cases where the authors used the same classification of epithelial cells and studied similar areas of the oral mucosa. The main reasons for such differences are various methods of smears fixation and subjective assessment of cytochrome, as well as gender and age differences, not taken into account by predecessors.

According to numerous studies, to increase the reliability and comparability of cytological studies results should refer to quantitative estimates, values that can be measured and expressed through quantitative indicators and, of course, in the dynamics of treatment.

With this purpose, have proposed various indices: nuclear-pyknotic (percentage of cells with pyknotic nucleus), keratinization (percentage of non-nuclear cells), eosinophilic (percentage of cells with eosinophilic-oxyphilic cytoplasm among superficial cells).

For the convenience of practical application and obtaining the most complete and objective cytological characteristics of the imprints of the oral mucosa, it is advisable to use the cell differentiation index, which takes into account the ratio of cells at different stages of differentiation, and a cytomorphometric method has been developed, which is based on counting the number of epithelial cells with signs of various types in the cytochrome. cytopathology: increased cytoplasmic basophilia, dystrophic and necrobiotic changes, «phaging». Based on the relative necrobiotic indicators of the number of altered cells, the authors proposed two indices: the destruction index, which reflects the activity of processes, and the inflammatory-destructive index, which correlates with the intensity and nature of the inflammatory process.

In recent years numerous studies<sup>5,6,8,25,26,30</sup> have shown that in the etiology and



## **Zaključak**

Analitički pregled literature pokazuje to da su mehanizmi poremećaja oralne epitelne homeostaze usko povezani sa procesima regeneracije, diferencijacije i deskvamacije i imaju vodeću ulogu u patogenezi oboljenja oralne sluzokože. Poslednjih godina, bilo je mnogo dijagnostičkih kriterijuma za primarne i sekundarne lezije oralne sluzokože, proučavana je mogućnost njihove kliničke primene, ali je efikasnost lečenja bolesti oralne sluznice još uvek nedovoljna. Postoji samo nekoliko studija o proceni procentualne korelacije epitelocita, ali one ne uzimaju u obzir starost i pol pacijenata. Tako je proučavanje procesa diferencijacije oralne sluzokože, uz dubinsku analizu citoloških karakteristika različitih anatomskih područja i morfoloških i citospecifičnih promena kod prisustva inflamatornog procesa u parodontalnim tkivima, relevantno i perspektivno područje istraživanja.

pathogenesis of a number of pathological processes of the oral mucosa a significant role belongs to the microbial factor, in particular representatives of saprophytic and opportunistic microflora. Most dental diseases don't have a specific pathogen and develop as a consequence of the opportunistic microflora proliferation in the conditions of sharp decrease in natural factors of protective and adaptive reactions of organism.

My/Our own clinical studies have shown<sup>6,8,34,35</sup> that a significant problem today is the timely diagnostics of dermatoses with an autoimmune component, such as lichen planus and acantholytic pemphigus. The difficulty of the diagnostic process is due to the lack of clear quantitative data about the regional percentage correlation of epithelial cells, taking into account the age and sex of patients, as well as stable cytological guidelines of these diseases in the preclinical stage. The isolated lesion of the oral mucosa is 30-35% of the total number of cases. Erosive-ulcerative and hyperkeratotic forms of lichen planus are optional precancerous lesions with a probability of tumor transformation of 7%.

## **Conclusion**

Analytical review of the literature shows that the mechanisms of disturbance of oral epithelial homeostasis are closely related to the processes of regeneration, differentiation and desquamation and play a leading role in the pathogenesis of oral mucosa diseases. In recent years, there have been many diagnostic criteria for primary and secondary lesions of the oral mucosa, the possibility of their clinical application has been studied, but the effectiveness of treatment of diseases of the oral mucosa is still insufficient. There are only a few studies on the assessment of the percentage correlation of epitheliocytes in norm, but they don't take into account age and gender. Thus, the study of the differentiation processes of the oral mucosa with the in-depth analysis of cytological features of different anatomical areas in the norm and morphological and cytospecific changes in the presence of an inflammatory process in periodontal tissues, is a relevant and perspective area of research.

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## ANTROPOMETRIJSKI PARAMETRI I ESTETIKA U IZRADI FIKSNIH STOMATOLOŠKIH NADOKNADA – 1. Deo

### ANTHROPOMETRIC PARAMETERS AND AESTHETICS IN THE MAKING OF FIXED PROSTHODONTIC RESTAURATIONS - Part 1

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#### Sažetak

**Uvod:** Savremene stomatološke procedure, a posebno one u stomatološkoj protetici, vraćaju funkcionalni kapacitet orofacijalnom sistemu i poboljšavaju izgled pacijenta. Savremeni koncept estetske stomatologije je što prirodniji izgled zuba, a uspeh terapije usko je povezan sa poštovanjem antropometrijskih parametara i korektnog odnosa tvrdih i mekih oralnih tkiva. Orofacijalne elemente ne treba posmatrati odvojeno od kompozicije lica jer sa njim čine neodvojivu celinu.

**Cilj rada** bio je analiza parametara orofacijalnog sistema koji utiču na estetiku fiksnih protetičkih nadoknada na osnovu literaturnih podataka i kliničkog iskustva.

**Zaključak:** Lepota osmeha određena je oblikom, bojom i proporcijama gornjih prednjih zuba. Na sklad u kreiranju osmeha bitno ne utiču pojedinačne numeričke vrednosti širine i dužine zuba, već njihov međusobni odnos. Lep osmeh podrazumeva konvergenciju dužinskih osa prednjih zuba u odnosu na središnju liniju zubnog luka, koja progredira od centralnog sekutića do očnjaka. Pored ovih kriterijuma treba uzeti u obzir i vidljivost sekutića, središnju liniju lica i zubnog luka, interdentalne tačke i kontakte, incizalne slobodne prostore kao i boju zuba kako bi se postigli maksimalni estetski efekti.

**Ključne reči:** antropometrijski parametri, estetika, protetika

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#### Abstract

**Introduction:** Modern dental procedures, especially those in prosthodontics, restore the functional capacity of the orofacial system and improve the patient's appearance. The modern concept of aesthetic dentistry is the most natural appearance of the teeth, and the success of the therapy is closely connected with the respect of anthropometric parameters and the correct ratio of hard and soft oral tissues. Orofacial elements should not be viewed separately from the composition of the face because they form an inseparable whole with it.

**The aim** of this study was to analyze the parameters of the orofacial system that affect the aesthetics of fixed prosthodontic restorations based on literature data and clinical experience.

**Conclusion:** The beauty of a smile is determined by the shape, color and proportions of the upper front teeth. The harmony in creating a smile is not significantly affected by individual numerical values of tooth width and length, but by their mutual relationship. A beautiful smile implies the convergence of the longitudinal axes of the front teeth in relation to the midline of the dental arch, which progresses from the central incisor to the canine. In addition to these criteria, the visibility of the incisors, the midline of the face and dental arch, interdental points and contacts, incisal free spaces as well as the color of the teeth should be taken into account in order to achieve maximum aesthetic effects.

**Keywords:** anthropometric parameters, aesthetics, prosthodontics

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za stomatologiju Niš. Sva prava zadržana.

## Uvod

Težnja da se nadoknadi gubitak zuba i povрати uloga narušenom orofacijalnom sistemu postoji oduvek. U svojim začetima, stomatologija je za cilj prevashodno imala vraćanje funkcionalnog i strukturnog integriteta tvrdog zubnog tkiva i, shodno tome, kao materijali za restauraciju, upotrebljavani su metali. Tehnološkim razvojem i sintezom novih estetskih materijala, restaurirani zubi vraćali su svoj prvobitni izgled, a stomatologija dobila novu, kozmetičku komponentu. Savremene stomatološke procedure, a posebno one u stomatološkoj protetici, vraćaju funkcionalni kapacitet orofacijalnom sistemu i poboljšavaju izgled pacijenta.

### *Značaj estetike u stomatologiji*

Gubitak zuba ili njihova destrukcija nedvosmisleno narušavaju izgled pacijenta. Sanacija i nadoknada izgubljenih zuba, remodelacija desni i blistav osmeh čine da se pacijent oseća zadovoljno i motivisano u prevazilaženju realnih i psihičkih prepreka u prihvatanju stomatološke nadoknade. Zanimljivo je to da će pacijent radije kompenzovati funkcionalne smetnje povezane sa loše izrađenim protetskim radom, nego prihvatiti nadoknadu koja mu se ne dopada<sup>1</sup>.

Mediji i moderni svet elektronskih komunikacija, a posebno društvene mreže, lepotu su od poželjne osobine pretvorile u socijalnu potrebu. Zatrpali velikim brojem „retuširanih“, često nerealnih, fotografija, koje su funkcijom bliže propagandnim obećanjima, stomatološki pacijenti postali su zahtevniji. Sa druge strane, ne sme se upasti u zamku generalizacije i kopirati „holivudski osmeh“, karakterističan po krupnim, uniformnim i neprirodno belim zubima. Savremeni koncept estetske stomatologije je što prirodniji izgled zuba, a uspeh terapije usko je povezan sa poštovanjem antropometrijskih parametara i korektnog odnosa tvrdih i mekih oralnih tkiva. Na taj način vraćamo se na stari paradoks naše, pre svega, kreativne struke – ulažemo maksimalne napore da stvorimo delo koje ne treba da se primeti.

Zadatak stomatologa je da povрати lep izgled destruiranih i oštećenih zuba, oblikuje osmeh i sve to uskladi sa fizionomijom lica. Usklađivanjem stomatoloških nadoknada sa preostalim zubima i njihov adekvatan odnos prema potpornom aparatu opravdava očekivanja pacijenata. Orofacijalne elemente ne treba posmatrati odvojeno od kompozicije lica, jer sa njim čine neodvojivu celinu<sup>1,2</sup>.

## Introduction

The desire to compensate for the tooth loss and restore the role of the damaged orofacial system has always existed. In its beginnings, dentistry primarily aimed at restoring the functional and structural integrity of hard dental tissue, and accordingly, metals were used as materials of choice for such restorations. With the technological development and synthesis of new aesthetic materials, the restored teeth returned to their original appearance, and dentistry received a new cosmetic component. Modern dental procedures, especially those in prosthodontics, restore the functional capacity of the orofacial system and improve the patient's appearance.

### *The importance of aesthetics in dentistry*

Tooth loss or destruction unequivocally impairs the patient's appearance. Rehabilitation and replacement of lost teeth, gum remodeling and a bright smile make the patient feel satisfied and motivated in overcoming real and psychological obstacles in accepting artificial dental compensations. Interestingly, the patient would rather compensate for functional disorders associated with poorly made prosthodontic restorations, than accept compensation that he does not like<sup>1</sup>.

The media and the modern world of electronic communications, and especially social networks, have turned beauty from a desirable feature into a social need. Overwhelmed by a large number of "retouched", often unrealistic, photographs, which are closer in function to propaganda promises, dental patients have become more demanding. On the other hand, we must not fall into the trap of generalization and copy the "Hollywood smile" characteristic of large, uniform and unnaturally white teeth. The modern concept of aesthetic dentistry is the most natural appearance of the teeth, and the success of the therapy is closely connected with the respect of anthropometric parameters and the correct ratio of hard and soft oral tissues. In this way, we return to the old paradox of our, above all, creative profession - we make every effort to create a work that should not be noticed.

The dentist's task is to restore the beautiful appearance of destroyed and damaged teeth, shape a smile and harmonize it all with the physiognomy of the face. By harmonizing the dental restorations with the Orofacijalne elemente should not be viewed separately from the composition of the face because they form an inseparable whole with it<sup>1,2</sup>.

## ***Estetika u stomatološkoj protetici***

Najbolji estetski rezultati nakon gubitka zuba postižu se fiksnim protetičkim radovima, zahvaljujući širokom spektru materijala odličnih mehaničkih i hemijskih svojstava, koji verno nadograđuju zubna tkiva, dajući im neophodnu tvrdoću i čvrstinu i skladan i prirodan izgled. Indikaciono polje fiksne protetike obuhvata pacijente sa nedostatkom zuba, destrukcijom zubnog tkiva, poremećajima u okluzo-artikulacionoj šemi, kao i one nezadovoljne bojom, oblikom i položajem zuba.

Izrada estetski prihvatljive fiksne protetičke nadoknade zahteva interdisciplinarni pristup različitih specijalističkih grana stomatologije. Iz tih razloga, parametri koji je determinišu moraju da budu jasno definisani, a odnose se na oblik, veličinu i boju veštačkih krunica i njihov odnos prema fizionomiji lica i obliku alveolarnih grebena. Poseban akcenat treba staviti na odnos fiksnih protetičkih radova i mekih oralnih tkiva, odnosno, prilagoditi ih ili preoblikovati te strukture u cilju dobijanja morfološkog i funkcionalnog sklada.

**Cilj** rada bila je analiza parametara orofacijalnog sistema, koji utiču na estetiku fiksnih protetičkih nadoknada, na osnovu literaturnih podataka i kliničkog iskustva. Upoznavanje osnovnih antropometrijskih smernica ima za svrhu bolju morfološku rekonstrukciju zubnog luka i poboljšanje estetskog učinka fiksnog protetičkog rada.

### ***Oblik i veličina zuba***

Lepota osmeha određena je oblikom, bojom i proporcijama gornjih prednjih zuba. Na sklad u kreiranju osmeha bitno ne utiču pojedinačne numeričke vrednosti širine i dužine zuba, već njihov međusobni odnos<sup>1,2</sup>. Taj odnos zavisi od rasne pripadnosti i pola pacijenta, a u Tabeli 1 prikazane su srednje vrednosti za belu rasu<sup>3</sup>.

## ***Aesthetics in prosthodontics***

The best aesthetic results after tooth loss are achieved with fixed prosthodontic restorations thanks to a wide range of materials with excellent mechanical and chemical properties, which faithfully mimic dental tissues, giving them the necessary hardness and strength and a harmonious and natural look. The indication field of fixed prosthodontics includes patients with missing teeth, destruction of tooth tissue, disorders in the occlusal-articulation scheme, as well as those dissatisfied with the color, shape and position of the teeth.

The development of an aesthetically acceptable fixed prosthodontic restoration requires an interdisciplinary approach of various specialist branches of dentistry. For these reasons, the parameters that determine it must be clearly defined, and they refer to the shape, size and color of artificial crowns and their relationship to the physiognomy of the face and the shape of the alveolar ridges. Special emphasis should be placed on the relationship between fixed prosthodontic restorations and soft oral tissues, that is, to adapt them in this way, or to reshape these structures in order to obtain morphological and functional harmony.

**The aim** of this study was to analyze the parameters of the orofacial system that affect the aesthetics of fixed prosthodontic restorations based on literature data and clinical experience. The introduction of basic anthropometric guidelines aims at better morphological reconstruction of the dental arch and improvement of the aesthetic effect of fixed prosthodontic restorations.

### ***Tooth shape and size***

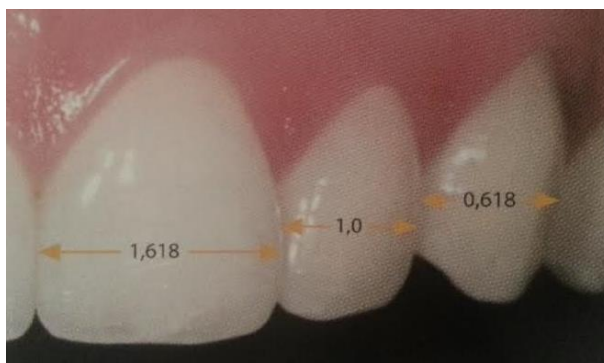
The beauty of a smile is determined by the shape, color and proportions of the upper front teeth. The harmony in creating a smile is not significantly affected by individual numerical values of tooth width and length, but by their mutual relationship<sup>1,2</sup>. This relationship depends on the race and gender of the patient, and Table 1 shows the mean values for Caucasians<sup>3</sup>.

**Tabela 1:** Proporcionalni odnos širine i dužine zuba (%) kod evropeidne (kavkazoidne) rase<sup>3</sup>  
**Table 1:** Proportional ratio of tooth width and length (%) in Caucasian race<sup>3</sup>

| Odnos širine i dužine zuba % /<br>Relationship between teeth width and<br>length % | Muškarci / Male | Žene / Female |
|------------------------------------------------------------------------------------|-----------------|---------------|
| Centralni sekutić / Central incisor                                                | 85              | 86            |
| Lateralni sekutić / Lateral incisor                                                | 76              | 79            |
| Očnjak / Canine                                                                    | 77              | 81            |

Analogno plastičnoj hirurgiji, u odnosu širine prednjih zuba postoji „zlatna“ proporcija, koja obezbeđuje maksimalni estetski učinak<sup>4,5</sup>. Sažeto govoreći, prednji zub estetski je lep ako njegova širina iznosi 60% veličine mezijalnog susednog zuba. Dakle, ako je širina lateralnog sekutića 1 cm, centralni sekutić širi je 1,6 puta, a očnjak 0,6 puta uži (Slika 1). Nedostatak ovog pravila je ograničavanje na širinu zuba, bez sagledavanja njegove dužine i okoline<sup>6</sup>.

Analogous to plastic surgery, there is a "golden" proportion in the ratio of the width of the front teeth, which provides the maximum aesthetic effect<sup>4,5</sup>. In short, an anterior tooth is aesthetically beautiful if its width is 60% of the size of its mesial adjacent tooth. Thus, if the width of the lateral incisor is 1cm, the central incisor is 1.6 times wider and the canine 0.6 times narrower (Figure 1). The disadvantage of this rule is that it is limited to the width of the tooth, without considering its length and surroundings<sup>6</sup>.



**Slika 1:** Zlatna proporcija primenjena na gornje prednje zube<sup>4</sup>  
**Figure 1:** Golden proportion applied to the upper front teeth<sup>4</sup>

Prema Willamsu, oblik centralnog sekutića odgovara obliku lica, te se oni mogu grubo klasifikovati na trouglaste, ovoidne i četvrtaste<sup>7</sup>. Oblik lica određuje se zamišljanjem dve linije koje prolaze 2,5 cm ispred tragusu i kroz ugao mandibule. Ukoliko su one međusobno paralelne, lice je četvrtasto, ako divergiraju prema bradi – ovalno, a ako konvergiraju – trouglasto<sup>7</sup>.

Uzimajući u obzir razlike u fizionomiji muškog i ženskog lica i tela, postoji praksa da se ženama modeluju fiksne restauracije „mekih“ formi, odnosno ovalniji i zaobljeniji zubi, dok su prvi izbor oblika zuba za muškarce četvrtasti zubi, koji odražavaju čvrstoću i snagu<sup>8</sup>.

According to Willams, the shape of the central incisor corresponds to the shape of the face, and they can be roughly classified into triangular, ovoid and square<sup>7</sup>. The shape of the face is determined by imagining two lines that pass 2.5cm in front of the tragus and through the corner of the mandible. If they are parallel to each other, the face is square, if they diverge towards the chin, they are oval, and if they converge, they are triangular<sup>7</sup>.

Taking into account the differences in the physiognomy of the male and female face and body, there is a practice of modeling fixed restorations of "soft" shapes, i.e. more oval and rounded teeth for women, while the first choice of tooth shape for men are square teeth that reflect strength and power<sup>8</sup>.

### ***Vidljivost sekutića (incizalna dužina)***

Incizalna dužina označava vidljivost sekutića pri različitim kretnjama gornje usne. Ona je promenljiv parametar, koji zavisi od starosti, pola, kao i od dužine, položaja i pokretljivosti gornje usne<sup>1</sup>.

Pri blago otvorenim ustima, kod mladih osoba, vidljivo je prosečno 3,5 mm gornjih zuba, dok su donji zubi jedva vidljivi. Starenjem se vidljivost inciziva smanjuje, što je uzrokovano opuštanjem mimičnih mišića gornje usne i trošenjem incizalnog brida tokom vremena. U donjem zubnom luku, vidljivost zuba povećava se zbog smanjenog tonusa mišića donje usne.

Incizalnu dužinu moguće je korigovati kliničkim produženjem krune u incizalnom ili gingivalnom smeru. Pri tome je potrebno voditi računa o izgovaranju pojedinih glasova, kao i vertikalnom i horizontalnom preklopu sekutića.

### ***Položaj zuba***

Lep osmeh podrazumeva konvergenciju dužinskih osa prednjih zuba u odnosu na središnju liniju zubnog luka, koja progredira od centralnog sekutića do očnjaka<sup>9</sup>. Odstupanje samo jednog zuba može bitno da remeti sklad i simetriju osmeha (Slika 2). Uzdužna osa gornjih centralnih sekutića je, gledajući u odnosu na središnju liniju, lagano zakošena distalno i svojim incizalnim bridovima dodiruje orijentacionu okluzalnu ravan. U vestibulo-oralnom smeru, vestibularna površina položena je okomito ili lagano vestibularno. Lateralni sekutići svojom uzdužnom osom još više naginju distalno i njihovi incizalni bridovi nalaze se oko 0,5 mm do 1 mm od okluzalne linije.

Očnjaci su postavljeni još više distalno, posmatrano sa prednje strane, zbog svog lingvalnog nagiba, u odnosu na incizalne bridove. Posmatrajući sa bočne strane, očnjaci i premolari prate vertikalnu dužinsku osu i dodiruju okluzalnu liniju.

### ***Incisal length***

The incisal length indicates the visibility of the incisor at different movements of the upper lip. It is a variable parameter that depends on age, gender, as well as the length, position and mobility of the upper lip<sup>1</sup>.

With a slightly open mouth in young people, an average of 3.5 mm of the upper teeth is visible, while the lower teeth are barely visible. As you age, the visibility of the incisor decreases, which is caused by the relaxation of the mimic muscles of the upper lip and the wear of the incisal edge over time. In the lower dental arch, the visibility of the teeth increases due to the reduced muscle tone of the lower lip.

The incisal length can be corrected by clinically extending the crown in the incisal or gingival direction. It is necessary to take into account the pronunciation of individual voices, as well as the vertical and horizontal overlap of the incisors.

### ***Tooth position***

A beautiful smile implies the convergence of the longitudinal axes of the front teeth in relation to the midline of the dental arch, which progresses from the central incisor to the canine<sup>9</sup>. The deviation of just one tooth can significantly disrupt the harmony and symmetry of the smile (Figure 2). The longitudinal axis of the upper central incisors, looking relative to the midline, is slightly obliquely distal and touches the orientation occlusal plane with its incisal edges. In the vestibulo-oral direction, the vestibular surface is laid vertically or slightly vestibularly. The lateral incisors with their longitudinal axis incline even more distally and their incisal edges are located about 0.5 to 1 mm from the occlusal line.

The canines are placed even more distally observed from the front due to their lingual inclination in relation to the incisal edges. Observed from the side, the canines and premolars follow the vertical longitudinal axis and touch the occlusal line.





**Slika 2:** Konvergencija dužinskih osa prednjih zuba u odnosu na središnju liniju zubnog luka<sup>4</sup>  
**Figure 2:** Convergence of the longitudinal axes of the anterior teeth relative to the midline of the dental arch<sup>4</sup>

### ***Središnja linija lica i zubnog luka***

Središnja linija lica predstavlja početnu tačku svake estetske analize<sup>10</sup>. Definiše se kao zamišljena vertikalna linija, koja deli lice na dve simetrične polovine. U 70% slučajeva, poklapa se sa središnjom linijom zubnog luka, koja se najčešće nalazi u nivou incizalne papile ili gornjeg vestibularnog frenuluma<sup>11</sup>. Blaga odstupanja ne utiču nužno na izgled pacijenta, te fiksnim protetičkim radom nije neophodno da se isprave.

Istraživanja su pokazala to da se gornja i donja središnja linija zuba ne poklapaju u 75% slučajeva, što, sa stanovišta lepog, i nije od velikog značaja, s obzirom na to da donji zubi nisu preterano vidljivi. Znači, donja središnja linija zubnog luka ne treba da bude determinanta pri određivanju središnje linije zubnog luka u gornjoj vilici.

Nemaju svi pacijenti simetrično lice. Bez obzira na odstupanja brade ili nosa od središnje linije lica, pacijenti mogu izgledati prijatno. Veći problem predstavljaju dijasteme između centralnih sekutića, koje je potrebno korigovati ortodontskom terapijom ili veštačkim krunicama, sa rizikom da one budu predimenzionirane.

### ***Interdentalne kontaktne tačke i površine***

Interdentalne kontaktne tačke i površine označavaju mesta dodira dva susedna zuba. Postoji tačno pravilo koje označava odnos između prednjih susednih zuba, a radi se o pravilu 50:40:30<sup>13</sup>(Slika 3).

Idealna zona dodira gornjih centralnih sekutića trebalo bi da iznosi 50% njihove dužine, zatim 40% dužine gornjih centralnih

### ***The midline of the face and dental arch***

The midline of the face is the starting point of any aesthetic analysis<sup>10</sup>. It is defined as an imaginary vertical line that divides a face into two symmetrical halves. In 70% of cases, it coincides with the midline of the dental arch, which is most often located at the level of the incisal papilla or upper vestibular frenulum<sup>11</sup>. Mild deviations do not necessarily affect the patient's appearance, and they do not necessarily have to be corrected by fixed prosthetic work.

Studies have shown that the upper and lower middle lines of the teeth do not match in 75% of cases, which is not of great importance from the point of view of general beauty, considering that the lower teeth are not overly visible. Thus, the lower midline of the dental arch should not be a determinant in determining the midline of the dental arch in the upper jaw.

Not all patients have a symmetrical face. Regardless of the deviation of the chin or nose from the midline of the face, patients can look comfortable. A bigger problem is the diastemas between the central incisors, which need to be corrected with orthodontic therapy or artificial crowns, with the risk of them being oversized.

### ***Interdental contact points and surfaces***

Interdental contact points and surfaces mark the points of contact of two adjacent teeth. There is an exact rule that marks the relationship between the front adjacent teeth, and it is the 50:40:30 rule<sup>13</sup>(Figure 3).

The ideal contact zone of the upper central incisors should be 50% of their length, then 40% of the length of the upper central

sekutića predstavlja idealnu zonu dodira između bočnih i centralnih sekutića, dok bi kontaktna površina između lateralnih sekutića i očnjaka trebalo da iznosi 30% dužine centralnih sekutića. Interdentalna papila trebalo bi da zauzima slobodni interdentalni prostor. To nije slučaj kada su kontakte površine pomerene apikalno.

incisors represents the ideal contact zone between the lateral and central incisors, while the contact area between the lateral incisors and canines should be 30% of the length of the central incisors. The interdental papilla should occupy free interdental space. This is not the case when the surface contacts are shifted apically.



**Slika 3:** Pravilo 50:40:30<sup>4</sup>

**Figure 3:** Rule 50:40:30<sup>4</sup>

### ***Incizalni slobodni prostori***

Incizalni slobodni prostori predstavljaju tamna područja između incizalnih bridova gornjih prednjih zuba, a postaju uočljivi tek pri otvaranju usta<sup>13</sup> (Slika 4). Njihova veličina i oblik, pre svega, zavise od oblika svakog pojedinačnog zuba, zatim od međusobnog razmaka susednih zuba, ali i od nekih patoloških promena, prilikom kojih se oni smanjuju, kao na primer pri patološkoj abraziji ili pak povećavaju – u slučaju hipodoncije nekog zuba. Ovi prostori najmanji su između centralnih sekutića, a najveći između lateralnih sekutića i očnjaka. Najčešće su trouglastog oblika.

Slobodni incizalni prostori mogu uticati na percepciju dužine i širine incizalnih bridova. Promena oblika incizalnog brida može uticati na iluziju sužavanja ili širenja zuba.

Ako se mezio-incizalni i disto-incizalni uglovi zaoble jače nego što je potrebno, zubi će se samo činiti dužim.

Izrazito naglašeni incizalni prostori stvaraju utisak smanjenja prednjeg segmenta, dok se njihovim izbegavanjem simulira ravna linija, koja daje utisak povećanja frontalnog fiksnog protetičkog rada.

### ***Incisal free spaces***

Incisal free spaces represent dark areas between the incisal edges of the upper front teeth, and they become noticeable only when the mouth is opened<sup>13</sup> (Figure 4). Their size and shape depend primarily on the shape of each individual tooth, then on the spacing of adjacent teeth, but also on some pathological changes in which they decrease, such as pathological abrasion, or increase - in the case of hypodontia of a tooth. They are the smallest between the central incisors and the largest between the lateral incisors and the canines. They are usually triangular in shape. Free incisal spaces can affect the perception of the length and width of the incisal edges. Changing the shape of the incisal edge can affect the illusion of narrowing or widening of the teeth.

If the mesio-incisal and dysto-incisal angles become more rounded than necessary, the teeth will only appear longer.

Distinctly emphasized incisal spaces create the impression of reduction of the anterior segment, while their avoidance simulates a straight line that gives the impression of an increase in frontal fixed prosthetic work.



**Slika 4:** Slobodni incizalni prostori<sup>4</sup>  
**Figure 4:** Free incisal spaces<sup>4</sup>

### **Boja zuba**

Boja je subjektivna senzacija, koja se prenosi aktiviranjem receptora na očnoj mrežnjači. Pri tome, boja predmeta zavisi od njegove sposobnosti da reflektuje svetlost, koja pada na njega<sup>1,14</sup>.

Boja, transparentcija, zamućenje i fluorescencija zuba nisu konstantne. Prilikom biranja boje, važno je uzeti u obzir samu ličnost, karakter i životni stil pacijenta. Izbor boje zuba kompleksna je tematika, kojoj treba posvetiti posebnu pažnju, pa su za postizanje optimalnog terapijskog učinka potrebne dodatne obuke terapeuta<sup>2,14</sup>.

### **Tooth color**

Color is a subjective sensation that is transmitted by activating receptors on the retina. In doing so, the color of an object depends on its ability to reflect light falling on it<sup>1,14</sup>.

Tooth color, transparency, turbidity and fluorescence are not constant. When choosing a color, it is important to take into account the personality, character and lifestyle of the patient. The choice of tooth color is a complex topic that needs special attention, so additional training of therapists is needed to achieve the optimal therapeutic effect<sup>2,14</sup>.

### **Zaključak**

Estetika je, pre svega u domenu stomatološke protetike, jedan od osnovnih izazova moderne stomatologije. Upotrebom dostupnih antropometrijskih podataka otvara se mogućnost preciznijeg planiranja i izrade fiksnih protetskih restauracijavisoke estetske vrednosti. Dostupnost ovih podataka omogućio je i razvoj sofisticiranih softverskih algoritama koji se koriste kao pomoćni alati u stomatološkoj tehnici i samoj stomatološkoj praksi.

### **Conslusion**

Aesthetics is, primarily in the field of prosthodontics, one of the main challenges of modern dentistry. The use of available anthropometric data opens the possibility for more precise planning and production of fixed prosthetic restorations of high aesthetic value. The availability of this data has also enabled the development of sophisticated software algorithms that are used as tools in dental laboratories and dental practice as well.

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## ORALNE MANIFESTACIJE KOD PACIJENATA OBOLELIH OD KOVIDA-19

## ORAL MANIFESTATIONS IN PATIENTS INFECTED WITH COVID-19

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### Sažetak

**Uvod:** Kod pacijenata obolelih od KOVID 19, se pored karakteristične kliničke slike respiratorne infekcije, mogu se dijagnostikovati i oralne manifestacije.

**Cilj:** Cilj rada je bio da se pregledom savremene literature sagleda zastupljenost promena u usnoj duplji odnosno prisustvo oralnih simptoma kod obolelih od KOVID-19, kako bi se ukazalo da oralne manifestacije mogu nastati usled virusne infekcije SARS-CoV-2.

**Metode:** Do relevantnih informacija koje su bitne za rad, došli smo pretragom dostupne elektronske baze podataka PubMed-a i Google Scholar.

**Rezultati:** Utvrđena je raznovrsna lokalizacija oralnih lezija kod obolelih od KOVID-19: sluzokoža jezika (dorzuma i bočne strane jezika), bukalna sluzokoža, tvrdo i meko nepce, unutrašnja strana usana i gingive. Najčešće su evidentirane ulceracije u različitim delovima usne duplje. Još uvek je kontraverzno pitanje da li su oralne lezije kod infekcije SARS-CoV-2 virusa nastale kao posledica primarnog dejstva samog virusa ili kao sekundarna manifestacija infekcije. Visoka zastupljenost receptora za angiotenzin-konvertujući enzim 2 na oralnim epitelnim ćelijama jezika i pljuvačnih žlezdi ukazuje da usna duplja može biti posebno podložna infekciji SARS-CoV-2. Disfunkcija čula ukusa je najčešći oralni simptom kod pacijenata obolelih od KOVID-19.

**Zaključak:** Oralne lezije, kserostomija, poremećaji čula ukusa mogu se javiti kod pacijenata kod kojih je dijagnostikovana infekcija KOVID-19, zbog čega je bitno načiniti iscrpan intraoralni pregled da bi se utvrdile promene u usnoj duplji i primenila adekvatna terapija.

**Cljučne reči:** KOVID-19, SARS-CoV-2, oralne manifestacije, poremećaj ukusa

### Abstract

**Introduction:** In addition to the characteristic clinical picture of respiratory infection, patients with COVID-19 can also be diagnosed with oral manifestations.

**Aim:** The aim of this study was to review current literature for the prevalence of changes in the oral cavity i.e., the presence of oral symptoms in patients with COVID-19, in order to indicate that oral manifestations may occur due to viral infection with SARS-CoV-2.

**Methods:** Important information relevant to the study was obtained by searching the available electronic PubMed and Google Scholar database.

**Results:** Oral lesions were found in different locations in patients with COVID-19: tongue mucosa (dorsum and lateral sides of the tongue), buccal mucosa, hard and soft palate, inner lip and gingiva. The most common were ulcerations in different parts of the oral cavity. It is still unclear whether oral lesions in SARS-CoV-2 virus infection were a consequence of the primary effect of the virus itself or a secondary manifestation of the infection. The high presence of angiotensin-converting enzyme 2 in oral epithelial cells of the tongue and salivary glands indicates that the oral cavity may be particularly susceptible to SARS-CoV-2 infection. Taste disorder is the most common oral symptom in patients with COVID-19.

**Conclusion:** Oral lesions, xerostomia, taste disorders can occur in patients diagnosed with COVID-19. Therefore, a comprehensive intraoral examination is necessary in order to determine changes in the oral cavity and apply proper treatment.

**Key words:** COVID-19, SARS-CoV-2, oral manifestations, taste disorders

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za stomatologiju Niš. Sva prava zadržana.

## Uvod

Bolest KOVID-19 prvi put je registrovana krajem 2019. godine u Kini, a uzročnik je novi koronavirus SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2). Bolest se veoma brzo proširila na sve kontinente i Svetska zdravstvena organizacija (SZO) proglasila je globalnu pandemiju 11 marta 2020. godine. Virus se prenosi kapljičnim, kontaktnim putem i aerosolom, a dominantno je zahvaćen respiratorni sistem<sup>1</sup>. Najčešći simptomi SARS-CoV-2 infekcije su: suvi kašalj, povišena telesna temperatura, problemi sa disanjem, bolovi u mišićima, nešto ređe se javljaju dijareje, glavobolje, hemoptizije, gubitak čula mirisa i ukusa<sup>2,3,4</sup>. Do sada opisane kliničke manifestacije infekcije SARS-CoV-2 virusa su raznovrsne i kreću se od blage do vrlo teške kliničke slike. Procenjuje se da 80% obolelih imaju blagu kliničku sliku bez potrebe za hospitalizacijom, 15% bolesnika zahteva bolničko lečenje i primenu kiseonika, a kod 5 % obolelih je neophodno lečenje u jedinicama intenzivne nege uz respiracijsku potporu i mehaničku ventilaciju<sup>5</sup>. Kliničke studije ukazuju da su predisponirajući faktori za razvoj teže kliničke slike: uzrast (>65 godina), kardiovaskularne bolesti, dijabetes melitus, hipertenzija, hronična opstruktivna bolest pluća, pušenje cigareta, imunodeficijencija i maligna oboljenja<sup>2</sup>.

Osnovni princip delovanja SARS-CoV-2 virusa zasniva se na vezivanju za receptore angiotenzin-konvertujući enzim 2 (ACE2), koji su široko rasprostranjeni u organizmu. ACE2 receptori su potvrđeni u različitim epitelnim ćelijama kože, sluzokože usne i nosne duplje, različitim endotelnim ćelijama. Princip po kome deluje SARS-CoV-2 virus zasniva se na izazivanju preterane imunološke reakcije, pri čemu dolazi do nastanka leukocitne oluje. Skoro istovremeno se javlja i citokinska oluja koja oslobađanjem proinflamatornih hemo-kina, dovodi do proinflammatorne kaskadne reakcije, što za posledicu ima aktivaciju koagulacije i stvaranje mikro-tromba<sup>6</sup>.

## Introduction

COVID-19 disease was first recorded in China in late 2019 and the cause was the new coronavirus SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2). The disease spread to all continents very quickly and the World Health Organization (WHO) declared a global pandemic on March 11, 2020. The virus is transmitted by droplets, contact and aerosols and it predominantly affects the respiratory system<sup>1</sup>. The most common symptoms of SARS-CoV-2 infection are: dry cough, fever, breathing problems, muscle pain, whereas somewhat rare symptoms include diarrhea, headaches, hemoptysis, loss of smell and taste<sup>2,3,4</sup>. The clinical manifestations of SARS-CoV-2 virus infection described so far are diverse and range from mild to very severe cases. It has been estimated that 80% of cases are mild and do not require hospitalization, 15% of patients require hospital treatment and oxygen therapy, and 5% of patients require treatment in the intensive care units with respiratory support and mechanical ventilation<sup>5</sup>. Clinical studies indicate that predisposing factors for the development of severe clinical picture include age (>65 years), cardiovascular diseases, diabetes mellitus, hypertension, chronic obstructive pulmonary disease, smoking, immunodeficiency and malignancies<sup>2</sup>.

The basic principle of action of SARS-CoV-2 virus is based on binding to angiotensin-converting enzyme 2 (ACE2) receptors, which are widely distributed in the body. ACE2 receptors have been confirmed in various cells of the skin, mucous membrane of the oral and nasal cavity, and various endothelial cells. The principle by which the SARS-CoV-2 virus works is based on causing an excessive immune response which triggers a leukocyte storm. Almost simultaneously, a cytokine storms occurs, which causes a release of proinflammatory chemokines thus provoking a proinflammatory cascade reaction the result of which is activation of coagulation and formation of microthrombi<sup>6</sup>.



## Oralne manifestacije

Pored zahvaćenosti donjih respiratornih puteva, virus SARS-CoV-2 može dovesti do pojave simptoma infekcije gornjih disajnih puteva, pri čemu je prisutan bol u grlu, nazalna kongestija i sekrecija iz nosa. Evidentirano je da gubitak čula mirisa može biti prvi simptom infekcije KOVID-19, dok se još nisu razvili drugi simptomi, zbog toga otorinolaringolog može biti prvi lekar koji sagledava pacijente<sup>7,8</sup>.

Podaci iz literature ukazuju da su kod pacijenata obolelih od KOVID 19 pored karakteristične kliničke slike respiratorne infekcije dijagnostikovane i oralne manifestacije<sup>9-11</sup>. Neophodna su dalja ispitivanja da bi se utvrdilo da li su oralne lezije kod SARS-CoV-2 virusa nastale kao posledica primarnog dejstva samog virusa ili kao sekundarna manifestacija infekcije<sup>12</sup>. U prilog činjenici da oralne manifestacije nastaju kao direktna posledica virusa je i to što je usna duplja prvo mesto kontakta sa SARS-CoV-2 virusom. Istraživanja ukazuju da veća prisutnost receptora za ACE2, u respiratornom tkivu i drugim organima, može da uslovi veću sklonost da se virus veže za te organe i dovede do njihovog oštećenja. To može da objasni nastanak disgeuzije i oralnih lezija kod pacijenata sa COVID-19, jer je utvrđena veća zastupljenost ACE2 u epitelnim ćelijama jezika i pljuvačnim žlezdama<sup>13,14</sup>. Histopatološka istraživanja ukazala su da postoji sličnost između trombon oštećenih krvnih sudova usne duplje i pluća, što takođe govori u prilog primarnoj manifestaciji SARS-CoV-2 virusa<sup>6,15</sup>. Sa druge strane oralne lezije mogu imati i sekundarni karakter, što ukazuje da nastaju kao: posledica terapije SARS-CoV-2 infekcije, usled primene imunosupresivne terapije koja predisponira nastanak sekundarnih bakterijskih infekcija, loše oralne higijene kao posledica intubacije<sup>6</sup>.

Oralne manifestacije virusom nisu česte, međutim, u odsustvu uobičajenih simptoma mogu ukazivati na početak SARS-CoV-2 infekcije. Posebnu pažnju treba posvetiti gubitku čula mirisa i ukusa, koje kod asimptomatskih pacijenata mogu biti jedini znak bolesti<sup>4,16</sup>. Veća prevalencija oralnih lezija utvrđena je kod starije populacije pacijenata i kod prisustva teže kliničke slike, dok nije utvrđena predispozicija prema polu<sup>9,10</sup>. Evidentirana je raznovrsna lokalizacija oralnih lezija nastalih kod obolelih od KOVID-19. Sluzokoža jezika, pre svega dorzuma i bočne strane jezika, ali i bukalna sluzokoža, tvrdo i meko nepce, unutrašnja strana usana i gingiva su samo neke od opisanih mesta oralnih manifestacija SARS-CoV-2 infekcije<sup>10,11</sup>.

## Oral manifestations

In addition to lower respiratory tract, SARS-CoV-2 virus can also cause infection of the upper respiratory tract, with symptoms such as sore throat, nasal congestion and nasal discharge. It has been documented that loss of smell may be the first symptom of COVID-19 infection, occurring before other symptoms, so an otorhinolaryngologist may be the first physician to examine patients<sup>7,8</sup>.

Literature data indicate that in addition to the characteristic clinical picture of respiratory infection, COVID-19 patients were also diagnosed with oral manifestations<sup>9-11</sup>. Further research is needed in order to determine whether oral lesions in SARS-CoV-2 virus are a consequence of the primary action of the virus itself or a secondary manifestation of the infection<sup>12</sup>. The oral cavity is the first point of contact with the SARS-CoV-2 virus which supports the fact that oral manifestations are a direct consequence of the virus. Studies indicate that a higher presence of ACE2 receptors in the respiratory tissue and other organs may be the reason why there is a greater tendency of the virus to bind to these organs causing their damage. This may explain the development of dysgeusia and oral lesions in COVID-19 patients because of a higher presence of ACE2 receptors in the epithelial cells of the tongue and salivary glands<sup>13,14</sup>. Histopathological studies have shown a similarity between thrombus-damaged blood vessels of the oral cavity and lungs, which also speaks in favor of the primary manifestation of the SARS-CoV-2 virus<sup>6,15</sup>. On the other hand, oral lesions can also have a secondary character, which indicates that they occur as a consequence of SARS-CoV-2 infection treatment, due to immuno-suppressive treatment which predisposes to the development of secondary bacterial infections, poor oral hygiene and as a consequence of intubation<sup>6</sup>.

Oral manifestations of the virus are not frequent but in the absence of common symptoms, they may indicate the onset of SARS-CoV-2 infection. Special attention should be paid to the loss of smell and taste which may be the only signs of the disease in asymptomatic patients<sup>4,16</sup>. A higher prevalence of oral lesions was found in older patient population and in patients with more severe clinical picture, whereas no predisposition was determined in relation to patients' sex<sup>9,10</sup>. Different locations of oral lesions in COVID-19 patients have been reported.

Iranmanesh i sar.<sup>10</sup> su analizom 35 radova o oralnim manifestacijama kod infekcije KOVID-19 utvrdili da je najčešća lokalizacija oralnih lezija na jeziku (38%), labijalnoj sluzokoži (26%) i nepcu (22%).

Opisani su različiti oblici oralnih lezija SARS-CoV-2 infekcije: eritematozni plak, ulceracije, vezikule, bule, petehije, mukozitis i deskvamativni gingivitis<sup>10,16</sup>. Najčešće opisivane promene su u vidu solitarnih ili multiplih ulceracija<sup>11</sup>. Vezikulobulozne lezije se često pojavljuju zajedno sa kožnim promenama, kao što su vezikule i petehije. Pojava eritroplakija i leukoplakija je uglavnom u korelaciji sa padom imunoloških odgovora organizma. Ređe se javljaju angina bulosa, reaktivacija herpes simpleks virusa tip 1, različite promene na gingivi, suvoća usne duplje, pojava bola i otoka jezika<sup>4</sup>.

Kod pacijenata evidentirana je velika distribucija vremena od dijagnoze KOVIDA-19 do pojave oralnih lezija i kreće se u rasponu od 4 do 90 dana<sup>17</sup>. Amorim Dos Santos i sar.<sup>12</sup> su u svom istraživanju utvrdili da kod blage kliničke slike oralne lezije se manifestuju pre ili u isto vreme sa početnim respiratornim simptomima, ali kod težih oblika kod kojih je potrebno bolničko lečenje i primena medikamentne terapije, lezije nastaju otprilike od 7 do 24 dana nakon pojave simptoma.

Još uvek nije dovoljno jasno koji je tačan patogenetski mehanizam nastanka suvoće usne šupljine, odnosno kserostomije kod obolelih pacijenata od KOVID-19. Pretpostavlja se da dolazi do smanjenog lučenja pljuvačke<sup>18</sup>. U brojnim prikazima slučajeva pretpostavljena je korelacija između kserostomije i aftoznih promena<sup>11</sup>. Pojedini autori su potvrdili da postoji i povezanost kserostomije sa disfunkcijom čula ukusa<sup>10</sup>.

Utvrđeno je da hiposekrecija pljuvačke može povećati rizik od infekcije SARS-CoV-2, jer je izmenjena zaštita oralne sluzokože koju ostvaruje pljuvačka. Usled hiposalivacije smanjena je fizička barijera u odnosu na viruse i time je povećana mogućnost adhezije i kolonizacije virusima. Takođe dolazi do smanjene produkcije antimikrobnih proteina i peptida<sup>18</sup>.

Prisustvo velike koncentracije ACE-2 u epitelnim ćelijama pljuvačnih žlezda, može biti razlog pojave infekcije i nastanka akutnog sialadenitisa, koji može usloviti i nastanak hroničnog sialadenitisa, kao i destrukciju žlezdanog tkiva usled dejstva zapaljenskog procesa<sup>19,20</sup>.

Potrebno je naglasiti da oralne patološke promene kod pacijenata sa KOVIDOM-19 nisu uvek direktno uzrokovane infekcijom SARS-CoV-2, već mogu da nastanu kao jatrogene komplikacije tokom lečenja KOVID-19.

Some of the described locations of oral manifestations of SARS-CoV-2 infection include the mucous membrane of the tongue, primarily the dorsum and lateral sides of the tongue, as well as buccal mucosa, hard and soft palate, inner lip and gingiva<sup>10,11</sup>. Iranmanesh et al.<sup>10</sup> analyzed 35 studies on oral manifestations in COVID-19 infection and found that the most common location of oral lesions was the tip of the tongue (38%), labial mucosa (26%) and palate (22%).

Various forms of oral lesions of SARS-CoV-2 infection have been described: erythematous plaque, ulcerations, vesicles, bullae, petechiae, mucositis and desquamative gingivitis<sup>10,16</sup>. The most commonly described changes were solitary or multiple ulcerations<sup>11</sup>. Vesiculobullous lesions often appear with skin changes such as vesicles and petechiae. The occurrence of erythroplakia and leukoplakia is mainly correlated with a decrease in the body's immune response. Angina bullosa, reactivation of herpes simplex virus type 1, various changes in the gingiva, dryness of the oral cavity, pain and swelling of the tongue occur less frequently<sup>4</sup>.

A long time distribution from the COVID-19 diagnosis to the appearance of oral lesions has been reported and it ranges from 4 to 90 days<sup>17</sup>. Amorim Dos Santos et al.<sup>12</sup>, found that in mild cases oral lesions developed before or at the same time as the initial respiratory symptoms but in severe cases that required hospitalization and medication treatment, the lesions occurred approximately 7 to 24 days after the onset of symptoms.

The precise pathogenetic mechanism of the dryness of the oral cavity, i.e., xerostomia in COVID-19 patients is still not completely clear. It is assumed that it is a consequence of decreased salivary flow<sup>18</sup>. Numerous case studies assume a correlation between xerostomia and aphthous changes<sup>11</sup>. Some authors have also confirmed a correlation between xerostomia and taste disorder<sup>10</sup>.

It has been determined that hyposecretion of the saliva can increase the risk of SARS-CoV-2 because of the changes in the protection of the oral mucosa provided by saliva. Due to hyposalivation, the physical barrier against viruses is lowered whereby the possibility of adhesion and colonization by viruses is increased. There is also a reduced production of antimicrobial proteins and peptides<sup>18</sup>.

The presence of a high concentration of ACE-2 in the epithelial cells of the salivary glands can be the reason for the occurrence of infection and development of acute sialadenitis, which can also cause chronic sialadenitis as well as the destruction of glandular tissue due to the inflammatory process<sup>19,20</sup>.



Usled produžene intubacije i primene drugih invazivnih postupaka, mogu da nastanu mehaničke traume i pojave oralnih lezija kod pacijenata<sup>21,22</sup>. Utvrđeno je i da kao reakcija nakon primene određenih lekova mogu se javiti propratne promene u usnoj duplji<sup>23</sup>. Kod pacijenata sa COVID-19 evidentirane su i oralne infekcije koje su ustvari oportunističke infekcije, koje se javljaju i kod drugih bolesti gde nastaje stečena imunodeficijencija. Kandidijaza i herpes simpleks infekcije nisu direktno povezane sa patološkim procesima infekcije SARS-CoV-2<sup>24-26</sup>. U nastanku oralne kandidijaze kod obolelih od COVID-19, veliku ulogu ima imunokompromitovani status, kserostomija, primena kortikosteroida kod pacijenata sa teškom kliničkom slikom i korišćenje antibiotika kod koinfekcije i nastanka bakterijske pneumonije.

Neophodno je dalje ispitivanje patofiziološkog mehanizma promena u usnoj duplji. Odnosno potrebno je utvrditi da li je njihov nastanak uslovljen direktnim dejstvom virusne infekcije COVID-19, koinfekcije, reakcije na lekove, uticaj stresa ili nastaju kao jatrogene komplikacije<sup>9-11</sup>.

### ***Poremećaj ukusa***

Prevalenca je disfunkcija čula ukusa je od 4,9% do 69,8% kod pacijenata obolelih od COVID-19<sup>27</sup>. Poremećaji ukusa se češće javljaju kod žena, bele rase, praćeni su lakšom kliničkom slikom i boljom prognozom<sup>12</sup>. S obzirom na afinitet, koji SARS-CoV-2 virus ispoljava ka nervnom tkivu, mirisni i gustatorni nervi nisu izuzetak. Iako tačna patogeneza poremećaja čula mirisa i ukusa nije u potpunosti razjašnjena, pretpostavlja se da uloga ACE-2 inhibitora, koji se posebno nalaze na jeziku, ima ključnu ulogu. Na početku infekcije COVID-19 se obično javlja anosmija i ageusija, što može pomoći u dijagnozi same bolesti. Faridi sar.<sup>4</sup> su ukazala da ukoliko pacijenti sa SARS-CoV-2 infekcijom imaju i gustatorne i olfaktivne smetnje, poremećaj čula mirisa se smatra primarnim. Preko 95% disgeuzija u korelaciji je sa poremećajem čula mirisa. Do sada je u literaturi opisano malo slučajeva disgeuzija u odsustvu olfaktornih disfunkcija. Zato su potrebna dodatna istraživanja, koja bi dala važne podatke o samoj prirodi gustatornih poremećaja, lokalizaciji oštećenja, kao i pragu čula ukusa.

It should be emphasized that oral pathological changes in COVID-19 patients are not always directly caused by SARS-CoV-2 infection but can occur as iatrogenic complications during COVID-19 treatment. Mechanical trauma and oral lesions can occur in patients due to prolonged intubation and other invasive procedures<sup>21,22</sup>. It has also been determined that accompanying changes in the oral cavity can appear as a reaction after the application of certain medications<sup>23</sup>. COVID-19 patients can also develop opportunistic infections of the oral cavity which occur with other acquired immunodeficiency diseases. Candidiasis and herpes simplex infections are not directly related to the pathological processes of SARS-CoV-2 infection<sup>24-26</sup>. Immuno-compromised status, xerostomia, the use of corticosteroids in severe cases and the use of antibiotics in coinfection and bacterial pneumonia all play an important role in the development of oral candidiasis in COVID-19 patients.

Further research of the pathophysiological mechanism of changes in the oral cavity is necessary. In other words, it is necessary to determine whether their development is caused by direct action of the COVID-19 viral infection, coinfection, drug reactions, the effect of stress or if they occur as iatrogenic complications<sup>9-11</sup>.

### ***Taste disorder***

The prevalence of taste disorders in COVID-19 patients ranges from 4.9% to 69.8%<sup>27</sup>. Taste disorders are more common in Caucasian women and are accompanied by mild symptoms and better disease outcomes<sup>12</sup>. Considering the affinity that SARS-CoV-2 exhibits towards the nervous tissue, the olfactory and gustatory nerves are no exception. Although the precise pathogenesis of the smell and taste disorders is not completely clear, it is assumed that ACE2 inhibitors, which are especially located on the tongue, play an important role. Anosmia and ageusia commonly occur at the onset of COVID-19 infection, which can help in the diagnosis of the disease itself. Farid et al.<sup>4</sup> indicated that if SARS-CoV-2 patients have both gustatory and olfactory disorders, the olfactory disorder is considered primary. Over 95% of dysgeusia cases are correlated with olfactory disorders. So far, few cases of dysgeusia in the absence of olfactory disorders have been described in the literature. Therefore, additional research is needed in order to obtain important data on the very nature of gustatory disorders, location of damage as well as the threshold of the sense of taste.

## Terapija

Tretman oralnih lezija kod pacijenata sa SARS-CoV-2 virusom, najviše zavisi od vrste i težine same lezije. U brojnim radovima naznačeno je da kod pacijenata sa blagom do umerenom kliničkom slikom, kao i kod asimptomatskih pacijenata nije primenjivana nikakva terapija. Kao glavni razlog navodi se sama priroda promena i njihova tendencija brze regresije. U slučajevima težih formi oralnih lezija najčešće primenjivani lekovi su antivirusici u kombinaciji sa antibioticima, antipireticima i analgeticima, ali je bitno multidisciplinarno sagledavanje pacijenta. Zbog antinflatnog efekta primenjuju se i kortikosteroidi i antihistaminici. Prisustvo bola, hiperemije i edema oralne sluzokože mogu otežati ishranu i govor pacijenta, zbog čega je potrebno pored sistemske terapije uključiti i lokalnu terapiju odnosno anti-septike, antimikotike, obezbediti adekvatnu ishranu i sprovesti oralnu higijenu<sup>28,29</sup>.

## Zaključak

Ulceracije oralne sluzokože, ksero-stomija, disfunkcija čula ukusa mogu se javiti kod pacijenata kod kojih je dijagnostikovana infekcija KOVID-19 zbog čega je bitno načiniti iscrpan intraoralni pregled da bi se utvrdile promene u usnoj duplji i primenila adekvatna terapija. Pored toga značajna je i adekvatna oralna higijena pacijenata sa KOVID-19 jer ona može znatno uticati na pogoršanje simptoma oralnih lezija.

## Treatment

The treatment of oral lesions in SARS-CoV-2 patients mostly depends on the type and severity of the lesion itself. Numerous studies have indicated that no treatment was applied in mild to moderate cases as well as asymptomatic cases. The main reason is the nature of the changes and their tendency to regress rapidly. In severe forms of oral lesions, the most commonly applied medications were antivirals in combination with antibiotics, antipyretics and analgesics but a multidisciplinary examination of patients is also important. Due to their anti-inflammatory effect, corticosteroids and antihistamines are also used. The presence of pain, hyperemia and edema of the oral mucosa can make nutrition and speech more difficult for patients, which is why it is necessary to include local therapy in addition to systemic therapy i.e., antiseptics, antifungals, to provide adequate nutrition and implement appropriate oral hygiene<sup>28,29</sup>.

## Conclusion

Ulcerations of the oral mucosa, xerostomia, and taste disorders can occur in patients diagnosed with COVID-19 and a comprehensive intraoral examination is therefore necessary in order to determine the changes in the oral cavity and apply proper treatment. In addition, appropriate oral hygiene of COVID-19 patients is also important as it may have a significant impact on the worsening of symptoms of oral lesions.

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Acta Stomatologica Naissi je naučni časopis Klinike za dentalnu medicinu, Medicinskog fakulteta Univerziteta u Nišu, koji publikuje radove iz svih oblasti stomatologije i srodnih medicinskih grana.

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Ako se koriste nestandardne skraćenice potrebno je prilikom prvog korišćenja celog izraza u tekstu dati njegov puni naziv, a zatim u daljem tekstu koristiti skraćenicu. Nazivi simptoma, znakova i bolesti, kao i anatomski i histološki detalji ne mogu se skraćivati.

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Please read carefully the following instructions to authors prior to manuscript preparation and submission. Papers which are not prepared according to the propositions and instructions will be returned to authors for corrections before forwarding them to reviewers. In case of unacceptable articles only illustrations will be returned.

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Acta Stomatologica Naissi publishes editorials, original scientific or clinical articles, review articles, preliminary reports, case reports, technical innovations, letters to the editor, articles from up-to-date literature, book reviews, reports and presentations from national and international congresses and symposiums which have not been previously submitted for publication elsewhere. All submitted articles will be reviewed by at least 2 reviewers, and when appropriate, by a statistical reviewer. Authors will be notified of acceptance, rejection, or need for revision within 6 weeks of submission. Articles are not paid for.

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When reporting experiments on human subjects, indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) or with the Helsinki Declaration (1964, amended in 1975 and 1983) of the World Medical Association.

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The title page should contain: a) the full title of the article (in upper case); b) first name, middle initial, and last name of each author without the academic degree; c) name of department and institutional affiliation for each author; d) running title of no more than 10 characters. At the bottom of the page, please indicate the name, academic degree and address (including E-mail, telephone and fax number) of the author responsible for correspondence.

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### Abstract and Key words

All original abstracts should be submitted with a structured abstract, consisting of no more than 250 words, and the following 4 paragraphs:

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Material and Methods: Describes how the study was performed.

Results: Describes the primary results.

Conclusion: Reports what authors have concluded from these results, and notes their clinical implications.

Key words: A maximum of 5 key words drawn from MeSH documentation. Abstract should be translated into English (US style), with the title, name(s) of author(s), institutional affiliation and key words.

To write papers in the form of a case report, a structured abstract should be done, as follows:

Basis of the problem: (describe the problem or occurrence in a few sentences),  
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disease or disorder is in question),

Results: (describe the results of the work and the final outcome),

Conclusion: (1-3 sentences that can also serve as a description of the whole procedure that was done and written in the paper).

To write papers in the form of a case report, a structured abstract should be done, as follows:

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disease or disorder is in question),

Results: (describe the results of the work and the final outcome),

Conclusion: (1-3 sentences that can also serve as a description of the whole procedure that was done and written in the paper).

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Each table with a brief title (on Serbian and English) should be typed double-spaced on a separate sheet of paper. Number tables consecutively (with Arabic numbers) in the order of their first citation in the text. Give each column a short or abbreviated heading. Place explanations in legends of all nonstandard abbreviations which are used in table. For units and measurements see paragraph below. Do not use internal horizontal and vertical rules. Place all tables at the end of your file. Always separate the individual columns using tabulators, not using space bar, i.e. tables must be in text format. Line drawings diagrams and halftone illustrations (photographs, photomicrographs, etc.) should be designated as figures. They should be listed on separate sheet and numbered consecutively with Arabic numerals according to the order in which they have been first cited in the text. Figures should be professionally drawn (not simply typewritten) and photographed. Each figure should be labeled on its back indicated the number of the figure, last name and the first letter of the author, and the topside of the figure. Photographs should be supplied in two copies. Color photographs are published only in case if author himself bears expenses. Photomicrographs must have internal scale markers, and symbols, arrows or letters should contrast with the background. Photographs of patients must conceal their identity unless patients approve the publishing of the photograph in written form. If you borrow or use already published photographs please submit a written permission for reproduction. Permission is not required for the documents in the public domain. Figures will not be returned unless requested. Captions and detailed explanations of the figures should be given in the legends. If symbols, arrows, numbers, or letters are used to identify parts of the figure identity and explain each one clearly in the legend.

### ACKNOWLEDGEMENTS

Acknowledgements are positioned before the reference list specifying general support by department chairman, acknowledgements of technical as well as financial and

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### Journals:

1. Standard journal reference. (Note: list all authors if six or less; when seven or more, list only first three and add et al): Glass DA, Mellonig JT, Towle HJ. Histologic evaluation of bone inductive proteins complexed with coralline hydroxyapatite in an extraskeletal site of the rat. J Periodontol 1989;60:121-125.

2. Corporate author: Federation Dentaire Internationale. Technical Report No.28. Guidelines for antibiotic prophylaxis of infective endocarditis for dental patients with cardiovascular disease. Int Dent J 1987;37:235.

3. No author given: Coffee drinking and cancer of the pancreas (editorial). BMJ 1981;283:628.

4. Volume with supplement: Magni R, Rossoni G, Berti R, BN52021 protect guinea pig from heart anaphylaxis. Pharmacol Res Commun 1988; 20 Suppl 5:75-8.

### Books or other monographs:

5. Personal author(s): Tullman JJ, Redding SW. Systemic Disease in Dental Treatment. St. Louis: The CV Mosby Company; 1983:1-5.

6. Chapter in a book: Rees TD. Dental management of the medically compromised patient. In: McDonald RE, Hurt WC, Gilmore HW, Middleton RA, eds. Current Therapy in Dentistry, vol. 7. St. Louis: The CV Mosby Company; 1980:3-7.

7. Dissertations and thesis: Teerakapong A. Langerhans Cells in human periodontally healthy and diseased gingiva. (Thesis). Houston, TX: University of Texas; 1987.92 p.

### Other published material:

8. Newspaper article: Shaffer RA. Advances in chemistry are starting to unlock mysteries of the brain. The Washington Post 1989 Aug 7; Sect.A:2 (col. 5).

### References - electronic quotations:

9. Online journals without volume and page information. Berlin JA, Antman EM. Advantages and limitations of metaanalytic regressions of clinical trials data. Online J Curr Clin Trials (serial online). June 4; doc 134. Accessed July 20, 2000.

10. Online journals with volume and page information. Fowler EB, Breault LG. Ridge augmentation with a folded acellular dermal matrix allograft: A case Report. J Contemp Dent Pract (serial online). 2001;2(3):31-40. Available from: Procter&Gamble Company, Cincinnati, OH. Accessed December 15, 2001.

11. World Wide Web. Centers for Disease Control and Prevention. Preventing emerging infectious diseases: Addressing the problem of antimicrobial resistance. Available at: <http://www.cdc.gov/ncidod/emergplan/antiresist/>. Accessed November 5, 2001.

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All measurements should be reported in terms of the International System of Units (SI)

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Avoid abbreviations in the text but whenever possible use standard abbreviations. However, if nonstandard abbreviations are used, the full term of which and abbreviation stands for should precede its first use in text. Names of symptoms, signs and diseases, as well as anatomic and histologic characteristics cannot be abbreviated.

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